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Ice Cream and Frozen Dairy Desserts: Classification and History

1.1 History of Ice Cream Making

In the 13th century, Marco Polo brought formulations of several types of ice cream from Asia to Europe. Therefore, the history of ice cream dates back much further in Asia than in other parts of the world. The art of ice cream making was introduced to Italy by Marco Polo, and from there, it spread to France, Germany, and England, eventually reaching the Americans. The first ice cream-making machine was invented by Marshall in the 19th century (Figure 1.1). In the year 1851 AD, the first ice cream factory was established in the United States by Jacob Fussell, and this marked the transition of ice cream making from an artisanal practice to an industrial one, leading to rapid growth and development. However, around the 1920s, the nutritional value of ice cream gained widespread recognition, and after World War II, the ice cream industry experienced significant expansion.

In the early 20th century, ice cream production expanded and became industrialized due to key factors such as advancements in production techniques, transportation of ice cream, and the preservation of the cold chain. The proliferation of refrigeration machines led to the replacement of salt and ice with a concentrated salt solution (which freezes easily at subzero temperatures). This solution increased the heat transfer rate between the ice cream mixture and the refrigeration unit, thereby boosting production speed. In continuous freezers, which take the form of a horizontal cylinder, the mixture was pumped in from one side and the ice cream was dispensed from the other side, resulting in a more consistent and rapid production compared to discontinuous systems. Such advancements were accompanied by the introduction of pasteurization (which mitigated hygiene concerns) and homogenization (which broke down fat into small droplets, resulting in creamier and smoother products). Eventually, the expansion of railway and

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Figure 1.1 The first ice cream-making machine was invented by Marshall in the 19th century.

automobile networks facilitated better transportation of raw materials and distribution of products over longer distances. In Iran, the first ice cream shop located next to a railway track dates back to the reign of Mozaffar al-Din Shah.

1.2 Definition of Ice Cream

Ice cream is a frozen food product made from cow's milk and can contain permissible edible ingredients such as sugar, dextrose, eggs, fruits, fruit juices, chocolate, nuts, flavorings, and food-grade colorings. Emulsifiers and stabilizers can also be used in its composition. The composition of ice cream varies from one region to another. Generally, a good ice cream contains around 12% fat, 11% nonfat milk solids, 15% sugar, 0.3% stabilizers

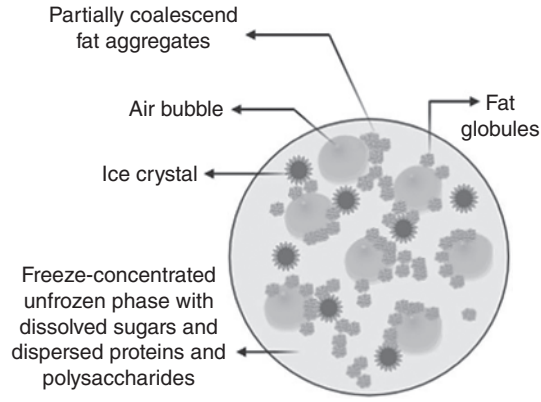


Figure 1.2 Schematic structure of ice cream; ice crystals, air bubbles, fat globules, and serum phase.

and emulsifier mixture, and a total of 38% dry matter. Ice cream is a complex composition of three phases: the gas, solid, and liquid phases. The gas phase consists of air bubbles uniformly distributed in the frozen phase. The liquid phase contains frozen fat globules, milk proteins, insoluble salts, colloidal stabilizers, sugars, and soluble salts. Thus, the final product is a three-phase system consisting of liquid, solid, and gas (Figure 1.2).

Ice cream is a highly delicious and nutritious food. Approximately, 100 grams of good-quality ice cream provides around 200 kilocalories of energy, along with 4 grams of protein, 0.13 grams of calcium, 0.105 grams of phosphorus, 0.1 gram of iron, 490 IU of vitamin A, 0.38 milligrams of thiamine, and 0.24 milligrams of riboflavin. The production and consumption levels of ice cream in some countries around the world are presented in Table 1.1.

1.3 Classification of Ice Cream

Various factors such as raw materials, consumer preferences, costs, and quality influence the formulation of different ice cream mixes. The percentage of stabilizers and emulsifiers required in different mixtures varies, and therefore the usage of these components should adhere to the manufacturer's recommendations. Ice cream can be classified based on brand name, ingredients, and flavoring agents used. Below, different types of ice cream and similar products are categorized using commercial methods. The formulation of regular ice cream is provided in Table 1.2.

Please note that the percentages provided here represent a hypothetical formulation for regular ice cream and are subject to variations based on specific recipes and manufacturing processes.

Table 1.1 Major ice cream-producing and consuming countries in the world.

