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Prevalence and Associated Risk Factors of Bovine Mastitis on Dairy Cattle in Mogadishu Somalia

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Abstract: Mastitis is one of the main problems that lead to economic inefficiency in dairy farms. In Somalia, the shortage of milk and milk products has many causes, however examination of sub-clinical mastitis and their prevalence has not been adequately addressed and no comprehensive research has been led on their epidemiology. Therefore this study was launched to assess the prevalence of mastitis in Mogadishu as well as identify the risk factors that are associated with mastitis occurrence. The study was cross sectional and took place between March 2019 to February 2020, to determine the prevalence and associated risk factors of mastitis on dairy cattle at Mogadishu, Somalia. The study conducted multistage sampling by first purposely selecting three districts from the 17 districts that comprises Mogadishu province. The area selection was based on the availability of dairy farms. Farms were also randomly selected by first listing farms in a piece of paper and selecting it from the bowel, while systematic selection was conducted at animal level by selecting every four animals for sampling and screening. In this study the overall prevalence found was 44.5% and quarter wise the prevalence was 19%. The present study revealed that the presence of mastitis among different age groups of the examined cattle had statistically significant difference in their prevalence ($p<0.05$), with the highest prevalence found in cattle 7 years and above of age with prevalence of (51.4%) compared to cattle <7 years of age (25.49 %). The study also revealed a statistically significant association between mastitis and stage of lactation of the cattle with animals with early stage of lactation having the highest prevalence (58.86%) compared to the cattle late stage of lactation with the (12.61%). Study also presented a significant association between prevalence of mastitis and production system was ($p<0.005$) which is higher in intensive systems with the (47.45%) and lower semi-intensive systems (31.4%). Presence of mastitis and hygienic level was also compared and a significant association was found ($p<0.05$). According to the breed, a significant difference was not found between the prevalence of exotic and local cattle ($p>0.05$) although exotic were found to have a slightly higher prevalence (47.33%) compared to local cattle (43.1%). Therefore this study recommended that the regular screening for early detection should be done at least once a week for monitoring udder health status of dairy animals.

Keywords: Mastitis, Risk Factors, Prevalence, Dairy Cattle, Prevention, Mogadishu, Somalia

1. Introduction

Mastitis is a global complex problem as it harmfully affects animal health, quality of milk and the economics of milk production, affecting all countries, including developed ones and causes vast financial losses [3]. There is agreement among authors that mastitis is the most extensive infectious disease in dairy cattle, and, from an economic portion, the most damaging [4-6].

Mastitis is a multi-causal and complex disease, which is described as inflammation of the parenchyma of glands in the mammary. It is expressed by physical, chemical and, usually, bacteriological changes in milk, and pathological changes in glandular tissues [2]. The occurrence of disease is a result of interaction between three major factors: infectious agents, host resistance, and environmental factors [1].

Subclinical mastitis persists as one of the most important causes of reduced milk production in dairy animals. Mastitis refers to an inflammation of the mammary tissue and is a general disease in dairy cattle. This condition also possesses the risk for the transmission of zoonotic diseases like tuberculosis, brucellosis, leptospirosis and streptococcal sore throat to human beings [2].

In sub Saharan Africa countries, livestock plays a

considerable role in both national economy and livelihood of pastoral communities. It contributes milk, meat, eggs, food, crop production, soil fertility, hide and skin, drought power, cash income and means of social integration especially in nonmarket exchange areas [7].

The livestock sector is fundamental to the economic and cultural life of the Somali people. The sector provides food and income to over 60 percent of the country's population [8]. Despite the animal sector being the back bone in rural, agro-pastoral and Somali dwellers, there is shortage of milk and this leads to extensive consumption of imported milk and discouragement to development of the dairy sector in Somalia. Hence, Somalia currently imports both milk powder and fresh milk to fill the gap between supply and demand.

In Somalia, even though the disease of mastitis has been known locally, it has limited study, making information available on the prevalence of disease in dairy cattle and associated risk factors.

