Applied Journal of Hygiene 3 (3): 45-50, 2014
ISSN 2309-8910

DOI: 10.5829/idosi.ajh.2014.3.3.919

The Occurrence of Bovine Mastitis and Associated Risk Factors in and Around Addis Ababa, Central Ethiopia

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Abstract: A cross-sectional study was done to estimate the prevalence and associated risk factors of bovine mastitis from November, 2009 to June, 2010 in Addis Ababa veterinary clinics. Three hundred forty six lactating cows from one commercial and 14 household were included in the study. These 346 lactating cows were subjected to California mastitis test (CMT), 169(48.8%) were mastitis positive, of which 131(37.9%) were sub-clinically affected and 38(10.9%) were clinically affected signifying the importance of sub-clinical case. California mastitis test (CMT) was conducted on milk samples from individual quarters of 1338 quarters examined for prevalence of clinical mastitis (CM), non-functional or blocked quarters and sub clinical mastitis and revealed that 3.4, 3.5 and 47.8%, respectively. Sub-clinical mastitis had highest relative occurrence on cow basis, prevalence of sub clinical mastitis was 131(37.9%) and was higher in cross bred 113(42.8%) than with that of zebu 18 (21.9%), significantly more sub clinical mastitis occurred in parity two and above 91 (41.4%) than those in first parity 40 (31.7%). Therefore, it was concluded that sub clinical mastitis is highly and widely prevalent than clinical mastitis. As it is economically damaging, the need to establish diagnostic facility to be able to early detect and screen large number of samples in emphasized and further work on identification of causative agent is recommended.

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

INTRODUCTION

In Ethiopia livestock represents major national resource and form an integral part of agriculture production system. The country has the largest livestock population of any African country with estimated greater than 35million cattle [1]. Cow represents the largest population of cattle production of the country; 42% of the total cattle heads are milking cows. However, compared to other countries in Africa, Ethiopia consumes less dairy products. Per capital consumption of milk in Ethiopia is as low as 17kg per head while the average figure for Africa is 26kg per head [2].

Milk and milk products play an important role in human nutrition throughout the world. Consequently, the products must be of high hygienic quality. In less developed part of the world and specifically in the hot tropics, high quality and safe products are most important but not easily accomplished [3].

Among the challenges of diary development in the tropics such as breed improvement, nutrition, management, control of infection, tick born disease, blood and internal parasitic disease; mastitis is considered to be the most frequent and most costly production disease in dairy herds of developing countries as it cause serious wastage and undesirable milk quality [4]. Mastitis is an inflammation of mammary gland by pathogenic bacteria or mycotic pathogens with route of infection most often being through teat canal and can occur as a wide range of clinical cases.

Mastitis could be classified as clinical or sub-clinical. Clinical mastitis usually observed as signs of inflammation such as change of color, redness, pain, swelling etc. Mastitis is a disease that has received a little attention in Ethiopia especially the sub-clinical type [5]. Most dairy farmers normally ignore sub-clinical mastitis which incidentally occurs at a much higher frequency than clinical mastitis, yet it is the worst in terms of lowered

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productivity [6]. The occurrence of mastitis depends on three components which include exposure to microbes, cow defense mechanism, environmental and management factors [7]. The first month of lactation is the most sensitive period for mastitis risk in the cow even in the well managed herds [8].

In Ethiopia, the available information indicates that bovine mastitis is one of the most frequently encountered diseases of dairy cows. According to Lemma *et al.* [9], of the major disease of cross breed cows in Addis Ababa milk shed, clinical mastitis was the second most frequent disease next to reproductive disease. Generally, the prevalence of clinical and subclinical mastitis in different parts of Ethiopia ranges from 1.2 to 21.5% and 19 to 46%, respectively [3, 9].

Using data from the published study, a quarter with sub clinical mastitis lost an average of 17.2% of its milk production. Production losses associated with sub clinical mastitis were estimated at 5.6% in Addis Ababa milk shed. Stratified losses were highest (9.3%) in urban dairy. A total loss of US$38 was estimated for each cow per lactation [10].

Mastitis milk can also pose a threat to human health. With severe clinical mastitis, gross abnormalities of milk are readily observed and the producer discards milk. But with sub-clinical mastitis milk carries bacteria that can cause severe human illness such as tuberculosis and brucellosis. Another public health concern regarding mastitis is antibiotic residues which initiate severe reaction in people allergic to antibiotics and development of antibiotic resistance strains of bacteria [3].

Mastitis especially sub-clinical mastitis is a problem, which threatens farm owners usually in decreasing milk yield irrespective of adequate feed provisions and deworming practices. Several risk factors, such as exposure to ticks and lesions of udder were found to be associated with mastitis [11]. In Addis Ababa except for some preliminary surveys by Hussen *et al.* [5] and Mangube [10], information is currently unavailable on the occurrence of bovine mastitis complex at veterinary clinic level, in which both smallholder dairy farms and individual owners were presented in the clinics for mastitis cases. Hence the study was especially designed to address the general burden and associated risk factors of mastitis in the area.

