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PREVALENCE AND RISK FACTORS OF CAMEL (*Camelus dromedarius*) MASTITIS BASED ON BACTERIOLOGICAL EXAMINATIONS IN SELECTED REGIONS OF ETHIOPIA

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ABSTRACT

A total of 956 quarter milk samples from 253 traditionally managed lactating camels were collected aseptically from Negele (Borena Region), Dire Dawa and Gewane (Afar Region). The multi-stage sampling was used. The samples were examined using standard microbiological techniques. Relatively, high (46.2%) prevalence of sub-clinical mastitis was recorded from the milk samples in Dire Dawa followed by 45.4% in Gewane (Afar Region) and 37.1% in Negele (Borena Region). Clinical mastitis was observed only in 1.1% in Negele (Borena Region). Five hundred and seventy one (59.73%) quarter milk samples had microorganism. Out of 571 isolates, 428 (75.00%) were of the major pathogens (MAP) and 143 (25.00%) were minor pathogens (MIP). The common pathogens isolated from sub-clinical mastitis were *S. aureus* and *E. coli* while from clinical cases were *S. aureus*, *S. hyicus*, *Streptococcus uberis*, *Bacillus cereus*, *E. coli* and *S. epidermidis*.

Key words : Bacteriological examinations, camel, Ethiopia, mastitis, prevalence, risk factors

Udder infection was considered one of the main constraints for camel rearing. For instance, it has been noticed in the slaughter houses that early culling of female camel in Iraq is attributed to chronic mastitis and infertility (Al-Ani and Al Shareefi, 1997). Moreover, El-Jakee (1998) reported that mastitis has negative impact on camel productivity.

In Ethiopia, camels are kept in arid and semi-arid lowlands of Borena, Ogaden and Afar regions. The camel population is estimated at one million in the country (Teka, 1991). The same author has also reported that the camel milk is the main food for the nomads in pastoral production system of Ethiopia, and they consume it in raw state. Based on that, Almaw and Molla (2000), Salah (2000) and Bekele and Molla (2001) investigated the udder infections in the dromedary camels in eastern, south western, and north eastern parts of the country. They also recommended that an extensive research is needed on the epidemiology and etiology of the camel mastitis. The present study was carried out to determine the prevalence of clinical and sub-clinical mastitis in the camel in Dire Dawa, Gewane (Afar Region), and Negele (Borena Region) of Ethiopia to identify bacteria that cause camel mastitis and to analyse some of the risk factors that effect the occurrence of camel mastitis.

Materials and Methods

The study was conducted in three different districts namely, Negele (Borena Region), Dire Dawa, and Gewane (Afar Region) in the southern, eastern and north eastern Ethiopia. A total of 956 quarter milk samples were collected from the study sites. The suckling calf was used to stimulate milk let-down. The teats were disinfected with cotton wool moistened with 70% ethyl alcohol. The first few squirts of milk were discarded and about 5-20 ml collected in a sterile universal bottle. The quarter milk samples were kept in an ice-box and transported as soon as possible to the laboratory and left at -20°C.

Bacteriological procedures

Frozen quarter milk samples were thawed at room temperature. The bacteriological culture was performed following the standard microbiological techniques (Quinn *et al*, 1994). One loopfull of milk

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Table 1. Prevalence of clinical and sub-clinical mastitis in camel in Negele (Borena Region), Dire Dawa, and Gewane (Afar Region) in Ethiopia.

Place	No. of quarter milk samples	No. of positive (prevalence %)	
		Clinical mastitis	Sub-clinical mastitis
Negele (Borena Region)	466	5 (1.1%)	173 (37.1%)
Dire Dawa	305	0.0	141 (46.2%)
Gewane (Afar Region)	185	0.0	84 (45.4%)
Over all	**956**	**5 (0.5%)**	**398 (41.6%)**

Table 2. Frequency and percentage of the bacteria isolated from camel mastitis in Negele (Borena Region), Dire Dawa, and Gewane (Afar Region) in Ethiopia.

