



## Quality of milk consumed by inhabitants of city corporation and rural areas of Sylhet division

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### ABSTRACT

This present study was undertaken to have a comparative investigation on the nutritional, chemical and microbiological quality of milk, supplied by the farmers from their own farm (OFM), middleman collecting milk from single farm (MMSL) or middleman collecting milk from multiple farms (MMOP), to the inhabitants of city corporation and rural areas of Sylhet division. A total forty four samples that collected from city corporation (28) and rural areas (16) were analyzed for nutritional (percentage of butter fat, solids not fat, protein, lactose), chemical (added adulterates and preservative status) and microbiological (Total Coliform Count, Total Staphylococcal Count) parameters among the sources. The result of the study reveals that milk of rural areas have little higher nutritional value compare to city corporation milk but there was no significant difference ( $p>0.05$ ). Total Coliform Count (TCC) and Total Staphylococcal Count in city corporation area were 325.32 and 642.67 CFU/ml whereas 296.76 and 610.23 CFU/ml) in rural areas indicating higher microbial load in the milk supplied to city corporation compare to rural inhabitants. It was also found that among the three sources of milk 75% of MMOP milk samples were adulterated with water where only 25% of OFM and no MMSL samples were adulterated with water. But preservatives like formalin, hydrogen peroxide were not found in any samples. So it may be concluded as, rural people get good quality milk compare to city corporations inhabitants but in both areas middleman who supplies milk of multiple farm, adulterate their milk with water.

### INTRODUCTION

Milk is defined to be the lacteal secretion, practically free from colostrums, obtained by the complete milking of one or more healthy cows, five days after and 15 days before parturition, which contains not less than 8.5 percent milk solids-not-fat and not less than 3.5 percent milk fat (U.S. Public Health Services, 1965; Itzerott G (1960). It is the characteristic secretion of mammary gland of all species of mammals, from man to whales, and they produce it for this purpose. Milk supply nutrients, vitamins and minerals in proper form and amount and thereafter called “almost complete” as well as wholesome nutritious food for all mammals including human

being (Neumann et al., 2002). The protein of milk is not a single compound but includes three major proteins namely: casein (80 % of total protein) and lactalbumin (18%) and lactoglobulin (2%). The essential amino acids like tryptophan and lysine are present in large quantity in milk, which are deficient in vegetable protein. Milk fat is commonly the most valuable constituent of milk. It has a special significance in nutrition, due to the presence of wide range of fatty acids and high content of short chain volatile fatty acids. It is easily digestible and serves as the concentrated source of energy and each gram of fat furnishes 9 calories of energy (Islam et al., 2013). Calcium and phosphorus, which are important for the formation of bones and teeth and almost all the

essential minerals needed by the body, are present in the milk.

Sylhet division is the northeastern division of Bangladesh. About 9.91 million people lives in this district within an area of 12298 Km<sup>2</sup> [BBS-2011] and the city corporation has also a high population density, with nearly 500,000 people living within 26.5 square kilometer (Siddiquee, 2006). Total estimate demand (250ml/day/person) of milk is 125000 liters in city corporation and 2352500 liters other than the city corporation (BDS 2002). But the milk productions both in the city corporation and in the villages are very negligible against the demand. To meet this demand of fluid milk of such a huge population three sources of milk is available in City Corporation namely own farm milk (OFM) or middleman selling it (MMSL) or middleman collected from multiple farm (MMOP) and in the villages this huge demand is mainly fulfilled by own farm (OFM) produced milk. Alongside of these sources a lots of powder milk are also imported to fulfill this demand. For fulfilling consumer's demand, quality milk production is necessary. Quality milk means, the milk which is free from pathogenic bacteria and harmful toxic substances, free from sediment and extraneous substances, of good flavor, with normal composition, adequate in keeping quality and low in bacterial counts. The supplied milk in Bangladesh is generally found adulterated (Islam et al., 1984). On the other hand, it is also an excellent media for growth of large variety of bacteria. It was reported that there are so many sources viz. udder, body of the cows, litter, floor, flies, insects and rodents, water supply, milker, milk utensils and atmosphere etc. for bacterial contamination of milk (Cousin, 1982). It also reported that milk and milk products derived from milk of dairy cows can harbor a variety of microorganisms and can be important sources of food borne pathogens (Oliver et al., 2005).

To ensure good quality milk for people it's necessary to prevent all the adulteration and surveillance of milk quality from government level. In our country Bangladesh Standards and Testing Institution (BSTI) play this rule but the most of the supplied milk in the market by the farmers, vendors and middleman may not cover

under this surveillance system. Therefore, the present study was undertaken with the aim to make a comparative study regarding nutritional, chemical and microbiological quality of the milk from different sources of city corporation and rural areas of Sylhet division.

