European Journal of Applied Sciences 9 (6): 287-295, 2017
ISSN 2079-2077

DOI: 10.5829/idosi.ejas.2017.287.295

Prevalence of Bovine Mastitis and Isolation of Causative Major Pathogens in and Around Jigjiga, Somali Region, Ethiopia

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Abstract: A cross-sectional study was conducted from October 2011 to May 2012 in and around Jigjiga town with the aim of determining the overall prevalence of bovine mastitis, identifying the major bacterial genera causing bovine mastitis and associated risk factors in the area. In the present study a total of 32 cross breed and 352 indigenous local breed were included. Milk sample were collected from randomly selected cows and subjected to screening test by using California mastitis test (CMT) immediately after milking for both clinical and subclinical cases. The present study revealed an overall prevalence of bovine mastitis in and around Jigjiga town was 9.1% (35/384), of which 1.8% (7) was clinical and 7.3% (28) subclinical mastitis cases. Prevalence of bovine mastitis showed highly significant variation among cross and local breed cows (p=0.01), previous mastitis history (p=0.01), intensive, semi-intensive and extensive husbandry (p=0.01) and different production scale (p=0.01). Total milk from CMT positive dairy cows (7 clinical and 28 subclinical cases) were collected and cultured for isolation of the causative bacterial genera. *Streptococcus spp* (60%) were the major pathogens that cause bovine mastitis in the study area. In general, this study unequivocally indicated that Bovine mastitis is serious problem affecting production and productivity in the district. The professionals and responsible stake holders should have to give special emphasis and new strategy for the prevention and control of bovine mastitis.

Key words: Bacteria · Clinical · Cows · Dairy · Risk Factor · Subclinical

INTRODUCTION

Ethiopia has the largest livestock population in Africa. Among these cows represent the largest population of cattle production of the country with about 49.3 million heads of genetically distinct cattle of which 9.9 million are dairy cows [1]. Even though, Ethiopia is the most populous country in cattle than any African country, up to 1997 the milk consumption was lower than other countries in the region [2]. The country's per capita milk consumption is estimated to be about 19.2 kg per year, which is far below the average per capita consumption of Africa, 37.2 kg per year [3]. In the livestock development policy to improve the per capita milk consumption, improvement of genetic potential of indigenous zebu through breeding with high-grade exotics was included. In years to come a significant percentage of dairy cattle population in Ethiopia would be improved breeds which are susceptible to the most diseases including mastitis [2].

Bovine mastitis is a single most common disease syndrome in adult dairy cows [4]. It is a major disease of cross breed cows. It is the second most frequent disease next to reproductive diseases [5]. Mastitis is the inflammation of parenchyma of mammary gland regardless of the cause. It is resulting from injurious agents including pathogenic microorganisms, trauma and chemical irritants [6]. Mastitis can be also defined as clinical (grossly evident changes to milk, the gland or the whole animal) or as subclinical (diagnosed using ancillary tests such as the California mastitis test). Mastitis is a multi-factorial disease, requiring exposure to a combination of environmental and pathogenic factors and with variable responses between animals [7-9].

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Mastitis is characterized by a range of physical and chemical changes in the milk and pathological change in the glandular tissue. The most important changes in the milk include discoloration and the presence of large number of leukocytes. There is swelling, heat, pain and edema in the mammary glands in many clinical mastitis cases [6]. Sub-clinical mastitis is a condition in which there is no detectable inflammatory change in the udder and no observable abnormalities in the milk. Often it is more prevalent than the clinical form, it usually precedes the clinical form and it reduces milk production and adversely affects milk quality [10]. Mungube *et al.* [11] reported that economic loss in Ethiopian highland crossbred dairy cows was due to subclinical mastitis.

The prevalence of clinical and subclinical mastitis in Ethiopian ranges from 1.2 to 21.5% and 19 to 46.6% respectively [12, 13]. A total of about 135 and over microorganisms have been reported to cause the mastitis; *Staph. aureus*, *Streptococcus agalactiae*, *Str. uberis*, *E. coli* and some others are the most common agents. The disease has been reported by several authors in different parts of the country. These studies have been shown the occurrence of a range of mastitis causing bacteria indicating Staphylococcus and Streptococcus as dominant and pathogenic species [14-16].

Bovine mastitis has various economic loses through loss of milk production, replacement cost of culled cows, extra labor, cost of treatment and control measures. Mastitis also has zoonotic implication by causing food poisoning and interfering with manufacturing process [6]. It is also associated with a number of zoonotic diseases in which milk acts as a vehicle of infection [17]. Generally, mastitis has both economic and public health importance. Major economic loss can occur in a dairy herd with mastitis problem. It is estimated that on average an affected quarter lead to 30% reduction in productivity and an affected cow causes 15% losses of its production for the lactation [18].

