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# Prevalence of camel (*Camelus dromedaries*) mastitis in Jijiga Town, Ethiopia

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**A cross sectional study of camel mastitis was conducted on 384 lactating camels from Jijiga between November 2011 to April 2012 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 30.2% (116/384) out of which, 4.9% (19/384), 25.3% (97) were clinical and sub-clinical mastitis, respectively. The overall quarter level prevalence was 25.8% (397/1536). There was significant (P<0.05) in prevalence between camels with teat lesion, tick infestation, parity or age to mastitis than those without these factors. Microbiological examination of 174 randomly selected CMT positive milk samples from clinical quarters, revealed that the majority of the isolates were coagulase negative *Staphylococci* (39.6%), followed by *Streptococcus dysagalactiae* (22.2%), *Corynebacteria* spp. (9%), *Bacillus* spp. (7.6%), *Streptococcus uberis* (7.6%), *Escherichia coli* (6.3%), *Staphylococcus aureus* (4.2%) and *Streptococcus agalactiae* (3.5%). 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.**

**Key words:**Camel, prevalence, lactating, mastitis, Jijiga.

## INTRODUCTION

The camel (*Camelus dromedaries*/one humped camel) is the most dominant and widely distributed animal in the tropical and subtropical continents of Africa and Asia. It makes an important contribution to human survival and utilization of these in dry and arid land (Abdurahman and Younan, 2004).

In Ethiopia, camels are kept in arid and semi-arid low lands of Borana, Somalia and Afar regions, which cover 50% of the pastoralist area in country. The major ethnic groups owing camels in Ethiopia are the Somali, Borana and Afar (Teka, 1991). The annual camel milk production in Ethiopia was estimated to be 75,000 tones (Felleke, 2003). In most pastoralists, camel milk is always consumed either fresh or in varying degrees of sourness in the raw state without heat treatment and, can pose a health hazard to the consumer. In their natural desert habitat, where camels are usually raised particularly during the long dry season, camels are subjected to severe stress conditions which render them susceptible to many diseases and ailments (Abbas et al., 1993; Agab, 1993). Although, camels were considered in the past, and for a fairly long time, as resistant to many disease causing factors (Dalling et al., 1988), it has been proved that camels are susceptible, to similar diseases that affecting the livestock or other animal species (Wilson et al., 1982; Abbas and Tilley, 1990; Saint-Martin et al., 1992; Abbas and Agab, 2002).

Mastitis is a complex disease occurring worldwide

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among dairy animals with heavy economic losses. Mammary infections results in milk compositional changes such as increase in leukocyte counts, leakage of plasma proteins into the milk and cell damage, resulting in leakage of intracellular constituents into milk, change in ion composition and decrease in milk production (Korhonen and Kaartinen, 1995). Bacterial infections are considered the primary cause of mastitis in domestic animals.

The causative agents of bovine mastitis are well defined There is extensive literature on bovine mastitis and to a lesser extent on ovine and caprine mastitis. In contrast, there is paucity of information about the etiological agents associated with camel mastitis. Few available studies indicate that *Staphylococcus aureus, streptococcus spp*. (Barbour et al., 1985; Abdurahman et al., 1995; Al-Ani and Al-Shareefi, 1997; Younan et al., 2001), *Micrococcus spp.* (Barbour et al., 1985; Al-Ani and Al-Shareefi, 1997), *Streptococcus agalactiae* (Abdurahman et al., 1995; Younan et al., 2001), coagulase negative *staphylococci* (Abdurahman et al., 1995), *Staphylococcus epidermides*, *Pasteurella haemolytica* (Al-Ani and Al-Shareefi, 1997), *Escherichia coli* (Abdurahman et al., 1995; Al-Ani and Al-Shareefi, 1997) and *Corynebacterium spp* (Barbour et al., 1985) have been implicated as causes of mastitis in camels.

There is extensive literature on bovine mastitis and to a lesser extent on ovine and caprinemastitis; however, little is known about mastitis in camels.

