Advances in Biological Research 10 (3): 147-153, 2016
ISSN 1992-0067
© IDOSI Publications, 2016
DOI: 10.5829/idosi.abr.2016.10.3.10419

Study on Prevalence of Bovine Mastitis in Tullo District of West Hararghe, Ethiopia

[1]Kasech Amdhun, [2]Alebachew Tilahun and [2]Alemu Aylate

[1]Alage Federal ATVET College, Ethiopia
[2]WolaitaSodo University, School of Veterinary Medicine, Southern Ethiopia

Abstract: A cross-sectional study was conducted in selected district of West Hararghe on lactating local zebu cows from November 2009 to May 2010 to determining the prevalence and predominant etiological factors of clinical and subclinical mastitis. A total number of 384 lactating cows with 1536 quarters were examined using clinical examination, California Mastitis (CMT) and microbial examinationto identify the causative agents of intra-mammary infection. In this study, 140 (9.1%), quarters belonging to 62 (16.1%) lactating cows were found to be CMT positive. However, pathogens responsible for mastitis were isolated from 119 (7.7%) quarters belonging to 48 (12.5%) cows. A total of 44 (2.87%) quarters and 20 (5.2%) cows were affected by clinical mastitis while 96 (6.3%) quarters and 42 (10.9%) cows were found to be affected by the subclinical mastitis. Bacterial isolation was done from48 cows and 119 quarters. Of 119 isolates, 45 (37.8%) and 74 (62.2%) quarters were from clinical and subclinical mastitis respectively.The predominant bacteria isolated from clinical mastitis were *E. coli* with isolation rate of 57.8% followed by *S. agalactiae,* Enterobacter, *S. aureus* and *S. epidermidis* with isolation rate of 13.3, 11.1, 8.9 and 8.9% respectively. Whereas from Subclinical isolation, *S. aureus* was predominant with isolation rate 47.3% followed by *E. coli, S. epidermidis,* Enterobacter *and S. agalactiae* with isolation rate of 28.4, 13.5, 5.4 and 5.4% respectively. If milk production in the study area has to be improved, creation awareness and control of mastitis through proper milking hygiene such as use ofwarm water to rinse the tools, individual towels for each cow and quarter, post milking teat disinfection and proper treatment of mastitis cases is important.

Key words: Bacterial isolation · California Mastitis · Clinical mastitis · Cows · Prevalence · Subclinical mastitis

INTRODUCTION

Ethiopia, located in tropical region, is one of the most populous countries in Africa, having an estimated population of more than 80 million. The country is very much dependent on agriculture. Livestock represent a major national resource and form an integral part of the agricultural production system. Ethiopia has the largest cattle population in Africa with an estimated population of 56.71 million. 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 multitude of factors. Mastitis is among the various factors contributing to reduced milk production [2]. 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 [3].

Mastitis is one of the most important diseaseaffecting dairy cows. It is a multi-factorial disease withworldwide distribution accounting for major economiclosses in dairy cattle [4] whichincurs serious economic losses to dairy industry. Anumber of previous reports from different parts of thecountry indicated that mastitis is a serious problem inthe dairy industry of Ethiopia [5]. Bovinemastitis can reduce milk yield, increase culling rate,incur treatment cost and occasionally result in death fromsevere infection [6].

Corresponding Author: AlebachewTilahun, WolaitaSodo University, School of Veterinary Medicine, Southern Ethiopia. Tel: +251913992418.

There are two forms of mastitis: subclinical and clinical mastitis. Subclinical mastitis is characterized by the presence of pathogenic microorganism in the milk and the inflammatory response detected only by screening test or laboratory procedures. Thus, signs of inflammation that are detected by visual observation or palpation such as swelling, heat, redness, pain or systemic response such as fever are not observed [7].

Mastitis is a management related diseasewhose prevention and control depends among otherfactors on the type of management employed. Ifmanagement is improved, there is a reduction in theincidence of clinical mastitis and vice versa. As withmost infectious disease, mastitis risk factors dependson three components i.e. exposure to the microbes, cowdefense mechanism and environment andmanagement factors [8].

Despite many years of research, subclinical mastitis remains the most economically damaging and zoonoticpotential disease for dairy industry and consumersworldwide irrespective of the species of animal [9]. Economic losses caused by mastitis include valueof discarded milk, reduction in quality of milk and cost oftreatment [7]. Bacterial contaminationof milk from affected cows may render it unsuitable forhuman consumption by causing food poisoning or interferencewith manufacturing process or in rare cases,provides mechanism of spread of disease to humans.Zoonotic diseases potentially transmitted by raw cow milkinclude brucellosis, caseous lymphadenitis, leptospirosis,listeriosis, melioidosis, Q-fever, staphylococcal foodpoisoning, toxoplasmosis and tuberculosis [6, 10].

