THE PREVALENCE OF MASTITIS AND ITS ASSOCIATED RISK FACTORS IN LACTATING DROMEDARY CAMELS IN AND AROUND HARGESA, SOMALILAND

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Abstract— In spite of it living in harsh env ronments of semiarid and arid zones, the dromedary camel is able to produce milk in valuable quantity. Camel milk is one of the main components of diet of the nomads in semiarid and arid zones and is an essential food for livelihood of people and it may be the only milk available in the Hargeisa district where other milking animals cannot be maintained. However, like other dairy animals, dromedary camels could be affected by udder infections such as mastitis. A cross sectional study of camel mastitis was conducted on 170 lactating camels from Hargiesa District Somaliland between August to December 2016 to estimate the prevalence and causes of mastitis, as well the risk factors involved on disease. Prevalence of mastitis was assessed by using California mastitis test (CMT). An overall prevalence of camel mastitis was found to be 30.5% (52/170) out of which, 4.7% (8/170), 25.8% (44/170) were clinical and sub-clinical mastitis, respectively. The overall quarter level prevalence was 30.2% (206/680). There was significant ($P<0.05$) in prevalence between camels with tick infestation, lactation stage, parity and age to mastitis than those without these factors. Microbiological examination of 206 randomly selected CMT positive milk samples from clinical and sub clinical quarters, revealed that the majority of the isolates were coagulase negative *Staphylococci* (33.6%), followed by *Escherichia coli* (25.9%) , *Streptococcus agalactiae* and *Streptococcus epidermidis*(11%), *Micrococcus* (6%) and finally *Pseudomanas* (4.8%). The prevalence of camel mastitis in the study area was found to be significantly high. Therefore, implementation of integrated approaches has great importance in the study sites for the prevention and control of mastitis hence minimizing economic loss and prevents significant public health risks. There was high sensitivity to Gentamicin, and Cloxacillin, and moderate sensitively to Ampicillin/Sulbactam and Trimoxazole and the greatest resistance was found with Tetracycline and Chloramphenicol.

Keywords: Antimicrobial sensitivity, Bacteria, Camel mastitis, Clinical Mastitis, Lactating camels, prevalence, risk factors, Sub clinical

1 INTRODUCTION

The one-humped camel (*Camelus dromedarius*) plays an important role as a primary source of subsistence in the Somaliland. Camels live in arid and semi-arid areas which are not suitable for crop production and where other livestock species hardly thrive.

Because of their outstanding performance in the arid and semi-arid environments of the western Somaliland, where browse and water are limited, pastoralists rely mainly on camels for their livelihood. In these areas, camels are mainly kept as a source of incomeandfor their milk production as they can produce milk for a longer period of time even during the dry season when milk from cattle is [1]. Somaliland possesses over 1.6 million dromedary camels [2]. and the majority of these camels are found in Eastern and Northern part of the country. The annual camel export in Somaliland is estimated to be 75, 000 [3]. Camel milk is one of the main components of diet of the nomads in semi-arid and arid zones and is an essential food for livelihood of people and it may be the only milk available in places where other milking animals cannot be maintained [4]. Camel milk also has valuable nutritional properties as it contains a high proportion of antibacterial substances and higher concentration of vitamin C in comparison with cow milk [5]. Milk can be considered as a good source of minerals, vitamins and characterized byhigher ratio of lactoferrin. Moreover, camel milk could meet a big part of the daily needs of humans from these nutrients because camel milk has most the essential nutrients[6]. Mastitis is a complex disease occurring worldwide among dairy animals with heavy economic losses. It results in milk compositional changes such as increase in leukocyte counts, leakage of plasma proteins into the milk, cell damage resulting in leakage of intracellular