In Ethiopia, urban and peri-urban dairy production systems are emerging as an important component of the milk production system. This system is contributing immensely towards filling in the large demand-supply gap for milk and milk products in urban centers, where consumption of milk and milk products is remarkably high [19]. The urban and peri-urban dairy production system has tremendous potential for development and could play a significant role in minimizing the acute shortage of dairy products in urban centers of Ethiopia. However, except in towns situated in the central highland areas of Ethiopia, very little researches have been done to identify status of bovine mastitis and overall constraints of dairy production systems in hot lowland areas, especially in and around Jigjiga town in particular and Somali region in general. Therefore, the present study was initiated to estimate the prevalence of bovine mastitis and identify the major genera of bacteria that cause bovine mastitis in and around Jigjiga town.

MATERIALS AND METHODS

Study Area: The present study was conducted on different farming systems in and around Jigjiga town. Jigjiga is the capital city of Somali regional state. It is located in Jigjiga zone, approximately 80km east of Harare and 60km west of border with the Republic of Somali Land (North Somalia). The Somali region has bimodal pattern of rainfall region; hence pastoralists practice two cropping seasons which are from March to April (long rainy season) and short rainy season from October to November [20]. According to the national metrological service agency [21], the mean annual rainfall is 660mm. Generally Jigjiga has low, unreliable and uneven distribution of rain fall. The temperature in the cattle raring area of Jigjiga zone is relatively high all year round, where the mean minimum and mean maximum temperature is 16 to 20°C and 28 to 38°C respectively.

Study Population: The study animals were all lactating dairy cows managed in small scale, medium scale and large scale with intensive, semi-intensive and extensive farming systems. The breeds of cattle included were indigenous zebu (352) and indigenous crossed with exotic breed (32), in the study sites. Husbandry and management of dairy cows' houses were poor. Milking method practiced on all selected lactating cows was hand milking. Udders and teats of cows were washed before milking only for the purpose of decrease friction between hand and teat during milking.

Sampling Technique and Sample Size Determination: Simple random sampling and purposive method was used for sampling of local indigenous lactating dairy cows and cross breed respectively. Because of the limited number of cross breed cows in the area purposive sampling were used sampling them. The desired sample size was calculated by considering 95% confidence level, 5% desired absolute precision and because of the absence of previous study in the area 50% expected prevalence where taken to determine the sample size using the formula given by Thrusfield [22]. Accordingly, a total of 384 dairy cattle were selected and included in the study.

$$N = \frac{1.96^2 \ Pexp\ (1\text{-}Pexp)}{d^2}$$

where,
N= required sample size
Pexp = expected prevalence
d = desired absolute precision

Study Design: A cross-sectional study design was conducted to determine prevalence of bovine mastitis& associated risk factors and also isolation and identification of major bacterial causes of mastitis in the period from October 2011 to May 2012 in and around Jigjiga town at cow and quarter level based on clinical manifestations for clinical mastitis and indirect test (CMT) for subclinical mastitis. This was conducted in cows found in small scale, medium scale and large scale of production system. The age of the study animals was categorized as young adults (3-5 years) and adults (6-9). Lactation stage was classified as early (< 3 months), medium (3-6 months) and late (> 6 months).

Study Methodology

Physical Examination: The udder was first examined visually and then through palpation to detect possible fibrosis, cardinal signs of inflammation, visible injury, tick infestation, atrophy of the tissue and swelling of the supra mammary lymph nodes. The size and consistency of mammary quarters were inspected for the presence of any abnormalities, such as disproportional symmetry, swelling, firmness and blindness. Viscosity and appearance of milk secretion from each mammary quarter was examined for the presence of clots, blood and watery secretions.

Milk Sample Collection: Milk sample collection was done according to the procedures recommended by National Mastitis Council [23]. To avoid the effect of time between milking and sampling on CMT, milk sample was collected before milking early in the morning. CMT dictated immediate processing, to avoid possibility of contamination and multiplication of microorganisms. Duplicate quarters' milk samples of approximately 10ml amount were taken; one sample was used for CMT and the remaining sample was used for bacterial isolation. After collection, samples were placed in icebox and processed in the same day or within few days. Milk collection procedure is described below. The udders and especially teats were cleaned and dried before sample collection. Each teat end was scrubbed vigorously with a pledged of cotton moistened (but not completely wet) with 70% ethyl alcohol. Recontamination of teats during scrubbing, was avoided by scrubbing, the teats on the far side of the udder first, then those on the near side. Separate pledged cotton was used for each teat.

