The Prevalence of Bovine Mastitis and Associated Risk Factors in Cross Breed Lactating Dairy Cows in Sebeta, Central Ethiopia

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Abstract: Cross sectional study was conducted from November 2015-April 2016 to determine the overall prevalence of bovine mastitis and assess the potential risk factors in 290 cross breed (Holstein Friesian) lactating dairy cows in Sebeta town. An overall prevalence of 56.5% (164/290) of mastitis where 9.31% (27/290) and 47.24% (137/290) of cows showed clinical and subclinical mastitis, respectively. Blind teat was examined in 19 (1.63%) out of 1160 quarters. The quarter level prevalence was found to be 28.4% (325/1141).Among the potential risk factors considered, presence of teat or udder lesion (x^2 =6.64. P< 0.05), had significant effect on the prevalence of subclinical mastitis. However, risk factors like age (x^2 =1.35, P=0.99), stage of' lactation (x^2 =5.86, P= 0.05), parity(x^2 =2.42, P=0.19), udder conformation (x^2 =0.99, P=0.31) and udder hygiene (x^2 =1.66, P=0.19) didn't show statistically significant association with occurrence of mastitis. The present study also showed the risk factors related with management (housing system and milking practice) with the occurrence of mastitis. Since, the possible significant economic losses that could be incurred by both clinical and subclinical mastitis, attention should be paid for further detailed investigation and control measures.

Key words: Bovine Mastitis · Prevalence · Risk Factors · Sebeta

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]. Milk and milk products produced from these animals provide an essential dietary source for the majority of rural population as well as considerable number of the urban and per-urban population. The total annual national milk production in Ethiopia ranges from 797, 9000 to 1, 197, 500 metric tons raw milk equivalents. Out of these, 85-89 percent of milk is contributed from cattle. However, this amount does not satisfy the national demand for milk and milk products in the country [2].

Among the major reasons stated for the low annual national milk yield, the disease of mammary gland known as mastitis is one of the most important factors [3].

Mastitis in dairy cows occurs worldwide and can be caused by infections with bacteria, yeast and fungi [4]. Bacteria are the most common cause of intramammary infection and the range of causal bacterial species varies with geographical location and management. In previous studies in developing countries, yeast or fungi represent a greater proportion of isolates than those from developed countries, possibly indicating different exposure levels, host susceptibility, or increased contamination of collected milk samples [5]. Mastitis is known to be a complex and a multifactorial disease, requiring exposure to a combination of environmental and pathogenic factors and with variable responses between animals. Many risk factors have been identified for clinical and subclinical mastitis in dairy animals such as breed, age, parity and stage of lactation [6].

Mastitis has been known to cause a great deal of loss or reduction of productivity to influence the quality and quantity of milk yield and to cause culling of animals at the age of high producing capacity [7]. Moreover, due to its latent form, heavy financial losses and great nutritional and technological impacts can be resulted. Because valuable components of the milk like lactose, fat and casein are decreased while undesirable components like ions and enzymes are increased and making the milk unfit for processing technology [8].

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According to the study carried out in England and Wales from 1989 to 1992, the average cost of a case of mastitis due to antibiotics used, milk discarded, reduction in quality and quantity of milk produced by a cow was estimated 60 pounds for each case and the economic loss due to both clinical and subclinical mastitis per lactation in Ethiopia is 270 ETB [9-10]. Based on the research works showed that on the average the affected quarter suffers a 30% reduction in productivity and affected cow a 15% loss its production [11].

In addition to its economic impact, there is a danger that the bacterial contamination of milk from affected cows may render it unsuitable for human consumption by causing food poisoning or in rare cases provide a mechanism of spread of disease to humans. Tuberculosis and streptococcal sore throat may be spread in this way [11]. Many infectious agents have been implicated as cause of mastitis in cattle. The most common organisms are *Streptococcus agalactiae* and *Staphylococcus aureus* [12], whereas, environmental mastitis is associated with coliforms and environmental Streptococci that are frequently found in the cows environment [13]. According to Radostits [14], the diagnosis of bovine mastitis is performed by clinical examination (inspection and palpation) for clinical forms of mastitis, screening (CMT) test for subclinical forms of mastitis and bacterial isolation for confirmatory diagnosis.

