

Detection of Subclinical Mastitis in Small Ruminants on Six farms in Northern Tanzania

Introduction

Small ruminants represent an important role in the pastoral life of the Maasai people of northern Tanzania. Although the Maasai culture centers on cattle, East African goats and Fat-tailed sheep are the predominant livestock in this area and are extensively managed on free range semi-arid landscape. The milk and meat from these animals are a main component of the Maasai diet. The milk is often consumed hot, combined with tea and spices and served as chai. The Maasai pastoralists also consume fresh or fermented milk. While both milk and meat are nutritionally important to these people, these animals are used for subsistence rather than high production. Because of this the estimated number of lactating small ruminants ranges from 5 to 20% of the typical herd or flock, and sheep and goats are managed and raised as one group.

This study was conducted in the Mondului district near the town of Gelai, a remote area which represents the traditional lifestyle of the Masaai. One water source from a nearby mountain spring, supplies two main water supply points for the entire area. Most of the residents live in smaller surrounding villages, or "bomas", comprised of traditional homes constructed of dung and stick, and encircled by fences made of thorny acacia braches. The homes have dirt floors and thatched roofs, with very poor ventilation. Young lambs and kids are housed inside the homes at night, while the adult livestock are housed within the thorn fences of the bomas. The typical day begins with the women collecting dung to patch the houses, then milking the livestock and preparing a meal. Because water is scarce, there is no hand-washing or proper teat sanitation prior

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to milking. These common practices would lend evidence that there is a potential for a high prevalence of mastitis among all livestock, including the small ruminants.

Mastitis is inflammation of the mammary gland and can be caused by several different bacterial and/or viral infections. Chronic infection of the mammary gland can lead fibrous replacement of glandular tissue, which can cause a significant decrease in milk production and quality. Further more, some of the common microbes which cause mastitis could serve as sources of food-borne illnesses and zoonotic diseases such as *Staphylococcus aureus* and *Eschericia coli*. (Smith). An important first step in analyzing this potential risk is determining if mastitis is present within the small ruminant population. However, few studies have researched the presence and/or prevalence of mastitis in small ruminants under these conditions. The purpose of this study was to determine if subclinical mastitis is present in small ruminants of the Maasai pastoralists in one area of the Monduli district in Northern Tanzania.

Materials and Methods

Based on evidence extrapolated from other studies (Ndegwa et al, 2000,) the prevalence of subclinical mastitis, of the approximately 15,000 small ruminants within a 5 mile radius of Gelai was estimated at 15%. It was also estimated that of this same population, 5-20% of small ruminants were lactating at any one time, depending on several factors, such as seasonal climate and recent rainfalls. A minimum sample size for detection was calculated using statistical software (Win Episcpe 2.0).

California Mastitis Tests (CMT) were conducted on 27 goats and 5 sheep for a total sample size of 32 animals, following manufacturer's instructions (ImmuCell, California Mastitis Test). Clean, filtered water was used to rinse the paddles between animals. All animals sampled were lactating from both udder halves and both halves were being milked by the owners twice daily. Lambs and kids were allowed access to the ewes and does only at dusk and dawn.

Results were recorded and analyzed in Microsoft Excel. Records included sample number, owner's name, description of the animal, GPS location, date, and CMT scores. For the purpose of this study, age and stage of lactation were not recorded. CMT scores of 2 or greater were recorded as a positive result.

Results

Of the 32 animals tested, 27 (84.38%) were East African goats and 5 (15.62%) were Fat-tailed sheep. None of the sheep had a positive CMT while 4 (14.82%) goats tested positive. The overall prevalence of the animals tested of 12.5% as summarized in Table 1.

Table 1. CMT Results by Type of Animal

| | Positive CMT | Negative CMT | Total |
|----------------|---------------------|---------------------|--------------|
| Caprine | 4 (12.5%) | 23 (71.88%) | 27 (84.38%) |
| Ovine | 0 (0%) | 5 (15.62%) | 5 (15.62%) |
| Total | 4 (12.5%) | 28 (87.5%) | 32 (100%) |

The data were also analyzed by udder half, left and right. There were 7 (10.94%) positive halves and 57 (89.06%) negative halves, and of the positive halves 4 (57.14%)

were from the left half, while 3 (42.86%) were from the right half, as summarized in Table 2.

