



## Original Research Article

# Evaluation of microbiological quality of ice creams marketed in Kolhapur city, Maharashtra, India

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## ABSTRACT

Ice cream is a favorite food item commonly consumed during summer in all age groups. Due to its composition, it can harbor many potent pathogens. Most ice creams become contaminated with microbes during production, transit, and preservation. Such contaminated food product can be responsible for food borne infections in children, elderly people and immune-suppressed patients. Therefore, the study was conducted to evaluate the bacteriological quality of ice creams sold in different areas of Kolhapur city, Maharashtra. Randomly collected ice cream samples were analysed for Total Viable Count (cfu/g), Coli form count (per 100 ml), detection of *E. coli*, *Shigella* species, *Salmonella* species and *Staphylococcus aureus*. All samples showed positive growth of bacteria ranging from  $1.2 \times 10^3$  to  $8.0 \times 10^7$  cfu/g. The study revealed that all the samples showed positive growth of coliform bacteria while 40% ice cream samples were contaminated by the *E. coli*, 33% samples showed positive growth of *Salmonella*, 40% showed growth of *Staphylococcus aureus* and 53% *Shigella* species. It indicates the lack of maintenance of hygienic conditions during preparation, preservation or serving of ice cream. Hence, the present study is undertaken to assess potential of health risk to public.

## Keywords

Icecream,  
Microbiological  
quality,  
*Escherichia coli*,  
*Salmonella*,  
*Staphylococcus  
aureus*.

## Introduction

Ice cream is the major dairy product which is one of the favorite food items in large segments of the population. It is a nutritionally enriched frozen dairy product consumed by all age groups particularly children mostly during summer (Sharif *et al.*, 2005). Ice cream is a product of mixture consisting milk, sweetening and stabilizing agents together with flavoring and coloring matter (Graff - Johnson, 1974). Different ingredients like milk, cream, evaporated or

condensed milk, dried milk, coloring material, flavors, fruits, nuts, sweetening agents, egg products and stabilizers are used in ice cream preparation. Also, there are many parameters which should be controlled accurately during processing to obtain a high quality ice cream with the required taste, flavor, viscosity, consistency and appearance (Yaman *et al.*, 2006). Due to its composition, it can harbor many potent pathogens. Handling and storage conditions

are some of these variables because they affect the physical, chemical and microbial quality of product (Marshall and Arbuckle, 1996, Warke *et al.*, 2000, Champagne *et al.*, 1994, Daniels *et al.* 2002). Most ice creams become contaminated with microbes during production, transit and preservation. The possibility of acquiring food borne diseases by infant, children, elderly people and immune-suppressed patients is more due to contaminated ice creams. During last few decades, it has been seen that consumption of contaminated ice creams are responsible for disease outbreaks in many countries from Asia, Europe, and North America (Chug, 1996; Djuretic *et al.*, 1997; Digrak and Ozcelik, 1991). Since the consumption of ice-cream is higher among children of vulnerable age groups, there is a need to maintain a high microbiological safety standard (Champagne *et al.*, 1994).

It is a known fact that relatively low storage temperature and pasteurization steps during processing of ice creams are considered to eliminate most of the pathogenic microorganisms. However, the addition of contaminated ingredients, improper handling and the use of improper storage temperatures are the factors that contribute to the potential hazards of the finished products especially during processing after pasteurization processes (Verma *et al.*, 1992).

Bacteriological quality of ice cream reflects hygienic practice in production and is an indication of good practice in production. It is an indication of food which determines the bacteriological quality of ice creams (Ambily and Beena, 2012). Hence, the present study was taken up to determine the bacteriological quality of ice cream marketed in Kolhapur city and to assess the potential of these frozen products to pose risk to public health.

## Materials and Methods

There are different types of ice creams available in market. The present study aims to determine the microbiological quality of ice-creams marketed in Kolhapur city, Maharashtra, India. The microbiological tests conducted for the ice cream samples were Total Viable Count, Coliforms count and detection of pathogenic micro organisms.

