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Epidemiology of Bovine Mastitis in Ethiopia

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Abstract

Mastitis is inflammation of the mammary gland, including not only intramammary tissues but also related anatomical structures such as nipples, mammary areolas, milk ducts. The occurrence of disease is an outcome of interplay between three major factors: infectious agents, host resistance, and environmental factors. It is considered to be one of the most important causes of economic losses in the dairy industries worldwide. Clinical Mastitis can be defined as a farmer's observed abnormality in the milk and/or the udder. Cows are visibly sick, or the milk is visibly abnormal. Subclinical Mastitis is by far the costlier disease in the majority of herds, and is often defined as the presence of a microorganism in combination with an elevated somatic cell count (SCC) of the milk. In Ethiopia, the diseases have got a major on dairy industry and the prevalence of disease has been reported by several authors in different parts of Ethiopia, several of these studies have shown the occurrence of a range of Mastitis causing bacteria, indicating *Staphylococcus*, *Escherichia coli* and *Streptococcus* as dominant and pathogenic species. Even though the disease is insufficiently investigated and information relating to its magnitude, distribution and risk factors is scant, breed, age, parity, tick infestation of udder, sequence of milking, floor, husbandry system, lactation stage and hygiene of udder were reported to be important risk factors for the prevalence of bovine Mastitis in Ethiopia. The diagnostic tests commonly used in Ethiopia are: California Mastitis test (CMT), bacterial culture and isolation direct microscopy, indicator paper test. Mastitis remain the most devastating disease in livestock production. Especially, the sub-clinical Mastitis remains to be an obscure and latent form of this disease that poses more serious economic losses to the dairy livestock sector, as the incidence is much higher in a dairy herd than the clinical one. Therefore, the nature of the disease necessitates research, early detection and effective control programs to be under taken.

Keywords: Bovine Mastitis; Ethiopia; California Mastitis test; Clinical Mastitis; Subclinical Mastitis; Somatic cell count

Introduction

Ethiopia, located in tropical region and the country is greatly dependent on Agriculture. Livestock production represents a major national resource and forms an integral part of the Agricultural production system and livelihood of the society. Ethiopia has the largest cattle population in Africa with an estimated population of 56.71 million [1]. Among this cow represents the biggest portion of cattle population of the country, around 20.7% of the total cattle heads are milking cows [1]. However, milk production often does not satisfy the country's requirements due to a different of factors. Of these factors, Mastitis is one the factors contributing to reduced milk production [2]. Mastitis is also associated with number of zoonotic diseases in which milk acts as a vehicle of infection [3].

Mastitis is defined as an inflammation of the parenchyma of mammary gland, which can reduce milk yield and alter milk composition [4]. The occurrence of disease is an outcome of interplay between three major factors: Infectious agents, Host resistance, and Environmental factors [5]. Mastitis in dairy cows occurs worldwide and can be caused by infections with bacteria, yeast and fungi [6]. There are two main classes of Mastitis. The first is clinical Mastitis, which manifests signs observed from the animal or the milk. The other is Subclinical Mastitis, which produces no visible signs from the udder except when using diagnostic tools. Despite many years of research, subclinical Mastitis remains the most economically damaging and zoonotic potential disease for dairy industry and consumer worldwide irrespective of species of animal [7].

Experimental

Mastitis is the common and costly disease causing loss in milk yield, treatment cost for dairy farmers and culling of animals at unacceptable age [8]. Since the quality and quantity of the milk is influenced by Mastitis, it is considered to be one of the most important causes of economic losses in the dairy industry worldwide. Economic losses caused by Mastitis also include value of discarded milk [9].

Dairy enterprise is very gradual in countries of sub Saharan Africa like Ethiopia. In this region, the low local milk production is as result of many factors including low genetic potential for milk production of indigenous breeds, the extensive and low inputs husbandry practices under which they are reared and wide spread livestock diseases [10]. According to CSA [11] in Ethiopia 11.33 million of total cattle for private holdings are milking cows; however, milk production often doesn't satisfy the countries milk requirement due to multitude factors. Some authors [12] reported a substantial economic loss in Ethiopian highland crossbred dairy cows due to subclinical Mastitis.

