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Cross - Sectional Study on Bovine Mastitis and its Associated Risk Factors in and Around Bedele and Mettu Districts of Ilu Aba Bor Zone, Ethiopia

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Abstract: Identifying the prevalence of Bovine mastitis and its associated factors is very important for further improvement of product and productivity from lactating cows. The objectives of this study were to assess and identify the prevalence of bovine mastitis and its associated factors in the study areas. The study was carried out in and around two districts namely, Bedele and Mettu Districts. The overall results of the study revealed that more than 86% of the interviewed respondents had ≤ 10 cows with mainly practicing of extensive rearing system. A total of 413 lactating cows were selected from all production systems. The Clinical mastitis was confirmed by using visual observations of the udder and the presence of blood, pus and other characteristics in milk whereas California mastitis test (CMT) was used for screening subclinical mastitis. The overall results revealed that 33.4 and 26.1% of the examined cows were identified as suffering from mastitis in Bedele and Mettu Districts, respectively. Generally, the prevalence of subclinical mastitis was dominantly observed than clinical mastitis. Chi-square analysis revealed that, the associated factors viz. age, mastitis history, lactation stage, milk production, parity, udder injury and tick infestations were significantly affected the prevalence of mastitis at ($p<0.05$) in both districts except stage of lactation in case of Mettu district. Creating awareness about the ways to reduce the prevalence of mastitis and their associated factors could be the solution to reduce losses by influences of mastitis. Therefore, the responsible bodies need to assess the associated intrinsic and extrinsic factors and measures have to be taken to reduce the incidence of mastitis and its influence on dairy farming. Using acaricides (Diazinole) spray according to the manufacturer's recommendation could be a possible measure to reduce tick infestation and proper management and good hygienic practices are also a possible measure to reduce the incidence of mastitis by controlling the transmission of the disease.

Key words: Associated Risk Factors · California Mastitis Test · Sub-Clinical Mastitis

INTRODUCTION

Livestock's are the backbone of Ethiopian agricultural sector in terms of economic benefits and food supplies [1]. Ethiopia is believed to have the largest livestock population in Africa and sector of livestock's has been adding a significant effect on the economy of the country and still promising to bring development to the country. Product and by-products of livestock are well-known as the main animal protein source for enhancing the nutritional status of the people [2]. In Ethiopia, cows represent the largest proportion of the cattle population of the country, while milk production does not satisfy the countries requirements due to multitude factors [3]. This is partly due to the low genetic potential of milk production of indigenous zebu cattle. Although, to increase milk production, cross breeding of indigenous zebu with exotic breeds particularly with Holstein Friesian is widely practiced which resulted in a larger portion of the dairy cattle population especially in urban and peri-urban areas. However, this market oriented dairy production and rapidly growing systems in many African countries are subjected to diseases of intensification including mastitis and reproductive disorders [4]. Mastitis is an inflammation of mammary gland that can be caused by physical or chemical agents but the majority of the causes are infectious and usually caused by bacteria [5, 6]. Bovine mastitis is the most

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common and costly disease which is affecting the dairy farms all over the world and results for the economic losses mainly from decreasing of milk production, culling of chronically infected cows, cost of treatment and penalties of milk quality [7].

In Ethiopia the economic loss due to both clinical and subclinical mastitis per lactation is 38 US$ [8]. Due to significant effect of mastitis over the income from milk production, different efforts have been made by different authors to assess the occurrence of mastitis on dairy herds in Ethiopia. Therefore, this disease is considered as the main constraint and recognized as the major root for low milk production in the country [9].

Indigenous breeds are mainly distributed in western and south western part of Ethiopia, while some of cross breed and exotic breeds (Holstein Friesian and Jersey) are also there in study areas. Studies on prevalence of bovine mastitis and its associated risk factors on an indigenous cattle keeping in and around Bedele and Mettu Districts are lacking. Therefore this study was anticipated to deliver an understanding about the major associated factors of bovine mastitis in the study areas.

