Microbial Quality of Ice Cream Sold in Kathmandu

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Abstract

Introduction Ice cream is popular and nutritionally enriched congealed dairy product. Since it harbors many potent pathogens, its microbial quality has always been crucially important to public health.

Objectives This study aims to access microbial quality of some selected national and international brands of Ice cream being sold in Kathmandu Valley.

Methods Altogether 72 ice cream samples of twelve different brands (6 Nepalese and 6 foreign brands), collected from different departmental stores of Kathmandu Valley during July to September of year 2004, were subjected to Mesophilic aerobic count, Total coli form count and Staphylococcal count and detection *Salmonella* spp. Detection of *Staphylococcus aureus* and *Salmonella* spp. was confirmed by various biochemical tests and growth characteristics on selective media as described by Benson (1994).

Results Out of total, 44 samples (61.1%), 49 samples (68.1%) and 16 samples (22.2%) exceeded standard value of mesophilic aerobic count, total coliform count and Staphylococcal count respectively. However, only one sample (1.4%) was found to be contaminated with *Salmonella* spp. The microbial quality of 'with additive' ice cream samples was poorer in comparison to plain samples. Comparison of the quality of Nepalese and foreign brands was not significant.

Conclusion The overall microbial quality of ice cream samples being sold in Kathmandu Valley is poor.

Keywords Mesophilic aerobic Count, Total Coli form Count, Staphylococcal count, *Salmonella* spp.

Introduction

Ice cream is a nutritionally enriched congealed dairy product produced by freezing pasteurized mixture of milk solid other than fat, sugar, emulsifier and stabilizer. Flavour enrichment of ice cream is because of optional addition of fruit nuts, candies, syrups and other flavoring ingredients[1]. Evolution of ice cream in its present form is because of gradual timely changes brought about according to human taste by changes in its preparation.

Ice cream is undoubtedly one of most popular and favorite food product in Kathmandu Valley among children and adults especially during summer season. Several international imported and Nepalese national brands of ice cream in variety of flavors have been marketed here.

Quality of ice cream depends on both extrinsic factors that include manufacture procedure, and intrinsic factors that include proportion of ingredients used. Ice cream, a milk based product is good media for microbial growth due to high nutrient value, almost neutral pH value and long storage duration. Primary sources of microbial contamination to ice cream include water and raw milk whereas secondary sources include flavoring agents, utensils and handling. Although pasteurization, freezing and hardening steps in production can estimate most of the microbial hazards, but still numerous health hazards are persistent due to various conditions.

Many psychrophiles and psychrotolerant microorganisms like *Listeria monocytogens*, *Staphylococcus aureus*, *Bacillus* species, *Salmonella* species, *Shigella* species, *Streptococus* spp., *Pseudomonas* spp., *Campylobacter* spp., *Brucella* spp. and coliform bacteria are generally present in ice cream[2].

Microbial quality of ice cream is determined by significant total microbial count, coliform count and presence of pathogenic microorganisms. Microbial quality determination is completely used to reflect hygienic practice in production. This investigation presents situational analysis of microbial quality of some selected national and international brands of Ice cream being sold in Kathmandu Valley.

Methodology

Altogether seventy-two ice cream samples (cups or as available in market) of twelve different brands (6 Nepalese: Softy, DDC, Nd's, Everest Kwality and Anmol; 6 foreign:

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Vadilal, Suzi, Icemart, Italian Ice cream, Neerala's and Baskin robins) were collected from different departmental stores of Kathmandu valley. Out of duplicate six samples of each brand, 3 were 'plain' and 3 were 'with additives'. The study was carried out from July to September of 2004. Immediately after transportation to laboratory, the samples were processed for microbial analysis.

Ice cream samples were serially diluted using quarter strength Ringer's solution. Standard viable count was made by pour plate technique on plate count agar (PCA) for Mesophilic aerobic count, on Violet Red Bile Salt Agar (VRBA) for Total coli form count and on Mannitol salt agar (MSA) for Staphylococcal count. Typical yellow colonies on MSA were identified as *Staphylococcus aureus* by gram staining, catalase, oxidase, oxidative fermentative (O-F) and coagulase test. Detection of *Salmonella* spp was done by enrichment in Selenite F broth followed by streaking on Xylose Lysine Deoxycholate (XLD) agar. Typical pink colonies with black centre were identified as *Salmonella* spp. by gram staining and various biochemical tests as described by Benson (1994)[3].

