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Assessment of biochemical and microbial quality of different market and raw milk available in Chattogram metropolitan area, Bangladesh

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Abstract

The ideal diet is mandatory for human being for maintaining daily activities and fulfilling the body requirements. Milk is considered as most unique food because of its ideal and balanced composition. This study investigated the major components of milk collected from five milk marketing agencies such Pran Dairy (PD), Aarong Dairy (AD), Milk Vita (MV), Farm Fresh (FF) and Rangpur Dairy (RD) and one from farm based direct seller in Chattogram metropolitan area. All the attributes of chemical quality (freezing point, fat percentage, SNF percentage, protein percentage, lactose percentage, and mineral percentage) of milk supplied through five agencies has significant difference (p = 0.0001) with farm raw milk but the exception is specific gravity which has no significant difference (P>0.05). Highest nutritional quality assessed in MV(highest concentration of SNF is 8.724 %) and AD (highest concentration of fat is 3.778%) in comparison to PD, FF and RD. Microbiological enumeration revealed for the counts of total viable bacteria (CFU/ml) and coliform (CFU/ml) were 850700±763 and 175±1.36 in the farm raw milk and 5 and 3 in PD and RD, respectively, whereas other three market milk were free from Coliform count. However, considering all chemical and microbial quantity market milk has shown more acceptable qualities than raw milk.

Keywords: Market milk, raw milk, chemical quality, microbial quality, Chattogram

Introduction

Milk is one of the most important foods of human beings. It is universally recognized as a complete diet due to its essential components like proteins, lactose, milk fat, minerals and vitamins in a highly digestible form and is recommended as compulsory part of daily diet. History indicates that the nations which used to have more calories from milk and milk products were more civilized and capable of having sound administration.

The average composition of milk is (i) Water (87.20%), (ii) Protein (3.50%), (iii) Fat (3.70%), (iv) Milk sugar or lactose (4.90%), (v) Ash (0.70%) and (vi) Dry matter (12.80%). These components may fluctuate by type of breed, type of feed they consumed, stage of lactation, age of cow, season etc. and between the individuals of same breed. The constituents of milk also vary from different milk processing and manufacturing companies due to consumer demand.

According to the most recent data of DLS milk production of Bangladesh is 2.82 million tons (DLS, 2010). The total numbers of the registered dairy farms are 5364 (http://www.dls.gov.bd/about_us.htm) and total number of milk processing plants are 14 in all over Bangladesh mainly UHT fluid milk, milk powder and yogurt (DLS, 2007).

There are a lot of sources for bacterial contamination of milk like udder, skin surface, litter, floor, flies, insects and rodents, water supply, milker's hand, utensils, atmosphere etc. Milk also may be contaminated by bacteria during plant processing, pre- and post-treatment as well as during packaging. Unfortunately, due to unorganized and non-regulated marketing system, the quality of milk is hardly maintained at consumer level. After processing transportation of milk with or without maintenance of cool chain which affects the physical as well as chemical quality of milk by altering the proportion of different constituents. Oliver *et al.* (2005) revealed that milk and milk products from raw milk can port a range of microorganisms and can be vital sources of food borne diseases. Chemical and microbiological analysis is important tool to monitor the quality of milk as well as dairy products.

Public health authority is employed the standards of milk and dairy products based on Bangladesh Standards (BDS). Thus, milk for consumption is hardly assumed to be of high quality. Keeping this in view, it is important to evaluate nutritional and microbiological quality of raw cow milk as well as different plant processing milk. Therefore, the present study was carried out in order to demonstrate the nutritional and microbial qualities of raw milk as well as processed commercial milk collected from different marketing sources at Chattogram, Bangladesh.

Materials and Methods

Study area and study period:

The study was conducted at the Dairy Science Laboratory under the Department of Dairy and Poultry Science, Chattogram Veterinary and Animal Sciences University (CVASU). Every 10 pasteurized milk samples from each company (Milk Vita, Pran Dairy, Aarong Dairy, Farm Fresh and Rangpur Dairy) were collected from different stationary shoppers from the Chattogram metropolitan area from 1st January to 5th July 2017.