MATERIALS AND METHODS

The study was conducted in and around Bedele and Mettu districts of Ilu Aba Bor Zone, Ethiopia. The districts are located at distance of 480 km (Bedele) and 600 km (Mettu) from Addis Ababa towards South West Ethiopia. Bedele and Mettu districts are located at longitude 36°21'E & 35.5822°E latitude 8°27'N & 8.2961°N, respectively. The altitude of Bedele is ranges from 2012 - 2162 m.a.s.l and Mettu also located at elevation of 1701 m.a.s.l [10, 11]. Generally the zone has 1, 633, 156.56 hectares of land of which 10% is high land, 67% medium land and 23% low land. Agriculture is the main livelihood of people with a mixed farming system and livestock plays an integral role for agriculture [12].

Sampling Method: Data for the assessment and screening test were collected using multi-stage sampling techniques. Purposive sampling technique was employed to select two districts based on the potential of milk production and density of cattle population from Ilu Aba Bor Zone, Ethiopia. The peasant associations were chosen based on cattle population and the households were further classified based on the presence and absence of lactating cows. Then after random sampling techniques was employed to select one lactating cow from each household. Based on the above techniques, the general information about husbandry practices and mastitis associated risk factors were collected using a closed or structured questionnaire with an intention of condensing the husbandry practices as well as for identifying the influence of associated factors across to the prevalence of mastitis in the study areas.

Determination of Sample Size: The number of animals required for the study was determined using the formula given by Thrusfield [13] for simple random sampling.

$$N = \frac{1.962\, P_{exp}\, (1 - P_{exp})}{d^2}$$

where; N = required sample size
P_{exp}= expected prevalence
d = desired absolute precision (Usually 0.05)

The sample size determination was using 95% level of confidence, 50% expected prevalence and 0.05 desired absolute precision. Generally, a total of 413 lactating cows were randomly selected from 413 households and then the owners of cows were interviewed to assess the general information of husbandry practices and mastitis associated factors.

Clinical Detection: Clinical detection of udder and milk from cows had been carried out by inspecting the size and consistency of quarters for checking of any abnormalities such as injury, swelling, firmness and blindness of the teat canal and two streaks of milk from each quarter in a strip of cup were inspected by visual inspection for checking the presence of any flakes, clots, pus, watery appearance, blood and color change [14].

CMT Screening Test: Clinically free of mastitis cows were tested by California mastitis test (CMT) and milk samples were collected from cows in which clinical mastitis was not detected to look for sub-clinical mastitis. Then samples were collected from each quarter of the udder and analyzed using CMT. From each quarters of udder, a squirt of milk sample was placed in each cup on the CMT paddle and an equal amount of 3% CMT reagent was added to each cup and mixed well. Reactions were graded as –Ve, T, +, ++ and +++ for negative, trace, slightly positive, positive and strongly positive, respectively [15].

Associated Risk Factors: The associated factors were compiled using structured questionnaires to evaluate the

effect of selected potential risk factors for the occurrences of mastitis. Age, mastitis history, lactation stage, milk production, parity, udder injury and tick infestation were the major associated factors studied in the study areas. Age of the cows was determined according to Pasquini *et al.* [16] based on the information from owners of the cows and dentition characteristics. Stage of lactation was categorized into three levels post-partum1st .3rd months (Early lactation), 4 -th 6 th months (Middle Lactation) and greater than 6th (Late Lactation) and similarly parity was categorized according to the number of calves produced (1 - 3, 4 –6 and ≥ 7 calves) and milk production per day (≤ 2 litters, >2 - <6 litters and ≥ 6 litters).

Data Management and Analysis: The collected data was analyzed using Statistical Packages for Social Sciences (SPSS, Version 20:0). Husbandry practices of households were summarized using a descriptive statistics and chi-square test was used to test the significances difference in prevalence of mastitis across the districts and associated risks factors.