Results

Out of total 72, all ice cream samples (100%) showed positive growth on Plate count agar. However 44 samples (61.1%) exceeded standard value of Mesophilic aerobic count which is $2.5x10^5$ cfu/gram[4]. In case of Total coliform count, 52 samples (72.2%) were found to be contaminated with coliforms and 49 samples (68.1%) crossed the standard value for coliforms that is 100 cfu/gram[4]. Similarly 51 samples (70.8%) showed the positive growth for *Staphylococcus aureus* on MSA. However, only 16 samples (22.2%) were found crossing the standard value[4] (100 cfu/gram) of Staphylococcal count. Only one sample (1.4%) was found to be contaminated with *Salmonella* spp.

The maximum count for Mesophilic aerobic bacteria was observed up to $1.52x10^8$ cfu/gram. However maximum count for total coli forms was

found to be $13x10^6$ cfu/gram. Staphylococcal count in maximum value was found 20,000 cfu/gram. (Table)

Table 1: Bacteriological load in Ice cream samples (n=72)

Parameters	Within Standard Value*		Exceeding Standard Value	
	Range	Average	Range	Average
Mesophilic aerobic Count (cfu/gram)	$100\text{-}1.5x10^5$	$3.7x10^4$ (n=29)	$2.7x10^5\text{-}1.52x10^8$	$10.47x10^6$ (n=43)
Total Coliform Count (cfu/gram)	0-100	13 (n=23)	$200\text{-}13x10^6$	$3.84x10^5$ (n=49)
Staphylococcal Count (cfu/gram)	0-100	28.25 (n=56)	130-20000	1907.5 (n=16)

* Mesophilic aerobic Count = $2.5x10^5$ cfu/gram
* Total Coliform Count = 100 cfu/gram
* Staphylococcal Count = 100 cfu/gram

Comparing the plain and with additive ice cream samples, 55.6 percentage and 63.9 percentage samples of plain and with additive ice cream respectively exceeded the standard value in terms of Mesophilic aerobic count whereas 66.7 percentage and 69.4 percentage respectively exceeded the standard value in terms of Total coli form count and only 16.7 percent and 27.8 percent plain and with additives samples respectively exceeded the standard value of Staphylococcal count. *Salmonella spp.* was detected in one of plain sample. (Table: 2)

Table 2: Comparison of types Ice cream samples

Type	Mesophilic aerobic Count (% of Samples)			Total Coliform Count (% of Samples)			Staphylococcal Count (% of Samples)			Detection of Salmonella spp
	NG	Within Standard Value	Exceeding Standard Value	NG	Within Standard Value	Exceeding Standard Value	NG	Within Standard Value	Exceeding Standard Value	
Plain (n=36)	0	44.4	55.6	27.8	33.3	66.7	27.8	83.3	16.7	2.8
With Additives (n=36)	0	36.1	63.9	30.6	30.6	69.4	16.7	72.2	27.8	ND

n=Number of Samples, NG= No growth, ND= Not detected

Higher percentage of foreign brands' ice cream samples exceeded standard value in comparison to that of Nepalese brand in terms of Mesophilic aerobic count and Staphylococcal count. However the case is reverse in terms of Total coli form count. The presence of

Salmonella spp. was detected in one of foreign brand ice cream sample. (Table 3)

Table: 3 Comparisons of Nepalese and Foreign Brands

Type	Mesophilic aerobic Count (% of Samples)			Total Coliform Count (% of Samples)			Staphylococcal Count (% of Samples)			Detection of Salmonella spp.
	NG	Within Standard Value	Exceeding Standard Value	NG	Within Standard Value	Exceeding Standard Value	NG	Within Standard Value	Exceeding Standard Value	
Nepalese Brands (n=36)	0	44.4	55.6	22.2	30.6	69.4	22.2	83.3	16.7	ND
Foreign Brands (n=36)	0	36.1	63.9	30.6	33.3	66.7	27.8	72.2	27.8	2.8

n=Number of Samples, NG= No growth, ND= Not detected.

Discussion

Ice cream is a fairly complex food containing sugar, emulsifiers and fats. As long as no bacteria or other harmful microorganisms contaminate any of the ingredients after processing, then ice cream while frozen is one of the safer commodities[1]. Depending on the available water, bacterial growth could be rapid in melted ice cream. If melted ice cream were contaminated and allowed to remain at elevated temperatures, freezing temperatures later would not make the product safe[2].