Bovine Mastitis as a disease, has received little attention in Ethiopia, especially the Sub clinical form. When modern dairy farming in the tropics was first adopted Mastitis was predicted to be important disease in dairy cattle and one of the most tasks of risk factors for Animal health and production problems to allow effective control strategies to be adopted [13]. The disease has been reported by several authors in different parts of Ethiopia [14-16]. However, still there is a gap in Ethiopia, the disease is insufficiently investigated and information relating to its magnitude, distribution and risk factors is scant. Such information is important to envisage when designing appropriate strategies that would help to reduce its prevalence and effects [16,17].

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Several of these studies have shown the occurrence of a range of Mastitis causing bacteria, indicating *Staphylococcus, Escherichia coli* and *Streptococcus* as dominant and pathogenic species, clinical Mastitis is readily apparent and easily detected. In contrast, detection of mammary quarters with Sub-clinical Mastitis is more difficult because signs are not readily apparent [18] and because of the lack of any overt manifestation, its diagnosis is a challenge in dairy animal management and in Veterinary practice. There are different levels for detection of Mastitis: an individual cow level in the herd, and a more large-scale testing for bulk milk [18]. Regarding the individual cow level, the sub-clinical form of the disease can be detected by bacteriological examination and somatic cell counts (SCC) [19]. Under field conditions, determination of SCC in milk is usually done using the California Mastitis test (CMT); in fact, CMT scores are directly related to average SCC [20,21]. Thus, the objective and significance of this paper is to review the general status of Bovine Mastitis and increase the awareness of the importance of disease in Ethiopia.

Epidemiology of Bovine Mastitis in Ethiopia

General aspect

In Veterinary medicine, Mastitis is referred to an intramammary inflammatory reaction caused by physical or chemical agents but bacteria accounts for the majority of cause and the majority of cases are infectious. In contrast, some authors in human literature consider Mastitis as either an infectious or non-infectious disease [22].

Etiology

The causative agent of bovine Mastitis could be physical or chemical agents but bacteria accounts for the majority of cause and the majority of cases are infectious. The disease has been reported by several authors on the prevalence and major causes of bovine Mastitis mostly in cross bred dairy cattle in different parts of the country [2,13,23,24]. Several of these studies have shown the occurrence of Mastitis causing bacteria, including, *Staphylococcus* and *Streptococcus* as dominant and pathogenic species [25-28]. The majority of isolates were *Staphylococcus aureus (S. aureus),* followed by *Coagulase negative staphylococci (CNS) Streptococcus agalactiae (S. agalactiae*), and the lowest isolation was *Bacillus* species (Table 1).

Types of Mastitis

Clinical Mastitis

Clinical Mastitis can be defined as a farmer observed abnormality in the milk and/or the udder. Clinical Mastitis then, is an observable disease [29-39]. Cows are visibly sick, or the milk is visibly abnormal. The incidence of clinical Mastitis ranges from 0 to more than 200 cases per 1000 cows per year [40-42]. In most studies the median incidence is around 20-25 cases per 100 Cows per year. Clinical Mastitis occurs in all dairy herds. Even well-managed herds, as judged by somatic cell count level and a high level of milk production, may be suffering from a high incidence of clinical Mastitis. Clinical Mastitis is mostly caused by bacteria. The most important are *S. aureus, E. coli, Klebsiella spp. and Streptococci (S. uberis, S. dysagalactiae)*. Clinical Mastitis is only the 'tip of the iceberg'.

Subclinical Mastitis

Subclinical Mastitis is by far the costlier disease in the majority of herds, and is often defined as the presence of a microorganism in combination with an elevated somatic cell count (SCC) of the milk. Various SCC cut-off points for the definition of subclinical Mastitis have been proposed. Most recent research seems to agree to a cut-off point at about 250,000 cells [43,44]. Several researchers have shown a log-linear relation between the somatic cell count of the milk and the milk production of the cow. The production decreases linearly with an increase in the log (SCC). A production loss of approximately 2 lbs. per natural log step above 5 is reported by several authors. The subclinical form of Mastitis in dairy cows is important because this form is highly prevalent than the clinical form and it usually precedes the clinical form, of long duration, difficult to detect, it reduces milk production and it adversely affects milk quality [45].

