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Prevalence, Risk Factors and Major Bacterial Causes of Camel Mastitis, in Gursum District, Eastern Hararghe, Ethiopia

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Abstract: A cross-sectional study was conducted in lactating camels kept under traditional management systems to determine prevalence of mastitis, risk factors and to isolate the major mastitis causing bacteria in Gursum district of Eastern Hararghe zone, Ethiopia. Mastitis indicator paper (MIP) was used to determine the prevalence of camel mastitis. Among total of examined 1264 quarters about 1.7% had blind quarters. The overall prevalence of mastitis at animal level was 31.0% of which 6.3 and 24.7% were clinical and subclinical cases, respectively. Tick infestation and udder lesions were significantly associated with camel mastitis ($P < 0.05$). Bacteriological examination of MIP positive camel milk samples revealed that *Staphylococcus* spp was the major causative agents for both clinical and sub clinical camel mastitis (43.2%) followed by *E. coli* (15.55%), other S*treptococcus* spp. (12.2%), including *Strep. agalactiae* (10%), *Klebsiella* spp. (7.77%), *Bacillus* spp. (6.6%) and other *Micrococcus* spp. (4.4%). The study demonstrated that camel mastitis is a problem which warrants appropriate control measures in order to improve the health of camels and quality of camel milk production in the study area.

Key words: Prevalence · Mastitis · Risk Factor · Bacteria · Eastern Hararghe

INTRODUCTION

The camel is a multipurpose animal that has outstanding performance in the arid and semi-arid environments where browse and water are limited. In pastoral area camels are mainly kept for milk production and produce milk for a longer period of time even during the dry season when milk from cattle is scarce [1]. The annual camel milk production in Ethiopia is estimated to be 75, 000 tones [2]. Nevertheless, like other dairy animals, camel can be affected by udder infection as mastitis [3].

Mastitis is the inflammation of parenchyma of the mammary gland, regardless of the primary cause which is a major disease problem that appears to be worldwide in distribution and affects all species of animals [4]. It results in milk compositional changes such as increase in leukocyte counts, leakage of plasma proteins into the milk, decrease in milk production, causes suffering for the animal and poses public health risk. Mastitis also influences the technological property of milk [5].

Mastitis occurs in clinical or subclinical forms. Clinical mastitis is self-evident and can be detected without special tests. Subclinical mastitis causes an increase in the total bacterial count in milk. It is responsible for reducing milk yield and has a much greater impact on the productivity of lactating animals than the sporadic clinical forms of the disease. Chronic intramammary infection ultimately leads to loss of intact quarters by destruction of the gland tissue [6].

Infection of the mammary gland is almost via the teat channel, originating either from the environment or from the infected udder of other animals which is transmitted through milker's hand or milking device [4]. The degree of transmission is affected by certain risk factors including season, prevalence in the herd, milking practice, management, milk yield, breed, level of inheritance and bacterial factors [7]. Bacterial infections are considered the primary cause of mastitis in domestic animals. The major causes of bovine mastitis have been well studied, however there is little information regarding the causative

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agents associated with camel mastitis. Some earlier studies have indentified that the bacteria *Staphylococcus aureus*, coagulase negative staphylococci, *Streptococcus species*, *Micrococcus species Staphylococcus epidermidis, Pasteurella haemolytica and E. coli* as a major causes of camel mastitis [8-10].

Occurrence of mastitis among lactating camel has been reported from some of camel - rearing countries like Somalia [8], Sudan [11], Kenya [10], Israel [12] and different parts of Ethiopia [13-17]. However, there is a paucity of information on the prevalence and etiological causes of camel mastitis in Gursum district of East Hararghe zone, Ethiopia. To design appropriate control program in a dairy herd, up to date information on the nature of mastitis and economic impact of the problem need to be known. Therefore this study was conducted with the objectives to determine the prevalence of camel mastitis in traditionally managed camels East Hararghe zone (Gursum district) based on the mastitis indicator card and culture growth. This study was also designed to identify the mastitis causing pathogens and assess some risk factors associated with the occurrence of camel mastitis in the study area.

