ISSN: 2518-2021 (Print), 2415-4474 (Online) Fundam Appl Agric 2016, 1(2): 70-74

Fundamental and Applied Agriculture

Journal homepage: www.f2ffoundation.org/faa

Dairy Science
ORIGINAL ARTICLE

Quality evaluation of raw milk collected from local markets at Madhupur upazila of Tangail district

Md Anwarul Islam[1], Md Harun-ur-Rashid[1], Shabbir Ahmed[2*] and A K M Masum[1]

[1]Department of Dairy Science, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[2]Department of Dairy and Poultry Science, Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur-1706, Bangladesh

ARTICLE INFO

Article history:

Received: 15 May 2016
Received in revised form: 30 June 2016
Accepted: 07 August 2016
Available online: 25 August 2016

Academic Editor: Sabina Yeasmin

Keywords:
Raw milk
Organoleptic
Chemical
Microbiological
Adulteration
Coliform

ABSTRACT

Milk is nature's best gift, however, it becomes adulterated by unscrupulous middlemen. A lot of research work has been carried out on quality evaluation of raw milk based on Mymensingh, Sirajgonj, Pabna and Bogra districts. But no particular research has been reported on quality evaluation of raw milk of Madhupur upazila at Tangail district. A large number of small scale farmers of Madhupur upazila are engaged in dairy cow rearing and sale milk in local market. That's why this experiment was set to evaluate the existing quality of raw milk available at Madhupur upazila of Tangail district. A total of 27 raw milk samples were collected from three selected local markets namely Anginarpar Bazar (A), Hatkhola Bazar (B) and Kakrait Bazar (C) during the period of 1st October to 29th November, 2013. Parameters studied in this experiment were organoleptic (colour, flavour, taste and texture), chemical (specific gravity, acidity, fat, protein, lactose, solids-not-tat, ash, total solids and moisture) and microbiological (total viable count and coliform count). Tests for adulteration such as starch, formalin, cane sugar and colouring agents were also performed. All the samples were more or less similar in respect of colour, flavour, taste and texture. From chemical parameters, significant difference was revealed (p<0.01) in case of acidity and fat content. Total viable count and coliform count was higher in the milk samples compared to standard, while statistical analysis of the samples showed a significant difference (p<0.05) in case of coliform count. Milk samples collected from Kakrait Bazar (C) were superior to other markets in terms of fat (36.83±0.29 g kg^{-1}), protein (34.17±1.26 g kg^{-1}), lactose (45.72±1.02 g kg^{-1}) and total solids (124.72±1.95 g kg^{-1}) content. Though there was a little fluctuation among the parameters regarding the standard, all the samples showed negative results in adulteration tests. It can be concluded that proper hygienic measures were not taken by farmers during milking and transporting to the market, otherwise the raw milk samples were of good quality.

INTRODUCTION

Milk is the nature's best and cheapest source of nutrition and used by all age groups in rural areas as well as in urban areas. It supplies nutrients like high quality protein, fat, carbohydrate, vitamin and mineral in significant amount than any other single food (Neumann et al. 2002). Consumers always demand for nutritionally enriched milk and milk products. The extensive consumption of milk and dairy products makes these foodstuffs targets for potential adulteration with financial gains for unscrupulous producers (Nicolaou et al. 2011). It is important to protect milk consumers by ensuring adequate quality control; for which, food analysts should have suitable methods for the detection of milk adulteration. Labeling and authenticity regulations may differ from country to country and contribute towards the need for analytical tests to enforce such legislation (Dennis 1998).

Milk secreted from healthy animals is usually contain small number of bacteria but may get contamination from dairy farm environment, external surface of teat or udder or animal body, utensils, utensils cleaning water etc. (Bramley 1982). Cousin

*Corresponding author: shabbirbau@gmail.com

(1982) 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. Bacterial contamination of raw milk can also originate from the animal body, air, milking equipment, feed, soil, feces and grass (Torkar and Teger 2008).

