

ICE-CREAM & FROZEN DESSERTS



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Module 11. Legal standards, microbial aspects of ice cream and safety aspects

Lesson 28

MICRO ENVIRONMENT IN ICE CREAM,MICROBIOLOGICAL QUALITY OF INGREDIENTS

28.1 Introduction

Micro environment refers to the immediate conditions that surround the ice cream. Micro environment may include the temperature, storage container, packaging material that surrounds the ice cream etc... During storage the temperature should be maintained at around -20°C without any major fluctuations. If there is variation in the temperature with time it may lead to quality deterioration in the ice cream and microbial spoilage. The surface of the container in which the ice cream is stored also plays a major role in the quality. The contact of ice cream with the container serves as a medium of heat transfer to maintain the storage temperature. High heat conducting, odourless, non-corrosive stainless steel material may be used to contain the ice cream to maintain the ice cream in a fixed frozen temperature. If packed in packaging materials prior to storage, they should not impart any colour, odour etc. There should not be any air pockets in the ice cream storage, as they serve as the sources of spoilage during storage.

The potential enteropathogens encountered in ice cream are mainly originating from either the gradients or as environmental contaminants. Amongst the ingredients,raw milk and cream are the likely source of *Campylobacter jejuni*, *Salmonella dublin*, *E. coli*, *Listeria monocytogenes* and *Yersinia enterocolitica*. Sweeteners, especially systems have been known to contribute *E. coli* and salmonella.The pathogenes of importance from egg and eggs products are Proteus, Salmonella, Enterococcus spp. Similarly, Colouring material can also be a source of *E. coli* and Salmonella from the environmental sources the major pathogens of importance are *Listeria monocytogenes*, *Yersinia enterocolitica* and Salmonella spp. They may be found more in wet than in dry areas of dairy plants.

28.2 Microbiological Quality of Ingredients

The ultimate quality of the finished ice cream depends not only on the numbers but also the types of bacteria present in the mix ingredients. In considering the mix ingredients we should, therefore, discuss not only numbers but also types of organisms, as far as possible.

The various mix ingredients that may act as the source microorganisms to the ice cream fall under the following heads.

- Dairy products
- Gelatin
- Sugar
- Flavouring materials
- Colouring materials
- Eggs
- Air

28.2.1 Raw Milk

The dairy products that enter the mix vary widely in their bacterial counts. Some of the dairy products such as liquid milk, cream and skim milk concentrate should have been subjected to adequate heat treatment, cooling and storage. The original raw milk may have a count of less than 10,000 per ml. if produced under sanitary conditions and properly cooled, or it may have a count as high as 5×10^6 to 1×10^8 cfu/ml. if carelessly produced and improperly cooled.

The numbers and types of micro-organisms in milk immediately after productions directly reflect microbial contamination during production, collection and handling. A use full indicator for monitoring the sanitary conditions present during the production, collection, and handling raw milk is the 'total' bacterial count or standard plate count (SPC). SPC values for raw milk can range from < 1000 cfu/ml, where contamination during productions is minimal, to $> 1 \times 10^{6.5}$ cfu/ml for milk intended for heat treatment before consumption. cfu/ml. High initial SPC values (eg. $> 100,000$ cfu/ml) are evidence of serious deficiencies in production hygiene, where as SPC values of $< 20,000$ cfu/ml reflects good sanitary practices. In many countries, a standard for grade A raw milk is an SPC of $< 1 \times 10^5$

Type of aerobic mesophilic microorganisms in fresh milk which form colonies on SPC agar are shown in Table 28.1.

Table 28.1 Type of aerobic mesophilic microorganisms in fresh milk

Micrococci	Streptococci	Asporogenes Gram positive Rods	Spore former Group	Gram -ve Rods groups	Miscellaneous groups
Micrococcus Staphylococcus	Enterococcus <i>Streptococcus agalactiae</i> <i>Streptococcus uberis</i>	Microbacterium Corynebacterium Arthrobacter	Bacillus	Pseudomonas Acinetobacter Flavobacterium Enterobacter Klebsiella Aerobacter Escherichia Serratia Alcaligenes	Streptomyces Yeasts Moulds

Table 28.2 Thermotrophic and psychrotrophic microorganisms in raw milk

Thermotrophic Genera ¹	Psychrotrophic Genera ²
Microbacterium	Acinetobacter-Moraxella
Micrococcus	Flavobacterium
Bacillus spores	Enterobacter
Clostridium spores	Alcaligenes, Bacillus
Alcaligenes	Arthrobacter

The most commonly occurring psychrotrophs in raw milk are the GNRs (Gram negative Rods). *Pseudomonas* spp. accounts for at least 50% of the GNRs with *Pseudomonas*

fluorescens predominating. Other species include *Pseudomonas putida*, *P. fragi*, *P. aeruginosa*, *Flavobacterium*, *Acinetobacter-Moraxella*, *Achromobacter*, *Alcaligenes*, *Chromobacterium*, *Aeromonas*, *Klebsiella*, and Coliform group comprise most of the remaining psychrotrophic GNRs. The majority of these coliforms are the *Aerobacter* spp. By using the most probable number (MPN) or membrane filter method for quantifying coliform, analyzed sample of 100ml of water may not have more than 1.1 MPN or 1 cfu on a membrane filter to be considered an acceptable potable water supply.

28.2.2 Microflora of pasteurized milk

- The microflora of pasteurized milk is primarily bacterial in nature, originate from
- Thermophilic organisms present in raw milk supply
- Raw milk contact with contaminated handling and processing equipment
- Entry after the pasteurization process.
- Typical total bacterial numbers in freshly pasteurized milk are less than 1000 cfu/ml.