In some parts of Ethiopia, the disease is insufficientlyinvestigated and information relating to its magnitude,distribution and risk factors is scant. Such information isimportant to envisage when designing appropriate strategies that would help to reduce its prevalence and effects [11, 12]. Although there are some studies of mastitis in central and other part of Ethiopia, there still areas such as the Eastern part of Ethiopia where such studies scarce to get enough information of the disease.Therefore, the present study was initiated with this background. The study aimed (i) to estimate the prevalence of subclinical and clinical mastitis at cow and quarter level, (ii) to isolate and identify the predominant agents of subclinical and clinical mastitis.

MATERIALS AND METHODS

The study was conducted in selected peasant association of Tullo district of West Hararghe zone from November 2009 to May 2010.

Study Population: The study animals were the local zebu lactating cows managed under extensive farming system in selected peasant associations (PAs). The indigenous zebu breeds in this study area were owned by producers and are managed extensively. The cows were in the field for the whole day to graze and in the evening, they were supplemented with straw. Milking was manually in all selected peasant associations (Pas).

Sample Size and Sampling Method: Purposive sampling technique was employed to select four peasant associations (PAs) and households based on ease of accessibility. Simple random sampling technique was followed for selection of 384 lactating zebu cows. The sample size was calculated based on the formula given below as described by Thrusfield [13]. For estimation of disease prevalence the sample was determined by assuming the expected prevalence to be 50%, the desired precision was 5% and a sample size of 384 lactating cows was determined based on the formula:

$$n = \frac{1.96^2 \text{ x } p_{exp}(1\text{-}P_{exp})}{d^2}$$

where n=number of sample size, p_{exp}= expected prevalence, d^2= absolute precision.

Study Design and Methodology: Cross-sectional and observation types of study were carried out from the beginning of November 2009 to May 2010.

Clinical Inspection of Udder: The udder was first examined visually and thenby palpation to detect possible fibrosis, inflammatoryswellings, visible injury, tick infestation, atrophy of thetissue and swellings of supra mammary lymph nodes.The teat condition (color changes, swelling at or nearthe teat base, swelling or firmness at or near the teatend, openness of the teat orifice, teat skin condition,signs of vascular damage like petechial hemorrhage,etc.) was evaluated during clinical examination [14]. Upon palpation, one can feel hot, painful swellingon udder and ventral abdomen and was manifested byloss of appetite, depression, recumbence and bloodmixed milk in acute mastitis. In chronic mastitis,continuous or intermittent discharge of pus, clots, flakes or watery secretion will be seen from the udder [15].

California Mastitis Test (CMT): The California Mastitis Test (CMT) wasperformed according to the manufacturer's instruction.In brief, a small sample of milk (approximately ½teaspoon) was collected from each quarter into a plasticpaddle that has 4 shallow cups

marked A, B, C and D.An equal amount of CMT reagent was added to the milkand the paddle rotated to mix the contents. Afterapproximately 10 seconds, the score was read whilecontinuing to rotate the paddle. Results were recordedas T (trace), 1, 2 or 3 based on the level of precipitation (coagulation) [16].

Bacterial Isolation: Bacteriological examination of milk was carried out using different laboratory media, staining techniques and primary as well as secondary biochemical tests [17, 18]. Strict procedures were used when collecting milk sample in order to prevent contamination with microorganisms present on the skin of cow`s flanks, udder and teats, on the other hands of the sampler and in the environment.

Statistical Analysis: The data was collected and recorded into Microsoft excel spreadsheet. Descriptive statistics such as proportion and percentages were used to summarize and present the data generated from the study. The prevalence of mastitis (clinical and subclinical) and proportion of predominant etiological agents were calculated using percentage value.

RESULTS

Overall Prevalence: A total number of 384 lactating cows and 1536 quarters were included in the study. Out of which 62 (16.1%) cows and 140 (9.1%) quarters were found positive for mastitis on CMT. Upon cultural examination pathogens responsible for mastitis were isolated from 119 (7.7%) and 48 (12.5%) quarters and cows, respectively. Of the total quarters included in the study, 45 (2.93%) quarters belonging to 30 cows were found to be blind. From cows having blind quarters, 15 (50%) cows have one blind quarter and 15 (50%) cows have two blind quarters. With regards to the location of the blind quarters, 10 (22.2%), 10 (22.2%), 12 (26.6%) and 13(28.8%) were found to be of the right rear (RR), right front (RF), left rear (LR), left front (LF) position respectively (Table 1).