This investigation presents the current status of microbial quality of ice cream being sold in Kathmandu Valley. All analyzed ice cream samples (n=72) showed positive growth on Plate count agar indicating the presence of pshycrophilic microorganisms. However 61.1 percentage samples exceeded standard value of mesophilic aerobic count with maximum load noted $1.52x10^8$ cfu/gram and 68.1 percentage samples crossed the standard value for Total coliform count. However, only 22.2 percentage samples were found beyond the standard value of Staphylococcal count. Only one sample (1.4%) was found to be contaminated with *Salmonella* spp. These results can be supported by the work of various other researchers. There is existence of higher numbers of pathogenic and non pathogenic bacteria in the ice cream samples of Kathmandu[5]. Udas (1996) also accessed similar results in the Kathmandu Valley[6].

Microbial quality of ice cream examined in India by Bhusan Reddy *et al*. (1994)[7], Phillipines by Orallo, Pangen and Cabrera (1999)[8], in Hongkong by Food and Environmental Hygiene Department (2001)[1], and in Bangladesh by M-E-Elahi *et al*. (2002)[9] also reported the more or less comparable results.

The presence of these organisms in ice cream samples may be because of their cold resistivity. *E. coli* proved to be moderately resistant, coliforms were somewhat more sensitive. Staphylococci showed in the beginning a lower drop, but in the course of time similar rates as coli and coliforms[10]. The *Staphylococcus aureus* strains were shown to have high resistance in ice cream. The survival rate of the organisms depended both on the specific peculiarities of the individual strains and on the composition of the ice cream mixture. Staphylococci were found to survive longer in milk ice cream[11].

The present study revealed that in comparison to overall microbial quality of plain ice cream samples, that of 'with additive' samples was poorer. (Table 2) It is obvious that added ingredients such as nuts increase the possibilities of microbial contamination.

We also compared the microbial quality of Nepalese brands and foreign brands. Higher percentage of foreign brands' ice cream samples exceeded the standard value in comparison to that of Nepalese brand in terms of mesophilic aerobic count and Staphylococcal count. This may be because of poor handling of retailers. However the case is reverse in terms of total coliform. The presence of coliform bacteria indicates the presence of fecal contamination of food. This suggests possibility that other intestinal pathogens may also present in food. These microorganisms are transmitted via fecal-oral route.

The presence of coagulase positive Staphylococcus, which is mainly *S. aureus* when transmitted from man and animal, can lead to staphylococcal food poisoning as a result of growth of the organism and release of enterotoxin in the food. Enterotoxin production and secretion occurs especially when ice cream products are not properly prepared and stored. The presence of starch and proteins also encourages enterotoxin production by microorganisms[2].

Although only one sample confirmed the presence of *Salmonella* spp in this study, but being potent pathogen it should be taken considerably. Although pathogenic microorganisms are resistant to freezing temperatures, in certain bacteriologic media, particularly selective ones, they can exhibit poor or no development. Consumption of ice cream contaminated with enterobacteria such as *Salmonella* has been the cause of several outbreaks[12]. The nationwide outbreak of salmonellosis was most likely the result of contamination of pasteurized ice cream premix during transport in tanker trailers that had previously carried nonpasteurized liquid eggs containing *S. enteritidi*[12]

Besides, several other researchers have observed the presence of other pathogenic organisms in ice cream. Incidence of pathogenic bacteria such as *Listeria monocytogenes* and *Staphylococcus aureus* were found in the higher numbers

together with other species of bacteria.[5] Two *Yersinia enterocolitica* strains were isolated from non-industrial ice cream, which suggests the possibility of post-manufacturing contamination[14.]

This presents the overall scenario of public health importance and food borne disease outbreaks especially consumption of popular dairy product ice cream. For nine different microbial diseases traced to dairy products for the period 1970-1979, ice cream (often contaminated by eggs) was the leading vehicle, followed by cheese and unspecified types of milk[14].

The results suggest negligence such as poor sanitation during the preparation/or storage of ice cream. These included the observed dirty premises, used utensils and the use of bare hands in preparing the products. Even the raw milk could be a possible source of contamination. Analysis of raw milk samples in different checkpoints of milk chain system showed that the samples were heavily contaminated by both coli forms and general bacterial load[15].

In developed countries ice cream receives quality control measures to increase its shelf life as well as prevent potential threat of public health. Due to non-enforcement of inspection act and lack of maintenance of standard relation to hygienic quality of ice cream, the consumers of these countries are deprived of getting quality ice cream. In the manufacturing processes, pasteurization is effective in destroying most of pathogenic bacteria and freezing and hardening processes can inhibit the microbial growth. Automatic machines that are widely used for ice-cream production in dairy industry minimize direct hand manipulation and possibility of cross contamination. Good manufacturing practice (GMP) would be a good way to improve hygienic quality of soft ice-cream, especially in all steps after pasteurization[1]. For the consumers, they should also observe some key points to avoid the exposure to microbiological hazards.

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