Table 2. CMT Results by Udder

| | Left Udder Half | Right Udder Half | Total |
|---------------------|------------------------|-------------------------|--------------|
| Positive CMT | 4 (57.14%) | 3 (42.86%) | 7 (10.94%) |
| Negative CMT | 28 (49.12%) | 29 (50.88%) | 57 (89.06%) |
| Total | 32 | 32 | 64 |

The 7 positive samples were comprised of 5 (71.43%) positive udder halves having a CMT score of 2, and 2 (28.57%) udder halves having scores of 3, as summarized in Table 3.

Table 3. CMT Scores of Individual Animals Recorded by Udder and Type of Animal

| | Left Udder Half | | | | Right Udder Half | | | | Total Halves |
|----------------|------------------------|---|---|---|-------------------------|---|---|---|---------------------|
| | 0 | 1 | 2 | 3 | 0 | 1 | 2 | 3 | |
| Species | | | | | | | | | |
| Caprine | 18 | 5 | 3 | 1 | 21 | 3 | 2 | 1 | 54 |
| Ovine | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 10 |
| Total | 23 | 5 | 3 | 1 | 26 | 3 | 2 | 1 | 64 |

Discussion

4 out of 32 small ruminants tested were considered to have positive CMT results. These results suggest subclinical mastitis is present in small ruminants in the Gelai area. More extensive sampling and testing, including cultures, should be performed to describe and characterize the subclinical mastitis within this population. Due to the lack of resources, including clinical laboratories, we were unable to accomplish this in the current study.

Most bomas lie within a 5-mile radius area from the main town making sampling time consuming but relatively consistent. Although a current census was not available, the human population is estimated at 17,000 (Mwenye Kiti, Gelai-Meru Goi, 2005.).

Despite an elevation range of 3,000-5,800 feet above sea level, the agricultural and cultural practices vary little; with the exception of crops, mostly corn, being raised in the higher elevations, but not in lower, more arid elevations. This helped with sampling because of the inherent consistency between farms and the large number of farms to sample. The farms visited were based on pre-existing relationships and acceptance, not randomly selected. Because of the consistency of cultural and agricultural practices between villages, this probably did not influence the results of this detection study.

Because of the lack of proper hygienic techniques, the prevalence of subclinical mastitis, used to calculate sample size, in this population was estimated to be higher than that of goats in a previous dairy goat study, 15% versus 9.8% respectively (Ndegwa et al, 2000) but less than the prevalence of subclinical mastitis of dairy cows stated in a separate study (Bishi.), 15% versus 15.9% respectively. Caprine milk tends to have higher leukocyte counts than bovine milk (Smith, 2002.), thus the CMT results were considered positive with a score of 2 or greater. CMT scores less than 2 were considered to be negative. Despite these possible differences between bovine milk and caprine and ovine milk, the CMT has been shown to be a reliable method for the diagnosis of subclinical mastitis in caprine (Maisi, 1988).

The CMT is a relatively simple field screening test for subclinical mastitis, but few pastoralists have access to even this level of technology. An agglutinating reaction occurs when the CMT reagent combines with leukocytes within a milk sample. Milk levels of leukocytes tend to be elevated whenever infection is present within the mammary gland. CMT scoring is based on the subjective interpretation of the agglutination reaction, with 3 being the highest score and associated with the greatest

number of leukocytes. Only one person read all the tests in order to minimize inconsistency between test results. The CMT is relatively inexpensive and foreign material such as dirt and hair will not interfere significantly with the test. (Unl.edu CMT).

There are four basic forms of mastitis: peracute, acute, subacute, and subclinical. It is important to diagnose subclinical mastitis for several reasons. Subclinical mastitis is estimated to be 15 to 40 times more prevalent than clinical, or observable, mastitis. Subclinical mastitis usually precedes the clinical form and has a longer duration, thus often reducing milk production and milk quality without recognition by the subsistence farmer (UFL, Mastitis in Dairy Goats). Studies have shown subclinical mastitis can cause a 53% and 30% reduction in milk yield in sheep and goats respectively (Gonzalo et al., 1994, Leitner et al., 2004). This decrease in milk production can also lead to the nutritional demise of kids and lambs. In a culture which relies so heavily on sheep and goats to combination of decreased milk for human consumption and the subsequent decrease in meat production could become catastrophic in a short period of time.

Further studies are needed to determine the true prevalence of subclinical mastitis in this small ruminant population, both at the individual level and the herd level. The estimated prevalence from this study is 12.5% (4 of 32). This is slightly less than the previously estimated value of 15%, but still not as low as similar studies (Ndegwa et al., 2000). Because this was not a prevalence study, no conclusions can be made regarding the significance of these differences.