Collecting Milk Samples: Teats towards sample collection were sampled first and then the far ones. The first 3-4 streams of milk were discarded. The collecting vial was held as near horizontal as possible and by turning the teat to a near horizontal position, approximately 10 ml of milk was collected into a universal sample collection bottle. After collection, the sample was placed in icebox and transported to the laboratory. The samples were either cultured or stored at 4 °C until cultured within few days.

California Mastitis Test Screening: Subclinical mastitis was diagnosed based on CMT result and nature of coagulation and viscosity of the mixture (milk and CMT reagent), which show the presence and severity of the intuition. Before sample had collected for bacteriological examination, milk samples were examined for visible abnormalities and were screened by the CMT. From each quarter of udder, a squirt of milk sample was placed in each of the cups on the CMT paddle and an equal amount of 3% CMT reagent was added to each cup and mix well by gentle circular motion for 15 second according to Schalm *et al.* [24] and Quinn *et al.* [25]. The test results were interpreted subjectively as either a negative, trace, 1+, 2+ or 3+ inflammatory response based on the viscosity of the gel formed by mixing the reagent with milk according to Radostits *et al.*[18]. To minimize the rate of false negatives, the test was read as negative versus positive with trace scores regarded as/ recorded as Positive. Fresh unrefrigerated milk was tested using the CMT for up to 12 hours. Reliable readings were obtained from refrigerated milk for up to 36 hours. When stored milk used, the milk was thoroughly mixed prior to testing because somatic cells tend to segregate with milk fat.

Bacteriological Examination of Milk Samples: Bacteriological examination was done according to the NMC and Quinn *et al.* [23, 25] and National Committee for Clinical Laboratory Standards [26]. A loopful of milk sample was streaked on to MacConkey agar and blood agar base enriched with 7% defibrinated sheep blood using the quadrant streaking method for each quarter. Blood agar plates were incubated aerobically at 37°C for 24 - 48 h. Then primary identification was made on basis of colony morphology, hemolytic characteristics, Gram reaction (shape and arrangement of bacteria), acid-fast,

catalase, motility, oxidase and O-F test (triple sugar iron). Staphylococci were grown on mannitol salt agar. Streptococci identified were grown on Edward media.

Data Management and Analysis: The data collected from individual animals and households were coded, entered and stored in Ms Excel spread sheet until analyzed using SPSS version 15 software. The prevalence of mastitis (clinical and subclinical mastitis) at cow level was dependent variable while breed, husbandry, production scale, previous mastitis history, stage of lactation and age were independent variables considered at cow level. The total prevalence was calculated by dividing the numbers of disease positive animals by total number of animals examined. The association between the occurrence of mastitis and potential risk factors were compared using chi-square test. In all chi-square test, probability of $p < 0.05$ was considered statistically significant.

RESULTS

Prevalence of Bovine Mastitis: Out of 384 lactating cows examined for study purpose, the results showed overall prevalence of clinical and sub-clinical mastitis as 7 (1.8%) and 28 (7.3%), respectively. So the overall prevalence of bovine mastitis in and around Jigjiga is 9.1% (Table 1).

Of the total 1536 quarters of lactating cows examined during the study period 140 quarters had mastitis, of which 89 weak positive, 41 distinct positive and 10 strong positive. Based on CMT result the prevalence of clinical and subclinical mastitis at quarter level were 0.8 and 8.3% respectively. The prevalence of clinical mastitis of right front and right hind quarters were 1 and 1.3% respectively, which was higher than left quarters (0.5%). The effect of quarters on the prevalence of mastitis was statistically significant (p=0.01) (Table 2).

Risk Factors Associated with Bovine Mastitis: A significantly higher infection rate ($P < 0.05$) was observed in cross breed cows 23 (71.9%) as compared with the local breeds 12 (3.4%). The results also showed significantly higher infection rate ($P < 0.05$) in cows with previous mastitis history (43.8%) than cows with no mastitis history (2.2%). Cows with early, medium and late lactation stage had 11.8, 7.5 and 6.6% rates of infection, respectively and the difference was not statistically significant ($p>0.05$). Rate of infection in young adult and adult dairy cows was 9 and 9.2%, respectively. Their difference was not statistically significant ($p>0.05$). Infection rate of the mammary gland of these groups was significantly influenced ($P < 0.05$) (Table 3). Out of 55 intensively, 27 semi-intensively and 302 extensively managed cows studied, the highest infection rate was seen in intensively managed cows (49.1%) followed by the semi-intensive (3.7%) and the least for the extensively managed animals (2.3%). There was a higher prevalence of mastitis in medium production scale (34%) than large production scale (15.2%) and small production scale (4.3%); the result was significantly different ($P < 0.05$) (Table 4).

