

Prevalence of Mastitis in Dairy Goats on Some Selected Farms in Morogoro and Arusha, Tanzania

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Abstract

*A study was done to evaluate the prevalence and significance of the mastitis problem in dairy goats where have been introduced in Tanzania. A total of 103 goats with 206 quarters from Magadu, Mgeta and Tengeru were screened for mastitis using the California mastitis test (CMT) reagent. A total of 177 quarter milk samples were available for bacteriological examination. Somatic cell count (SCC) was performed on 94 samples. Statistical analyses were carried out on the logarithm of SCC for the effects of location, parity, stage of lactation, exotic blood level and CMT score. The overall prevalence of subclinical mastitis on animal and quarter basis was 80.5 % and 72.8%, respectively. Infectious organisms were isolated in 35.5% of the cultured samples. Organisms isolated included *Staphylococcus spp* (49.2%), *Streptococcus spp* (14.2%), *Bacillus spp* (4.8%), *Escherichia coli* (26.9%), *Candida albicans* (3.2%) and *Klebsiella spp* (1.6%). The overall agreement between the CMT and bacteriological examination was 34.6%. Somatic cell count increased with increasing CMT score. SCC for CMT score negative was 1.06×10^6 while for the CMT score of trace and above the SCC was above 2.0×10^6 . It is concluded that subclinical mastitis in dairy goats is a serious problem in the surveyed areas.*

Keywords: Prevalence, mastitis, causative organisms, dairy goats

Introduction

Mastitis is said to be common in lactating goats wherever they are kept (Devendra and Mc Leroy, 1982). Studies on caprine mastitis have revealed that the disease is accompanied by lowered milk yield (Dulin et al., 1983). High mortalities of kids born to does with mastitis are often experienced. The possibility of zoonoses by mastitis causing pathogens and the residual effects of antibiotics used in the treatment and control of mastitis make mastitis a public health concern (Atherton and Newlander, 1987).

Reports on bovine mastitis research in Tanzania show high prevalence in the surveyed areas. Among the organisms reported from caprine mastitis *Staphylococcus spp* are the most prevalent (Manser, 1986). There has been no published work on prevalence of caprine mastitis in Tanzania.

Since farmers and farm managers differ in the manner they manage their animals, especially hygienic considerations, prevalence and severity of mastitis is likely to vary depending on the area and the control measures employed. Although

there has been an increasing interest of raising dairy goats in Tanzania, the seriousness of this disease is not known. This study was therefore, aimed at establishing the prevalence of mastitis in dairy goats.

Materials and methods

Study area

This study was carried out in three areas, namely Magadu dairy farm, Mgeta in Morogoro and Tengeru in Arusha. These are among the areas with high concentration of dairy goats in Tanzania. Magadu dairy farm belongs to the Department of Animal Science and Production of the Sokoine University of Agriculture (SUA). In Mgeta goats belonged to individual farmers, while goats in Tengeru belonged to individual farmers and the Livestock Training Institute (LITI) Tengeru.

Animals

Animals used in this study were lactating dairy goats of different breeds. The breeds involved were: Crossbred goats of varying Norwegian landrace blood levels at Magadu and Mgeta, Toggenburg, Saanen, Anglonubian and French Alpine (Tengeru). In Mgeta 31 out of 41 lactating does were sampled. At Magadu all lactating animals in the flock were sampled. At LITI Tengeru and the two surrounding villages (Akheri and Sing'isi) all 17 lactating does were sampled.

Screening for subclinical mastitis

Lactating animals in the three locations were screened and scored for mastitis using the California Mastitis Test (CMT) as described by Schalm and Noorlander (1957). Screening was performed twice at two months interval at Magadu, and only once at the other two locations.

Sample collection

Samples for isolation of bacteria

The udder of each animal was swabbed using cotton wool soaked in a disinfectant ("Dettol"). About two streams of mid-stream milk was then collected from each individual quarter into sterilized screw cap vials. The samples were placed in a cool box and transferred to a refrigerator where they were stored at $< 10^{\circ}\text{C}$ until cultured. Samples from Magadu were cultured the same day. Samples from Mgeta were cultured the next day or after a period not exceeding 72 hours. Samples from Tengeru were cultured after five days. At first only CMT positive samples were sampled for bacteriological examination, but later all quarters were sampled.