Likewise there is limited information on the prevalence and causative agents of camel mastitis in Ethiopia. The prevalence and causes of mastitis differ markedly due to geographical area and individual herd management (Guidry, 1985). To establish an efficient mastitis control program in a dairy herd, baseline information on the nature of mastitis and economic impact of the problem need to be known (Honkanen-Buzalski and Pyörälä, 1995). Therefore, the objectives of the study were to determine the prevalence of mastitis in the study area, isolate the possible causes of the diseases and to identify the possible risk factors of the diseases. These can generate baseline information on status of the disease that could serve as an input for possible interventions programs on the problem by the regional government or at national level.

## MATERIALS AND METHODS

### Study area

The study was conducted from November 2011 to April 2012 around Jijiga in Eastern part of Ethiopia. Jijiga is located approximately 80 km East of Harar and 60 km West of the border with Somalia and located at distance of 628 km Eastern of Addis Ababa. The areas are geographically found at a latitude and longitude of 9°21'N and 42°48' E, respectively and characterized by unreliable and erratic rainfall with a precipitation ranging from 300 to 600 mm per annum, high ambient temperature 30°C, sparsely distributed vegetation dominated by *Acacia* species, cactus and bushy woodlands (Tafesse, 2001). These are arid and semi-arid lowlands lying at an elevation of 500 to 1500 m above sea level and are not suitable for crop production.

In these areas, camels are herded by nomadic pastoralists who rely mainly on livestock husbandry for their livelihood. A single-visit, multiple-subject diagnostic survey (ILCA, 1990) was used to assess the occurrence of mastitis and traditional management practices used to control mastitis in camels. A total of 53 households who own camels and who are familiar with camel husbandry were selected from Jijiga region using purposive sampling technique. Households at each location were selected based on accessibility of the village and willingness of the camel owners to take part in the interview.

The camels were at different stages and numbers of lactation, and they were of various age groups. Information about traditional management, herd size, milking frequency, milking procedure, occurrence of mastitis, and traditional mastitis control methods was obtained from camel owners by means of a semi-structured questionnaire. The camels were fed exclusively on natural browse, watered on the average every 3 to 4 days, herded during the daytime on communal grazing lands and kept at night in traditional enclosures (Corral) made of thorny bushes and tree branches as protection from predators. The camels were milked on the average three times a day.

### Study animals

The study animals are lactating camels that were kept under traditional management from different areas of in and around Jijiga region. A total of 384 lactating cow-camels destined for inspection of prevalence of clinical and subclinical mastitis accordingly.

### Sampling and study type

A cross-sectional study was conducted on 384 lactating camels in which case study animals were visited once for data collection and sample taking. Regarding the sampling procedure area around Jijiga region were selected based on present camels population and accessibility of information thereby, accordingly collecting the sample were achieved.

### Sample size

The desired sample size for the study was calculated using the formula given by Thrusfield (1995) with 95% confidence interval (CI) and 5% desired absolute precision. Accordingly, the estimated sample size was 384 camels.

### Physical examination of the udder

Mastitis was detected using California mastitis test (CMT) result of clinical inspection of the udder (Table 1). In this study, the clinical cases were defined based on Radostits et al. (2000) which is characterized by swollen, reddened, hardened udder, painful upon palpation and alteration in the color and consistency of milk depending on the degree of inflammation. Thus, the General udder abnormalities, the size of rear and forequarters and fibrinosis were examined by deep palpation. Tick infestations, presence of lesion were also noted. The milk was examined for its consistency, color and other visible abnormalities. The clinical mastitis was recognized by abnormal milk, sign of udder infection and detection of mastitis by positive culture result. In contrast, sub-clinical mastitis was recognized by apparently normal milk and increased in leukocyte

**Table 1.** Interpretation for California mastitis test.

| CMT score | Interpretation | Visible reaction | Total cell count |
|---|---|---|---|
| 0 | Negative | Milk fluid is normal | 0-200,000 (0-25% neutrophils) |
| T | Trace | Slight precipitation | (1.5-5) $\times 10^5$ (30-40% neutrophils) |
| 1 | Weak positive | Distinct precipitation but not gel formation | (4-15)$\times 10^5$ (40-60 neutrophils) |
| 2 | Distinct positive | Mixture thickens with gel formation | (8-50) $\times 10^5$ (60-70% neutrophils) |
| 3 | Strong positive | Strong gel that is cohesive with a convex surface | ≥5,000,000 (70-80% neutrophils) |

Source: Quinn et al. (1999).

number as evident by CMT and positive culture result.

