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**Short communication**

# SURVEY OF MASTITIS IN DAIRY HERDS IN THE ETHIOPIAN CENTRAL HIGHLANDS

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**ABSTRACT:** Prevalence of mastitis amongst dairy herds (n=725) and cows (n=2681) of Addis Ababa milk shed was investigated. California Mastitis Test (CMT) was conducted on milk samples from individual quarters. Of 10,908 quarters examined, prevalence of clinical mastitis (SCM), nonfunctional or blocked quarters (NFBQ) and subclinical mastitis (SCM) were 1.2%, 3.8% and 38.9%, respectively. Subclinical mastitis had highest relative occurrence (88.1%). Prevalence of quarter SCM was over 40% in Urban (n=5402) and Peri-urban Dairy (n=2454), and 25.1% in Dairy Herds Intra-urban of the Secondary Towns (n=2334) and the same increased with the herd size. On cow basis, prevalence of SCM was 18.7% and was higher in crossbred (n=2287; 21.3%) than with zebu (n=397; 4.3%). Significantly more SCM occurred in parity two and above (n=1978; 20.6%) than those in first parity (n=699; 13.2%) but this did not increase with lactation number. Over 87% of CMT reactions were scores distributed between Score 1 to 3, and were suggestive of infection. It was concluded that SCM is highly and widely prevalent. As it is economically damaging, the need to establish diagnostic facility to be able to early detect and screen large number of samples is emphasized and further work on identification of causative agents is recommended.

**Key words/phrases: Crossbred cows, dairy herds, local zebu, mastitis, subclinical mastitis**

## INTRODUCTION

Mastitis refers to the inflammation of udder regardless of the cause. The inflammatory process involves either the secretory cells of the mammary glands or its connective tissue or both. Mastitis has wide-spread distribution and the causative agents can be either physical or infectious and thus are many and varied (Schalm *et al.*, 1971; Blood and Radostits, 1989). It can appear with different degree of severity or intensity and variation in duration. In Ethiopia among the major mastitis causing bacteria identified include *Staphylococci, Streptococci* and Corynbacteria species (Nesru Hussein *et al.*, 1993; Geressu Biru, 1989).

Mastitis should be viewed as a herd problem for it commonly reduces milk yield and consequently has great economic significance. It is also true that more exact definition of mastitis is becoming increasingly complex (Giesecke, 1974; Blood and Radostits, 1989). Nevertheless, the cases of mastitis characterized by an overt manifestation of signs are described as clinical mastitis. By far the majority of mastitis cases world-wide are subclinically diagnosed (Schalm *et al.*, 1971). According to the International Dairy Federation's definition, in subclinical mastitis no obvious evidence of inflammation is apparent but an increased cell count and an alteration in the chemical composition of the milk can be found with appropriate testing (Tolle, 1971; Tesfu Kassa *et al.*, 1986). In a recent questionnaire based study conducted by the International Livestock Research Institute, mastitis was identified as a constraint by wider group of dairy producers in and around Addis Ababa characterized as "Addis Ababa milk shed" (ILCA, 1994). The present study was designed to investigate the prevalence of mastitis amongst dairy cows in the central Ethiopian highlands.

## MATERIALS AND METHODS

### *Location*

The study covered the Ethiopian central highlands where Addis Ababa is at the middle and surrounded by foci of towns identified as constituents of the milk shed of Addis Ababa (ILCA, 1994). The towns were Akaki, Kaliti, Kotebe, Sebeta, Sendaffa, Sululta and Debre Zeit, and scattered within the radius of 50 km from Addis Ababa. The altitudes of the region extend between 1880 and 2560 m above sea level, estimates for Debre Zeit and Sululta, respectively. The

study period was between December 1995 and May 1996 which constituted the dry period of the region.

