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A Study on Prevalence and Economic Importance of Mastitis in Dairy Farms in and Around Sebeta, Oromia Regional State, Ethiopia

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Abstract: A cross-sectional study was conducted from November 2007 to April 2008 in dairy farms in and around Sebeta Town. Four hundred lactating cows from fifteen households were included in the study. From these 400 cows subjected to California Mastitis Test (CMT), 265 (66.3%) were mastitis positive, out of which 231 (87.2%) were sub clinically affected and 34 (12.88%) were clinically affected signifying the importance of sub clinical cases. The findings of the present study revealed that potential risk factors of mastitis namely age and parity were found to have a statistically significant association with CMT results ($P<0.05$). The overall prevalence of sub clinical mastitis was 57.75% and 46.1% at cow and quarter level respectively. Reduced milk productions due to sub clinical mastitis were 2.8 (24.34%), 2.35 (20.43%) and 2L (17.39%) in quarters with scores +1, +2 and 3 respectively. With the given distribution of CMT scores in the study population, a quarter with subclinical mastitis lost 34.26% of its milk production. Total loss due to mastitis in the study animals amounted to be 291,468.55 birr/lactation/year (1099.88 birr/cow/year). Milk production losses, treatment and withdrawal losses contributed 93.3, 6.2 and 0.5% respectively. Based on the finding, effort should be made to control mastitis so as to ensure quality of milk, prevent economic loss and public health hazard.

Key words: Economic · Mastitis · Prevalence · Sebeta

INTRODUCTION

Among the challenges of dairy development in the tropics such as breed improvement, nutrition, management, control of infection, tick-borne diseases, blood and internal parasitic diseases; mastitis is considered to be the most frequent and most costly production disease in dairy herds of developed countries [1] as it causes serious wastage and undesirable milk quality. Mastitis is an inflammation of mammary gland by pathogenic bacteria or mycotic (fungus) pathogen with route of infection most often being through teat canal and can occur as a wide range of clinical case.

As mastitis is an economically important disease causing reduction of productivity and death of the animal and culling economic analysis is required in order to balance the cost of controlling and preventing mastitis against economic loss attributable to this disease.

Although it may be economical to reduce a higher level of a disease in herd flock, it may be economic to reduce even further the level of a disease that is present in only low level. As it is the most infectious disease the occurrence of mastitis depends on three components which includes exposure to microbes, cow defense mechanisms, environmental and manage mental factors [2]. The first month of lactation is the most sensitive period for mastitis risk in the cow even in the well managed herds [3].

The quality and management of housing for dairy cattle has a major influence on the type of mastitic pathogens, which may infect the mammary gland and increase the degree of infectious pressure. The size of milking herd as well may positively be associated with an increased incidence of clinical mastitis because it is more difficult to control contagious mastitis in a herd with a great prevalence of infection and a larger number of cows to cows' contacts [3].

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Mastitis milk can also pose a threat to human health. With severe clinical mastitis, gross abnormalities of milk are readily observed and the producers discard milk. But with subclinical mastitis milk carries bacteria that can cause severe human illness such as tuberculosis and brucellosis [4]. Another public health concern regarding mastitis is antibiotic residues which initiates severe reaction in people allergic to antibiotics and development of antibiotic resistant strains of bacteria [5].

In general, the economic impact due to mastitis can be summarized as reduced milk production; loss of antibiotic containing milk (discarded), cost of veterinary services and drugs and decreased value of culled cows with increased cost of replacement cows [6]. The magnitude of the incidence and economic important of mastitis is not properly assessed in Sebeta area where there are several smallholder dairy farms. Therefore, the objectives of the study were to assess the prevalence of mastitis and identify associated risk factors and to estimate the cost associated with mastitis in and around Sebeta.

MATERIALS AND METHODS

Study Area: The study was conducted in Sebeta town, South West Showa Sebeta district from November 2007 to May 2008. The town is 25 km south west of Addis Ababa, in Oromia Regional government. The farmers around Sebeta follow a mixed crop-livestock farming system and a cereal legume cropping system.