constituents into milk, change in ion composition and decrease in milk production [7]. Mastitis has both an extreme zoonotic and economic importance. It is the cause of multiple Despite of its nutritional, medicinal and economic importance, nowadays, public health concern associated with microbial food safety has arisen and numerous epidemiological reports have implicated non-heat treated milk and raw milk products as the major factors responsible for illnesses that are caused by food-borne pathogens [8]. Raw camel milk may contain microorganisms that are pathogenic for man and their source may lie either within or outside the dam's udder [9]. Similarly, pathogenic bacteria in raw milk can act as a direct consequence of udder diseases [7]. Many microorganisms can get access to milk and milk bi-products among which species, *Escherichia coli, Streptococcus sppStaphylococcus aureus, Streptococcus spp*(*Streptococcus epidermis* and*Streptococcus agalactia)*, *Escherichiacoli, Klebsiella spp, miccroccusspp and* othersare recognized to be of primary concern [9]. *E. coli* is one of the main inhabitants of the intestinal tract of most mammalian species including humans. Most of the *E. coli* species are harmless, but some of its strains are known to be pathogenic bacteria, causing severe intestinal and extra intestinal diseases in humans. The milk sold in its raw form has a higher possibility of being contaminated with *E.coli, streptococcus, staphylococcus, Micrococcus, Psemaudnos;* hence, posses a great hazard to the public health. Mastitis is a complex disease occurring worldwide among dairy animals with heavy economic losses. It results in milk compositional changes such as increase in leukocyte counts, leakage of plasma proteins into the milk, cell damage resulting in leakage of intracellular constituents into milk, change in ion composition and decrease in milk production [4]. Mastitis has both an extreme zoonotic and economic importance. It is the cause of multiple hazardous effects on human health and animal production [10]. Camel mastitis has been estimated to affect more than 25% of lactating she-camel [4]-[11]. The disease is also known to cause approximately 70% losses in milk production [12]. Bacterial infections are considered to be the primary cause of mastitis in domestic animals. The causative agents of bovine mastitis are well defined but as far as camels are concerned, there is paucity of information about the etiological agents associated with camel mastitis. Few available literatures indicate that *Staphylococcus aureus*, *Streptococcus* spp, *Escherichia coli*, *Micrococcus* spp, *Streptococcus agalactiae,* coagulase negative *Staphylococci, Staphylococcus epidermides* and *Corynebacterium* spp [13]. [14] Have been implicated as causes of mastitis in camels. Mastitisis a frequent and important problem among livestock herds in most of countries. The occurrence of mastitis is influenced by risk factors, such as parityofthe she-camel, presence of tick, age and lactation stage [15]. Many different bacterial spp. that have importance, have so far been isolated from mastitic mammary glands in camels either in the form of pure or mixed infection. There are various studies which have been conducted worldwide on the isolation and identification of bacterial organisms (*Staphylococcus*, *Streptococcus*, *E. coli* and *Bacillus* species were the major isolates) in mastitic camel milk and their effect on quantity and quality of milk [13]- [15]. Bacterial infections are considered to be the primary cause of mastitis in domestic animals. The causative agents of bovine mastitis are well defined but as far as camels are concerned, there is paucity of information about the etiological agents associated with camel mastitis. The antimicrobial sensitivity test was conducted in various studies using Bauer–Kirby technique, as described by [16]. The antimicrobial agents were used to test sensitivity and resistance of bacteria isolated from milk of mastitic animal. The most antimicrobial agents were carbenicillin, gentamycin, kanamycin, erythromycin, ampicillin, cephalothin, tetracycline, penicillin G, colistin, sulphomethoxazole and streptomycin [16].

The main obejectives of this paper is

- To determine the prevellance, associated risk factors of camel mastitis,
- To isolate and identify the major bacterial pathogens associated with clinical and sub-clinical mastitis in lactating dromedary camels in and around Hargeisa district
- To profile the anti-biogram properties/responses of the isolated pathogens.

METHODOLOGY

Study Area

The current study was conducted in and around Hargeisa district in western part of Somaliland. The areas are characterized by unreliable and erratic rainfall with a precipitation ranging from 300 to 600 mm per annum, temperature ranges of 18 to 24 °C. The area also contains sparsely distributed vegetation cover that is dominated by Acacia species, Cactus and bushy woodlands [1]. Agro-geographically speaking, the study sites cover both arid and semi-arid lowlands lying at an altitude of 1,334 meters above sea level and are not suitable for crop production. In these areas, camels are herded by nomadic pastoralists who mainly rely on livestock husbandry for their livelihood.

