



Microbiological quality assessment of ice cream marketed in Thrissur city with special reference to *Salmonella* spp.

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Abstract

The research was undertaken to determine the microbiological quality of ice cream sold in retail shops in Thrissur city. The study aimed to evaluate the safety and hygiene of ice cream, sold in the retail market. Ten samples of ice cream each from six different brands were meticulously collected and microbiological parameters like Total viable count (TVC), coliform count and presence of *Salmonella* spp. were investigated. The mean TVC varied from 2.29 ± 0.06 to $4.55 \pm 0.03 \log_{10}$ CFU/g indicating the overall microbial load present in the ice cream, while mean coliform count ranged from 2.0 to $2.83 \pm 0.04 \log_{10}$ CFU/g which served as an indicator of faecal contamination. Total viable counts of all the sixty samples analysed were within the standards set by Food Safety and Standards Authority of India (FSSAI). However, coliform count of one brand exceeded FSSAI guidelines. Presence of *Salmonella* spp. was not identified in any of the samples analysed. While the majority of the samples analysed complied with the established safety standards, the elevated coliform count in one brand indicates a need for improved quality control measures. This finding highlights the relevance of continuous monitoring and compliance to food safety standards to ensure consumer health and safety. Ongoing surveillance and adherence to food safety regulations are essential to maintain the microbiological quality of ice cream and protect public health.

Keywords: Ice cream, total viable count, coliform count, *Salmonella*

Ice cream is a nutritious frozen dairy product that is widely appreciated by people of all ages, particularly children, during the warm summer season. It is a frozen blend composed of dairy products, sweeteners, stabilisers, emulsifiers and flavourings. Additional components such as egg products, colourants and starch hydrolysates may also be included. This blend, commonly known as a mix, undergoes pasteurisation and homogenisation prior to the freezing process. Freezing, accompanied by agitation to introduce air, results in a smooth and creamy texture in the final product (Marshall *et al.*, 2003). Ice cream creates a favourable environment for the proliferation of pathogenic or spoilage microorganisms, attributed to its abundant nutritional composition, nearly neutral pH and prolonged shelf life (Pal *et al.*, 2012). The growth of pathogenic microorganisms during different phases of ice cream production is significantly affected by several key factors, including the quality of raw milk, the heat treatment applied to the milk and the adherence to hygiene standards by personnel and plant hygiene maintained during the entire production process. Although the pasteurisation process and the

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utilisation of low storage temperatures significantly reduce the number of pathogens during ice cream production, there is still a potential risk to the final products. This risk arises from post-pasteurisation practices that may include the incorporation of contaminated ingredients, inadequate handling and unsuitable storage conditions (Verma, 1992).

Ensuring the microbial safety of ice cream is crucial, since it is commonly consumed by children, the most vulnerable group. *Salmonella*, a gram-negative facultative anaerobic bacterium belonging to the *Enterobacteriaceae* family, presents a serious threat to human health. Consuming ice cream contaminated with *Salmonella* poses significant risks to the gastrointestinal system, manifesting symptoms such as diarrhoea, fever and abdominal cramps. Therefore, the current research was conducted to assess the bacteriological quality of ice cream sold in Thrissur city with special reference to *Salmonella*.

A total of 60 samples of ice cream which comprises of 10 samples each from six different industrial brands were aseptically collected from different retail outlets of Thrissur city. The ice cream samples were allowed to thaw to room temperature. One gram of each sample was diluted in 9 mL of 0.1 per cent peptone water to create a one-tenth dilution. Serial dilutions were then prepared up to 10^{-5} and the specific dilutions were utilised for the assessment of microbiological parameters. The total viable count for each sample was assessed using the pour plate method as per BIS (1981). The estimation of coliforms per gram of the sample was conducted using the pour plate method as per BIS (1981). The results were expressed as CFU per gram.

The methodology described by Andrews *et al.* (2001) was used to evaluate the presence of *Salmonella* spp. in all samples collected. Ice cream samples were collected using aseptic techniques and a 25g portion was homogenised in 225 mL of buffered peptone water. The samples were subsequently pre-enriched at 37 °C for 18 hours. Upon completion of the incubation period, one mL was transferred to nine mL of Rappaport Vassiliadis (RV) *Salmonella* enrichment broth and subsequently incubated at a temperature of 42 °C for 18 hours. Following the incubation period, a loopful of inoculum was transferred onto Xylose Lysine Deoxycholate (XLD) agar and incubated at 37 °C for 18 hours. The suspected colonies were subjected to morphological and biochemical analyses to confirm the presence of *Salmonella*.

The data gathered from the experiments were statistically analysed using one-way ANOVA with the SPSS software version 24.0 (Snedecor and Cochran, 1994).