Study Population: The study population consisted of all dairy cows found in and around Sebeta region. Majority of the dairy farms in the area are kept under small holder intensive farms and there are only few large commercial intensive farms.

Study Animals: The study animals were all lactating cows from each conveniently selected household. The cows were introduced from other places and they were all cross breeds. These cows are kept intensively and maintained tied in stalls under zero grazing.

Sample Size: Sample size was determined with an expected mastitis prevalence of 50.35% reported in Adama [7] at 95% confidence interval and 5% precision level. This was established by previous study in Adama with similar climatic condition to Sebeta. The following formula was employed to get the target sample of milking cows as described elsewhere [9].

$$n = \frac{1.96^2[P_{exp}(1 - P_{exp})]}{d^2}$$

Where,
n = required sample size.
1.96 = the value of z at 95% confidence interval.
P_{exp} = expected prevalence of Mastitis
d^2 = desired absolute precision level at 95% confidence interval.
Substituting the values, n = 384, the required sample size is therefore 384.

Study Design: A cross-sectional study was undertaken to measure the prevalence of mastitis in and around Sebeta from November 2007 to April 2008. A questionnaire survey was undertaken through per-tested questionnaire to assess the potential risk factors and economic impact associated with mastitis in the study area.

Clinical Examination: Physical visualization of inflammation (heat, pain, redness, swelling, loss of function) was examined in the Sebeta small holder dairy farms to check for the presence of mastitis.

California Mastitis Test (CMT): California mastitis test was performed at the time of milking and the procedure was carried out as described elsewhere [10]. This test identified sub clinical cases and also clinical cases which were not overtly clear were defined by CMT.

Determination of Economics of Mastitis: Primary findings and published works were both used to estimate the economic losses of mastitis. Milk production losses due to subclinical mastitis were determined by the help of split udder technique while those due to clinical mastitis were estimated using published works. Treatment and withdrawal losses were more estimated from primary findings.

The economic losses were estimated with a financial function of the form given below:

Y = a+b+c,

Where, Y= Total losses due to mastitis, a = reduction in milk yield, b = cost of treatment, c = milk withdrawal loses.

Losses in milk yield and treatment costs were considered at a quarter level and lose estimation was based on the following four considerations [8]:

- A cow was assumed to have a uniform quarter production of 2.875 liters based on the daily yield of 11.5L /days/ cow with 2,760L in 240 days lactation period.
- A cow suffers from subclinical mastitis (SCM) at least for one quarter during the lactation period.
- A cow suffers from clinical mastitis four times and therefore received treatment four times.
- Treatment was only restricted to clinical cases since majority of the farm owners were not even aware of the presence of subclinical mastitis.

Treatment cost: Mastitis drugs and their prices were identified from veterinary drug shops and field veterinarians. No single drug was preferred to the others depending on its availability, price and also on the veterinarians preference. The Average prices of the commonly used intramammary infusion and parentral antibiotics were used in the estimation and information about veterinarian fees was collected from the veterinary clinics in and around Sebeta, accordingly:

- Cost of intramammary treatment (X) = price per unit X treated quarters x treatment duration x number of times a cow was treated in lactation.
- Cost of parentral treatment (Y) = number of cows treated X price of total dose in ml per cow X treatment duration X number of times a cow was at risk in a lactation.
- Veterinarians fees (z) = number of cases X charge per case X number of treatment duration in lactation.

Therefore, total treatment cost = X + Y + Z [8]

Withdrawal losses: A loss due to milk withdrawal was calculated as:

- Cows treated X losses amounted to cows treated X milk production / cow / day X treatment duration in lactation.

Milk Production Losses*:* It was difficult to assess milk production losses due to lack of record keeping even in large dairy farms and awareness of farm owners regarding subclinical mastitis. However a split udder investigation was carried out on the farms having approximately similar finding system and cross breed dairy cows. This approach was attempted to determine milk production with or without subclinical mastitis.

The difference between the milk yield of +1, +2, +3 constituted the milk loss at the corresponding CMT score. The quarter milk lose was derived by multiplying the number of different CMT score positive quarters milk by their corresponding milk production and average. The milk loss was calculated as below:

Quarter milk loss = (All quarters scored +3 X quarter production with the same CMT-) + (All quarters scored +2 X quarter production with the same grade) + (All quarters scored +1 X quarter production at the same grade)/ Total number of positive quarters.

