Short communication

Prevalence and risk factors of bovine mastitis in Ambo town of West Shewa Zone, Oromia, Ethiopia

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Abstract

A cross-sectional study was conducted to estimate the prevalence and associated risk factors of mastitis in dairy cows from November, 2012 to July, 2013 in Ambo town of West Shewa Zone, Oromia Regional State. Thorough clinical examination was made on all lactating cows for evidence of signs of clinical mastitis followed by collection of milk sample for examination of gross changes of milk secretion and screening using California Mastitis Test (CMT). Mastitis was categorized as clinical if lactating cows exhibited clinical features of mastitis, or subclinical based on degree of coagulation up on examination using CMT. A total of 151 dairy cows were selected from all volunteer dairy farms in Ambo town of West Shewa Zone of Oromia region state. Sixty three (41.7%) cows had mastitis, of which 9.9% (15/151) were clinical and 31.8% (48/151) were subclinical mastitis cases. The quarter level prevalence was 44.4% (268/604), comprising 9.3% (56/604) clinical and 31.8% (198/604) subclinical forms of mastitis. In addition, 5.5% (33/604) of teats were found to be blind up on clinical examination of udder and teat. The Chi-square (χ^2) analysis of intrinsic risk factors revealed significantly ($P<0.05$) higher prevalence of mastitis in crossbred cattle (47.2%) than indigenous (15.4%), in cattle above 7 years (75%) than less than 2-6 years of age (28%) and cows given more than 4 calves (81.3%) than those with less than 4 calves (31.1%) irrespective to their lactation stage. There was also significantly ($P<0.05$) higher mastitis prevalence in larger (46.6%) than smaller herds (24.2%) and among the farming systems in semi-intensive (47.1%) and intensive (42.3%) than extensive (8.1%) management system. The present study indicated higher prevalence of mastitis linked with several risk factors. Thus, early diagnosis and regular screening of cows for subclinical mastitis together with treatment of clinical cases are of paramount importance. Moreover, control and prevention strategies should be designed and implemented

with great emphasis given to risk factors to reduce bovine mastitis and its impact on milk production and food security.

Keywords: Ambo town, CMT, Dairy Cows, Mastitis, Prevalence, Risk factors

Introduction

Mastitis (inflammation of mammary gland) causes a great deal of loss or reduction of milk yield to influence the development of dairy industry. It is a complex disease of multi-factorial etiology caused by a variety of microorganisms including bacteria, fungi, algae, etc. The majority of mammary infections are caused by bacteria namely Staphylococci, Streptococci and Enterobacteriacae. Organisms such as coagulase negative staphylococci (CNS), environmental streptococci, *Mycoplasma* species, and *Serratia* spp. are increasingly implicated as emerging pathogens causing mastitis (Radostits *et al.*, 2007). Mastitis can be classified as clinical and subclinical. Clinical mastitis is characterized by change in the morphology of the udder, chemical and physical changes in the milk, while the subclinical form is without any noticeable manifestations of inflammation. Subclinical mastitis is more common than the clinical mastitis and causes the greatest overall losses in most dairy herds (Eriskine, 2001).

Several scholars agree that mastitis is one of the most costly diseases of dairy industry throughout the world. It is estimated that on average an affected quarter suffers 30% reduction in productivity and an affected cow losses 15% of its production for the lactation (Bartlet *et al.*, 1991; Radostits *et al.*, 2007). The economic implication of bovine mastitis derives from the high costs of treatment and diagnosis, loss of milk production, early culling and cost of control program in clinical and subclinical cases. A large proportion of mastitis is not detectable only by clinical examination of the udder and milk that poses economic loss from decreased production only, which is difficult to estimate the economic losses (Mihaela *et al.*, 2009). In addition, the bacterial contamination of milk from affected cows may render it unsuitable for human consumption due to zoonosis, food poisoning and antibiotic residue in the milk following mastitis (Radostits *et al.*, 2007).

In Ethiopia, even if it is not well established, several studies in various parts of the country were conducted on bovine mastitis (Hundera Sori *et al.*, 2005; Kifle Argaw and Tadelle Tolosa, 2008; Gizat Almaw *et al.*, 2009; Birhanu Mekibib *et*

al., 2010). However, more research outputs are needed on the epidemiology of the disease in many areas of the country including Ambo in order to support the control and prevention strategies of this economically important disease. Bovine mastitis is one of the diseases the country's dairy farm personnel, particularly Ambo district livestock experts and dairy owners complain for its being the cause of culling and reduction of milk production. Currently there is a growth of modern dairy farming in urban and peri-urban areas of major towns in Ethiopia. Moreover, the milk production in Ethiopia is expected to increase more rapidly in response to the fast growing demand for milk and milk products resulting from increasing human population in urban areas, and rising consumer income (GOE, LMP, 2007). Thus, it is necessary to have epidemiological information about mastitis and factors associated with udder infection so as to improve dairy production and uphold quality of milk for consumers. Therefore, the objectives of the present study were to estimate prevalence of the clinical and subclinical mastitis and identify potential risk factors in dairy cows in Ambo town.