### *Selection of farms/herds*

Multi-stage sampling procedures were followed to randomly select farms/herds first and then cows using data from Addis Ababa Dairy Producers' Association and the Ministry of Agriculture. The selection of farms/herds represented the three dairy production subsystems of Addis Ababa milk shed. Under Peri-urban Dairy (PD) category selected were farms/herds in Akaki, Kaliti, Kotebe, Sebeta, Sendaffa and Sululta. Representing Urban Dairy (UD) and those Dairy Herds in Intra-urban of Secondary Towns (DHIST) were from the city of Addis Ababa and that of Debre Zeit town, respectively. In the event when an owner refused or a farm/herd was unavailable for the survey, selection of a similar farm was made from the reserve list.

### *Herd investigation*

In the survey each farm was visited and information on management and production conditions of the farms and individual cows was collected using two separate data sheets. For diagnoses of clinical mastitis (CM) and nonfunctional or blocked quarters (NFBQ), clinical examination was conducted on all the four quarters of the cow. Clinical mastitis was diagnosed when there were signs of inflammation and macroscopical abnormal changes in milk such as purulent discharge or when blood was observed. No attempt was made to classify according to its severity. For diagnosing subclinical mastitis (SCM), individual quarter milk samples were collected from apparently normal glands of cows. The California Mastitis Test (CMT) reagent was used. As cows in the first week after calving or those at the last stage of lactation normally show strong positive reaction to CMT, this group of cows were excluded from testing.

The test for SCM was carried out in all selected farms at the usual milking time, which was early in the morning. About 2 ml of foremilk was collected from each of the four mammary quarters of the cow into the respective CMT paddle wells and an equal volume of CMT reagent was squirted from the plastic bottle. After a brief rotary movement of the mixture, the reaction was scored as negative, trace (score 0), weak (score 1), distinct positive (score 2) and strong positive (score 3) based on the amount of gel formation (Schalm *et al.*, 1971).

*Data analysis*

Data analysis was performed using the General Linear Models procedure of the SAS program (1987). Individual quarter and cow findings were examined on the basis of the prevailing production subsystems, different parity groups and between breeds (local zebu vs their crosses with Holstein Friesian). The distribution of CM, NFBQ, and SCM across the four quarters and that of CMT results were also tested. Chi-square, odds ratio (OR) and 95% confidence interval (CI) were used to determine level and strength of association.

## RESULTS

A total of 431 local zebu and 2250 predominantly Friesian x zebu crossbred cows were investigated in 725 herds. Invariably all the farms under the study practised hand-milking. The distribution of farms/herds and cows examined by dairy production subsystems defined as UD, PD and DHIST are shown in Table 1. The average number of cows per dairy farm/herd for UD, PD and DHIST were greater than 4, 13 (range, 13.2-76.5) and less than 2, respectively. The prevalence and distribution of udder infections across the four quarters are presented in Table 2; SCM cases had the highest relative occurrence of 88.1%. Both CM and NFBQ occurred numerically more in rear left quarters but not that of SCM (Table 2; $p > 0.05$).

The percent of positive quarters for SCM test in the entire milk shed was 38.9%. This was significantly higher (40%) in the UD (43.3%) and PD (42.5%) than in the DHIST group (25.1%, $p < 0.01$; OR=2.26; CI=2.04, 2.51) and the same was observed to increase with the herd size (Table 1). The distribution of CMT-positive findings in the three production subsystems is shown in Figure 1 ($\chi^2 = 200.4$, $p < 0.01$). Over 87% of the total scores were distributed between Score 1 and Score 3. The distribution of the reactions in the DHIST category, however, were noticeably raised towards Score 0. The DHIST subsystem, on the other hand, consisted of predominantly zebu cows (Table 1).

The occurrence of SCM amongst dairy cows by breed (Table 3) and by parity of the cows (Fig. 2) were also examined; and the prevalence , on individual cow basis, was 18.7% and was significantly ($p < 0.01$) higher in the crossbred (21.3%) than with the local zebu (4.3%; OR=5.68; CI=3.50, 9.08). Similarly, the prevalence was significantly more in parity 2 and above (20.6%) than with

cows in first parity (13.2%;$\chi^2$ = 20.9, p < 0.01; OR=2.40; CI=1.89, 3.06); but the same did not increase with the lactation number ($\chi^2$ = 1.07; p > 0.05).