Major Isolated Bacterial Pathogens: All of CMT positive milk (35 samples) was cultured for identification of genera of bacteria that cause bovine mastitis. After 24-48 hours all cultured samples were germinated. After culturing streptococci, staphylococci, *E. coli* and micrococcus were isolated. The relative prevalence rates of these bacterial genera isolated from the clinical and sub-clinical cases are shown in Table 5. Streptococci genera were major pathogens (60%) which account for 57.14% clinical and 60.71% subclinical mastitis cases. Staphylococci were also isolated from clinical and subclinical mastitis at the rate of 28.57 and 35.71%, respectively.

Table 1: Prevalence of mastitis (clinical and subclinical) in dairy cows in Jigjiga town

		Number of mastitis positive			Prevalence%		
No of cows examined	None mastitis	Clinical	Subclinical	Total	Clinical	Subclinical	Total
384	349	7	28	35	1.8	7.3	9.1

Table 2: Prevalence of clinical and subclinical mastitis at quarter level

		Interpretation of CMT findings				No. of mastitis positive (%)			
Quarters	No. of quarters examined	N	W	D	S	Clinical	Sub clinical	Total	p-value
RF	384	349	17	15	3	4 (1)	31 (8.1)	35 (9.1)	0.01
RH	384	349	21	11	3	5 (1.3)	30 (7.8)	35 (9.1)	
LF	384	349	25	8	2	2 (0.5)	33 (8.6)	35 (9.1)	
LH	384	349	26	7	2	2 (0.5)	33 (8.6)	35 (9.1)	
Total	1536	1396	89	41	10	13 (0.8)	127 (8.3)	140 (9.1)	

Key:-RF=right front, RH=right hind, LF=left front, LH=left hind, N=negative, W=weak positive, D=distinct positive, S=strong positive

Table 3: Prevalence of mastitis in relation to Breed, Age, Lactation stage and previous mastitis history

Risk Factors	Nº of examined	Nº of Mastitis positive			Prevalence%			P-value
		Clinical	Subclinical	Total	Clinical	Subclinical	Total	
Breed								
Cross	32	4	19	23	12.5	59.4	71.9	0.01
Local	352	3	9	12	0.9	2.6	3.4	
Age								
Young	232	4	17	21	1.7	7.3	9	0.984
Adult	152	3	11	14	2	7.2	9.2	
Lactation Stage								
Early	161	4	15	19	2.5	9.3	11.5	0.295
Medium	147	3	8	11	2	5.4	7.5	
Late	76	-	5	5	-	6.6	6.6	
Previous history								
Yes	64	6	22	28	9.4	34.4	43.8	0.01
No	320	1	6	7	0.3	1.9	2.2	

Table 4: Prevalence of mastitis in different husbandry systems and different production scales

	Nº of examined cows	Nº of Mastitis positive			Prevalence (%)			P- value
		Clinical	Subclinical	Total	Clinical	Subclinical	Total	
Husbandry								
Intensive	55	5	22	27	9.1	40	49.1	0.01
Semi- intensive	27	-	1	1	-	3.7	3.7	
Extensive	302	2	5	7	0.7	1,7	2.3	
Production Scale								
Small	301	3	10	13	1	3.3	4.3	0.01
Medium	50	4	13	17	8	26	34	
Large	33	-	5	5	-	15.2	5.2	

Table 5: Bacterial genera isolated from bovine clinical and subclinical mastitis

Genera of Bacteria	Clinical		Subclinical		Pooled (Total)	
	Numbers	%	Numbers	%	Numbers	%
Staphylococci	2	28.57	10	35.71	12	34.29
Streptococci	4	57.14	7	60.71	21	60
E. coli	-	-	1	3.57	1	2.86
Micrococci	1	14.29	-	-	1	2.86
Total	7	100	28	100	35	100

DISCUSSION

This study showed the overall prevalence of mastitis in local and crossbreed cows in and around Jigjiga town is 9.1%. On the contrary, the reports of Biru [28] (63.4%), Tolla [29] (61.11%) and Zerihun [30] (68.1%) were higher than the present findings (9.1%). The prevalence of clinical and subclinical mastitis was 1.8 and 7.3%, respectively. The prevalence of clinical mastitis is in agreement with report that states the prevalence of clinical in Ethiopian range is from 1.2 to 21.5% [12, 13] and likewise the prevalence of subclinical mastitis is inconsistent with the report of who stated the prevalence of subclinical mastitis is between 19 to 46.6% [27]. The variability in the prevalence of bovine mastitis between reports could be attributed to difference in climate zone, management of the farms and breeds considered.