#### Milk sample collection

The camel calves were allowed to suckle in order to stimulate milking and milk samples were collected from all CMT positive quarters during screening for sub-clinical mastitis. The teat of affected quarter was carefully washed with clean water and soap, dried and teat ends were disinfected with cotton swabs soaked in 70% alcohols and allowed to dry. Approximately 10 ml of milk was collected aseptically after discarding the first stream of milk. Samples were placed immediately into an ice box (4-8°C) and brought to the Regional Veterinary Diagnostic and Research laboratory for processing and storage.

#### California mastitis test (CMT)

Sub-clinical mastitis was diagnosed based on CMT results and the nature of coagulation and viscosity of the mixture (milk and CMT), which show the presence and severity of the infection, respectively. Before sample collection for bacteriological examination, milk samples were examined for visible abnormalities, they were screened by CMT according to Quinn et al. (1999) from each quarter of the udder, a squirt of milk sample was placed in each of the cups on CMT paddle and an equal amount of 3% CMT reagent was added to each cup and mixed well. The interpretation was in such a way that CMT score: 0 was taken as negative, while CMT scores trace, 1+, 2+ and 3+, were considered positive, thus forming five categorical classes. All milk samples considered positive irrespective of CMT results were bacteriological examined.

#### Bacteriological examinations

Among the CMT positive milk samples (369) and milk samples collected from clinical quarters (48), 174 samples were randomly selected and used for bacteriological analysis. A loopful of each milk sample was streaked on defibrinated sheep (5%) blood agar. Plates were incubated at 37°C for 48 h. Among the 260 colonies grown, 174 colonies selected randomly and subjected to the following tests as recommended by the National Mastitis Council (NMC) (1987): morphology, haemolysis pattern and Gram stain. Gram-positive cocci were tested for catalase, and catalase-positive isolates further tested with coagulase test. Streptococci were identified by performing CAMP, esculin, reffinose, salicin, mannitol, and inulin tests. Gram-negative rods were further differentiated by testing for motility, lactose fermentation (growth on MacConkey agar) and by using oxidase test.

#### Questionnaire survey

A general questionnaire survey was carried out in which of age of camel, parity number, housing, feeding, source of water, economic importance of mastitis, milking order of lactating, camels traditional husbandry system used by camel owners, stage of lactation, pre milking udder preparation and hygiene were included in questionnaire.

#### Data analysis

The data were recorded in Microsoft excel spread sheet for statistical analysis. Descriptive statistics was used to summarize the data and calculate same of sample statistics and various proportions. Additionally, Chi-square test was used to see the presence and strength of association of the potential risk factors with occurrence of mastitis using SPSS.

## RESULTS

### Animal level prevalence of mastitis

A total of 384 clinical as well as sub-clinical cases of lactating camels were examined during study period by using CMT. The overall mastitis prevalence was 30.2% (116/384) out of which, 19 (4.9%), 97 (25.3%) camels showed clinical and sub-clinical mastitis, respectively (Table 2). From the 384 camels, 130 (33.9%) camels had varying degree of tick infestation and 10 (2.6%) had lesion on the teat and udder. Out of these 130 ticks

**Table 2.** Prevalence of mastitis both at animal level and quarter level based on CMT and grown culture.

| Sample | CMT | | |
|---|---|---|---|
| | Number tested | Number positive | Prevalence (95%) |
| Camel level | 384 | 97 | 25.3 |
| Quarter level | 1508 | 369 | 24.2 |

