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Assessment of Microbial Quality in Ice Cream within Tiruchirappalli City, Tamil Nadu, India

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ABSTRACT: This study aimed to evaluate the microbial quality of ice cream sold at Tiruchirappalli city, Tamil Nadu, India. A total of 125 samples including branded ice cream packed in different packaging materials (75), kulfi samples (25) and softy ice cream (25) samples were subjected to total viable count (TVC), coliform, yeast and mould and *Staphylococcus aureus* count. The mean TVC and coliform count for ice cream, kulfi and softy, the mean coliform count were $0.6\times10^1\pm0.25$, $0.7\times10^2\pm0.28$ and $4.66\times10^2\pm1.41$ respectively. Few samples of kulfi and softy ice cream were harbouring few *staphylococcus aureus* which needs to be monitored strictly. The mean yeast and mould count were $0.65 \times 10^2\pm0.26$, $1.56 \times 10^3\pm0.48$ and $41.66\times10^3\pm8.33$. As the microbiological quality of few ice creams, most of the kulfi and softy are poor preventive measures have to be specifically targeted not only in production steps but also in postproduction period up to the consuming in order to prevent any food poisoning.

Keywords: Ice cream, Kulfi, Total Viable Count, *Staphylococcus aureus*, Coliforms, Yeats and Mould.

INTRODUCTION

Ice cream is a frozen dairy product that is an excellent source of nutrients and is enjoyed by people of all ages, primarily children especially during the summer months (Sharif *et al*., 2005). Due to its composition as an oil-in-water emulsion, unfrozen ice cream mix supports microbial growth and survival when contaminated, effectively dispersing fat and dissolving other nutrients (Ojokoh, 2006). The combination of high milk content, near-neutral pH, and extended storage time makes ice cream a prime medium for microbial growth (Bigalke and Chappel 1984). Owing to its abundant nutrients, it is vulnerable to microbial contamination at several phases of production and during the incorporation of components. The elevated concentrations of nutrients such as lactose, proteins, and its neutral pH (6-7) provide ice cream an optimal medium for growth for microorganisms, some of which can lead to severe infections and epidemics, including cholera, typhoid, and bacillary dysentery in humans (Ahmed *et al*., 2009). The quality of ice cream is influenced by extrinsic variables, such as the manufacturing process, and intrinsic variables, such as the ratio of components utilized. The principal sources of microbial contamination in ice cream are water and raw milk, whereas secondary sources comprise flavoring compounds, utensils, and handling practices. Despite the effectiveness of pasteurization, freezing, and hardening processes in mitigating microbiological threats, multiple health risks exist owing to varied situations. The operators, who may be carriers of specific illnesses, might also contaminate the product with potentially harmful organisms.

Contamination leading to microbial growth in ice cream can originate from various sources during production, storage, and distribution. Water and raw milk are primary sources, while flavoring agents, utensils, and handling contribute to secondary contamination (Yaman *et al*., 2006; Ahmed *et al*., 2009; Mokbul *et al*., 2016).

Maintaining ice cream safety and quality demands a stringent focus on preventing microbial contamination, particularly after pasteurization, which can originate from air, equipment, personnel, and water. This requires modern, hygienically designed facilities, meticulous selection of raw materials like milk, rigorous equipment and personnel hygiene practices, consistent water chlorination, and adherence to robust food safety management systems throughout production and sales. Crucially, proper pasteurization of the ice cream mix is essential to eliminate initial pathogens, and vigilant post-pasteurization controls, including cold chain maintenance and regular testing, are necessary to safeguard consumer health and prevent foodborne illnesses (Perihan, 2023).

Therefore, to guarantee product safety, the microbiological quality of ice cream must be optimal and devoid of germs, given its significant consumption by youngsters. This study aims to evaluate the microbiological and hygienic quality of commercially

accessible ice cream in Tiruchirappalli city, Tamil Nadu, India.

MATERIALS AND METHODS

One hundred and twenty five samples including branded ice cream (75), packed in different packaging materials (25 cone, 25 bars, 25 ball, 25 polyesterne cups), kulfi* (25) and softy ice cream (25) samples were purchased from different stores in Tiruchirappalli city. The acquired ice cream was deemed a single representative sample. An exact volume of 1 ml of ice cream was in an aseptic manner pipetted from the well-mixed sample and put into a sterile, empty test tube, which was then sealed with cotton. We added 9 ml of diluent to this ice cream to achieve a 1:10 v/v dilution. Additionally, decimal dilution was generated as per the standard procedure outlined by APHA (1960).

Total viable count, and coliform count were estimated as per standard methods for examination of Dairy products (I.S.No. 1479, part III (1977). The procedure adopted for the enumeration of yeast and mould count was as per IS : 3507 : 1966. Saphylococcus agar No. 110 was used to enumerate Staphylococcus species. Yeast and Mould count was performed in Potato Dextrose Agar.