- SCM losses = W*X*Y* Z* where W was quarters affected in the positive animals, X was daily milk yield per quarter, Y was the percent loss, Z was days in lactation when a cow had the disease.
- CM losses =Quarters affected X duration of clinical case X number of times at risk.

Cows with untreated clinical mastitis loss up to 50 % of quarter milk production [8]. The two estimates were summed to give milk losses in birr.

Data Analysis: Data was coded and stored in Microsoft Excel spread sheet. Descriptive analysis such as proportion and frequency as well as measurement of qualitative assessment of association of risk factor s with mastitis was done using Chi-square test implying statistics package for social science (SPSS version 12.0).

RESULTS

A total of 400 dairy cows originated from 6 commercial and 15 small holder dairy farms in and around Sebeta town were investigated for the presence of mastitis. Out of 400 cows tested 265 (66.3%) were found positive to California mastitis test and clinical examination.

The overall prevalence of mastitis was found to be 66.3%. The prevalence of mastitis was higher in cows (68.9%) than in heifers (50%), which were found to be statistically significant ($P< 0.05$) (Table 1).

The prevalence of mastitis was higher in cows with udder tick (90%) than in cows without udder tick (65.6%), however, it was not statistically significant. The present study showed no difference in prevalence of mastitis among dairy cows with teat lesion and without teat lesion.

Table 1: Data layout of the potential risk factors of mastitis and associated χ^2 – test result of dairy farms in and around Sebeta

Variable	No. tested	positive (%)	*P*-value*
Parity			
One	56	28(50%)	
>One	344	237(68.9%)	0.000
Udder tick			
Absent	390	256 (65.6%)	
Present	10	9 (90%)	0.108
Teat lesion			
Absent	389	258(66.3%)	
Present	11	7(63.6%)	0.853

* Significance test at α=0.05

Table 2: Blind and CMT scores of each quarter of lactating dairy cow in 6 commercial and 15 smallholder dairy farms.

	Right front	Right hind	Left front	Left hind	Total
Negative (0)	203	172	195	235	805
Weak positive (+1)	55	45	52	47	199
Distinct positive (+2)	75	46	53	75	249
Strong Positive (+3)	101	73	47	64	285
Blind	16	15	21	10	62
Total	450	351	368	431	1600

Table 3: Prevalence of mastitis at cow and quarter level of dairy farms in and around Sebeta.

	Number tested	positive (%)
Clinical		
Cow level	400	34(8.5%)
Quarter level	1600	54(3.375%)
Sub clinical		
Cow level	400	231(57.75%)
Quarter level	1600	741(46.31%)
Overall		
Cow level	400	265(66.25%)
Quarter level	1600	795(49.69%)

From these 400 dairy cows 49 (12.25%) were dry cows of which 22(45%) were mastitic and among 321 lactating cows 186(57.94%) were mastitic. A total of 1600 quarters were considered in this study and 62 quarters (3.87%) of them were blind or nonfunctional. The functional quarters were 1546(96.6%) from which 741(46.31%) quarters were sub clinically affected. Quarter CMT result indicated that 285, 249, 199 and 805 quarters were CMT score strong positive (+3), distinct positive (+2), weak positive (+1) and negative (0) respectively (Table 2).

Four hundred cows with 1600 quarters were investigated and 34 cows with 54 (3.375%) teats were clinically positive. The over prevalence of clinical mastitis was 3.37% and 8.5% % at quarter and cow level respectively (Table 3).

Two hundred thirty one (57.75%) of the cows were sub clinically positive at the time of screening. The overall prevalence of sub clinical mastitis was 46.31% and 57.75% at quarter and cow level respectively (Table 3).