In Ethiopia, the available information indicated that bovine mastitis is one of the most frequently encountered diseases of dairy cows. According to Hussein *et al.* [15] the major diseases of crossbred cows in Addis Ababa milk shed, clinical mastitis was the second most frequent disease next to reproductive diseases, in which 171 cows out of 556 were found to be affected. Generally, the prevalence of clinical and sub clinical mastitis in different parts of Ethiopia range from 1.2 to 21.5% and 19 to 46.6%, respectively [5, 16-18]. Even though, mastitis is studied in different parts of the country it had been observed that it is still causing significant impact in the dairy industry, hence need further study and appropriate interventions in different areas in order to increase the production and productivity of dairy farms. Therefore, the present study was conducted with the objectives to determine the prevalence of mastitis and associated potential risk factors in cross breed (Holstein Frisians) lactating dairy cows.

MATERIALS AND METHODS

Study Area: The study was conducted in Sebeta town from November 2015-April 2016. Sebeta town is located 25 km south west of Finfinne (Addis Ababa). The livestock population of the area comprised about 6395 cattle, 1702 sheep, 1123 goat, 1157 horse, 922 mule, 20616 donkey and 6520 poultry [19].

Study Animals: The study animals were cross breed (Holstein Friesian) lactating dairy cows owned by small holder farmers with different herd size, calving history and management conditions. The average herd size was 10and the maximum was16 lactating cows of large scale dairy farm. Animals were categorized based on age, parity, lactation stage and presence or absence of risk factors such as teat or udder lesion, conformation of udder, udder hygiene and clinical state of the udder, blind teat and management and housing types.

Sample Size Determination: The sample size was determined at 95% confidence interval at desired accuracy level of 5% According to Thrusfield [20] and using expected prevalence of 74.7% by Zeryehun *et al*. [21].

$$N = (1.96)2x \; Pexp \; (1- Pexp)/d2$$

where: N=number of sample size
Pexp=expected prevalence
d2=Absolute precision

Therefore, by inserting the expected prevalence (74.7%) into the formula the sample Size required for the study is 290.

Study Design: Cross sectional study was conducted to determine the overall prevalence of bovine mastitis and determinants of risk factors in cross breed (Holstein Friesian) lactating dairy cows in Sebeta from November 2015 to April, 2016. Both clinical and subclinical mastitis prevalence was determined at cow and quarter level. The study was based on the questionnaire survey, physical and clinical examinations of clinical cases and screening test using CMT test for subclinical cases.

Study Methodology
Clinical Examination: The udder was first examined visually and then through palpation to detect visible abnormalities, possible fibrosis, inflammatory swellings, visible lesion, asymmetry, indurations, firmness and blindness. Mammary quarters often became blind when there were repeated infections and little or no treatment was provided. Information related to the previous health history of the mammary quarters and causes of blindness was obtained from interviews with owners of the farm.

Clinical mastitis was recognized by some pathology in udder, which is manifested by swelling, pain, redness and heat in case of acute mastitis. In addition, viscosity and appearance of milk secretion from each mammary quarter were examined for the presence of clots, flakes, blood and watery secretions.

California Mastitis Test (CMT): Subclinical mastitis was diagnosed based on CMT results and the nature of coagulation and viscosity of the mixture (milk and CMT reagent), which showed the presence and severity of the infection, respectively [22].The California mastitis test (CMT) was carried out according to the method described by [23]. Udder and teat was first washed with water and disinfected by commercial detergents then, a squirt of milk, about 2 ml from each quarter was placed in each of four shallow cups in the CMT paddle. An equal amount of the commercial reagent was added to each cup. A gentle circular motion was applied to the mixtures, in a horizontal plane for 15 seconds and the result was recorded as positive (distinct precipitation with gel formation) and negative (no precipitation and gel formation). The prevalence of clinical and subclinical mastitis was determined at cow and quarter level.