The shortage of milk and milk products has many causes, however examination of sub-clinical mastitis and their prevalence has not been adequately addressed and no comprehensive research has been led on their epidemiology. Therefore, in this study it appeared interesting to carry out an investigation of the prevalence of bovine mastitis and associated risk factors at Mogadishu Somalia, in order to provide valuable data for development of disease control programs and management practices.

2. Literature Review

Mastitis is the most widespread and costly disease in dairy cattle occurring all through the world. It is of exacting concern for farmers in developing countries like Ethiopia. Costs due to mastitis include reduced milk production, condemnation of milk due to antibiotic residues, veterinary costs, culling of chronically infected cows and occasional deaths [20]. Moreover, mastitis has a serious zoonotic potential linked with shedding of bacteria and their toxins in the milk [21].

2.1. Classification of Mastitis

Mastitis is categorized into two types, based on symptoms: clinical mastitis (CM) and Subclinical mastitis (SCM). This can also be divided either into an acute or chronic form, based on the time course of disease. The former classification is important in order to make a decision on the right way of treatment and prevention [22]. In disparity, no visible signs are seen either on the udder or in the milk in case of sub-clinical mastitis, but the milk production decreases and the somatic cell count increases. It is more general and has a serious impact in older lactating animals than in the first stage of lactation heifers [23].

2.2. Risk Factors

Environmental Risk Factor: One of the environmental risk factors is season. Most cases occur during summer months in housed cattle & are commonly environmental infections; especially if the season is wet the prevalence of infection is greater. Milking practice includes efficiency of the milking person, milking machine, too high milking speed management system [13]. Without proper management factors such as reproduction culling, feeding, milking, hygiene, disease control and vet cycles, rearing, sheltering, prevention can have a huge impact on the occurrence of mastitis. Geographic, seasonal, climatic and weather conditions obtaining stress in dairy cattle [24].

Host Risk Factor: Includes age of the animal, stage of lactation, breed & milk yield. The incidence of infected quarters increases with age, peaking at 7 years, stage of lactation, most new infections occur in the first 2 months of lactation, especially the environmental infections but in heifers there is a much larger incidence in the first month after calving. High yielding cows are generally considered to be more susceptible to mastitis & to teat injury [13].

Genetic: Deficiencies of certain characteristics of modern dairy cows e.g. size shape and suspension of udder, morphology of teat and teat canal, milking ability and milk flow rate that affect the natural defense mechanisms of the udder against infection [25]. According to [26], anatomical characteristics of dairy cattle are unequal for all breeds, in a way that the udder and teat morphology could favor an individual performance or a determined breed.

2.3. Economic Importance of Mastitis

Mastitis, both clinical and subclinical, is known for resulting in a considerable economic loss. [27] Divided the losses into following categories: Milk yield loss, loss from discarded milk, veterinary service, medicine, increased sanitation (both stall and milk hygiene), additional labor and equipment.

Mastitis has been known to cause a great deal of loss or reduction of productivity to influence the quality & quantity of milk yield & to cause culling of animals at unacceptable age. A survey conducted in the major milk producing countries showed that each year, mastitis affects 15 to 20% of cows. Most estimates have revealed a 30% reduction in productivity per affected quarter & a 15% reduction in production per cow lactation [13]. Mastitis is a disease that leads to reduced milk yield and an increased number of clinical treatments, resulting in early cow culling. Thus mastitis inflicts huge losses to the producers in the dairy industry.

2.4. Control and Prevention of Mastitis

The best way to reduce prevalence of mastitis is to prevent new intra-mammary infections (IMI). However, few intervention studies have been performed and preventive measures are generally suggested on the basis of risk factors associated with mastitis or specific pathogens rather than on the results of intervention studies. Recommended preventive measures are usually based on the proposed 10 Point Plan [28] and depend on herd management systems (i.e. conventional milking or robotic milking, tie stalls or free housing, etc.) and/or on the most prevalent udder pathogens present.

