Ice Cream and Frozen Desserts

Revised 2024

Thermal Properties

	Chocolate		Strawberry	
	English	**Metric**	**English**	**Metric**
Moisture, %	55.70	--	60.00	--
Protein, %	3.80	--	3.20	--
Fat, %	11.00	--	8.40	--
Carbohydrate, %	28.20	--	27.60	--
Fiber, %	1.20	--	0.30	--
Ash, %	1.00	--	0.70	--
Specific Heat Above Freezing	0.74 Btu/lb*°F	3.11 kJ/(kg*K)	0.76 Btu/lb*°F	3.19 kJ/(kg*K)
Specific Heat Below Freezing	0.66 Btu/lb*°F	2.75 kJ/(kg*K)	0.65 Btu/lb*°F	2.74 kJ/(kg*K)
Latent Heat of Fusion	80 Btu/lb	186 kJ/kg	86 Btu/lb	200 kJ/kg

	Vanilla	
	English	**Metric**
Moisture, %	61.00	--
Protein, %	3.50	--
Fat, %	11.00	--
Carbohydrate, %	23.60	--
Fiber, %	0.00	--
Ash, %	0.90	--
Specific Heat Above Freezing	0.77 Btu/lb*°F	3.22 kJ/(kg*K)
Specific Heat Below Freezing	0.65 Btu/lb*°F	2.74 kJ/(kg*K)
Latent Heat of Fusion	88 Btu/lb	204 kJ/kg

Storage Conditions

	Refrigerated Mixes	Frozen Desserts
Temperature	32 to 40°F (0 to 4.4°C)	-15 to -25°F (-26 to -32°C)
Storage Period	Up to 2 weeks*	Up to 5 months
Relative Humidity	Controlled by packaging	

*Assuming a paperboard or plastic container; storage period may be up to 4 months if the product is sterilized and sealed in a can. As the temperature increases above 40°F (4.4°C), the storage period decreases significantly, especially with non-sterile products.

Background

Ice cream, sherbet, and water ice:

Frozen dairy desserts are blends of sugar (cane or cane and corn syrup), cream, and nonfat milk solids which are used to make ice creams. Sherbet contains very little cream and nonfat milk solids, and water ice contains none of these. Sugars comprise at least 30% of these sherbet mixes. Mellorine is a frozen dessert in which the milk fat is replaced by vegetable fat. Paravine is a nondairy frozen dessert. The U.S. Code of Federal Regulations governs minimum composition for fat, milk solids, food solids, and weight per unit volume of finished product.

Stabilizers, blends of vegetable gums and extracts, are used in frozen desserts to bind water, thus controlling the growth of ice crystals during temperature fluctuations. No more than 0.5% stabilizer is the legal standard in the U.S. Emulsifiers may also be added to control the smoothness of the mix and aid in whipping. Maximum amounts depend on the emulsifier. The emulsifiers are normally added with the stabilizer as a blend.

Blends of ingredients are pasteurized, homogenized, and cooled before freezing. At the mechanical freezer the liquid flavor, color, and fruit juice are added to the liquid mix. This mix is pumped into the freezer where the draw temperature is reduced to about 20°F (-7°C). The amount of sweetener is critical since the level added affects the draw temperature. Alternative sweeteners, e.g., high fructose corn syrups (42-55%), and other sweeteners may decrease the total quantity of sweetener needed; therefore, it is necessary to consider which solids to add as a replacement. During chilling, millions of tiny ice crystals are formed and air is incorporated. Addition of fruit pieces, candy, or nuts to this plastic, aerated mass is accomplished with a fruit feeder after the mechanical freezer. Packaging and rapid hardening at -20°F (-29°C) follows. Ice cream and related products should be stored at -18°F (-27.8°C) or lower (colder).

Some ice cream and low fat ice cream mix is packaged in large paperboard or bag-in-box containers like milk for use by stores that have soft-serve freezers. Like the larger counterpart, these freezers whip and chill the mix to about 20°F (-7°C) where it can then be dispensed directly into a cone.

There is some question as to whether low fat and nonfat ice creams have as long a frozen shelf life as full fat ice cream. The full fat ice creams may successfully be stored at -20°F (-28.9°C) for up to 6 months; however, low fat/nonfat products should not be stored for more than 4 months.

U.S. regulatory definitions:

Regular ice cream must contain at least 10% milkfat and at least 20% total milk solids. Reduced fat ice cream is made with 25% less fat than reference ice cream. Light (or lite) ice cream is made with 50% less fat or 1/3 fewer calories than reference ice cream, and for caloric reduction less than 50% of calories are

derived from fat. Low fat ice cream contains not more than 3 grams of milk fat per serving. Nonfat ice cream contains less than 0.5 g of fat per serving.

Defect attributed to improper frozen storage:

Textural defects arise when storage freezer temperatures fluctuate or product is allowed to warm in movement between freezers. Since it is four times easier thermodynamically to refreeze water to existing ice crystals, no new ones develop after the mechanical freezer processing. Thus, ice crystals grow with each temperature fluctuation until noticeable textural changes cause consumer complaint.

Prolonged warming will cause loss of air and settling of a sugar syrup. Product in this state is totally unacceptable before or after refreezing. The product develops a soggy, heavy characteristic which is offensive to consumers.

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