28.3 Cream

In fresh cream, the predominating organisms at 50°C are *Pseudomonas*, *Alcaligenes*, *Acinetobacter*, *Aeromonas*, and *Achromobacter*, and at 30°C, are *Corynebacterium*, *Bacillus*, *Micrococcus*, *Lactobacillus* and *Staphylococcus*. EU standards (EEC, 1992) for pasteurized cream is shown in Table- 28.3.

Table 28.3 EU standards for pasteurized cream

<i>L. monocytogenes</i>	Absent in 1g
<i>Salmonella</i> spp.	Absent in 25 g

28.4 Butter

Historically, butter has not been regarded as high risk products. However, the presence of a potentially pathogenic genus given an indication of a post process contamination problem. EU

regulations require *L.monocytogenes* to be absent in 1g butter, salmonella spp. to be absent in 25 g and coliform in butter made from pasteurized cream to be $<10^5$. Butter and anhydrous milk fat (butter oil) are products made under careful control from cream that has been heat treated at a relatively high temperature. Therefore, a very high microbiological quality is to be expected, and spoilage is usually the result of chemical changes producing rancid and other off flavours. Tests for yeasts, moulds, mesophilic bacteria, coliforms and the presence of lipophilic organisms should be carried out. However, in particular the presence or absence of *Pseudomonas fragi* should be noted, as these organisms can cause unpleasant taints in butter. Butter should preferably be stored at a temperature below -20°C and as for all the ingredients, careful stock control should be ensured.

Standards for maintaining the quality of the ingredient:

In India, the Bureau of Indian standards (BIS) has prescribed a maximum limits for total count of 2,50,000/ g and coliform count of 10/g. Also the ice cream should be phosphatase negative. However the BIS standards are not mandatory. In UK, a modified methylene blue test has been valuable in helping to raise the hygienic quality of ice cream to high level. The International Commission on Microbiological Specifications for Foods (ICMSF) suggested the limits for ice cream as show in Table28.4.

Table 28.4 ICMSF standards for plain ice cream

Microbiological test	Acceptable (Max. per g)	Defective (\geq per g)
Standard plate count	10^4	2.5×10^5
Coliform	10	10^3
<i>Staphylococcus aureus</i>	10	10^2
Salmonella spp	Nil	Nil

Table 28.5 Suggested microbiological tests for raw materials

Raw material	Microbiological tests
Milk	SPC, coliform count
Milk powder	SPC, spore count
Butter	SPC, yeast and mould, coliforms, lipolytic count
Cream	SPC, coliform count
Sugar	SPC, yeast & mould , coliform
Confectionery item	SPC, coliform, yeast & mould, staphylococci

28. Processing Standards

Table 28.6 Minimum heat treatment for pasteurization of ice cream mix

Method	Temperature	Time
LTLT	69°C (155 °F)	30 min
HTST	80 °C (175°F)	25s
	83 °C (180 °F)	15s

28.6 Concentrated Milks

Skim milk powder may, on occasion, contain numbers of *Bacillus cereus*. In addition *Listeria monocytogenes* may survive the typical spray drying process and thus dried milk may serve as a source of *Listeria*.

The American Dry Milk Institute has classified skim milk powder intended for human consumption into two grades:-

- Extra grade – The bacterial count must be less than 30,000 cfu/ml when 10g of powder is suspended in 100ml of sterile water.

- Standard grade – The bacterial count must be less than 100,000 cfu/ml of the above said suspension.

28.7 Sugars

The number of organisms contributed to the ice cream mix by the sugar is usually insignificant. However it was found to be necessary to heat the sugar solution separately in the form of a solution to 112.7° to 115.5°C, in order to meet the rigid standards which classify ice cream with a count of less than 10,000/g as good and with a count of less than 50,000/g as fair. Granulated sugar, as well as other dry sugars such as dextrose, should be almost sterile, and the only organisms that may normally be present are small numbers of yeasts. Sugar syrups, sucrose, corn syrups, or mixtures of these, or lactose and whey syrups, again may contain some yeasts. It is suggested that tests for yeasts should be made on bulk deliveries of sugar and sugar syrups.

Typical manufacturer's maximal standards for microorganisms in syrups are: SPC, 100 cfu/g; yeasts, 20 cfu/g; moulds, 20 cfu/g *Escherichia coli* absent in 30g and Salmonella absent in 100g.

28.8 Flavoring and Coloring Agents

Other food stuffs added to icecream include flavoring and coloring materials. They include fruits [canned, fresh or frozen (in concentrated sugar syrup)], nuts, chocolate, broken biscuit, colors and flavors. Most of these should be of a satisfactory microbiological standard, particularly canned fruits, but fresh and frozen fruits may contain yeasts; nuts may be infected with moulds (with the risk of aflatoxin); and desiccated coconut may be a hazard because it can be contaminated by Salmonella and should be heat – treated. The examination of these materials should include a visual inspection and the enumeration of mesophilic bacteria, coliform, yeasts and moulds.

Colors may be infected by careless handling and this must be avoided by maintaining good management control. Flavors are normally added to the mix after it has been heat treated, and so they must also be handled with great care to avoid contamination.

Flavouring ingredients, mainly vanilla extract, is mostly an insignificant source of bacteria as the concentration of alcohol in the extract effectively prevents any growth. Fresh strawberries have been reported to be a source of *E. coli*.

28.9 Air

Air that is incorporated into the ice cream may be a source of contamination. Therefore, it is of crucial importance that the air be filtered so as to ensure that no contamination can be attributed due to the introduction of air.

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