STUDY ON THE QUALITY OF COMMERCIAL MARKET MILK AVAILABLE IN BANGLADESH

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Abstract
The study was designed to analysis the nutritional and microbial quality of farm's milk and commercially processed brands milk of Bangladesh; to find out the specific source of microorganism in total milk processing and marketing. There were collected and analyzed 20 raw milk from different farms of Sirajgonj, Rajshahi, Chapainababgoan and Pabna and pasteurized and UHT milk from local shops. In the proximate analysis of raw milk, 4.1% fat, SNF 9.2%, Lactose 4.9%, Protein 3.55, Solid 0.8, corrected lactometer reading 26 were found. The processed milk contain fat 3.55%, SNF 8.24%; Lactose 3.36%; Protein 3.17%; Solid 0.7%, corrected lactometer reading 28. Adulteration test of processed milk are shown negative except for sugar and skim milk powder. During the microbial analysis of Total Coliform and Total Plate Count of the milk, it was found that there was >22000cfu /ml of total plate count in raw milk which exceeds the BDS standards while in pasteurized milk it was 7000/ml. In UHT milk the Total Plate Count was nill. It was found that, total plate count in farmer's hand was 178 CFU/ml and in milking pot it was 94 cfu/ml. Total coliform count in farmer's hand was 44 CFU/ml and in milking pot 27 CFU/ml. Finally we can conclude that raw milk is high in nutrients than processed milk and free from any adulteration but from the microbial point of view processed milk are almost free from any microbial contamination and are very safe to drink than raw milk.

Keywords: Pasteurized milk, UHT milk, nutritional quality, microorganism, adulteration.

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1. INTRODUCTION

Milk is considered as the nature's single most complete food (Mahony, 1998) and is definitely one of the most valuable and regularly consumable foods. Fresh milk is the most important complete diet for all age people as it contains the essential nutrients as lactose, protein, fat, mineral and vitamins in a balanced ratio rather than the other foods. In addition to these major components, milk also contains many components in a lower concentration like organic acids, peptides etc (Walstra *et al*., 2008). According to World Health Organization (WHO) an adult person requires at least 250 ml milk every day. Milk is very important in daily diet especially for the expectant mothers as well as growing children (Javaid *et al*., 2009). A good quality milk means, the milk which is free from harmful toxic substances, sediment, pathogenic bacteria and extraneous substances and have good color, flavor, with standard nutritional composition (Khan *et al*., 2008). Consumers always want fresh, wholesome and nutritious food that is produced and processed in a sound, sanitary manner and is free from microbial pathogens. To fulfill consumer's demand, a good quality milk production is compulsory. Like many other developing countries in Bangladesh milk is produced mostly in unorganized way and generally it being supplied to the consumers from the urban and rural areas by Goalas. Although there is little milk pockets and some established dairy farm where surplus milk can be stored hygienically but this perishable product has never received particular attention for by sanitary distribution to the consumers. As a result fresh milk easily deteriorates to become unsuitable for processing and human consumption (FAO, 2001). Milk serves as a good medium for the growth of many microorganisms, especially *Streptococcus*, *Micrococcu*, *Lactobacillus* and *Staphylococcus*

sp. Human microbial pathogens that can be found in raw milk include *Listeria monocytogenes*, *Salmonella* spp. and *Campylobacter jejuni* (Jayaroa & Henning, 2001). Raw milk can be contaminated from different sources such as air, milking equipment, feed, soil, feces and grass (Torkar and Teger, 2008). Oliver *et al*. (2005) reported that milk and milk products can harbor a variety of pathogenic microorganisms and can be significant sources of food borne pathogens. The presence of these pathogenic bacteria in milk emerged as major public health concerns, especially for those individuals who still drink raw milk (Ryser, 1998). Fresh milk immediately after drawn usually contains a low microbial load (<1000 cfu/ml), but the loads may increase up to 100 fold or more once it is stored for some time at normal temperatures (Godefay and Molla, 2000). High levels contamination of milk with of spoilage or pathogenic bacteria is usually unsuitable for further processing since it does not meet the consumers' expectations in terms of nutritional value, safety and satisfaction (Nanu *et al*., 2007). So total bacterial count of milk has a significant effect on the quality and safety of dairy products (Szteyn *et al*., 2005). Physiochemical analysis is important tool to monitor the quality milk and other dairy products. Adulteration in food is done either for financial gain or lack of proper hygienic conditions of processing, storing, transportation and marketing. It is equally important for the consumer to know the common adulterants and their effects on health (Faraz *et al*., 2013). Increased concentration of hard water in milk showed the adverse effect on quality of milk by increasing the acidity, thereby reducing the shelf life of milk (Deshmukh *et al*., 2006). Maintaining high milk quality is challenging due to unhygienic milking by farmers and humidity. The processed milk which is now becoming popular is distributed to the consumer who can't produce milk or can't collect milk from farmer. For this reason many industry has been grown up in which milk is processed commercially and supply to the consumers. The present study was conducted to compare the quality of raw milk and processed milk. The study was also conducted to analysis the nutritional and microbial quality of farm's milk and commercially processed dairies of Bangladesh; to find out the specific source of microorganism in total milk processing and marketing system such as in milking, chilling, receiving, cooling, heating and filling; to analysis the adulteration practices in milk and to observe the hygiene practiced at farm milk and processed milk.