RESULTS AND DISCUSSION

Husbandry Practices: The overall results about rearing systems and herd size percentage of the study areas were presented in Table 1. A total of 413 households from two districts were interviewed during the study period. The overall result of the study indicated that 9.7, 87.9 and 2.4 percent of the respondents have been practicing semi-intensive, extensive and intensive rearing system, respectively. As result indicates, most of the livestock keepers in both districts were practicing extensive livestock rearing system and it is in agreement with the findings of Abate *et al.* [17]. The findings further indicate that most of the householders had less than 10 cows, which is also in line with the findings of FAO [18].

Mastitis Prevalence: According to the result indicated in Table 2, the prevalence of mastitis in Bedele and Mettu districts was 33.4 and 26.1% and out of the total prevalence 26.8 and 20.5% was sub-clinical mastitis, respectively. The prevalence of mastitis in the study areas is in close accordance to the findings of Jirata and Indalem [19] and Endale *et al.* [20] from in and around Wolayta Sodo and in Sodo Town, respectively. The prevalence of clinical and sub clinical mastitis as observed in the study is however lower than those reported by Sarba and Tola [21] and Hajie and Teka [22] from Ambo district and East Shewa Zone, respectively. The result of this finding is also lower than those reported by Tesfahywet and Gerema [23] in Eastern Hararghe Zone and also in Holeta Town by Mekbib *et al.* [24]. As observed from Table 2, prevalence of clinical and sub-clinical mastitis was not statistically significant across the study areas. However, there is a slight difference in prevalence percentages among the two study areas and this could be due to somewhat slight difference in management practices and husbandry systems, environmental conditions, intrinsic and extrinsic risk factors.

Associated Risk Factors: The result pertaining to the influence of associated risk factors on prevalence of mastitis in Bedele and Mettu districts were presented in tables 3 & 4. The result recorded in this finding indicate that, the associated factors viz. age, mastitis history, lactation stage, milk production, parity, udder injury and tick infestations were significantly affect the prevalence of mastitis at ($p<0.05$) in both districts except stage of lactation for Mettu district.

Age: The results presented in table 3 and 4 indicate that the prevalence of mastitis was higher in adult cows than young adults. The result of present study pertaining to the higher prevalence of mastitis with increasing age is in agreement with the findings of Kero and Tareke [25] for selected area of Southern Ethiopia; Tesfaye *et al.* [26] for area of Nazareth, Ethiopia; Mungubet *et al.* [27] for central part of Ethiopia; Moges *et al.* [28] for an area of in and around Gonder, Ethiopia. However, higher prevalence of mastitis at younger age is recorded by Mekonnin *et al.* [29] for an area of in and the surrounding areas of Sodo Town, Wolayta Zone, Ethiopia and Lidet *et al.* [30] for an area of in and around Areka Town, Southern Ethiopia. The higher prevalence of mastitis in relation to age increment may be attributed to increases in susceptibility of cow's udder for the infectious agent and it is in accordance with the finding of Radostitis *et al.* [6] who reported that, an older cows have largest teats and more relaxed sphincter muscles, which increase the accessibility of infectious agent in the cows udder.

Mastitis History: The recorded result in Table 3 and 4 indicate that, the prevalence of mastitis was higher in cows had previous mastitis history than that of the cows hadn't. The result of this finding is in accordance with the study by Mokenin and Tesfaye [31] whom reported that the occurrence of mastitis in cows which had pervious

Table 1: Husbandry practices of respondents in percentage

	Study areas		
Variable	Bedele District N (%)	Mettu District N (%)	Overall N (%)
Rearing System			
Semi-intensive	24(12.1)	16(7.4)	40(9.7)
Extensive	168(84.8)	195(90.7)	363(87.9)
Intensive	6(3)	4(1.9)	10(2.4)
Total	198(100)	215(100)	413(100)
Herd size			
ג 10 cows	192(97)	208(96.7)	400(96.9)
>10 cows	6(3)	7(3.3)	13(3.1)
Total	198(100)	215(100)	413(100)

Table 2: Prevalence of clinical and sub-clinical mastitis at cow level in the study areas