## **METHODS AND MATERIALS**

### **Collection of samples**

A total 44 samples were collected from different part of Shylhet City Corporation (28) and rural areas (16) of Sylhet division randomly. These samples were collected from farmer who sales their own farm milk (OFM) or middlemen selling it (MMSL) and middlemen collected from multiple farm (MMOP).

### **Sampling procedure**

The OFM samples were collected from farms after milking all the cows and properly mixing with the help of plunger and dipper. The MMSL and MMOP samples were collected from households and bulk sources of vendors with the help of plunger and dipper.

### **Sample preservation and transportation**

Immediately after collection the samples were kept into the deep freeze and transported to the laboratory using insulated ice box maintaining temperature and sterile condition.

### **Quality tests**

Solids-not-fat (SNF) %, butter fat (BF) %, protein %, lactose%, density, freezing point, mineral % of milk was determined by using Lactostar machine (Germany). Added preservatives (formalin, hydrogen per oxide) and adulterates (added water, cane sugar, starch and powder milk) detection test were performed as per the instruction (DGHS, 2005).

### **Microbiological examination of samples**

For enumeration of TCC (Total Coliform Count) and TSC (Total Staphylococcal Count) tenfold dilution of each raw milk sample was prepared

using peptone water. For the determination of TCC, 0.1 ml of each dilution was transferred using sterile pipette and spread on MacConkey agar using a sterile glass spreader for each sample. The plates were then kept in an incubator at 37<sup>0</sup>C for 24-48 hours. Following incubation, plates exhibiting 30-300 colonies were counted. The average number of colonies in a particular dilution was multiplied by the dilution factor to obtain the TCC. The TCC was expressed as the number of organism of colony forming units per ml (CFU/ml) of samples according to ISO (1995). TSC was also determined by following the similar method of TCC count except the agar. In case of TSC, Mannitol salt agar was used.

### Gram's staining

Gram's Method of staining was performed as per the procedures recommendation of Cowan (1985) to study the morphology and staining character of each isolated bacteria.

### Statistical analysis

The data were recorded and categorized in Microsoft Office Excel sheet and finally analyzed by Compare means One-way ANOVA by using statistical software STATA 11.5 version.

## RESULTS AND DISCUSSION

### Quality of milk

#### *Nutritional test*

The nutritional components were determined by using lactostar machine, which are showed in Table 1 and Table 2. The BF%, SNF%, protein% and lactose% of Sylhet city corporation samples were 3.422%, 8.088%, 3.125% and 4.355% respectively. On the other hand the BF%, SNF%, protein% and lactose% of Sylhet rural samples were 3.535%, 8.319%, 3.247% and 4.516% respectively (Table 1).

Statistical analysis showed that average fat contents of milk samples collected from different areas not show any significant difference, but BF% of rural area samples were slightly higher than the city corporation milk samples. Lowest

BF% was recorded 1.81% in city corporation area which is lower than the BSTI-2002 standard. This result is similar to the findings Asaduzzaman (2000). It indicates that in rural area adulteration is lower than the city corporation areas. (Table1). Among the three sources of milk, MMSL and OFM meet the BSTI-2002 standard but the milk supplied by the MMOP was inferior quality. This may be support the findings of Debnath et al., (2014). Middleman who collected milk from different farms may adulterate it before sell. (Table 2)

The SNF% of two sample groups also didn't have any significant difference. The SNF% percentage in both city and rural area samples are quite satisfactory which agreed with SNF% findings of Debnath et al., (2014) (Table1). The SNF% of OFM, MMSL, and MMOP were recorded 8.36%, 8.74% and 7.1% respectively (Table 2). The SNF content of FPM was slightly higher than the findings of Graf (1976) and similar to the findings of Debnath et al., (2014) in case of raw farm milk. (Table 2).

The Protein percentage in milk samples of City Corporation and rural areas are very similar and not differ significantly that showed in (Table 1). The protein content of OFM, MMSL and MMOP were 3.24, 3.38, and 2.24%, respectively (Table 2). The highest protein was found in MMSL and lowest in MMOP. The protein content of raw milk was recorded 3.38%, which differed from the present findings of Lingathurai et al., (2009).

No significant difference found between two sample groups based on their lactose% (Table 1). Rural area samples have little more lactose percentage than the city corporation samples. On the other hand, the lactose content of OFM, MMSL and MMOP were respectively (Table 2). Middleman who collects milk from multiple farms supplied lowest quality milk in the market; they may adulterate milk after they collect it from the farmers. (Table 2).

### *Tests for adulteration*

The frequency of water adulteration was little bit higher in city corporation area then the rural areas (Table 3). It was 28.5% in city and 25% in rural

areas. But sample from both areas negative in powder milk, starch and cane sugar adulteration.

