Bovine Mastitis in Zebu and Crossbred Cattle under the Extensive Management System in Tanzania

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ABSTRACT : A study was carried out to evaluate the incidences and causes of bovine mastitis in Tanzanian shorthorn zebu (*Bos indicus*) in the traditional sector and crossbred cows (*Bos taurus*×*Bos indicus*) in the dairy ranching sector, both found under the extensive range management system. Management practices were evaluated through a survey study using structured questionnaires. A total of 120 lactating cows (60 cows from each sector) were screened for the disease using the California Mastitis Test (CMT). Confirmatory tests used for infected cows included; the Direct Microscopic Somatic Cell Count (DMSCC), culture, bacteriological and biochemical laboratory assays. Survey results showed that management practices were generally very poor in both sectors with 84% of the surveyed herds being kept and milked under very unhygienic environmental conditions. The level of infection was higher in the crossbred cows (5% clinical and 38.3% sub-clinical mastitis) and lower in the zebu cows with only sub-clinical mastitis (23.3%). Crossbred cows had ($p<0.05$) higher somatic cell counts than zebu cows. The four highest-ranking bacterial isolates in order of importance were *Staphylococcus aureus, Escherichia coli, Streptococcus agalactiae* and *Bacillus spp.* It was concluded that bovine mastitis under the extensive management system in Tanzania was a result of poor management practices and that zebu cows were more resistant to the diseases than crossbred cows. ***(Asian-Aust. J. Anim. Sci. 2002. Vol 15, No. 5 : 751-756)***

Key Words : Zebu, Crossbred, Management, Environment, Bacteria, Cell Counts

INTRODUCTION

Modernization of the dairy industry in Tanzania has involved the introduction of exotic breeds of cattle from Europe and elsewhere in efforts to improve the genetic potential for milk yield by local zebu cattle through crossbreeding. Accompanying this has also been mastitis, a disease of the udder, which has become widespread in the country (Msanga et al., 1989; Shekimweri et al., 1998; Shem et al., 2001). The disease is of economic importance as it can cause serious economic losses; thorough reduced productivity by cows (Blood and Radosttis, 1985) and high veterinary costs (Shekimweri et al., 1998). Bovine mastitis is associated with bacterial infection (Blood and Radosttis, 1985) and its spread is associated mainly with poor husbandry and related cow management practices. Hand milking is the most common method used to milk cows both in the modern dairy and in the traditional sectors in Tanzania.

Mastitis infection in the commercial smallholder and large-scale dairy cattle herds is very high. About 2.4% to 8.3% and 59.3 to 62% clinical mastitis and sub-clinical mastitis respectively has been reported in smallholder dairy cattle farms (Mosha, 1998; Shekimweri et al., 1998) and in zero grazed and semi intensively managed dairy cows (Shem et al., 2001) in Tanzania. The major infectious agents of clinical and sub-clinical mastitis cases reported by the above authors were *Streptococcus agalactiae*, *Staphylococcus aureus* and *Escherichia coli* as also reported elsewhere in literature (Blood and Radottis, 1985).

Most of cattle in Tanzania are kept in the traditional sector. The information on bovine mastitis in this important milk-producing sector is neither available in Tanzania nor in the rest of East Africa. Knowledge on the extent of the bovine mastitis infection in the traditional livestock sector is of special importance from the human health point of view as most of the milk in Tanzania is consumed raw due to lack of milk processing and marketing infrastructure. The objective of this research was to study traditional udder health management and milking practices both in the traditional sector and in the commercial dairy ranching sector and whether differences in mastitis infection rates have a genetic basis.

MATERIAL AND METHODS

The same research methodology as described by Shem et al. (2001) was also followed for this study.

Study area

The study was carried out in Morogoro Rural District.

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Morogoro Region. Tanzania during the rainy season (March to May. 2000). The area is located at an altitude of 500-600 metres above sea level with temperatures ranging from 27°C to 31°C during daytime decreasing to not less than 14°C at night during the coolest months of June and July. The area receives bimodal rainfall with long rains from February/March to May and short rains from October to November. The dry period is from June to September.

Animals and their management

Twelve herds (six from traditional Masai pastoral herds and six from dairy ranch herds) were selected from a sampling frame of 48 herds using the systematic sampling technique (Metrrick. 1993). From these. a total of 120 indigenous Tanzania shorthorn zebu (*Bos indicus*) and crossbreds (*Bos taurus* × *Bos indicus*) (60 in each group) were randomly selected (10 in each herd).

