



Bacteriological Quality of Milk at Different Levels of Collection in Goa

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ABSTRACT

The bacteriological quality of milk at different levels of collection was studied. Samples were collected in sterile containers at quarterly intervals. The samples were analysed for total viable count, methylene blue reduction test (MBRT) and California mastitis test (CMT). Subclinical mastitis was found in 23.8% of the animals. The average methylene blue reduction time decreased from the farm to the processing unit. The average counts were 2.67×10^4 , 1.59×10^4 , 9.23×10^5 and 2.35×10^6 cfu/ml at farmers' field, milking utensils, collection centers and receiving dock (processing point), respectively. The milking methods, milk containers and time interval from the collection at the udder level to the receiving dock played a major role in the deterioration of the milk quality along with the climatic conditions prevalent in a particular season.

Keywords: Milk, bacteriological quality, total viable counts.

Introduction

Dairy plays a dynamic role in India's agro-based economy. Today, India ranks first in the world in terms of milk production. In Goa, there is ample scope for income generation through livestock production. The territory has about 1,00,000 cattle and 45,000 buffaloes. The assessment of microbial load at various stages of manufacture or processing may serve as a useful tool for quality assessment and improvement which will result in longer shelf life which is a desirable market requirement. Keeping fresh milk at an elevated temperature together with unhygienic practices in the milking process may result in microbiologically inferior quality. Apparently, these are common practices for small-scale farmers who produce fresh milk and sell it to local consumers

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or milk collection centres (Chye *et al.*, 2004). This study was carried out to investigate the microbiological quality and safety of locally produced raw milk and to identify the relevant sources of contamination and critical point in the chain of locally produced raw bovine milk.

Materials and Methods

A total of 647 milk samples from dairy animals were collected at different levels of collection and processing (udder, milking utensils, dairy cooperative society (DCS) and receiving dock) within Goa region during 2006–2009. Samplings were done at quarterly interval (January, April, July and October). Prior to milking, the contamination of the surface of the material and the containers was determined by flushing all containers with 100 ml of sterile water. A total 55 swab samples were also collected from cans and milk processing line.

All the samples were collected in sterile screw cap tubes. Samples were collected early in the

morning at udder, milking utensils, and dairy cooperative society levels. For samples at udder level, milking animals were randomly selected on each farm. Milk from four of the teats of the cow was collected directly in sterile screw capped tube. The second milk sample was collected from the can in which milk was drawn in the can from the same cow. When this can reached at DCS, third sample was collected. At DCS the milk got transferred in another big can, which came to receiving dock at processing unit, where fourth sample was collected. All the samples were kept in icebox, transported to the laboratory under chilled conditions and processed for microbiological analysis. The time between milking and transportation to the processing unit was also assessed. At each visit, farm management and general hygiene were evaluated with emphasis on milking procedures, cleaning of containers and material.

The methylene blue reduction test was performed according to the IDF (1990). California mastitis test (CMT) test of the milk samples was carried out by using CMT reagent (3 g of sodium lauryl sulphate and 300 mg of bromocresol purple added in 100 ml distilled water). 0.5 ml of milk was taken in paddle and 0.5 ml of CMT reagent was added. The paddle were rotated for 1 min and observed for clump formation up to 1 min. For enumeration of bacteria, the samples were serially diluted in peptone water (Himedia, Mumbai) and appropriate dilutions were plated on plate count agar using the spread plate method. The plates were incubated at 37°C for 24 h for aerobic mesophilic counts. The enumerations were done according to ICMSF (1978). The data was analysed using paired t-test using statistical package WASP.2 (www.icargoa.res.in).

The milk passed through at least four to five steel/aluminum containers, two funnels and two sieves before reaching the container, which is processed at the processing unit. The containers were cleaned thoroughly. Soap is used sometimes; washing of hands and udders was a common practice.

Results and Discussion

Subclinical mastitis was found in 23.8% of the animals (at least one positive quarter per cow) by

CMT. Subclinical mastitis was reported to be more important in India (varying from 10-50% in cows and 5-20% in buffaloes) than clinical mastitis (1-10%) (Joshi and Gokhale, 2006). In another study, of the 507 milk samples collected, 454 (89.5%) were California mastitis test (CMT) positive (Adesiyun, 1994).

