

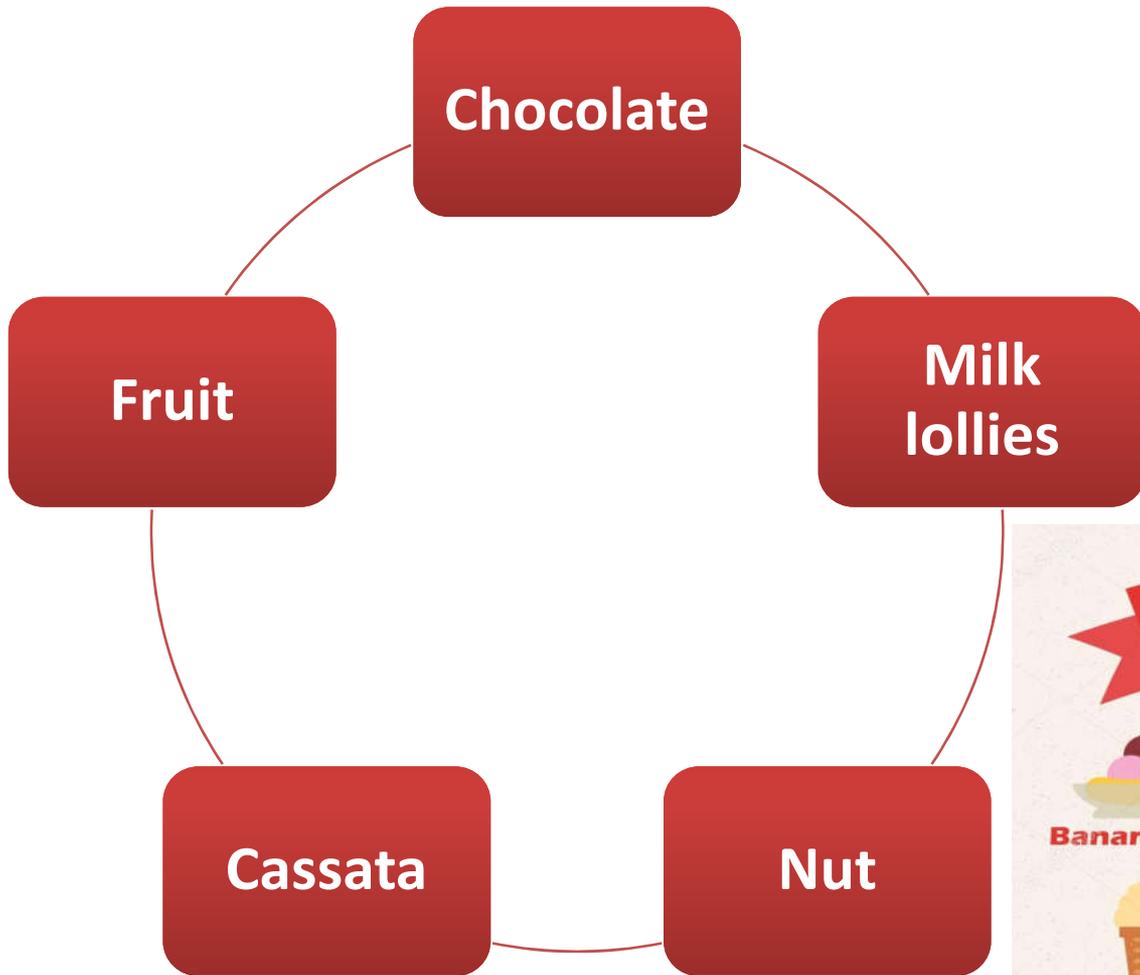


Microbiology of Ice-cream and Frozen Desserts

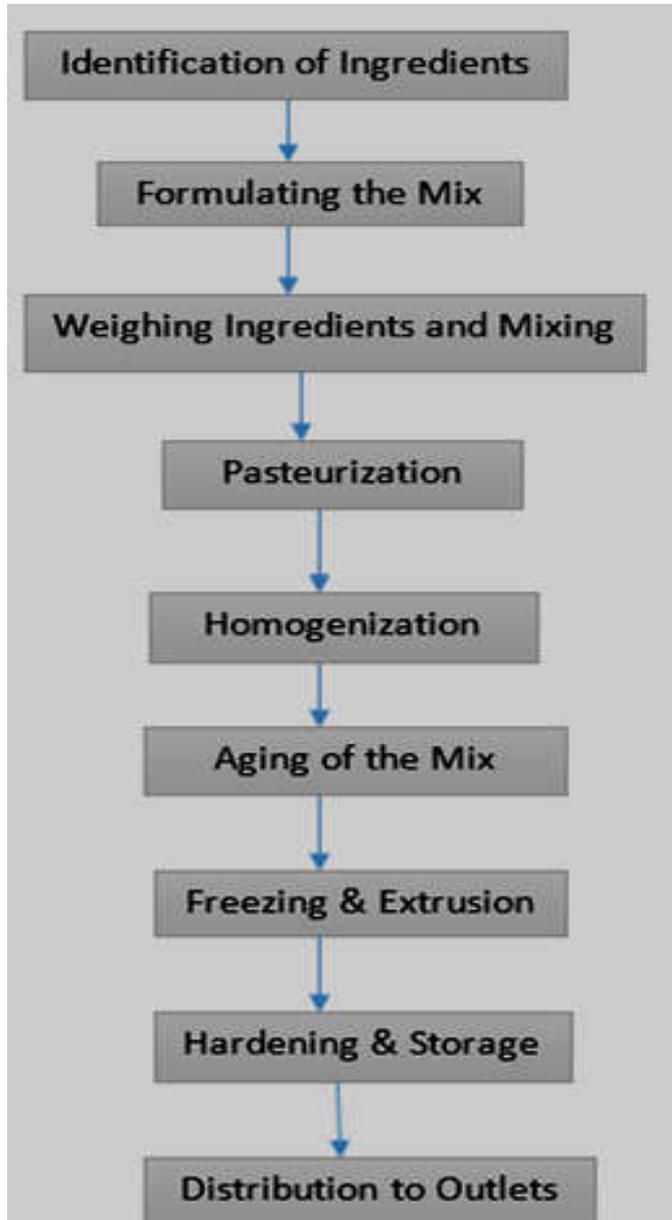
About Ice-cream.....

- 1. Highly delicious and nutritionally rich frozen milk product occupying an important position amongst the dairy products.**
- 2. Obtained from cow or buffalo milk or a combination or from cream, with or without addition of cane sugar, eggs, fruits, nuts, fruit juices, chocolates, edible flavours and emulsifiers not exceeding 0.5% wt. The mixture must be suitably heated before freezing.**
- 3. The product should contain not less than 10% milk fat, 3.5% protein and 36% total solids.**

Types of Ice-cream.....



Processing Scheme of Ice-cream.....



Skim milk preheated to 50 C followed by mixing with skim milk powder, sugar, glycerol monostearate and sodium alginate with cream or butter.

79.4 C for 25 sec

First stage-3500/2500 psi
Second stage-500/1000 psi

0-4 C

-6.1 to -3.8 C

-17.8 to -28.9 C

Microbiological Quality of Ice-cream.....

Ice-cream is a rich source of nutrients which is subjected to microbial contamination at various stages of manufacture and during addition of ingredients. Handlers may contaminate the product with potential pathogenic microorganisms. Microflora of ice-cream include both pathogenic and non-pathogenic microorganisms. Higher pasteurizing temperatures are required for ice-cream mix as compared to milk because of the protective action of sugar and increased milk solids on bacteria.