Economic Analysis of Mastitis: Split udder*:* Eight hundred five quarters had CMT score 0 and 741 had +1, +2, +3 respectively. Average milk production per quarter was 2.875 liter per milking. This means one cow per lactation or milking yields 2.875L per day. In the case of clinical mastitis such as blind teats the production loss was 2.875 liter of milk per day. Accordingly, 34 cows with 54 blind quarters loss 2.875 X 54 X 240 liters of milk per cow per year. Since one cow lactation period is 240 days per year. Seven hundred forty one quarters were found positive in this study, out of which 293,249 and 199 had a CMT score of +3, +2 and +1 respectively. Average milk production per quarter was 2.875 liters. CMT score 0, +1, +2 and +3 had average milk production 2.875, 2.80, 2.35 and 2.0 liters. Average quarter milk production with sub clinical mastitis was therefore,

= (293 X 2) + (249 X 2.35) + (199 X 2.8) = 8.17L
Loss per cow/day due to clinical mastitis = 741

$$\frac{\text{Average milk yield per day X number quarters clinically blind}}{\text{Number of cows with at least one blind teat}} = \frac{2.875X54}{34} = 4.566L$$

Total milk production losses in the study animals amounted was ((2.875 X 54 X 240) + (231 X 0.733 X 240)) X4 = 311,590.08 birr /lactation/ year.

Teat Blindness: From 400 dairy cows investigated for mastitis, 34 of them were with 54 blind teats. The average milk production of a teat was 2.875liter per day before teats became blind. The duration of lactation of one dairy cow was 8 months (240 days) on average. So within a year, 2.875X54X240=37,260L of milk (149,040 birr) was lost per year.

Treatment Cost: Treatment cost comprised veterinarian charges, materials like towels and cost of medicines. The commonly used mastitis drugs were multiject, penstrep and oxytetracycline. The cost due to treatment was therefore calculated as:

- Parentral treatment = penstrep and oxytetracycline with an average 12ml/day and 20ml/day with 0.3 birr per milliliter (ml) and with expected 250 -300 kg of cow body weight.

- Cost of intramammary infusion = 16X 561 X 3X = 10,752 birr (16 cost of treatment, 561 treated quarters, 3 days of treatment duration, 4 number of times a cow was at risk).
- Parentral treatment cost = 18 / 100 X 18 X 12 X 0.3 X 4 X 3 = 139.968 birr (18/100 proportion of cows with sub clinical mastitis, 18 treated cows, 12 dose rate /day, 0.3 charge/ml, 3 duration of treatment, 4 risk time in lactation).
- Veterinarians fees = 18 X 100 X 4 =72.00 birr (18 number of case treated, 100 veterinarian fee per cow, 4 risk period in lactation).
- Total treatment cost = cost of intramammary infusion +cost of parentral antibiotics + cost of veterinarians fee / case = 10752 + 139.968 + 7200 = 18,091.968 birr (1,066.2 birr per cow).

Withdrawal Losses: Even though most dairy farmers do not discard milk due to mastitic pathogens, one dairy farm was found to be milk discarding. In this dairy farm, 17 dairy lactating cows were screened and 13 of them were sub clinically mastitic and these sub clinically affected cows were recommended to be treated. In this manner, the cow's milk was discarded following treatment.

The average cow's milk production was 8L per day. Therefore, the amount of milk discarded was 8 X 13 X 5 = 520 liter (8L of milk produced per day, 13 numbers of cows treated and 5 times of withdrawal). This indicated 520L X 4 birr per litre = 2080 birr loss to the farm in that period.

Total loss due to mastitis was therefore calculated as:

- Total loss = cost of treatment + cost of veterinarians + withdrawal losses.
- 76.5 / 100 X 13 X 12 X 0.3 X 3 = 140.15 birr (76.5/100 proportion of cows with subclinical mastitis, 13 cows treated 12 dose rated / day, 0.3 charge/ml and 3 duration of treatment).
- Cost of veterinarians = 1300 birr.
- Cost of parentral antibiotics = 0.3X 12 X 13 X3 =140.0 birr (0.3 charge/ml, 12 dose rate, 13 treated cows, 3 duration of treatment).
- Total loss = 140.15 + 1300 + 140.0 = 1580.15 birr per cow/ lactation

DISCUSSION

This study was carried out to determine the prevalence and economics of mastitis in and around Sebeta dairy farms. A total of 400 crossbred cows in 6 commercial and 15 smallholder farms were investigated cross-sectionally. From these, 56 (14%) were heifers out which 28(50%) were mastitis positive and the rest 344 (86%) were cows out of which 237(68.9%) were mastitis positive.