Isolates*	Clinical mastitis	Sub-clinical mastitis	Total
	n (%)		
Major pathogens (MAP)			
Staphylococcus aureus	2 (22.2)	139 (24.7)	141 (24.6)
Setreptococcus agalactiae	0.0	15 (2.7)	15 (2.6)
Str. uberis	2 (22.2)	38 (6.8)	40 (7.0)
Enterococus faecalis	0.0	3 (0.5)	3 (0.5)
Micrococcus spp.	0.0	3 (0.5)	3 (0.5)
Actinomyces pyogenes	0.0	4 (0.7)	4 (0.7)
Baillus cereus	1 (11.1)	51 (9.1)	52 (9.1)
Pasteurella haemolytica	0.0	12 (2.1)	12 (2.1)
E. coli	1 (11.1)	98 (17.4)	99 (17.3)
Klebsiella pneumonae	0.0	5 (0.9)	5 (0.9)
Enterobacter aerogenes	0.0	54 (9.6)	54 (9.5)
Sub-total	**6 (66.7)**	**422 (75.1)**	**428 (75.0)**
Minor pahongens (MIP)			
Staphylococcus hyicus	2 (22.2)	54 (9.6)	56 (9.8)
S. epidermidis	1 (11.1)	51 (9.1)	52 (9.1)
S. intermedius	0.0	5 (0.9)	5 (0.9)
Str. pyogenes	0.0	6 (1.1)	6 (1.1)
Str. pueumonmae	0.0	2 (0.4)	2 (0.4)
Corynebacterium bovis	0.0	8 (1.4)	8 (1.4)
Aeromonas hydrophila	0.0	6 (1.1)	6 (1.1)
Serratia marcescens	0.0	3 (0.5)	3 (0.5)
Proteus mirabilis	0.0	3 (0.5)	3 (0.5)
Proteus vulgaris	0.0	2 (0.4)	2 (0.4)
Sub-total	**3 (33.3)**	**140 (24.9)**	**143 (25.0)**
Total	**9 (100.0)**	**562 (100.0)**	**571 (100.0)**

* = The isolates from all regions; n = Number of isolates; (%) = percentage of isolates

Table 3. The association between occurrence of camel mastitis and various risk factors.

Factors	$\chi 2$	*P*-value
Tick infestation	0.00	1.000
Teat lesion	0.26	0.612
Conformation of the udder	2.60	0.107
Precious history of mastitis	0.05	0.826
Anti-suckling devices[a]	7.77	0.005**

The results for all regions except the anti-suckling devices only for Negele (Borena Region)

χ^2 = Chi-square; *P* - value = significant level; **: P-value < 0.01
a = anti-suckling devices: odds ratio (OR) = 1.807, 95% confidence interval (CI) = (1.207-2.698)

was streaked on 5% sheep blood agar and MacConkey agar. The plates were incubated aerobically at 37°C for 24 and 48 hours. Presump-tive identification of bacteria on primary culture was done on the basis of colony morphology, hemolytic characteristics, Gram-stain and biochemical tests.

Case definition

An individual mammary quarter was defined as non-infected (NI) if no microorganism was isolated, infected with major pathogens (MAP) if *Staphylococcus aureus*, *Streptococcus agalactiae*, *S. uberis*, *Enterococcus faecalis*, *Micrococcus* spp, *Actinomyces pyogenes*, *Bacillus cereus*, *Pasteurella haemolytica* and coliforms were present, and infected with minor pathogens (MIP) if coagulase-negative *Staphylococci* (CNS), *Corynebacterium bovis* and other environmental pathogens were isolated. This classification was based on the presence of pathogens which are responsible for udder infection (Quinn *et al*, 1994; Abdurahman *et al*, 1995; Obied *et al*, 1996; El-Jakee, 1998; Radostits *et al*, 2000; Bekele and Molla, 2001).