Chemical analysis of milk:

Specific gravity was determined by using Quevenne Lactometer following the procedure described by Aggarwala and Sharma (1992). Fat content was determined by Gerber method (James, 1995). Acidity of milk was tested by titration method as per procedure described in AOAC (1971). Protein test was done by Kjeldahl method, solids not fat (SNF) content was determined by difference as reported by Harding (1995), using the following formula:

$$\text{SNF content (\%)} = \text{TS (\%)} - \text{Fat (\%)}$$

Total Viable Count (TVC):

Bacto agar was used for enumeration of SPC. Tenfold dilution of each raw milk sample was prepared using peptone water and 0.1 ml of each dilution was transferred agar. Inoculated plates were incubated at 37°C for 48 hours to facilitate viable bacterial growth. The number of colonies in a particular dilution was multiplied by the dilution factor to obtain the TVC.

Coliform count:

Total coliform was determined by the same method used in the enumeration of SPC. The medium used for coliform was Violet Red Bile agar (VRB). After incubation for 24 hours at 37°C typical pinkish and centrally red colonies were counted and total coliform was calculated.

Data recording and analysis:

The obtained data were imported and stored in Microsoft Excel-2007. SPSS 16 statistical software was used for the calculation of mean, standard error, correlation coefficient®, t-test and significant value (p).

Results and Discussion

Physico-chemical properties of raw and market milk:

The average fat percentage of farm raw milk was found 3.94±0.22%, which was supported by Debnath *et al.* (2009) who demonstrated that the butter fat of milk from different sources from Chittagong metropolitan area varied from 3.52 to 4.01%. The fat percentages of market milk are slightly lower than the raw milk, it may occur due to skimming of milk or may be due to standardization of milk during pasteurization. These results are in line with earlier studies (Prasad, 1997; Memon, 2000; Chaudhry, 2002; Inayat, 2002).

Table 1: Average nutritional composition of farm raw milk (Mean±SE)

Parameters	Mean±SE
Fat	3.94±0.22
SNF	7.91±0.17
Protein	3.11±0.08
Lactose	4.32± 0.10
Sp. Gravity	1.026±0.0008
Freezing point	-0.46±0.007
Mineral	0.68±0.01

The study indicated that the average SNF content of farm milk was 7.91±0.17%, which was lower than the findings of Debnath *et al.* (2009) who reported that SNF% from farm produced milk was 8.33% in Chattogram metropolitan area. The lower SNF value might be due to smaller sample size. Solids not fat (SNF) contents of milk obtained from different markets milk such as Pran Dairy, Aarong Dairy, Milk Vita, Farm Fresh and Rangpur Dairy milk were 7.265±0.033%, 8.345±0.028%, 8.724±0.026%, 8.26±0.018% and 8.096±0.030% respectively (Table 2) but this result did not meet the reported work of Prasad (1997) and Inayat (2002). However, except Pran Dairy and Rangpur Dairy milk all the market milk sample follow the standard value of SNF of cow milk which is 8.25% (FDA, 2020).

The average protein and lactose content of farm raw milk were 3.11±0.08% and 4.32±0.10%, respectively. These values were lower than the values of Eckles *et al.* (1951), demonstrated that milk should contain 3.80% protein and 4.80% lactose. This study also indicated that the average protein content of Pran Dairy, Aarong Dairy, Milk Vita, Farm Fresh and Rangpur Dairy market milk were 3.006±0.06%, 3.282±0.016%, 3.41±0.016%, 3.163±0.021%, and 3.152±0.014% respectively (Table 2). Except Aarong dairy all of them were lower than the expected value. The lower percentage of protein content in market milk could be attributed to processing practices in milk industry. Milk available at markets is usually heated during pasteurization which may denaturize whey proteins (Packard, 1995).

However, in this study the lactose percentages of different markets milk were Pran Dairy (4.001±0.041%), Aarong Dairy (4.398±0.045%), Milk Vita (4.47±0.02%), Farm Fresh (4.24±0.027%) and Rangpur Dairy (4.119±0.029%) (Table 2) has significant difference. Generally, milk contains (4.7-4.9) % lactose (Jennes and Patton, 1959).

Specific gravity of farm raw milk was 1.026±0.00, which was supported by Eckles *et al.* (1951). This study found insignificant difference among the specific gravity of all the market milk (Table 2) and among five samples milk vita had highest density (1.031±0.0045).