Cows from ranches were selected based on their phenotypic characteristics due to the lack of breeding records and all the cows in the study were estimated to be in their 2nd to 4th lactations with an average production of 2 to 3 and 6 litres per cow per day for the zebu and the crossbred cows. respectively. All cows were in their early lactation (between 1st to 3rd month). Cow lactation numbers were estimated based on the number of calving reported by the herdsmen. Milk yields were estimated by carrying out spot yield measurements for each cow twice every two weeks for the duration of the study and an average figure calculated accordingly.

Management of the cows was almost similar both for the zebu and crossbred herds. The cows were grazed extensively on native pastures on communal or privately owned un-improved grazing lands with no supplementation with green forage. Supplementation with small amounts of maize or rice bran at milking times was done rarely in some the dairy ranch system. Cows under the traditional system were hand milked in the morning and in the evening in open kraals adjacent to the homesteads where they were also kept at night for security reasons. On the dairy ranches cows were also hand milked in specific sheds. which served as milking parlours. Partial suckling calf rearing method was practiced both under the traditional and dairy ranching management systems. The calf and visual contact was used to stimulate milk let down through suckling

Manure was removed from the kraals. once or twice every two months. Cattle in the dairy ranch management system were kept in the open enclosure paddock system, which were also not different from those under the traditional system except that they were made of barbed wire.

Survey study

Existing management practices were identified and evaluated through a one-point survey method using questionnaires (Horton, 1982). Information was collected on the milking and feeding practices. housing and general hygiene. Supplementary data were collected through personal observations and discussions with herdsmen. opinion leaders and resident extension officers from the Ministry of Agriculture and Livestock Management. In total, 48 cattle herd owners or managers were interviewed during the survey (28 and 20 from the traditional and the dairy ranch systems. respectively).

Sampling procedure

Each cow was sampled twice once during the morning and again during the evening milking. The morning samples were collected and preserved in vacuutainer tubes. The two samples were later pooled and sub-sampled to obtain a representative sample. During sampling. extraneous bacteria were excluded by discarding the first three strokes of milk from each teat to avoid contamination. Approximately a 10 ml milk sample was collected from each quarter for each sampled cow into sterile universal bottles and subjected to the California Mastitis Test (CMT) as described by Schalm et al. (1971). The CMT was done during the afternoon milking time to get correct interpretation of the reactions under natural light conditions and scores assigned as shown in table 1.

Milk samples for each individual cow were tested separately. Milk leucocytes counts were carried out on all the CMT tested samples using the Direct Microscopic Somatic Cell Count (DMSCC) method. using the modified Newman Lampart stain. The stain was prepared by mixing 54 ml of 95% ethanol and 40 ml of trichloroethane as described by the International Dairy Federation (IDF/FIL. 1979). Clinical mastitis was determined by palpation and visual observation of first squirts of milk drawn from each teat.

Isolation and characterization of the bacterial strains.

A loop full from a sub-sample of 0.5 ml of each CMT positive milk sample was passed onto a blood agar plate

Table 1. Arbitrary scores assigned to the various degrees of coagulation

Degree of coagulation	Assigned score	Observation after CMT
-ve	0	When the mixture was watery with no clots
+1	1	When the mixture was slimy with no gel formation
+2	2	When the mixture was slightly watery with clumps of coagulated material
+3	3	When the background was definitely watery with larger clumps of coagulation than in 2.

using a sterile wire loop. Similarly, a sample was also streaked onto MacConkey agar (prepared according to the manufacturer's instructions (Oxoid Ltd. Basingstoke Hampshire. England) and Edward's medium (Machangu and Muyungi. 1988) to selectively favour the growth of *Enterobacteriaceae spp.* and *Streptococcus spp.*, respectively. All plates were incubated at 37°C for 18-24 h. Growth on the primary culture media was tentatively identified by colony morphology and haemolytic characteristics. Coagulase and sugar fermentation tests were carried out to confirm the genera *Staphylococcus* and *Streptococcus*, respectively. IMVIC tests to confirm the genera, *Klebsiella*, *Pseudomonas spp.* and *E. coli* were carried out according to the IDF/FIL (1979) method.

Statistical analysis

The survey data were summarized into simple means and frequency distributions using the SPSS statistical package for social sciences. Means of somatic cell counts from milk samples from zebu and crossbred cows were compared using the student's t-test (Statsview. 1999).

