ASSESSMENT OF CONTAMINATION OF MILK AT DIFFERENT STAGES OF COLLECTION

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ABSTRACT

Good quality milk in relation to composition and hygiene is a basic requirement to process the 'ready to drink' milk which is presently in great demand. Inevitably this market trend has stimulated milk-procuring agencies to examine milk for both composition and quality of milk at the various stages in the collection chain. A very large proportion of milk in Sri Lanka is produced by small holder dairy farmers where clean milk drawn directly from the udder is likely to be contaminated before it reaches a processing plant. Polluted water, unclean receptacles, long transit time with increased environmental temperatures, are some of the potential causes for increased bacterial counts in milk which reflect contamination. The purpose of this study was to identify the amount of contamination of milk at the different stages of collection and the influence of preservatives in reducing such contamination. The study was conducted among 40 dairy farmers in three villages around Kandy. The farmers were visited three times during a period of six months. In the first visit, a sample of milk was collected to determine the degree of contamination. At the second visit a sample was collected for the California mastitis test (CMT) and the third visit was made to create an awareness of the importance of clean milk production. Ten per cent of sample drawn from the udder was positive for Methylene-Blue dye Reduction test (MBRT) after one hour. In contrast, 15% of milk samples collected from the bucket and 50% of the samples collected at the Milk Collecting Centers were found to be positive for MBRT after one hour, and by the end of the third hour all the collecting center samples were found to be positive. It was observed that polluted water and general unhygienic conditions were the main contributors to contamination of milk. Among the samples collected from the three villages, the management practices in one village was very poor. In this village even the samples collected directly from the udder were found to be heavily contaminated and 77% of them gave a positive reaction to the CMT. The addition of hydrogen peroxide was found to reduce the bacterial counts indicating that it is a useful preservative. The third visit helped to educate farmers on cleaner milk production resulting in a better price for their milk.

INTRODUCTION

The dairy cow is an efficient converter of non-conventional resources into human food in the form of milk and meat. Cow milk is regarded as a complete single food as it contains nutrients such as carbohydrates, proteins, fat as well as vitamins, minerals, and essential amino acids in proportions that are easily digested and absorbed by man. Dairy farming is therefore a useful means of providing essential nutrients to enrich the human diet and also for enhancing household income (Diggins and Bundy 1961, Harvey and Hill 1946).

In the early days of milk production in Sri Lanka, dairying was a village activity where a few households had a limited number of cows that were milked and the milk bartered for other necessities or commodities. The social and economic changes with the passage of time

saw many changes in rural farming activities including dairying. With increasing migration of rural folk to urban and semi-urban areas, dairying transformed from a cottage activity to a somewhat commercial enterprise, especially with the purchasing of milk by procuring agencies. The latter change required milk, which is a highly perishable commodity, to be transported from the places of production often in rural areas to processing plants that converted the milk into forms that had a longer shelf life as liquid milk or products such as butter, cheese, ice cream yoghurt, and milk powder (Franklin and Barbar 1962, Chamberlain 1989).

Milk drawn from the udder is clean but is subject to contamination from various sources such as polluted water, unclean receptacles etc. Indeed, milk already contaminated at the point of origin when transported over long distances at temperatures above 4°C will lead to further deterioration with increased bacterial counts, that render milk unsuitable for processing and unsafe for human consumption. It is also possible for milk to have a high bacterial count owing to inflammatory diseases in the udder such as mastitis. In Sri Lanka, over 90 per cent of milk is produced by small-holder dairy farmers and high bacterial counts in milk have been identified as a major impediment to processing it into products with a longer shelf life.

The objective of the present study was to identify the points at which milk was contaminated within the small-holder dairy cattle management system using conventional platform tests and to assess the degree of awareness about clean milk production.

MATERIALS AND METHODS

This study was carried out in the mid-country in three villages-Bokalawela, Suduwella and Upper Galaha. Forty farmers were involved and their history was taken prior to the study. The hygienic practices were observed routinely, when they were doing their morning milking. Four milk samples were collected separately (into autoclaved bottles) at four different stages of milk collection. The first milk sample was taken directly from the udder, the second from the farmer's bucket, the third from the collecting center bulk container, and the final sample from the chilling center tank. The keeping quality of milk was assessed by Methylene Blue dye Reduction Test (MBRT) and the Resazurin Test (RT).

While milking the following were observed; the hygienic condition of the farm, nature of cattle shed, source of water, cleanliness of the utensils, whether udder washing was done, and cleanliness of farmers hands. After milking, the time taken to reach the collecting center also was noted. After 2 weeks a second visit was made to perform the California mastitis test on the cows whose udder samples were contaminated. Finally a third visit was made to advice the farmers on clean milk production.

The farmers were categorized into three groups depending on whether cleanliness was very good, moderate or poor.