Questionnaire Survey to Assess Risk Factors: In the survey each farm was visited and information on management and production conditions of the farms and individual cows was collected using two separate data sheets. Risk factors considered at cow attributes were age, lactation stage, parity, udder hygiene, udder conformation and teat or udder lesion. Stage of lactation was categorized in to three level as1- 120 days postpartum (early lactation), 121- 240 days (middle lactation) and days greater than 240 (late lactation) and similarly parity was categorized as 1- 3 calves(few), 4 - 7 calves(moderate) and

> 7 calves(many). Age was also categorized into three level as young (3-5), young adult (6-9) and adult (>9) according to [24]. Additionally, risk factors associated with management and housing system of the farms were floor type, housing ventilation, drainage system, use of towel, hand washing and disinfection before milking, udder and teat washing disinfection after milking and cow wash.

Data Analysis: The data collected from individual animals and farms were coded, entered and stored in Ms Excel spread sheet until analyzed using Stata 11 statistical software package. Prevalence of bovine mastitis was determined as the proportion of affected cows out of the total examined using descriptive statistics. The association between the occurrence of sub clinical 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

In the present study out of 290 examined lactating cows the prevalence of mastitis was 56.5% (clinical 9.31% and sub-clinical mastitis 47.2 %). Blind teat was found in 19 quarters (1.63%) (5 FL, 2 FR, 7 RL and 5 RR) out of 1160 quarters. The quarter level prevalence was found to be 28.48% (325/1141); from which 2.45% (28/1141) was of clinical form revealing active cases of mastitis with visible sign of inflammation on the udder and changes in milk consistency and 26.0% (297/1141) was of subclinical mastitis based on California mastitis test (Table 1). The occurrence of subclinical mastitis by quarter location was 71(23.9%), 75(25.25%), 79(26.59%) and 72(24.24%) in the front left (FL), front right (FR), rear left (RL) and rear right (RR), respectively (Table 2).

Table 1: Prevalence of clinical and subclinical mastitis at cow and quarter level in the examined smallholder lactating dairy cows

	Clinical mastitis			Subclinical mastitis		
Observation level	No examined	Positive	%	No examined	Positive	%
Cow level	290	27	9.31	290	137	47.2
Quarter level	1141	28	2.45	1141	297	26.0

Table 2: Prevalence and distribution of udder infection across the four quarters in dairy cows

	Clinical mastitis		Subclinical mastitis	
No quarter examined	1141	Prevalence	1141	Prevalence
No of quarter affected	28	2.41%	297	26.0%
Front left	9	32.1%	71	23.9%
Front right	5	17.85%	75	25.25%
Rear left	10	35.71%	79	26.59%
Rear right	5	17.85%	72	24.24%

Table 3: Association of different risk factors with the occurrence of mastitis

Risk factors	Total no	No(%) of positive	X^2	P. value
Age				
3-5	135	60(44.4)	1.35	0.5
6-9	107	51(47.66)		
>9	48	26(54.16)		
Lactation Stage				
Early	94	35(37.23)	5.86	0.05
Mid	90	45(50)		
Late	106	57(53.77)		
Parity no				
1-3	152	70(45.75)	2.42	0.29
4-7	122	57(46.72)		
>7	15	10(66.67)		
Teat or Udder Lesion				
Present	20	15(75)	6.64	0.01
Absent	270	122(45.19)		
Udder Hygiene				
Satisfactory	166	73(43.98)	1.66	0.19
Non-satisfactory	124	64(51.61)		
Udder Conformation				
Pendulous	184	91(49.46)	0.99	0.31
Non-pendulous	106	46(43.4)		
Floor type				
Concrete	274	131(47.81)	0.64	0.42
Muddy	16	6(37.5)		

Table 4: Summary of questionnaire survey and personal observation in 40 dairy farms

