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Evaluation of Microbial Load And Quality of Milk & Milk Based Dairy Products

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ABSTRACT

Milk has an importance as valuable & nutritious food product. So, it is essential to evaluate their microbiological quality before consumption. Our study was carried out to examine the microbial load and quality of milk & milk based products. Total 87 samples of 13 different types of milk & dairy foods were collected from different locations in Dhaka city, Bangladesh were taken to the laboratory and stored for analysis. Total viable counts, Total coliform count and fungus count was analyzed & average count of these parameters were compared to FDA microbiological standards to evaluate their quality.

INTRODUCTION

Food spoilage is an enormous economic problem worldwide. Through microbial activity alone, approximately one-fourth of the world's food supply is lost (Christen et al., 1992). Milk is an essential food that contain many nutrients and provide a quick and easy way of supplying protein, vitamin, calcium, phosphorus, magnesium, zinc, iodine to the diet of human nutrition. But its liquid form is not preferable to human. Therefore, there are several products which are made out milk called as dairy products, which preserve the nutritative values of milk and makes it easily acceptable to consumers (Frank et al., 1992). Milk can be consumed in the form of cheese, butter, ice cream or milk drinks, during meals or snacks. The significance of milk in human nutrition is now well established as it is considered as the best, ideal and complete food for all aged groups (Houghtby et al., 1992). Due this highly nutritious nature of the milk and milk foods, it serves as an excellent growth medium for a wide range of microorganisms. Its high water activity, moderate pH and available nutrients are the principal factors which contribute to microbial growth. Milk not only serves as a potential vehicle for transmission of some pathogens but also allows these organisms to grow, multiply & produce toxins. A variety of pathogenic organisms may gain access into milk and milk products from different sources and cause different types of food borne illness. The microbiological quality of milk and dairy products is influenced by the initial flora of raw milk, the processing conditions, and post-heat treatment contamination (Houghtby et al., 1992). It can also be subjected to contamination during transport, storage and manufacturing processes.

Consumption of raw milk and milk products remains a well-identified risk factor for foodborne disease. In some countries, especially those with a warm climate, raw milk and milk products such as cheese continue to be responsible for many outbreaks of gastroenteritis (Huis in't Veld JHJ, 1998). Spoilage occurs when microorganisms degrade the carbohydrates, proteins, fats of milk and produce deleterious end products. It may be seen that Lactobacillus or Streptococcus species ferment the lactose to lactic acid and acetic acids turning the milk sour. Undesirable microbes that can cause spoilage of dairy products include Gram-negative psychrotrophs, Coliforms, lactic acid bacteria, yeasts and moulds. In addition, various bacteria of public health concern such as Salmonella spp., Listeria monocytogenes, Campylobacter jejuni, Yersinia enterocolitica, pathogenic strains of Escherichia coli and enterotoxigenic strains of Staphylococcus aureus may also be found in milk and dairy products (Kumbhar et al., 2009). Psychrotrophic bacteria can produce large amounts of extracellular hydrolytic enzymes and the extent of recontamination of milk products with these bacteria is a major determinant of their shelf life. Fungal spoilage of milk & milk products is marked by the presence of a wide-variety of metabolic byproducts, causing off-odors and flavors, in addition to visible changes in colour and texture.

The nutritive value of milk and milk products depends upon their cleanliness, purity and wholesomeness (Nahar et al., 2007). For this reason, increased emphasis should be placed on the microbiological examination of milk and dairy foods. The aim of this study is to evaluate microbial load, quality, presence of Coliform bacteria in milk and milk based products.

MATERIALS AND METHODS

Collection of Dairy Products

87 samples of 13 different types of milk & dairy foods were collected from different locations in Dhaka city, Bangladesh. Samples of each milk or dairy product were collected aseptically, transferred to sterile plastic bags and directly transported to the laboratory under cold conditions. They were stored at 4°C and analyzed within 24 hours.