The relative high prevalence of clinical mastitis in right hind quarters (1.3%) and right front quarter (1.04%) in this study agrees with the finding of Dodd *et al.* [31] and Shirmeko [32]. This may be due to greater production capacity of hindquarters, the likelihood of fecal and environmental contamination of hindquarters and ease of first grasping by milker's hand in case of right front quarters. Subclinical mastitis was high in both breeds compared to clinical mastitis. In the current study the rate of sub-clinical mastitis (7.3%) was higher than that of the

clinical mastitis (1.8%) as was reported by Kerro and Tareke [13] (62.9 versus 37.0% in Southern Ethiopia), Biru [28] (39.5 versus 23.9%) and Hunderra *et al.*,[33] (36.67 versus 16.11%) in central, Ethiopia. This variation in prevalence between subclinical and clinical mastitis may be due to the fact that, the defense mechanism of the udder reduces the severity of the disease.

The prevalence of mastitis reported in Addis Ababa [27] (5.3%) and Bahr Dar [34] (3.9%) was lower than the present finding. However, Higher prevalence than the present finding was reported by Workineh *et al.* [35] (25.1%) in Addis Ababa and Yomiyu, Yonas and Tesfu [36] 56.5% in Sebeta, Ethiopia. The prevalence of subclinical mastitis in crossbreeds at cow level based on CMT in the present study (59.4%) is similar to the finding of Hunderra, Ademe and Sintayehu [33] who reported (56.29%) in and around Sebeta. However; Shirmeko [32] reported lower prevalence (40%) when compared to the present finding. Subclinical mastitis in local zebu breeds in the present finding (2.6%) was lower than reported by Temesgen [37] (25%) in Mekele, Tigray, Ethiopia. Mastitis is a complex disease and the difference in results could be due to difference in management system between the farms, genetic variation of cows and amount of production. Breed was found to be statistically significant ($p < 0.05$). The occurrence of mastitis was more likely in crossbreds than to local zebu. Increases in milk yield from genetic selection may be accompanied in genetic susceptibility to mastitis [38]. Therefore, the lower prevalence in local zebu breeds in this study could be associated with difference in genetically controlled physical barrier like streak canal sphincter muscle, keratin in the teat canal or shape of teat end where pointed teat ends are prone to lesion [39]. In addition to physical barrier, difference in occurrence of mastitis in these breeds could arise from differences in cellular immunity [40]. The lower occurrence of mastitis in local breeds in addition to genetic factors could be attributed to milking practice. Previous and recent works support the importance of suckling both in the calf and cow including udder health [41, 42].

The present study observed higher prevalence of mastitis during early lactation (11.9%) as compared to mid (7.5%) and late lactation stages (6.6%). It was in line with the reports by Kerro and Tareke [13] who also reported the same findings in Southern Ethiopia and this may be due to an absence of dry period therapy and birth related influences. Radostits [43] suggested that, the mammary gland is more susceptible to new infection during the early lactation stage and late dry period. This might be due to the absence of udder washing and teat dipping, which in turn might have increased the presence of potential pathogens on the skin of the teat. The increasing prevalence of mastitis with increasing age is in argument with the findings by Kerro and Tareke and Nibret, Yilikal and Kelay [13, 44] who found that, the risk of clinical and subclinical mastitis increase with the advancing age of the cow. Similar finding is also reported by Fufa *et al.* [45] and Jafer *et al.* [46] who stated that cows in parity number greater than three had significantly higher mastitis prevalence ($P < 0.05$) than those 2-3 and primiparous.

The study revealed a prevalence of bovine mastitis 49.1, 3.7 and 2.3% in intensive, semi intensive and extensive husbandry system, respectively. There was highly significant association of mastitis between intensive, semi intensive and extensive ($p<0.05$). The main source of the infection was the udder of infected cows transferred via milker's hands, utensils, towels and the environment (floor) in which the cows were kept [18]. As prevalence was showed in large scale (15.2%), medium scale (34%) and small scale (4.3%), the association was highly significant ($p<0.05$). These infections were generally the result of contagious mastitis and caused by an inability of mastitis control rather than a physiologic effect [40]. These could be result of the contagious bacteria that can be easily transmitted during milking by single person from infected cows to healthy.

The cows that had previous mastitis history in the flock showed prevalence 43.8%. It was more significant when compared with the cows which did not have history of mastitis ($p<0.05$). It may be due to lack of screening tests and treatment of subclinical mastitis and inadequate follow up of clinical and chronic cases remains hidden and result distraction of mammary tissue [47]. It might be result of reservoir in the flock of dairy cows, environment and presence of drug resistant bacteria. This also might be an indication of a serious mastitis problem on the respective flock and of the absence of a culling program that can serve as a means to remove source of this mammary pathogens for other cows.