Samples for somatic cell count

Samples for somatic cell count were collected separately from each quarter into Universal bottles. The samples were preserved using Potassium dichromate pellets (Weaver and Kroger, 1977).

Laboratory procedures

Isolation and identification of bacteria

The milk samples were cultured on Blood and McConkey agar and examined after 24 and 48 hours for bacterial growth. The cultural characteristics and standard biochemical tests were carried out on the isolates in order to identify the organisms.

Somatic cell count

The direct microscopic cell count as described in IDF document 114

(1979) was carried out on each sample and statistically analysed

Prevalence: Prevalence was computed using the formula by Putt et al. (1987).

$$P = \frac{NM}{TL} \times 100$$

Where:

P = Prevalence

NM = Number of mastitic does

TL = Total number of lactating does tested

Somatic cell count

Statistical analyses were performed for data from Magadu and Mgeta only. Animals having incomplete records as regards parity and stage of lactation were excluded from the study. Smears having lysed and aggregated cells were also rejected.

Somatic cell count data from the two locations were combined for analysis. Analysis was carried on the logarithm of raw SCC data ($\log_{10} \text{SCC}$) for the effects of mastitis, parity, stage of lactation, location, quarter and sampling phase. The results are presented as antilogs (Geometric means). The analyses were performed according to the General Linear Models (GLM) procedure (SAS, 1988).

The model used was:

$$Y_{ijklmno} = \mu + L_i + T_j + B_k + S_l + Q_m + R_n + E_{ijklmno}$$

where:

$Y_{ijklmno}$ = dependent variable: Somatic cell count from the oth doe of the ith location with jth CMT score, kth parity, lth stage of lactation, mth quarter and nth Norwegian blood level.

μ = General mean

L_i = Effect of the ith location (1 = Magadu, 2 = Mgeta)

T_j = Effect of the jth CMT score (j = 0, 1, 2, 3, 4)

B_k = Effect of the kth parity (k = 1, 2, 3, 4)

S_l = Effect of the lth stage of lactation (1, 2, 3)

Q_m = Effect of mth quarter (1 = right, 2 = left)

R_n = Effect of the nth Norwegian blood level (1 = 50% Norwegian, 2 \geq 50% Norwegian)

$E_{ijklmno}$ = Random error

Results

Prevalence of subclinical mastitis

Table 1 shows the prevalence of subclinical mastitis on quarter and doe basis as determined by CMT. The overall prevalence on quarter and animal basis for the three locations was 72.8% and 80.5%, respectively. Mgeta had the highest preva-

Table 1: Prevalence of subclinical mastitis on doe and quarter basis in the three locations

Location	No. examined		No. CMT +ve		% prevalence	
	Does	Quart*	Does	Quart*	Does	Quart*
Magadu1	28	56	22	39	78.5	69.6
Magadu2	27	54	22	41	81.4	75.9
Mgeta	31	62	28	51	90.3	82.2
Tengeru	17	34	11	19	64.7	55.8
Overall	103	206	83	150	80.5	72.8

Quart = quarters

lence followed by Magadu and Tengeru. Clinical mastitis was not observed throughout the study. Table 2 shows prevalence in relation to CMT score for the different locations.

Aetiology of mastitis

Table 3 shows the number of samples available for bacteriological examination per location and the number of positive cases. The overall percent isolation of bacteria in the present study was 35.5%. Mgeta had the highest proportion of

isolations (70.5%) followed by Tengeru (31.2%) and Magadu 15.0% and 20.3% for the first and second samplings, respectively. Cases of bacterial isolation from CMT negative samples were obtained in the three locations.

The relationship between CMT score and bacterial isolation was erratic eg. of the ten(10) isolates from Tengeru eight were from CMT negative samples while about 42% of the isolates in Mgeta were from samples of CMT score of trace, 30% from

Table 2: CMT Score and respective number (%) of quarter record for each location

CMT Score	Magadu1	Magadu2	Mgeta	Tengeru
Negative	17(30.4)	13(24.0)	11(17.7)	15(44.1)
Trace	11(19.6)	10(18.5)	20(32.3)	8(23.5)
+1	12(21.4)	9(16.6)	18(29.0)	2(5.9)
+2	14(25.0)	11(20.3)	13(21.0)	8(23.5)
+3	2(3.6)	11(20.3)	0	1(2.9)
Total	56	54	62	34

Table 3: Number of samples cultured, percent growth in each location and agreement between CMT positive samples and bacteriological examination

