

Research Article



Prevalence and Major Pathogens Associated with Clinical and Subclinical Mastitis in Dairy Camel (*Camelus dromedarius*) in Benadir Region of Somalia

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Abstract | A cross-sectional study of camel mastitis was conducted on 150 lactating camels from July to December 2019 to figure out the prevalence of both clinical and subclinical mastitis in lactating camels in the Benadir Region of Somalia and also to recognize the associated microorganisms as causal agents of mastitis. The prevalence of this study was measured by using California mastitis test (CMT). Milk samples were collected from the Deyniile District, Benadir Region of Somalia. The overall prevalence of mastitis was 16.66% (7.93% on the quarter basis), the prevalence of clinical and subclinical mastitis was found to be 22.78% and 9.85% on the animal basis and 9.37% and 6.15% on quarter basis, respectively. The hind quarters were more frequently affected than the fore-quarters. The bacteriological inspection of milk samples revealed that *Staphylococcus* spp. was the primary etiological agent in both clinical and subclinical mastitis in camels (38.88%), followed by *Streptococcus* spp. (18.51%), *Enterobacterium* spp. (14.81%), *Corynebacterium* spp. (14.81%), *Micrococcus* spp. (5.55%), *Pasteurella* spp. (5.55%) and *Pseudomonas aeruginosa* (1.85%). The prevalence of camel mastitis in the study area was significantly low this might be because of the environmental factors as well as the hygienic managements of the farms. Therefore, implementation of integrated approaches has great importance in the study sites for the avoidance and management of mastitis hence minimizing economic loss and prevents significant public health risks.

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Introduction

Camels are important livelihood assets to human survival in less agroecological parts

of African, Asian and Arabian deserts (Ali *et al.*, 2019). According to FAO (2020), the total of camel populations of the Universe is supposed to be 35 Million, *Camelus dromedarius* (One Humped

Camel) is 89% while *Camelus bactrian* (Two Humped camels) is only 11% and mostly kept by nomads mainly in Asia and Africa. *Dromedarius* camel is an important source of milk, meat and even in transportation mainly in the desert area. In addition, the camel can carry heavy loads for several days in some of the world's most hostile conditions (Köhler-Rollefson *et al.*, 2001). Livestock rearing mainly camel is very common in Somalia's rural areas and the adjacent regions of Ethiopia, Kenya, and Djibouti. The Livestock sector is the backbone of the Somali economy since it creates employment opportunities (60%), an income of foreign currency (80%), as well as contributes to Gross Domestic Products (40%) (Somalia Economy, 2020). Of the world's estimated 14 million camels, the Somalia population estimates around 10 million people and has more than seven million camels the highest number of the world (Mohamed, 2016). There is no other community in the earth like the Somali community where the camel plays such an essential part in their culture as well as in their indigenous budget (Farah *et al.*, 2004). Although Somalia has a major population of camels in the globe, camel production is very low in terms of milk due to diseases such as mastitis. Mastitis is an inflammation of mammary glands (Mpatswenumugabo *et al.*, 2017) and is divided into clinical mastitis which shows clinical signs and subclinical mastitis which doesn't show any clinical signs from the udder except for using detection tools. It's very easy to detect clinical mastitis by seeing clotted milk, while subclinical mastitis can be confirmed only by using several tests such as California mastitis test (CMT), Microscopic Somatic Cell Count (MSCC), Whiteside test (WST), sodium lauryl sulfate test (SLST), surf field mastitis test (SFMT) (Hoque *et al.*, 2015; Sharma *et al.*, 2010) and Electrical Conductivity (EC) (Hegde *et al.*, 2013). The mastitis control program can reduce economical loss and increase herd efficacy and milk hygiene.

Materials and Methods

Study animal, population and location

A total of 150 lactating cow-camels that were kept under traditional management in the Deyniile district of the Benadir region, Somalia (Latitude: 2.073453°, Longitude: 45.275559°) was considered to figure out the prevalence of clinical and subclinical mastitis. The study area is close to the equator and has

comparatively a dry climate. The area covers a total landmass of 1657 km² and has a human population of 2.5 million.

Study design and sampling

The cross-sectional study was conducted from July to December 2019 on 150 lactating cow-camels in which case study animals were visited once for data collection and regarding the sampling procedure area, Deyniile District of Benadir region was selected based on present camels' population and accessibility of information thereby, accordingly collecting the sample were achieved.

Sample size

Using the method given by Thrusfield (2005) with a 95% confidence interval (CI) and 5% desired absolute precision, the desired sample size for the study was calculated. Accordingly, the estimated sample size was 150 lactating camels.