Prevalence of Clinical Mastitis: Clinical mastitis was diagnosed on the basis of visible signs of inflammation such as warm, swollen and pain up on palpation which have been considered as acute clinical mastitis while misshaped, atrophied, hard and fibrotic quarters were considered as chronic mastitis. The data presented in Table 2 shows that a total of 20 (5.2%) cows and 44 (2.86%) of quarter were found to have clinical mastitis. From 1536 total quarters, 7 (0.5%) and 37 (2.4%) were acute and chronic forms of mastitis respectively.

Prevalence of Subclinical Mastitis: The prevalence of subclinical mastitis at cow and quarter level based on CMT and bacteriological examination is presented in table 3. Out of 384 cows and 1536 quarters, 42 (10.9%) cows and96 (6.3%) quarters were CMT positive. On cultural isolation, mastitis causing bacteria were isolated from 32 (8.3%) and 75 (4.9%) cows and quarters respectively.

Table 1: Overall prevalence of clinical and subclinical mastitis at cow and quarter level

		Overall prevalence	Blind quarters			Location of blind quarters			
Observation	Total number	CMT	Total blind quarter	One blind quarter	Two blind quarter	RR	RF	LR	LF
Cow level	384	62(16.1%)	30(7.8%)	15(50%)	15(50%)	8 (26.7%)	7 (23.3%)	12 (40%)	3 (10%)
Quarter level	1536	140(9.1%)	45(2.92%)	15(33.5%)	30(66.7%)	10 (22.2%)	10 (22.2%)	12 (26.6%)	13 (28.8%)

Abbrev. CMT (California Mastitis Test), RR (Right Rear), RF (Right Front), LR (Left Rear), LF (Left Front)

Table 2: Prevalence of clinical mastitis at cow and quarter level on clinical observation

			Form of mastitis	
Observation	Number of observation	Total number of positive	Acute	Chronic
Cow level	384	20 (5.2%)		
Quarter level	1536	44 (2.86%)	7 (0.5%)	37(2.4%)

Table 3: Prevalence of subclinical mastitis at cow and quarter level using CMT test

Observation	Number of observation	Total number of positive	Mastitis causing bacteria isolation
Cow level	384	42(10.9%)	32(8.3%)
Quarter level	1536	96(6.3%)	75(4.9%)

Table 4:Type of pathogens isolated from CMT positive milk samples at the study area

	Clinical mastitis		Subclinical mastitis		Total	
Bacterial isolate	Number	Proportion	Number	Proportion	Number	Proportion
E. coli	26	57.8%	21	28.4%	4739.5%	
Enterobacter	5	11.1%	4	5.4%	9	7.6%
S. aureus	4	8.9%	35	47.3%	39	32.8%
S. epidermidis	4	8.9%	10	13.5%	14	11.8%
S. agalactiae	6	13.3%	4	5.4%	10	8.4%
Total	45	100%	74	100%	119	100%

Bacterial Isolation: Bacteria isolated from a total of 48 cows and 119 quarters as presented in Table 4 below, which shows name, number and proportion of bacteria isolated. Of 119 isolated quarters, 45 (37.8%) and 74 (62.2%) quarters were from clinical and subclinical infected cowsrespectively. The predominant bacteria isolated from clinical mastitis were *E. coli*with isolation rate of 57.8% followed by *S. agalactiae,*Enterobacter, *S. aureus* and *S. epidermidis* with isolation rate of 13.3, 11.1, 8.9 and 8.9% respectively. Whereas from Subclinical isolation,*S. aureus* was predominant with isolation rate 47.3% followed by *E. coli,S. epidermidis,* Enterobacter *andS. agalactiae* with isolation rate of 28.4, 13.5, 5.4 and 5.4% respectively.