All study animals were also investigated for the prevalence of udder tick and from these 400 animals, 10 cows with udder tick were tested for mastitis out of which 9 (90%) were mastitic positive. In addition to this, the animals were investigated for teat lesion and 11 of them were with teat lesion out of which 7 (63.6%) were mastitis positive. From this we can say that parity (production level), udder tick and teat lesion have their own role in predisposing the animals to mastitis in addition to other management factors.

As it is indicated above the prevalence of mastitis in cows with udder tick dairy cows and teat lesion indicates that both udder tick and teat lesion can be considered as other predisposing factors to mastitis. Therefore, the statistically insignificance of the two could be due to the small sample size of the animals with these two factors.

From total examined animals,66.25% of them had abnormalities in their udders, teats and milk as evidence of mastitis. This finding closely agrees with those of Biru [11] who had reported the prevalence 61 and 67.4% respectively. But great variation is observed from Takele [12], Tesfaye[13], Mungube[14] and Tadesse [8] who had reported a prevalence of 53, 53.3, 52.2 and 50.3% respectively. On the other hand this rate is relatively higher than the finding of Demelash [15], Berhanu[16] and Gizat[5] who had reported prevalence of mastitis as 33.3, 38.5 and 38.4% respectively.

In this study the prevalence of subclinical mastitis at a cow level was (57.75%) which is higher than the finding of Shirmeka [17], Managube[14] and Tadesse[8] who had reported 40.95,46.6 and 43.4% respectively. The present finding is also higher than that reported by Berhanu[16], Bishi [18] and Gizat [5] who had reported 31.7, 34.30, 34.4% respectively. Mastitis is complex disease and the difference results from different investigations at different times indicates difference in management system, climate, awareness of mastitis and variation in resistance between breeds and other risk factors between farms.

The prevalence of clinical mastitis investigated as 8.5% is comparable with that of Berhanu[16],Mangube [14] and Tadesse [8] who had reported 7.8, 6.6 and 6.9% respectively.

A split udder investigation to determine losses due to subclinical mastitis revealed that on average, a quarter produces 2.875 liters /milking / hence a total of 11.5 liter per cow per day. This is higher compared to Mekonen[19],

Mangube[14] and Tadesse [8] who had reported 8.8, 6.56 and 7.8 L respectively. Quarters with CMT scores 0,+1,+2 and +3 yielded 2.875, 2.8,2.35 and 2.0L Per milking respectively, which varies greatly from Mangube [14] and Tadesse [8] who had reported 0.9188,0.861and 0.616L and 1.043, 1.033, 0.9286 and 0.741L / milking respectively.

Mastitis loses were estimated to be 291468.55 birr per lactation per year which varies greatly with that of Tadesse [8] who had reported 33973.68 birr per lactation per year. This loss could be reduced or totally avoided with proper mastitis control and prevention measures. Milk production losses contributed to 93.25% of the total losses, which is higher than Mangube [14] and Tadesse [8] who had reported 17.1 and 12.8% respectively.

Treatment costs including drug and veterinary charge accounted for 6.21% and withdrawal losses were 0.54% which is incomparable with what was reported by previous study [8] being 31.5, 9.3 and 3.3 % respectively. These all losses were without including loss due to culling which could account for more than half of the total loss. This is due to lack of record keeping in the farms whether they are commercial or smallholder.

The findings of the present study revealed that potential risk factors of mastitis namely age and parity were found to have a statistically significant association with CMT results ($P<0.05$). The overall prevalence of sub clinical mastitis was 57.75% and 46.1% at cow and quarter level respectively. Several potential risk factors, such as exposure to ticks and lesion of udder were found to be associated with mastitis. Therefore, routine test of dairy cows should be performed to identify sub clinical cases, hygienic standards like use of pre and post milking dipping using detergents like soap.

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