Materials and Methods

Study area

The study was carried out in Ambo town of West Shewa Zone, Oromia Regional State from November, 2012 to July, 2013. Ambo town is the administrative center of the Zone of West Shewa located 114 km west of Addis Ababa at latitude of 8°59′N 37°51′E and longitude of 8.983°N 37.85°E. The elevation of Ambo town ranges from 1900 to 2275 meters above sea level. Its temperature ranges from 19^0C to 29^0C with an average of annual temperature of 22^0C and the average annual rain fall of about 900 mm. The number of cattle in the area is estimated around 133,202 (CSA, 2003).

Study animals

Study animals consisted of were dairy cows including cross breed and indigenous zebu cows. The *Horro* dominant indigenous breed in the area followed by short horn highland breed and is managed under extensive system. Most of the crosses in the area are the hybrids of these indigenous breed and Holstein-Friesian and are reared either under extensive, intensive, or semi intensive system.

Study design and sample size determination

A cross-sectional study was used to screen mastitis in lactating dairy cows. The sample size was determined according to the formula given by Thrusfield (2005) by assuming the expected prevalence to be 74.4% (Zeryehun Tesfahowot *et al*., 2013) and 95% statistical confidence level at 5% absolute precision. Accordingly 290 lactating cows were intended to examined, however only 151 lactating cows were included in the study due to few number of lactating dairy cows and unwillingness of some dairy farm owners in the town. In general, 25 dairy farms of which 23 were small-holders (owning <10 cows) and 2 were from medium sized (owning>10 cows) owned by volunteer owners were included in the study. The udder and teats of all lactating cows in selected farm were clinically examined and milk samples were collected for CMT test.

Data collection

Data collection format was prepared and used to record age, breed, parity, and lactation stage of cows at the same time while milk samples were taken. Age of the animals was determined based on birth records and dentition (Payne, 1990) and grouped as young adults (2 to 6 years), and adults/old (≥7years). Stage of lactation was categorized as early (<5thmonth), and late (>5th month). Parity was also categorized as few (with 1-4 calves), and many (≥5 calves). Information on extrinsic factors such as management system (as extensive, intensive and semi-intensive), herd size (as <10 cows and >10 cows), and education status (as illiterate and literate) was also gathered.

Clinical examination of udder

The udders were carefully inspected followed by through palpation to detect possible fibrosis, inflammatory swellings, visible injury, tick infestation, atrophy of the tissue, and swelling of supramammary lymph nodes. The size and consistency of mammary quarters were checked for the presence of abnormalities, such as disproportional symmetry, swelling, firmness, and blindness. Viscosity and appearance of milk secretion from each mammary quarter were examined for the presence of clots, flakes, blood, and watery secretions (Demelash Biffa *et al*., 2005).

California mastitis test (CMT)

California mastitis test (CMT) was performed at the time of milking and the procedure was carried out as described elsewhere (Quinn *et al*., 1999). This test identifies sub-clinical cases and also clinical cases which are not overtly clear. From each quarter of the udder, a squirt of milk was placed in each of the cups on the CMT paddle and an equal amount of 3% CMT reagent was added to each cup and mixed well. The result of CMT was based on the nature of coagulation and viscosity of the mixture which show the presence and severity of the infection respectively (Harmon, 1994). Mastitis detection was made based on CMT result for subclinical cases. Accordingly, the degree of coagulation was graded as (-) negative, '+' (Slightly positive), '++' (Moderately positive) and '+++' (Highly positive). Results graded above slightly positive were all considered as CMT positive. In addition to CMT result, milk with pus flakes, clots, or blood-tinged watery secretion, yet no visible or palpable changes in mammary quarters, and acute mastitis with signs of inflammation and or systemic involvement were diagnosed as clinical mastitis.

Data management and analysis

Data entry and management was made using Microsoft Excel 2007 while data analysis was carried out using SPSS-17 Software. Descriptive statistics was performed to summarize the prevalence of mastitis and blind teat. The Chi-square (χ^2) test was used to assess the association of potential risk factors with prevalence of mastitis. In all the analyses, confidence level of 95% and significance level of $\alpha \leq 0.05$ were used.