MATERIALS AND METHODS

Description of Study Area and Animal: The study was conducted from November 2011 to April 2012, in Gursum district, East Hararghe zone, Ethiopia. According to East Hararghe zone Agricultural Development Department report, the estimated total numbers of livestock in the zone were 2, 224, 049 cattle, 1, 456, 282 goat, 674, 804 sheep and 460, 710 equine and 161, 286 camels while the number of poultry were estimated to be 1, 200, 574 in the zone. The study animals were all lactating camels that were kept under traditional management system.

Sample Size Determination: The desired sample size for the study was calculated by using the formula given by Thrusfield [18], with 95% confidence interval (CI), 5% desired absolute precision and expected prevalence of 29% [23]. Accordingly a total of 316 lactating camels were sampled from the study area.

Study Design and Sampling Method: A cross-sectional design was conducted in order to determine the prevalence and major causes of camel mastitis in Gursum district. Three pastoral associations were selected purposively based on their accessibility and willingness of the camel owners for sampling. Proportional sampling method was considered based on the camel population present in each pastoral association. Accordingly a total of 316 lactating camels were sampled from three pastoral associations namely 121 camels from Daketa, 97 from Qore and 98 from Noleyye. Individual lactating camels were selected for clinical examination and mastitis card test using systematic random sampling technique. In this study the clinical cases were defined based on Radostits *et al*. [4] which are characterized by swollen, reddened, pain full up on palpation of the udder and alteration in the color and consistency of milk depending on the degree of inflammation. Other informations like presence of tick infestations, traumatic wound and presence of anti-suckling devices were also recorded. The milk was examined for its consistency, color and other visible abnormalities.

Milk Sample Collection and Bacteriological Analysis: Milk sample collection was carried out early in the morning and late in the afternoon at time of milking. Before milking, all quarters were carefully examined by visual observation and palpation. The teat ends were disinfected with water and cotton moistened with 70% alcohol. After the discarding the first few streaks, milk samples were tested using mastitis indicator for screening and card positive milk samples were kept in ice-box and immediately transported to Jigjiga Regional Veterinary Diagnostic and Research Laboratory for culturing and Biochemical tests. All card positive milk samples were subjected to bacteriological examination according to Quinn *et al.* [19]. Each milk sample (10µl) was streaked onto a plate of blood agar and MacConkey agar. The plates were incubated at 37°C for 24-48 hr. and examined for any bacterial growth, morphologic feature, pigmentation and haemolytic characteristics of the colonies. Subcultures were made to obtain pure isolates for further bacteriological identification according to the standard procedures described by Quinn *et al*. [19] and NMC [20].

Data Analysis: The recorded data were entered into micro soft excel spread sheet and transferred to SPSS version 17.0 for analysis. The overall prevalence of mastitis was determined by dividing mastitis indicator paper positive to the total examined animal. Risk factor associated with the occurrence of mastitis like presence of tick infestation and wound was compared by using Chi-square test. *P-value* < 0.05 was considered statistically significant for Chi-square test.

RESULTS

Prevalence of Mastitis: A total of 316 traditionally managed lactating camels were examined for mastitis detection and an overall prevalence of 31 % (Table 1) was recorded out of which, 6.3 and 24.7% camels were found to be affected with clinical and subclinical mastitis respectively, based on clinical examination and mastitis indicator paper (Table 2).

Risk Factors: This study revealed that had lesions on the udder and teats were all positive (100%) for mastitis both clinically and sub-clinically whereas out of 51 lactating she camels with tick infested udders were 60.7% positive for mastitis. A significant association was observed among camels with tick infested and wounded udder or teats in this study ($P < 0.05$) (Table 3).

Quarter Wise Prevalence of Mastitis: Out of the total 1243 examined teats, 314 (25.3%) teats were found positive using mastitis indicator paper for both clinical and subclinical mastitis excluding the blind teats from which the milk sample was not taken. The proportion of mastitis positives in relation with quarter was presented in (Table 4) below.

