

Difficulties & Solutions in Making Healthier Ice Creams



What is Ice Cream

Ice cream is a frozen dairy product made by freezing a pasteurised mix under agitation to incorporate air and to ensure uniformity and consistency.

The ice cream mix is composed of water, milk fat, milk solids-not-fat (MSNF), sweeteners, stabilizers, emulsifiers, and flavourings.

Ice cream is a dispersion of air bubbles, ice crystals and fat in a freeze-concentrated solution of sugars, proteins and minerals.



Ice cream (Indian Standards)

ICE CREAM: Product made with Milk fat and Milk Protein

Requirement	Ice Cream	Medium Fat Ice Cream	Low Fat Ice Cream
Total solids	Not less than 36%	Not less than 30%	Not less than 26%
Weight/ volume (g/L)	Not less than 525	Not less than 475	Not less than 475
Milk fat	Not less than 10%	More than 2.5% but less than 10%	Not more than 2.5%
Milk protein (Amount of nitrogen* 6.38)	Not less than 3.5%	Not less than 3.5%	Not less than 3.0%



Mega-drivers for Ice cream





Ice-Cream business and Market in India

- Ice cream noticeably being a seasonal product:
 - Peak demand - April to June (summers)
 - Leaning demand - November to January (winters)
- An increased trend in consumption of ice creams in winter:
 - Changing consumer perception,
 - Regional variations,
 - Diverse consumer acceptations,
 - Favourable retail locations,
 - Wide product range and innovation,
 - Festivities and sale,
 - Marketing promotions.



Ice-Cream business and Market in India



- Factors boosting ice cream business in India:
 - Rapid growth and urbanization
 - Increase in purchasing capacity
 - Increased awareness of the consumers
 - Modernized cold supply chain and storage facility
 - Evolution of retail outlet facilities

INDIA ICE CREAM MARKET

The market is projected to witness strong growth during next **five years**

■ *Dominance in the market*



BY DISTRIBUTION CHANNEL

- Supermarkets/Hypermarkets
- Convenience Stores
- **General Trade**
- Ice Cream Parlors
- Online Stores
- Others

BY FLAVOR

- Vanilla
- **Chocolate**
- Fruit
- Others

BY END USER

- Institutional
- **Retail**

BY CATEGORY

- **Impulse**
- Take-Home
- Artisanal

BY PRODUCT

- Cup
- Stick
- Cone
- Brick
- Others



Source: IMARC / Internet

Icecream is Healthy!!!??

- **Basic ice cream composition**

- Milk Fat
- Milk solids-not-fat
- Sugar
- Stabilizers
- Emulsifier
- Flavouring
- Colouring



Composition (%)							
Milk fat	10.0	11.0	12.0	13.0	14.0	15.0	16.0
Milk solids-not-fat	11.0	11.0	10.5	10.5	10.0	10.0	9.5
Sucrose	10.0	10.0	12.0	14.0	14.0	15.0	16.0
Corn syrup solids	5.0	5.0	4.0	3.0	2.0	–	–
Stabilizer ^a	0.35	0.35	0.30	0.30	0.25	0.20	0.15
Emulsifier ^a	0.15	0.15	0.15	0.12	0.10	0.10	–
Total solids	36.5	37.5	38.95	40.92	40.35	40.3	41.65

NOTE: There is high variability in composition depending on type of ice cream.