Management /housing	Scores in number (%)				
	Very good	Good	Poor	Yes	No
Drainage system	3(7.5)	26(65)	11(27.5)		
Ventilation in the house	13(32.5)	12(30)	15(37.5)		
Daily barn cleaning				23(57.5)	17(42.5)
Use of towel				19(47.5)	21(52.5)
Hand washing and disinfection before milking				28(70)	12(30)
Udder or teat washing and disinfection after milking				37(92.5)	3(7.5)
Cow wash				17(42.5)	23(57.5)

Risk Factors Associated with Sub-Clinical Mastitis:
The association of different potential risk factors and the occurrence of sub clinical mastitis in Sebeta small holder dairy farms are shown in table 3. Presence of teat or udder lesion (x2 =6.64. P< 0.05) showed statistically significant association with the occurrence of mastitis. However, risk factors like age (x2 =1.35, P=0.99), Lactation stage (x2 =5.86, P= 0.05) parity(x2 =2.42, P=0.19), udder conformation (x2 =0.99, P=0.31) and udder hygiene (x2 =1.66, P=0.19) didn't show statistically significant association with occurrence of mastitis. The different factors associated with management and housing system of the animals that are assessed by questionnaire survey and personal observation are summarized in Table 4.

DISCUSSION

The present study has given a due attention to determine the prevalence of mastitis in lactating dairy cows and assessment of determinant risk factors. This study indicated a prevalence of mastitis of 56.5% (9.31% clinical mastitis and 47.2 % sub-clinical mastitis) at cow level and 28.4% at quarter level. The finding of present study on prevalence of mastitis (56.5%) is slightly greater than the result reported in the same area by Sori *et al*. [25] who reported prevalence of (52.78%). This is could be due to difference in the breeds of animal included in the studies, because both cross and local breed cows were included in their study. The finding of present study is in

line with the previous reports by Benta and Habtamu [24]who reported prevalence of mastitis in dairy cows to be 56.5% in batu.

The overall prevalence of clinical mastitis in this study was 9.31% which is comparable to the reports done in different dairy farms: in and around Mekelle (6.55%) by Wudu [26], in three states dairy farms around Addis Ababa (7%) by Yirgalem *et al*. [27] and in central high lands of Ethiopia (6.6%) by Mungube *et al*. [10]. While it was lower higher in the reports done in dairy farms in Dire Dawa Administrative Council and Eastern Hararghe Zone (19.8%) by Birhanu [28], in WelaytaSodo, Southern Ethiopia (15.1%) by Biffa *et al*. [29], in two major states owned dairy farms at Rapi and DebreZeit, Ethiopia (21%) by Workineh *et al*. [18]. This study showed a wider difference in prevalence of mastitis with other areas, which could be attributed to variation in management type, environmental hygiene and difference in handling of lactating cows.

Occurrence of subclinical mastitis was found high when compared to clinical mastitis. The prevalence of subclinical mastitis at cow level based on CMT test in the present study was (47.2%), which is in close agreement with the reports done by mekebib et al. [30], who reported 48.6% for sub-clinical mastitis. However, the result obtained for subclinical mastitis (46.8%) in this study was greater than the finding by Girma [31]who reported 33.8%, in Holeta, central Ethiopia and lower higher than the finding of Bishi [32] and NMC [33]who reported that 34.30 and 34.40% in Addis Ababa and Bahir Dar, Ethiopia, respectively. The high prevalence of sub-clinical mastitis may be attributed to improper milking hygiene and absence of order in milking of mastitis animals before the healthy ones all of which might have increased the prevalence [14].

In this study, the presence of teat or udder lesions showed significant association (x^2 =6.64, P< 0.05) with the occurrence of sub-clinical mastitis with the prevalence of (75%) in cow with teat lesion and (45.19%) cow without teat lesion. Comparable findings were reported by Sori *et al*. [25] with the prevalence of (68.8%) in cow with teat lesion and (18.2%) in cow without lesion and by Biffa *et al*. [29] with prevalence of (84%) in cow with teat lesion and (47.7%) without teat lesion. Animals with skin lesions on their teats or udder had a high prevalence of mastitis, possibly because of colonization of the lesion by pathogens.