Physical examination of camel's teats and udder

Visual inspection and systemic palpation of teats and udder of the lactating camels were done. Visible lesions of udder were recorded. The lesions included chapped cracked skin, injuries, vesicles, wounds, scars, fly bites, allergic reactions, warts, photosensitization, chemical damage, cuts, and abrasions.

Collection of milk samples

The camels were restrained and the udder washed with clean water. The teats were dried with a disposable paper towel and disinfected with 70% alcohol. Milk samples were collected from each teat of all the 150 lactating camels using aseptic methods, regardless of whether they have clinical mastitis or not. After discarding the first strips of milk, 10 ml from each halve collected into labeled sterile sample bottles. The bottles were capped and kept in cool boxes with ice packs at 4°C and transported within 2 hours to the KASMO University, Mogadishu, Somalia for laboratory analysis.

Laboratory analysis of milk samples

The CMT was done to detect mastitis in camel (clinical and subclinical). According to Quinn *et al.* (1999) interpretations were done and the results were scored as 0, Trace (T), 1, 2, or 3 subjects on the concentration of reaction. Sample with a CMT score of 0 or T was considered as negative while those scores of 1, 2, or 3 were considered as positive.

Biological isolation

The collected samples were cultured on the media (general, choosy and exceptional indicator media) with exceptional supplements depending on the nature of bacteria; whether they are fast/ slow developing or demanding/normal during development (i.e., aerobic, 10% Co₂ and anaerobic conditions). Depending on the species of microorganisms, the time of incubation was set from 24 to 72 hours. Temperature of incubation was 37°C for most of the cases although some cases need to be incubated on another range i.e. 25-45°C. Identification of the microorganism was done by commercially presented groups of Biochemical and enzymatic analysis (API 20 A, NE, E and API 20 Coryn) fast microbial recognition systems Vitek 2 (Biomérieux France).

Statistical analysis

Collected data were organized in Microsoft Excel before transferred to the SPSS sheet. The Statistical Package for the Social Science 20.0 was used for all suitable statistical analysis.

Results and Discussion

Prevalence

A total of 150 lactating camels (580 quarters) were examined to determine the prevalence of clinical and subclinical mastitis in camels. Among 150, 79 camels (320 quarters) examined for the presence of clinical mastitis, and 18 camels (30 quarters) were positive to clinical mastitis, and the prevalence is 22.78% (9.37% on the quarter basis). Remaining 71 camels (260 quarters) were examined for estimating the presence of subclinical mastitis, and 7 camels (16 quarters) were positive to subclinical mastitis, and the prevalence is 9.85% (6.15% on the quarter basis) (Table 1). Mastitis pathogens were found in the udder discharge of camels confirming subclinical mastitis. Taking into consideration of total population (n=150) during the study, the prevalence of mastitis on the animal basis was found to be 16.66% while 7.93% on the quarter basis. It was further observed that hind quarters were affected with both clinical and subclinical infections (69.99% and 62.5%, respectively) more frequently than fore-quarters (30.00% and 37.5%, respectively) (Table 2).

Frequency distribution of mastitis pathogens

The data presented on the relative frequency of types of microorganisms that come across in udder infection

were mentioned in Table 3. The study showed that *Staphylococcus* spp. was the greatest significant organism involved in the causation of clinical and subclinical mastitis in camels (38.88%) followed by *Streptococcus* spp. (18.51%) and become the second most pathogen involved as a causative agent, *Enterobacterium* spp. and *Corynebacterium* spp. (14.81%). The prevalence of miscellaneous organisms including *Micrococcus* spp., *Pasteurella* spp., and *Pseudomonas aeruginosa* was low i.e., 5.55%, 5.55%, and 1.85% respectively.

Mastitis is recognized as one of the very important diseases for dairy industry globally because of its economic significance. Practically, mastitis occurred in all domesticated species of animals and reported from all over the world (Halasa *et al.*, 2007). The disease causes colossal losses in terms of reduced milk production, cost of treatment, veterinarian's fee, discarding of milk and many more (Yathiraj *et al.*, 2007). Camel production contributes significantly to the national economy in Somalia as they form a significant proportion of livestock exports and it has the most camel population in the world (FAO, 2015). The Camel is a very important source of income in dairy industries in the climate of Benadir region of Somalia (Dubad *et al.*, 2019), but their milking potential is affected by udder infections. The status of the disease remains largely unknown in this region, and yet there is no much researches has done toward such diseases. The prevalence of camel mastitis as discovered during this study is considered very low especially when compared to the report of Bekele and Molla (2001). Environmental factor as well as the handling practice of the owner might be a reason in variation of the prevalence of camel mastitis. Comparable result (15.8%) is also reported by Abdurahman and Bornstein (1991) in Jijiga and higher rate of CMT result 47.3% in Afar (Bekele and Molla, 2001). Tick burden, together with the thorny plant of desert and ant suckling material, seems to be a risk factor to the occurrence of mastitis in camels in the study area. Tick infestation can cause teat and skin lesions. This is one of the factors that predispose camels to mastitis since lesions caused by ticks facilitate bacterial entry and cause permanent tissue damage and influenced by poor hygiene of udder (Megersa, 2010). The definition related to the low prevalence of this study is the hygienic of milking ways and the good sanitized situation of the milking zone. It was also observed during this study that the prevalence of clinical mastitis was greater than subclinical mastitis.

