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Research article

Evaluation of nutritional quality, contamination, adulteration and preservative quality of different sources of milk

Kober, A.K.M.H.[1*], Bari, M.S.[1], Morshed, S[2], Momin M.M.[1]

[1]*Department of Dairy and Poultry Science, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong- 4225, Bangladesh*

2Department of Applied Chemistry and Chemical Technology, Chittagong Veterinary and Animal Sciences University, Khulshi, Chittagong- 4225, Bangladesh

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Corresponding Author :
Email: humayuna2002@yahoo.com
Tel: 01712164794

ABSTRACT

The present study was conducted at Dairy Science laboratory of Chittagong Veterinary and Animal Sciences University to evaluate nutritional quality, contamination, adulteration and preservative status of different sources of fluid milk. Milk samples were collected from farm, vendors and departmental stores. Test performed to evaluate the milk samples were chemical (% of butter fat, solids-not-fat and protein), added preservatives, adulteration status and microbial population (standard plate count, coliform and salmonella count). Results indicate that available market milk irrespective of brand maintaining the Bangladesh Standard Testing Institute (BSTI) standards as far as butter fat, solids- not-fat, protein and microbial quality is concerned. The nutritional and microbial quality of farm produced milk (FPM) was good except high coliform count. The nutritional and chemical quality of FPM and market milk (MM) of all five brands were satisfactory but vendors supplied milk was below standard due to water adulteration. Microbial quality of MM of all five brands was very safe for human consumption. High fat content even after watering and presence of formalin in 8% samples of vendor supplied rural milk (VSRM) indicates evening milk of previous day might be mixed with morning milk of next day. It may be concluded that these adulterants and preservatives in milk may cause severe public health related problems.

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INTRODUCTION

Milk is very valuable food, readily digested and absorbed. It consists of nutrients, which are needed for proper growth and maintenance of body. Chemical and microbiological analysis is important tool to monitor the quality of milk. Milk from various mammals is used for producing different dairy products including cream, butter, yoghurt, ghee, sour milk etc. (Adam, 2009). Consumers always demand nutritionally enriched milk and dairy Products. Adulteration of milk can causes the deterioration of milk products and to ensure milk quality requires the necessity and greater emphasis on regulatory aspects with advanced methods of analysis and monitoring milk production and processing, and the new product ideas such as genetically modified foods and the nutraceuticals have set new goals for quality assurance and food safety. Health hazard chemicals such as formalin causes vomiting, diarrhea and abdominal pain. Hydrogen peroxide damages the stomach cells, which can lead to gastritis and inflammation of the intestine and bloody diarrhea (Murthy *et al.,* 1981). The sperm production also decreased from the testicles (Ali *et al.,* 2005). Urea causes increase in bleeding from the uterus, unnecessary hairs on face especially of women and children (Baumgartner *et al.,*

2005). Higher amounts of starch may cause diarrhea due to the effects of undigested starch in the colon.

To meet the demand of fluid milk of such a huge human population nearly 2,592,439; (BBS 2001) four sources of milk is available in Chittagong Metropolitan area (CMA) namely as farm produced milk (FPM), vendor supplied farm milk (VSFM), vendor supplied rural milk (VSRM) and market milk (MM) of different brands though the quality of milk is not beyond question. High quality milk and milk products are necessarily of consumers demand for which milk production and distribution of quality milk is of utmost importance from the view point of public health. Now a day the milk borne zoonotic bacteria *Salmonella species* is an alarming in throughout the world including Bangladesh. To keep a surveillance of milk quality especially from government level is necessary like other governments in different countries. Though Government of Bangladesh possess BSTI under the ministry of Science and Technology to play this role but surveillance is almost unperceivable. Information is very limited on the quality of milk from different sources in CMA. However exanimation of all type of milk both at the point of production i.e. at the farm level, at the point of delivery from the farm as well as at the point of distribution to the hands of direct consumers need to be performed. In both farm and village conditions good quality milk can be expected from good management practices of dairy cows. Any irregularity causes the deterioration in quality of milk produced. (Islam *et al.,* 2002). Islam *et al.,* (1984) studied the quality of milk supplied by different vendors in Mymensingh Town and found that the quality of milk available in the local market were inferior to milk produced at Bangladesh Agricultural University Dairy Farm. This result indicates that the consumers are not getting good quality milk from local markets. In order to prevent this, it needs to create awareness among the consumers about the quality of what they are consuming. Information is very limited on the quality of different vendors milk, farm produces, non brand milk as well as different brand milk in Chittagong area. Hence, the present study was undertaken with the aim to make a comparison regarding nutritional quality, contamination, adulteration and preservative status among the milk of FPM, VSFM, VSRM and MM in CMA.