Top ice cream-producing countries:		
Rank	**Production (Million hectoliters per year)**	**Country**
1	26.3	New Zealand
2	8.17	Australia
3	8.17	Canada
4	8.1	Italy
5	4.14	Sweden
6	2.14	Denmark
7	9.13	Finland
8	2.9	Switzerland
9	2.8	China
10	4.5	France
11	8.3	Germany
12	2.3	United States
Top ice cream-consuming countries:		
Rank	**Consumption (Liters per capita per year)**	**Country**
1	26.3	New Zealand
2	22.5	United States
3	17.8	Canada
4	17.6	Australia
5	14.4	Switzerland
6	14.2	Sweden
7	13.9	Finland
8	9.2	Denmark
9	8.2	Italy
10	5.4	France
11	3.8	Germany
12	1.8	China

Data represents a specific time period and may have changed since then.

Table 1.2 Formulation of regular ice creams.

Percentage of ingredients	Regular ice cream formulation (1)
Fat	18
Nonfat milk solids	7
Sugar	18
Stabilizers	0.2
Total solids	43.2

Percentage of ingredients	Regular ice cream formulation (2)
Fat	16
Nonfat milk solids	8.5
Sugar	17
Stabilizers	0.25
Total solids	41.75

Percentage of ingredients	Regular ice cream formulation (3)
Fat	14
Nonfat milk solids	10
Sugar	15
Stabilizers	0.3
Total solids	39.3

Percentage of ingredients	Regular ice cream formulation (4)
Fat	12
Nonfat milk solids	11
Sugar	15
Stabilizers	0.3
Total solids	38.3

Percentage of ingredients	Regular ice cream formulation (5)
Fat	10
Nonfat milk solids	11.5
Sugar	15
Stabilizers	0.3
Total solids	36.8

1.3.1 Regular Ice Cream Types

Regular ice cream is a type of ice cream in which the total volume of flavoring and coloring ingredients is less than 5%. Examples of this type include vanilla ice cream, coffee ice cream, caramel ice cream, and orange ice cream. The following section provides explanations of various types of regular ice cream:

Coffee Ice Cream:

To make coffee ice cream, you add 0.946 liters of coffee extract (or you can use a concentrated coffee extract obtained from 453.6 grams of ground coffee) to 37.85 liters of the regular ice cream mixture. Additionally, you can add 141.75–198.45 grams of color derived from 50% burnt sugar (caramel) to enhance the flavor.

Vanilla Ice Cream:

For producing vanilla ice cream, you include 170.1–340.2 grams of flavoring ingredients and 8 milliliters of yellow color to every 37.85 liters of the regular ice cream mixture. The actual amount of flavoring may vary based on the mixture's composition, individuals' preferences, and the desired intensity of the vanilla flavor.

Saffron Ice Cream:

To prepare saffron ice cream, you add 85.05 grams of pure saffron extract and 56.7 grams of caramel to every 37.85 liters of the regular ice cream mixture.

Caramel Ice Cream:

You add an appropriate amount of caramel to achieve the desired taste and color for caramel ice cream. Alternatively, you can use 2.838 liters of caramel syrup for every 35 liters of the regular ice cream mixture (approximately 113.4 grams of syrup per 3.785 liters of ice cream). To make caramel syrup, a mixture of 5 parts sugar and 3 parts 20% fat cream is boiled until a light coffee color is achieved.

Mint Ice Cream:

To create mint ice cream, you incorporate 113.4–226.8 grams of mint extract and add green color to achieve a light green hue to every 37.85 liters of the regular ice cream mixture. Sometimes, 1814.4–2721.6 grams of chopped green mint mixture can be added to 35/95 liters of the regular ice cream mixture.

Butterscotch Ice Cream:

In this type of ice cream, you add 3.785 liters of butterscotch syrup, which is used in the production of butterscotch pastries, to 37.85 liters of the regular ice cream mixture. Additionally, a yellow color is added along with the syrup.

Bisque Ice Cream:

For making bisque ice cream, you combine 1814.4–3628.8 grams of starch noodles, sponge cake, finger sweets, grapes, cookie dough, brownie, or similar small and finely chopped ingredients with 35.95 liters of the regular ice cream mixture. These additions are made through a noncontinuous freezer.

Creamy Sweet Ice Cream (Biscuit, Tortoni):

In this type of ice cream, you blend 0.473 liters of dark brown sugar syrup or ingredients that contribute to the flavor with 37.85 liters of high-fat (14–17% fat) ice cream mixture. The mixture can be expanded by a maximum of 50% (overrun) of its frozen volume, and after filling, crushed starch noodles are added on top.

Candy or Confection Ice Cream:

There are many types of ice creams with various names and flavors in this category. These types of ice creams contain 5–8% of different types of confections or candies. These confections and nonsoluble additives are usually added to the unfrozen ice cream using noncontinuous freezers. Additionally, it is possible to continuously add raw materials to a product that is in the process of freezing using a feeding device. The various types of these ice creams are as follows:

(A) **Butter Paste Ice Cream:** 2721.6 grams of crumbled butter bread are added to 35.95 liters of regular ice cream mixture.

(B) **Chocolate Ice Cream:** 1.892 liters of grated milk chocolate or milk chocolate syrup are added to 35.95 liters of regular ice cream mixture. The chocolate is added to the ice cream that has partially frozen in a noncontinuous freezer.

(C) **Peanut Ice Cream:** 1814.4–2721.6 grams of chopped peanut particles are added to 35.95 liters of regular ice cream mixture.