Location	No. of samples examined		No. positive		% growth	* No. CMT and bact +ve	% agreement
	CMT	Bact.	CMT	Bact			
Magadu1	56	40	39	6	15.0	5	12.8
Magadu2	54	54	41	11	20.3	10	32.2
Mgeta	62	51	51	36	70.5	35	68.6
Tengeru	34	32	19	10	31.2	2	10.5
Overall	206	177	150	63	35.5	52	34.6

Magadu1 = Magadu at first sampling

Magadu2 = Magadu at second sampling

Bact = bacteriological examination

+Ve = positive (scores 1 - 4)

*Bacteriologically positive cases from CMT negative samples excluded

CMT score +1, 25% from CMT score +2 and 3% from CMT negative samples. The overall percent agreement between CMT positive reaction and bacteriological results was 34.6%.

Table 4 shows the type and frequency of organisms isolated in the three locations.

The most prevalent organisms in this study were *Staphylococcus spp* (49.2%) most of which (96.7%) were *Staphylococcus aureus*. Other organisms isolated included *Escherichia coli* (26.9%), *Streptococcus spp* (14.2%) of which 22.2% was *Streptococcus agalactiae*. Other isolates

Table 4: Type and frequency (%) of organisms isolated

Type	Magadu1	Magadu2	Mgeta	Tengeru	Overall
<i>Staphylococcus spp</i>	83.3	90.9	25.0	70.0	49.2
Type	16.6	0	22.2	0	14.2
<i>Escherichia coli</i>	0	9.0	41.8	10.0	26.9
<i>Klebsiella spp</i>	0	0	2.7	0	1.6
<i>Bacillus spp</i>	0	0	8.3	0	4.8
<i>Candida albicans</i>	0	0	0	20.0	3.2

Table 5: LSM means (\pm SE) of logarithm somatic cell count (SCC) for the various factors

Factor	n	SCC x 10 ⁶	Factor	n	SCC X 10 ⁶
Overall	94	3.63 \pm 1.20			
CMT			Stage		
-ve	16	1.06 \pm 1.89 ^a	1	16	1.31 \pm 1.64 ^a
T	25	2.16 \pm 1.49 ^a	2	52	7.68 \pm 1.51 ^b
+1	24	3.59 \pm 1.55 ^{ab}	3	26	9.79 \pm 1.60 ^b
+2	20	5.70 \pm 1.60 ^b			
+3	9	44.6 \pm 2.00 ^c			
Parity			Location		
1	31	4.82 \pm 1.53	Magadu	64	4.17 \pm 1.56
2	24	4.45 \pm 1.55	Mgeta	30	5.12 \pm 1.45
3	20	3.91 \pm 1.73			
4	19	5.44 \pm 1.67			
Quarter			N Blood		
Left	46	4.18 \pm 1.42	50%	80	3.38 \pm 1.36
Right	48	5.11 \pm 1.46	> 50%	14	4.78 \pm 1.86

-Ve, T = Negative and Trace CMT score, respectively, N = Norwegian, LS means with common superscripts within column and within factor were not significantly different at $p > 0.05$

included *Bacillus sp.* (4.8%), *Candida albicans* (3.2%) and *Klebsiella sp.* (1.6%).

Somatic cell count

Least squares means of somatic cell count estimated according to CMT score and other factors are presented in Table 5. The values in Table 5 are antilogs. The overall mean quarter somatic cell count (SCC) was $3.63 \pm 1.20 \times 10^6$. Subclinical mastitis had a significant effect on somatic cell count ($P < 0.001$). Another factor which influenced somatic cell count significantly was stage of lactation ($P < 0.01$). There was an increase in somatic cell count with increasing CMT score. Cell counts increased consistently from negative CMT score up to score +2, there was then a sharp increase from score +2 to score +3.

Discussion

Prevalence of mastitis

The overall prevalence of 72.8% and 80.5% on quarter and animal basis, respectively, found in this study is higher than the results of similar studies by Guha *et al.* (1989) in India and Manser (1986) in Britain.

The high overall prevalence rates could be due to poor hygiene and management. Poor hygiene has been associated with increased incidence of mastitis (Shekimweri *et al.*, 1998). The only mastitis control measures being practised in the three locations was use of warm water for pre-milking udder treatment and treatment of mastitis. Although farmers were aware of the precautions and proper milking procedures, it could be that they did not practice them.