Types of Microflora Depends on Factors:

- ❖ Initial flora of ingredients
- ❖ Type of processing treatments
- ❖ Storage conditions of ice-cream mix
- ❖ Post processing contamination
- ❖ Hygienic conditions of handlers

Yeasts	Pathogenic bacteria	Spoilage bacteria
<i>Candida sake</i>	<i>S. aureus</i>	<i>E. coli</i>
<i>Candida curvata</i>	<i>Salmonella</i>	<i>S. faecalis</i>
<i>Saccharomyces</i>	<i>Brucella sp.</i>	<i>Pseudomonas aeruginosa</i>

Factors Affecting Microbiological Quality of Ice-cream.....

- ❖ **Ingredients: Milk based and Non-milk based**
- ❖ **Milk based:**
- ❖ **Milk and cream: Milk and cream should be free from coliforms. Coliforms if carried over to ice-cream do not die and conditions favour their growth. Cream having off-flavours of non-microbial origin (feed, weed) may affect the quality of product. Cream should not have total count exceeding 2,00,000/g (raw) and 60,000/g (pasteurized).**

❖ Concentrated and dried milks: Thermotolerant and thermophilic bacteria can pose problem. Since skim milk powder sometimes contain *B. cereus*, it can cause spoilage to ice-cream mix through causing proteolysis and coagulation in milk. Skim milk powder may also contain heat stable enterotoxin of *S. aureus*, thereby causing food poisoning. Condensed milk should not have more than 500 org/g and dried milk 50,000 org/g. Coliforms in dried milk should not exceed 90/g.

❖ Butter and butter oil: Butter and butter oil are made from highly heat treated cream. Butter should be regularly checked for total count, coliforms, yeasts and molds, mesophilic and lipolytic bacteria. *P. fragi* causing unpleasant taints in butter should be absent.

❖ **Non-milk based Ingredients:**

❖ Vegetable oil: Vegetable oil used in non-dairy ice-cream is delivered in a form free from contaminating organisms. Sometimes traces of moisture found can support growth of microbial flora.

❖ **Sugar and sweetening agent:** Sugar and sweetening agents (sucrose, invert syrup, cane sugar and honey) are used in granulated or in liquid form. Sugar can sometimes be contaminated with aerobic mesophilic, thermophilic, non-acid producers, coliforms and yeasts and molds. The total bacterial count should not be more than 200/g.

❖ **Stabilizers (carrageen, guar gum, gelatin):** These are added to maintain smooth body and texture of the product by preventing appearance of ice-crystals. Gelatin being an animal product may be a possible source of spoilage and disease-causing organism.

❖ **Fresh fruits:** Fresh fruits (dominated by yeasts) likely increase the microbial load in the product and the extent of contamination depends upon the nature of fruit and conditions of handling.

❖ **Dried fruits:** These do not pose any serious microbiological problem except as a source of surface yeasts and molds. Sometimes fruits are treated with sulphur dioxide and methyl bromide to kill microbes.

❖ **Nuts (coconut and walnut):** Coconuts have been occasionally implicated in salmonellae infection in humans whereas walnuts associated with mold and parasitic infections. Coconuts must be heat treated when desiccated to avoid contamination by salmonellae. Canned/fresh nuts can be sterilized by mixture of ethylene oxide and carbon dioxide (1:9).

❖ **Colors:** Aqueous solution of colors may contain large number of organisms. Since it is added after pasteurization of mix, it may increase the contamination level in the product.

❖ **Emulsifying agents (egg yolk, glycerol monostearate, tweens):** Added to maintain fat globules as individual separate units. Egg yolk can be source of contamination in ice-cream.

❖ **Flavors:** Flavor preparation have alcohol and thus have very few bacteria. It must be handled with care and stored in cool, dry conditions to avoid contamination.

❖ **Processing:** Although ice-cream is a heat treated product, it is an excellent vehicle for the transmission of enteric infections of human and bovine origin. Thus, quality will depend on the manner in which the processing equipment is operated and maintained.