Study Desing

A cross-sectional study design was undertaken on

96 lactating and traditionally managed camels (*Camelus dromedarius*) in several selected households. The study took place during the months of April, May, Jun, July, August and September 2018 in Salaxley Aw barkhadle, Qool Cady, Toon, Arabsiyo BalligubadlevillagesofHargeisa district. These villages are the only villages with the highest population of camels in Hargeisadistrictand part of them are located along the border between Somaliland and Ethiopia.

Selection of the Study sites

The villages within Hargeisa district were selected based on the sizeable population of camels, good security and passable roads. The local District Veterinary Officer (DVO) and the District Livestock Production Officer (DLPO) were engaged in the sensitization and mobilization of the camel producers so that the producers would be aware of this study and to explain their expected role in the study. The DVOs and DLPOs prepared the list frame of all the eligible camel owners in each study division within the county. The number of camels sampled in each division is propostional to the population of camels in the division. The process continued until the required sample size was attained.

Sampling techniques

The age of the camels was estimated (by observing the eruption and wearing of the front permanent teeth) since there were no records available. Accordingly, they were categorized as young (4-6years), adults (6-8 years inclusive), and older ones (>8years). The stage (length) of lactation was categorized as early (1stto 4thmonth), mid (4thto 8thmonth), and late (> 8thmonth). Furthermore, the number of parity was categorized as few (≤ 3 calves), moderate (4-7 calves) and many (> 7 calves).

Sample Size Determination

The following formula was used to calculate the sample size (Threshfold*et al.*, 2003):

$n= Z_{\alpha}2pq/L^2$

Where, n= sample size,

Z_{α}= the value of z that gives 95% confidence interval (1.96),

p= a priorprevalence (estimated prevalence),

q= 1-p, and

L= Allowable error.

$$n = \frac{z\alpha 2pq}{L2}$$

$$n= (1.96)^2 *0.5*0.5 \quad = 384 \text{ Sample.}$$
$$(0.05)^2$$

Accordingly, the prevalence of mastitis in camels was not estimated previously. Thus, adopting a p of 50% and L of 5%, a total of (96 camels* 4 quarter) 384 camel milk samples were sampled for the present study.

Sample Collection, Transport and Handling: Milk samples were collected according to the National Mastitis Council guideline with slight modification. Briefly, the udder was washed with tap water and dried when there is a considerable amount of dirt to be removed. The teat ends were swabbed with cotton soaked in ethyl alcohol (70%). Approximately 5-10 ml of milk was aseptically collected from each quarters of the lactating camel into pedal and then adding equal volume of CMT and mixed. CMT positive samples were put a sterile universal bottle, after discarding the first three milking streams. The samples were transported in an icebox toHargiesaVeterinary Laboratory center. CMT positive milk samples were then stored at 4 ^{o}C until they were further processed for bacterial isolation and identification. The CMT test procedure was mainly carriedasdescribed by Schalm and Noorlander (1957) [17]. Immediately after sample collection, an equal volume of CMT reagent (Delaval, Poland) was mixed with an equal volume of sampled milk in each segment of the CMT paddle and mixed gently. Quarters whose scores were negative, trace and 1+ were considered healthy while scores ≥ 2+ were considered infected or positive for subclinical mastitis. The test mixture (milk sample and the CMT reagent) was discarded and the paddle washed with clean water after each use to enable it to be used in the next selected lactating camel.