MATERIALS AND METHODS

The study was conducted from November 2009 to June 2010 in and around Addis Ababa in veterinary clinics.

Study Population: The study population consisted of all dairy cows found in and around Addis Ababa. Majority of the dairy farms in the area are kept under smallholder intensive farms and there are only few large commercial intensive farms. The study animals were all lactating cows presented in the clinics for different reasons and from each conveniently selected household.

Study Design: Prevalence of mastitis was determined cross sectionally from November 2009 to June 2010 in and around Addis Ababa at cow and quarter level based on clinical manifestations for clinical and sub clinical mastitis.

Sample Size Determination and Sampling Strategy: Sample size was determined with an expected mastitis prevalence of 66.3% reported in Sebeta around Addis Ababa [11] at 95% confidence interval and 5% precision level. The following formula was employed to the target sample of milking cows as described elsewhere [12].

$$n = \frac{(1.96)^2 \, P\exp \, (1 - P\exp)}{d^2}$$

where,

n = Required sample size.
1.96 = The value. of Z at 95% confidence interval
Pexp = Expected prevalence of mastitis
d^2 = Desired absolute precision level at 95% confidence interval. Therefore, the required sample size was therefore 346.

Simple random sampling was considered to select the animal, assuming the difference in cluster (households in this study) was minimal when herd size was so small. To select these cows, neither list of lactating cows (sampling frame) nor a house hold was found in the study area. It was difficult to record all lactating cows; therefore, the household or owners list was taken as a sampling frame.

Data Collection: Questionnaire was administered to evaluate the effect of potential risk factors on the occurrence of mastitis. Data on each sampled cow was collected in a properly designed format. Risk factors such as breed, parity, stage of lactation and hygienic condition were recorded.

Collecting Milk Samples: The udder and specially teats were cleaned and dried before sample collection. Each teat end was scrubbed vigorously with a pledged of cotton moistened with 70% ethyl alcohol. The first 3-4 streams of milk were discarded then approximately 2ml of milk was collected from each quarter and placed in each of four shallow cups in the CMT paddle.

CMT Screening: California mastitis test (CMT) was performed at the time of milking and the procedure was carried out as described elsewhere [6]. This test identifies sub-clinical cases and also clinical cases which are not overtly clear.

Data Management and Analysis: Data obtained from the lactating cows and laboratory results were coded and uploaded into Microsoft Excel 2010 spreadsheet computer program and analyzed using STATA version 11.0 for Windows (Stata Corp. College Station, USA). Univariate logistic regression was performed utilizing the same program for the first set of questions included potential risk factors. Odd ratio and 95% CI were computed and the 95% confidence level was used and results were considered significant at $P < 0.05$

RESULTS

Prevalence and Associated Risk Factors: A total of 346 lactating cows (82 local and 224 crossbreed) in one commercial and 14 private small holder dairy farms in and around Addis Ababa milk shed were investigated from November 2009 to June 2010 cross sectionally to determine the magnitude of mastitis. Out of 1338 quarters examined 48(3.5%) were blocked. Clinical prevalence at cow level was 12.9% in cross breed and 4.8% in local zebu. Risk factors related to type of breed and parity number and breed, lactation stage and parity number were significantly associated with the infection rates of clinical mastitis and sub clinical mastitis, respectively ($P< 0.05$) (Table 1).

A total of 1384 quarters were considered in this study and 48 quarters (3.4%) of them were blind and non-functional. The functional quarters were 1335(96.5%) from which 638(47.8%) quarters were sub-clinically affected (Table 2). The result of each quarters indicated that 202, 257, 226 and 650 quarters were strong positive (+3), distinct positive (+2), weak positive (+1) and negative (0) respectively (Table 3).

Three hundred forty six cows with 1384 quarters were investigated and 38 cows with 48 (3.4%) teats were clinically positive. The over prevalence of clinical mastitis was 3.4% and 38 (10.9%) at quarter and cow level respectively. One hundred one (37.9%) of the cows were sub-clinically positive at the time of screening, 49 teats (3.5%) were blind. The overall prevalence of sub-clinical mastitis was 47.8 and 37.9% at quarter and cow level respectively (Table 4).

Table 1: Presence of clinical and subclinical mastitis at cow level in relation with breed, parity and lactation stage in and around Addis Ababa

Risk factors	Prevalence (%) of clinical mastitis	OR (95% CI)	P-value
Breed			
Local	4.8%	1	
Cross	12.8%	2.8(1.0, 8.30)	0.04
Lactation stage			
Early	7.8%	1	
Middle	9.0%	-	
Late	16.2%	1.5(0.78, 3.13)	0.46
Parity number			
One	7.14%	1	
Greater than one	13.2%	2(0.9, 4.40)	0.08
Risk factors	Sub clinical mastitis	OR (95% CI)	P-value
Breed			
Local	21.9	1	
Cross	42.8	2.42(1.40, 4.30)	0.03
Lactation stage			
Early	34.3	1	
Middle	33.0	1.2(0.80,2.34)	
Late	46.8	1.8(1.20, 3.51)	0.04
Parity number			
One	31.7	1	
Greater than one	41.4	2.5(1.51, 3.42)	0.02