Mastitis caused by contagious pathogens are mainly prevented through improvements in milking hygiene, use of post-milking teat disinfectants, blanket dry-cow therapy, and treatment, segregation, or culling of infected animals, while environmental pathogens are primarily prevented by improvement in barn or pasture hygiene and general optimization of the cows' immune system. More knowledge about the impact of udder pathogens and bacterial genotype on udder health and production, as well as a better understanding of herd variation in IMI occurrence in regards to species, genotypes of species, seasonal variations, and parities is needed. With more knowledge about spread of infections, and more knowledge about which infections have the highest impact on udder health, the best prevention methods, motivated both economically and by animal welfare, can more easily be chosen.

3. Methods

3.1. Study Area

Benadir Region consists of 17 districts. It borders with middle Shebelle in the north and the east, lower Shebelle in the west and Indian Ocean in the south. The region lies between latitude 2.0469°″N and longitude 45.3182°″E. The study was conducted at some selected intensive and semi-intensive Dairy farms of Benadir Region. The study was carried out in Mogadishu where many dairy farms were available.

Since there is limited information on Benadir in cattle population therefore, three districts were selected purposively due to their cattle population. Samples were collected randomly from the semi intensive and intensive dairy cattle herds.

3.2. Study Time

This study was conducted from March 2019 to February 2020; both dry and wet seasons were included and it took a period of one year as the sample size was determined.

3.3. Study Design

A cross-sectional study was conducted to determine the burden or the prevalence of mastitis in the study area. This study descriptive, attempting to determine and accomplish to describe risk factors of mastitis in dairy cattle in Mogadishu, Somalia.

3.4. Sample Size

The desired sample size for the study was calculated using the Formula given by [9] with 95% confidence interval (CI) and 5% desired absolute precision and there was no previous study on prevalence of bovine mastitis on lactating cattle in Benadir region, so the expected prevalence was used 50%.

Therefore:

$$n = \frac{z^2(\text{p exp})(1-\text{p exp}))}{d^2} = \frac{1.96^2(0.5)(1-0.5)}{0.05^2} = 384$$

Therefore, the Sample size was 384 of lactating cattle.

3.5. Data Collection Instrument

Research instrument was the California mastitis test Kit. Milk samples from each quarter were collected in a clean CMT Paddle. The CMT paddle has four shallow cups marked A, B, C, and D to help identify the individual quarter from which the milk was obtained. Each of the marked four shallow cups has marking lines measuring 2ml.

3.6. Sampling Methods and Milk Sample Collection

Farm selection was purposive due to the nature and production systems used in Benadir Region. The region was selected because it harbors dairy production corridors of Somalia. It is heavily invested by businesses and mostly practices both intensive and semi-intensive production systems. Farm selection was based on random selection by listing all dairy cattle farms in the vicinity of Mogadishu then they were but in a bowel and selection was done randomly.

Systematic selection was done at individual animal level where every 4th was selected for the sampling and screening. This systematic sampling was achieved by calculating the total number of cattle from the farm through farm communication and then the interval is achieved by applying the following formula:

K: N/n

Milk samples were directly from the udder of the animal in the early morning. The teats were cleaned with ethanol soaked cotton wool. Starting from the teats furthest away from the collector, teats were cleaned with 70% alcohol and given time to dry and then, the first three streams of milk were discarded and then milk was collected directly from udder to the sterile CMT paddle.

3.7. Data Analysis

Data was recorded in Microsoft Excel 2010 and passed to SPSS version 20.0 for analysis. The overall prevalence of mastitis was determined by using cross tabulation. Risk factor associated with the occurrence of mastitis like: age, breed, lactation period, hygiene and milk yield level, was used to find if they are associated with occurrence of mastitis using Chi square model (X^2) at $P<0.05$, since that data was mainly nominal X^2 was the best model to find association of the risk factors.

4. Results

384 cattle were screened at farm level for mastitis and from different districts in Mogadishu. The cattle sampled were lactation stage from different farms with intensive and semi-intensive production system.