(D) **Marshmallow Ice Cream:** 1814.4–2721.6 grams of marshmallow (a sweet dough containing sugar, starch, and corn syrup) are added to 35.95 liters of regular ice cream mixture.

(E) **Chocolate Powder Ice Cream:** 1814.4–2721.6 grams of milk chocolate powder are added to 35.95 liters of regular ice cream mixture.

(F) **Licorice Ice Cream:** 113.4 grams of licorice paste and 36.85 grams of fennel oil are added to 35.95 liters of regular ice cream mixture until a dark color is achieved.

(G) **Molasses Ice Cream:** 1814.4–2721.6 grams of molasses are added to 35.95 liters of regular ice cream mixture.

(H) **Toffee Ice Cream:** 1814.4–2721.6 grams of chopped toffee is added to 35.95 liters of regular ice cream mixture. To prepare the toffee, a mixture of 907.2 grams of butter and 2268 grams of sugar is heated to

160°C, and after removing from heat, half a tablespoon of baking soda is added. The mixture is thoroughly mixed, then mixed with 680.4 grams of nuts, spread, and dried.

(I) **Ginger Ice Cream:** 3628.8 grams of chopped ginger root jam is added to 35.95 liters of regular ice cream.

1.3.2 Chocolate Ice Cream

Chocolate ice cream is flavored with cocoa or chocolate. The required amounts of cocoa to create the chocolate flavor using a mixture of cocoa and chocolate syrup, chocolate syrup, and chocolate are 1587.6–2041.2, 2494.8, 1224.72–1360.8 grams per 37.85 liters of ice cream mixture, respectively. Different types of chocolate ice cream are described below. The chocolate ice cream formulation is presented in Table 1.3.

Simple Chocolate Ice Cream: Chocolate syrup is added to 34 liters of regular ice cream mixture. This chocolate syrup is prepared from 1360.8 grams of cocoa or 1814.4 grams of chocolate syrup, 1360.8 grams of sugar, and 3/78–5/67 liters of water. Sugar and cocoa are mixed together, and enough water is added to them to form a paste. Then, it is heated with steam in a double-walled vessel. As the syrup thickens, water is gradually added while continuously stirring. It is then heated up to a temperature of 80°C and after being discharged, it is cooled down for use. The required amount of water prevents the syrup from thickening excessively.

Mint Chocolate Ice Cream: 1814.4–2721.6 grams of dried mint leaves are added to 35.95 liters of regular ice cream mixture.

Malt Chocolate Ice Cream: To 34 liters of regular ice cream mixture, half of the chocolate syrup is used for chocolate ice cream and 0.946 liter of malt syrup is added. If malt syrup is not available, 453.6–907.2 grams of malted milk can be used instead.

Table 1.3 Chocolate ice cream formulation.

Ingredient percentage	Chocolate ice cream				
Fat	16	14	12	10	8
Nonfat milk solids	8	10	11	12	12.5
Sugar	19	17	16	16	16
Cocoa	3.5	3	3	3	2.7
Stabilizers	0.2	0.25	0.25	0.3	0.3
Total solids	46.7	44.25	42.25	41.3	39.5

Chocolate Almond Ice Cream: 1814.4–2721.6 grams of chopped almond is added to 35.95 liters of chocolate ice cream mixture.

Chocolate Marshmallow Ice Cream: 1814.4–2721.6 grams of marshmallow is added to 35.95 liters of chocolate ice cream mixture.

Chocolate Coffee Ice Cream: To 28.38 liters of regular ice cream mixture, 9.46 liters of chocolate mixture and 226.8–340.2 grams of coffee syrup or sufficient coffee extract are added to create a mild coffee flavor in the product.

1.3.3 Fruit Ice Cream

Fruit ice cream contains actual fruit and can also include fruit essence and coloring. Fruits like pineapple, apricot, strawberry, etc., whether fresh, frozen, or in conserved form, can be used in fruit ice cream. Fruit ice creams can be flavored by incorporating 10–15% fruit into regular ice cream mixtures, where the type of fruit and desired intensity of flavor influence the amount of fruit used. When using frozen fruit for making fruit ice cream, the fruit-to-sugar ratio varies between 1:2.5 and 1:4. The type of fruit also plays a determining role in formulation. Various types of fruit ice creams are described below:

Strawberry Ice Cream: To 30.28 liters of regular ice cream mixture, 7.57 liters of processed aseptic strawberry puree is added. In this type of ice cream, fruit is used in the form of puree and is firm, and to achieve a desirable yellow color, a certain amount of red color is also added.

Peach Ice Cream: To 30.28 liters of regular ice cream mixture, 7.57 liters of fruit is added. To enhance the intensity of flavor and color, a portion of this fruit should be in the form of puree. The color of the ice cream should be light yellow.

Cherry Ice Cream: To 32.17–34 liters of regular ice cream mixture, 3.78–5.67 liters of cherry is added. Sour cherry concentrate should be used to improve the taste. The color of this ice cream should be light red.

Apricot Ice Cream: To 30.28 liters of regular ice cream mixture, 7.57 liters of apricot is added. The color of this ice cream should be light yellow.