Bacteriological Examination

After culturing, bacteriological examination was carried out following standard methods laboratory and field handbook on bovine mastitis, [18]. To identify major bacterial agents associated with mastitis.In brief, milk samples from the deep freezer were thawed to room temperature and one loopful (10µl or 0.01ml) of the sample was aseptically streaked on Blood Agar (5% defibrinated sheep blood) plates and MacConkey Agar (MA) plates [19]. Bacterial growths were identified and recorded after

incubation for 24 to 48 hours at 37ºC aerobically. Primary cultures were considered to be positive when bacterial growth was observed on the inoculated plates and negative when no bacterial growth was observed. Pure culture was further obtained by sub-culturing part of typical and well isolated colony on a corresponding medium and incubated further at 37 ºC aerobically for 24 hours. Identification of bacterial isolates was done based on colony morphological features and hemolytic reactions (primary cultures), gram staining reactions and biochemical tests on pure cultures (Quinn *et al.,*1994) [18].. Gram stain procedures were performed according to the method described by [18]. To differentiate *Staphylococcus*and*Streptococcus*spp, catalase reaction was performed on all Gram- positive isolates employing the rapid slide technique as described by Cheesburgh, [8]. A drop of 3% hydrogen peroxide was placed on a slide, organism was added and mixed and then observed for bubbling to confirm the presence of catalase enzyme. Catalase negative reaction were indicated by the presence of *Streptococcus*sppwhereas catalase positive indicated *Staphylococcus* spp. Coagulase test was carried out to differentiate *Staphylococcus aureus*from other *Staphylococcus* spp. Christie, Atkins and Munch-Petersen (CAMP) test and growth in MacConkey agar plate was also carried out to differentiate *Streptococcus agalactiae*from other mastitis causing *Streptococcus.*

Antimicrobial Sensitivity Test

The antimicrobial susceptibility testing for all isolates was performed using the standard agar disc diffusion method based on the criteria set by the Clinical and Laboratory Standards Institute. For susceptibility testing, a pure culture of all identified bacterialcolonies were taken from nutrient agar and transferred into a tube containing 5 ml of sterile normal saline solution and mixed gently to make a homogenous suspension. The turbidity of the bacterial load was checked using 0.5 Mc Farland standards. A cotton swab was used to streak the bacteria across the surface of Muller-Hinton agar and wait for about 3 minutes for the solution to dry. Antibiotic disks were then placed on the agar surface using a clean sterile forceps and gently pressed so as to confirm their attachment. Following this, the plates were aerobically incubated at 37 ºC for 24 hr. The antimicrobial disks used for susceptibility testing were Amoxicillin (5 µg), Gentamicin (10 µg), Cloxacillin (5µg), Co-trimoxazole (5µg), Tetracycline (30 µg), Ciprofloxacin (5 µg), and Chloramphenicol (30 µg). Finally, the diameters of the zone of inhibition around the disks were measured to the nearest millimeter using a digital electronic caliper, and the isolates were classified as susceptible, intermediate and resistant to the drugs tested according to the interpretation standards of the Clinical and Laboratory Standards Institute (CLSI, 2008) [21].. Moreover, isolates showing resistance to three or more antimicrobial subclasses were considered as multidrug resistant (MDR) isolates.

Statistical Data Analysis

All data collected were entered in Microsoft Excel 2007 worksheet as database and exported to Instata Plus for statistical analysis. Descriptive statistics were generated using the same statistical package. Differences in proportions were assessed using the chi square at 5% level of significance in univariate analysis.

RESULTS

Bacterial Culture and Identification

A total of 96 clinical and sub-clinical cases of lactating camels were examined for mastitis using CMT during the study period. In general, a total of 384 quarter milk samples (124 Salaxley village, 108 QoolCaday, 48 from Aw-barkhadle, 28 from Toon, 20 from Arabsiyo and 56 from Balligubadle) were collected from the 96 cow camels during the study period. Accordingly, the overall mastitis prevalence was 33.3% (32/96) out of which, 11 (11.5%) and 21(21.8%) camels showed clinical and sub-clinical mastitis respectively.

Table 1: Prevalence of mastitis at animal and quarter levels based on CMT and grown culture.

Prevalence of subclinical mastitis at camel level

The overall camel-level prevalence of subclinical mastitis in the study area was 21.8%(21/96), out of which 8 camels (8.3%) had only one quarter affected, 6 (6.25%) had two quarters affected,

Sample	CMT		Prevalence (%)
	#Tested	#of positive	
Camel level	96	32	33.33
Quarter level	384	128	33.33

4(4.1%) three quarters affected, and only 3 (3.1%) had all the four quarters affected. Furthermore, results of the current study have shown that the prevalence of subclinical mastitis at animal level was found to be highest in Aw-barkhadle (32.7%) while the lowest being for Arabsiyo(14.2%)(Table 2).