Several confounders could be considered, but the two most significant confounders in a prevalence study of this population would likely be age and stage of lactation. Age would be difficult to document because culturally, the Maasai do not track

age. Stage of lactation, however, could be classified relatively easily since most owners do have an idea of when the animal began lactation, at least relative to the other animals in the herd. Although not confounders, some effect modifiers which could also affect the results of a prevalence study would include, herd prevalence of contagious mastitis, season, and the prevalence of other diseases, such as Ovine Progressive Pneumonia (OPP) and Caprine Arthritis and Encephalitis (CAE). OPP and CAE are both lentiviruses which can cause severe fibrosis and agalactia (Smith, 2002). This can lead to a condition commonly referred to as hard bag or hard udder. This condition could easily be misdiagnosed as a severe mastitis.

Sampling would be difficult because of the remote location, and acceptance by pastoralists. There are some central areas which could be utilized for sampling, but there would probably need to be some sort of incentive for the local pastoralists to be interested in participating and overcome their suspicions of outsiders. A verbal questionnaire in the study would be needed to assess agricultural practices, herd size, percent of herd lactating, etc. Also, cultures of the milk would be more easily obtained if the animals came to a central location. These cultures would be used to validate the CMT results, and to further characterize the subclinical mastitis.

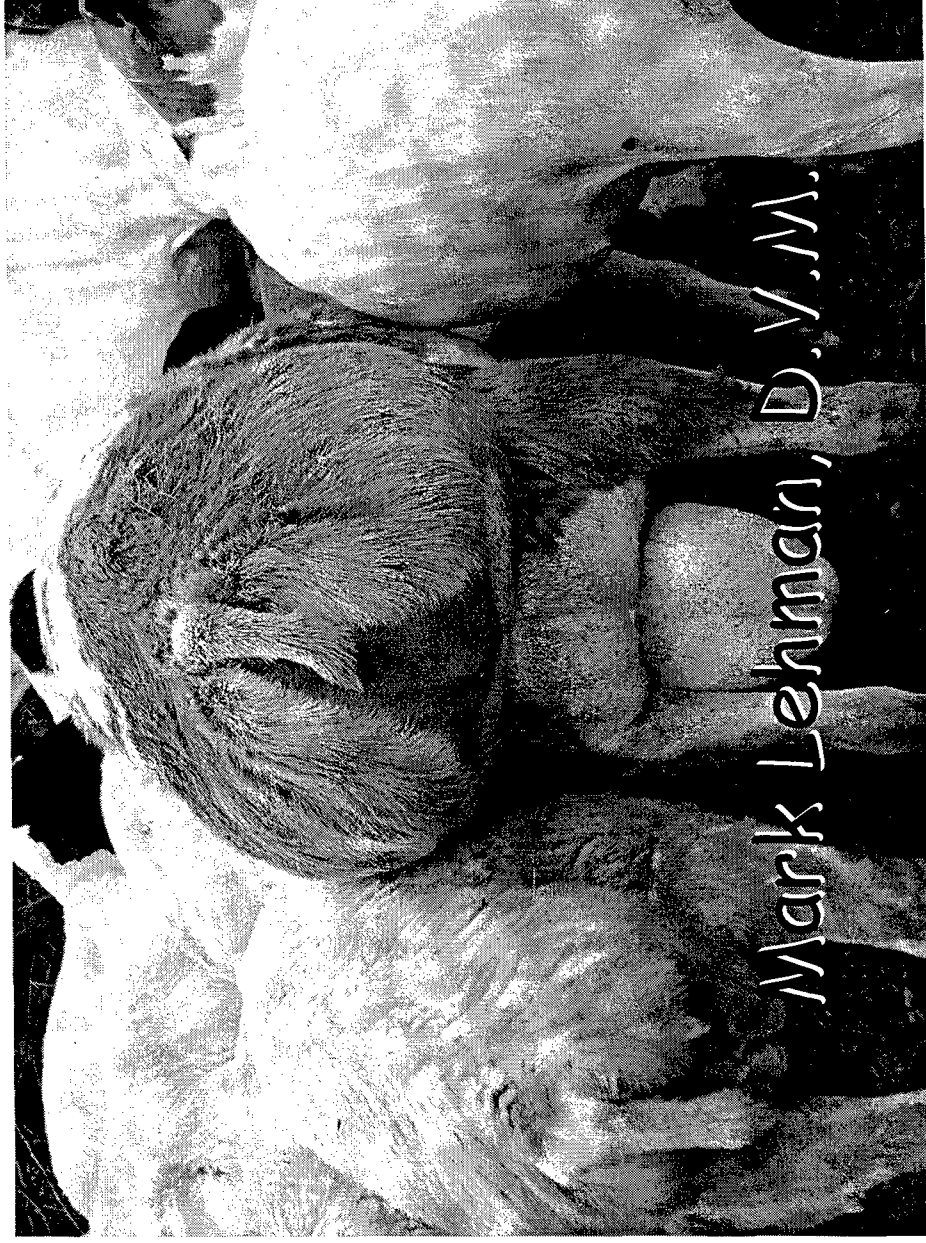
Characterizing the subclinical mastitis would be an important step in prevention and treatment. Some bacteria such as *Mycoplasma mycoides* has a more dramatic effect on the health of the offspring (Smith 2002.) than do other microbes, such as *Staphylococcus aureus*, which may have a more direct health effect on humans. Regardless of the cause, the basic control plan needs to center around education, prevention, and surveillance.