DISCUSSION

In the present study, a total number of 1536 quarters from 384 lactating zebu breeds from district of West Hararghe were investigated in a cross sectional study conducted between November 2009 to May 2010. Out of that, the current overallprevalence of mastitis at cow and quarter level were 16.1% (62/384) and 9.1% (140/1536) respectively.In this study, the prevalence of clinical and subclinical mastitis was 5.2 and 10.9% respectively. The 5.2% prevalence for clinical mastitis obtained in this study area is a little bit higher than the report ofBishi [5] which was 4.4% and the 3.6% prevalence reported by Mungube [19]. Both these studies were conducted in Addis Ababa and surrounding. This result is also higher than the report by Darsema [20] who reported a prevalenceof 3.54% in Dire Dawa and East Hararghe administrative region. However the result of this study was very much less than that of KerroDego and Tareke[21], who reported prevalence of 37.1% in selected areas of Southern Ethiopia, similarly higher prevalence of mastitis was reported by Biru [22] with prevalence of (23.9%) in Southern Ethiopia. The difference observed maybe due to the difference in breed, of target animal, their management system and the environmental hygienic condition in the study areas [23].

In the case of subclinical mastitis, cow level prevalence of 16.1% obtained in the study areas was still high. This result is not in agreement with the one reported by Getahun [24] who reported 22.3% from his work in smallholder dairy farms in the central highlands of Ethiopia. Also this finding was by far less than the 57.5% prevalence reported by Tesfaye [25] which was obtained from his work on indigenous zebu and BorenaHollistein crosses in South Wello and Dego and Tareke [20] who reported prevalence of 62.9% and Biru [22] in Southern Ethiopia with prevalence (39.5%). This variation could be due to variation in the susceptibility of different breeds of cattle to mastitis-causing organisms. The difference in management practices and environmental conditions could also be responsible for this variation. The previous studies earlier mentioned were carried out on exotic and crossbred cows, while our study includes only Zebu cows. Zebu cattle have been known for their relative resistance/ tolerance against many infectious diseases. Our study focuses on Zebu cows owned by smallholder farmers who own few cows. This might have decreased the potential of contagious mastitis causing pathogens and made easier to clean the cows' environment and in turn might have also decreased mastitis causing environmental pathogens. As mastitis is a complex disease, involving interactions of various factors, which include management, environmental, animal risk factors and causative agents, its prevalence, will vary [6].

Prevalence of subclinical mastitis is higher than that of clinical mastitis in the present study, which is in the agreement with several earlier reports from different parts of Ethiopia [2, 21, 26-32] and elsewhere in Africa [33]. Since, environmental factors play significant role, the prevalence of subclinical mastitis varies in dairy animals [6]. Subclinical mastitis has been reported to be higher than clinical mastitis owing to the defense mechanism of the udder, which reduces the severity of the disease [7]. In most reports includingthe present study, clinical mastitis is far lower than subclinical mastitis [2, 29, 28, 34, &35]. This could be attributed to little attention given to subclinical mastitis, as the infected

animal shows no obvious symptoms and secrets apparently normal milk and farmers, especially small holders, are not well informed about invisible loss from subclinical mastitis. In Ethiopia, the subclinical forms of mastitisreceived little attention and efforts have been concentrated on the treatment of clinical cases [29].

Out of 1536 quarter examined, 2.93% (45/1536) were blind,which may be an indication of serious mastitis problemon the herd and lack of screening tests and treatment of subclinical mastitis and inadequate follow up chronicmastitis were considered to be the major reason for thedevelopment of quarter blindness [2].

The most important isolates found in this study were *E .coli* and *S. aureus* with 57.8 and 47.2% for clinical and subclinical mastitis respectively. *Staphylococcus agalactiae* (13.3%) and Enterobacter(11.1%) species followed *E. coli* in this order as the cause of clinical mastitis. Whereas, in subclinical cases *S. aureus*was followed by *E. coli,S. epidermidis*, Enterobacter with the rate 28.3, 13.3, 6.75 and 5.4% respectively. However, Dego and Tareke [21] found *Staphylococcus* (36.75%); followed by *Streptococcus* (23.8%) and total coliforms (14.1%) of which *E. coli*was10% and *Klebsiella* constituted the remaining 4.1% to be the predominant organisms isolated both from clinical and subclinical cases. Animal, pathogens, environmental and management risk factor, which influence the prevalence of mastitis could be the reason for these variations [36].

Prevalence of mastitis at cow level was dependent on breed, parity, age, stage of lactation and some management problems like milking of cows at any stage,increased milk yield from genetic selection may be accompanied in genetic susceptibility to mastitis [36]. According to Erskine [7], primiparous cows have more effective defenses mechanism than multiparious cows. The prevalence of subclinical infection increases at the age of lactation progresses. These infections are generally the result of contagious mastitis and caused by an ability of mastitis control [7].