4.1. Overall Prevalence of Mastitis

In the study a total of 384 lactating cattle were tested for mastitis. Out of which 171 tested positive, and makes the overall prevalence 44.5%.

Table 1. *Overall prevalence of mastitis in selected dairy cattle farms in Mogadishu.*

Number of examined	Number of positive	Number of negative	Prevalence (%)
384	171	213	44.5

Source: Primary Data.

4.2. The Prevalence of Mastitis According to the Risk Factors on Dairy Cattle

Table 2. *Prevalence of mastitis according to the age.*

		No examined	No positive	%	Ch^2	P value
Age	>7 years	102	26	25.49	20.378	0.000
	7 years & >	282	145	51.4		

Source Primary Data.

According to Age of cattle there was difference in the prevalence of mastitis, with 26 of the 102 tested of the age below 7 years, and the age of 7 years and above were found 145 of the 282 examined. Therefore, prevalence was higher in 7 years and above Cattle and it varied significantly (P<0.05) with the age.

Table 3. *Prevalence of mastitis according to the Hygiene of farm.*

		No examined	No positive	%	Ch^2	P value
Hygiene	Poor	122	81	66.4	39.324	0.000
	Fair	193	71	36.8		
	Good	69	16	23.3		

Source Primary Data.

According to the Hygiene of the farms, the study shows a significant difference between poor, fair and good hygiene, with poor hygiene farms having a higher prevalence than middle and good hygiene farms with P-value (0.000).

Table 4. *Prevalence of mastitis according to the production system.*

	No examined	No positive	%	Ch^2	P value
Intensive	314	149	47.45	5.950	0.01
Semi-intensive	70	22	31.4		

Source: Primary Data.

According to the production system of the cattle, the study shows a significant difference between semi-intensive and intensive production system, with intensive system having a higher prevalence than intensive system with P-value (0.01).

Table 5. *Prevalence of mastitis according to the lactation stage.*

		No Examined	No Positive	%	Ch^2	P value
Lactation stage	Early	265	156	58.86	71.156	0.000
	Late	119	15	12.61		

Source: Primary Data.

According to the above table, there is significance difference between early stage of lactation (4week-4month) and late stage of lactation (above month) with 156, and 15 positive cows respectively with a P-value (0.000) and Ch^2 (N=384) 71.156. Therefore, the prevalence of mastitis was higher to the early lactation stage of cattle screened with CMT.

Table 6. *Prevalence of mastitis according to the milk yield level.*

		No examined	No positive	%	Ch^2	P value
Milk yield level	High	266	156	58.6	69.824	0.000
	Low	118	15	12.7		
Total		384	171			

Source: Primary Data.

As shown in Table 6, there is significance difference between high milk yield cattle and low milk yield cattle with P-value (0.000).

Table 7. *Prevalence of mastitis according to the breed of cattle.*

		No examined	No Positive	%	Ch^2	P value
Breed of cattle	Local	253	109	43.1	0.630	0.246
	Exotic	131	62	47.33		

Source: Primary Data.

According to Breed there was no difference in the prevalence of mastitis, with 109 of the 253 Local cattle (43.1%) were found positive, and 62 out of the Exotic Cattle 131 (47.33%) were found positive P-value (>0.05).

Table 8. *Number of quarters affected.*

Quarter	No examined	No positive	%
Front left teat	384	86	22.39
Front right teat	384	63	16.4
Right back teat	384	69	17.9
Left back teat	384	75	19.5
Overall	1536	293	19

Source: Primary Data.

A total of 1536 quarters were examined, of which 293 (19%) were positive for mastitis as shown above table. According to this table the distribution of mastitis between different quarters has no significant association with P value (P 0.376) and Ch^2 (N=384) 66.

5. Discussions

A total of 384 dairy cows, from which 253 local and 131 exotic breeds from Mogadishu were investigated in a cross-sectional study conducted between March 2019 and February 2020.