Microbiological examination

Sterilization, examination of culture and preparation of the serial dilution from the samples and culturing methods were done (Richter et al., 1992). Total viable count was determined using plate count agar (Richter et al., 1992). The plates were incubated at 37°C for 24 hours. Coliform count was determined using MacConkey agar (S Alterkruse et al., 1994). The plates were incubated at 37°C for 24 hours. The count of fungus was determined using potato dextrose agar (Tatini et al., 2003). The plates were incubated at 25°C for 5 days. The growth was examined visually with naked eyes for colonies appearance and changes in media and then the colonies were counted using manual colony counter.

Statistical Analysis

Statistical analysis was performed to determine the mean total viable count, mean Coliform count and mean fungus count in milk and dairy foods.

RESULTS

A total of 87 milk & dairy food samples of 13 types were collected for analysis of three microbiological parameters- total viable count, total Coliform count and total fungus count (Table 1). In case of cream sample, the mean viable count was 7.4 cfu/g and mean Coliform count was absent. According to FDA standard total viable count and total Coliform count of this cream sample were within the acceptable limit

Mean viable count, Coliform count and fungus count of yoghurt was 9.5×103 cfu/g, 430 MPN/g, 3.4×103 cfu/g respectively. According to Okpalugo et. al., 2008, the mean viable count of yoghurt samples was 2.2×105 cfu/ml. This sample was not acceptable in Coliform count according to FDA standard. So, this yoghurt sample was unacceptable in microbiological quality. In icecream sample, the mean viable count and mean Coliform count was 6.5×103 cfu/g and 36.06 MPN/g respectively which is acceptable according to FDA standard for icecream. Mean fungus count was 3.5×102 cfu/g.

Mean viable count, coliform count and fungus count of chocolate products was 2.1×103 cfu/g, 0 MPN/g, 3.2×102 cfu/g respectively. There

Table 1: Types & number of samples analyzed

Serial No.	Type of Samples	No. of Samples
1	Cream	05
2	Yoghurt	04
3	Borhani	04
4	Icecream	10
5	Chocolate	06
6	Full cream milk powder	08
7	Baby milk	06
8	Skimmed milk	06
9	Condensed milk	06
10	UHT milk	06
11	Raw milk	06
12	Local cheese	10
13	Processed cheese	10
	Total= 13	**87**

Table 2: Mean Coliform count of milk & milk based samples

Type of Samples	Mean Coliform Count (MPN/g or 100ml)	FDA Standard* (cfu/g or ml)
Cream	0	10^3
Yoghurt	430	10^2
Ice-cream	36.06	10^3
Chocolate products	0	10^2
Full cream milk powder	0	Not found
Baby milk	0	Not found
Skimmed milk	0	Not found
Condensed milk	0	10^2
Local cheese	0.98	103
Processed cheese	0	10^2
Borhani	<3	Not found
UHT milk	0	Commercial sterile
Raw milk	0	Not found

* FDA Standard, Philippines, Circular No. 2013-010|| 27 February 2013

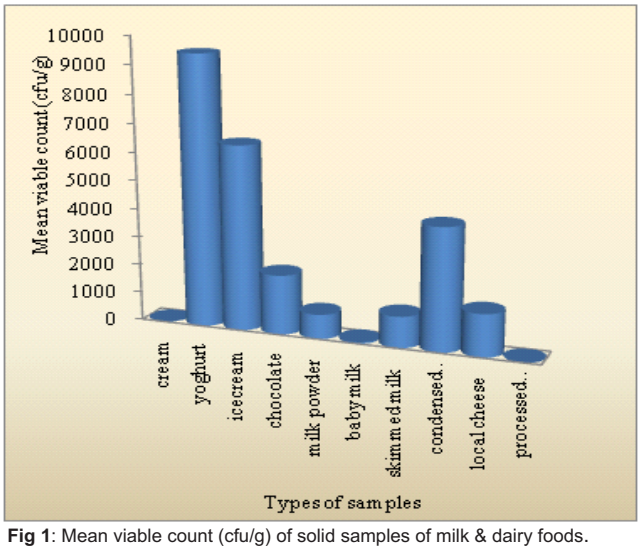

Fig 1: Mean viable count (cfu/g) of solid samples of milk & dairy foods.