MATERIALS AND METHODS

The experiment was conducted at Dairy Science laboratory under the Department of Dairy and Poultry Science of Chittagong Veterinary and Animal Sciences University (CVASU) during a period from September 2012 to March 2013.

A survey was conducted by using a pretested questionnaire at randomly selected 120 daily fluid milk consuming families at Khulshi and Jalalabad areas of CMA. Among the 120 families 14, 29, 22 and 55 were consumed FPM, VSFM, VSRM and MM (A, B, C, D and E brands), respectively.

Collection of sample and sampling

All sources of milk samples were collected at every experimental day for analysis. A total of 14 FPM, 29 VSFM, 22 VSRM and 55 MM (5 brands and 11 samples of each brand) samples were collected from different departmental stores, dairy farms, households and bulk sources of vendors. Milk, in cans and bulk tanks, were thoroughly mixed to disperse the milk fat before collection of milk samples for analysis. Plunger and dipper were used in sampling from milk containers.

Qualitative and quantitative tests

Specific gravity, butter fat, solids-not-fat, total solids, protein, preservatives detection, adulteration detection, standard plate count, coliform count, salmonella count tests were performed to check the quality of milk. Specific gravity test of milk was performed by using the method described by FAO (1984). The percentage of fat by Gerber method; Solids-not-Fat (SNF) and total solids (TS) were determined according to Eckles *et al.,* (1951). Standard Plate Count (SPC) and coliform count were performed by the American Public Health Association (1967). Salmonella count was done according to the procedure described in the manual of FDA (1995). The Protein percentage was determined by the method used by Payne (1932). The preservatives and adulteration detection were performed by the method as described in ISI (1960).

Statistical analysis

All data were recorded after chemical and microbiological analysis. The recorded data were tabulated for further analysis of compare means (One-way ANOVA) by using SPSS 16.0 version and Microsoft office excels worksheet 2007.

RESULTS AND DISCUSSION

Nutritional and microbiological parameters

Compositional properties of milk analysis results is presented in the table 1. In MM sample, fat and lactose percentages were little bit lower than the standards. The lower specific gravity value of vendor supplied rural milk indicates more water adulteration. The nutritional quality of farm produced milk and rural milk was deteriorated by middlemen due to water adulteration. This result is agreed with the findings of Islam *et al.,* (1984).

Table 1. Comparison between chemical and microbial contents of samples and standards using One-way ANOVA

Sources	Specific gravity	BF%	SNF%	Protein%	SPC CFU/ml	Coliform CFU/ml	Salmonella CFU/ml	LS
FPM	1.028±0.0	3.75±0.04	8.33±0.07	3.13±0.01	2630±33	105±1.10	Nil	**
VSFM	1.026±0.0	3.52±0.02	7.98±0.09	2.68±0.02	3740±48	120±1.26	Nil	**
VSRM	1.027±0.0	4.01±0.06	7.85±0.03	2.50±0.02	5140±23	130±1.69	Nil	**
MM	1.027±0.0	3.41±0.02	8.20±0.01	3.37±0.01	2660±71	Nil	Nil	**
Std.value (raw)	1.026	3.5	8.5	3.40	0.2-1.0M	<100	Nil	
BD Std. for MM	1.026	3.5	8.00	3.3	20000	<10	Nil	

Values given as Mean±SE for every variable,*Significant at the 0.05 level. ** Significant at the 0.01 level, LS = level of significant, FPM= farm produced milk, VSFM= vendor supplied farm milk, VSRM = vendor supplied rural milk, MM= market milk, M= Million.