Culture Results: A total of 98 mastitis indicator paper positive milk samples were cultured for bacteriological isolation and 90 (91.8%) were culture positive. The most prevalent mastitis causing pathogens in this study were Gram positive bacteria, with the prevalence of 76.7 % (69/90) followed by Gram negative bacteria 23.3% (21/90). This study revealed that *Staphylococcus* spp. were the most predominant pathogens constituting 43.2% out of which (22.2%) and 21% were

Table 1: Prevalence of mastitis both at the animal and quarter level based on the on mastitis indicator paper

	Mastitis indicator paper		
	No of tested	No of positive	Prevalence (%)
Camel level	316	98	31
Quarter level	1264	314	24.8

Table 2: Prevalence of clinical and sub-clinical form of mastitis at animal level

	Camel level (n=316)	
Type of mastitis	No of positive	Prevalence (%)
Clinical	20	6.3
Sub-clinical	78	24.7

Table 3: Association between tick infested and wounded udder with occurrence of mastitis in the study

Status of udder		No examined	No of mastitis positive (%)	Prevalence	*P- value*
Tick infested					0.03
	Yes	51	31	60.7%	
	No	265	67	25.3 %	
Wounded					0.000
	Yes	33	33	100%	
	No	283	65	23.0%	

Table 4: The mastitis indicator paper with regard to each teat

		Mastitis indicator paper result (n=1243)		
Quarter	Number of blind teat	Trace	No. positive	% positive
Left hind	6	6	63	5.1
Left front	7	8	86	6.9
Right hind	2	6	83	6.7
Right front	6	6	82	6.6
Total	21	26	314	25.3

Table 5: Isolated bacteria from cultured samples

Bacterial species	Number of isolates	Proportion (%)
Coagulase positive spp. *(S. aureus)*	19	21
Coagulase negative *Staphylococcus* spp.	20	22.2
S. agalactiae	9	10
Other *Streptococcus* spp.	11	12.2
Micrococcus spp.	4	4.4
Bacillus spp.	6	6.6
Sub total	69	76.7
Escherichia coli	14	15.6
Klebsiella spp.	7	7.8
Sub total	21	23.3
Total	90	100

coagulase negative *Staphylococcus* spp. and coagulase positive *Staphylococcus aureus* (21%) respectively. Other bacterial isolates were *Streptococcus* spp. (12.2%), *S. agalactiae* (10%) and *Micrococcus* spp. (4.4%), *E. coli* (15.55%), *Klebsiella* spp. (7.77%) and *Bacillus* spp. (6.6%) (Table 5).

DISCUSSION

Among 316 traditionally managed lactating camels examined for mastitis, an overall prevalence of 31% (98/316) was obtained in the current study. This finding is lower than the report of Seifu and Tafesse [21], who found an overall prevalence of 76.0% among traditionally managed camels (*Camelus dromedarius*) in selected pastoral areas in Eastern Ethiopia and 59.8% report from Afar region of North Eastern Ethiopia by Bekele and Molla [17]. However, the finding of the present study is comparable with that of Osman [22] who found an overall prevalence of 29% in Jigjiga zone, Somali Regional state. On the other hand, the finding of clinical (6.3%) and sub-clinical mastitis (24.7%) reported in this study is in disagreement with the finding of Megersa [23] who reported the prevalence of sub-clinical mastitis ranged from 28.6 to 37.6% and clinical mastitis ranged from 10-17% respectively in Borana areas of southern Ethiopia. However, prevalence of sub-clinical mastitis obtained in the current study is higher than that of 20.5 and 15.8% reported by Almaw and Molla [17] and Osman [22] respectively. The variation in prevalence with those observed in other areas might be due to difference in management systems and the agro-ecological zone/region [24]. An earlier study by Abdurahman [25] had showed that camels are much more susceptible to mastitis, mainly in areas where hygienic conditions are poor and treatment of mastitis is not undertaken. Other author also suggested that the occurrence of mastitis might be influenced by some heritable characteristics such as capacity of milk production, teat structure and udder conformation as well as genetic variation in disease resistance among breeds [8].