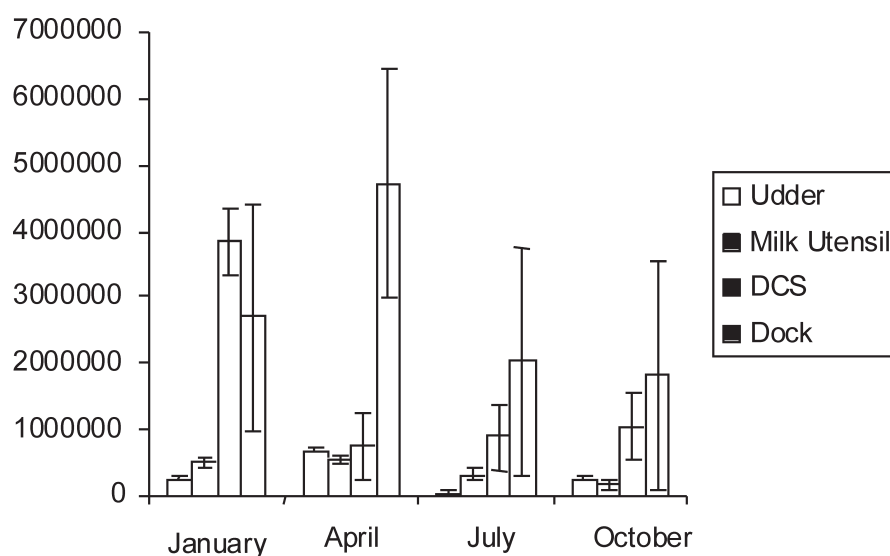
The average methylene blue reduction time decreased from the farm to the processing unit. The reduction time is significantly correlated ($P < 0.001$) with the critical control point of milk in the chain. This denotes the exponential increase in contamination from the udder to the processing point.

The total viable counts varied from $<10^3$ to 5.94×10^6 cfu/ml at farmers' field, $<10^3$ to 5.94×10^6 cfu/ml at milking utensils, 3.4×10^4 to 5.0×10^7 cfu/ml at dairy cooperative society and 2.07×10^5 to 4.0×10^8 cfu/ml at receiving dock. The average counts were 2.67×10^4 , 1.59×10^4 , 9.23×10^5 and 2.35×10^6 cfu/ml at farmers' field, milking utensils, collection centers and receiving dock (processing point), respectively. The data is presented in Fig. 1. The total counts at udder level and for samples from milking utensils differed significantly ($P < 0.005$) from that of receiving dock level. Similar findings were reported by Godefay and Molla (2000) in Ethiopia while studying the bacteriological quality of raw cow's milk taken at different sampling points from four dairy farms and a milk collection centre. The total aerobic plate count per ml of pre-processed raw milk was found to be high ranging from 5.8×10^5 to 5.7×10^8 in Trinidad (Adesiyun, 1994).

The total counts of swabs were 7.3×10^5 for aluminum cans, 2.3×10^5 for steel cans and 6.33×10^4 at processing lines (Table 1). The average total viable counts of can rinse were 3.11×10^6 . The highest microbial load occurred during summer season, while the lowest counts occurred during winter season. The total counts of the samples collected during October at udder level were significantly different from the counts of the samples collected during January. Also the total counts of the samples collected during January significantly ($P < 0.005$) differed from the counts of the samples collected from milking utensils during April. The seasonal value

Table 1: Analysis of swab samples (n = 55)

Source	Total plate count		
	Maximum	Minimum	Average
Aluminium can	6.8×10^4	<10	0.73×10^4
Steel can	1×10^4	<10	0.23×10^4
Processing line	26.2×10^4	<10	6.33×10^4

**Fig. 1: Microbiological quality of milk in different seasons at four different levels of collection/processing**

indicated that the environmental temperature of the also matters in the microbial quality of milk. Comparatively high value during summer indicated increased microbial growth. It was observed that the load of the microorganism was high in raw milk in all seasons. The high microbial load indicated unhygienic practices prevailing at the production level. Proceeding time and normal environmental condition allows favorable growth of microorganism increasing microbial load. In some cases, from DCS to dock microbial load increased by 1-3 log unit per ml.

The health of the dairy herd, milking and pre-storage conditions are also basic determinants of quality (Aumaitre, 1999). Another source of

contamination by microorganisms is unclean teats. However, in the present study the bacteriological counts in milk due to unclean udders was low, but intense manipulation of small quantities of milk using several containers increased the count of microflora in milk. The use of unclean milking and transport equipment contributed to the poor hygienic quality of the milk. These observations are in line with findings in Ethiopia (Godefay and Molla, 2000).

Microbial contamination of raw milk may occur from 3 main sources: from within the udder (mastitis associated organisms), from environmental organism transfer via dirty udder and teat surfaces, and from improperly cleaned and sanitized milking equipment. Additionally, improper cooling and

prolonged storage of milk can also influence bacterial count by increasing the rate of bacterial growth during storage of milk (Elmoslemany *et al.*, 2009).

It was observed that the period between time of collection of milk and its transportation to processing unit was critical for change in microbial count. On an average, it required 4.5 h between milking and arrival at processing unit. The milk produced at farmers' field was of the best quality except on few occasions. However, further handling of the milk added to the microbial contamination. Presence of subclinical mastitis increases the microbial count of the raw milk. As far as possible the time duration between milking and arrival of milk at processing unit need to be decreased or reduced. Chilling plants may be established at far off places for initial cooling of milk so that the bacterial multiplication is minimal. The clean milk production starts at the farm therefore animals, shed, utensils and the milking personnel all contribute to the quality of milk. A backward linkage of quality of milk and status of animal health, the milking surroundings need to be established. This will help in taking corrective actions and to break the unhealthy link. Therefore, it is recommended that training and guidance should be given to farms' owners and their workers responsible for milking.

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