Determination of clinical and sub-clinical mastitis

The clinical mastitis was recognised by abnormal milk and gross signs of udder infection. Sub-clinical mastitis refers to the existence of inflammation of the udder in the absence of gross signs. This was established by bacteriological examinations (major pathogens).

Statistical analysis

Stata 6.0 for Windows 98/95/NT was used for data analysis. Chi-square (χ^2) was used for assessing the statistical associations of various risk factors with mastitis. The logistic regression model was employed to obtain the odds ratios between different factors and occurrence of camel mastitis.

Results

Prevalence of clinical and sub-clinical mastitis

Prevalences of both clinical and sub-clinical mastitis are given in Table 1. High prevalence of sub-clinical mastitis was recorded from quarter milk samples in Dire Dawa and Gewane (Afar Region) as 46.2% (n = 141) and 45.4% (n = 84), respectively. However, there were no clinical cases recorded in these two areas. Sub-clinical mastitis was present in 173 (37.1%) quarter milk samples examined from Negele (Borena Region). Only 5 (1.1%) quarters had clinical mastitis in this area.

Intramammary infection

A total of 956 quarter milk samples from 253 traditionally managed lactating camels were collected aseptically and examined using standard microbiological techniques irrespective of the results of California Mastitis Test (CMT) and somatic cell counts (SCC). Five hundred and seventy one (59.73%) quarter milk samples had microorganisms and 385 (40.27) quarter milk samples were found negative for microbial analysis. Out of 571 milk samples, 428 (75.00%) isolates were identified as major pathogens (MAP) and 143 (25.00%) isolates were considered minor pathogens (MIP) (Table 2).

The major pathogens isolated from sub-clinical mastitis were *S. aureus* 24.7% (n = 139), *E. coli* (17.4%, n = 98), *Enterobacter aerogenes* (9.6%, n = 54), *Bacillus cereus* (9.1%, n = 51) and *Streptococcus uberis* (6.8%, n = 38). Coagulase-negative *Staphylococci* (CNS) (*S. hyicus* and *S. epidermidis*) were the common minor pathogens and they accounted for 9.6% (n = 54) and 9.1% (n =51) of the total microorganisms of sub-clinical mastitis, respectively.

The microorganisms isolated from clinical cases were *S. aureus* 22.2% (n = 2), *S. hyicus* 22.2% (n = 2), *Streptococcus uberis* 22.2% (n = 2), *Bacillus cereus* 11.1% (n = 1), *E. coli* 11.1% (n = 1) and *S. epidermidis* 11.1% (n = 1). These were isolated from 5 quarter milk samples collected in Negele (Borena Region).

Risk factors analysis

There was no statistical significance between the occurrence of camel mastitis and various risk factors (tick infestation, teat lesions, conformation of the udder, and previous history of mastitis) (Table 3). A positive correlation (χ^2 =7.77; *P*-value = 0.005) was only recorded between the use of anti-suckling devices and occurrence of camel mastitis. Logistic regression model showed that anti-suckling devices could be a risk factor for camel mastitis (OR= 1.807; 95% CI=1.207-2.698).

Discussion

The clinical mastitis was recorded in Negele (Borena Region) only with very low prevalence (1.1%) which is not significantly different than 2.1% reported by Almaw and Molla (2000) in eastern Ethiopia. However, this proportion of clinical mastitis was lower than those reported by Bekele and Molla (2001) in Ethiopia (12.5%), Barbour *et al* (1985) in Saudia Arabia (15%) and Obied *et al* (1996) in Sudan (19.5%).

High prevalence of sub-clinical mastitis in the camel was recorded in Dire Dawa (46.2%) followed by Gewane (45.4%) and Negele (37.1%). The prevalence is very high as compared to those recorded by Almaw and Molla (2000) and Bekele and Molla (2001) of 22.05% and 18.95% in eastern Ethiopia and 19.1% and 17.8% in north-eastern Ethiopia based on the CMT and bacteriological results, respectively.