	Study areas (districts)			
Prevalence of Mastitis	Bedele N (%)	Mettu N (%)	χ^2	P-Value
Number of examined cows	198(100%)	215(100%)	2.630	0.105
Clinical	13(6.6%)	12(5.6%)		
Sub-Clinical	53(26.8)	44(20.5%)		
Total prevalence	66(33.4%)	56(26.1%)		

χ^2 = Chi-square. p ≥ 0.05 = non-significant

Table 3: Prevalence of mastitis associated to intrinsic and extrinsic factors in Bedele District

Risk Factors	Category	Number of animal Examined Cows	Number of Positives (%)	χ^2	P-Value
Age	≤ 5 years	93	15(7.6)	23.359	0.000*
	>5 years	105	51(25.8)		
Mastitis History	Yes	39	27(13.6)	28.163	0.000*
	No	159	39(19.7)		
Lactation Stage	Early	78	21(10.6)	7.788	0.020*
	Mid	81	36(18.2)		
	Late	39	9(4.5)		
Milk Production per day	≤ 2 litters	171	54(27.3)	10.812	0.004*
	>2 and <6 litters	15	3(1.5)		
	≥ 6litters	12	9(4.5)		
Parity	1 – 3 calves	123	30(15.2)	19.622	0.000*
	4 – 6 calves	69	30(15.2)		
	≥ 7 calves	6	6(3.0)		
Udder Injury	Yes	27	21(10.6)	27.789	0.000*
	No	171	45(22.7)		
Tick Infestation	Yes	120	57(28.8)	27.511	0.000*
	No	78	9(4.5)		

χ^2 = Chi-square. *p<0.05 = Significant.

Table 4: Prevalence of mastitis associated to intrinsic and extrinsic factors in Mettu District

Risk Factors	Category	Number of animal Examined Cows	Number of Positives (%)	χ^2	P-Value
Age	≤ 5 years	94	13(6.05)	12.941	0.000*
	>5 years	121	43(20.0)		
Mastitis History	Yes	54	24(11.2)	12.672	0.000*
	No	161	32(14.9)		
Lactation Stage	Early	70	15(7.0)	1.354	0.508
	Mid	95	28(13.0)		
	Late	50	13(6.0)		
Milk Production per day	≤ 2 litters	197	56(26.0)	6.919	0.031*
	>2 and <6 litters	9	0(0.0)		
	≥ 6litters	9	0(0.0)		
Parity	1 – 3 calves	109	13(6.0)	22.927	0.000*
	4 – 6 calves	92	37(17.2)		
	≥ 7 calves	14	6(2.8)		
Udder Injury	Yes	46	20(9.3)	9.232	0.002*
	No	169	36(16.7)		
Tick Infestation	Yes	156	49(22.8)	8.491	0.004*
	No	59	7(3.3)		

χ^2=Chi-square. *p<0.05 = Significant

mastitis history is five times more than cows which hadn't mastitis history from smallholder holder dairy farms in Adama, Ethiopia. However, this finding is in contrast to the result reported by Rahmeto *et al.* [32] from Hawassa milk shed, South Ethiopia. The highest prevalence of mastitis due to the previous mastitis history might be attributed to high dominant isolate of *S. aureus* [22, 33] which is the major cause for mastitis in the study areas by inhabiting both intramammary and udder skin.

Stage of Lactation: The results pertaining to the prevalence of mastitis in relation to the stage of lactation are displayed in Table 3 and 4. The result indicates that the stage of lactation was significantly affecting the prevalence of mastitis in Bedele district. The finding of this study is in line with the study recorded by Jirata and Indalem [19] and Zeryehun *et al.* [33] form in and around Addis Ababa and Wolayta Sodo, Ethiopia, respectively. In contrast to this, the prevalence of mastitis is similar along the three stage of lactation in Mettu districts and it is in accordance with the findings of Getachew and Edilu [34] from an area of Ambo district, Ethiopia. The result variations across the stages of lactation between the two districts could be related to the type of management system of rearing livestock as well as it could be somewhat agro ecological differences.