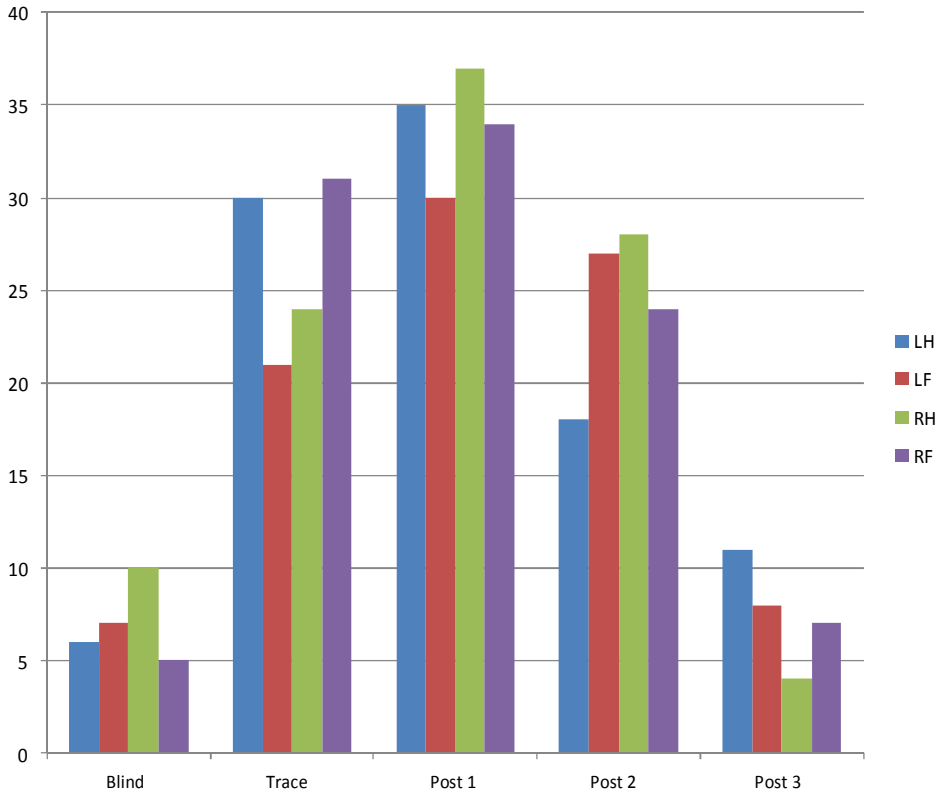


**Figure 1.** The relative proportion (number) of positives (either trace, +, ++, +++) in relation with quarters.

infested udder of lactating camels, and 68 where positive for mastitis. This indicates high percentage (52.3%) of mastitis was found among the tick infested group.

## Quarter level prevalence of mastitis and microbiological culture

Out of the total 1536 examined teats, 369 (24.5%) teats were CMT-positive. In Table 2, the quarter level calculated prevalence of 24.5% (369/1508) was only based on the CMT result excluding the blind teats from which the milk samples could not be taken. Otherwise, the overall quarter level prevalence of mastitis was 25.8% (397/1536). The relative proportion (number) of positives (either trace, +, ++, +++) in relation with quarters is presented in (Figure 1 and Table 3). In addition to this, among the milk samples subjected to bacteriological examination, 144 (82.8%) yielded mastitis pathogens (Table 4). From these, 144 growths, the most prevalent mastitis causing agent were Coagulase negative *staphylococci* (39.6%; n = 57/144) and least one was *Streptococcus agalactiae* (3.5%; n=5/144).

## Analysis of risk factors

Mastitis is prevalent in the area and its incidence is influenced by age, parity number, hygiene of milking process, and presence of lesion on udder or teats were found significantly associated ($p < 0.05$) with the prevalence of mastitis in lactating camel. There was the lowest prevalence (5.2%) of mastitis in she-camels of 5 to 7 years of age, while the highest (51.7%) in the animal

**Table 3.** CMT result with regard to each teats.

| Quarters | No of blind teats | CMT result | | | | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | No of positive teats in each category | | | | Total positive | Total negative | |
| | | Trace | + | ++ | +++ | | | |
| Left behind | 6 | 30 | 35 | 18 | 11 | 100 | 284 | 384 |
| Left front | 7 | 21 | 30 | 27 | 8 | 93 | 291 | 384 |
| Right behind | 10 | 24 | 37 | 28 | 4 | 103 | 281 | 384 |
| Right front | 5 | 31 | 34 | 24 | 7 | 101 | 283 | 384 |
| Total | 28 | 106 | 136 | 97 | 30 | 397 | 1139 | 1536 |

**Table 4.** Bacterial species isolated from quarter milk samples (n = 174) obtained from traditionally managed camels in and around Jijiga.

| Bacterial species | Number of isolates | % of total isolates |
|---|---|---|
| *Coagulase negative staphylococci* | 57 | 39.6 |
| *Streptococcus dysagalactiae* | 32 | 22.2 |
| *Corynebacteria spp.* | 13 | 9.0 |
| *Bacillus spp.* | 11 | 7.6 |
| *Streptococcus uberis* | 11 | 7.6 |
| *Escherichia coli* | 9 | 6.3 |
| *Staphylococcus aureus* | 6 | 4.2 |
| *Streptococcus agalactiae* | 5 | 3.5 |
| Total | 144 | 10 |

aged between 14 to 16 years in Table 5.