RESULTS

Management

The drainage systems in 84% of the surveyed kraals were extremely poor with pools of dirty water and urine creating conducive environment for enhanced microbial growth and multiplication. especially during the rainy season. Milking practices in both systems were very poor (table 2) with no proper sanitary and prophylactic measures being undertaken on a routine basis to prevent the spread of mastitis causing pathogens. Unheated tap water was used to wash hands only in dairy ranches and the udder before milking and towels of any kind were not used for drying the udder and teats before and after milking was not used in all the herds surveyed. About 58.3, 29.2 and 12.5 percent of the interviewed milkers washed. did not wash or occasionally washed their hands before and after milking. respectively. Family members carried out milking on traditional farms while hired labour was used in the dairy ranch system. Letting the calf run and suckle the dam after milking ensured completed emptying of the udder in all the surveyed herds. The partial-suckling calf rearing method (whereby the calf was allowed to suckle from its dam at the begging and at the end of milking) was used in both management systems. Zebu cows on the average produced 2 litres of milk and crossbred cows produced an average of 6 litres.

While disinfectants, detergents and prophylactic agents are available in Morogoro town (12-54 km distance from the nearest to the most distant research herd). they were used only on a few dairy ranches for two reasons: 1) lack of knowledge on their use and 2) their higher price in comparison to the price of milk. Detergents and disinfectants were not used in both management systems. Prophylactic measures like dry cow treatment to prevent mastitis infection were not done in all the surveyed farms. The majority of the interviewed herders carried out chemotherapy treatment of infected cows.

Incidence of mastitis

None of the cows screened in the traditional sector had clinical mastitis. Sub-clinical cases were fourteen (23.3%) in this management system. However. in the dairy ranch system, three (5%) had clinical mastitis. The number of sub-clinical mastitis cases was twenty-three (38.3%) in this group. Overall. crossbred cows (on dairy ranches) were more susceptible to mastitis infection than zebu cows. Out of the 37 mastitis-infected 23 cows (62.2%) were from the commercial herd and the rest 14 (37.8%) were from the traditional herds.

Causative agents and somatic cell counts

All the clinical and sub-clinical cases were of bacterial origin. *Staphylococcus aureus* was the most frequently isolated bacteria from milk samples in 83.3% of the sampled herds (table 3). The second. third. fourth and fifth most common bacteria were *Escherichia coli, Streptococcus agalactiae, Bacillus spp.* and *Klebsiella pneumonia*, which were isolated from and 66.7, 50.0, 33.3 and 16.7% of the herds screened. Other isolated mastitis causing bacteria were *Streptococcus dysgalactiae*. (16.7%) and. *Pseudomonas aeruginosa* (8.3%).

The means of somatic cell counts of mastitis causing bacteria between the two management systems are also shown in table 3. Results in the same table show zebu cows in the traditional sector to have had ($p<0.05$) lower cell counts than the crossbreed cows in the dairy ranch sector.

DISCUSSION

Bovine mastitis infection rates in both the Masai and the dairy ranch sectors of the extensive management system were lower than expected considering the dirty environment in which the cows were kept and the poor management practices observed. Under good hygienic conditions manure removal reduces the incidences of mastitis by reducing contaminants on the ground (Mahlau and Hyera. 1984: Eberhart et al.. 1979). Milking practices in both systems were also very poor creating ideal conditions for the spread of mastitis causing microorganisms. Infection rates were higher in the dairy ranch herds than that in the traditional herd system and no clinical bovine mastitis cases were observed in the latter. Sub-clinical mastitis infection rate on the other hand, was reported at 23.3% of the infected cows

Table 2. Milking management practices and other influencing factors in the surveyed herds

Factor	Response	Traditional herd	Commercial herd	Frequency distribution	Percent of the total
Use of towels	Used	0	0	0	0
	Not used	28	20	48	100
Hand milking method	Closed fist	0	0	0	0
	Stripping	28	20	48	100
Milkers	Hired	0	20	20	41.7
	Family labour	28	0	28	58.3
Milking status	Complete	28	20	48	100
	Incomplete	0	0	0	0
Hand washing	Done	8	20	28	58.3
	Not done	14	0	14	29.2
	Occasionally	6	-	6	12.5
Udder washing	Done	0	20	20	41.7
	Not done	28	0	28	52.3
Average milk yield l/cow/day	Zebu	2-3	-	-	-
	Crosses	6	-	-	-
Use of teat dip	Used	0	0	0	0
	Not used	28	20	48	100
Use of disinfectant	Used	0	0	0	0
	Not used	28	20	48	100
Chemotherapy measures	Used	0	10	10	20.8
	Not used	28	10	38	79.2
Prophylactic measures	Used	0	0	0	0
	Not used	28	20	48	100
Use of detergents	Used	0	0	0	0
	Not used	28	20	48	100
Availability of drugs and inputs	Available	0	10	10	20.8
	Not available	28	10	30	79.2
Price of milk	Satisfactory	0	0	0	0
	Not satisfactory	28	20	48	100