Table 2: Prevalence of subclinical mastitis at animal/camel level in the study areas.

Study site	#Tested	#Positive	Prevalence (%)
Toon	7	2	2.08
Qoolcaday	27	5	5.2
Salaxley	31	4	4.2
Aw-barkhadle	12	3	3.1
Baligubadle	14	6	6.25
Arabsiyo	5	1	1.04
Total	96	21	21.88

Quarter Infection Rates

Out of the 384 quarter samples examined for CMT and bacterial culturing, the prevalence of quarter level mastitis was found to be 33.3% (128/384). Quarter wise, it was found that the right quarters were highly affected (12.5%) compared to the left quarters (9.375%). The adjusted crude odds ratio (OR) was 4.34 indicating that mastitis infection and the quarters of the camel's udder were significantly associated. The results further showed that the right fore-quarter (RFQ) was the most frequently infected quarter (15.6%) followed by the right hind-quarter (RHQ) at prevalence of 7.8%. The two left quarters (LFQ and LHQ) were the least infected quarters (Table 3).

Table 3: Prevalence of mastitis at quarter level in the study areas.

Quarter	Positive	Negative	Total	Prevalence	*COR 95%CI	P-value
RFQ	60	80	140	15.6%	4.34	0.24
RHQ	30	60	90	7.8%		
Total	90	140	230			
LFQ	20	70	90	5.2%	1.5	0.24
LHQ	18	46	64	4.6%		
Total	38	116	154			

*Crude Odds Ratio at 95% confidence interval; Chi-square= 4.34, P-value= 0.24.

Assessment of Associated Risk Factors

Among many potential explanatory variables, four were considered as potential risk factors for the occurrence of sub-clinical mastitis in this study. These were stage of lactation, age, tick and parity of the lactating camels. Results showed that there was a statistically significant association ($P<0.05$) among four the risk factors (stage of lactation, parity, tick and age) and the prevalence of mastitis. Lactating camels who gave birth more than two times, infested ticks, old and early lactating camels are highly chance to get mastitis than less infested ticks, young and lactating camels who give birth less than twice. As shown table 4.

X^2= Chi-square, COR= Crude odd ratio, CI= Confidence Interval at 95%.

The results from the table below shows that there were associations between the risk factors (Lactation stage, Age, Tick infestation and Parity) and the occurrence of mastitis in camels at $p>0.05$. This is because the calculated chi-square values in the table are more than the critical value of 3.84 at 95% confidence.

Table 4: Association between the occurrence of mastitis and its risk factors

Risk factors	Mastitis	Non masti-tis	Total	Prevalence%	X^2	*$COR_{95\%CI}$	P-Value
Parity							
> 2 calving	20	28	48	41.7	8.2	2	0.12
≤ 2 calving	12	36	48	25			
Total	32	64	96				
Lactation stage							
> 2 month	19	29	48	39.5	6.4	1.9	0.22
≤ 2 month	13	35	48	27			
Total	32	64	96				
Tick							
Tick infested	23	25	48	47.9	5.6	2.92	0.215
Tick free	9	39	48	18.75			
Total	32	64	48				
Age (years)							
6-8 inclusive	25	23	48	52	4.2	3.22	0.11
> 8	7	41	48	14.5			
Total	32	64	96				

Bacterial Isolation and Identification

The bacteria isolated from the 128 quarter samples are shown in Table 8. A total of126bacteria were isolated with the most predominant bacterium being *Staphylococcus aureus* with prevalence of 24.2% (31/128), followed by *E. coli* with prevalence of 21% (27/128). *Streptococcus agalactiae* and *Staphylococcus epidermidis* were the third predominant isolates with prevalence of 13.2% (17/128) each. *Micrococcus spp*with prevalence of 7.8% (10/128) and *Pseudomonas* with of prevalence 6.25% (8/128) were the least isolates. A diagnosis of 'no bacterial growth' was made. In 18 cases which is 14% (18/128). There were no contaminated samples recorded. Overall all milk samples produced mixed types of bacterial growth in the primary cultures. This indicated that there was a multiple infection of the quarters. Identical pathogens were also isolated from different quarters of individual camels and from camels within the same herd suggesting that transmission from Within the same herd suggesting that transmission from Quarter to quarter and camel to camel had occurred (Table 5).

