Bovine Mastitis and its Selected Risk Factors in Smallholder Lactating Dairy Farms in Hawassa, Ethiopia

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Abstract: A cross sectional study was conducted in Hawassa town, SNNPR State to determine the overall mastitis prevalence and identify the role of some potential risk factors in 183 randomly selected smallholder lactating dairy cows of 53 Holstein Friesian, 113 Holstein-indigenous zebu cross and 17 indigenous zebu breeds. Clinical mastitis prevalence was determined through examination of abnormalities of milk, udder or cow. Indicator paper test was used for determination of subclinical mastitis prevalence. Of the total 183 lactating smallholder dairy cows examined for bovine mastitis 9 (4.9%) had clinical mastitis, while 56 (30.6%) subclinical mastitis. Out of 9 (4.9%) clinical mastitis, 9.43 & 3.53% occurred in high grade Holstein and Holstein-indigenous zebu, respectively but indigenous zebu breeds was found not affected. Subclinical mastitis at cow level based on indicator paper test was significantly higher (32.07%) in Holstein, than (30.9%) in cross breed and (23.5%) in indigenous zebu (P<0.05 value); Quarter level subclinical mastitis prevalence based on indicator paper test was (32.07%), (30.2%) and (23.5%), in Holstein, Holstein-indigenous cross breed and indigenous zebu, respectively. Among the potential risk factors considered, breed (X²=17.3, P< 0.05), presence of teat lesion and/or tick infestation (X²= 7.73, P< 0.05), stage of lactation (X²=13.8, P< 0.05), and parity number (X²=19.4, P< 0.05), had significant effect on the prevalence of subclinical mastitis. Considering 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 · Clinical mastitis · Risk factors · Subclinical mastitis

INTRODUCTION

Ethiopia has the largest livestock population in Africa with an estimated 35 million tropical livestock units (TLU) including 31 million cattle, 42 million sheep and goats, 7 million equines [1]. Within the country south nation, nationalities, people’s regional (SNNPR) state has got significant amount of livestock population contributing in the economic growth. With the zone level in the region, Hawassa City, Sidama zone of SNNPR regional State are known in livestock population having 1,573,318 cattle, 183,462 goats, 221,505 sheep, 49,150 horses, 48,653 asses and 1,196,506 poultry [2].

There are several types of diseases which potentially infect and affect the wellbeing of livestock population among which mastitis is the common and costly disease causing loss in milk yield, treatment cost for dairy farmers and mastitis as well considered as the most complex disease because of its multifactorial causation [3]. Despite of many years of research mastitis remains the most economically damaging disease for the dairy industry worldwide and it has also public health importance by serving as a vehicle in the spread of diseases like tuberculosis, streptococcal food poisoning and brucellosis [4]. The economic loss due to both clinical and subclinical mastitis per lactation in Ethiopia is 270 ETB [5]. According to the reports of FAO [6] the total annual national milk production in Ethiopia ranges from 797,900 to 1,197,500 metric tons of raw milk. Out of total national milk production, between 85 and 89% is contributed from cattle. [7] reported a mastitis prevalence rate of 85.8 and 81.2% using CMT and SCC, respectively. According to the same report, out of the CMT positive animals, 37.2% did harbor a causal agent for mastitis. Mastitis as a disease has received little attention in Ethiopia, especially...
the subclinical form. Efforts have only been concentrated on the treatment of clinical cases. Very limited researches have been done concerning on the status of Bovine mastitis in Hawassa City unlike that of other areas of the country. The study area is one of the most known potential dairy areas in the country, where smallholder dairy production is practiced. Therefore, this study was designed in line with the following objectives:

- To estimate prevalence of Bovine mastitis in smallholder lactating dairy cows of Hawassa town, Sidama Zone.
- To assess mastitis occurrence with some selected potential risk factors.

**MATERIALS AND METHODS**

**The Study Animals:** The study animals that had been sampled were lactating smallholder dairy cows of different herds with different caving history and with different management conditions. The animals in this study were high grade Holstein Friesian, predominantly Holstein-indigenous zebu cross breeds and indigenous local zebu lactating cows in smallholder farms. The average herd size was 5.5 lactating cows.