Aetiology of mastitis

In the present study 35.5% of the quarters screened were infected. This com-

pared well with the prevalence of 36% and 37.5% reported by Manser (1986) and Guha *et al.* (1989) respectively. The figures found in this study were higher than results reported by Maisi (1990) and Contreras *et al.* (1995) who found prevalences of 20.2% and 18.0%, respectively. These results were, however, lower than the prevalence of 56% reported from Nigeria by Anyam and Adekeye (1995) for caprine mastitis.

In addition to poor hygiene, contamination could be another reason for the high prevalence of infection observed in this study. Although every possible caution was taken to exclude contamination, the possibility of airborne organisms and inhabitants of the streak canal contaminating the samples cannot be ruled out. Giesecke (1975) concluded in an analysis using bovine serum albumin, that many of those conditions diagnosed as infectious mastitis were teat canal infections.

The principal aetiological agent in the present study was *Staphylococcus aureus*. This is in agreement with reports by Anyam and Adekeye (1995) and Manser (1986). Studies by Akaro and Minga (1994) on bovine mastitis in Tanzania, showed a high prevalence of *Staphylococcus aureus*. The tendency of Staphylococcal species to cause long lasting infections in caprine udders coupled with their presence on the teat skin may explain the high prevalence of *Staphylococcus spp* in the present study.

Other organisms isolated in this study included *Streptococcus spp*, *Escherichia coli*, *Klebsiella spp*, *Bacillus spp* and *Candida albicans*. *Streptococcal caprine* mastitis has also been reported by Guha *et al.* (1989). However, the significance of

Streptococcus spp as an aetiology of caprine mastitis has been doubted by Manser (1986) and Contreras *et al.* (1995). Isolation of *E. coli* as a pathogen in goat udders has been reported by Anyam and Adekeye (1995), Guha *et al.* (1989) and Contreras *et al.* (1995). The toxins released by coliform bacteria are known to bring about severe mastitis (Radostits and Blood, 1985). Since this was not observed, the high prevalence of *E. coli* could be due to contamination and this may be a reflection of poor hygiene, the poorest being Mgeta followed by Tengeru. *Escherichia coli* is a common inhabitant of the gastrointestinal tract of human and farm animals (Anyam and Adekeye, 1995), this could have increased its prevalence in the present study.

Bacteria were isolated from 34.7% of the CMT positive quarters. This is low when compared with percent agreement of 63% reported by Shekimweri *et al.* (1998). Such findings suggest that inflammation was either of non-infectious origin or due to organisms other than bacteria which could not be detected by the methods used in the present study.

Somatic cell count

The mean somatic cell count of 1.06×10^6 cells/ml for mastitis free samples in the present study was higher than that reported by Manser (1986) and Vihan (1989) who reported mean (geometric) somatic cell count of 0.207×10^6 and 0.392×10^6 , respectively from mastitis free goats. The present results suggest that somatic cell counts are higher in goat milk than in bovine milk both in mastitis and mastitis free cases.

The sharp increase in somatic cell count observed between CMT score +2 and +3 was not expected. The trend could be due to the fact that the number of observations in CMT score +3 was relatively low and through random chance could bias the esti-

mates. High counts of the order found in score +3 were also found in the lower scores before analysis, the effect was levelled out possibly due to inclusion of more samples with relatively lower counts. Miller and Kearns (1967), comparing CMT scores with microscopic cell counts (as stipulated by Schalm and Noorlander, 1957) in individual quarter samples of bovine milk, found percent accuracy of 90.7, 56.7, 48.9 and 66.3 for CMT scores of negative, +1, +2 and +3, respectively. They therefore concluded that the best way to deal with the CMT is to score the reaction as positive or negative only. The California mastitis test is recommended for animals in active lactation (Schalm and Noorlander, 1957). The does used in the present study were at different stages of lactation. Stage of lactation had a significant influence on yield and cell counts. The concentration effect on cell counts due to lowered yield in late lactation could bring about higher counts than can be explained by inflammatory reaction alone. All of the CMT score of +3 samples came from does in late lactation and most from Magadu.

Conclusions

The present study has shown that subclinical mastitis is a serious problem in dairy goats in the surveyed areas. In addition, *Staphylococcus spp* were the principal causative agents of caprine mastitis in the present study, this has concurred with reports on caprine and bovine mastitis.

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