Results

Over all prevalence of mastitis

Of the total 151 examined lactating cows, 63 cows (41.7%) cows were found to be positive for mastitis. Out of this 15 (9.9%) were clinical mastitis and 48 (31.8%) subclinical mastitis cases. Of 604 quarters examined, 33 (5.5%) teats were found blind. From the functional 571 teats examined; 56 quarters (9.3%) showed clinical mastitis. From those teats screened by CMT, 192 quarters (31.8%) showed evidence of subclinical mastitis (Table 1).

Table 1: The prevalence of mastitis at individual animal and quarter level in dairy cows of Ambo Town

Disease status	No. of animals examined	No. of positive (%)	95 % CI	No. of quarter examined	Number of positive (%)	95% CI (%)
Clinical mastitis	151	15 (9.9)	5.1–14.8	604	56 (9.3)	7.0 – 11.6
Subclinical mastitis	151	48 (31.8)	24.3-39.3	604	192 (31.8)	28.6 – 35.5
Blind teats	-	-	-	604	33 (5.5)	3.7 – 7.3
Total	151	63 (41.7)	33.8– 9.7	604	281 (46.5)	

No= number, CI= confidence interval

Risk factors

As shown in Table 2, the present study revealed significantly higher prevalence of mastitis (47.2%; n=56) in cross breeds as compared to local breeds (15.4%; n=4) in ($P<0.05$). With respect to age, there was an observation of significantly higher ($P< 0.005$) prevalence in old cows (75.0%; 31/44) than in young cows (28.0%; 30/107). There was also significant association between parity and mastitis evidenced by higher infection rate of 81.3% (26/32) in cows having more than 4 calves 31.1% (37/119) than in cows having less than 4 calves (Table 2). In contrary, the prevalence of mastitis was not significantly influenced by stage of lactation, though there is higher prevalence of in early stage (45.9%; 34/74) than in late stage (37.7%; 29/77).

Table 2: Prevalence of mastitis in milking cows based on intrinsic and extrinsic factors

Risk factors	Category	No. of examined	No. of positive (%)	x^2	P value
Breed	Cross	125	56 (47.2)	8.960	0.003*
	Local	26	4 (15.4)		
Age	Young adult (2-6 years)	107	30 (28.0)	28.281	0.000*
	Adult (≥7years)	44	31 (75.0)		
Parity	Few (<4 calves)	119	37 (31.1)	26.093	0.000*
	Many (>4 calves)	32	26 (81.3)		
Lactation stage	Early (<5month)	74	34 (45.9)	1.065	0.302
	Late (>5 month)	77	29 (37.7)		
Herd size	Small (<10 cows)	33	8 (24.2)	5.306	0.021*
	Large (>10 cows)	118	58 (46.6)		
Educational status	Illiterate	45	20 (44.4)	0.195	0.658
	Literate	106	43 (40.6)		
Management system	Extensive	12	1 (8.1)	6.307	0.043*
	Semi-intensive	68	32 (47.1)		
	Intensive	71	30 (42.3)		
Tick control activity	Yes	47	19(40.4)	0.047	0.828
	No	104	44(42.3)		

χ^2 = Chi-square *= P< 0.05 (significant)

Analysis of extrinsic risk factor solicited higher infection rate in animals from larger herd size (46.6%) than small herd size (24.2%). In comparing prevalence among management systems, the highest infection rate was observed in semi-intensively managed cows (47.1%) followed by cows in intensive management system (42.3%) and the least in extensively managed cows (8.1%). Both herd size and management systems were found to be significantly associated with the udder infection (P<0.05). Nevertheless, there was no statistically significant (P>0.05) difference in prevalence between animals owned by illiterate (44.4%) and literate (40.6%) owners; the same is true for owners practicing tick control (40.4%) and those who did not(42.3%).

Discussion

This study showed the overall prevalence of mastitis in dairy cows in Ambo town to be 41.7%, which is comparable with 39.5%, 44.1% and 44.6% prevalence reports of Geresu Biru (1989), Delelesse Girma (2010) and Mengistu Mekuria *et al*. (1986), respectively, from various parts of Ethiopia. However, it is relatively lower than the report of 52.78% by Hundera Sori *et al.* (2005) and 71 % by Birhanu Mekibib *et al.* (2010). On the other hand Demelash Biffa *et al*. (2005) and Nessru Husein *et al*. (1997) reported 33% and 25%, respectively, which are lower than the present finding. The different reports are from different management system, breed of cattle and agro-climatic areas, thus this could attribute to the variability of mastitis prevalence among reports.