**Study Methodology:** A cross sectional type of study was conducted to determine the prevalence of bovine mastitis. The study was carried out in 183 randomly selected smallholder lactating dairy cows. Both clinical and subclinical mastitis prevalence was determined cross-sectional at cow and quarters level based on clinical examination for clinical mastitis and Indicator Paper Test (IPT) for subclinical mastitis. Sample size was determined according to Thrusfield [8] at 95% CI, 5% precision and with expected prevalence of 38% [9]. A total of 183 smallholder lactating dairy cows; 17 indigenous local zebu, 113 Holstein Friesian-indigenous Zebu cross and 53 high grade Holstein, relatively under the same management were included in the study.

**Clinical Examination for Clinical Mastitis:** To determine prevalence of clinical mastitis udder was examined for visible abnormalities, symmetry, size, consistence, presence of lesions and/or ticks. Milk was examined for any change using strip cup in color, consistency and for grossly visible changes. Clinical mastitis was recognized by some pathology in udder, which is manifested by swelling, pain, redness and heat in case of acute mastitis. Whereas, hardening of the udder, blockage of the teats, atrophy or fibrosis and abscess formation were manifested in chronic mastitis. Acute mastitis was also recognized by changing in milk color, presence of flaks and clots.

**Indicator Paper Test:** To determine prevalence of subclinical mastitis the milk samples were screen using indicator paper. It was carried out by adding a drop of milk sample to the test paper and observing the possible color change of the paper. If yellow color of the paper is not change and remains as it is or shows slight change, such samples were considered as negative. A change of color from yellow to green or bluish green was noticed as positive.

**Risk Factors:** Semi structured questionnaire was compiled to evaluate the effect of sleeted potential risk factors on the occurrence of mastitis. Risk factors considered at cow attributes were breed (high grad Holstein-Friesian, Holstein indigenous zebu cross breed and indigenous zebu breeds), parity, stage of lactation (early, middle and late), and the presence/absence of tick or lesion or udder injury on udder skin or teat and previous mastitis history. The stage of lactation was categorized into three levels as 1 – 120 days postpartum (early lactation), 121 – 240 days (middle lactation) and days greater than 240 (late lactation) and similarly parity was categorized as ≤ 3 calves birth, 4-7 calves and > 7 calves.

**Questionnaire:** A structured questionnaire was prepared and information regarding farm attributes and cow attributes was collected. The cow attributes include breed, age, parity, tick infestation, udder injury, lactation stage, previous history of mastitis and other relevant information related. Farm attributes include number of lactating cows, housing system, farm hygiene, hygienic practices before, during and after milking, tick control practice and previous history of mastitis in the farms levels. Stage of lactation was categorized early (1st to 4th month), mid (4th to 8th month) and (8th month to the beginning of dry period), similarly parity was categorized as few (calves with ≤ 3), moderate (4 – 7 calves) and (> 7 calves).

**Data Analysis:** Prevalence of bovine mastitis related to specific risk factors was determined as the proportion of affected cows out of the total examined [8]. Effects of specific variables including breed, age, parity, tick infestation, udder injury and or teat injuries, stage of lactation, and previous history of mastitis were
investigated using chi-square and these were calculated to assess the risk levels of categories under each risk factor and analyzed using stata 7 statistical software package. In all chi-square test applications, probability of $P<0.05$ was considered statistically significant.

RESULTS

In this study a total of 113 Holstein Friesian and indigenous zebu cross breed, 53 high grade Holstein Friesian and 17 indigenous zebu cows were investigated in 25 smallholder dairy farms, each farm held a minimum of 6 and a maximum of 23 lactating cows. Both clinical and subclinical mastitis prevalence was determined cross-sectional at cow and quarter level based on clinical examination for clinical mastitis and indicator paper test for subclinical mastitis. Invariably all the smallholder dairy farms under the study practiced hand-milking. Prevalence of bovine mastitis varied significantly among the different risk factors associated with the occurrence of mastitis under this study and the results on the prevalence and risk assessments were given independently.

Prevalence of Clinical and Subclinical Mastitis: Among 183 lactating cows examined in smallholder dairy farms in Hawassa town, SNNPR State for Bovine mastitis 9 (4.9%) had clinical mastitis, while 56 (30.6%) subclinical mastitis cases. Out of 9 (4.9%) clinical mastitis, 9.43% occurred in high grade Holstein and 3.53% Holstein indigenous zebus cross and none clinical mastitis was observed in indigenous zebu breeds. Based on indicator paper test subclinical mastitis prevalence was 30.6% at cow level (Table 1).