Table 1: *The prevalence of clinical and subclinical mastitis based on animals and quarters on CMT and grown culture.*

Types of infection	No. of examined camels	No. of examined quarters	No. showing mastitis		Prevalence rate on	
			Animals	Quarters	Animal basis	Quarter basis
Clinical	79	320	18	30	22.78%	9.37%
Subclinical	71	260	7	16	9.85%	6.15%
Total	150	580	25	46	16.66%	7.93%

Table 2: *Spreading of clinical and subclinical infections in camels according to the quarter of position involved.*

Types of infection	No. of infected quarters	Left behind	Left front	Right behind	Right front
Clinical	30	10 (33.33%)	3 (10.00%)	11 (36.66%)	6 (20.00%)
Subclinical	16	3 (18.75%)	2 (12.5%)	7 (43.75%)	4 (25.00%)
Total	46	12 (26.08%)	3 (6.52%)	21 (45.65%)	10 (21.73%)

Absolute values refer to total number of infection and values in parenthesis refer to the percentage of infection within the category.

Table 3: *Comparative occurrence of different category of clinical and subclinical pathogens of mastitis infection.*

Type of infection	Clinical	Subclinical	Total
No. of quarters examined	30	260	290
No. of infected quarters	23	15	38
No. of mixed infection	3	13	16
Total isolations	26	28	54
<i>Staphylococcus</i> spp.	12 (46.15%)	9 (64.28%)	21 (38.88%)
<i>Streptococcus</i> spp.	6 (23.07%)	4 (14.28%)	10 (18.51%)
<i>Corynebacterium</i> spp.	4 (15.38%)	4 (14.28%)	8 (14.81%)
<i>Enterobacterium</i> spp.	2 (7.60%)	6 (21.42%)	8 (14.81%)
<i>Micrococcus</i> spp.	1 (3.84%)	2 (7.14%)	3 (5.55%)
<i>Pasteurella</i> spp.	1 (3.84%)	2 (7.14%)	3 (5.55%)
<i>Pseudomonas aeruginosa</i>	0 (0.00%)	1 (3.57%)	1 (1.85%)

Absolute values refer to total number of pathogens and values in parenthesis refer to the percentage of pathogens within the category.

The majority of the clinical cases in this study were sub-acute infections, with signs of swelling of the udder and teats, heat, irregular milk discharge, congestion of mammary gland and painful condition. It was further observed that hind quarters were affected with clinical and subclinical infections more frequently than the fore-quarters. A higher risk of infections in hind quarters compared to the front ones which could be due to the unfavorable hygienic condition; greater exposure to dung and urine. As well as a result of the smaller size of the hind teats through a corresponding smaller teat canal, the defense prospective in the behind quarter could be reduced. However, (Saleh and Faye, 2011) found that subclinical mastitis was higher in fore-quarters than hind quarters. Bacteriologically, the present study reveals that gram-positive bacteria was the major causal agent of both clinical and subclinical mastitis in camel which is also supported by the study

of Abdul *et al.* (2006); Regassa *et al.* (2013). A higher proportion of *Staphylococcus* spp. among gram-positive bacteria found in the study is also similar to the result of Woubit *et al.* (2001).

Conclusions and Recommendations

The current cross-sectional study revealed a low prevalence of mastitis in camel herds in Deyniile district of Benadir Region, Somalia but the segregation of pathogenic bacteria from the camel milk samples recommends the need for firm hygienic processes for the period of the production and conducting of camel milk to mitigate the risks of community/public health. There is a need to increase control measures of diseases through vaccination, educating nomadic pastoralism to minimize the adverse effect of mastitis on their daily life.

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Author's Contribution

MIM and OSLJ collected samples and performed laboratory testing. YAM performed statistical analysis. AIM and PM prepare the manuscript. PM finalize the manuscript, provide critical comments and corresponding the study. All authors read the manuscript and agree to be responsible for any aspect of the manuscript.

Conflict of interest

The authors have declared no conflict of interest.

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