Concerning the udder wound, penetrating and non penetrating superficial skin lesions of the teat and udder were observed on 33 camels and all of them (100%) were mastitis positive compared to the prevalence of those camel without udder lesions. Higher prevalence of mastitis 72.2% in camels with udder lesions were also reported by Teketelew and Bayeleyegn [26] in which the udder/ teat skin scratches can be caused by thorn plant of the desert. Generally trauma might be directly responsible for mastitis because the injury could predispose the udder to bacterial invasion. The udder/ teat skin lesions observed in lactating camels could be attributed to the tick burdens of infested udders and by scratches caused by thorny plants of the desert. In the Gursum district the use of anti-suckling devices in camel by the owner is practiced only during the day time when the young calves older than one year are herded together with their dams which otherwise kept around the house. When the camels travel long journeys, they are exposed to thorny plants of the desert together with heavy tick infestations could predispose the udder to bacterial infection, which persist as chronic infection. This is one of the many factors that predispose camels to mastitis and influenced by poor udder hygiene [23]. Similar to this fact, this study also revealed that the presence of tick infestations on the udder is one of the potential risk factor identified for the occurrence of mastitis. Previous studies have showed that tick infestation predispose the udders to bacterial infections by creating a conducive environment for the entrance of the majority of mastitis causing microorganisms and leave permanent tissue damage [13, 25 & 27].

Gram positive cocci were the main pathogens isolated from camel milk samples containing 70% of the total isolates. Various authors also reported that these pathogens are major mastitis causing agents in camels [15, 28], in dairy cows [4, 19, 29& 30] and in goat and sheep [31]. The bacteria isolated from cultures like *S. aureus* and other coagulase positive *Staphylococcus* were mainly responsible for clinical mastitis but some agents like S*treptococcus agalactiae*, were found in both clinical and sub-clinical mastitis described by Younan *et al*. [10].This finding is in agreement with the report from Dire Dawa and Gewane by Abdul-Gadir *et al.* [15] and Negale Borana by Woubit *et al.* [14] who reported the prevalence of 75 and 74% respectively. This study revealed that predominantly higher proportion of *Staphylococcus* (21%) among the isolated bacteria which is comparable with report of Woubit *et al.* [14] who reported 21.5*% S. aureus* from the total isolates. Previous studies have indicated that *S. aureus* is the most pathogenic among the mastitis causing agents. It causes chronic, clinical or subclinical mastitis associated with a reduction of milk yield and is difficult to treat [32, 33]. The increase in number of isolates of *S. aureus* and other major mastitis causing pathogens might be attributed to the lack of supply and infrequent use of antimicrobials and the inaccessibility of camel owners to veterinary services as compared to dairy cow owners in urban and peri-urban areas.

CONCLUSIONS

This study indicated that mastitis is a prevalent disease among lactating she-camels of the study area. It was observed that the occurrence of camel mastitis was significantly associated with udder health and the presence of ticks and lesions on the udder. Among the important mastitis causing bacteria Gram positive cocci (*S. aureus* and *S. agalactiae*) were found to be the most predominant bacteria. Therefore appropriate control and preventive measures should be implemented against pathogenic mastitis causing bacteria by creating awareness to the camel owners about the importance of hygienic milking such as good sanitation and proper milking technique. A strategic tick control program should also be implemented, to reduce the risk of mastitis in lactating she-camels. Furthermore, to control the zoonotic impact of some of bacteria, milk consumers should be oriented about the importance of consuming boiled milk.