❖ **Preparation of mix:** Mixing of various ingredients like milk, sugar, stabilizer, butter and flavors at 60 C and ensuring ingredients are completely dissolved. As pasteurization cannot destroy all the bacteria present, a grossly contaminated raw mix could result in an inferior product. Microbiological quality of raw ingredients should be high and plant contamination should be minimized.

❖ **Homogenization:** The mix is homogenized through a two-stage homogenizer at a temperature of 60-65 C and 2000 psi pressure. This operation tends to split clumps of bacteria. Homogenizer should be thoroughly cleaned and sanitized.

❖ **Pasteurization:** The process kills almost all pathogenic and non-pathogenic bacteria. Time-temperature combination is 68.3 C for 30 min (Batch method) or 79.4 C for 25 sec (HTST). Pasteurization temperature is high in comparison to milk because ingredients and air exert protective effect on microorganisms. There should be maintenance of pasteurizing plant as ice-cream has more solids and there may be heavy deposits on the pasteurizer plates. Cooling of mix after pasteurization should be done at -1.1 C to 4.4 C and cooler should be kept sterilized to prevent contamination of pasteurized mix.

❖ **Ageing:** After cooling, the mix is kept for ageing for 1-3 days at 4.4 C. Ageing facilitates adsorption of proteins on fat globules thus, improving the body and texture of ice-cream. Proper temperature should be maintained.

- ❖ **Freezing:** Freezing of the mix done at -6.1 to -3.8 C causes reduction in total number of bacteria in the product due to physical destruction of cells by agitation in the presence of ice-crystals. Gram-negative rods and the vegetative cells of yeasts and molds are easily killed than Gram-positive bacteria, and bacterial and fungal spores are largely unaffected by subzero temperatures. However, freezing may increase in bacterial count because of the whipping step which breaks bacterial clumps.
- ❖ **Packaging:** Packaging materials sometimes can contribute to the bacterial load of ice-cream but storage temperature will not allow their multiplication.
- ❖ **Hardening and storage:** Hardening of ice-cream after it comes from freezer results in decrease of temperature (-17.8 to -28.9 C) and causes a destructive effect on organisms. Longer period of storage does not reduce the number of bacteria to any great extent.

❖ **Hygiene: Hygiene plays an important role in influencing microbiological quality of ice-cream.**

❖ **Personnel hygiene: Handlers are important sources as at final stages of packaging and marketing , it is likely to be contaminated by human carriers. Prohibition of smoking, hand and clothing cleanliness, routine medical inspection of workers should be carried out.**

❖ **Plant hygiene: The presence of coliforms in ice-cream is due to contamination from unhygienic equipments. Storage tanks, pasteurizers and pipelines (CIP), freezers (batch and continuous), packing machinery should be regularly cleaned. Inspection of the plant should be made regularly and bacteriological tests (Swab and Rinse test) should be periodically carried out.**



Frozen Desserts.....

Frozen Yoghurt

- Contains less lactose than ice cream containing a similar amount of fat. The unique characteristic of frozen yoghurt is that it contains cultures of *S. thermophilus* and *L. bulgaricus*.

Sherbet, Sorbet and Water Ices

- Sherbets contain 2–5% total milk solids, neither sorbets nor ices contain milk solids. All three product groups are high in sweetener; fruits, fruit juices, or fruit flavoring; and are generally acidic. Because sherbet contains milk solids, it must be pasteurized. Water ices and sorbets may not be required to be pasteurized. Their low pH restricts growth of microbes. Furthermore, mixes remain susceptible to contamination from ingredients, equipment, personnel, and the environment.

Frozen Novelties

- With novelty items the main microbiological considerations relate to cleanliness of equipment with which the novelties are formed or packaged. The typical plant runs continuously for many hours, and molds of the forming equipment are subjected to alternate cold and warm temp. There is little opportunity for microbial growth, contaminants from the environment are not likely to be killed during operation. High degree of sanitation within the area of freezing, forming, and packaging of novelties is to be maintained.