Prevalence of Mastitis in Ethiopia

Over the last several years, a number of studies are available that describe the prevalence of bovine Mastitis in different parts of the country [14,26,35,37,46-51]. The prevalence reports were heterogeneous and were affected by several factors including locality, breed, management and diagnostic methods used. Accordingly, the prevalence for all types of Mastitis (i.e., without considering the classifications) ranged from 0.4% to 81.1%. Studies on prevalence of bovine Mastitis in Ethiopia were usually made through physical clinical examination of the udder in cases of clinical Mastitis and through the use of one of the cow side tests for sub clinical cases. The most commonly used cow side test in the publications reviewed was CMT, followed by indicator paper test [32,37,47-50,52,53]. In both clinical and subclinical cases, authors have used bacteriological methods for isolation and identification of the causative agents (Table 2).

Species isolated	Area of study	Prevalence %
Staphylococcus aureus	Asella, Holleta district, Addis Ababa, Aleta Wondo, Hawella Tula and Aleta Chuko, Sebeta, North Shewa Zone, Adigrat, West Arsi Zone, Lemu Bilbilo district (Arsi Zone)	9.42-83.47
Coagulase negative staphylococcus	West Arsi Zone, Addis Ababa, Holleta, Debrezeit, Wolayta Sodo, Bahir dar	3.9-51.9
Streptococcus agalactiae	West Arsi Zone, Sebeta, Addis Ababa, Adigrat, Holleta, Arsi Zone, Debrezeit, Doba district (West Hararghe zone), Bahir dar	3.73-25.3
Streptococcus dysgalaciae	Sebeta, Addis Ababa, Holleta, Doba district, Bahir dar	4.48-10.6
Klebsiella pneumonia	West Arsi Zone, Addis Ababa, Holleta, Sidamo Zone	3.3-10.7
staphylococcus intermidius	Selale, Lemu Bilbilo district, zone, Doba district, Asella, Sidamo Zone	6.6-23.19
E. coli	West Arsi Zone, Sebeta, Addis Ababa, Adigrat, Holleta, Arsi Zone, Debrezeit, Doba district, Tullo district (West Hararghe Zone) Wolayta Sodo, Asella,	0.75-28.4
P. aureuginosa	Sebeta, West Arsi Zone, Selale, North Shewa Zone, Holleta, Doba district, Asella, Addis Ababa	0.72-9.7
Corynebacterium bovis (C. bovis)	Sebeta, Addis Ababa, Selale, North Shewa Zone, Holleta, Doba district	1.45-7.04
Bacillus species	Sebeta, Addis Ababa, Holleta, Doba district, Sidamo Zone, Asella	0.8-5.71
Micrococcus species	Sebeta, Addis Ababa, Holleta, Selale	2.28-22.2

Table 1: Bacterial isolated from bovine clinical and subclinical Mastitis in different part of Ethiopia.