**Table 1. Number of farms/herds and cows sampled for mastitis survey by dairy production subsystem and location in the central Ethiopian highland.**

| Dairy production subsystem | Location | Number of farms/herds sampled | Number of local zebu cows sampled | Number of crossbred cows sampled | Number of cows per farm/herd sampled |
|---|---|---|---|---|---|
| UD | Addis Ababa | 321 | 40 | 1332 | 4.3 |
| PD | Akaki | 4 | 2 | 72 | 18.3 |
| | Kaliti | 7 | 0 | 119 | 17.0 |
| | Kotebe | 8 | 0 | 102 | 12.8 |
| | Sebeta | 2 | 2 | 151 | 76.5 |
| | Sendaffa | 6 | 1 | 101 | 17.0 |
| | Sululta | 9 | 0 | 119 | 13.2 |
| | Debre Zeit | 368 | 386 | 254 | 1.7 |
| Total | | 725 | 431 | 2250 | 3.7 |

UD, Urban Dairy; PD, Peri-urban Dairy; DHIST, Dairy herds Intra-urban of Secondary Towns.

**Table 2. Prevalence and distribution of udder infections across the four quarters in dairy cows of the Ethiopian central highlands.**

| | Clinical mastitis (CM) | Nonfunctional or blocked quarters (NFBQ) | Subclinical mastitis (SCM) |
|---|---|---|---|
| Number of quarters examined | 10908 | 10908 | 10736 |
| Number of quarters affected[1], | | | |
| Front Left (%) | 32 (25.0) | 81 (20.0) | 987 (24.9) |
| Front Right (%) | 31 (24.2) | 98 (24.1) | 1021 (25.7) |
| Rear Left (%) | 38 (29.7) | 122 (30.0) | 969 (24.4) |
| Rear Right (%) | 27 (21.1) | 105 (25.9) | 992 (25.0) |
| | 128 | 406 | 3969 |
| Prevalence Rate (%) | 1.2 | 3.8 | 38.9 |
| Relative Percent of quarters affected | 2.8 | 9.0 | 88.1 |

[1] $\chi^2$ = 10.8; p > 0.05.