Table 5: Prevalence and isolation rates of bacterial pathogens isolated from mastitic camel milk in the study areas.

G. stain result	Bacterial species	# of isolates	Prevalence (%)
Nil (no growth)	0	18	14
Gram +	*Staphy- aurous*	31	24.2
	Strept- agalactiae	17	13.2
	Staphylo- epidermidis	17	13.2
	Micrococcus	10	7.8
	Pseudomonas	8	6.25
Gram -	*E. coli*	27	21
Total		**128**	**100**

Results of Antimicrobial Sensitivity Test

Results of antibiotic sensitivity against bacterial isolates were shown in table (6). The antimicrobial susceptibility test of the isolated bacteria generally showed high susceptibility to the most of the used antimicrobial agents. There was high sensitivity to Gentamicin, and Cloxacillin and moderate sensitively to Ciprofloxacin and Trimoxazole and the greatest

resistance was found with Tetracycline and Ampicillin (Table 6).

Table 6: Results of antimicrobial sensitivity test of the isolated bacteria from mastitic milk samples.

Bacteria	Iso	Am	Gen	Co-	Clox	Chlo	Tetr	Cipr
Staphylococcus aureus	31	2	2	1	2	0	0	1
Streptococcus aga-lactiae	17	1	2	1	2	0	0	2
Staphylococcus epidermidis	17	1	2	1	1	0	1	1
Micrococcus	10	0	2	2	1	2	0	1
Pseudomonas	8	0	1	0	1	2	0	0
E. coli	27	0	2	1	2	1	1	2

2= sensitive, 1= moderately sensitive and 0= resistant.
Iso= isolated, Amp= Ampicillin, Gen = Gentamicin, Co- Co-Trimoxazole, Chlo= Chloramphenicol, Tetr= Tetracycline, Cipr = Ciprofloxacin, Clox= Cloxacillin.

DISCUSSION

The overall prevalence (33.3%) of camel mastitis in the current study was higher than the reports of [20]. who reported an overall mastitis prevalence of 29 % in Jijiga Zone, Somali Regional State, Ethiopia. However, the prevalence report in the current study is lower than the report from Afar Region, North Eastern Ethiopia (59.8 %) by [21], and 66.8 % prevalence from Sudanese camel herds by [22]. The results also indicated that the most affected quarters were the right quarters with high prevalence of 12.5% in the right fore quarter (RFQ) and 9.37% in the right hind quarter (RHQ). This suggested the likelihood that in most cases during milking, the calf was left to suckle the left quarters and the right quarters were milked by the owners and because of poor hygienic milking. The udder is predilection site for tick infestation which causes skin and teat 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 udder hygiene [23].

Similar to this fact, the current study also revealed that the presence of tick infestation on udder is one of the potential risk factors for the occurrence of mastitis. As mentioned earlier by many of the researchers this could be due to the fact that tick infestation can predispose the udder area by creating a conducive situation for the entrance of majority of mastitis causing microorganisms A positive relation was observed between mastitis and lactation stage, Age, parity and tick infestation. Prevalence of mastitis in early stage of lactation was significantly higher. This was sometimes due to the fact that most new infection occurs during the early part of dry period and in the first two month of lactation, especially with environmental pathogens [24]. The most predominant bacterium isolated from this study was *Staphylococcus aureus* with prevalence of 24.2% followed by *E. coli* with prevalence of 21% and *Streptococcus agalactiae* &*Staphylococcus epidermidis* at 13.2% prevalence each.