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REFERENCES

1. Tafesse, B., Z. Mekuriaw and R.M.T. Baars, 2002. Milk production performance of the one humped camel (Camelus dromedarius) under pastoral management in semi-arid eastern Ethiopia. Liv. Prod. Sci., 76: 37-44.
2. Felleke, G., 2003. A Review of the small scale dairy sector-Ethiopia. FAO prevention of food losses programme: milk and dairy products, post-harvest losses and food safety in sub-Saharan Africa and the near East. (http://www.fao.org/ag/ againfo /projects/en/pfl /documents.html).
3. Matofari, J.W., Y. Mario, E.W. Mwatha and P.O. Okemo, 2003. Microorganisms associated with subclinical mastitis in Kenyan camels (*Camelus dromedarius*). J. Trop. Microbiol., 2: 11-16.
4. Radostits, O.M., C.C. Gay, K.W. Hinchcliff and P.D. Constable, 2007. Mastitis. In: Veterinary Medicine: A Text book of disease of cattle, sheep, pigs, goats and horses. 10th ed., Ballier, Tindall, London, pp: 674-762.
5. Korhonen, H. and L. Kaartinen, 1995. Changes in the composition of milk induced by mastits. In: The bovine udder and mastitis. Eds., Sandholm, M., T. Honkanen-Buzalski, L. Kaartinen and S. Pyörälä. University of Helsinki, Finland, pp: 76-82.
6. Younan, M., 2004. Milk hygiene. In. Milk and meat from the camel: Handbook in products and processing. Zurich. Eds Farah and Fischer, 232: 67-76.
7. Quinn, P.J., B.K. Markey, M.E. Carter, W.J. Donelly and F.C. Leonard, 2002. Veterinary Microbiology and Microbial Disease. Blackwell Science Ltd, a Blackwell publishing Company, pp: 465-475.
8. Abdurahman, O., H. Agab, B. Abbas and G. Åström, 1995. Relations between udder Infection and somatic cells in camel (*Camelus dromedaries*) milk. Acta. Vet. Scand., 36: 424-431.
9. Al-Ani, F.K. and M.R. Al-Shareefi, 1997. Studies on mastitis in lactating one-humped camels (*Camelus dromedarius*) in Iraq. J. Camel Pract. Res., 4: 47-49.