Area	Region	Diagnostic test used	No. of animal tested	No. positive animal	Subclinical Mastitis	Clinical Mastitis	Prevalence (95% CI)
Holleta	Addis Ababa	CMT	444	302	46.8%	21.2%	68% (63.7-72.3)
Kofale and Shashemene districts	Oromia	CMT, bacteriological examination	358	136	30.7%	7.3%	38% (32.9-43.1)
Jikawo Woreda of Nuer Zone	Gambella Region	CMT	121	73	48.76%	11.57%	60.33% (51.63-69.03)
Mekelle small holder's Dairy farms	Tigray Region	CMT	351	221	54.4%	3.9%	62.9% (57.8-68)
Small Holder Lactating Dairy Farms in Hawassa	SNNP	Indicator paper test (PT)	183	65	30.6%	4.9%	35.5% (28.6-42.4)
Areka Woreda and Wolayta Zone	SNNP	bacteriology	384	203	43.5%	9.4%	52.9% (48.1-57.9)
Bahir Dar	Amhara	CMT, bacteriology	384	242	59.38%	3.65%	63.02% (58.3-67.7)
Eastern Amhara	Amhara	CMT, bacteriology	215	112	42.1%	3.8%	52% (45.3-58.7)
Hawassa	SNNP	CMT, bacteriology	529	331	59.2%	3.4%	62.6% (58.3-66.7)
Tullo district, West Hararghe	Oromia	CMT bacteriology	384	62	10.9%	5.2%	16.1% (12.4-19.8)
Addis Ababa	Addis Ababa	CMT, bacteriology	499	373	55.1%	19.6%	74.7% (71-78.4)
Sidama Zone	SNNP	CMT, bacteriology	96	43	42.7%	2.08%	44.79% (35-54.6)
Asella	Oromia	CMT	223	144	38%	26.5%	64.5% (58.3-70.7)
Kombolcha	Amhara	California Mastitis test	150	84	46%	10%	56% (48.2-63.8)
Debrezeit	Oromia	CMT, bacteriology	300	18	5.3%	0.7%	0.4% (-0.3-1.1)
Hawassa	SNNP	Indicator paper test (PT), bacteriology	201	61	25.4%	5.0%	30.3% (24.1-36.5)
Wolayta Sodo	SNNP	CMT, bacteriology	386	134	21%		34.7% (30-39.4)
Doba, West Hararghe	Oromia	CMT, bacteriology	384	89	15.89%		23.18% (19-27.4)
Asella	Oromia	CMT, bacteriology	66	44	54.5%	12.1%	66.6% (55.2-78)
Lemu Bilbilo, Arsi Zone	Oromia	CMT, bacteriology	300	126	36.7%,	5.3%	42% (36.5-47.5)
Addis Ababa	Addis Ababa	CMT, bacteriology	331	172	36.86%,	15.41%	52.27% (47-57.6)
Holleta Agricultural Research Center	Oromia	CMT, bacteriology	90	73	73.3%	7.8%	81.1% (73.1-89.1)

Table 2: Prevalence of Mastitis in different area of Ethiopia.

Results and Discussion

Risk factors

Different authors have different idea regarding the predisposing factors of Mastitis in Ethiopia but most of them do agree on considering breed, age, parity and lactation stages as important risk factors influencing the prevalence of bovine Mastitis. Additional risk factors considered by some investigators include: tick infestation of udder, sequence of milking, cleanliness of floor, husbandry system, and hygienic practices of the udder. During the review of studies conducted in Ethiopia, it was observed that different authors use different intervals for the categories of risk factors they included in their studies. That made it impossible to use intervals in presentation of the reviews. For this reason, author based tabulation was used to summarize different risk factors in the following sub-sections.

Breed

Studies conducted in Ethiopia generally show an increasing trend in the prevalence of Mastitis with increasing exotic blood levels (Table 3). 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 [9]. 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

Breed	No of animal examined	Prevalence
Holstein-Friesian (HF)	343	71.7%
Jersey	20	70.0%
Cross (local × HF)	66	48.5%
Local	15	66.7%
Local	169	24.3%
Cross	189	50.3%
Local	83	39.8%
Cross	446	66.8%
Holstein Friesian	53	32.07%
Cross	113	30.9%
Zebu	17	23.5%
Indigenous *zebu*	216	23.1%
Jersey	88	44.3%
High-grade *Holstein*	82	54.8%
Cross	144	55.6%
Local	156	29.5%
HF=*Holstein-Friesian*		

Table 3: Prevalence of Bovine clinical and subclinical Mastitis associated with different breeds.

(Table 4). The highest prevalence in older cows is because of their largest teats and more relaxed sphincter muscles, which increase the accessibility of infectious agent in the cows' udder [9].

Lactation stage

Stage of lactation affect Mastitis prevalence significantly as a research conducted in Ethiopia implies (Table 5).

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 [2].

Parity

The likelihood of Mastitis is higher in multiparous cows having four or more calvings compared with primiparous cows as studies conducted in Ethiopia shows (Table 6). 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 [20].

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 [13,14]. This might be due to absence of udder washing, milking of cows with common milkers' 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 [33].