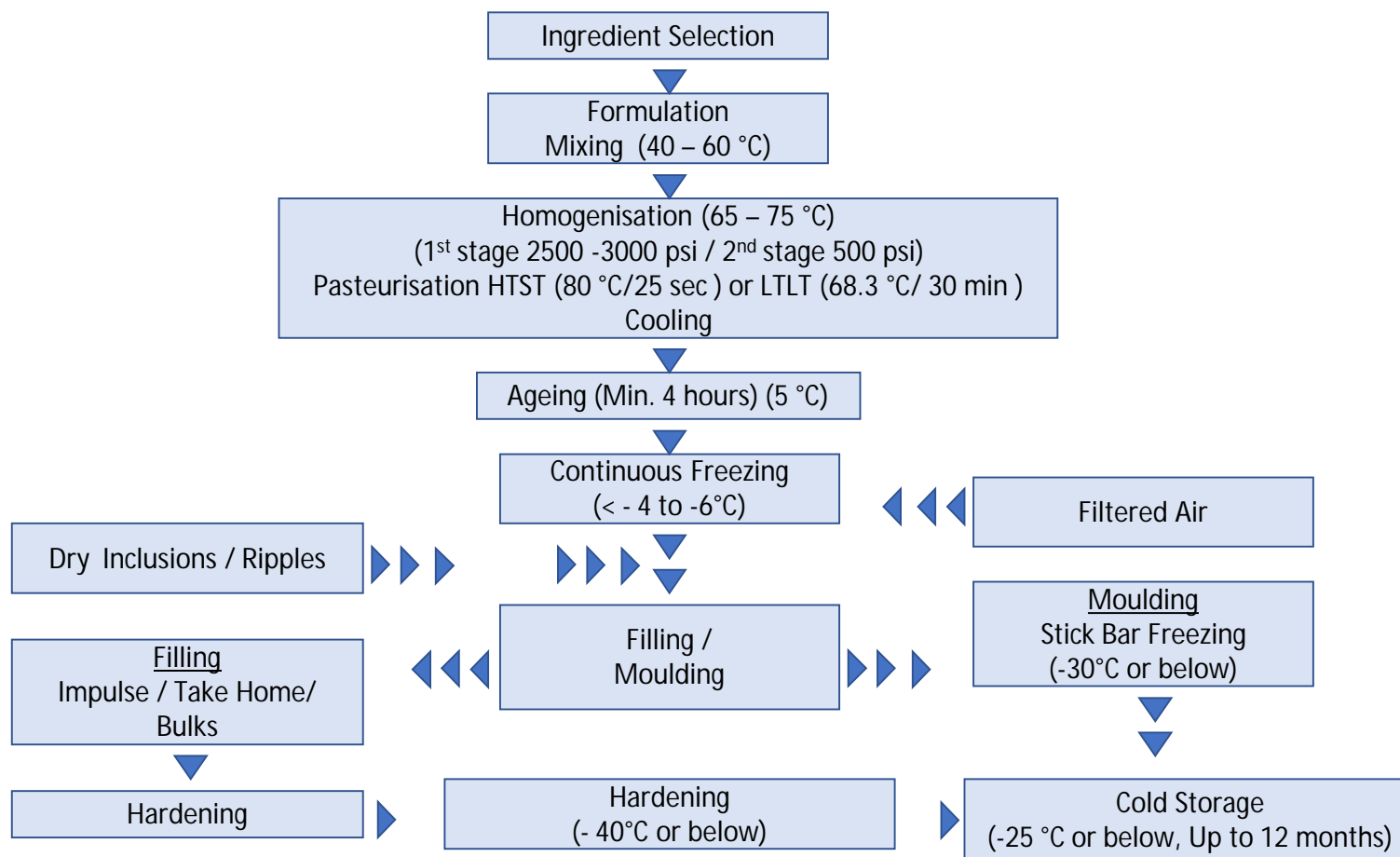
How to make Ice cream??

- Selection of Ingredients
- Formulation
- Mixing
- Homogenisation
- Pasteurisation
- Ageing
- Freezing
- Filling/packing
- Hardening
- Storage and distribution





Ice cream Process Flow





Selection of Ingredients

Milk Fat

Sources:

- Milk fat is used in the form of whole milk, cream, butter or anhydrous milk fat (AMF).

Functions:

- Imparts Characteristics richness and mellow the ice cream flavour
- Retard the rate of whipping
- Contributes to smoothness of texture
- Contributes to body & melting resistance

Nutritional Importance:

- Milk Fat contains some important nutrients like fat soluble Vitamins A & D.
- Milk Fat is known to provide good body composition, smooth working joints and good skin.
- Each gram of fat yields 9 calories.



Selection of Ingredients

Milk solids-non-fat (MSNF)

Milk Solids Not Fat (MSNF) comprise of Lactose, **Milk Protein** and Minerals like **Calcium**.

Sources:

- Milk solids-not-fat derived from whole milk, skim milk, condensed milk, milk powders, whey powder, whey protein concentrates, whey protein isolates, milk protein concentrates etc

Functions:

- Proteins present in MSNF helps to make ice cream more compact and smoother.
- It improves mix viscosity, air incorporation, texture and melting qualities
- Lactose adds slightly to sweet taste and minerals tends to slightly salty taste.

Nutritional Importance:

- 100g of Icecream contains Minimum 3.5 g Milk Protein
- Calcium helps us to build strong bones and teeth.
- Both Lactose and Protein yield 4 kcal/g.



Selection of Ingredients

Sugars

Sources:

- Many different types of sugar can be used, such as cane and beet sugar, glucose, dextrose and invert sugar (a mixture of glucose and fructose).