Even though stage of lactation had no significant association with the occurrence of mastitis the prevalence of subclinical mastitis in this study was (37.25%), (50%) and (53.77%) in early, mid and late lactation, respectively, also reported by several investigators [10, 29, 34, 35] in Ethiopia. The former two authors reported high prevalence of sub-clinical mastitis for cows in mid and late stage of lactation as it is the case in this finding, while the late two reported higher prevalence in early stage of lactation. The variations in the effect of stages of lactation between the difference studies could be related probably to the disparities in age, udder hygiene and breed of the sampled animals.

In addition, in this study the risk of mastitis occurrence increased with increasing age and parity even though they didn't show statistically significant association which could be due to higher difference in number of animal sampled between compared groups (adult and young, cows with many calves and few calves). Accordingly, several numbers from young cows with few calves are sampled. Cows with many calves (>7) and those categorized udder adult stage (>9 age) were scored point prevalence (66.67%) and (54.16%), respectively than those having few calves (1-3) and young's (3-5 age) with prevalence of (45.7%) and (44.4%), respectively. This is in line with the previous reports on mastitis in Ethiopia by Kerro and Tarekegn [35] and Alebachew and Alemu [36].

The highest prevalence of subclinical mastitis was recorded in this study in those cows with pendulous (49.46%) when compared to cows with non-pendulous udder (43.4%), this finding urged with Sori *et al*. [25], who found prevalence of mastitis (77.78%) in pendulous udder and (50.00%) in non-pendulous udder. High prevalence of subclinical mastitis was also recorded in this study in those cows with poor hygiene udder (51.61%) than cows with satisfactory udder hygiene (43.98%). This report is in line with finding of Mekebib *et al*. [30] who report prevalence of mastitis (62.5%) in cows with poor udder hygiene and (42.1%) in cows with satisfactory udder hygiene. Pendulous udder exposes teat and udder to injury and the pathogens may easily adhere to the latter, getting access to the gland tissue and also poor hygiene udder predispose mammary gland to microorganisms that cause environmental mastitis.

The predominant housing type in the present study was closed type with concrete floor and all farms included in the study practice hand milking. Among the 40 farms assessed, 19(47.5%) use towel, 28(70%) wash and disinfect their hands before milking and 37(92.5) wash and disinfect teat/udder after milking. Hand milking methods in the entire farms that included in this study was believed to be one of the predisposing factors to increase the prevalence of mastitis. In addition to this and

other predisposing variables discussed so far, those dairy farms that didn't wash their cows (53.3%) are more prone to incidence of mastitis than those who wash their cows (46.7%). Because washing of cows will reduce contamination of environment and host with infective microorganisms which have potential to cause the disease.

CONCLUSIONS AND RECOMMENDATIONS

The overall high cow level 56.5% and quarter level 28.4% prevalence of mastitis in the present study signify the effect of mastitis in Sebeta dairy farming. The occurrence of mastitis found to be associated with presence and absence of teat or udder lesion ($x2 =6.64$, $P< 0.05$). The risk factors like age ($x^2 =1.35$, $P=0.99$), Lactation stage ($x^2 =5.86$, $P=0.05$), parity($x^2 =2.42$, $P=0.19$), udder conformation ($x^2 =0.99$, $P=0.31$) and udder hygiene ($x^2 =1.66$, $P=0.19$) didn't show statistically significant association with occurrence of mastitis. Lack of maintenance of strict hygiene and good sanitary environment could be contributory factors in the occurrence of subclinical mastitis. Based on the above conclusive remarks the following recommendations are forwarded:

- Adequate housing and general sanitary condition of the farms should be improved and maintained.
- The farmers should ensure strict personal hygiene and that of animals and working equipment's.
- Regular screening for early detection of intra mammary infection and effective treatment should be implemented all across the country.
- The government and responsible stake holders should have to give special emphasis and new strategy for the prevention and control of bovine mastitis.

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