The finding of 9.9% prevalence of clinical mastitis and 31.8% prevalence of subclinical mastitis in the present study is in accordance with the view of scholar's that subclinical mastitis is 3 to 4 times more frequent than clinical mastitis (Radostits *et al*., 2007). The study closely agrees with the reports of Demelash Biffa *et al*. (2005), Birhanu Mekibib *et al.* (2010), Mesele Abera *et al.* (2013) and Rigbe Haftu *et al*. (2012), however it was lower than the report of Firaol Tafa *et al.* (2015) and Ararsa Duguma *et al*. (2014). The higher prevalence of subclinical mastitis might be the strong cows' udder defense mechanism (Jha *et al*., 2010), whereas the lower prevalence of clinical mastitis is attributed to treatment after appearance of the clinical signs. Moreover, the higher prevalence of subclinical mastitis in the study area could be attributed to the little attention given to it and farmers are not aware about the silent cases of mastitis.

High prevalence of blind mammary quarters (5.5%) closely agrees with the result of Demelash Biffa *et al.* (2005). Lack of screening subclinical mastitis and late or not treating clinical cases could possibly leads mammary gland to blindness. Blind mammary quarters contribute to high subclinical mastitis and loss of milk production with a subsequent impact on food security. The quarter level prevalence of clinical (9.3%) and subclinical (31.8%) mastitis in this study indicate the economic significance of the disease Hundera Sori *et al*. (2005). The relatively higher prevalence of mastitis in right front quarters (21.3%) and left hind quarters (22.4%) in this study agrees with the findings of other scholars (Zeryehun Tesfahowot *et al*., 2013; Hundera Sori *et al*., 2005). This might be due to ease of grasping the right front quarters first while milking and the higher production capacity of hind quarters (Radostitis and Blood,

1994), and the chance of getting environmental and fecal contamination in the case of hind quarters (Hundera Sori *et al.*, 2005).

According to Radostitis and Blood (1994) and Schultz *et al*. (2001) the higher susceptibility of higher yielding cows to mastitis could be attributed to the anatomy of teat and udder and certain physiological characteristics such as fewer phagocytic cells in higher yielding cows associated to dilution. In line with this, it was found in this study that the prevalence of mastitis in cross-bred cows (47.2%) was significantly higher than local cows (15.4%) [$P < 0.05$]. Significantly higher prevalence of mastitis (75%) in older than young adult cows (28.0%) was in agreement with Harmon (1994) who reported increased prevalence of mastitis with advancing lactation number. Jha *et al.* (2010) explained the contribution of better active mononuclear leukocyte function in primiparous cows than the multiparous cows. This is in agreement with our current finding of significantly higher prevalence of mastitis in cows with many calves (81.3%) than with few calves (31.1%). Moreover, cows with advanced parity become more productive, so it can be assumed that as the parity of cows advance and the age increases cows become prone to mastitis.

The rate of infection revealed significant variation between small herd size (24.2%) and large herd size (46.6%) ($p<0.05$). This indicates that, beside the lack of knowledge of the community regarding to the animal husbandry the large size can affect the health of animals. A wide range of farm and animal level management factors can influence husbandry conditions (Demelash Biffa *et al*., 2005). This was obvious in the present study, which showed significant higher prevalence in semi-intensive (47.1%) and intensive farming systems (42.4%) when compared to extensive farming system (8.1%). This could be attributed to the variation in hygienic standards of dairy environment and milking conditions as the cows in these systems in the current study were maintained in dirty and wet area which favors the proliferation and transmission of mastitis causing organisms. In conjunction with this the questioner finding indicated that majority of the dairy farms were not visited by veterinarian and training for farm owners was not practiced at all which could negatively influence dairy health management in the area.

Conclusion

The present study indicated mastitis is a prevalent disease in dairy cows in Ambo town. Breed, age, parity, herd size and management system are the main factors that were associated with the likelihood of contracting mastitis. The subclinical cases are by far more frequent than the clinical ones. Unequivocally, silent loss of milk production due to subclinical mastitis along with blind teats could cause adverse effect on the dairy activity of the town. This implies that mastitis has an overlooked impact on dairy development and food security in the area. Therefore, awareness should be created to make possible early diagnosis and regular screening of cows for subclinical mastitis together with treatment of clinical cases. Moreover, mastitis control and prevention strategies should be designed and implemented with consideration of the age and parity of cows and management system so as to reduce its influence on milk production and food security. Further detailed epidemiological, microbiological and economic analysis studies are suggested at countrywide level to shape the existing control and prevention strategies.

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