Bacteriological quality of icecream marketed in Thrissur town, Kerala, India

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Abstract

Aim: To assess the bacteriological quality of ice creams marketed in Thrissur town, Kerala.
Materials and Methods: Twenty seven ice cream samples randomly collected from selected retail outlets and street vendors in the town over a period of two months were analyzed for total viable count and for the presence of coliforms, *Escherichia coli, Staphylococcus aureus, Salmonella* spp. and *Listeria monocytogenes*.
Results: Total Viable Count ranged from 1.2×10^2 to 8.2×10^3 CFU/g in industrial brands whereas in street vendor samples it was high in the range of 5.2×10^5 to 6.6×10^6 CFU/g. Coliform counts were high in 30 % of the samples. 27 % of the samples had high Staphylococcal count. *E coli* were isolated from two samples from street vendors and *Salmonella* spp. from one of the samples. *Listeria spp.* was not isolated from any of the samples.
Conclusion: The presence of potential pathogens in the ice cream samples reveals the significance of implementation of quality control measures in marketing ice creams thus reducing the public health hazards.
Key words: *Coliform* count, Ice-cream, *Salmonella* spp., *Staphylococcal* count,

Introduction

Ice cream is indeed one of the widely accepted food products in Kerala among children and adults. It is prepared by freezing a pasteurized mix containing milk products (milk, condensed milk, milk powder and cream), sugar, emulsifiers, stabilizers, flavouring and colouring agents, blended in a desirable proportion. Pasteurization is effective in destroying most of the pathogenic bacteria and freezing and hardening processes can inhibit the microbial growth; the use of automated machines minimizes direct handling of the product, thus eliminating all the possibilities of contamination. In spite of all these, ice cream has been recently implicated in food poisoning outbreaks in Kerala [1]. The high content of nutrients like lactose and proteins and its neutral pH make it an excellent growth medium for microbes some of which may cause serious disease outbreaks like cholera, typhoid and bacillary dysentery in human beings [2]. The source of microbial contamination can be at various stages of manufacture from humans and environmental sources [3]. Inappropriate product handling especially at the selling point will further increase the chance of ice cream to act as a vehicle for pathogens.

Microbial quality of ice cream is determined by total viable bacterial count, coliform count and presence of pathogenic microorganisms. Many psychrophiles and psychrotolerant bacteria like *Listeria monocytogens*, *Staphylococcus aureus*, *Salmonella* spp., *E. coli* and other coliforms were isolated from ice creams [2]. Bacteriological quality of ice cream reflects hygienic practice in production and is an indication of food safety. Hence, the present study was taken up to determine the bacteriological quality of ice cream marketed in Thrissur town, Kerala and to assess the potential of this frozen product to pose risk to public health.

Materials and Methods

In this study, 27 ice cream samples were collected randomly from selected retail outlets and street vendors in Thrissur town. The samples comprised of seven packed/industrial ice cream brands; three samples each were collected for each brand over a period of two months. Six vendor samples collected during the same period were also assessed

Table-1. Bacteriological quality of icecream marketed in Thrissur town, Kerala

Sample No.	Type of ice cream	TVC (cfu/g)	Coliform Count (cfu/g)	Staphylococcal Count (cfu/g)	Salmonella spp.	Listeria spp.	E.coli
1.	Brand 1	5.6×10^3	-	-	-	-	-
2.	Brand 1	4.3×10^3	-	-	-	-	-
3.	Brand 1	3.2×10^3	7				
4.	Brand 2	2.2×10^3	-	-	-	-	-
5.	Brand 2	1.9×10^3	9	11	-	-	-
6.	Brand 2	2.0×10^3	12				
7.	Brand 3	1.2×10^2	-	-	-	-	-
8.	Brand 3	2.3×10^2	-	-	-	-	-
9.	Brand 3	1.6×10^2	-				
10.	Brand 4	1.1×10^3	111	-	-	-	-
11.	Brand 4	1.8×10^3	32	-	-	-	-
12.	Brand 4	1.7×10^3	56				
13.	Brand5	3.0×10^3	135	-	-	-	-
14.	Brand5	3.2×10^3	108	16	-	-	-
15.	Brand 5	2.7×10^3	81				
16.	Brand6	6.8×10^2	-	-	-	-	-
17.	Brand6	8.2×10^2	-	-	-	-	-
18.	Brand 6	7.9×10^2	-				
19.	Brand 7	4.2×10^3	-	-	-	-	-
20.	Brand 7	6.7×10^3	-	-	-	-	-
21.	Brand 7	5.4×10^3	-				
22.	Street vendor 1	8.9×10^5	120	39	-	-	+
23.	Street vendor 2	4.1×10^6	107	-	-	-	-
24.	Street vendor 3	6.6×10^6	248	107	+	-	+
25.	Street vendor 4	5.2×10^5	123	64	-	-	-
26.	Street vendor 5	1.2×10^6	106	71	-	-	-
27.	Street vendor 6	9.2×10^5	98	13	-	-	-

for their microbiological quality. Total viable count (TVC), total coliform count and Staphylococcal count were determined in plate count agar (PCA), Violet Red Bile Salt Agar (VRBA) and Mannitol salt agar (MSA) respectively as per the standard procedures [4]. Eosin methylene blue (EMB) agar was used for *E. coli* count. For the detection of *Salmonella* and *Listeria,* enrichment was initially done using Selenite F broth and *Listeria* Enrichment Broth and then plated on Brilliant Green Agar and PALCAM agar respectively. Typical colonies were selected and their identity was confirmed by standard biochemical reactions [5].