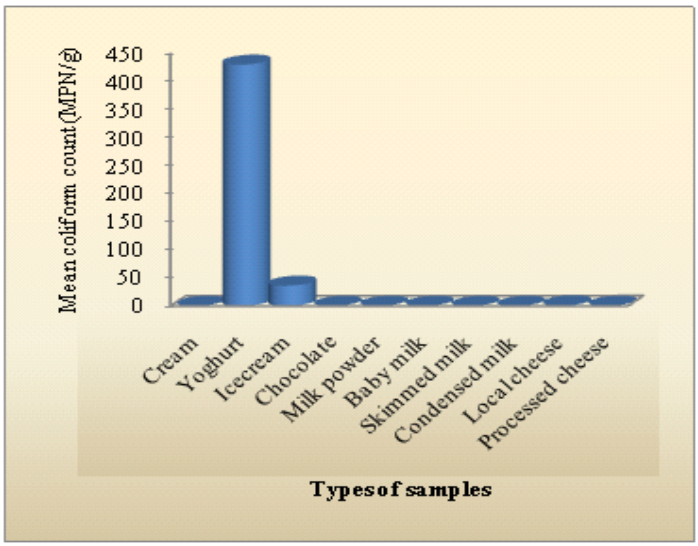

Fig 2: Mean Coliform count (MPN/g) of solid samples of milk & dairy foods.

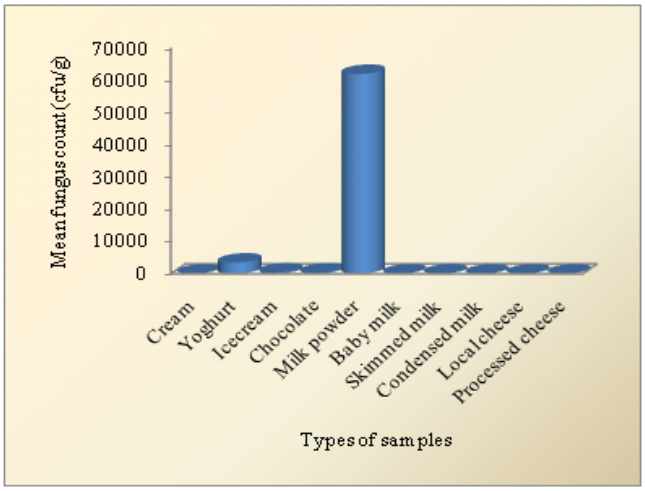

Fig 3: Mean fungus count (cfu/g) of solid samples of milk and dairy foods.

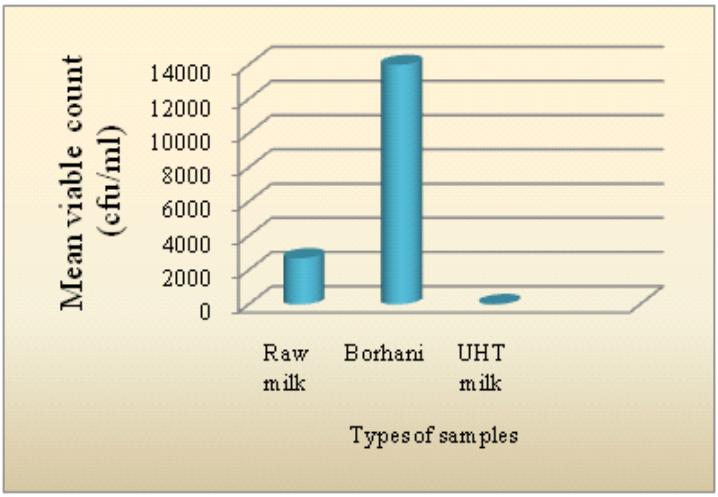

Fig 4: Mean viable count (cfu/ ml) of liquid samples of milk & dairy foods.

counts were within the acceptable range according to FDA standard.

Among the solid milk samples, the mean viable count of full cream milk powder was 8.6×102 cfu/g and mean fungus count was 6.2×104 cfu/g. The Coliform count was not found. The mean viable count was also within the range of FDA standard.

The Mean viable count of condensed milk was 4.3×103 cfu/g. The total Coliform and fungus count was absent in condensed milk. Condensed milk was acceptable in quality according to FDA standard.