Prevalence of Mastitis at cow level is higher in those farms<4 years' duration of farming, feed provision before milking and milking of clinical cows at any stage, poor drainage/slope for stable area which results accumulation of liquid such as urine and water used for cleaning of udders during milking, the liquid material mixed with the feces of the cows that led to dirty udder and teat there infection could enter [54-56]. The occurrence of Mastitis based on body condition and history of previous Mastitis was also reported [49].

Age	No of animal examined	Prevalence %
3-6 years	296	59.1%
7-10 years	126	86.5%
11-13 years	22	81.8%
3-5 years	176	4.5%
5-7 years	88	48.9%
>8 years	94	90.4%
Young Adult (3-5)	22	40.91
Adult (6-9)	27	62.96
Old (>9)	72	65.23
≤5 years	227	37.4
>5 years	302	81.5
2-6 years	44	47.73
7-12 years	52	38.46
3-5 years (Young adult)	323	65.0
6-10 years (adult)	176	93.2
3-7 years	161	12.4
8-12 years	203	23.1
Older than 12 years	20	45
3.5-6 years	134	44.5
6-9 years	133	33.3
9-13 years	33	22.2
2-4 years	70	32.9
4-6 years	134	35.1
>7 years	96	58.3

Table 4: Prevalence of Bovine clinical and subclinical Mastitis associated with different age group.

Lactation stage	No of animal examined	Prevalence %
3 Week-4 Month	223	50.7
5-8 Month	146	83.65
9-14 Month	75	89.3
1-3 Month	174	37.4
4-6 Month	144	31.3
>7 Month	40	65
Early (<4 m)	37	56.76
Mid (5-7 m)	74	55.41
Late (>7 m)	10	80.00
Early	66	21.2
Mid	67	25.3
Late	50	50
1–2 Months	198	79.8
3–6 Months	186	43.0
≥ 7 Months	145	64.1
Early	21	47.62
Mid	42	28.57
Late	33	57.56
Early (<4 month)	133	87.2
Mid (5-7 Month)	132	65.9
Late (>8 Month)	234	73.1
Early (1-120 days	228	43.85
Middle (120-240 days	137	32.25
End (<240 days)	21	23.80
1-3 Months	99	44.4
4-6 Months	86	30.23
7-9 Months	118	2.54
Greater than 9 months	81	3.7
Early	108	6.4
Mid	128	16.7
Late	64	44.4
1-3 Months	101	54.5
4-6 Months	157	31.2
>7 Months	42	52.4

Table 5: Prevalence of Bovine clinical and subclinical Mastitis associated with different lactation stage.

Diagnostic Method Used

Clinical examination of Mastitis

Clinical examination was conducted to determine prevalence of clinical Mastitis. Udder was examined for visible abnormalities, symmetry, size, consistency, presence of lesions and/or ticks. Clinical Mastitis was recognized by some pathology in udder, which is manifested by sign of inflammation like swelling, pain, redness and heat in case of acute Mastitis. Whereas, hardening of the udder, blockage of the teats, atrophy or fibrosis and abscess formation were manifested in chronic Mastitis. Acute Mastitis was also recognized by change in milk color, presence of flakes and clots [48].

California Mastitis test (CMT)

This California Mastitis test (CMT) a screening test for subclinical Mastitis. This test is preferred to be screening tests for subclinical Mastitis as they can be used easily, yielding rapid as well as satisfied result which was used by taking a small sample of milk (approximately ½ teaspoon) An equal amount of CMT reagent was added to the milk and the paddle rotated to mix the contents. After approximately 10

Parity	No of animal examined	Prevalence%
1-3	346	61.6**
4-7	98	90.8*
1-3 Calves	122	12.3**
4-6 Calves	124	29
>6 Calves	112	75.9*
Few (1-3)	23	56.52
Moderate (4-7)	51	64.71*
Many (>8)	47	57.45
1 Calve	66	25.8
2 Calves	145	41.4
3 Calves	115	65.2
≥ 4 Calves	203	88.2*
1-3 Calves	68	48.53
4-5 Calves	24	29.16
>/=6 Calves	4	25.0
1-3 Calves	209	12.9
4-6 Calves	159	25.1
Greater than 6	16	56.25*
1-3 Calves	60	33.3
4-6 Calves	100	35
>7 Calves	140	56.7*
*these category is highly significantly different (p-value<0.05) **these categories are not significantly different (p-value>0.05)		

Table 6: Prevalence of Bovine clinical and subclinical Mastitis associated with different parity.

seconds, the score was read while continuing to rotate the paddle. Results were recorded as T (trace), 1, 2 or 3 based on the level of precipitation (coagulation) [57].