Results and Discussion

The results are given in Table No. 1. According to Food Safety and Standards Regulations [6], TVC of ice cream should not exceed 2, 50,000 /gram. In the present study, we observed that the TVC was within the prescribed limit for all the industrial ice cream brands (1.2×10^2 to 8.2×10^3 CFU/g). However, none of the street vendor samples conformed to the standards (5.2×10^5 to 6.6×10^6 CFU/g). Kumar et al. [7] conducted a study to assess the bacteriological quality of local made open scoop ice cream sold by street hawkers in different areas of Jalandhar city, Punjab and found that the samples of all the areas show heavy contamination of bacteria ranging from 0.1×10^9 CFU/g to 10.2×10^9 CFU/g. Although the samples we analyzed were

having lesser counts, they were not in the safe limits. Better microbiological quality of branded ice cream samples may be attributed to pasteurization of the ice cream mix, clear industry guidance on microbiological standards and prompt adherence to cold chain. Contamination of the mix, temperature abuse of the mix and inadequate cleaning of the equipment and premises of sale can lead to TVC counts in excess of 10^6 cells [4]. TVC of the frozen dairy products are generally considered as indices of plant sanitation and handling conditions.

As per FSSA [6], the coliform count in ice cream should not be more than 100/gram. In the present study, 30 % of the samples contained coliforms above the prescribed limit. Though TVC was within the prescribed range, coliform count exceeded the limits in three brands. Satisfactory TVC with high coliform count clearly indicates inadequate handling practices at the selling point. Plant hygiene and personnel hygiene should be suspected when coliform count of the product is high [8]. The scoop water can get contaminated by the unhygienic conditions during the sale. Kanbakan et al. [9] reported that inadequate cleaning of the hands, same person selling ice cream and collecting money, open cones and unclean cloth for cleaning the scoops can contribute to high coliform count. Anuranjini et al. [10] also reported the incidence of high coliform count in ice creams marketed in

Mangalore town.

FSSA [6] stipulates that *E. coli* should be absent in one gram of ice cream. In the present trial, *E. coli*, indicative of feacal contamination were isolated from two samples marketed by street vendors. This finding highlights the importance of personnel hygiene at the selling point. In many cases, the final stages of packing and marketing is likely to be frequently contaminated by human carriers. Equipment hygiene at the food service establishment is also very important to assure safe products for consumers.

Handler's hygiene is to be suspected in case of increased Staphylococcal count. Results of Staphylococcal count also suggest the need to improve handling measures of finished products. According to FSSA [6], *Staphylococcus aureus* should be less than 10/gram of the sample. In this study, we noticed that 27 % of the samples showed a higher count. Warke et al. [11] reported presence of *S. aureus* in all ice cream samples sold in some retail outlets in Mumbai, India. Although, we found organisms at a lower rate than the above mentioned study, they were high when compared to reports from developed countries. Joshi et al. [12] found that *Staphylococcus aureus* can survive better in frozen products like ice creams and can elaborate enterotoxins leading to food poisoning outbreaks. The presence of starch and protein are reported to favour enterotoxin production. The possible sources of this organism in ice cream could be from human hands, nose, skin and clothing of handlers. Coughing, talking and sneezing produce droplets which could settle on ice cream during transportation which may act as a source of contamination [13].

Salmonella was isolated from one sample sold by a street vendor which incidentally had high coliform count also. As per the standards, Salmonella should be absent in 25 gram of the sample. In the present work, Salmonella was isolated from representative sample of one gram itself. The result is suggestive of the alarming situation that the product poses to public health. Raw material quality, processing quality and hygiene at all levels till consumption are crucial to assure product safety. Consumption of contaminated ice cream has been the cause of several food poisoning outbreaks [14,15]. A recent report [1] on gastrointestinal infections in children due to consumption of contaminated ice creams from the make-shift stall outside the temple premises in Kinanur-Karindalam village near Neeleswaram, North Kerala also supports the view that there is an urgent requirement to implement food safety guidelines to ensure the safety and quality of ice creams all over Kerala.

In the present study, we could not isolate *L. monocytogenes* from any of the samples. El-Sharef et al. [16] in Libya reported an isolation rate of 6% for Listeria from ice cream. Windrantz and Arias [17] succeeded in isolating *L. monocytogenes* in 12.3% of 65 ice cream samples. In our case inability to isolate may be due to the small sample size taken and it does not guarantee excellent processing and storage conditions.

In this study, we found a correlation between the coliform count and the Staphylococcal count. Samples with high coliform count had a high Staphylococcal count also. *Escherichia coli* count was also found to be related to this. We could isolate *E. coli* from the samples sold by street vendors 1 and 3 which were high in coliforms and *Staphylococcus aureus*. The bacteriological analysis of the ice cream from the street vendor 3 reflected the unhygienic vendor handling practices. This sample was found to have the highest TVC (6.6×10^6 cfu/g), coliform (2.48×10^2 cfu/g) and *S. aureus* (1.07×10^2 cfu /g). *E. coli* and Salmonella were also isolated from the same sample.

Conclusion

Ice cream is one of most popular and favorite food products all over the world. It is an ideal media for microbial growth due to high nutritive value and long storage duration. Once the ice cream becomes contaminated, freezing temperature could not make the product safer later. At retail shops, improper storage temperature and prolonged storage time affects the microbiological quality of ice-cream. The same reasons would have contributed to poor quality of branded ice cream also. To improve quality of ice-cream, Good manufacturing practice (GMP) is mandatory especially at all post pasteurization steps. The use of good quality raw materials and automatic machines to minimize handling will be effective in assuring quality. Adoption of good sanitation practices and application of the HACCP principles in the system along with education of workers on personal hygiene will definitely improve the quality of ice cream.

Author's contribution

RA conducted the study and prepared the manuscript under the guidance of AKB. Both authors read and approved the final manuscript.

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Competing interests

Authors declare that they have no competing interests.

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