Although milk is an ideal food for human but its nutritive value depend on its wholesomeness. Quality of milk can be deteriorated by any irregularities. Milk adulteration, poor hygiene, malpractices, lack of preservation technology, cooling facilities and sanitary conditions are the main causes of producing low quality milk and also are the most pressing public health issues. Adulteration of milk by water is done to increase its volume and then starch and reconstituted milk powders are added to increase its viscosity. To increase the shelf life of milk, dirty ice and some chemicals like hydrogen peroxide, carbonates, bicarbonates, antibiotics, caustic soda and even the most lethal chemical formalin is also used. Sometimes inferior cheaper materials or elements like pond water, cane sugar and powdered milk is also used (Prasa 1999). This addition decreases the nutritive value of milk. These adulterants, preservatives and drugs in milk cause very serious health related problems (Afzal et al. 2011).

The adulteration of milk is banned due to the ill effects. Carbonate in milk produces gastrointestinal problems including gastric ulcer, diarrhea, colon ulcer and electrolytes disturbance (Beall and Scofield 1995). The hydrogen peroxide disturbs the antioxidants in the body disturbing the natural immunity hence increasing aging (Clare et al. 2003). Chloride in the milk disturbs the acid base balance in the body and also blood pH (Hu and Murphy 2004).

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. In Bangladesh, milk is produced mostly in non-organized way and usually it is supplied to the consumers from the urban and rural areas by milkman. Although, there are little milk pockets area especially milk vita and some established dairy farms where surplus milk is readily available, this perishable product has never received particular attention in hygienic distribution to the consumers (Khan et al. 2008). In the developed countries sufficient works have already been done about the quality of milk produced under various conditions. However, very limited numbers of research works have been carried out in our country regarding milk quality. The present study was undertaken with the aim of investigating the hygienic quality and adulteration status of raw milk available at Madhupur upazila of Tangail district. The objectives of this experiment were to evaluate the physical, chemical and microbial qualities of raw milk collected from different local markets and to detect the adulterants in milk collected from different markets of Madhupur upazila.

MATERIALS AND METHODS

Place and Period of Experiment

The analysis of this present experiment was conducted at the Dairy Chemistry and Microbiology Laboratory of the Department of Dairy Science, Bangladesh Agricultural University (BAU), Mymensingh, during the period of 1st October to 29th November, 2013.

Collection and Transportation of Samples

Raw milk samples were collected from three different local markets of Madhupur upazila: Anginarpar Bazar (A), Hatkhola Bazar (B) and Kakrait Bazar (C). After collection, the samples were transported to the laboratory using ice boxes. Samples were collected 3 times from these local markets and each time 9 samples (3 samples from each market) were collected. Then one (1) composite sample representing each market (A, B and C) was analyzed in the laboratory during each trial. Thus, total 27 samples were collected during the whole experimental period.

Analysis of the Samples

The samples were analyzed to monitor their quality and adulteration status.

Organoleptic tests

The collected samples were observed and judged individually by a panel of expert judges according to the organoleptic parameters- colour, flavour, taste and texture.

Chemical tests

The specific gravity was determined by using Quevenne lactometer (Kimble Glass Co., USA) according to the method described by Aggarwala and Sharma (1961). Acidity was determined by titration with N/10 sodium hydroxide solution using the procedure of Aggarwala and Sharma (1961). Fat percentage was estimated by Babcock method using the procedure described by Aggarwala and Sharma (1961). Protein was determined by Kjeldahal procedure. Lactose was determined by calculation method. Ash was determined by muffle furnace according to Association of Official Agricultural Chemists (AOAC, 2003). Total solids (TS) and moisture content of the samples were determined by oven drying method according to AOAC (2003). Solids-not-fat (SNF) was determined by calculation method.

Microbiological tests

The number of total viable bacteria (Colony Forming Unit; CFU/ml) and coliform bacteria (CFU/ml) was determined by recommended methods of the American Public Health Association (APHA 1967).

Adulteration tests

To check adulteration, collected samples were subjected to following tests: starch, formalin, cane sugar, colouring agents etc.