2. MATERIAL AND METHODS

2.1 Study Design

An experimental study was carried out to performance analysis of raw milk and industrially processed milk available in Bangladesh

2.2 Place of Experiment

The sample analyses were conducted at Milk and Microbiology Laboratory in Akij Food and Beverage Ltd. and in the laboratory of Food Technology and Nutritional Science (FTNS) Department, Mawlana Bhashani Science and Technology University (MBSTU), Tangail, Bangladesh.

2.3 Sample collection

Raw milk samples were collected from the 4 farms of Sirajgoan, Pabna, Chapainababgoan, and Dhaka district and also from Akij farm. Different brand of UHT and pasteurized milk were collected from local shops.

2.4 Organoleptic Test

Different branded pasteurized and UHT milk were evaluated for color, flavor and test by a panel of 20 judges by using a five-point Hedonic scale as described by Larmond (1977)

2.5 Proximate Analysis

The milk analyzer was used to making quick analysis of milk on fat (FAT), non-fat solids (SNF), proteins, lactose and water content percentages, temperature (^{0}C), freezing point, solids, as well as density of sample. The milk sample was taken at 20^{0}c temperature. Then we put the sample in holder with the required

quantity of milk in the recess of the analyzer and then the starting button was activated. The analyzer sucked the milk, made the measurement and returned the milk in the sample-holder and the display showed the results. Before analyze each milk sample the milk analyzer (lacto scanner) was clean with distilled water as the same process above. Milk fat was determined by Gerber Method (1995).

2.6 Microbiological Analysis

Total Coliform Count (TCC), Total Plate Count (TPC) of sample was done according to the method as described in the standard methods for the examination of dairy products (ICMSF, 1998).

2.7 SWAB test

The microbial analysis of farmer hands and milk pots were done by using SWAB square content method. Firstly SWAB stick bud was scraped on a particular surface of farmer hands and container which contact with the milk. Then it was taken to the microbiology lab for microbial analysis. The stick bud was diluted with 1 ml distilled water and poured into the sterile Petridis.

2.8 Adulteration Test

2.8.1 Test for Detection of Salt

5 ml of silver nitrate reagent was taken in a test tube and then added 2-3 drops of potassium dichromate reagent and finally 1 ml of milk added to the above test tube and mixed thoroughly. If the contents of the test tube turned yellow in color, that indicated milk contains salt. If it turned to chocolate or reddish brown in color, the milk sample was free from salt.

2.8.2 Test for Detection of Sugar in Milk

About 10 ml of milk was taken in a test tube and then added 5 ml of hydrochloric acid along with 0.1 g of resorcinol. After shaking the test tube it was placed in a boiling water bath for 5 min. Red color indicated the presence of added cane sugar in milk.

2.8.3 Test for Detection Soda

After taking 2 ml milk in test tube it was mixed with 2 ml of Alizarin and shaked well. If the color changed to light violet then the milk is considered as soda positive.

2.8.4 Test for Detection of Starch

At first 3 ml milk was taken in a test tube and then boiled it thoroughly. After cooling the milk to room temperature added 2 to 3 drops of 1% iodine solution. Color changed to blue indicates that the milk is adulterated with starch.

2.8.5 Test for Detection of Hydrogen Peroxide

About 5 ml milk was taken in a test tube and then added 5 drops of Paraphenylenediamine and shaked it well. If the color changed to blue confirmed that the milk was added with hydrogen peroxide.