For study purpose, ice cream samples were divided in three categories like branded, non branded and self-made ice creams. These ice cream samples were collected from popular ice cream shops as well as road vendor ice creams from local places like public gardens and ice cream parlors. The samples were analyzed in the month of November, 2013 and in February, 2013. The ice cream samples were collected and analyzed twice. During the analysis samples were collected and preserved at lower temperature for further analysis.

Total Viable Counts were determined by incorporating 10-fold diluted samples into molten Nutrient Agar plates. The plates were allowed to set and then incubated at 37°C for 48 h. Coliform counts of the ice cream samples were determined by Multiple Tube Fermentation Technique (Feng *et al.*, 2007). The tubes showing acid and gas productions were streaked on Mac Conkey's agar plate to obtain discrete colonies. Typical lactose fermenting colonies (n = 5) were picked up and identified as *Escherichia coli* by standard biochemical reactions (Collee *et al.*, 1996). In addition, the samples were also screened for enteric pathogens like *Salmonella* species, *Shigella* species and *Staphylococcus aureus*. The sample dilutions were spread on selective and differential media by spread plate method. Then, the plates were incubated at

37°C for 24 hr. After incubation plates were observed for presence of pathogenic bacteria

## Results and Discussion

According to Indian Food Safety Standards and Regulations (2011), Total Volatile Count (TVC) of ice cream should not exceed 2, 50,000 cfu/g. In the present study, it was observed that the TVC for all the self made ice creams was ( $2 \times 10^5$  to  $7 \times 10^5$  cfu/g) and for branded ( $1.2 \times 10^3$  to  $7.0 \times 10^3$  cfu /g). However, none of the road vendor ice cream samples showed TVC within the standards ( $4.3 \times 10^7$  to  $8.0 \times 10^7$  cfu/g). A study was conducted regarding bacteriological quality of local made open scoop ice creams sold by street hawkers in different areas of Jalandhar city, Punjab which showed heavy contamination of bacteria ranging from  $0.1 \times 10^9$  to  $10.2 \times 10^9$  cfu/g (Kumar *et al.*, 2011). The microbial counts in ice cream samples may have resulted from inadequate processing, such as initial improper cooling of the hot ice cream mix, which may lead to multiplication of microorganisms present in ice cream immediately after pasteurization (Ojokoh, 2006). It is also indicated that high microbial count occurrence in virtually sterile mix may occur when cooled slowly at a temperature conducive to spore germination (Beck, 1973).

The presence of coli form organisms is taken as an indication that other pathogenic organisms may also present in the sample (Trabulsi *et al.*, 2002). During the present study all the samples showed presence of coli form bacteria. The maximum coli form count was 400 cfu/gm in the road vender's ice cream sample and minimum count was 9 cfu/gm in the branded samples. Coliforms being non-spore formers should be susceptible to pasteurization. Their post pasteurization presence in ice creams

indicates faulty heat process during preparation. Also, the other reasons for contamination may either come from water, lack of personal hygiene of the ice cream manufacturer, utensils used for ice cream. It was observed that coli form bacteria were present in all samples. Similar, findings were also reported by Anuranjini *et al.*, (2008) also reported the incidence of high coli form count in ice creams marketed in Mangalore town.

Further, the isolation and confirmation of *E.coli* was done by IMVIC test. It was observed that about 40 % samples showed presence of *E. coli* with maximum *E. coli* count (4 cfu/ gm) in road vender ice cream sample. A study conducted by Ahmed and Shakoori (2002) reported 640-683 *E. coli* colonies per 100 ml of drinking water. Such water can be the major source of contamination when used for preparation of ice creams. Once the ice cream become contaminated, freezing temperature later could not make the product safer (Jay, 1996).

About 40 % ice cream samples showed presence of *Staphylococcus* species most of them were purchased from road vendors in the city. The maximum occurrence of these organisms was in road vendors ice cream samples i.e. 7 cfu/gm. It is assumed that the possible sources of this organism in ice cream hands, skin and clothing of handlers where it is commonly found; (Hobbs and Golbert,1982). There are other sources like coughing, talking and sneezing which produce droplets. These droplets could settle on ice cream during transportation, storage and retailing (Ojokoh, 2006).