Statistical Analysis

Data collected from different parameters were statistically analyzed as per Completely Randomized Design (CRD) using the MSTAT-C statistical program. Analysis of variance (ANOVA) test was done to find out the statistical difference among the different treatments. Least significance difference (LSD) test was performed to rank the treatment means (Gomez and Gomez 1984).

RESULTS AND DISCUSSION

Organoleptic Parameters

The colour of the raw milk samples from three different markets (A, B and C) were almost similar, yellowish white in colour. Ara et al. (2010) analyzed milk samples from Sylhet Govt. Dairy farm, Sylhet Agricultural University and found that 50% of the samples were yellowish white and 50% were whitish in colour.

It was found that 100% of the milk samples had normal flavour (pleasant aromatic flavour). This might be due to the fact that farmers take hygienic measures during milking and did not allow the cows to eat some sorts of flavoured feed prior to or

during milking their cows. Same results were found by Monem (2012) who analyzed milk samples from Bogra town.

The taste of all milk samples collected from three different markets was slightly sweet. Safi (2012) reported that the taste of the milk samples collected from Mymensingh Sadar was slightly sweet. Same result was also found by Akhirul (2012) who studied the raw milk samples of Muktagacha upazila.

The texture of raw milk sample was examined before starting the experiment. All the milk samples showed normal texture (free flowing liquid). This result agreed with the findings of Mahedy (2012) who revealed that all the collected samples of Mymensingh town were normal in texture (free flowing liquid).

From the above discussion it may be pointed out that the organoleptic scores of raw milk collected from different markets of Madhupur upazila were more or less similar.

Chemical Parameters

The scores of chemical parameters for different milk samples are given in Table 1. Statistical analysis showed that there were no significant difference within the mean specific gravity of samples (p>0.05). The result of specific gravity of sample A (1.030±0.00) was completely in agreement with Bari (2001), who found that the average specific gravity of Cow's milk from BAU Dairy Farm was 1.031. Generally normal cow's milk may range in specific gravity from 1.027 to 1.035 with an average of 1.032 (Eckles et al. 1951).

Statistically significant differences were found in acidity content of three different samples (p<0.01; Table 1). The acidity percentages of milk collected from three sources were 0.154±0.01% (A); 0.160±0.00% (B); 0.169±0.01% (C) which is slightly higher than the findings of Bari (2001), who found that acidity of Mymensingh town was 0.14±0.03% percent. Ali (1999) also found that the average of acidity milk samples from BAU Dairy Farm; different Hall milk suppliers and vendors were 0.15%, 0.16% and 0.15% respectively.

Fat content of milk collected from all three markets of Madhupur upazila was in normal range (35.47-36.83 g kg^{-1}; Table 1). Statistical analysis showed that the differences between the fat percentages of milk obtained from the different markets were significant (p< 0.01). The highest fat content was found in sample C than other two samples.

There were no significant differences among the protein content of the milk collected from different markets (Table 1). Statistically Hatkhola Bazar (B) showed lower protein content than the others. Safi (2012) found the average protein value of milk samples from local markets of Mymensingh Sadar was 33.42±1.83; 32.95±2.88; 34.71±2.63 and 33.92±3.01 g kg^{-1}. The average value of protein in this study was 34.03±0.68; 32.73±1.24 and 34.17±1.26 g kg^{-1} for market A, B and C, respectively, which is agreed with this data but slightly lower than the work of Hossain (2009) who reported that the average values of protein from the milk of BAU Dairy Farm, Mymensingh was 36.65 g kg^{-1}. This might be due to addition of water, genotypic variation and nutritional level of cows.

Statistical analysis showed that the lactose contents of the milk collected from different markets were 44.91±1.65 (A); 45.08±1.91 (B) and 45.72±1.02 (C) g kg^{-1} which did not differed significantly. In this experiment, highest value (45.72±1.02 g kg^{-1}) of lactose obtained from Kakrait Bazar (C). The mean content of lactose of this experiment was higher than Mahedy (2012) who revealed that lactose content in milk collected from different sweetmeat shops in Mymensingh town was 39.13±3.2; 39.05±2.05 and 38.61±3.61 g kg^{-1}.