2.8.6 Test for detection of formalin

Firstly 10 ml of milk was taken in a test tube and then added 5 ml of conc. sulphuric acid on the sides of the test tube without shaking. Violet or blue ring appears at the intersection of the two layers indicated the presence of formalin.

2.8.7 Detection of Skim Milk Powder in Milk

About 10 ml of milk sample was taken in a test tube and then added nitric acid drop by drop in to the milk sample. Development of orange color indicated the milk was adulterated with skim milk powder. Samples without skim milk powder showed yellow color.

2.9 Data Analysis

All analysis was performed in triplicate. All the ends of data collection, data were complied, tabulated and analyzed. The local units were converted in to the standard units. The comparisons in different sample were carried out by SPSS (16) programme.

3. RESULTS AND DISCUSSION

An experimental study was carried out to performance analysis of raw milk and industrially processed milk available in Bangladesh. To find out the physical and organoleptic test of some selected brands of milk available in Bangladesh color, flavor taste of the milk were tested. In this study we found that the color of all branded pasteurized and

UHT milk was creamy white except brand-2 UHT milk (brownish). The flavor of all pasteurized and UHT milk was fresh milky except for brand-3 pasteurized milk. The flavor of brand-3 pasteurized milk was not good. The taste of brand-2 pasteurized and brand-2 UHT was sweet and for brand-1 pasteurized and brand-1 UHT milk was fresh milky and fair for brand-3 pasteurized milk. P^H reading was found highest in brand-2 pasteurized milk (6.97) and lowest in brand-2 UHT milk (6.63). The conductivity of milk and freezing point found highest in brand-1 pasteurized milk and lowest in brand-2 pasteurized milk.

Table-02 shows the proximate analysis of raw milk collected from different farms and chilling center and pasteurized and UHT milk of different leading brands available in Bangladesh. Proximate composition of raw milk shows in table-2 which is changed in pasteurized and UHT milk due to the application of heat that is normally used to destroy various microorganisms. In raw milk it was found 4.19% fat, 9.2% SNF, 4.9% lactose, 3.55% protein, 0.88% solid and 26 CLR. In brand-1 pasteurized milk it contained 3.50%% fat, 8.95% SNF, 4.75% lactose, 3.43% protein, 0.77% solid and 29.84 CLR. Brand-2 pasteurized milk contained 3.35%fat, 7.78% SNF, 4.11% lactose, 3% protein, 0.67% solid and 25.40 CLR and in brand-3 pasteurized milk found 3.23% fat, 8.99% SNF, 4.78% lactose, 3.45% protein, 0.77% solid and 30.22 CLR. Whereas Brand-1 UHT milk contained 3.84% fat, 8.24% SNF, 4.36% lactose, 3.17% protein, 0.71% solid and 26.8 CLR. In brand-2 UHT milk contained 3.78% fat, 8.17% SNF, 4.32% lactose, 3% protein, 0.70% solid, 26 CLR.

Table-01: Major Physical and organoleptic analysis of leading brand pasteurized and UHT milk available in Bangladesh

Types of analysis	Test Parameter	Brand-1 Pasteurized Milk	Brand-2 Pasteurized Milk	Brand-3 Pasteurized Milk	Brand-1 UHT Milk	Brand-2 UHT Milk
Organoleptic Test	Color	Creamy white	Creamy white	Creamy white	Creamy white	Brownish
	Flavor	Fresh Milky	Fresh Milky	Poor	Fresh Milky	Fresh Milky
	Taste	Fresh Milky	Sweet	Fair	Fresh Milky	Sweet
Physical Test	pH	6.77	6.95	6.73	6.73	6.63
	Conductivity	4.45	3.93	4.37	4.10	3.95
	Freezing Point	-0.559	-0.477	-0.561	-0.512	-0.509

Table 02: Proximate analysis of raw milk and processed milk

Composition	Raw milk	Brand-1 pasteurized milk	Brand-2 pasteurized milk	Brand-3 pasteurized milk	Brand-1 UHT milk	Brand-2 UHT milk
Fat (%)	4.19	3.50	3.35	3.23	3.84	3.78
SNF (%)	9.2	8.95	7.78	8.99	8.24	8.17
Lactose (%)	4.9	4.75	4.11	4.78	4.36	4.32
Protein (%)	3.55	3.43	3	3.45	3.17	3
Solid (%)	0.88	0.77	0.67	0.77	0.71	0.70
CLR	26	29.84	25.4	30.22	26.8	26