In Baby milk, total viable count ranged from 10 to 1.1×102 cfu/g. The mean viable count was 4.5×10 cfu/g and mean fungus count was 1.6 cfu/g. Mean viable count was within the acceptable limit according to FDA standard.

Among the cheese samples, mean viable count and mean Coliform count of locally collected cheese was 1.5×103 cfu/g and 0.98 MPN/g. The fungus count was absent. In case of processed cheese, mean viable count was 8.5 cfu/g. The Coliform count and fungus count was absent. Both locally collected and processed cheeses were acceptable in total viable and Coliform count according to FDA standard.

All average parameters of solid samples are shown in Figure-1, 2 &3.

Among the liquid samples, the mean viable count, mean Coliform count and mean fungus count of borhani was 1.4×104 cfu/ml, <3 MPN/100ml and zero respectively. In UHT milk, the mean viable count was 2.2×10 cfu/ml. Mean Coliform and mean fungus count was absent in UHT milk. The mean viable count of raw milk sample was 2.7×103 cfu/ml. The mean fungus count was 1.7×104 cfu/ml. The total Coliform count was absent in raw milk. According to FDA Standard, mean viable count of raw milk sample was within the range. All average parameters of liquid milk and milk based samples are shown in Figure-4, 5 &6.

DISCUSSION

Total bacterial count, presence of Coliform organism, fungus count are commonly used to reflect hygienic status of final products and effectiveness of hygienic practice in the production of dairy or other food related products.

A variety of diseases are potentially transmitted through milk. The source of a pathogenic agent occurring in milk may be either a cow or a human and it may be transmitted to other milk products (Pelczar, 2007). Unsatisfactory sanitation or unsuitable time and temperature during storage or production may also be the contamination source of microorganisms.

The Coliform count is an indicator of a possible sanitation failure. The overall risk to frozen food products is extremely low. The cold temperature simply does not allow for the growth of pathogens. In fact, there are very few reported food-borne illnesses associated with frozen food products. Bacteriological growth occurs at an exponential rate, not at a linear rate. Therefore, it is more meaningful to consider bacteria counts in terms of doubling. A two-generation increase, or two doublings, is considered significant.

Cream is a kind of dairy product, which is used in manufacturing of butter. If the environmental and sanitary conditions during packaging and handling of cream are proper, then it can be used for production of different dairy products. According to FDA standard our cream sample was microbiologically acceptable in quality.

In this study, we analyzed ice-cream samples and found Coliform organisms. The presence of Coliform bacteria indicates the presence of faecal contamination in food. This suggests the possibility of presence of other enteropathogenic bacteria in the food (Omar H Baraheem et al., 2007).

The presence of higher number of fungus in chocolate products represented the bad quality of the food. Fungus is the main spoilage organisms found in cultured milk (yoghurt, sour cream, buttermilk etc) because the higher acidity in these products inhibits many bacteria (M. Ellin Doyle, 2007). Fungus cause various degree of decomposition & deterioration of food products. They can virtually grow any type of food, processed food & food mixtures at any time.

Generally locally collected cheese samples are highly contaminated by bacteria than the processed one. But in our study, both types of samples were microbiologically acceptable except the very negligible amount of Coliform count (0.98 MPN/g). Bhowmick et al., 2006 found the range of Coliform bacteria from 6.0×103 -5×103 cfu in cheese samples. Fawaz et al., 2011 found that the total viable count and Coliform count were high in locally produced cheese (log 3.79 and log 3.34) compared to the imported one (log 3.67 and log 3.09) respectively. But they found yeast and mould count higher in imported (log 1.09) compared to the locally produced (log 0.94) cheeses.

Borhani is served in many localities in Bangladesh. It is served with much viable count which possesses a severe threat to the human of the consumers. Bhowmick et al., 2006 found the range of Coliform bacteria from 5.24×105 -0.5×104 cfu in Borhani.

Microbial contamination in raw milk is mainly the result of milk contamination during/after milking. Residual water in milking machines, milk pipelines or coolers, dirty udder and teats, inadequate cleaning of surfaces of dairy equipments for reception, transport and storage of milk are the most common sources of microbial contamination (Dubravka et al., 2012).