Statistically no significant difference was found among the ash content of samples. The result of ash contents of this experiment were 7.60±0.87; 7.69±0.59 and 7.92±0.10 g kg^{-1} for market A, B and C, respectively, which was higher than Amin (2005) who found that the average ash content of milk collected from Mymensingh town was 6.78 g kg^{-1}.

There were no significant differences within the TS content of milk collected from different markets of Madhupur upazila. Different work had been done regarding this experiment. The result of TS content of this experiment was 121.78±1.38 (A); 121.78±2.78 (B) and 124.72±1.95 (C). Mahedy (2012) found lower TS content than present work which was 109.56±2.34; 109.17±2.69 and 108.38±4.72 g kg^{-1}, respectively. Islam (2006) who studied the milk quality of local cows in BAU Dairy Farm and found that the total-solids content of cow's milk was 142.50 g kg^{-1}. The present study does not agree with the above statement.

Table 1. Chemical parameters of raw milk samples (mean ± SD) collected from different markets of Madhupur upazila of Tangail District

Parameter	A	B	C	LSD value	Significance
Specific gravity	1.030±0.00	1.029±0.00	1.029±0.00	-	NS
Acidity (%)	0.154^{c}±0.01	0.160^{b}±0.00	0.169^{a}±0.01	0.006	**
Fat (g kg^{-1})	35.47^{b}±0.50	36.67^{a}±0.29	36.83^{a}±0.29	0.743	**
Protein (g kg^{-1})	34.03±0.68	32.73±1.24	34.17±1.26	-	NS
Lactose (g kg^{-1})	44.91±1.65	45.08±1.91	45.72±1.02	-	NS
Ash (g kg^{-1})	7.60±0.87	7.69±0.59	7.92±0.10	-	NS
Total Solids (g kg^{-1})	121.78±1.38	121.78±2.78	124.72±1.95	-	NS
Moisture (g kg^{-1})	876.54±3.90	878.24±2.80	875.27±1.95	-	NS
SNF (g kg^{-1})	86.41±1.95	85.47±3.10	87.74±1.60	-	NS

A= Anginarpar Bazar, B= Hatkhola Bazar, C= Kakrait Bazar, SNF= Solids-Not-Fat, LSD= Least Significant Difference.
In a row, figures with different superscripts (a,b,c) differ significantly: **= (p<0.01), NS= Non-significant.

Moisture content of milk samples of different source was statistically non-significant. The highest value of moisture was obtained from the samples collected from Hatkhola Bazar (878.24±2.80 g kg^{-1}). Average moisture content in the samples collected from local markets of Madhupur upazila was a bit lower than Asaduzzaman (2009), who found statistically higher moisture content in milk (895.77 g kg^{-1}) collected from local markets of Mymensingh town.

The SNF content of milk from different places was similar (p>0.05). The average SNF content of sample C was 87.74±1.6 g kg^{-1} which agreed with Islam (2006) who reported that the average SNF percentage of milk of local cows was 87.0 g kg^{-1}. In another work, Hossain (2009) showed higher SNF content in milk collected from BAU Dairy Farm which was 98.65 g kg^{-1}.

Microbiological parameters

Statistically no significant difference was found in case of total viable count (TVC) per ml of raw milk (Table 2). Average TVC /ml of "Grade-A" raw milk should not exceeding 200000 for milk to be pasteurized. From this study it was found that the raw milk collected from different markets was not “Grade-A” category in terms of total viable bacterial count. The higher TVC of this experiment may be due to poor hygienic milking, dirty utensils, any extraneous materials in milk, cows suffering from mastitis, dirty hands of the milkers, the time elapses between milking and bringing to the market to sale etc. Lee et al. (1983) conducted an experiment in Seoul of Korea and found that the bacterial count in raw milk ranged from 4×10^6 to 2.7×10^7CFU per ml.