CONCLUSIONS

In a spite of a large research efforts aimed to gain prevalence and to develop a new control tools for mastitis, the subclinical occurrence of the mastitis remains a substantial problem for dairy producers. The results of the present study indicated a relatively high prevalence of subclinical mastitis in dairy cattle of the study area. The relatively high prevalence reported in this study clearly indicated lack of strategic control measures against the disease as well as poor surveillance measures. Lack of maintenance of strict hygiene and good sanitary environment may be contributory factors in the cause of subclinical mastitis. It is therefore important that producers should ensure strict personal hygiene and that of animals and general sanitary conditions of the farms should be improved and maintained. The predominant bacteria isolated were *E. coli* with isolation rate of 57.8% and *S. aureus* with a rate of 47.3% from clinical and subclinical mastitis respectively.Furthermore, all dairy producers know that early detection of intra-mammary infection and anti-microbial susceptibility test are important for selecting and implementing proper therapy.

ACKNOWLEDGMENTS

Authors would like to thank Hirna Regional Veterinary Laboratory workers for their material and technicalsupports.

REFERENCES

1. Central Statistical Authority (CSA), 2014. Report on livestock and livestock characteristics; Volume II, Ethiopia, Addis Ababa.
2. Biffa, D., E. Debela and F. Beyene, 2005. Prevalence and risk factors of mastitis in lactating dairy cows in southern Ethiopia. Intern. J. Appl. Res. Vet. Med., 3: 189-198.
3. Mohamed, A.M., S. Ehui and Y. Assefa, 2004. Dairy development in Ethiopia, International food policy research institute, 2033 K Street, Washington, DC, 2006 USA. Discussion.
4. DeGrave, F.J. and J. Fetrow, 1993. Economics of mastitis and mastitis control. Vet. Clin. North America. Food Animal Practice, 9: 421.
5. 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.M.Sc. Thesis, Faculty of Veterinary Medicine, Addis Ababa University School of Graduate Studies and Freie Universidad, Berlin.
6. Radostitis, O.M., C.C. Gay, K.W. Hinchclif and P.D. Constable, 2007. Veterinary Medicine. A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats and Horses. 10th ed., Saunders Elsevier, Spain. pp: 1045-1046.