The standard plate count indicates the presence of viable microorganisms, offering valuable information

about the microbiological quality of the tested product and the quality of its raw materials. Furthermore, it acts as an indicator of the hygiene and cleanliness practices maintained throughout the manufacturing, handling and storage of the product. In the present investigation, the mean TVC of ice cream samples varied from 2.29 ± 0.06 to $4.55 \pm 0.03 \log_{10}$ CFU/g. As per FSSAI regulations, the total viable count in ice cream should not exceed 2,00,000 per gram. TVC of all the samples analysed were within the limit set by FSSAI. A study carried out by Rahman *et al.* (2015) revealed that the total viable bacterial count varied between 4.9×10^3 and 7.9×10^5 CFU/mL. In a study conducted by Barman *et al.* (2017) TVC of ice cream samples analysed ranged between 2×10^4 and 5.25×10^7 CFU/g. An investigation conducted by Yan *et al.* (2022) to evaluate the microbial quality of ice cream marketed in various regions across China, revealed that 6.10 per cent of the samples had TVC exceeding 10^5 CFU/g. The differences observed between the conclusions of other researchers and our study may be attributed to differences in storage conditions or sanitation measures implemented at the point of sale.

Coliforms are indicators of faecal contamination. The occurrence of these organisms in ice cream indicates potential unsanitary conditions and practices during its processing, packaging, and storage. According to FSSAI regulations, the permissible limit for coliform bacteria in ice cream is a maximum of 100 per gram. The mean coliform count of samples ranged from 2.0 to $2.83 \pm 0.04 \log_{10}$ CFU/g. Fifty samples (83 per cent) met the prescribed limit set by FSSAI for coliforms in ice cream. A total of ten samples from the same brand failed to meet FSSAI specifications. Ambily and Beena (2012) reported that 30 percent of the ice cream samples analysed surpassed FSSAI limits of microbial counts. In another study, Barman *et al.* (2017) reported that the coliform count in ice cream samples analysed varied from 0 to 1.325×10^4 CFU/gm. According to a study conducted by Paul *et al.* (2018) twenty percent of branded ice cream samples and ninety percent of samples gathered from street vendors of Dhaka city exceeded the standard limit for coliform bacteria. The findings of Gohar *et al.* (2018) showed that the branded ice cream samples exhibited notably low levels of both total viable count and coliform count. Additional sources of coliform contamination include ingredients introduced post-pasteurisation, environmental elements and flaws in packaging materials. It is essential that primary ingredients maintain low total counts and are free from coliform bacteria.

According to FSSAI standards, *Salmonella* must not be present in a 25 g sample of ice cream. This study found no evidence of *Salmonella* in any of the samples that were analysed. Ahmadi and Panda (2015) conducted research on the detection of *Salmonella* spp. and *E. coli*. in 265 ready-to-eat dairy products sold in Himachal Pradesh. The analysis concluded that none of the samples exhibited

Table 1. Microbiological quality of ice cream samples

Brand name	Total viable count (log ₁₀ CFU/g)	Coliform count (log ₁₀ CFU/g)	Presence of Salmonella
A	2.29 ^c ± 0.05	2.00 ^c ± 0.00	Absent
B	4.55 ^a ± 0.03	2.09 ^b ± 0.01	Absent
C	2.29 ^c ± 0.06	2.09 ^b ± 0.01	Absent
D	2.33 ^c ± 0.06	2.09 ^b ± 0.01	Absent
E	2.33 ^c ± 0.06	2.09 ^b ± 0.01	Absent
F	2.66 ^b ± 0.06	2.83 ^a ± 0.04	Absent

^{abc} means bearing the same lowercase letter as superscript within a column do not differ significantly ($p \geq 0.05$)

a positive result for *Salmonella* spp. Similarly, the analysis conducted by Guclu *et al.* (2022) in ice cream samples for the detection of *Salmonella* spp. resulted in negative findings. Paul *et al.* (2018) indicated that *Salmonella* spp. was isolated from 15.15 percent of the ice cream samples collected from street vendors of Dhaka city. Our research findings revealed that the samples collected were safe to consume, as they were free from Salmonella contamination.

Summary

The present study reveals that the ice cream samples collected from Thrissur city exhibited no evidence of *Salmonella* spp. contamination. Incorporating Hazard Analysis and Critical Control Points (HACCP) principles is vital for identifying and mitigating potential hazards in the production process. By minimising manual handling through mechanisation, manufacturers can reduce the risk of contamination and human error. Automation also facilitates precise control over mixing, freezing and other critical stages, resulting in a more consistent product. It enables the production process to maintain optimal temperatures and times, which is crucial in achieving the desired texture and flavour profiles in ice cream.

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Conflict of interest

The authors declare that they have no conflict of interest.

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