Apple Ice Cream: To 30.28 liters of regular ice cream mixture, 7.57 liters of chopped apples are added. Frozen apples should be packed with a 1:7 ratio of sugar. The apple flavor can be enhanced by adding 320 milliliters of apple essence to the ice cream.

Pineapple Ice Cream: To 34 liters of regular ice cream mixture, 3.785 liters of grated pineapple are added.

Banana Ice Cream: To 34 liters of regular ice cream mixture, 3.785 liters of grated banana are added. If fresh bananas are used, they should be

fully ripe. Adding a small amount of citric acid or lemon juice can prevent browning of fresh fruit and improve its taste.

Orange Ice Cream: To 34 liters of regular ice cream mixture, 3.785 liters of orange juice and 0.946 liters of lemon juice are added. Additionally, 1360.8 grams of fruit sugar is added at the beginning. The color of this ice cream should be light orange.

Orange and Pineapple Mixed Ice Cream: To 34 liters of regular ice cream mixture, 3.785 liters of grated pineapple and sufficient concentrated orange juice are added to create an orange flavor. The color of this ice cream should be light orange.

Lemon Ice Cream: To 34 liters of regular ice cream mixture, 3.785 liters of fresh or frozen lemon juice, 0.946 liters of orange juice, and 1360.8 grams of sugar are added. The color of this ice cream should be lemon yellow.

Mulberry Ice Cream: To 34 liters of regular ice cream mixture, 3.785 liters of black or red mulberry puree with sugar (in equal proportions) are added. Adding mulberry extract is essential to enhance the flavor.

Fig and Nut Ice Cream: To 34 liters of regular ice cream mixture, 3.785 liters of canned figs and 907.2 grams of chopped nuts are added. The color of this ice cream should be light brown.

Grape Ice Cream: To 34 liters of regular ice cream mixture, 3.785 liters of concentrated grape juice are added.

Blueberry Ice Cream: To 30.28 liters of regular ice cream mixture, 7.57 liters of blueberry puree are added.

Vanilla Cherry Ice Cream: To 30.28 liters of regular ice cream mixture, 7.57 liters of intact cherries (without damage and stems removed) are added. Fruits are added using a special feeder for raw materials.

Date Ice Cream: To 30.28 liters of regular ice cream mixture, 7.57 liters of chopped dates are added.

1.3.4 Nutty Ice Cream

This type of ice cream contains nuts such as almonds, walnuts, pistachios, etc., and can also include flavorings for both color and taste enhancement. A regular ice cream mixture with 10–14% fat content can be made flavorful by adding 3–6% nuts. Buttery and caramel flavors are commonly used. Various types of nutty ice cream are described below:

Nutty Ice Cream with Toasted Almond Flavor: To 35.95 liters of regular ice cream mixture, 1814.4–2268 grams of toasted or roasted almonds are added. Almond flavoring and caramel colorings are also used.

Pistachio-Flavored Nutty Ice Cream: To 35.95 liters of regular ice cream mixture, 1814.4 grams of chopped pistachios and pistachio extract (enough to create a flavor and light green color) are added.

Creamy Walnut-Flavored Nutty Ice Cream: To 35.95 liters of regular ice cream mixture, 1360.8 grams of special buttery sweet (that creates a crunchy sound when chewed) and 907.2 grams of chopped walnuts are added. This type of ice cream can also be prepared using 34 liters of the regular mixture and 4536 grams of walnut, either coarsely ground, finely milled, or a mix of the two.

Walnut-Flavored Nutty Ice Cream with Maple Syrup: To 35.95 liters of regular ice cream mixture, 907.2–1360.8 grams of chopped walnuts and 85 grams of pure maple extract are added.

Walnut-Flavored Nutty Ice Cream: To 35.95 liters of regular ice cream mixture, 1814.4–2268 grams of chopped walnuts are added.

Caramel-Flavored Nutty Ice Cream: To 35.95 liters of regular ice cream mixture, 1360.8 grams of chopped nuts, 56.7 grams of caramelized sugar (for color), and caramel flavorings are added.

Nutty Pineapple Ice Cream: To 34 liters of regular ice cream mixture, 3.785 liters of pineapple and 1360.8 grams of chopped nuts are added.

Walnut Crunch Ice Cream: To 35.95 liters of regular ice cream mixture, 2721.6 grams of ground candy with chopped walnuts are added.

Banana Nutty Ice Cream: To 35.95 liters of regular ice cream mixture, 2.84 liters of grated bananas and 907.2 grams of chopped nuts are added.

Chocolate Almond Ice Cream: To 35.95 liters of chocolate ice cream mixture, 1814.4 grams of whole or chopped almonds are added.

Toffee Almond Ice Cream: To 35.95 liters of regular ice cream mixture, 1814.4 grams of chopped buttery toffee and 907.2 grams of chopped almonds are added.

Pineapple and Coconut Nutty Ice Cream: To 34 liters of regular ice cream mixture, 2.84 liters of grated pineapple and 1814.4 grams of chopped coconut are added.