Education should include participatory assessment and training, which is likely to be sustainable (Catley, 2002). First the pastoralists must understand the problem and learn how to detect it. They must also be able to see an advantage in changing the current situation; otherwise they will not embrace ownership of a program, which is vital to the long term success of a control program. Some control measures common in developed areas may be ineffective or unattainable in this environment. Slight modifications in traditional practices may be more advantageous. Milking the animals before gathering the dung, as well as milking the first lactation stage animals first, could be advantageous, as well as hand washing, although water is scarce. Likewise, brushing the dirt off the teat and discarding the first few strippings of milk are more realistic practices than the application of betadine teat preparations. Quantifying milk production and recording lactation data would be helpful to show a positive difference in a control plan. Culling the sickest animals and testing for diseases such as OPP and CAE may be difficult, but if combined with other services by paravets, they could be options. The extralabel use of drugs and poor observance of milk withdrawal times would also be important factors to considered, both for herd health as well as human health.

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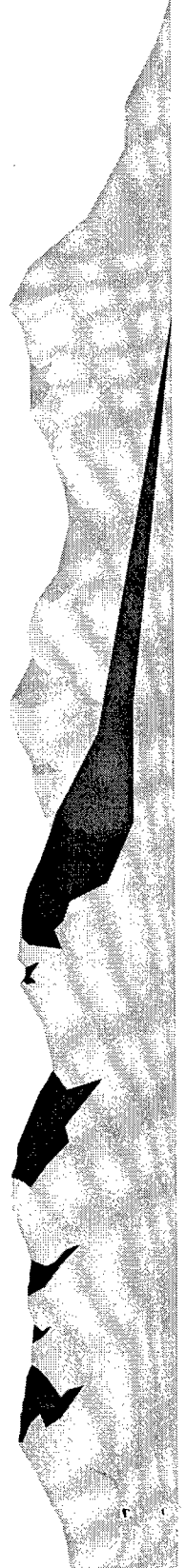
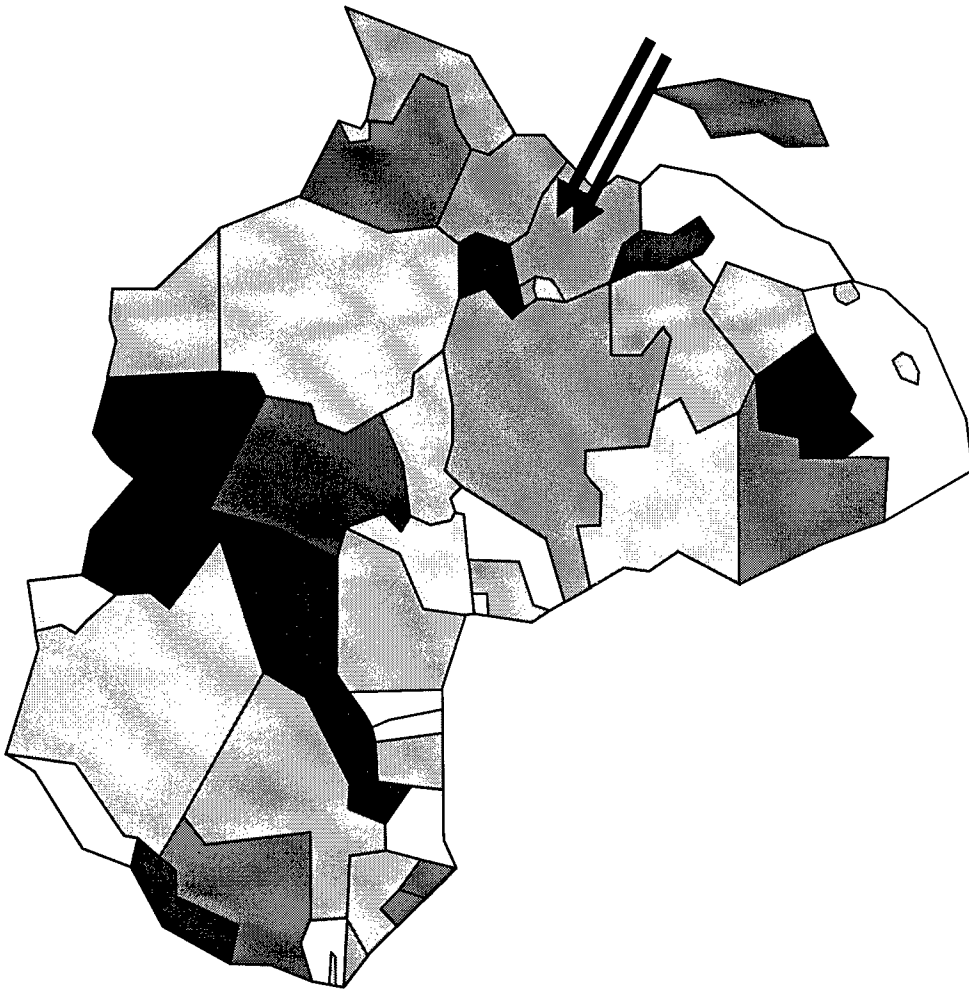
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Overview