Methylene-blue dye reduction test (MBRT)

Bacteria and somatic cells in milk change the redox-potential of the medium by utilizing dissolved oxygen in milk. Consequently, a reducing power is developed and it can reduce dyes like Methylene blue and Resazurin. Some enzymes like dehydrogenases and flavin enzymes in bacteria also can reduce these dyes. These enzymes transfer hydrogen from

substrate to biological acceptors. Methylene-blue acts as an acceptor. Due to bacterial activity the colour of Methylene blue is reduced from blue to white. Therefore, colour change can be used as an indication of bacterial activity. If the bacterial count is high the time taken to reduce the dye is low.

To perform the test, one milliliter of Methylene blue is added to 10 ml of milk in a sterile labelled test tube. The tube is sealed with a sterile stopper. After gentle mixing the tube is incubated in a water bath at 37° C. The tube is examined at one hour intervals and it is inverted before returning to the water bath. The time taken for Methylene blue to get discoloured is recorded.

Resazurin test (RT)

To perform this test, one milliliter of Resazurin dye is added to 10 ml of milk in a sterile labelled test tube. The tube is sealed with a sterile stopper. After gentle mixing the tube is incubated in a water bath at 37° C. Resazurine dye is bluish purple in colour and when it is reduced the dye colour changes to pink. This colour intensity can be measured by using a Lovibond Comparator. The tube is first examined after 10 minutes and thereafter at one hour intervals. The tube is inverted before returning it to the water bath. The dye colour is reduced due to the action of bacteria. The bacteria change the redox-potential in milk by utilizing dissolved oxygen in the milk.

California mastitis test (CMT):

This test is used to identify sub-clinical mastitis. Two mililitres of milk and approximately the same volume of CMT reagent is mixed in a CMT paddle to identify positive cows.

The CMT reagent destroys the cell membrane of somatic cells and react with nuclear materials to form a gel. The degree of gelation is proportional to the number of somatic cells present in the sample. Any amount of gel formation is considered as a positive result. According to the degree of gelation, it is possible to categorize the results as negative, trace, 1, 2, and 3 (Radostitsom Blood & Gay, 1994). In sub-clinical mastitis the somatic cell count is high, hence such milk will give positive results for CMT.

RESULTS AND DISCUSSION

Fig. 1 shows that 10% of milk samples drawn from the udder was positive by the MBRT after one hour. In contrast, 15% of milk samples collected from the bucket and 50% of the samples collected at the Milk Collecting Centers were also found to be positive for MBRT after one hour, and by the end of the third hour all the collecting center samples were found to be positive. This may be due to the unhygienic milking practices of the farmers, unhygienic utensils used in milking, and long duration of transport.

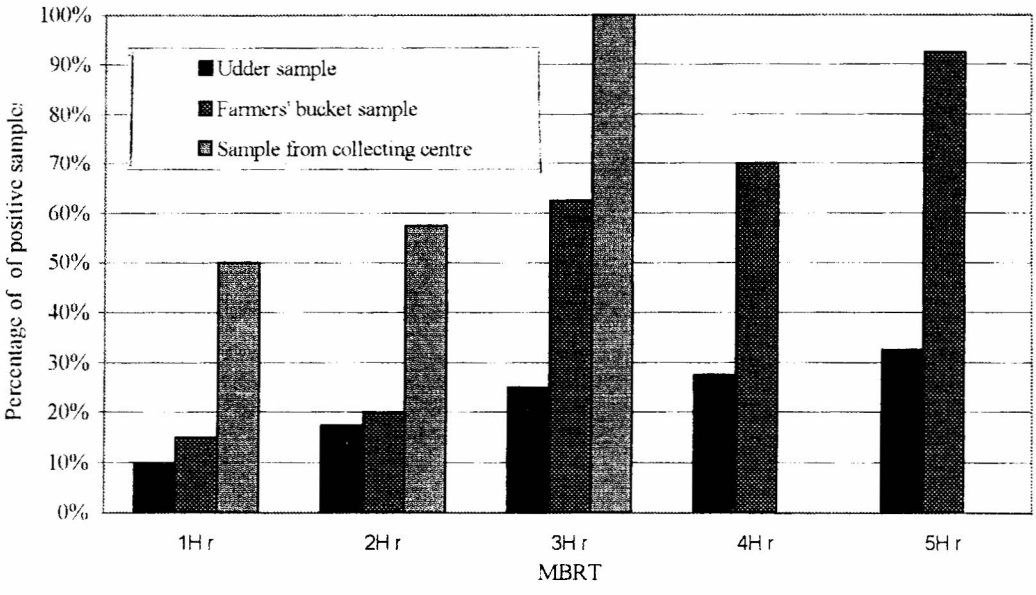

Fig.1. Relationship between Methylene-Blue reduction time and the percentage of positive samples