Peanut-Flavored Nutty Ice Cream: To 35.95 liters of regular ice cream mixture, 1814.4–2721.6 grams of chopped peanuts or peanut butter are added.

1.3.5 Yoghurt Ice Cream

This type of ice cream mixture is cultured using yoghurt bacteria and may be classified as probiotic ice cream (Homayouni 2008). Fruits, nuts, and various flavoring ingredients can be added to the mixture before or after

pasteurization and culturing. Yoghurt ice cream is produced by freezing and simultaneously agitating a pasteurized mixture containing milk fat, nonfat milk solids, sweeteners, and yoghurt. Various flavorings can be used, often incorporating fruits. After pasteurizing the milk, a mixture of *Lactobacillus bulgaricus* and *Streptococcus thermophilus* bacteria is introduced into the yoghurt components. If pasteurization is performed after culturing these bacteria, it needs to be indicated on the product label. Typically, the milk is subjected to high-temperature treatment (e.g., at 85°C for 15 minutes) before inoculating with yoghurt starter. In industrial production, the titratable acidity of the final yoghurt mixture should be 0.30%. Usually, 10–20% yoghurt (by weight) is used in the mixture. To mitigate the tangy flavor of regular yoghurt, efforts are made to reduce the level of acetaldehyde taste in yoghurt ice cream. The tangy taste of yoghurt is slightly more pronounced compared to low-fat ice cream, even when the fat content of both is the same. The increased attention toward yoghurt ice cream compared to other frozen dairy products is due to the belief that yoghurt bacteria aid lactose digestion and offer other immune-modulating properties. Yoghurt ice cream contains relatively low fat content, and its labeling varies based on the fat content, similar to the nomenclature used for other ice cream types. If it contains less than 0.5 gram of fat per 113 grams serving, it is labeled as "fat-free yoghurt ice cream." If it contains 0.5–3 grams of fat, it is labeled as "low-fat yoghurt ice cream," and if it contains more than 3 grams of fat, it is labeled as "full-fat yoghurt ice cream." The formulation of peach and strawberry-flavored yoghurt ice cream is presented in Tables 1.4 and 1.5.

Table 1.4 Formulation of peach-flavored yoghurt ice cream.

Ingredients	Quantity
Regular ice cream mixture (5% fat content)	11.35 liters
Low-fat yoghurt	3.785 liters
Yoghurt stabilizer	3.785 liters
Peach puree	0.473 liters
Peach cubes	1.892 liters
Peach flavor extract	85 grams
Yoghurt acid (lactic acid)	28.35 grams
Citric acid	28.35 grams

Table 1.5 Formulation of strawberry-flavored yoghurt ice cream.

Ingredients	Quantity
Regular ice cream mixture	11.35 liters
Low-fat yoghurt	3.785 liters
Yoghurt stabilizer	3.785 liters
Strawberries	2.13 liters
Frozen strawberries	1.892 liters
Yoghurt acid (lactic acid)	42.525 grams
Citric acid	28.35 grams
Strawberry flavor extract	7.08 grams

1.3.6 Puddings

Nesselrode Pudding: In Nesselrode pudding, 30.28–32.17 liters of regular ice cream mixture with 14–16% fat content are mixed with 5.676–7.568 liters of various commercial fruits. The fruits are added after the mixture has frozen to a certain extent, using a specialized fruit feeder device. The Nesselrode mixture typically includes 0.946 liters of grated pineapple, cherries, cherry preserves, various types of raisins, 340.2 grams of orange peel preserves, and 907.2 grams of chopped almonds and walnuts. The product's color should be light orange, and often, the regular ice cream mixture is used instead of a high-fat mixture for making Nesselrode pudding.

Berry Pudding: To prepare berry pudding, 3.78–7.56 liters of regular ice cream mixture are mixed with a blend of various suitable fruits. The product's color should be light pink. The pudding mixture contains small pieces of red cherries (1.892 liters), shredded pineapple (1.892 liters), and chopped almonds (907.2 grams). It is worth mentioning that red coloring is added to the mixture after it is prepared.

Frozen Pudding: For this type of pudding, nuts, essences, or flavoring ingredients are added to berry ice cream.

Peach Pudding: To 30.28 liters of parfait ice cream mixture (16% fat), after it is slightly frozen, 1360.8 grams of chocolate syrup, various types of fruit and nuts, including 907.2 grams of figs, 907.2 grams of dates, 3628.8 grams of mixed fruit preserves, 907.2 grams of walnuts, 226.8 grams of vanilla extract, 6 tablespoons of cinnamon, and 1 tablespoon of ginger are added. The fruits and nuts should be chopped and mixed with spices before adding to the slightly frozen mixture. Spices are also added before the

freezing process begins. Sometimes, for making peach pudding, 30.28 liters of regular ice cream mixture is mixed with 3628.8 grams of egg yolks, 2721.6 grams of sugar, 3.784 liters of orange juice, 1814.4 grams of walnuts, and 226.8 grams of vanilla.

Date Pudding: To 34 liters of regular ice cream mixture, 2721.6 grams of dates and 907.2 grams of chopped walnuts are added.