<table>
<thead>
<tr>
<th>Observation level</th>
<th>Clinical mastitis</th>
<th>Subclinical mastitis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. examined</td>
<td>Positive case</td>
</tr>
<tr>
<td>Cow level</td>
<td>183</td>
<td>9</td>
</tr>
<tr>
<td>Quarter level</td>
<td>732</td>
<td>20</td>
</tr>
</tbody>
</table>

Table 2: Prevalence and Distribution of udder infections across the four quarters in dairy cows

<table>
<thead>
<tr>
<th>No. of quarter examined</th>
<th>Clinical mastitis</th>
<th>Subclinical mastitis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Prevalence</td>
<td>Prevalence</td>
</tr>
<tr>
<td>No. of quarter affected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front left</td>
<td>3</td>
<td>15%</td>
</tr>
<tr>
<td>Front right</td>
<td>6</td>
<td>30%</td>
</tr>
<tr>
<td>Hind left</td>
<td>5</td>
<td>25%</td>
</tr>
<tr>
<td>Hind right</td>
<td>6</td>
<td>30%</td>
</tr>
</tbody>
</table>

Risk Factors Associated with Sub-clinical Mastitis: The prevalence of subclinical mastitis was significantly higher in high grad Holstein-Friesian (32.07%) than Holstein indigenous zebu cross bred (30.9%) and indigenous zebu (23.52%) ($X^2=17.3$, $p<0.05$), in cows with a lesion and/or tick infestation on the skin of the teat and/or udder than in cows without this factors ($X^2=7.73$, $p<0.05$), cows with high number of calves (4-7) (58.5%) than those of cows having less (1-3) calves (22.5%) ($X^2=19.4$, $p<0.05$), in late lactation (50.0%) than mid lactation (23.37%) and early lactation (21.2%) ($X^2=13.8$, $p<0.05$). In the present study from selected potential risk factors breed ($P<0.05$), stage of lactation ($P<0.05$), parity ($P<0.05$), presence of tick and/or udder injuries ($P<0.05$) have statistically significant effect (Table 4), but others selected risk factors have no significant effects in the prevalence of sub-clinical mastitis ($P>0.05$).
Table 3: Prevalence of Sub-clinical Mastitis with Associated Risk Factors

<table>
<thead>
<tr>
<th>Breeds</th>
<th>Stage of lactation (days)</th>
<th>Parity no.</th>
<th>Lesion/udder injuries</th>
<th>Tick infestation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total no. examined</td>
<td>53</td>
<td>113</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Total no. infected</td>
<td>17</td>
<td>35</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Prevalence (%)</td>
<td>32.07</td>
<td>30.9</td>
<td>23.5</td>
</tr>
</tbody>
</table>

HF = Holstein Friesian
HIZ = Holstein indigenous Zebu cross
Z = indigenous zebu
+ = present
- = absent

Table 4: Risk Factors of Bovine Sub-clinical mastitis

<table>
<thead>
<tr>
<th>Variables</th>
<th>X2</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breed</td>
<td>17.3</td>
<td>0.05</td>
</tr>
<tr>
<td>Stage of lactation</td>
<td>13.8</td>
<td>0.001</td>
</tr>
<tr>
<td>Parity</td>
<td>19.42</td>
<td>0.01</td>
</tr>
<tr>
<td>Presence of tick and/or udder injury</td>
<td>7.73</td>
<td>0.005</td>
</tr>
</tbody>
</table>

DISCUSSION

This study has given a due attention to determine the prevalence and its risk factors assessment for bovine mastitis. The mean prevalence of mastitis of 35.5% in cows and 16.94% in quarters is lower than that recorded by is lower than that recorded by Radostits and Colleagues [10] that, in most countries and irrespective of the cause, the prevalence rate of mastitis is about 50% in cows and 25% in quarter. The overall prevalence of clinical mastitis in this study was 4.9% which is comparable to the reports done in different dairy farms, in Diredawa Autonomous and East Hararge Administration Regions (3.54%) [11], in and around Gondar (4.4%) [12]; in and around Mekele (6.55%) [13]; in three states dairy farms around Addis Ababa (7%) [14]; in Bahir Dar (3.9%) [15]; and in central high lands of Ethiopia (6.6%) [5]while it islower in the reports done in Welayta Sodo, Southern Ethiopia (15.1%) [16]; in and around Sebete in Ethiopia (16.11%) [17]; in dairy farms in Dire-Dawa Administrative Council and Eastern Hararghe Zone (19.8%) [18]; in two major states owned dairy farms at Rapi and Debrezeit, Ethiopia (21%) [19]but it isa far lower in the research finding in selected areas of Southern Ethiopia (37%) [20].