In spite of water adulteration, the butter fat content was higher in case of VSRM compare to other three sources. It might be due to reason that milk was collected from indigenous cows or mixing of previous day's evening milk to the next day's morning milk since indigenous and evening milk contain more fat. The FPM contained 3.75% butter fat which is satisfactory but quality deteriorated by vendor suppliers. The SNF content of FPM, VSFPM, VSRM and MM were 8.33, 7.98, 7.85 and 8.20%, respectively. The highest SNF content was estimated in FPM and lowest in VSRM. The protein content of FPM, VSFPM, VSRM and MM were 3.13, 2.68, 2.50, and 3.37%, respectively. The highest protein was found in MM and lowest in VSRM. The less protein content in VSRM might be due to feeding problem with the cows and adulteration of milk with water. The coliform count was higher in case of FPM, VSFPM, and VSRM than the standard value but lower in case of MM. The higher count of coliform in case of FPM, VSFPM and VSRM indicates that proper hygienic measures were not taken before milking the cows. Salmonella organisms were not found in any categories of milk of studied sources.

Table 2. Chemical and microbial contents of MM of different brands and standards using One-way ANOVA

Brands	BF%	SNF%	Protein%	SPC CFU/ml	Coliform CFU/ml	LS
A	3.40±0.05	8.16±0.03	3.29±0.02	2400±50	Nil	**
B	3.50±0.03	8.23±0.02	3.34±0.02	2000±51	Nil	*
C	3.30±0.05	8.26±0.02	3.35±0.03	3300±72	Nil	**
D	3.50±0.03	8.22±0.02	3.48±0.01	2200±60	Nil	**
E	3.35±0.04	8.15±0.02	3.39±0.01	3400±72	Nil	**
Average	3.41±0.02	8.20±0.01	3.37±0.01	2660±71	Nil	
BD Standard	3.50	8.00	3.30	<20000	<10	

Values given as Mean±SE for every variable,*Significant at the 0.05 level. ** Significant at the 0.01 level

Table 2 shows that the bacterial count of MM of all five brands available in CMA were very satisfactory. The same table also shows that all brands of MM contained a bit higher amount of SNF and protein though the average butter fat percentage was a bit lower than the Bangladesh Standard, 2002 except brand D and B but it is very acceptable. Table 2 also shows that the quality of brand D was the best in every respect among the brands of MM available in CMA. These observations were consistent with Debnath *et al.,* (2014) who investigated the quality of available brand fluid milk consumed by the inhabitants of Chittagong City.

Preservatives

Milk samples from all sources were tested for the added preservatives commonly used namely formalin, hydrogen peroxide, borax and bicarbonate (Debnath et al., 2014). All the samples from distinguished sources were free from hydrogen peroxide, borax and bicarbonate.

Table 3: Preservatives status of milk collected from different sources

Sources	Formalin (+ve %)	Hydrogen peroxide (+ve %)	Borax (+ve %)	Bicarbonate (+ve %)
FPM	0	0	0	0
VSFM	0	0	0	0
VSRM	8.0	0	0	0
MM	0	0	0	0

But only 8% samples contained added formalin which is dangerous for human health and other three sources of milk free from any type of added preservative. This result is agreed with the findings of Debnath et al., (2012).

Adulteration

The collected milk samples of all sources were tested for adulterants such as starch, cane sugar, added water and powder milk. Among the adulterants only added water was found in case of VSFPM and VSRM but the milk from FPM and MM sources were free from added water. Water adulteration was detected in 62% and 46% of samples in case of VSRM and VSFM, respectively. Standardization is the common steps for market milk processing and it is done either by adding skim milk or powder milk. So, adulteration of power milk test was not performed in case of MM.

Table 4: Adulteration status of milk collected from different sources

Sources	Starch (+ve %)	Cane sugar (+ve %)	Added water (+ve %)	Powder milk (+ve %)
FPM	0	0	0	0
VSFPM	0	0	46.0	0
VSRM	0	0	62.0	0
MM	0	0	0	0

This result is similar to that of Debnath *et al.,* (2012) who showed that water adulteration was detected in milk samples of six different points.

CONCLUSION

Milk is ideal food for human health. Adulteration of milk reduces the quality of milk itself and the dairy products. In the present study, preliminary investigations were carried out to ascertain the chemico-microbilogical characteristics including adulteration and preservative parameters and nutritional quality of FPM, VSFM, VSRM and MM milk samples at selected area. Nutritional and chemical quality of FPM and MM of all five brands were satisfactory but vendors supplied milk was below standard due to water adulteration. Microbial quality of MM of all five brands was very safe for human consumption. These findings may be helpful for the concerned regulatory bodies to monitor the quality of the commercial milk and milk products in the market. It would be a great interest if further investigations are to be carried out to examine other organic and inorganic components of milk. The study will create awareness among consumers level in urban and rural areas of Bangladesh.

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