Milk samples were collected from milk storage containers just after
northern Kenya, the dromedary camel (Camelus dromedarius) is
becoming a popular livestock animal. They can go days without water
and continue producing milk under drought conditions when other
livestock cannot1, making camels important for food security and
human welfare in arid environments.

Currently, there is only one camel milk pasteurization plant in Kenya,
and an estimated 10% of Kenyans (6.4 million people) drink
unpasteurized camel milk. This has high public health risks in terms of
pathogen transmission from camels to people6. Despite a deficit of knowledge on camel husbandry and diseases, great
potential is seen for the Kenyan camel milk industry both nationally
and internationally3. However, low milk quality and low production per
animal have resulted in low profitability for milk producers.  Mastitis is
one of the major hindrances to productivity and results from
unhygienic milking practices among pastoralists6.

Several studies in Kenya and neighboring Ethiopia have estimated
mastitis prevalence in camel herds ranging from 25% to 76%.1-4 High
mastitis prevalence is a concern both because of decreased production
potential and also because of the pathogens that may be transmitted to
consumers of raw camel milk.

Hypotheses
• Mastitis and high bacterial contamination of milk will be associated
  with increased camel age, parity, and tick load as well as decreased
  body condition and calf age.
• Mastitis and high bacterial contamination of milk will be associated
  with unhygienic milking practices, little or no knowledge of
  mastitis, and little access to veterinary resources.

Materials and Methods
• Research was conducted in Laikipia county, Kenya. A total of 116
camels were sampled in 11 different herds. Herd size ranged from
13-137 camels, and the number of lactating females ranged from
2-40 individuals per herd.
• At each herd all lactating camels were tested for mastitis using the
California Mastitis Test (CMT). Age, body condition score (BCS),
parity, calf age, and tick load were recorded for each camel.
• A questionnaire addressing herd demographics, husbandry, milking
practices, milk storage, and access to veterinary care was conducted
at each herd.
• Milk samples were collected from milk storage containers after
milking. These samples were cultured on Blood Agar and
MacConkey plates. Standard Plate Counts were performed to
quantify bacterial contamination.

Results

Do mastitis-positive and negative camels differ?

Figure 2. Mastitis-positive camels were older (p=0.001, df=111) and
had had more calves (p=0.03, df=111) than mastitis-negative camels.
Mastitis-positive and negative camels did not differ in their body
condition scores (BCS) or tick loads.

Mastitis Prevalence

Figure 3. Mastitis prevalence is positively correlated with mean calf age
(p=0.02, R²=0.47). Other camel metrics and milking practices did not
demonstrate a relationship with mastitis prevalence within herds.

Bacterial Contamination

Figure 4. Log of colony forming unit count on blood agar demonstrated a
trend towards a positive correlation with mean calf age
(p=0.08 R²=0.24).

Hypothetical relationships between mastitis and bacterial contamination
in northern Kenya are shown in Figure 4. As calf age increased,
bacterial contamination increased as well.

Figure 5. Proportion of herds (n=11) using various hygienic practices
during milking and milk storage.

Hygienic Milking Practices

Figure 6. Proportion of herds (n=11) using various strategies to
clean udders, hands, and storage containers.

Discussion

Conclusions

A mastitis prevalence of 19% at the animal level is lower than reported
by other studies, which range from 23-76%4. This may reflect more
hygienic milking practices in Laikipia or a low sensitivity (60%) of
CMT for camels1.

As other studies have found, increased age and parity were associated
with having mastitis. Unlike other studies4, high tick load was not
associated with mastitis, which is likely due to regular treatment for
ticks by every herd in this study.

Other studies found higher mastitis prevalence was associated with
early stage of lactation (younger calves), the reverse of our results. In
this study both mastitis prevalence and milk bacterial contamination
were higher later in lactation, with the former possibly explaining the
latter. Dromedary lactation is about one year2, yet two year-old calves
were still nursing to some degree in this study. This suggests extended
lactation may have negative consequences for udder health and milk
quality.

Though milking practices and knowledge of mastitis did not predict
mastitis prevalence or bacterial contamination, local knowledge of
mastitis is low. Little is done to keep udders clean or prevent pathogen
duration during milking. Education on causes and prevention of
mastitis as well as the influence of camel age and lactation stage on
mastitis is needed for Laikipia camel herders. Additional education on
the risks of raw milk consumption and appropriate hygienic milking
practices would be beneficial.

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Figure 1. The California Mastitis Test (left) and testing (right).

Figure 7. Common containers used for milk storage included a) wooden
gourds, b) plastic jerry cans, and c) aluminum containers. Plastic and
aluminum containers were cleaned with water or soap and water. Wooden
gourds were sterilized using smoke.