Subclinical mastitis was high in all breeds compared to clinical mastitis. The prevalence of subclinical mastitis at cow level based on indicator paper test in the present study (30.6%) iscomparable to the reports done in different dairy farms: in Bahir Dar (34.4%) [15]; Bishi [21] who reported (34.3%); Abainehe and Sintayehu [22] (34.6%); Sori et al. [23] (45.4%) in and around Sebeta . But the present finding is by far lower than the reports of Kerro and Tarekegn [20] in local, Friesian and Jersey cows in Ethiopia (63%); Machang and Muyungi [24]in Tanzania (67%) and Kivaria et al. [25] in lactating cows in smallholder farms in Tanzania. Mastitis is a complex disease and the difference in results could be due to variations in herd size, management practices, proportion of exotic gene inheritance, agro-climates and other risk factors might have contributions to the observed differences in prevalence rates of mastitis among the finding of the various workers.

The significant difference between the high grad Holstein-Friesian, Holstein indigenous zebu crossbred and indigenous zebu may be associated with their high milk yield. Radostits et al. [26]stated that high yielding cows are more susceptible to mastitis than low-yielding ones. This may be due to the ease with which injuries are sustained in large udders, so that foci for the entrance of pathogens are created, and stress associated with a high milk yield may upset the defence system of the animal [4]. On the other hand, this difference between breeds may be due to other uncontrolled factors, such as management, rather than to a true breed difference, since cows in this study were not all under the matching conditions. Further study is required to evaluate the breed difference.

The significant effect of stage of lactation on prevalence of subclinical mastitis in this study was (21.2%), (25.37%) and (50.0%) in early, mid and late lactation, respectively, also reported by Nesru [27] and Mungube et al. [5] and Kerro and Tareke [20] and Biffa et al. [28] 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, parity and breed of the sampled animals.
Animals with skin lesions on their teats and/or udder had a high prevalence of mastitis, possibly because of colonization of the lesion by pathogens [29], found, in the Kiambu district of Kenya, that mammary gland quarters with teat lesions were 7.2 times more likely to have a positive CMT and 5.6 times more likely to have bacterial organisms isolated from them than those without any teat lesions. In this study, the prevalence of sub-clinical mastitis was significantly higher in cows with teat lesions. Similar finding were reported by Sori et al. [23], Kerro and Tareke [20] and Biffa et al. [28] where the prevalence of sub-clinical mastitis was significantly higher in cows with teat lesions.

Parity was found a significant influence on the prevalence of subclinical mastitis. Cows with many calves (4-7) were point prevalence of (58.5%), than those of cows having (1-3) calves (22.5%). The risk of subclinical mastitis increases with increasing with parity in this study which agrees with the research finding by Sergeant and Colleagues [30] and by Busato et al. [31], who found that the risks of clinical and subclinical mastitis increase significantly with advancing age of the cow, which approximately to the parity number.

In Ethiopia, the subclinical form of mastitis received little attention and efforts have been concentrated on the treatment of clinical cases [32]. According to Mungube et al. [5] losses associated with sub-clinical mastitis (SCM) in cross-bred dairy cows in the central high land of Ethiopia was found to be US$ 38 for each cow per lactation. Usually Ethiopian farmers specially smallholders are not well informed about the invisible loss from subclinical mastitis [32] and were also true in Tanzanian farmers [25].

CONCLUSIONS AND RECOMMENDATION

Bovine mastitis is the important disease which affects the profitability of the dairy industry, not only the dairy farm business but also the economy of the country would also be affected, just by increasing the cost in different forms as it occurred once. Most research workers showed that on the average the affected quarter suffers a 30% reduction in productivity and affected cow a 15% loss in production. Taking into account these figures the overall cow level 30.6% and quarter level 14.2% prevalence of mastitis in the present study signify the effect of mastitis in Hawassa dairy farming. In this study a significant number of mastitis was subclinical 30.6% compared clinical cases (4.9). The occurrence of mastitis was found to be associated with breed, parity, stage of lactation and presence of teat and/or udder lesions.

In view of these findings the following recommendations were forwarded.

- It is essential that the smallholder dairy owners in the study area should be advised to avoid teat injury, monitor the udder health status regularly and implement control strategies as required.
- Awareness should also be created among smallholder farmers about the economic impact and benefits of controlling mastitis.
- Adequate housing with proper sanitation and regular screening for early detection and treatment, follow up of chronic cases, culling of older cows with repeated attacks should be presented and practiced by the owners.

REFERENCES


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