Table 2: Average nutritional composition of pasteurized market milk (Mean±SE)

Brand name / Parameters	Pran Dairy	Aarong Dairy	Milk vita	Farm fresh	Rangpur Dairy	P- value
Fat percentage	3.297±0.027	3.778±0.018	3.630±0.023	3.502±0.026	3.520±0.024	0.0001
Protein percentage	3.006±0.06	3.282±0.016	3.41±0.016	3.163±0.021	3.152±0.014	0.0001
Lactose percentage	4.001±0.041	4.398±0.045	4.47±0.02	4.24±0.027	4.119±0.029	0.0001
SNF percentage	7.265±0.033	8.345±0.028	8.724±0.026	8.26±0.018	8.096±0.030	0.0001
Density percentage	1.009±0.008	1.024±0.001	1.03±0.001	1.022±0.0005	1.022±0.0003	0.0006
Mineral percentage	0.631±0.008	0.718±0.019	0.786±0.018	0.731±0.010	0.707±0.013	0.0001
Freezing point	-0.4125±0.004	-0.4773±0.004	-0.504±0.002	-0.446±0.002	-0.4272±0.003	0.0001
Specific gravity	1.026±0.0008	1.029±0.0060	1.031±0.0045	1.028±0.0034	1.029±0.0040	.08

The average freezing point of farm raw milk was -0.46±0.007 these results agree with the work of Shah (1996) and Prasad (1997). The means of freezing point of market milk samples collected from Pran Dairy, Aarong Dairy, Milk Vita, Farm Fresh and Rangpur Dairy were -0.4125±0.004, -0.4773±0.004, -0.504±0.002, -0.446±0.002 and -0.4272±0.003 respectively (Table 2). This findings agreed with results of Rasmussen *et al.* (2002).

The average mineral content of farm raw milk was 0.68±0.01%, according to Eckle s*et al.* (1951), milk should contain 0.65 % minerals and the current study agreed with his finding. Maximum mineral percentage recorded from Milk vita, Farm fresh, Aarong Dairy and Rangpur Dairy were 0.78%, 0.73%, 0.72% and 0.71% gradually (Table 2). These results differ from those reported by Hamid (1994) who obtained lower ash content. However, the findings were in accordance with Barakat (1995) who obtained ash of 0.59±0.09%.

***Microbial quality*:**

Total aerobic counts are usually used to assess the overall sanitation and storage conditions of raw milk. The average TVC count of raw milk was (850700±763) which is significantly higher than different market milk. The results of this study correlated with the findings of Iknomov *et al.*(1956) who reported that the total bacterial counts ranged from 1, 25,000 to 9,000,000 per ml of milk depending on milking techniques and cleanliness. The skin of animal, milker's hand, cow shed, milking utensils and the absence of cooling combined with higher temperature might activate and enhance the growth and multiplication of bacteria and therefore increase the acidity of milk (Ahmed and El Zubeir, 2007). Pasteurized market milk such as Pran Dairy and Rangpur Dairy had TVC count of 5 CFU/ml and 3 CFU/ml, respectively whereas Aarong Dairy, Milk Vita, Farm Fresh TVC count were 0 CFU/ml). However, the entire collected pasteurized market milk sample was free from Coliform contamination in our present study (Table 3).

Table 3: Microbial quality of different market milk

Sample	TVC (CFU/ml)	Coliform (CFU/ml)
Raw milk	850700±763	175±1.36
Pran Dairy	5	0
Aarong Dairy	0	0
Milk vita	0	0
Farm fresh	0	0
Rangpur Dairy	3	0
P–value	0.0001	

The average coliform count of raw milk (175±1.36 CFU/ml) was higher than the market milk and statistically highly significant whereas Mutukumira *et al.* (1996), found the Coliform counts ranged from 3.2 × 10^2 to 2.3 × 10^5 CFU/ml. According to Fountaine *et al.*, 1980, a single coliform bacterium such as only one *Salmonella* organism per 100 gm of contaminated milk may cause disease to human.

Conclusion

Comparison of the chemical composition and microbial tests of milk samples from five different market milk and farm raw milk has shown that the raw milk had fewer desirable traits nutritionally and microbiologically. Considering all the parameters, it could be concluded that the overall acceptability of market milk supplied by Aarong and Milk Vita was better followed by Farm Fresh, Rangpur Dairy and Pran Dairy. However, none of the samples meet the standards of whole milk. Therefore, it is recommended that the manufacturers should emphasize to set milk pricing structure on the basis of quality of milk and standardize the raw milk during processing.

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