Only water adulteration was found in case of OFM (25%) and MMOP (75%) samples. Other adulteration tests were found negative for all three sources. The results for formalin and hydrogen peroxide test of milk samples collected from city and rural areas of Sylhet division showed negative result. It means that milk from all three sources OFM, MMSL and MMOP were free from preservatives.

The frequency of water adulteration was little bit higher in city corporation area then the rural areas (Table 3). It was 28.5% in city and 25% in rural areas. But sample from both areas were found negative in powder milk, starch and cane sugar adulteration.

The nutritional quality of milk was deteriorated by middlemen due to water adulteration. This result is

Table 1  
Nutritional quality of milk from two sample groups.

Parameter	Sylhet city corporation		Sylhet rural areas		p value
	Mean	SD	Mean	SD	
BF (%)	3.422	0.909	3.525	0.684	0.78
SNF (%)	8.088	1.031	8.319	1.687	0.69
Protein (%)	3.125	0.402	3.247	0.649	0.58
Lactose (%)	4.355	0.564	4.516	0.913	0.61
Density	1.027	0.004	1.027	0.006	0.70
Freezing Point	-0.500	0.065	-0.468	0.119	0.43
Mineral (%)	0.793	0.065	0.4687	0.119	0.07

Table 2  
Nutritional quality of milk from three sources.

Parameter	OFM		MMSL		MMOP		p value
	Mean	SD	Mean	SD	Mean	SD	
BF (%)	3.538	0.688	4.215	0.233	2.77	1.11	0.09
SNF (%)	8.36	1.29	8.74	1.36	7.1	0.597	0.16
Protein (%)	3.248	0.500	3.38	0.558	2.247	0.234	0.15
Lactose (%)	4.52	0.702	4.71	0.777	3.82	0.334	0.16
Density	1.02	0.005	1.02	0.006	1.02	0.001	0.26
Freezing Point	-0.495	0.098	-0.525	0.040	-0.445	0.022	0.50
Mineral (%)	0.739	0.187	0.815	0.007	0.745	0.025	0.83

agreed with the findings of BSTI-2002, BDS-1702. The percentage of water adulteration was highest in MMOP (Table 4). Other adulteration tests were found negative for all three sources.

Among the preservatives formalin and hydrogen peroxide are most frequently used. Formalin (40% Formaldehyde solution) is generally used to preserve biological elements, which is also illegally used to preserve milk for a long time. Formalin is a poisonous chemical that may cause different kinds of disease or may disrupt digestive system. But the results for formalin and hydrogen peroxide test found negative for all the samples.

### Microbiological tests

Microbiological load were found more on city corporation samples than the rural samples which may due to poor hygienic measurement (Table 5).

Table 3  
Status of added adulterates and preservative in milk of two areas.

Source of Milk	Types of added adulterate								Types of preservative			
	Water		Powder milk		Starch		Cane sugar		Hydrogen Per Oxide		Formalin	
	+ve%	-ve%	+ve	-ve%	+ve%	-ve%	+ve%	-ve%	+ve%	-ve%	+ve%	-ve%
SCC	28.5	71.5	00	100	00	100	00	100	00	100	00	100
SR	25	75	00	100	00	100	00	100	00	100	00	100

Table 4  
Status of added adulterates and preservative in milk from three sources.

Source of Milk	Types of added adulterate								Types of preservative			
	Water		Powder milk		Starch		Cane sugar		Hydrogen Per Oxide		Formalin	
	+ve%	-ve%	+ve%	-ve%	+ve	-ve%	+ve%	-ve%	+ve	-ve%	+ve%	-ve%
OFM	25	75	00	100	00	100	00	100	00	100	00	100
MMSL	00	100	00	100	00	100	00	100	00	100	00	100
MMOP	75	25	00	100	00	100	00	100	00	100	00	100

Table 5  
The average value of TCC and TSC in milk of SCC and SR.

Source of milk	Total coliform count/ml		Total Staphylococcal count/ml	
	CFU/ml	log	CFU/ml	log
SCC	325.32	2.523	642.67	2.821
SR	296.76	2.501	610.23	2.823

## CONCLUSION

The result of present study showed that nutritional, chemical and microbiological quality of milk supplied in rural areas were little better compare to the milk supplied in city corporation area but there was no significant difference. It also reveal that middleman who collect milk from multiple farm may adulterate milk with water and other things thus may supply poor quality milk compare to the farmers who sales their own farm milk or middleman selling it. Further study needed regarding chemical (adulteration) and microbiological quality of all sources of milk. Respective authority and BSTI should come forward to ensure safe and quality milk for people of Sylhet division.

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