An overall prevalence of 44.5% was found by the study which is in close study carried out in Ethiopia by [10] who reported 44.1%. On the other hand, the study is not in agreement with previous study carried out in Hawassa, Southern Ethiopia by [11] which reported 62.6% of prevalence.

The quarter level prevalence of the current study was 19% which is an agreement with some earlier study carried out in Southern Ethiopia by [12] who reported a prevalence of 19%. This findings was lower than that of [19], who reported 31.4%.

This variability in prevalence of mastitis between different reports could be attributed to differences in farm management practices or to differences in study methods and instruments employed by the investigators. Another possible explanation could be the fact that the difference in the observed prevalence of mastitis among studies may be attributed to various factors like environmental, animal risk factors and causative agents [13].

In current study observed higher prevalence of mastitis during early lactation as compared to late lactation stage was in line with the reports by [12] who also reported the same findings in Southern Ethiopia and this may be due to an absence of dry period therapy and birth related influences.[2] suggested that, the mammary gland is more susceptible to new infection during the early and late dry period, which may be due to the absence of udder washing and teat dipping, which in turn may have increased the presence of potential pathogens on the skin of the teat. According to the [13] 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 with dilution. In contrast to the present finding, [14] reported higher prevalence of mastitis in the late stage of lactation. The variations in the effect of stages of lactation among different studies could be related to disparities in age, parity and breed of the sampled animals.

The increasing prevalence of mastitis with increasing age is in agreement with the findings by [12], and by [15] who found that the risk of clinical and subclinical mastitis increased significantly with the advancing age of the cow.

In this study it was also found that there was an association between high milk yield and mastitis infection at a $p<0.05$. This is in agreement with [16], who reported association of milk yield and mastitis at $P<0.05$.

The status of cows' udder, and leg hygiene was also noted as part of the risk factors that enhance the occurrence of mastitis. Based on the udder, leg hygiene and score used, most of the examined cows had slightly very dirty udders, legs and there was a marked increase in the detection of mastitis as the level of dirtiness increases. This dirtiness of cows' udder and legs was the result of poor hygiene of the dairy farms. Of the total farms investigated, 65% were categorized as poor hygienic due to lack of waste drainage system and accumulation of manure and urine. In agreement to the present study, a significant association between poor udder hygiene and increased risk of mastitis has also been reported by [17].

High prevalence was observed in the current study with the intensive system and the lower prevalence was found in the semi-intensive system. This is an agreement with the study carried out by [16]. The higher prevalence in semi-intensive and lower in intensive systems was reported by [18]. This could be attributed to the variation in hygienic standards of dairy environment and milking conditions as the cows in these systems in this study were maintained in a dirty and wet area

which favors the proliferation and transmission of mastitis causing organisms.

Figure 1. *An intensive farm in Yaqshid District.*

Figure 2. *Cleaning teats with alcohol.*

Figure 3. *CMT paddle milk with reagent and gel formation.*

6. Conclusion

The study confirmed the presence of significant association between the prevalence of Bovine mastitis and several risk factors like age, management system, stage of lactation, milk yield level and hygienic status, where cattle of 7 years and above of age, those under poor hygienic level and intensive production system all showed higher prevalence.

In general, results from this study indicate that mastitis has a clear significance for the livestock producers in Benadir region and Somalia as a whole and need a serious control and preventive issue.

7. Recommendations

Having the above conclusions, the following recommendations are forwarded:

1) Regular screening for early detection should be done at least once a week for monitoring udder health status of dairy animals.
2) Treatment and control of mastitis are recommended to alleviate the problem.
3) Adequate research has to be made to figure out the prevalence at country level and take appropriate control measures.
4) The mastitis which is highly prevalent and economically important should gain attention. In this regard awareness should be created on the importance of mastitis to farmers.
5) Poor farm hygiene should be avoided in order to prevent cross contamination and increased chance of infection.
6) Farmers should be advised to keep records in order to gain statistics on health status of dairy animals in herds.

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