## Questionnaire result

Camel owners were interviewed from different area and 70% of them responded that mastitis was a disease they are aware of and this disease is known by different names in the study areas (Table 5). “Gofla” is the predominant type of camel mastitis in the study areas and it causes a significant decline in milk yield as reported by the respondents. It is a clinical type characterized by swelling of the udder. ‘Arar’ (Carcar) is a mild type and the second prevalent type of camel mastitis in the areas. It causes swelling of the udder and release of pus from the teats. Jid was the third abundant type of mastitis in camels. It is a chronic form and causes blind teats. However, they were not aware of sub-clinical mastitis. They thought that they can control the spread of the disease by milking cow-camels at the end of milking, but most respondent (57%) did not have the awareness of the way of transmission of the disease. They milk the entire herd in the same container (that is made of wood).

In the area, milking procedure is usually carried out by one person. Almost more than half of the respondents indicated that while preparing utensils for milking they wash and smoke milking utensils with wood called *Oliva africana* which is locally called “Ugay” before milking camels and they explained that this keeps milk for longer period of time. Of the twenty camel owners interviewed, majority of respondents (98%) reported that they do not practice washing their hand prior to milking and 96.7% of camel owners explained that the use of anti-suckling material to prevent calf from suckling. They do this by tying two pair of teats together with fiber which definitely causes trauma to the udder and predispose to mastitis. Furthermore, most of them explained the effect of ecto-parasite (ticks) as a causative agent of udder and teat lesion (Table 6).

## DISCUSSION

The overall prevalence (30.2%) of mastitis in camel herds as determined by the CMT and clinical examinations of the udder and the milk samples is lower than that reported by Obeid et al. (1996) who found an overall mastitis prevalence of 66.8% in Sudanese camel herds and 59.8% report of Afar Region, North Eastern Ethiopia by Bekele and Molla (2001). However, the present finding is consistent with the findings of Osman et al. (1991) who found an overall mastitis prevalence of 29% in Jijiga zone, Somali Regional State.

**Table 5.** Risk factor associated with occurrence of mastitis.

| Factor | Mastitis | Non-mastitis | Total | P-value |
|---|---|---|---|---|
| Tick free | 48 | 206 | 254 | |
| Tick infested | 68 | 62 | 130 | |
| Total | 116 | 268 | 384 | |
| **Parity** | | | | |
| 1st | 49 | 108 | 148 | |
| 2nd | 40 | 102 | 151 | |
| 3rd and more | 27 | 58 | 85 | |
| Total | 116 | 268 | 384 | |
| **Age (Yr)** | | | | |
| 5 to 7 | 6 | 98 | 104 | |
| 8 to 10 | 20 | 67 | 87 | |
| 11 to 13 | 30 | 57 | 87 | |
| 14 to 16 | 60 | 46 | 104 | |
| Total | 116 | 268 | 384 | |
| **Lactation stage in month (m)** | | | | |
| 1 to 2 | 50 | 110 | P160 | |
| 3 to 9 | 38 | 98 | 136 | |
| 10 to 18 | 28 | 60 | 88 | |
| Total | 116 | 268 | 384 | |

**Table 6.** Indicates respondent answers and tick infestation.

| Milking procedure | % of total respondents in and around Jijiga | | |
|---|---|---|---|
| Wash udder/teats before milking | None | | |
| Wash hands before milking | 96.7% not practiced | | |
| Wash/smoke milk utensils before milking | 98% practiced | | |
| Let the calf to suckle before milking | 100% | | |
| **Tick infestation (% of total herd)** | **Mastitis** | **Non-mastitis** | **Total** |
| Tick infested | 68 | 62 | 130 |
| Tick free | 48 | 206 | 254 |
| Total | 116 | 268 | 384 |