The prevalence of streptococci species in the present study was 60%, which was higher than the amount reported for the same species by Zerihun [30] who reported (27%) in dairy cows. Staphylococci were also isolated as the major pathogens of mastitis in the area and it might be due to lack of effective udder washing and drying, post milking teat dip and drying, entire cow hand washing and disinfection in the milking routine of the area. Contamination of milker's hands, wash clothes and

any contaminated material from infected quarter has been reported to quickly lead to spread of mastitis. From there it is shed into the milk, which serves as a source of infection for healthy cows during the milking process [18].The low prevalence of *E. coli* (2.9%) and micrococcus (2.9%) could be due to higher prevalence of other pathogens of all the isolates, contagious pathogens showed greater frequency than others. This finding is not comparable with the report of Kasech, Alebachew and Alemu [48] who found the predominant bacteria isolated was *E. coli* with isolation rate of 57.8% followed by *S. agalactiae*, Enterobacter, *S. aureus* and *S. epidermidis*. The high prevalence of *Staphylococcus* species in the present study is in agreement with findings of several other investigators [49]. Staphylococci are the most important and prevalent mastitis causing organisms globally including Ethiopia [49]. This organism causes contagious mastitis and primarily resides in the mammary gland of cows.

CONCLUSIONS

Bovine mastitis is an economically important serious disease causing a direct and indirect loses especially in sub-Saharan Africa. The present study showed the prevalence of bovine mastitis in and around Jigjiga is 9.1%. The study also revealed that subclinical mastitis was more prevalent than clinical mastitis. Although the overall prevalence of mastitis in the present study was relatively lower than previous studies in Ethiopia, mastitis is still a disease that would threaten the dairy production in the district. Previous mastitis history, intensive husbandry farming system, breed and lack of screening test and treatment of subclinical mastitis were identified as important factors that enhance the occurrence of bovine mastitis. Furthermore, the higher prevalence of subclinical mastitis coupled with little attention received for subclinical mastitis and efforts has been focused on the treatment of clinical cases in the area, high economic loss could come from sub clinical mastitis. In general, this study unequivocally indicated that Bovine mastitis is serious problem affecting production and productivity in the district.

Based on the above conclusive remarks the following recommendations are forwarded:

- The farmers should ensure strict personal hygiene, proper washing, drying and disinfection of udders and milkers' hands and working equipment's to reduce the spread of mastitis.
- Periodically monitoring of infection status of the udder and screening test of subclinical mastitis should be under taken to treat and reduce impact of the disease.
- The professionals and responsible stake holders should have to give special emphasis and new strategy for the prevention and control of bovine mastitis.

ACKNOWLEDGMENT

The authors would like to thank Jigjiga Regional Veterinary Laboratory for providing all the necessary facilities. We are also like to thank owners for their willingness for milk sample collection from their animals.

REFERENCES

1. CSA (Central Statistical Agency), 2013. Federal Dominance of Democratic Republic of Ethiopia central statistical Agency Agricultural sample Survey. Report on Livestock and livestock characteristics (private peasant holding): 2: 10-15.
2. Asfaw, W., 1997. Livestock development policy in Ethiopia. In: Livestock Development Policies in Eastern and Southern Africa. CTA, OAU/IBAR, Ministry of Agriculture and Cooperatives, Swaziland (Eds.). Paper presented in a seminar held in Mbabane, Swaziland, 28 July – August 1997.
3. FAO (Food and Agricultural Organization of the United Nations), 2000. Food and Agriculture Organization 2000 Year book. Rome, Italy.
4. Smith, K.L. and J.S. Hogen, 1993. Environmental mastitis. In: The Veterinary Clinics of North America, Food Animal Practice, Update On Bovine Mastitis. Ed., Hunt, E. W. B. Saunders Company, pp: 489-518.
5. Lemma, M., T. Kassa and A. Tegegene, 2001. Clinically manifested major health problems of crossbred dairy herds in urban and periurban production systems in the central high lands of Ethiopia. Tropical Animal Health Production, 33: 85-89.
6. Pyorola, S., 2003. Indicates of information in the diagnosis of mastitis. Veterinary Research, 34: 565-576.
7. Fox, L.K., S.T. Chester., J.W. Hallberg, S.C. Nickerson, J.W. Pankey and L.D. Weaver, 1995. Survey of intramammary infections in dairy heifers at breeding age and first parturition. Journal of Dairy Science, 78: 1619-1628.