Although there are significant differences concerning microbiological standards of freshly produced raw milk, it may be stated that raw milk of satisfactory quality should contain less than 10,000 microbial cells per ml, and a total count of more than 50,000 per ml means that the raw milk is unsatisfactory (Radomir Lásztity).

CONCLUSION

Food borne illness may be caused by pathogen contaminated food & food products. Dairy foods are no exception to that. Dairy animals may carry human pathogens. Such pathogens present in milk may increase the risk of causing food borne illness. Moreover, the procedure of milking, subsequent pooling and the storage of milk carry the risks of further contamination from man or the environment or growth of inherent pathogens. The presence of these pathogenic organisms or heavy microbial load may cause higher health risks for the consumers. So, it is recommended to take possible measure during preparation and storage of this food items. Our study will give overall bacterial load and quality of some selected milk and milk based products at a glance. It is now essential to concentrate greater attention in food security and the food production with special care in order to eliminate almost entirely the presence of any pathogen contamination.

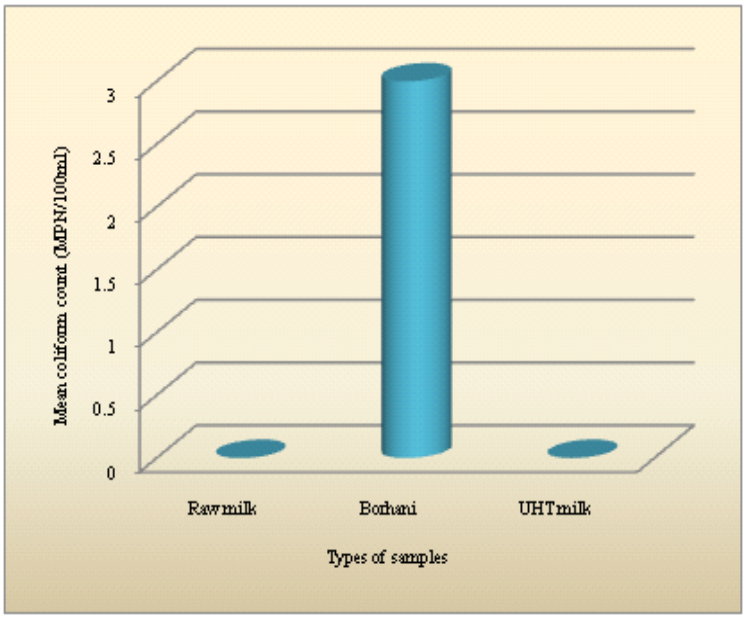

Fig 5: Mean Coliform count (MPN/100ml) of liquid samples of milk & dairy foods.

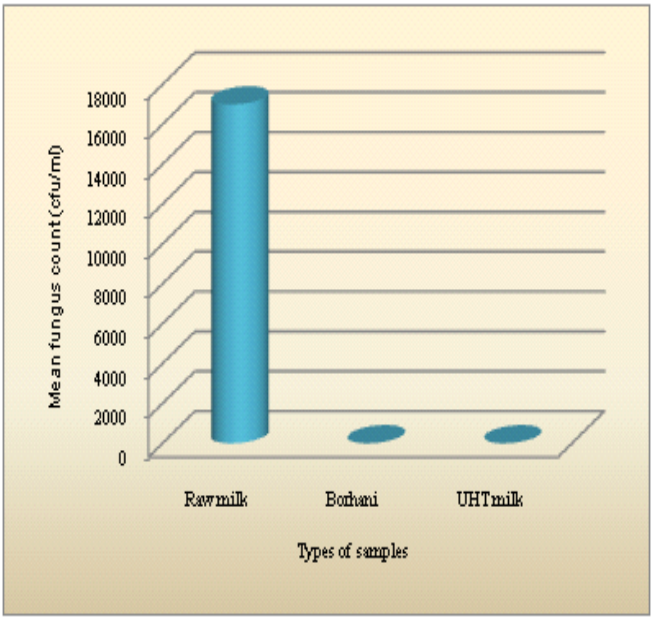

Fig 6: Mean fungus count (cfu/ml) of liquid samples of milk and dairy foods.

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