The bacteriological results showed that *S. aureus* and coagulase-negative Staphylococci (*S. hyicus* and *S. epidermidis*) were the common microorganisms isolated from sub-clinical mastitis. These microorganisms have been diagnosed as the main causative agents of sub-clinical mastitis in camels (Abdurahman *et al*, 1995; Obied *et al*, 1996 and Bekele and Molla, 2001). *Streptococcus uberis*, *Streptococcus agalactiae* and *Corynebacterium bovis* were also prevalent pathogens isolated from camel milk of sub-clinical mastitis. Similarly, Bekele and Molla (2001), El-Jakee (1998), Almaw and Molla (2000), and Abdurahman *et al* (1995) have isolated these microorganisms from mastitic camels. Radostits *et al* (2000) explained that *Streptococcus agalactiae* is a highly contagious obligate microorganism of the bovine and a major cause of udder infection. While, Todhunter *et al* (1995) reported that the proportion of intramammary infections caused by environmental Streptococci such as *Streptococcus uberis* has markedly increased. In addition, these authors indicated that this pathogen is the leading cause of both sub-clinical and clinical mastitis in dairy cattle worldwide. *C. bovis* was considered as a minor pathogen. It is mildly pathogenic and the main reservoir is the infected glands or teat ducts (Radostits *et al*, 2000).

In this study, *E. coli* was isolated from both sub-clinical and clinical mastitis. Radostits *et al* (2000) reported that in contrast to contagious mastitis, environmental mastitis caused by coliform bacteria is primarily associated with clinical mastitis, rather than sub-clinical mastitis. However, Saad and Thabet (1993) and Bekele and Molla (2001) isolated *E. coli* from mastitic camels and regarded as the principle

agent for both clinical and sub-clinical mastitis in dromedary camels. The other coliforms isolated in this study were *Enterobacter aerogenes* and *Klebsiella pneumoniae*. The important role of *Klebsiella pneumoniae* in camel mastitis has been reported in Egypt (El-Jakee, 1998).

Further microorganisms isolated from sub-clinical mastitic milk were *Pasteurella haemolytica* and *Bacillus cereus*. These results are in agreement with those of Bekele and Molla (2001) who isolated *Pasteurella haemolytica* and *Bacillus* spp. from sub-clinical mastitis in camels in north-eastern Ethiopia. However, Radostits *et al* (2000) considered these bacteria as uncommon pathogens that cause sporadic and severe mastitis. In addition, they usually affect one animal in the herds.

The microorganisms isolated from clinical cases in this study were *Staphylococcus aureus*, *Streptococcus uberis*, *S. hyicus*, *Bacillus cereus*, *E. coli*, and *S. epidermidis*. Similar isolates have been reported by different investigators as important agents of clinical mastitis in camels (Ramadan *et al*, 1987; Al-Ani and Al-Shareefi, 1997; Almaw and Molla, 2000; Bekele and Molla, 2001).

Results of the risk factors analysis showed that the use of anti-suckling devices was a contributory factor for camel mastitis. It is probable that these devices positively enhanced the spread of intramammary infection among camels. Similarly, in Sudan Abdurahman *et al* (1995) and Obied *et al* (1996) explained that the use of anti-suckling devices might be regarded as predisposing factor for camel mastitis.

The results of tick infestations and teat lesions are in contrast with the observations of Bekele and Molla (2001). These researchers suggested that heavy tick infestation and teat lesions might be responsible for udder infection and also lead to udder abnormalities and deformities and blind teats in Afar milking camels. The disagreement can be attributed to the large number of the camels that were observed having tick infestations and a few of them with teat lesions in this study. These could have affected the outcome of the final analytical results.

In conclusion, the results of the present study revealed that mastitis in camel is prevalent in the study sites. The pathogenic bacteria that cause mastitis in camels are similar to those of the cows. Use of anti-suckling devices was incriminated as a risk factor in spreading of intramammary infection in camels.

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