This finding is not in agreement with other findings from esastern Sudan [25], Ethiopia [7] and from Kenya [13]. who reported that *Staphylococcus aureus* and *Streptococcus agalactiae* were the most common causes of camel mastitis. It has also been reported in Kenya [26]. That *Staphylococcus aureus* was the major cause of subclinical mastitis in bovine (63%). As was also described by (2001). [13], the prevalence of *Staphylococci* varies according to different studies, but there is nearly no publication on bacteriological hygiene of milk where *Staphylococci* are not mentioned [27]. Since of *E. coli* has been reported by other authors at between 1.0 and 17.3 % in samples taken from healthy camels [28] and [29] Therefore the prevalence of *E. coli* from this study was higher than what has been reported earlier in other studies. [14] and [13]. stressed that the mastitis in milking dromedary camels caused by *Staphylococcus aureus* (Coagulase Positive) is not only of veterinary interest but represents a direct threat to human health considering that *S. aureus* can produce heat stable enterotoxins that are not inactivated during pasteurization of milk or production of milk products and can provoke food intoxication (vomiting and

diarrhoea). The Coagulase negative *Staphylococcus* (CNS) most often isolated from camel milk is *Staphylococcus epidermidis* [30]-[29].

[13]. reported *Streptococcus agalactiae* as one of the main causes of clinical mastitis in camels and a potential human pathogen, causing intestinal infections mainly in newborns. A study to determine the sensitivity of mastitis pathogens, isolated during the present investigations, revealed that Most of the *Staphylococcusspp,* and *Streptococcus spp*. Were sensitive to, gentamycin, AmpicillinandCloxacillinbut resistant to chloromphenicol and tetracycline The other mastitis pathogens like *E coli*, *Micrococcus*and*Pseudomonas*isolates were showed variable pattern of sensitivity to the antimicrobial agents like co-Trimoxazole, Gentamycine, Tetracycline and chloramphenicol. This suggested that these antimicrobial agents could be used for treatment of mastitis in camels in U.A.E. More or less similar pattern of sensitivity of the bacterial isolates in the present study to some of the above mentioned antimicrobial agents have been reported by [32], [33].

CONCLUSIONS

This study revealed high prevalence of mastitis in camel herds in the sampled area. The high prevalence of mastitis was attributed to inadequate hygienic condition of the dairy environment and tick infestation Additionally,it was observed that the occurrence of camel mastitissignificantly vary with stage of lactation indicating ahigher prevalence during early stage of lactation. Finally,among the important mastitis causing bacteria, coagulasenegative *Staphylococci, Streptococcus agalactiae,E. coli, Staphylococcus epidermidis, MicrococcusSpp and Pseudomonas*were found the most common.Therefore, good management practices with propersanitation and tick control measures are required toprevent the incidence of mammary infection in camels inthe study areas. The isolation of genera of pathogenicbacteria from the camel milk samples suggests the needfor strict hygienic measures during the production andhandling of camel milk to reduce public health hazards.Furthermore, public education should be given to improvetheir awareness about the importance of proper herd health management and hygienic milking practices. In order to minimize the adverse effect of mastitis on theyield, quality of milk and zoonotic impact of the pathogen.

Recommendations

Therefore, in light with the above conclusion, the following recommendations are forwarded:

- Government should encourage livestock sector by establishing monitoring and emergency teams.
- Giving trainings and workshops for the camel owners.
- Camel producers and any other camel milk consumers should avoid consuming raw camel milk but instead boil the milk before consuming.
- Hygienic milking procedures should be followed when milking camels.
- Milking order where you milk non mastitic camels first and camels or quarters with mastitis infections last should be adhered to
- Treatment of camels with mastitis infections using the conventional drugs should be promoted while avoiding non-conventional treatment.
- There is need to create awareness on camel mastitis among camel keepers. At the moment there is low level of awareness among pastoralists.
- More veterinary extension staff should be trained on camel mastitis diagnosis and control as it affects camel productivity.
- MOL in Somaliland should have several mastitis control strategies which needed be put in place such as milking procedures, milking order, strict hygiene, post milking teat disinfection, use of antibiotic dry-off therapy and the culling of persistently infected camels.
- In order to control and prevent mastitis in camels, it is highly advisable to avoid risk factors such as use of anti–suckling devices, tick infestation, and udder lesions.

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REFRENCE

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