Table-03: Adulteration test of different brands of pasteurized and UHT milk

Name of Test	Brand-1 Pasteurized Milk	Brand-2 Pasteurized Milk	Brand-3 Pasteurized Milk	Brand-1 UHT Milk	Brand-2 UHT milk
Sugar	-(ve)	+(ve)	-(ve)	-(ve)	+(ve)
Salt	-(ve)	-(ve)	-(ve)	-(ve)	-(ve)
Soda	-(ve)	-(ve)	-(ve)	-(ve)	-(ve)
Starch	-(ve)	-(ve)	-(ve)	-(ve)	-(ve)
Formalin	-(ve)	-(ve)	-(ve)	-(ve)	-(ve)
H_2O_2	-(ve)	-(ve)	-(ve)	-(ve)	-(ve)
SMP	+(ve)	+(ve)	-(ve)	-(ve)	-(ve)

Table 04: Comparison of pasteurized, UHT and raw milk with BDS (1702:2002) standard

SL.NO	Parameter	BDS (1702:2002)	Pasteurized milk	UHT milk	Raw milk
1	Fat	3.50% min.	3.36%	3.81%	4.19%
2	CLR	28 min.	28.49	26.4	26
3	SNF	8 min.	8.57	8.21	9.2
4	Acidity	0.15max.	0.15	0.15	0.14
5	pH	6.6-6.8	6.78	6.68	6.76
6	Adulterant	-(ve)	-(ve)	-(ve)	-(ve)
7	TPC	<20000/ml	7000/ml	Nil	>22000/ml
8	TCC	<10/ml	4/ml	Nil	>15/ml

Adulteration of milk is very common nowadays. In this study, adulteration test of sugar, salt, soda, starch, formalin, H_2O_2 and SMP were performed (table-3). All adulteration tests except of SMP and sugar for pasteurized milk showed negative results. Pasteurized milk showed positive result for SMP that is normally used to increase CLR when extra fat is removed. Sugar is used to increase the concentration and taste of the milk.

Table-04 shows the comparison of pasteurized, UHT and raw milk with the Bangladesh Standard 1702:2002. According to BDS (1702:2002) standard milk must contain minimum 3.5% fat and all the branded pasteurized and UHT milk fulfilled the criteria although in raw milk it was found more percentage of fat than the standard level. In case of CLR test the average value of pasteurized milk was 28.49, UHT 26.4 and in raw milk 26 whereas the minimum BDS (1702:2002) standard was 28. Average solid nonfat and acidity level in pasteurized and UHT milk was found in satisfactory level when comparing wit BDS (1702:2002) standard value. No adulterant was found in any kind of branded milk. Surprisingly it was found that total plate count and total coliform in local raw milk is more than 22000/ml & 15/ml respectively where the BDS is less than 20000/ml & 10/ml respectively. Beside that in pasteurized milk total plate count and total coliform is 7000/ml and 4/ml respectively and due to high temperature the UHT milk is found less than 1/ml.

4. CONCLUSIONS

Milk has long been associated with good health and is a great source of nutrition but it should be 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 commercial milk complies the nutritional quality as per given standard by BDS standard whereas the local raw milk is slightly higher. Usually adulterants were not found in commercial milk except SMP, Sugar and water. Major numbers of the farmer of dairy farms were illiterate and they had not enough knowledge about personal hygiene and farm sanitary practices according to the HACCP plan as the parts of Good Manufacturing Practice and unconscious about food safety. The sources of pathogenic bacteria came from natural source and unhygienic handling of milk by the workers especially improper hand washing of milkman and the unhygienic condition of cows and milking pot.The following recommendations can be suggested based on the present study. It may help milk processor and policy makers to take appropriate decision to improve the quality and safety of milk.

1.Although the raw milk contains slightly high amount of fat than commercial but has a large amount of TBC and TC count so it should more careful to feed the milk to children and should boil properly before consuming.

2.Govt. and non-govt. organization should arrange several training program on hygiene, sanitation and food safety for the farmer. The processor should maintain the HACCP and GMP plan effectively and careful on the personal hygiene and sanitary practice of daily worker of the processing area especially.

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