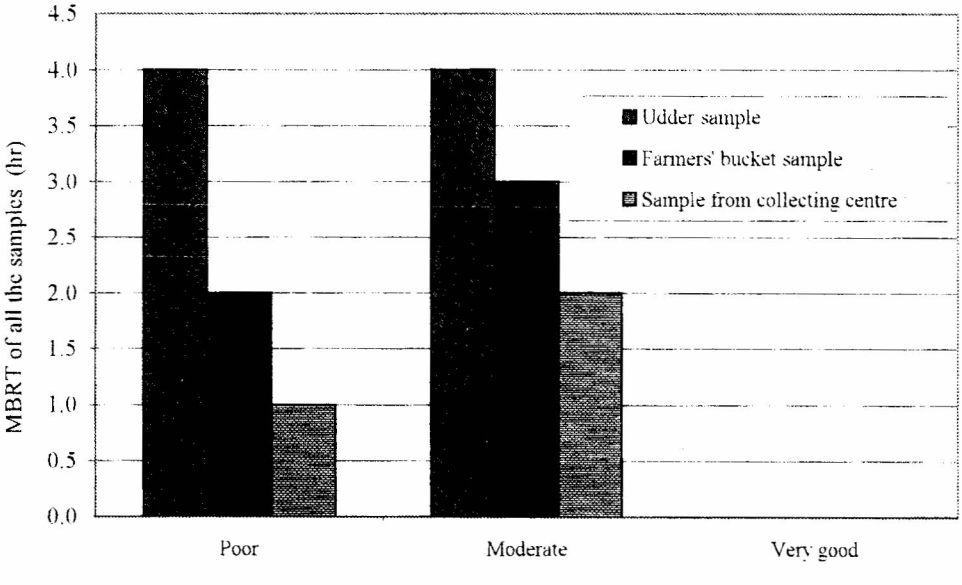

Fig.2. Relationship between hygienic milking practice and MBRT

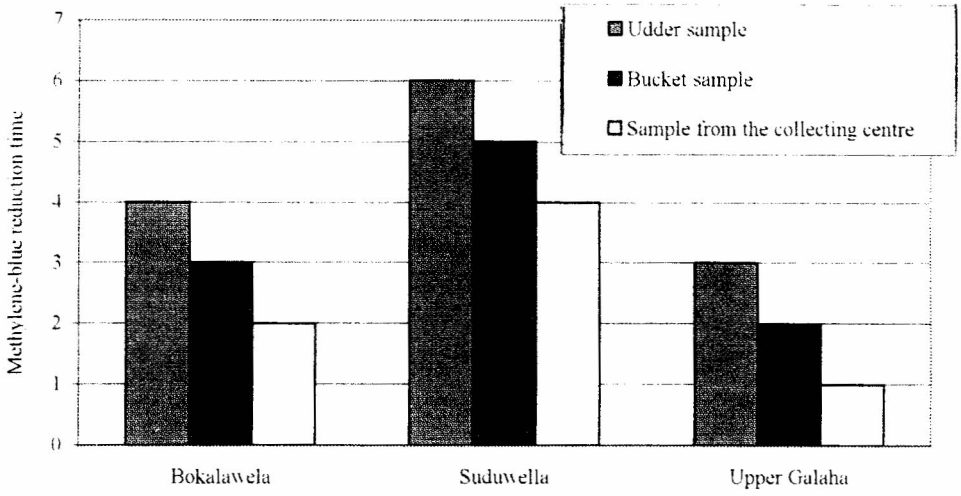

Fig.3. A comparison of milk contamination among the three villages

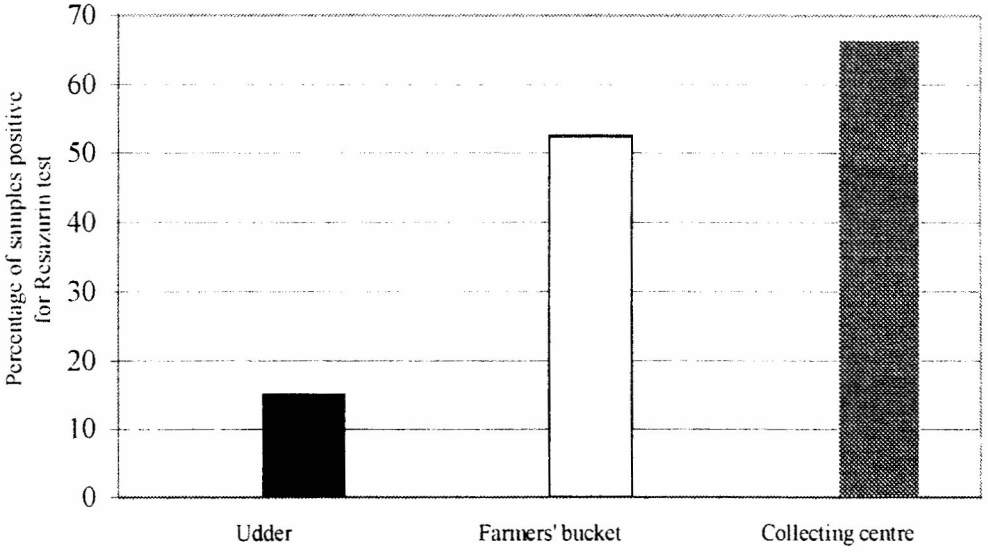

Fig.4. Contamination distribution in different stages of collection of milk

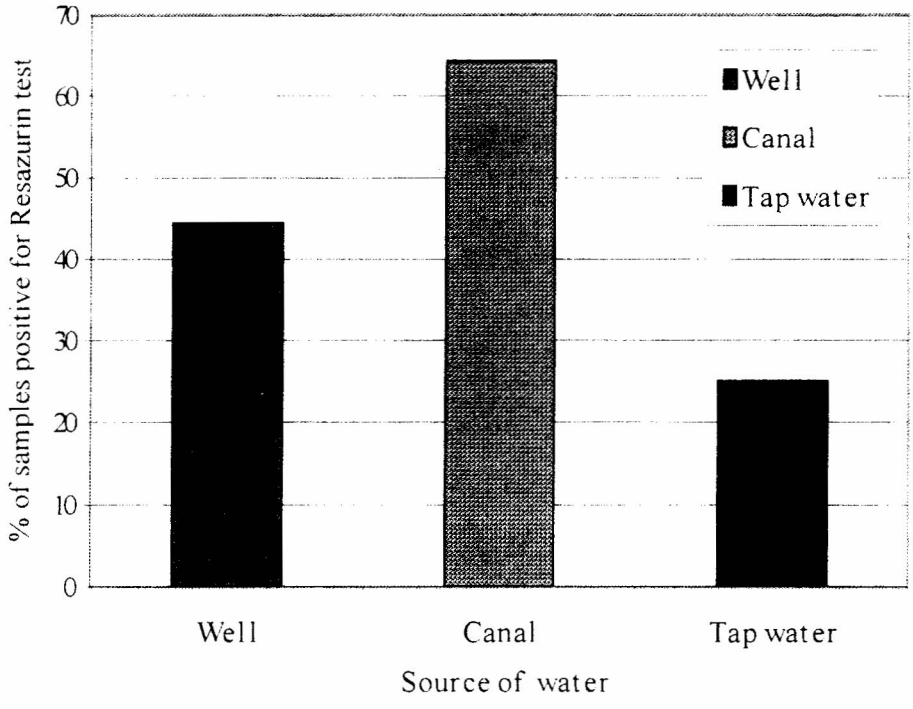

Fig.5. Relationship between source of water and contamination of milk

When farmers were categorized according to cleanliness of milking none fell into the category of "very good". The MBRT for the udder samples was similar in the two categories of "poor" and "moderate" (Fig. 2) indicating that contamination began only after retraction of milk from the udder.

Fig. 3 revealed that among the three villages, samples from Upper Galaha were highly contaminated. That may be due to the unhygienic milking practices and poor socio-economic status of these villagers.

In Fig. 4 only 15% of udder samples show positive results for Resazurin Test indicating lower contamination at udder level. In contrast, 66.6% of collecting center samples show positive results indicating highest contamination of milk at the collecting center level. This could be a result of long duration taken to reach the collecting center at high ambient temperatures in this tropical climate. The poor refrigeration facilities also would have attributed to this condition.

The milk samples from farmers who used tap water indicate lowest contamination. In contrast, samples from those who used washing water from near by canals show highest contamination (Fig. 5). This may be due to the treated water coming in the water line.
Seventy seven percent of milk samples were positive for CMT test.

CONCLUSIONS

Milk in the udder is clean but is easily contaminated from many sources when drawn out. Unhygienic milking practices, contaminated water, and a relatively long transit time from collection to processing have a major impact for heavy contamination of milk.

An analysis of reasons for contamination revealed that it was largely due to ignorance of the farmers; therefore, making the latter aware of clean milk production will make a significant impact in improving the quality of milk.

Clean milking practices with the use of clean water and clean receptacles at milking, general improvement in husbandry practices, and delivery of milk quickly to collecting centers or points of collection, will enhance the quality of milk. The introduction of a scheme for remuneration for clean milk will indeed be an incentive for clean milk production by small holder dairy farmers.

SUGGESTION

In order to increase awareness of farmers in producing good quality milk, it is better to introduce a scheme of increased payment for good quality milk.

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