Table 2. Total Viable Count and Coliform Count (mean ± SD) of milk collected from local markets of Madhupur upazila

Parameter	A	B	C	LSD value	Significance
Total Viable Count (CFU/ml)	$7.5\pm0.65\times10^5$	$9.5\pm0.83\times10^5$	$10.0\pm1.53\times10^5$	-	NS
Coliform Count (CFU/ml)	$53.33^b\pm15.28$	$86.67^a\pm15.28$	$96.67^a\pm15.28$	30.52	*

A= Anginarpar Bazar, B= Hatkhola Bazar, C= Kakrait Bazar, CFU= Colony Forming Unit, LSD= Least Significant Difference.
In a row figures with different superscripts (a,b,c) differ significantly: *= (p<0.05), NS= Non-significant.

Statistically there was significant difference exists (p<0.05) among the milk of three markets in terms of coliform counts (Table 2). Coliform count is a practical indicator of milking hygiene as it is easy and inexpensive to perform, and is often correlated with the population of other bacteria in bulk tank milk (Pantoja et al. 2009).This may be due to poor sanitary condition of the water of the barn, improper cleaning of dairy utensils, hand of the milkers, unhygienic handling of the raw milk during marketing etc.

Adulteration Tests

The results for starch test of milk sample collected from three markets of Madhupur upazila showed negative results. Akhirul (2012) observed the same results in the samples collected from Muktagacha upazila. Formalin (40% Formaldehyde solution) is generally used to preserve milk for a long time. All milk samples collected from Madhupur upazila showed negative results in formalin test. Safi (2012) also reported negative results of formalin test for all the milk samples collected from Bhangnamari, Sutiakhali, Vabokhali, Sombhuganj and Mymensingh sadar. The raw milk samples collected from three local markets of Madhupur upazila showed negative results in cane sugar test. All the samples of raw milk showed negative results for colouring agents. So it can be concluded that the farmers are conscious and no starch, formalin, cane sugar and colouring matters had been added to the milk collected from local markets of Madhupur upazila.

CONCLUSION

From organoleptic parameters, it was observed that almost all of the samples were more or less similar in respect of colour, taste, flavour and texture. Considering chemical parameters, milk collected from Kakrait Bazar was superior in terms of fat, protein, lactose, ash, TS and SNF content than two other markets of Madhupur upazila. But surprisingly the total viable count and coliform count was higher in Kakrait bazar sample compared to the two other samples. All tests showed negative results for adulteration. Nevertheless, although there was no adulteration found in the experimental site, some dishonest milkmen are increasing adulteration incidence day by day; which deteriorating consumers interest and also the milk plants. So, steps should be taken for the consumer as well as farmers to develop their knowledge about the quality and characteristics of good quality milk.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interests regarding the publication of this paper.

REFERENCES

Afzal A, Mahmood MS, Hussain I, Akhtar M. 2011. Adulteration and microbiological quality of milk. A Review: Pak J Nutr, 10: 1195-1202.

Aggarwala AC, Sharma RM. 1961. A Laboratory manual of milk inspection. 4th ed. Asia Publishing House, Bombay, Calcutta, New Delhi, India, pp. 14.

Akhirul M. 2012. Detection of adulteration of milk collected from local markets at Muktagacha upazila of Mymensingh District. M.S Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Alii MS. 1999. A study on the quality of milk consumed by students of different halls and residential people of Bangladesh Agricultural University, Mymensingh. M.S Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

American Public Health Association (APHA). 1967. Standard Methods for Examination of Dairy Products. 11th Edition, ALPHA, Inc: New York, pp.50-53.

Amin MN. 2005. Studies on the physical and chemical quality of raw milk collected from different sweetmeat shops of Mymensingh town. M.S Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Ara A, Uddin MJ, Rahman MM, Saha S. 2010. Quality of raw milk consumed by residential people of Sylhet Agricultural University campus, Sylhet. Int’l J Biol Res, 1: 23-25.