Functions:

- Provides sweetness and improve texture
- Contribute to Total solids, provides bulk & body
- Enhance flavour
- Influence freezing point- control amount of frozen water in ice cream- softens final product.

Nutritional Importance:

- Contribute to nutritive value
- Sugar is an instant source of energy as this contains glucose
- It yield 4 kcal /g.

Selection of Ingredients

Emulsifiers and stabilisers

- Emulsifiers and stabilisers are typically used as combined products at dosages of 0.5 % in the ice cream mix.
- Emulsifiers are mainly non-ionic derivatives of natural fats, which have been esterified so they attract water molecules at one end and fat molecules at the other. The main components of the emulsifiers used in ice cream production are mono and diglycerides of fatty acids.
- In general, there are two types of Stabilisers / hydrocolloids: protein in the form of gelatine, and carbohydrates, including seaweed colloids, hemi-cellulose and modified cellulose compounds etc.

Functions of Stabilizers / Hydrocolloids:

- Improves mix viscosity, air incorporation, texture and melting qualities
- Water binding / immobilizing effect – smooth body & texture, improves storage stability.
- Limit ice crystal growth during heat shock
- Contributes for melting resistance

Functions of Emulsifiers:

- Improves whipping quality and texture
- Dryness of ice cream on extrusion from freezer
- Richer mouth feel and creamy sensation
- Improved air cell distribution
- Improved heat shock resistance



Selection of Ingredients

Flavours

- Flavours are a very important factor in the customer's choice of ice cream and can be added at the mixing stage or after pasteurisation. The most popular flavours are vanilla, chocolate and strawberry.
- Flavours are classified in three groups:
 - Natural,
 - Nature-identical
 - Artificial.

Functions:

- Improves palatability of product by aroma
- Impart Freshness & resemblance



Selection of Ingredients

Colours

- Natural or Synthetic Food colours are added to the mix to give the ice cream an attractive appearance. Limits for addition of colours are defined as per local legislation e.g. for India Food Safety and Standards Regulation.

Functions:

- Improves appearance and reinforce flavour

Other ingredients

- Many moulded and extruded ice cream products are coated with chocolate.
- Ripples (sauces) are incorporated in ice cream for taste and appearance, e.g. as pencil filling and top decoration.
- Dry ingredients are added through an ingredient feeder. A great variety of products are used: chocolate, nuts, dried fruit pieces, crackles, cookies, caramel pieces, etc.

Need for healthier ice creams..

- The global rise in prevalence of Type II diabetes
- People are becoming health conscious
- We are living sedentary lifestyle
- Cautious consumerism is on rise
- Food items with incorporation of healthy and natural ingredients are trending

Consumer Perception which make them feel ill:

- Too high in calories, sugar or fat
- Contains too many artificial ingredients
- Consumer reads the ingredient labels before eating



How Nutritional Values of Ice cream Can further be Enhanced...

Healthy & Natural Ingredient Based:

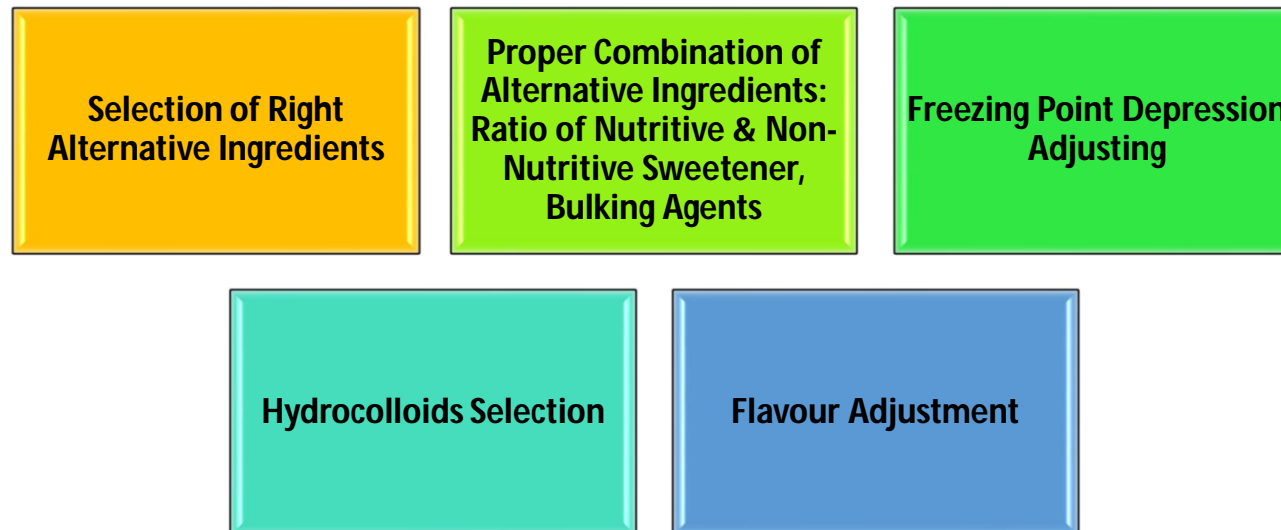
- Topped with Dry Fruits & Nuts
- Natural ingredients: Fruits, No additives, No added Colour / No added Flavours
- Higher Protein & Dietary Fibres