1.3.7 Special Ice Creams

Egg and Milk Ice Cream: To 34 liters of regular ice cream mixture, 3.785 liters of a mixture of milk and eggs are added. The milk and egg mixture can be prepared using 6804 grams of eggs, 3402 grams of fresh egg yolks, 1814.4 grams of egg powder, 3628.8 grams of sugar, and 204.2 grams of cream (20% fat). This mixture is heated at a temperature of 71°C for 20–30 minutes and then homogenized. This type of ice cream can also be prepared using 37.85 liters of regular ice cream mixture, 680.4 grams of egg yolk powder, 85 grams of vanilla extract, 56.7 grams of lemon juice, 0.45 liters of cane essence, 85 grams of egg yolk color, and various seasonings.

Raisin Fermented Ice Cream: To 34 liters of regular ice cream mixture, 11,340 grams of seedless raisins and 113.4–170.1 grams of fermented syrup or aromatic materials such as cane essence and yellow color are added.

Date and Walnut Ice Cream: To 34 liters of regular ice cream mixture, 6804 grams of dates, 1360.8–1814.4 grams of walnuts, and a certain amount of color are added. Dates and walnuts should be mixed with a little sugar and then added to the ice cream mixture.

Sweet Potato Ice Cream: To 24.5 liters of regular ice cream mixture, 12,700.8 grams of sweet potato puree (1:7 ratio with sugar), 0.946 liters of lemon juice, 56.7 milliliters of vanilla extract, and 113.4 grams of Prussian orange color are added. 1814.4 grams of mashed Avocado is mixed with 453.6 grams of sugar. Then, 7257.6 grams of this mixture is added to 40,824 grams of the previous mixture.

Honey Ice Cream: A well-composed honey ice cream mixture consists of 10% milk fat, 10% nonfat solids, 8% sugar, 9% honey, and 0.3% stabilizers. Using too much honey can lead to freezing and firmness issues. In such cases, using a formulation of 10% milk fat, 1% nonfat solids, 8% low DE (dextrose equivalent) corn syrup, 12% honey, and 0.25% stabilizers can yield a highly flavorful product with sufficient sweetness. Honey with a milder taste and lighter color is preferred in ice cream.

Plum Ice Cream: To 30.28 liters of regular ice cream mixture, 7.57 liters of pureed plum (1:4 ratio with sugar), 0.473 liters of grated orange zest, and 56.7 grams of vanilla are added. Plums should be prepared after peeling and removing the pit from the fruit. Plums give the product a golden yellow color and a soft texture that makes it delicious.

Watermelon Ice Cream: To 37.85 liters of regular ice cream mixture, 283.5–340.2 grams of watermelon-flavoring materials are added. This type of product is pink in color.

Rhubarb Ice Cream: To 32.17 liters of regular ice cream mixture, 5.67 liters of cooked and grated rhubarb (1:3 ratio with sugar), 907.2 grams of chopped walnuts, 0.946 liters of orange slices, 56.7 grams of vanilla, and 14.175 grams of nutmeg flakes are added. This product has a pink color.

Pumpkin Ice Cream: To 30.28 liters of regular ice cream mixture, 7.57 liters of cooked pumpkin puree, 0.946 liters of orange slices, 56.7 grams of vanilla, 14.175 grams of cinnamon, and 7.08 grams of nutmeg flakes are added.

Fruit Cube Ice Cream: For the fruit mixture, dissolve 170.1 grams of flavored gelatin in one cup of water, and mix 567 grams of this product with fruit (typically frozen fruit with sugar). Add 4 eggs, 2 cups of sweetened condensed milk, 1/33 cup of sugar, 1.892 milliliters of corn syrup, and 170.1 grams of vanilla pudding mix. Mix these ingredients together. Then, add the fruit mixture to the ice cream mixture. The resulting mixture, with a volume of 5.676 liters, will be sufficient for freezing in the freezer.

Homemade Ice Cream: By using the ingredients from Table 1.6 along with flavoring materials and freezing the mixture in an ice and salt freezer, one can obtain a gallon of ice cream. Adding a tablespoon of vanilla extract can flavor the mixture. The gelatin used should be dissolved in half a cup of cold water.

Table 1.6 Primary ingredients of homemade ice cream.

Ingredients	Ice cream formulations				
Heavy cream (liter)	1.23	1.23	1.42	1.42	0.946
Milk (liter)	1.42	1.42	1.42	1.42	0.946
Concentrated milk (gr)	385	385	425	425	425
Sugar (glass)	2	2	2	2	2
Gelatin (teaspoon)	1	1	1	1	1

1.3.8 Other Types of Ice Cream

French Custard Ice Cream: This type of ice cream is made using eggs. The weight of solid materials in frozen custard should be less than 1.4, and in unfrozen products, less than 1.2 of the total weight.

Fruit Puree Ice Cream: This type of ice cream includes flavoring ingredients and pieces of fruit candy, such as mint sticks.

Biscuit Ice Cream: This ice cream has a distinct flavor and incorporates ingredients like raisins, sweet breads, cakes, and other bakery products.