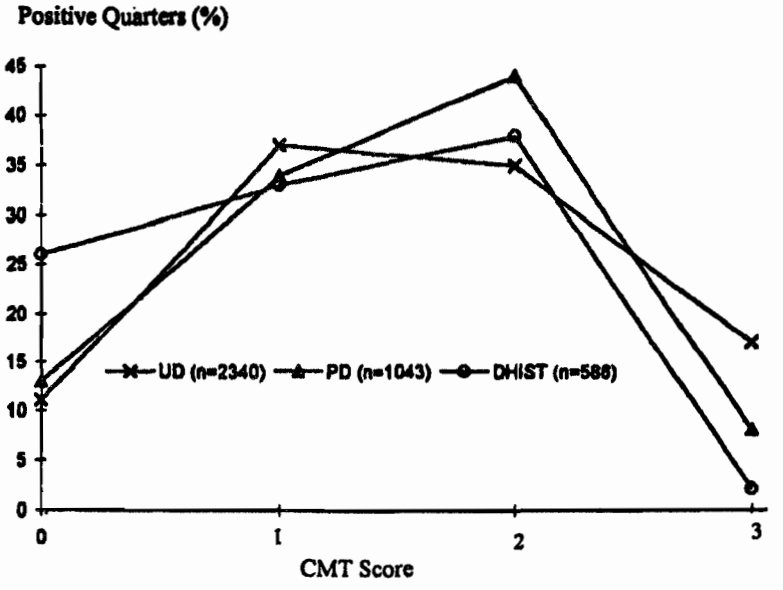


**Fig. 1. Distribution of California Mastitis Test (CMT) in Addis Ababa milk shed.**

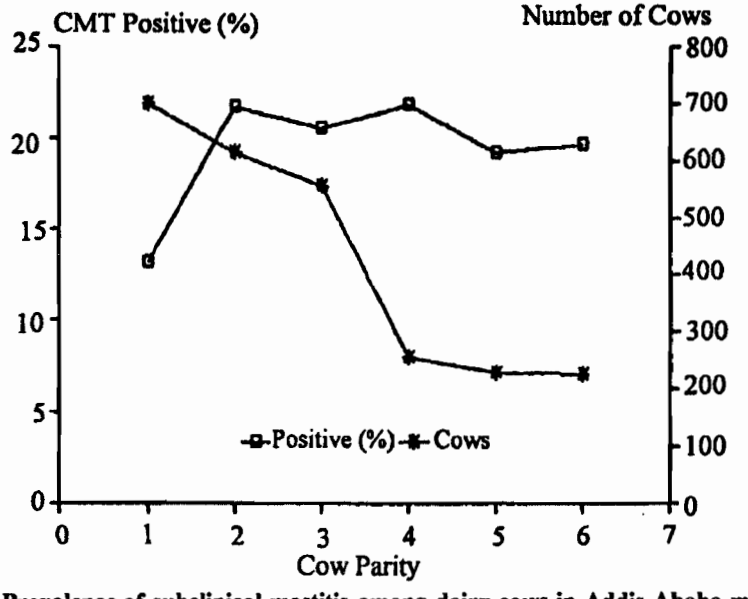


**Fig. 2. Prevalence of subclinical mastitis among dairy cows in Addis Ababa milk shed.**

## DISCUSSION

From the findings, it was evident that on quarter-basis, the frequencies of clinical mastitis (1.2%) and nonfunctional or blocked quarters (3.8%) occurred at low levels and the subclinical cases were relatively more prevalent (38.9%) in the entire Addis Ababa milk shed. The few previously published works pertaining to mastitis in Ethiopia focused on identification of the causative bacteria and sensitivity tests of the isolates to antibiotics (Nesru Hussein *et al.*, 1993; Geressu Biru, 1989). Several unpublished and theses works have dealt with clinical and subclinical mastitis and treatment responses. In a national survey conducted in Jamaican dairy herds, clinical mastitis occurred at 0.8% (Zingeser *et al.*, 1991). On the other hand, prevalence of 16.5% was reported for nonfunctional quarters among dairy cows in Kenyan herds (Maina and Mulei, 1993). In the present study, the distribution of udder infections over the four quarters revealed also higher occurrence of clinical and nonfunctional or blocked quarters in the rear left quarter but this was not statistically significant (Table 3, $p > 0.05$). Pearson and Mackie (1979) reported significantly more cases of clinical mastitis in that quarter of dairy cows. Nevertheless, in agreement with most other studies (Abdelrahim *et al.*, 1989; Zingeser *et al.*, 1991; Fang *et al.*, 1993) related to bovine mastitis, the relative prevalence of subclinical mastitis was considerably high (88.1%) and the same clearly indicated the importance that needs to be attached to this particular problem.

**Table 3. Prevalence of subclinical mastitis in cows and quarters examined by CMT amongst dairy farms/herds in three production subsystems of the Ethiopian central highlands.**

| Variable | UD[1] CMT Tested | | PD[1] CMT Tested | | DHIST[1] CMT Tested | |
|---|---|---|---|---|---|---|
| | N | Positive (%) | N | Positive (%) | N | Positive (%) |
| Breed[2] | | | | | | |
| Crossbreed cows | 1359 | 293 (21.6) | 656 | 148 (22.6) | 272 | 45 (16.5) |
| Local zebu cows | 37 | 2 (5.4) | 3 | 0 | 357 | 16 (4.5) |
| Quarters | 5402 | 2340 (43.3) | 2454 | 1043 (42.5) | 2334 | 586 (25.1) |

UD, Urban Dairy; PD, Peri-urban Dairy; DHIST, Dairy herds Intra-urban of Secondary Towns.
[1, 2] $\chi^2 = 244.4$, $p < 0.01$ and 61.98, $p < 0.01$, respectively.