Table 2: Prevalence and distribution of udder infections across the four quarters in and around Addis Ababa

Quarters affected	Clinical mastitis	Blocked	Sub clinical mastitis	Negative
Left forequarter (%)	20.8	24.5	23.8	26.5
Right forequarter (%)	27.1	22.4	25.7	24.3
Left hindquarter (%)	31.3	24.5	25.5	24.0
Right hindquarter (%)	18.8	28.6	24.9	25.2
Prevalence rate (%)	3.4	3.5	47.8	46.9

Table 3: Blind and clinical mastitis scores of each quarter of lactating dairy cows in and around Addis Ababa

	Right forequarter (%)	Left forequarter (%)	Right hindquarter (%)	Left hindquarter (%)
Negative (0)	45.7	49.7	47.4	45.1
Weak positive (1)	14.5	16.8	16.2	17.9
Distinct positive (2)	17.9	18.2	18.2	19.9
Strong positive (3)	18.8	11.8	14.2	13.6
Blocked	3.2	3.5	4.0	3.5

Table 4: Prevalence of mastitis at cow and quarter level in and around Addis Ababa

	No. of tested	Positive
Clinical		
Cow level	346	38(10.9)
Quarter level	1384	48(3.4)
Subclinical		
Cow level	346	131(37.9)
Quarter level	1335	638(47.8)
Overall		
Cow level	346	169(48.84)
Quarter level	1384	686(49.5)

DISCUSSION

A total of 346 cows, 82 lactating local and 224 crossbreds from one commercial and 14 private smallholder farms were investigated cross-sectionally.

Clinical prevalence at cow level was 34(12.8%) in crossbred and 4(4.8%) in local zebu. The clinical prevalence in crossbred in this study is higher than that of Aklilu [11], Berhanu [13] and Tadesse [14] who had reported 8.5, 7.8 and 6.9%, respectively. However, the present finding is lower than that reported by Workineh *et al.* [15], (25%) in Addis Ababa, Ethiopia. Mastitis is a complex disease and the difference in result could be due to difference in management system between the farms. Subclinical mastitis was high in both breed compared to clinical mastitis. The prevalence of sub clinical mastitis in crossbred at cow level based on CMT in the present study was 42.8% which is similar to the findings of Mangube [10], Tadesse [14] and Shirmeka [16] who had reported 46.6, 43.4 and 40.95%, respectively. However, the present finding is higher than that of Gizat *et al*. [3] and Berhanu [13] who had reported 34.4 and 31.7%, respectively.

One hundred sixty nine (48.84%) of the examined animals had abnormalities in their udders, teats and milk as evidence of mastitis. This finding closely agrees with those of Mangube [10], Tadesse [14], Takele [17] and Tesfaye [18], who had reported a prevalence of 52.2, 50.3, 53 and 53.3%, respectively. But great variation is observed from Aklilu [11], Biru [19] and Bedane *et al*. [20] who had reported 66.25, 61and 59.1% %, respectively.

In this study as well as in other similar studies, overwhelming cases of mastitis were subclinical compared to that of clinical mastitis in both breeds [15, 21]. In Ethiopia, the subclinical form of mastitis receives little attention and efforts have been concentrated on the treatment of clinical cases [5], while the high economic loss could come from sub clinical mastitis. According to Radostits *et al*. [22], infected quarters lead to 15% of reduction in milk yield. Usually Ethiopian farmers especially smallholders are not well informed about the invisible loss from sub clinical mastitis [5] since dairying is mostly a side line business in these farms.

Among the risk factors considered to have an effect on the occurrence of mastitis, breed was found to be statistically significant ($P < 0.05$). The odd of occurrence of mastitis was two times more likely in cross breeds compared to local zebu. Increase in milk yield from genetic selection may be accompanied in genetic susceptibility in mastitis [23]. Therefore, the lower prevalence in local zebu cows in this study could be associated with difference in genetic controlled physical barriers like streak canal sphincter muscle, keratin in the teat canal or shape of teat end where pointed teat ends are prone to lesion [24]. In addition to physical barrier, difference in occurrence of mastitis in these breeds could arise from difference in cellular immunity [25].

In the present study, parity number one and greater than two and late lactation stage were also found to increase occurrence of mastitis significantly ($P<0.05$). According to Erskine [25] primiparous cows have more effective defense mechanism than multiparous cows. The prevalence of sub clinical infection increases as the stage of lactation progresses. These infections are generally the result of contagious mastitis and caused by an inability of mastitis control rather than a physiologic effect.

CONCLUSION

Mastitis especially sub-clinical mastitis is a problem, which threatens farm owners usually in decreasing milk yield irrespective of adequate feed provision and deworming practice. Several risk factors such as breed, parity number and lactation stage and farm hygiene were found to be associated with mastitis.

ACKNOWLEDGEMENT

We would like to thank all staff members of Aklilu Lemma Pathobiology Institute and administrators of Sholla and Akaki zonal veterinary clinics who allowed us to carry out our research and for their positive attitude

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