Mousse Ice Cream: This ice cream contains whipped cream along with sugar, and coloring and flavoring agents. It receives minimal aeration during freezing and sometimes uses condensed milk to enhance its texture. To make a small quantity of mousse, whip 3.785 milliliters of cream until firm. Then, mix it vigorously with 907.2 grams of sugar, 1–2 drops of suitable color, and 14.175–28.35 grams of vanilla. Small pieces of dates, nuts, and dried fruits are added to the mixture. The mixture is placed in a container and allowed to set without additional whipping. For large-scale production, 22.2 liters of heavy whipped cream, 7.57 liters of milk, 6350.4 grams of sugar, 170.1 grams of stabilizer, and 870.1 grams of vanilla are used. To dissolve the stabilizer, mix it with about 907.2 grams of sugar and blend it with the whipped cream. Heat the milk to the required temperature to dissolve the stabilizer, then combine it with the remaining initial ingredients. Chill the mixture to 0°C, intermittently freezing it to achieve a slight increase in volume before firming it up before consumption.

Rainbow Ice Cream: Vanilla ice cream blended with syrup and chocolate, creating a marbled appearance once hardened.

Gourmet Ice Cream: This type of ice cream usually combines various flavoring ingredients.

Napoleon Ice Cream: Consists of two or more flavors of ice cream packaged together.

Sweetened Ice Cream: A type of ice cream containing 2–7% fat and 12–15% nonfat dry solids, sweeteners, and flavoring agents.

Fruit Ice Cream: Fruit ice cream is made from fruit puree, sugar, stabilizers, and dairy products. It resembles regular ice cream but uses whole milk, reduced-fat milk, condensed milk, dry milk, or a mixture of these instead of all or part of the water content.

Sherbet Ice Cream: This type of ice cream is made from fruit juice, sugar, and stabilizers. It might contain fruit acids, coloring, and flavoring. It attains a suitable texture upon freezing. Typically, 28–30% sugar is used in sherbet formulations. Overrun (the expansion factor) is about 20–25% in sherbets. Dairy products are not used in its formulation.

Soft-Serve Ice Cream: This product is consumed immediately after being dispensed from the freezer, in a soft and creamy state. There is no hardening stage involved.

Novelties Ice Cream: These new types of ice creams are a combination of frozen and semifrozen dairy mixtures, presented in various shapes, sizes, and colors. Examples include Eskimo pies, coated ice cream bars, sandwiched ice creams, and cubed ice cream bars between layers of biscuits that are packaged in waxed paper.

Frappe: A type of chilled product consisting of a blended mixture of fruit-infused water, with a slightly soft and smooth texture. This product is consumed as a cold beverage. Frappé is prepared similar to ice cream, but it is consumed in a soft form. To prepare 18.5 liters of frappé, 4082.4 grams of sugar, 2041.2 grams of solid corn syrup, 85.05 grams of pectin, and 3.785 liters of fruit juice are mixed together, and with enough water (10,409 grams), its volume reaches 18.5 liters. Before consumption, it freezes into a soft mixed texture.

Granite Ice Cream: A type of frozen ice cream that is slightly aerated during freezing. As a result, its overrun is lower. The same ingredients used to prepare regular ice cream are used for making granite. Less aeration and whipping occur during the freezing of granite. This product has a coarser texture compared to regular ice cream.

Souffle Ice Cream: A syrup containing egg yolks or whole eggs.

Lacto: A milk-based syrup that incorporates fermented milk, yoghurt, or cultured milk in its composition. Lacto is prepared from a mixture of fruit-flavored ice cream containing sour milk (cultured), buttermilk, or other cultured dairy products. To produce grape lacto, 11.355 liters of buttermilk, 4082.4 grams of sugar, 680.4 grams of egg yolk, 3 cups of lemon water, and 0.946 liters of grape juice are used. Sugar is dissolved in the milk and grape juice, followed by the addition of egg yolk. The egg white is beaten and added to the mixture, then transferred to a noncontinuous freezer. Instead of grape juice, cranberry, cherry, or orange juice can also be used.

Fruit Salad Ice Cream: A mixture of whipped cream and large fruit pieces that is consumed as a fruit salad after freezing. Mayonnaise sauce can be added when consumed. This product is a combination of large fruit pieces mixed with whipped cream or ice cream. Around 3.785 liters of mixed pineapple, red cherries, apricots, peaches, pears, or plums are combined with 2.52 liters of whipped cream to give it a mayonnaise-like taste. The mixture is left to firm up, and around 2.52 liters of soft ice cream can be used as a substitute for whipped cream. If an 85-gram packet of gelatin

is dissolved in a cup of hot water and added to the cold fruit mixture, the volume of the salad increases.

Sculpted Ice Cream: This category includes ice cream, ice, and shaped syrups that are made in single or multiple colors and various flavors, and then decorated. Types of sculpted ice cream include:

(A) Layered cube-shaped ice cream with decorative centers.
(B) Cookie-shaped or cylindrical ice cream.
(C) Cake-shaped tube ice cream.
(D) Ice creams shaped like different fruits, flowers, and animals.
(E) Multilayered ice creams with different colors, where a layer of fruit jam is placed between two ice cream layers or fruit pieces may be added as soon as the ice cream exits the freezer.