Specific Need Based :

- Low Fat Ice cream
- No added sugar ice cream
- Lactose Free Ice Cream
- Probiotic Ice cream



Solution to Challenges of Using Alternate Ingredients to Replace Fat/ Sugar Partly





Challenges to make Lower-fat ice creams



- Removal of Fat from ice cream formulations leads to following challenges:
 - A very hard and very cold and icy product with weak body and poor keeping quality
 - Reduction of Total Solids below regulation
- It is possible to formulate reduced-fat or “light” ice creams up to 4 % Fat with traditional ingredients like:
 - slightly enhanced levels of sugars (to maintain similar freezing curve to regular ice cream and body)
 - slightly enhanced levels of stabilizers (to enhance viscosity).
- To maintain the fatty mouthfeel for ice cream lower than 4% Fat, alternative ingredients like Fat replacer are used.



Solutions to make Lower-fat ice creams

- **Carbohydrate based Fat replacers**
 - Contribute bulk and increase viscosity and include Water-soluble carbohydrate polymers.
 - Cellulose products, Starches, Dextrins, Maltodextrins, and Polydextrose.
 - Helping to limit ice crystals growth.
- **Protein based Fat replacers**
 - **Example:** Cheese whey and egg white.
 - These proteins are processed into colloidal particles that vary in diameter from 0.1 to 3.0 mm, a size range that permits them to be sensed on the tongue as creamy.
- **Fat-based Fat mimetics**
 - Examples: Monoacylglycerols and diacylglycerols and useful in low concentrations (<1.0%).
- Fat-free formulations typically contain 12–13% milk solids-not-fat along with a combination of sugars (sucrose and corn syrup solids), either high molecular weight carbohydrates or protein-based fat replacers, and appropriate stabilizers.
- Decreasing the fat content of ice cream decreases the creamy sensation and increases the intensities of flavors of skim milk powder and of corn syrup. It is important to mask the flavour of alternative ingredients for better consumer acceptance.



Challenges to make No added Sugar ice creams



- The global rise in prevalence of Type II diabetes – People have an impaired capacity to decrease blood glucose levels after consumption of high sugar-containing products.
- Removal of Sugar from ice cream formulations leads to following challenges:
 - A very hard and very cold and icy product with weak body and poor keeping quality
 - Reduction of Total Solids below regulation
- Challenges for usage of Sugar Alternatives
 - Lack of clean taste / equivalent sweetness to sugar
 - Imbalance in freezing point depression (**freezing curve to regular ice cream**)
 - May have laxative effects (usage must be restricted in the formulations)

Solutions to make Low Calorie / No added Sugar ice creams

- In the production of no added sugar ice cream, replacement of sucrose and glucose with an acceptable sweetener / bulking agent, to lower the glycemic index.
- Sugar Alternatives / Bulking Agents:
 - The sugar alcohols e.g. Polyols (they are absorbed much more slowly than glucose).
 - Fructo-oligosaccharides (FOS): Relative Sweetness 0.3 to 0.6. Provides Desirable Well Rounded Sweetness profile. (FOS cannot be hydrolyzed by the gastrointestinal enzymes)
 - Polydextrose: *It is a multi-purpose food ingredient used to replace sugar, fat and calories and to increase fiber content of foods.*
- These alternative sweeteners allow matching of the freezing curves to conventional formulations due to their freezing point depression characteristics.
- If necessary, sweetness levels can be boosted with a nonnutritive high potency artificial or Natural sweeteners e.g. Aspartame or Sucralose or Steviol glycosides or Mogrosides.
- These high potency artificial or Natural sweeteners do not contribute to total solids or freezing point depression and have lingering taste effect.





Thank You!