- Gelai
- Study Design
- Mastitis and CMT
- Results
- Lessons learned



TANZANIA



The Maasai (Tanzania)

- semi-nomadic pastoralists
- savanna
- tribal culture
- depend on livestock
 - inkishu and enkishui (cattle) (life)



Gelai



Study Design

- Brucellosis
 - Blood draw
 - Reluctant participants
 - Not sustainable by locals
- California mastitis test
 - Local interest
 - Easy test
 - Nutritional deficits



Mastitis and CMT

- Subclinical and Clinical mastitis
 - Decreases milk production
 - Difficult to detect
- CMT
 - Agglutination test
 - Screening test
 - Follow with culture as gold standard
 - Bovine vs caprine/ovine



Methods and Materials

- CMT kit
- Filtered Water



Sample Size

- Estimate 15,000 small ruminants
 - 5 mile radius (2 hour walk)
 - City council chairman
- Win Epi
- n=19



Results

| | Positive CMT | Negative CMT | Total |
|---------|--------------|--------------|-------------|
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Discussion

- Future Studies
 - Prevalence
 - Causative agent(s)
- ownership
- goals vs flexibility
- economy and democracy



Summary

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Acknowledgments

- Dodd family
- CVM
- Laata



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| REPORT DOCUMENTATION PAGE | | | Form Approved OMB No. 0704-0188 | |
|--|---|--|--|--|
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| 1. AGENCY USE ONLY (Leave blank) | 2. REPORT DATE 18.Oct.05 | 3. REPORT TYPE AND DATES COVERED MAJOR REPORT | | |
| 4. TITLE AND SUBTITLE DETECTION OF SUBCLINICAL MASTITIS IN SMALL RUMINANTS ON SIX FARMS IN NORTHERN TANZANIA | | | 5. FUNDING NUMBERS | |
| 6. AUTHOR(S) CAPT LEHMAN MARK W | | | | |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) OHIO STATE UNIVERSITY | | | 8. PERFORMING ORGANIZATION REPORT NUMBER CI04-1687 | |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) THE DEPARTMENT OF THE AIR FORCE AFIT/CIA, BLDG 125 2950 P STREET WPAFB OH 45433 | | | 10. SPONSORING/MONITORING AGENCY REPORT NUMBER | |
| 11. SUPPLEMENTARY NOTES | | | | |
| 12a. DISTRIBUTION AVAILABILITY STATEMENT Unlimited distribution In Accordance With AFI 35-205/AFIT Sup 1 | | | 12b. DISTRIBUTION CODE | |
| 13. ABSTRACT (Maximum 200 words) | | | | |
| 14. SUBJECT TERMS | | | 15. NUMBER OF PAGES 22 | |
| | | | 16. PRICE CODE | |
| 17. SECURITY CLASSIFICATION OF REPORT | 18. SECURITY CLASSIFICATION OF THIS PAGE | 19. SECURITY CLASSIFICATION OF ABSTRACT | 20. LIMITATION OF ABSTRACT | |