Melorin: The formulation of this ice cream is similar to regular ice cream, except that butterfat is replaced with vegetable or animal oils.

Frozen Dairy Products with Artificial Sweeteners: In these products, nonsugar and non-nutritive sweeteners are used instead of sugar.

Nondairy Frozen Desserts: The ingredients of these products are similar to ice cream but without dairy components.

Parfait: For every 7.57 liters of ice cream mix, 16% fat, 1200 grams of egg yolk powder, or 3628.8 grams of whole egg are added. After baking (at 41°C for 30 minutes), it turns into a pastry, which is then cooled to 38°C. This pastry is added to 26.49 liters of the same ice cream mix, and 37.85 liters of the resulting parfait mix is flavored as usual, similar to ice cream.

Frozen Sherbet: It is similar to ice cream but with relatively high sugar content (30%) and consists of 30–50% fruit and fruit juice, pectin, gum stabilizers (0.4%), and usually 2.6% egg white. Its overrun is also 20% or less. Citric acid is added to improve the taste, and water is used to adjust the volume of the mixture.

Punch: Punch is a type of frozen dessert prepared by mixing 26.5 liters of water, 9072 grams of sugar, 0.946 liters of lemon juice, 0.946 liters of grape juice, and some vanilla essence. Adding 141.75 liters of stabilizing agents can freeze the product for consumption.

Soffle: This product is prepared from a mixture of fruit-flavored ice cream to which whole eggs are added. Due to the volume increase during freezing, the product expands. To prepare this product, 28.38 liters of fruit-flavored ice cream mix, 3628.8 grams of whole egg, and 7.57 liters of fruit puree are used.

Fancy Molded Ice Cream: "Ofa" is composed of molded ice cream and fruit, containing two or more layers of ice cream with fruit placed between them. To prepare "Ofa," strawberry is used, which practically encompasses the entire ice cream. It is then allowed to be set and covered

with a thin layer of pectin-enriched strawberry. Finally, the mold is filled with vanilla or strawberry ice cream. The fruit should have a viscosity that creates somewhat extended lines in the ice cream, resulting in a marbled appearance of the final product.

Spumoni: Vanilla ice cream is filled into a spumoni cup, about one-fourth of its height, and compressed well against the sides. Then, the cup is filled up to half with chocolate ice cream. In the end, it is topped off with a mixture of fruit and whipped cream, and then set. The fruit and whipped cream mixture is initially obtained by whipping 3.785 liters of cream. Later, it is intensely mixed with 3.785–5.67 liters of dried fruit, to which 453.6 grams of sugar are added.

Frozen Malt Products: To prepare frozen malt products, 13.24 liters of low-fat ice cream mix, 0.946 liters of malt syrup, a quantity of chocolate syrup obtained from 225 grams of cocoa (or 453.6 grams of chocolate syrup), 340.2 grams of sugar, and 0.946–1.419 liters of water are mixed and frozen.

Lactose-Free or Low-Lactose Ice Cream: Many consumers cannot fully digest lactose. Lactose malabsorption is sometimes accompanied by discomfort in the digestive system. In this condition, lactose is not digested in the small intestine and is fermented and produces gas and acid upon reaching the large intestine. Gas production causes pain and discomfort and can lead to diarrhea in acute cases. Often, individuals with lactose malabsorption can consume ice cream as part of a meal. The solution for individuals with more severe malabsorption is to consume lactose-free frozen desserts. These products are prepared from milk that has passed through ultrafiltration or diafiltration to remove lactose, or from milk in which lactose has been hydrolyzed. Ultrafiltration for lactose removal reduces the concentration of solids in the solution and increases the freezing point. On the other hand, lactose hydrolysis results in two glucose and galactose molecules for each lactose molecule, lowering the freezing point. By ultrafiltration and removing 50% of the lactose, and hydrolyzing the remaining lactose, the initial freezing point is maintained. It should be noted that all methods of lactose reduction definitely come with increased ice cream production costs.

Smoothies: Smoothies are beverages made by blending fresh or frozen fruit, fruit juice, and frozen milkshake mix, yoghurt, or sherbet. They fall into a category similar to milkshakes but often feature a broader range of flavoring ingredients. While various formulations exist for smoothies, a typical recipe includes a combination of whole fruit and/or fruit juice, cream or yoghurt, and crushed ice. This mixture is blended using a high-speed blender and served promptly.

Drinkable Probiotic Ice Cream (Milkshakes): Milkshakes are typically prepared for immediate consumption at retail outlets, often fast-food establishments. These shakes are made using milkshake mixes produced at dairy processing facilities, which are then packaged and shipped in bulk containers. A typical milkshake mix contains approximately 3% milk fat, 13% milk solids-not-fat, 8% sugar, 3% corn syrup solids, and 0.4% stabilizer, resulting in a total solids content of around 28.4%. Milkshakes can also be crafted in ice cream retail shops by blending scooped ice cream with milk using a high-speed blender, following a more traditional approach than using a freezing machine (Marshall et al. 2003; Homayouni 2008).

References

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