*Kulfi is a famous South Asian ice cream prepared with boiling milk, usually from water buffalo. It is available in a variety of flavors, including pistachio, mango, cardamom (elaichi), apple, orange, peanut, avocado, anchovy, and saffron (kesar). Kulfi varies from Western ice cream in that it has a deeper flavor and creamier texture. In contrast to traditional ice cream, which is whipped with air or overrun, kulfi is made from solid, thick milk

RESULTS AND DISCUSSION

The microbiological quality of the packed ice cream, kulfi and softy ice cream samples are presented in Table 1. The mean total viable count of branded ice cream, kulfi and softy ice cream samples were 4.73±1.35, 5.23±1.02 and 5.54 ±1.28 log CFU/g respectively. All 125 samples exhibited positive growth on plate count agar, confirming the presence of pshycrophilic bacteria. Abo El-Makarem (2017) reported that, 60 percent of the packed ice cream showed positive growth on total bacterial count and the values were $1.9 \times 10^3 \pm 0.3 \times 10^3$ CFU/g. Whereas Youssif *et al.* (2020) reported higher values (15×10^5 CFU/g) for packed ice cream.

The mean coliform count of branded ice cream, kulfi and softy ice cream samples were 1.77±0.25, 2.91±0.28 and 2.66 ±1.14 CFU/g respectively. This is in accordance with the finding of El-Ansary (2015) who reported that the incidence of coliforms in the examined ice cream sample was 21%, with a mean value of $4.58 \times 10^3 \pm 1.50 \times 10^3$. The permissible Coliform standards for ice cream should not exceed 10/ml (Frazier and Westhoff 1958 ; James and Jay 1978). According to the Indian Standards (BIS), an allowable coliform count for ice cream is 90 per gram. The majority of the samples of branded ice cream and kulfi exhibited a coliform count of fewer than 90 per gram. However, the samples from several vendors, as well as all samples of soft serve ice cream, exceeded the prescribed limit. The presence of coliform organisms in ice creams post-pasteurization indicates a failure in the heat treatment process during preparation. In the interim, contamination can potentially stem from water sources, inadequate personal hygiene practices of the ice cream producer, and the utensils employed in the ice cream-making process (Jadhav and Raut 2014).

All the ice cream samples exhibited no evidence of the Staphylococcal group. However, a limited number of samples of kufi and softy exhibit the presence of some colonies of *Staphylococcus aureus.* Conversely, Batish and Chander (1987); Reddy *et al.* (1994); Nazem *et al.* (2010) indicated that numerous ice cream samples obtained from local markets exhibited significant levels of staphylococcal contamination. Contaminants can typically enter ice cream from various sources, including soil, dust, contaminated equipment, and the hands of individuals, either during storage or while filling the vending machine for sale (Mathews *et al*., 2013).

Coagulase-positive staphylococcus, primarily *S. aureus* when transmitted from humans and animals, can cause staphylococcal food poisoning due to the organism's growth and subsequent release of enterotoxin in food. Enterotoxin production and secretion predominantly occur when ice cream products are inadequately prepared and stored. Starch and proteins promote the production of enterotoxins by microorganisms (Jay, 1992).

The mean yeast and mould count in branded ice cream, kulfi and softy ice creams were 2.65 ±0.26, 4.56 ± 0.48 and 4.62±1.58 CFU/g respectively. This is in accordance with the findings of Akar and Ozdemir (2022) who reported that 4.22 log cfu/g of yeast and mould count was observed in industrial ice cream samples.

The nutritive richness of ice cream is widely understood; however, the technicalities associated with its production and handling present numerous challenges. There are significant challenges concerning the quality of ice cream, particularly in relation to its microbiological standards, which remain unsatisfactory. Throughout various stages, including production, transportation, storage, and preparation, milk intended for consumption may become contaminated with biological agents. Biological agents contaminating food are linked to ingredients introduced after pasteurization and environmental factors, including air quality, storage tank defects, structural cracks in the facility, and packaging materials (Bigalke and Chappel 1984).

With respect to the data presented above, it was discovered that all of the brands of ice cream samples were within the permitted level of public health safety. This was due to the fact that the samples did not surpass the total viable count of 2,50,000 and the coliform count of 90 per gram, both of which are specified by the Bureau of Indian Standards. Taking into account the findings as a whole, it is evident that each and every ice cream sample was risk-free. Due to the presence of staphylococcal germs, it is also crystal clear that just a few of the kulfi and the vast majority of the softy ice cream were not suitable for human consumption.

Table 1: Microbial quality of ice cream obtained from different sources.

Sr. No.	Count	Branded Ice Cream	Kulfi (Indian Ice cream)	Softy ice cream
1.	Total viable count (CFU/g)	4.73±1.35	5.23±28.02	5.54 ±112.8
2.	Coliforms (CFU/g)	1.77±0.25	2.91±0.28	2.66 ±1.14
3.	Stahylococcus (CFU/g)	—	1.30±0.16	1.47±0.12
4.	Yeast and mould (CFU/g)	2.65 ±0.26	4.56 ± 0.48	4.62±1.58

CONCLUSIONS

The microbiological integrity of the majority of softy ice cream, kulfi, and some branded ice creams requires enhancement to mitigate the risk of foodborne illness. The overall rates of dissatisfaction with soft ice cream were greater than those associated with hard ice cream. Implementing good manufacturing practice (GMP) could significantly enhance the hygienic quality of softy ice-cream, particularly in all processes following pasteurization. Consumers should be mindful of several important factors to minimize their risk of exposure to microbiological hazards. Therefore, the bacteriological quality of ice cream and its safety for human consumption rely completely on the manufacturing process and the handling during storage or sale, in addition to the health and hygienic practices of the personnel involved in its production.

FUTURE SCOPE

The findings of this study will be utilized to develop stringent protocols aimed at preventing contamination during production, handling, and post-processing stages of ice-cream.

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