Asaduzzaman. 2009. Detection of adulteration of milk collected from Bangladesh Agricultural University Dairy farm and local markets of Mymensingh. M.S Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Association of Official Agricultural Chemists (AOAC). 2003. Official methods of analysis, 17th ed. Association of official Agriculture Chemistry. Washington, D.C.

Bari AKM. 2001. Comparative study of platform tests on milk in the local markets and Bangladesh Agricultural University dairy farm. M.S Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Beall DP, Scofield RH. 1995. Milk-alkali syndrome associated with calcium carbonate consumption: Reports of 7 patients with parathyroid hormone levels and an estimate of prevalence among patients hospitalized with hypercalcemia. J Med, 74: 89-96.

Bramley AJ. 1982. Sources of *Streptococcus uberis*in the dairy herd. 1. Isolation from bovine feces and from straw bedding of cattle. J Dairy Res, 49: 369-373.

Clare DA, Catignani GL, Swaisgood HE. 2003. Biodefence properties of milk: The role of antimicrobial proteins and peptides. Current pharmaceutical design, Bentham Sci. Publishers, 9: 1239-1255.

Cousin MA. 1982. Presence and activity of psychrotrophic microorganisms in milk and dairy products: A review. J Food Prot, 45: 172-207.

Dennis MJ. 1998. Recent developments in food authentication. Analyst, 123: 151-156.

Eckles CH, Cobms WB, Macy H. 1951. Milk and milk products. 4th edition, McGarh-Hill Book Company: New York, USA, pp. 49-57.

Gomez AK, Gomez AA. 1984. Statistical procedures for agricultural research. Second edition. Jhon Willey and Sons, New York. pp. 95-109.

Hossain MS. 2009. Effect of milk production and milk composition of early lactating cows by supplementation of rice powder with concentrate. M.S Thesis, Department of Dairy Science, BAU, Mymensingh.

Hu W, Murphy MR. 2004. Dietary Cation-Anion difference effects on performance and acid-base status of lactating dairy cows: A Meta- Analysis. J Dairy Sci, 87: 2222-2229.

Islam MR. 2006. Milk yield and quality of different genotype of dairy cows of BAU dairy farm. M.S. Thesis, Department of Dairy Science, BAU, Mymensingh.

Khan MTG, Zinnah MA, Siddique MP, Rashid MH, Islam MA, Choudhury KA. 2008. Physical and microbial qualities of raw milk collected from Bangladesh Agricultural University dairy farm and the surrounding villages. Bangladesh J Vet Med, 6: 217-221.

Lee JT, Park SY, Korea IK, Kin HU. 1983. Quality of raw milk in Korea. Korean J Dairy Sci, 5: 22-28.

Mahedy H. 2012. Quality of raw milk available at different markets at Mymensingh town. M.S Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Monem PK. 2012. Quality of raw milk available at different markets of Bogra Town. M.S Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Neumann OG, Harris, Rogers. 2002. Contribution of animal source of foods in improving diet quality and function in children in the developing world. J Nutr Res, 22: 193-220.

Nicolaou N, Xu Y, Goodacre R. 2011. MALDI-MS and multivariate analysis for the detection and quantification of different milk species. Anal Bioanal Chem, 399: 3491-3502.

Pantoja JCF, Reinemann DJ, Ruegg PL. 2009. Associations among milk quality indicators in raw bulk milk. J Dairy Sci, 92: 4978–4987.

Prasad J, Tyagi AK, Neeraj. 1999. Principles and Practices of Animal Nutrition. 1st Edition, Kalyani Publishers, New Delhi-11002.

Safi U. 2012. Study on the quality evaluation and detection of adulteration of raw milk at Mymensingh sadar upazila in Mymensingh. M.S Thesis, Department of Dairy Science, Bangladesh Agricultural University, Mymensingh.

Torkar KG, Teger SG. 2008. The Microbiological quality of raw milk after introducing the two day's milk collecting system. Acta Agri Slovenica, 92: 61–74.