Table 3. Mastitis causing bacteria and somatic cell counts from infected cows

Herd/breed	Bacterial spp	No. of herds surveyed	Frequency of distribution of isolated cases	% of the surveyed herds	Rank	Somatic cell count/ml
	Staphylococcus aureus	12	10	83.3	1	
	Escherichia coli	12	8	66.7	2	
	Streptococcus agalactiae	12	6	50.0	3	
	Bacillus spp.	12	4	33.3	4	
	Klebsiella pneumoniae	12	2	16.7	5	
	Streptococcus dysgalactiae,	12	2	16.7	5	
	Pseudomonas aeruginosa	12	1	8.3	7	
Masai herd		-	-	-	-	2,429.168[a]
Ranch herd		-	-	-	-	4.131,476[b]

[a,b] significantly different $p<0.05$.

in the traditional herd while a corresponding figure of 38.3% was observed in the dairy ranch herd. These figures were lower than those reported by Shekimweri et al. (1998) and Shem et al. (2001) for zero and semi-intensively grazed dairy cattle in smallholder dairy farms also from Tanzania.

The infection rates in this study were also lower than that reported by Mahlau and Hyera (1984) who reported 40% to 71.4% for sub-clinical mastitis also in smallholder and large-scale commercial farms respectively. However, the sub-clinical infection rates under both the traditional and dairy ranching systems were higher than the infection rate (21%) recorded by Shekimweri, et al. (1998) in large-scale

commercial dairy farms where management practices are generally higher.

Clinical mastitis was diagnosed only in the dairy ranch herds at the infection rate of 8.3%, which was similar to those reported by Mosha (1998) but higher than those reported by Shekimweri et al. (1998) and Shem et al. (2001) in Tanzania and by Hamir et al. (1978) in Kenya. This difference in levels of clinical mastitis between the relatively better managed intensive systems under which the above reported data was obtained and the extensive systems under which the current data was obtained could undoubtedly be attributed management. Data in table 2, and from the other survey data reported earlier shows that milking practices, general husbandry and housing were very poor in both the traditional and dairy ranch systems, which might have contributed to the proliferation of mastitis causing pathogens. The differences in the levels of infection between crossbred cattle in the current study and the exotic and grade cows kept on the more intensified dairy system were therefore, to a greater extent due to management rather than genetic factors (Wilson et al., 1997; Shem et al., 2001).

Zebu cattle had lower mastitis infection rates and lower somatic cell counts than crossbred cows probably due to their low genetic potential for milk yield (Payne and Wilson, 1999) compared to the crossbred cows with exotic blood which are reported to be more susceptible to mastitis (Mollel and Matovelo, 1998). Rodriquez (1997) reported high milk producing breeds especially the Holstein-Friesian to be more susceptible to Streptococcal and Staphylococcal mastitis than lesser breeds. However, a lower correlation between breed and bacterial load in mastitis milk has been reported (Shem et al., 2001). Dodd and Griffin (1975) concluded that mastitis might persist in a herd due to variations in the pathology, and that this could be could be a function of bacterial infection or bovine genetics. Controlled studies where zebu cattle could be compared to crossbred and exotic cattle are needed to shed more light on this.

Somatic cell counts (table 3) in the two herds exceeded the accepted threshold level for clinical mastitis, i.e. above 500 x 10^3 per ml. (Golda et al., 1984). Bacterial cell counts were higher in crossbred cows due to their higher potential for milk yields, a genetic inheritance from their *Bos taurus* ancestry as earlier postulated. This conclusion is in agreement that of Wilson et al. (1997). However, poor milking practices (table 2) and the unhygienic conditions in the kraals and enclosures could have contributed more to the reported high somatic cell counts as also reported by Shem et al. (2001) in smallholder dairy farms Tanzania. The partial suckling method to a great extent might have contributed to the low infection rates in the traditional cows screened as allowing calves to suckle their dams after milking ensured complete udder emptying, denying the pathogens a growth medium in which to multiply. Although there is no evidence given, it is suspected that hired labour on dairy ranches had poor milking practices compared to family labour in the traditional herd sector, a factor which might also have contributed to the higher somatic cell counts and mastitis infection rates in the dairy ranch sector 21%.

CONCLUSIONS

The results from this study point to management rather than genetic factors as the major causative factor for mastitis in extensively managed cows. Lack of clinical and the low sub-clinical infection rates in zebu cows might, however, be due to some genetic factors inherent to zebu cattle which makes them more resistant to mastitis than crossbred. Further research under more controlled conditions is needed before to ascertain this conclusion. Research is also needed to study the genetic diversity among the zebu breeds and populations in Tanzania and elsewhere for gene conservation purposes as they contain valuable genotypic and phenotypic traits, which are not found in *Bos taurus* breeds which might also include resistance to mastitis.

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