Moreover, *Salmonella* species (1–8 cfu/g) and *Shigella* species (1–5 cfu/g) were also isolated from some ice cream samples. It was observed that about 40% samples

showed presence of *Salmonella* species while 53% samples showed presence of *Shigella* species. *Salmonella* is still the most important agent causing acute food borne diseases (Tood, 1997). Consumption of ice cream contaminated with enteropathogenic bacteria such as *Salmonella* has been the cause of several disease outbreaks (Hennessy *et al.*, 1996).

Contaminated ice creams could be responsible for food poisoning in masses. Therefore, the presence of possible pathogenic organisms in the analyzed ice

cream samples should be viewed with concern by the consumers. Not only bacteria but some viruses and fungal species are also responsible for spreading diseases. It should also be noted that some species of *Aspergillus* are known to produce powerful mycotoxins which are harmful to man, thus their occurrence in ice cream is undesirable. It is needed to continuously monitor the food products. Sanitary education through training and workshops to producers, distributors and retailers during processing and sale of the product can be the possible remedy to avoid such problems.

**Table.1** Collection of different categories of ice creams from Kolhapur city

S. No.	Road vendor ice-creams (X) (n= 6)	Self made ice creams from parlors (Y) (n= 5)	Branded ice creams (Z) (n= 4)
1	(X1)	(Y1)	(Z1)
2	(X2)	(Y2)	(Z2)
3	(X3)	(Y3)	(Z3)
4	(X4)	(Y4)	(Z4)
5	(X5)	( Y5)	----
6	(X6)	----	---
<b>Total samples =15</b>			

**Table.2** Media used for isolation of microorganisms

S. No.	Parameters	Media used
1.	Total Plate Count	Nutrient agar
2.	Coliform Group	Mac Conkeys broth
3.	<i>Salmonella</i> species	Bismuth Sulphite agar
4.	<i>Staphylococcus aureus</i>	Mannitol salt agar
5.	<i>Shigella</i> species.	Deoxycholate citrate agar
6.	<i>E. coli</i>	EMB agar

**Table.3** Types of microorganisms and their percentage (%) occurrence in ice cream samples

S. No.	Types of microorganisms	Percentage (%)
1.	Coliform Count	100
2.	<i>Staphylococcal</i> species (cfu/g)	40
3.	<i>Salmonella</i> species (cfu/g)	33
4.	<i>E. coli</i> (cfu/g)	40
5.	<i>Shigella</i> Species (cfu/g)	53

**Table.4** Bacteriological quality of ice creams marketed in Kolhapur City, Maharashtra, India

S. No.	Type of ice cream	TVC (cfu/g)	Coliforms Count (Per 100 ml )	<i>Staphylococcal</i> species (cfu/g)	<i>Salmonella</i> species (cfu/g)	<i>E. coli</i> (cfu/g)	<i>Shigella</i> species (cfu/g)
1.	Road vendor ice-creams (X1)	$8.0 \times 10^7$	160	4	8	2	--
2.	Road vendor ice-creams (X2)	$7.1 \times 10^7$	61	--	3	4	2
3.	Road vendor ice-creams (X3)	$4.8 \times 10^7$	24	5	--	3	4
4.	Road vendor ice-creams (X4)	$6.5 \times 10^7$	180	7	--	--	2
5.	Road vendor ice-creams (X5)	$5.8 \times 10^7$	350	--	---	4	5
6.	Road vendor ice-creams (X6)	$4.3 \times 10^7$	400	3	7	3	1
7.	Self made ice creams (Y1)	$2 \times 10^5$	24	--	5	--	--
8.	Self made ice creams (Y2)	$7 \times 10^5$	10	--	--	--	--
9.	Self made ice creams (Y3)	$3 \times 10^5$	12	--	--	--	4
10.	Self made ice creams (Y4)	$2 \times 10^5$	17	---	--	--	2
11.	Self made ice creams (Y5)	$3.5 \times 10^5$	9	4	--	--	--
12.	Branded ice creams (Z1)	$1.2 \times 10^3$	10	--	--	--	--
13.	Branded ice creams (Z2)	$4.4 \times 10^3$	12	--	--	2	--
14.	Branded ice creams (Z3)	$7.0 \times 10^3$	6	3	--	--	--
15.	Branded ice creams (Z4)	$2.8 \times 10^3$	5	--	1	--	1

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