8. Barnouin, J. and M. Chassagne, 2001. Predictive variables for the occurrence of early clinical mastitis in primiparous Holstein cows under field conditions in France. Can. Veterinary Journal., 42:47-53.
9. Compton, C.W., R.C. Heuer, K.I. Parker and S. McDougall, 2007. Risk factors for peripartum mastitis in pasture-grazed dairy heifers. Journal of Dairy Science, 90: 4171-4180.
10. Gianneechini, R., 2001. Occurrence and aetiology of clinical and sub-clinical mastitis and antimicrobial susceptibility of udder pathogens in dairy herds in a region in Uruguay. Swedish University of Agricultural Sciences. Uppsala. M.Sc. Thesis, ISSN 1403-2201.
11. Mungube, E.O., B.A. Tenhagen, F. Regassa, M.N. Kyule, Y. Shiferaw, T. Kassa and M.P.O. Baumann, 2005. Reduced milk production in udder quarters with subclinical mastitis and associated economic losse in crossbred dairy cows in Ethiopia. Tropical Animal Health Production, 37: 503-512.
12. Hussein, N., T. Yehualashet and G. Tilahum, 1997. Prevalence of mastitis in different local and exotic breeds of milking cows. Ethiopian journal of Agricultural Science, 16: 53-60.
13. Kerro, O. and F. Tareke, 2003. Bovine mastitis in selected areas of southern Ethiopia. Tropical Animal Health and Production, 35: 197-205.
14. Lakew, T., G. Wirtu and A. Tegegne, 2009. Survey of mastitis in dairy herds in the Ethiopian central highlands. Ethiopian Journal of Science, 22: 291-301.
15. Gebreyohannes, Y.T., F.G. Regassa and B. Kelay, 2010. Milk yield and associated economic losses in quarters with subclinical mastitis due to Staphylococcus aureus in Ethiopian crossbred dairy cows. Tropical Animal Health Production, 42: 925-931.
16. Megersa, B., T. Chala, F. Abunna, A. Regassa, M. Berhanu and D. Etana, 2010. Occurrence of mastitis and associated risk factors in lactating goats under pastoral management in Borana, Southern Ethiopia. Tropical Animal Health Production, 42: 1249-1255.
17. Jenkins, P.A., 1982. Diagnostic bacteria, Biology of micro bacteria, Academic press, London.
18. Radostits, O.R., D.C. Blood and D.C. Bay, 1994. Veterinary Medicine, A Text Book of the Diseases of Cattle, Sheep, Goats and Horses. 8thed. London: Bailler Tindall, pp: 563-614.
19. Azage, T. and G. Alemu, 1998. Prospect for Peri-urban Dairy Development in Ethiopia Ethiopian Society of Animal Production (ESAP) Publication No. 5. Addis Ababa, Ethiopia.
20. IPS (Industrial Project Service), 2010. Resource potential assessment and project identitication study of Somali region, Agricultural resource, industrial project service, Addis Ababa, 3(9): 137-191.
21. NMSA (National Metrological Service Agency), 2010. Annual metrological report.
22. Thrusfield, M., 1995. Veterinary epidemiology. Veterinary clinical studies Royal (Dick) school Veterinary studies University of edinburgn. 3rd ed. Blackwell science ltd, a Black well publishing company, pp: 229-270.
23. NMC (National Mastitis Council), 1990. Microbiological procedures for the diagnosis of bovine udder infection. 3rd ed. Arlington VA: National Mastitis Council Inc.
24. Schalm, O.W., E.J. Carrlole and N.C. Jain, 1971. Bovine Mastitis. Philadelphia: Lea and Teliger, pp: 1-21.
25. Quinn, P.J., M.E. Carter, B.K. Markey and G.R. Carter, 1994. Mastitis. In: Clinical Veterinary Microbiology. Mosby International Limited, London, pp: 327-344.
26. NCCLS (National Committee for Clinical Laboratory Standards), 1997. Performance standard for antimicrobial disk and dilution susceptibility test for bacteria isolated from animals and humans. Approved Standard, NCCLS document M 31-A, NCCLS, Villanova, PA.
27. Bishi, A.S., 1998. Cross sectional and longitudinal prospective study of bovine clinical and subclinical mastitis in peri urban and urban dairy production systems in the Addis Ababa region, Ethiopia. Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit and Freie University at Berlin, Msc. Thesis.
28. Biru, G., 1989. Major bacteria causing bovine mastitis and their sensitivity to common antibiotics. Ethiopian Journal of Agricultural Science, 11: 43-49.
29. Tolla, T., 1996. Bovine Mastitis in Indigenous Zebu and Boran Holstein Crosses in Southern Wollo. Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, DVM. Thesis., pp: 25-27.
30. Zerihun, T., 1996. A Study on Bovine Subclinical Mastitis at Stela Dairy Farm. Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, DVM. Thesis., pp: 25-27.