The prevalence of quarter subclinical mastitis, which was over 40% in the UD (43.3%) and PD (42.5%), and 25.1% in the DHIST ($p < 0.01$), showed a rise as the herd size increased. In dairy herds, using CMT, prevalence of quarter subclinical mastitis as high as 38.4% in southeastern China (Fang *et al.*, 1993) and as low as 9.95% in India (Parai *et al.*, 1992) have been reported. Contrary to our findings, however, survey of mastitis conducted in the British and Jordanian dairy herds showed decline of udder infections as the size of the herd increased (Wilson and Richards, 1980; Lafi *et al.*, 1994). Obviously, parallel to the increase in cattle population, there have been a corresponding change in herd management that played a major role in this respect. In our conditions, however, it appears likely that with the increase of herd size, the hygienic conditions decline and the farms are prone to fouling and improper bedding. These conditions are known major predisposing factors of mastitis (Klastrup and Halliwell, 1977; Blood and Radostits, 1989).

On individual cow basis, the prevalence of subclinical mastitis was significantly different between the local zebu and crossbred cows (4.5% vs 21.3%, $p < 0.01$). The number of animals involved in the study however was limited (Table 3), at least for one breed. Furthermore, the crossbred cows were reportedly more susceptible to subclinical mastitis (Parai *et al.*, 1992); besides, the amount of milk produced by the zebu is so low that they appear less vulnerable to udder problems (Nesru Hussein *et al.*, 1993). As expected, however, there was a significant difference in prevalence of subclinical mastitis between first parity and parity 2 and above (13.2% vs 20.6%, $p < 0.01$). A tendency for a rise of the prevalence with lactation number was also observed in the PD herds. In the rest of the production subsystems, it was not so apparent due to, perhaps, management and the associated number of cows representing the different age groups. This is in agreement with Dohoo and Meek (1982) who reported that the increased frequencies of infection accounts more than the mere increase in age *per se*.

The CMT used in the survey is an indirect method which allowed monitoring the occurrence of subclinical mastitis in quarters, individual cows or herds done by estimating the somatic cell counts of milk samples (Schalm *et al.*, 1971). Using this method, screening of quarters milk samples for early detection of mastitis is achieved and the costs of bacteriological examination reduced. A number of factors are, however, known to influence somatic cell counts in bovine milk without the intervention of mastitis. These factors cause variation in somatic cell

counts which make interpretation of findings more difficult (Giesecke, 1974; Dohoo and Meek, 1982). As a result, a number of suggestions have been made on the discriminatory level of somatic cell counts to be able to identify affected quarters. It is now clear that deciding on the threshold level is crucial; if too high discriminatory levels are set, then that may result in a great number of false negative cases (i.e. too many of subclinical mastitis will be missed). The reverse is also true. It is particularly more complex in conditions such as ours where hand-milking is the most common means of milking cows (Klastrup and Halliwell, 1977). Consequently, for local purposes, establishing our own standards and discriminatory levels is useful.

In the present work no attempt was made on isolation and identification of infectious causative agents. A number of studies, however, clearly showed the close association between the level of infection and somatic cell counts of milking udder (Schalm *et al.*, 1971; Klastrup and Halliwell, 1977; Dohoo and Meek, 1982). Cell counts of 400,000 per milk ml are used to identify infected quarters (Blood and Radostits, 1989). Nevertheless, in our finding, almost over 85% of all CMT reaction scores on quarter samples were between 1 and 3 and these, most likely, raise the possibility of isolating pathogenic bacteria (Nesru Hussein *et al.*, 1993).

In conclusion, the results showed that a large proportion of mastitis cases in the Addis Ababa milk shed are SCM. The observed high prevalence of SCM is particularly damaging economically. On the technical side, the early identification of SCM cases can only be done under specialized settings and thus, establishment and incorporation of a suitable diagnostic facility for screening large number of samples so as to be able to serve the growing dairy business in the region is of paramount importance. Additionally, the high prevalence of bovine SCM can be of much concern to public health and hence further study in line with identification of causative agent is recommended.

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