On the other hand, the reported clinical (4.9%) and sub-clinical mastitis (25.3%) reported in the current study is consistent with the finding of Magarsa (2010) who reported prevalence of sub-clinical mastitis ranged from 28.6 to 37.6% and clinical mastitis ranged from 10 to 17%, respectively during minor wet, major wet and dry season in dromedary camels in Borana area of Southern Ethiopia. Furthermore, the finding of this study regarding the clinical and sub-clinical mastitis also agree with finding of Abdurahman et al. (1995) who reported prevalence of (5.9%) in Sudan also reported 8.3% prevalence of clinical mastitis in Jijiga. Higher result of clinical mastitis were also reported by Barbour et al. (1985) 15%, Magarsa (2010) 17% in minor wet season and Obied et al. (1996) 19.5% in Saudi Arabia, Borana and Sudan, respectively.

From the present study, the prevalence of sub-clinical mastitis at quarter level was 24.5%, which is agreeable with that of 20.5% reported by Almaw and Molla (2000). Comparable result (15.8%) is also reported by Abdurahman and Bornstein (1991) in Jijiga and higher rate of CMT result were reported by Taketelew and Bayleyegn (2001) 47.3% in Afar.

Tick burden, together with thorny plant of desert and

ant suckling material, seems to be risk factor to the occurrence of mastitis in camels in the study area. 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 Megersa, (2010). 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.

Concerning to udder lesion, penetrating and non-penetrating superficial ski lesion of the teat and udder were observed and out of 10 camels having udder lesion, all of them (100%) were mastitis positive compared to the prevalence of those camels without udder lesion. High prevalence of mastitis 72.2% in camels with udder lesion was reported by Teketelew and Bayleyegn (2001) in afar region. Woubit et al. (2001) also recorded that the udder or teat skin scratches can be caused by thorny plant of the desert. Generally, trauma may be responsible directly to mastitis which can result injury and predispose to bacteria invasion of the udder.

A positive relation was observed between mastitis and lactation stage. 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 (Radostits et al., 2000).

The high percentage of mastitis pathogens isolated from camel milk samples examined in the present study is consistent with the findings of Woubit et al. (2001) who reported that 74% of the CMT positive quarter milk samples of camels in Borena area of southern Ethiopia yielded pathogenic bacteria. Gram-positive *cocci* were the main cause of mastitis in the camels and constituted 93.8% of the total isolates. This finding is in line with that reported by Obied et al. (1996) and Woubit et al. (2001). Among the bacterial isolates, coagulase negative staphylococci (CNS) were identified as the predominant mastitis causing organisms in the camels studied. This agrees with the report of Abdurahman (2006) who found that CNS and *S. aureus* represented 61.1 and 38.9%, respectively of the total isolates and considered as the main organisms that cause mastitis in the Bactrian camel. *Streptococcus dysagalactiae* was the second most common cause of mastitis in the camel herds examined in this study.

This finding agrees with that reported previously by other researchers (Woubit et al., 2001; Abdurahman, 2006; Guliye et al., 2002). *Streptococcus agalactiae* and *S. aureus* were reported to be the most common causes of camel mastitis in Eastern Sudan (Obeid et al., 1996) and Kenya (Younan, 2004).

The bacteria isolated from camel milk samples in the present study are types that cause both contagious and environmental mastitis. Correct and good milking techniques are essential in the prevention of both environmental and contagious mastitis. The teats must be cleaned with individual clothes dipped in hot water. The fact that the pathogens isolated from camel milk samples in the present study are bacteria that causes both environmental and contagious mastitis suggest that proper management and adequate hygienic condition of the environment (enclosures) are required in order to minimize occurrence of mastitis in the study area.

## Conclusion

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 mastitis significantly vary with stage of lactation indicating a higher prevalence during early stage of lactation. Finally, among the important mastitis causing bacteria, coagulase negative staphylococci, Streptococcus dysgalactiae, Corynebacteria spp were found the most common. Therefore, good management practices with proper sanitation and tick control measures are required to prevent the incidence of mammary infection in camels in the study areas. The isolation of genera of pathogenic bacteria from the camel milk samples suggests the need for strict hygienic measures during the production and handling of camel milk to reduce public health hazards. Furthermore, public education should be given to improve their awareness about the importance of proper herd health management and hygienic milking practices in order to minimize the adverse effect of mastitis on the yield, quality of milk and zoonotic impact of the pathogen.

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