7. Erskine, R.J., 2001. Mastitis Control in Herds. In: Herd Health: Food Animal Production Medicine. 3rd. ed., W. B. Sounders Company, Philadelphia, pp: 397-435.
8. Suriyasathaporn, W., Y.H. Schukken, M. Nielsen and A. Brand, 2000. Low somatic cell count: a risk factor for subsequent clinical mastitis in dairy herd. J. Dairy Sci., 83: 1248-1255.
9. Ojo, O.E., M.A. Oyekunle, A.O. Ogunleye and E.B. Otesile, 2009. Escherichia coli, O157:H7 in food animals in part of South-Western Nigeria. Prevalence and *in vitro* antimicrobial susceptibility. Trop. Vet., 26(3): 23-30.
10. Mungube, E.D., B.A. Tenghagen, 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 losses in crossbred dairy cows in Ethiopia. Trop. Anim. Health. Prod., 37(5): 503-512.
11. Mekibib, B., M. Furgasa, F. Abunna, B. Megersa and A. Regassa, 2009. Bovine Mastitis: Prevalence, Risk Factors and Major Pathogens in Dairy Farms of Holeta Town, central Ethiopia. Vet. World, 3(9): 397-403.
12. 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. Trop. Anim. Hlth. Prod., 42: 1249-1255.
13. Thrusfield, M., 2007. Veterinary epidemiology. 3rd edition, Blackwell Publishing.
14. More, P.C., 1989. Tick borne Diseases of Livestock in Africa. In: Manual of Tropical Veterinary Parasitology. English version. C. A. B. International: Wallingford, UK, 331-343.
15. Chauhan, R.S. and D.K. Agarwal, 2006. Textbook of Veterinary Clinical and Laboratory Diagnosis. 2nd. Jaypee Brothers Medical Publishers (P), New Delhi, pp: 103.
16. Mellenberger, R., 2000. Dept. of Animal Sciences, Michigan State University and Carol, J. R., Dept. of Dairy Science, University of Wisconsin-Madison April.
17. Quinn, P.J., M.E. Carter, B. Markey and G.R. Carter, 1994. Clinical veterinary microbiology, London, wolfe: pp: 21&118
18. Sears, P.M., R.N. Gonzalez, D.J. Wilson and H.R. Han, 1993. Procedures for mastitis diagnosis and control. Vet. Clin. and Food Animal Practical, 9: 445- 467.
19. Mungube, E.O., 2001. Management and Economics of Dairy Cow Mastitis in the Urban and Peri-urban Areas of Addis Ababa Milk Shed. Faculty of Veterinary Medicine, Debere- Zeit, Ethiopia, MSc. Thesis.
20. Darsema, G., 1991. A Survey of Bovine Mastitis in Different Dairy Farms: Dire Dawa Autonomous and East Hararghe Regions. Faculty of Veterinary Medicine, Addis Ababa University University, Debere- Zeit, Ethiopia, Doctor of Veterinary Medicine Thesis.
21. KerroDego, O. and F. Tareke, 2003. Bovine mastitis in selected areas of Sothern Ethiopia. Trop. Anim. Hlth. and Prod., 35(3): 197-205.
22. Biru, G., 1989. Major Bacteria Causing Bovine Mastitis and Their Sensitivity to Common Antibiotics. Eth. J. Agric. Sic., 11: 47-54.
23. Quinn, P.J., M.E. Carter, B.K. Markey and G.R. Carter, 1999. Mastitis In: Clinical Veterinary Microbiology, Mosby International Limited, London, pp: 327-344.
24. Getahun, K., 2006. Bovine Mastitis and Antibiotic Resistance Pattern of Major Pathogens in Small Dairy Farms in the Central Highlands of Ethiopia Faculty of Veterinary Medicine, Addis Ababa University, Debere- Zeit, Ethiopia, MSc. Thesis.
25. Tesfaye, H., 1995. Prevalence of Bovine Mastitis in Indigenous Zebu and Borna-Holestin Crosses in South Wello: Isolation and Drug Sensitivity of the Isolates. Faculty of Veterinary Medicine, University, Debere- Zeit, Ethiopia, Doctor of Vet. Medicine Thesis.
26. Abera, M., B. Demie, K. Aragaw, F. Regassa and A. Regassa, 2010. Isolation and identification of *Staphylococcus aureus* from bovine mastitic milk and their drug resistance patterns in Adama town, Ethiopia. Journal of Vet. Med. and Animal Health, 2: 29-34.
27. Mekibib, B., M. Furgasa, F. Abunna, B. Megersaand A. Regassa, 2010. Bovine Mastitis, Prevalence, Risk Factors and Major Pathogens in Dairy Farms of Holeta town. Central Ethiopia. Vet. World, 9: 397-403.
28. Lakew, M., T. Tolosa and W. Tigre, 2009. Prevalence and major bacterial causes of bovine mastitis in Asella, South Eastern Ethiopia. Trop. Anim. Hlth. Production, 41: 1525-1530.

29. Almaw, G., A. Zerihun and Y. Asfaw, 2008. Bovine mastitis and its association with selected risk factors in smallholder dairy farms in and around Bahir Dar, Ethiopia, Trop. Animal Health Production, 40: 427-432.
30. Getahun, K., K Belihu, M. Bekana and F. Lobago, 2008. Bovine mastitis and antibiotics resistance pattern in Selalle smallholder dairy farms, Central Ethiopia. Trop. Animal Health Prod.; 40: 261-268.
31. Mungube, E.O., B.B. Tenhhagen, T. Kassa, F. Regassa, M.N. kuyle, M. Garinar and M.P.O. Baumann, 2004. Risk factors for dairy cows' mastitis in the central highlands of Ethiopia. Trop. Anim. Health. Prod., 36(5): 463472.
32. Workineh, S., M.H. Bayleyeng and L.N.D. Potgieter, 2002. Prevalence and etiology of mastitis in cows from two Ethiopian diaries. Trop. Anim. Health. Prod., 34: 19-25.
33. Kivaria, F.M., J.P. Noordhuizen and A.M. Kapaga, 2004. Risk indicators associated with subclinical mastitis in smallholder dairy cows in Tanzania. Trop.Animal Health Production; 36: 581-592.
34. Sori, H., A. Zerihun and S. Abdicho, 2005. Dairy Cattle Mastitis in Sebeta, Ethiopia. InternationalJournal of Vet. Med., 3: 332-338.
35. Haftu, R., H. Taddele, G. Gugsa and S. Kelayou, 2012. Prevalence, bacterial causes and antimicrobial susceptibility profile of mastitis isolates from cows in large-scale dairy farms of Northern Ethiopia. Trop. Animal Health Prod., 44: 1765-1771.
36. Radostitis, O.M., G.C. Gay, D.C. Blood and K.W. Hinchillif, 2000. Veterinary Medicine, 9th Edition, Harcourt Limited, London, pp: 603-700.