31. Dodd, F.M., D.R. Westgarth, F.K. Neave and R.G. Kingwill, 1969. Mastitis the strategy of control. Journal of Dairy Science, 9:52-68.
32. Shirmeko, G., 1996. Prevalence and Etiology of Subclinical Mastitis in Frisian Indigenous Zebu Breeds of Dairy Cows in and around Bahirdar. Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, DVM. Thesis., pp: 23-27.
33. Hunderra, S., Z. Ademe and A. Sintayehu, 2005. Dairy Cattle Mastitis In and Around Sebeta, Ethiopia. Internal Journal of Applied Research Veterinary Medicine, 3: 4.
34. Gizat, A., 2004. A cross-sectional study of bovine mastitis in and around Bahir dar and antibiotic resistance patterns of major pathogens. Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, Msc. Thesis.
35. Workineh, S., M. Bayleyegne, H. Mekonnen and L.N.D. Potgieter, 2002. Prevalence and etiology of mastitis in cows from two major Ethiopian dairies. Tropical Animal Health and Production, 34: 19-25.
36. Yomiyu, M., G. Yonas and K. Tesfu., 2017. The prevalence of bovine mastitis and associated risk factors in Cross Breed Lactating Dairy Cows in Sebeta, Central Ethiopia. European Journal of Biological Sciences, 9(3): 106-112.
37. Temesgen, W., 1999. A Study on bovine mastitis in and around Makelle. Faculty of Veterinary Medicine, Addis Ababa University, Debre Zeit, DVM Thesis.
38. Schutz, M., 1994. Genetic evaluation of somatic cell score for United States dairy cattle. Journal of Dairy Science, 77: 2113-2129.
39. Seykora, A.J. and B.T. McDaniel, 1985. Udder and teat morphology related to mastitis resistance. Journal of Dairy Science, 68: 2087-2093.
40. Erskine, R.J., 2001. Mastitis control in dairy herds. In: Radostits, O. M. (ed.): Herd Health: Food Animal Production. 3rd ed. Philadelphia: W. B. Saunders Company, pp: 397-435.
41. Mejia, C.E., T.R. Preston and P. Fajersson, 1998. Effects of restricted suckling versus artificial rearing on milk production, calf performance and reproductive efficiency of dual purpose Mpwapwa cattle in a semi-arid climate. Livestock Research for Rural Development, 10: (1). Retrieved January 15 2012 from http://www.lrrd.org/lrrd10/1/meji101.htm.
42. Froberg, S., E. Gratte, K. Svennersten-Sjaunja, I. Olsson, C. Berg, A. Orihuela, C.S. Galina, B. García and L. Lidfors, 2008. Effect of suckling ('restricted suckling') on dairy cows' udder health and milk letdown and their calves' weight gain, feed intake and behaviour. Applied Animal Behaviour Science, 113: 1-14.
43. Radostits, E., C.C. Gay, D.G. Blood and K.W. Hinchcliff, 2000. Veterinary Medicine: A Textbook of Diseases of Cattle, Sheep, Goats, Pigs and Horses. 8th ed., London, Balliere Tindall. pp: 673-679.
44. Nibret, M., A. Yilikal and B. Kelay, 2011. A cross sectional study on the prevalence of sub Clinical Mastitis and Associated Risk Factors in and around Gondar, Northern Ethiopia. International Journal of Animal and Veterinary Advances, 3: 455-459.
45. Fufa, A, F. Gemechis., M. Bekele and R. Alemayehu, 2013. Bovine Mastitis: Prevalence, Risk Factors and Bacterial Isolation in Small-Holder Dairy Farms in Addis Ababa City, Ethiopia. Global Veterinaria, 10(6): 647-652.
46. Jafer, K., D. Haimanot, J. Hawi, Z. Tilahun and K. Girma, 2016. A Study on Bovine Mastitis, Isolation and Identification of Staphylococcus Species in Dairy Farms of Dire Dawa City, Eastern Ethiopia. Global Veterinaria, 16(3): 222-230.
47. Biffa, D., 1994. The Study on the Prevalence of Bovine Mastitis in Indigenous Zebu Cattle and Jersey Breeds in Wollaita Sodo, Characterization and in vitro Drug Sensitivity of the Isolates. Thesis, Debrezeit: Faculty of Veterinary Medicine, Addis Ababa 46. University, Ethiopia.
48. Kasech, A., T. Alebachew and A. Alemu, 2016. Study on Prevalence of Bovine Mastitis in Tullo District of West Hararghe, Ethiopia. Advances in Biological Research, 10(3): 147-153.
49. Bedane, A., G. Kasim, T. Yohannis, T. Habtamu, B. Asseged and B. Demelash, 2012. Study on Prevalence and Risk Factors of Bovine Mastitis in Borana Pastoral and Agro-Pastoral Settings of Yabello District, Borana Zone, Southern Ethiopia. American-Eurasian J. Agric. and Environmental Science, 12(10): 1274-1281.