THE DIFFERENCE BETWEEN ICE CREAM AND OTHER FROZEN DESSERTS

Ice cream

A frozen treat has to have **at least 10% milkfat** to be labeled ice cream, according to the Food and Drug Administration. Ice cream is also churned as it's frozen to give it a lighter texture.

Gelato

Thanks to using **less cream and more milk**, gelato has a lower fat content than ice cream. It's churned slower to give it a dense and creamy texture.

Soft serve

Soft serve typically has **less milkfat than ice cream** and more air incorporated into it to achieve its fluffy texture.



Frozen custard

Frozen custard contains **at least 1.4% egg yolk solids** and at least 10% milkfat, helping to give it a thicker consistency.

Sherbet

Typically flavored with fruit, sherbet contains a lower milkfat content — **between 1 and 2%**. It also tends to be slightly sweeter than ice cream.

Sorbet

This **nondairy dessert** is typically made using frozen juices, purees, and other flavorings like wine.

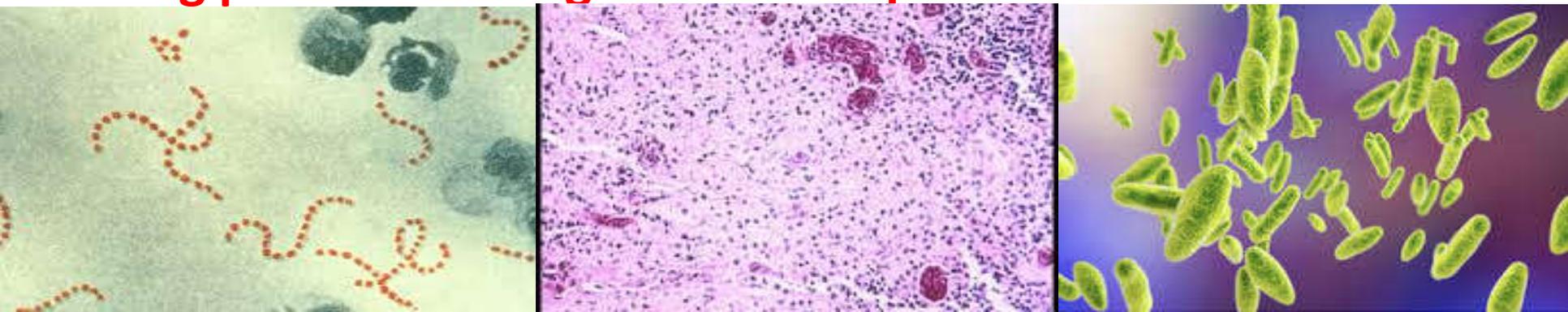
Frozen yogurt

The process of making frozen yogurt is quite similar to ice cream, except ingredients **include yogurt cultures**.

Public Health Significance and Survival of Pathogens in Ice cream.....

Streptococcus pyogenes, *Salmonella typhosa*, *Salmonella paratyphi* and *Brucella abortus* as well as toxins of some organisms are of great public health significance in ice-cream as they cause septic sore throat, typhoid, paratyphoid and undulant fever respectively. Acute gastroenteritis with sudden onset of vomiting or diarrhoea or both with abdominal cramping pain are the typical food poisoning symptoms. The pathogens might come through contamination at various stages during the manufacturing process. The various possible sources are:

- a. Unhygienic handling
- b. Long period of storage at low temperature



Regulatory Microbiological Standards.....

Products	SPC	Coliforms	<i>S. aureus</i>
Ice-cream and frozen desserts	1x10⁵/g	10/g	10/g

Products	<i>E. coli</i>	<i>Salmonella/ Shigella</i>	<i>L. monocytogenes</i>
Ice-cream and frozen desserts	Absent/ g	Absent/ 25 g	Absent/ g