Milk Production: According to the result presented in Table 3 and 4, the prevalence of mastitis was statistically different across different amount of milk production per cow. The result of the present study is in agreement with study by Radostits *et al.* [6] who reported that the high yielder cows are more exposed for the occurrences of mastitis comparing with the low yielder cows. The result of this findings is also in accordance with the findings of Nibret *et al.* [35] and Rahmeto *et al.* [32] from Hawassa, Southern Ethiopia and Kemal *et al*. [36] from in and around Sinana district, Ethiopia however, study by Misrak *et al*. [37] reported an insignificant differences in prevalence of mastitis between high and low yielder cows from Bishoftu Town, Ethiopia.

Number of Parity: The results pertaining to the prevalence of mastitis is presented in Table 3 and 4. The observed result indicates that the prevalence of mastitis was higher in cows that had large number of parity than those had small number of parity. The result of this findings is in agreement with the study reported by Getachew and Edilu [34] form Ambo district, Ethiopia, Zeryehun *et al.* [33] from in and around Addis Ababa, Ethiopia, Nibret *et al.* [35] from Hawassa, Kero and Tareke [25] form selected area of Southern Ethiopia, Biffa *et al.* [38] from Southern Ethiopia, Mungubet *et al.* [27] from central part of Ethiopia and Mureithi and Njuguna [39] from urban and peri-urban areas of Thika Sub County, Kenya. The contrasting finding was also reported by Iraguha *et al*. [40] from dairy cows in Nyagatare district, Rwanda. Increasing parity number is one of the forecasters distinguished to associate with the incidence of mastitis. The likelihood of mastitis was 24.8 times higher in multiparous cows having four or more calving compared with primiparous cows [32]. The prevalence of mastitis with parity might be associated with the position of udder in older cows as well as wider opening of teat canal could be a possible attributes for more prevalence in mastitis.

Udder Injury: The result as observed in Table 3 and 4 revealed that the prevalence of mastitis was higher in cows had injured udder/teat than those cows hadn't injured. The finding of current study is in accordance with the study reported by Nibret *et al.* [35] form Hawassa, Ethiopia, Bedacha and Menghistu [41] form Batu and its environs, Ethiopia and Rahmeto *et al.* [32] from Hawassa milk shed, South Ethiopia. The higher prevalence of mastitis may be attributed to higher contamination with opportunistic bacteria those inhibits on udder skin, milker's hand and unhygienic bedding materials [42].

Tick Infestation: The result as observed in Table 3 and 4 revealed that the prevalence of mastitis was higher in cows infected with tick than those cows not infected. The observed result of the present study is consistent with the study by Nibret *et al.* [35] form Hawassa, Ethiopia, Jirata and Indalem [19] from in and around Wolayita Sodo, Ethiopia, Biffa *et al.* [38] from lactating cows in Southern Ethiopia. The higher incidence of mastitis may be due to the injury that caused during removal of the tick manually as well when the tick is getting to complete the life cycle. Moreover, there is inflammation of udder and fibrosis due to the bite on the udder/teat. Practicing good tick controlling activity is important to reduce the incidence of mastitis [21].

CONCLUSIONS AND RECOMMENDATIONS

The study was conducted to access the prevalence of mastitis among indigenous cattle reared in and around Bedele and Mettu districts of Ilu Aba Bor Zone, Ethiopia. This study revealed that, mastitis is the type of disease

that has direct impact on food security as well as on an economy of the households. The study further indicated that there is high incidence of sub-clinical mastitis comparing with clinical mastitis in the study areas. Intrinsic and extrinsic factors viz. age, mastitis history, lactation stage, parity, tick infestation, milk production and udder injury were significantly affect the prevalence of mastitis in both districts except stage of lactation in Mettu district. Therefore, the responsible bodies need to assess the associated intrinsic and extrinsic factors and measures have to be taken to reduce the incidence of mastitis and its influence from dairy farming. Using acaricides spray according to the manufacturer's recommendation could be possible measures to be taken to reduce the infestation of ticks. Proper management and good hygienic practices could also be a possible measure to reduce the incidence of mastitis by controlling the transmission of the disease.

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