10. Younan, M., Z. Ali, S. Bornestein and W. Muller, 2001. Application of california mastitis test in intramammary *Streptococcus agalactiae* and *Staphylococcus aureus* infection of camels (*Camelus dromedaries*) in Kenya. Prev. Vet. Med., 51: 307-316.
11. Obied, A.I.M., H.O. Begadi and M.M. Mukhtar, 1996. Mastitis in camel (Camelus dromedaries) and the somatic cell count of camel milk. Res. Vet. Sci., 16: 55-58.
12. Guliye, A.Y., C. Vancrevald and R. Yagil, 2002. Detection of sub-clinical mastitis in dromedary camels using somatic cell count and the N-acetyl beta- D-Glucosominidase test. Trop Anim Health Prod., 34: 95-104.
13. Almaw, G. and B. Molla, 2000. Prevalence and etiology of mastitis in camels (*Camelus dromedaries*) in eastern Ethiopia. J. Camel Pract. Res., 7: 97-100.
14. Woubit, S., M. Bayleyegn, P. Bonnct and S. Jeanbaptiste, 2001. Camels (*Camelus dromedarius*) mastitis in Borana lowland pastoral, south western Ethiopia. Revued Elevage et De Veterinary Des Pays Tropicaux, 54: 207-212.
15. Abdul-Gadir, A.E., G. Hildebrand, J.N. Kleer, B. Molla, M.N. Kyule and M.P. Baumann, 2006. Comparison of California mastitis test, somatic cell and bacteriological examinations for detection of camel (*Camelus dromedaries*), mastitis in Ethiopia. Berl. Munch Tierarzil Woshenschr, 119: 5-49.
16. Abera, M., O. Abdi, F. Abunna and B. Megersa, 2010. Udder health problems and major bacterial causes of camel mastitis in Jijiga, Eastern Ethiopia: implication for impacting food security. Trop. Anim. Health Prod., 42: 341-347.
17. Bekele, T. and B. Molla, 2001. Mastitis in lactating camels (*Camelus dromedaries*) in Afar Region, North-Eastern Ethiopia. Berl. Munch Tierarztl Wochenschr., 114: 169-172.
18. Thrusfield, M., 2005. Veterinary Epidemiology, 3rd ed., Blackwell Publishing Company, Black Well Ltd, UK.
19. Quinn, P.J., M.E. Carter, B. Markey and G.R. Carter, 2004. Clinical Veterinary Microbiology. London Wild life Publisher, pp: 95-101.
20. National Mastitis Council (NMC), 2004. Microbiological procedures for the diagnosis of udder infection," 3rd ed., National Mastitis Council Inc. Arlington, VA.
21. Seifu, E. and B. Tafesse, 2010. Prevalence and etiology of mastitis in traditionally managed camels (Camelus dromedarius) in selected pastoral areas in eastern Ethiopia. Ethiop. Vet. J., 14(2): 103-113.
22. Osman, A., 2008. Prevalence of camel mastitis and major bacterial causes in Jigjiga Zone, Somalia region, DVM thesis, Hawassa University, Faculty of Veterinary Medicine.
23. Megersa, B., 2010. Epidemiology of major camel disease in Borana low land, Southern Ethiopia. Dry Lands Coordination Group Report., pp: 1-2.
24. Chafe, U.M., A. Musa and B. Dogara, 2008. Studies of some health aspects of traditional camel management in Northwestern Nigeria. LRRD. 20, Article #31, Retrieved November 3, 2014, from http://www.lrrd.org/lrrd20/2/chaf 20031. Htm.
25. Abdurahman, O.A.Sh., 2006. Udder health and milk quality among camel in the Erer vally of eastern Ethiopia. Division of comparative reproduction, obstetrics and udder health. Department of clinical science, Swedish university agricultural science, upsala, Sweden, pp: 1-9.
26. Teketelew, B. and M. Bayeleyegn, 2001. Mastitis in lactating camels (*Camelus dromedarius*) in Afar Region, Northeastern Ethiopia. Berlmunch Tierarztl Wochenchr, 1145: 169-72.
27. Abdurahman, O.A.Sh. and M. Younan, 2004. The udder health. In: Farah and Fisher (editor).Milk and Meat from the camel, hand book on product and processing. Vdf Hochschulverlag AG and der ETH Zurich, Zurich/Singen, pp: 73-76.
28. Hawari, A.D. and D.S. Hassawi, 2008. Mastitis in one humped she-camels (*Camelus dromedarius*) in Jordan. J. Biol. Sci., 8: 958-961.
29. Zadoks, R.N., H.G. Allore, H.W. Barkema, O.C. Sampimon, G.J. Wellenberg, Y.T. Gro¨hn and Y.H. Schukken, 2001. Cow and quarter-level risk factors for *Streptococcus uberis* and *Staphylococcus aureus* Mastitis. J. Dairy Sci., 84: 2649-2663.
30. Kerro, O. and F. Tareke, 2003. Bovine mastitis in selected areas of Southern Ethiopia. Trop. Anim. Health. Prod., 35: 197-205.
31. Coetzer, J.A.W., G.R. Thomson and R.C. Tustin, 1994. Infectious disease of livestock with special reference to Southern Africa, Vol. II. Cape Town, South Africa, Oxford University Press.
32. Sol, J., O.C. Sampimon, H.W. Barkema and Y.H. Schukken, 2000. Factors associated with cure after therapy of clinical mastitis caused by *Staphylococcus aureus*. J. Diary Sci., 83: 278-284.
33. Grabber, H.U., J. Naskova, E. Studer, T. Kaufmann, M. Kirchhofer, M. Brechbuhl, W. Schaeren, A. Steiner and C. Fournier, 2009. Mastitis-related subtypes of bovine *Staphylococcus aureus* are characterized by different clinical properties. J. Diary Sci., 92: 1442-1451.