Surf field Mastitis test

The samples were subjected to surf test. For this purpose, 3% Surf solution was prepared by addition of three grams of commonly used detergent powder 3 gm surf (Surf Excel, Unilever, Pakistan) in 100 ml of distilled water. Milk samples and surf solution were then mixed in equal quantities in Petri dishes. The formation of gel depicted the positive samples [58].

Indicator paper test

This test technique is used as screening test to determine the prevalence of subclinical in animal. Milk sample were tested using the paper by adding milk sample to test paper and observing the color change of paper. Sample is negative if the yellow color of paper is not changed or shows a slight change in color. A change of color from yellow to green or bluish green was recorded as positive [48].

White side test

The principle of this test is based on the increased number of leukocyte in mastitic milk. Milk sample are placed on a clean dry glass slide and add a drop of 4% sodium hydroxide and mix with a glass rod. If the milk is from animal having Mastitis, it becomes thickened and flakes appear. While the negative milk sample remain the same [59,60].

Bacteriological examination

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 [28].

As described by [61-63] aseptic procedures for collecting quarter milk samples were followed. The time chosen for milk sample collection was before milking. Udders and especially teats were cleaned by anti-septic's and water and dried before sample collection. Each positive CMT milk sample was collected separately to avoid confusion and cross contamination and was subject to laboratory for routine bacteriological investigation and cultured onto 10% sheep blood agar and MacConkey agar plates [62,64].

The suspected colonies could be identified morphologically, microscopically, biochemically and culture with fine bacterial growth were considered as positive and those with no visible growth taken as negative [65].

Direct microscopy

The milk sample was centrifuged and stained smear made from the deposit. A Gram stain was used routinely. The ZehilNeelson staining was performed for rare cases when bacteria such as *M. bovis* are suspected.

Biochemical tests

For the primary isolation and identification of Mastitis causing microorganisms, colony size, shape, color, pigmentation, hemolytic characteristic, gram's reaction, oxidase, O-F tests were performed. After these colonies were sub cultured to different media, such as Mannitol salt agar, MacConkey agar (Oxiod, Hampshire, England), Edward's medium (Oxiod Hampshire, England), Eosin methylene blue medium (EMB) (Oxiod, Hampshire, England) to get a pure culture and the secondary biochemical tests such as, coagulase test, urease test, IMVIC tests, sugar tests were done for bacterial species identification. The procedures for the identified pathogens were referred from.

Conclusion and Recommendations

Mastitis is still a major problem to farms and the review findings suggested that Mastitis is one of important disease of dairy cattle. Subclinical form is the most prevalent type of Mastitis in Ethiopia. Stage of lactation, parity, age, breed inadequate hygienic condition of dairy environment, and milking hygiene were the most important risk factor contributing to the prevalence of Mastitis. In cow diagnosis of Clinical Mastitis is based on the appearance of abnormally appearing milk while diagnosis of Subclinical infection is more problematic since the milk appears normal but usually has an elevated somatic cell count. Diagnosis of Subclinical Mastitis can be made in a variety of ways including direct measurement of the somatic cell count (SCC) level or indirectly by performing a California Mastitis test (CMT) on suspected quarters. Several causative agents of Mastitis were reported in Ethiopia. *Staphylococcus aureus, Streptococcus agalactiae and E. coli* were observed to be the major causes of Mastitis.

Having the above conclusions, the following recommendations are forwarded:

- Regular screening for early detection and treatment, follow up of chronic case, and control of subclinical Mastitis are recommended to alleviate the problem.
- Adequate research has to be made to figure out the prevalence at country level and take appropriate control measures.
- 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.

A detailed research regarding the prevalence and risk factors distribution of the disease should be made which enable effective control measures.

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