ICE-CREAM & FROZEN DESSERTS

Module 8. Defects in ice cream

Lesson 22
DEFECTS IN ICE CREAM – FLAVOUR, BODY & TEXTURE

22.1 Introduction

High quality ingredients are required in the production of high quality ice cream. Adherence to formulation, industry processing standards and proper storage requirements are also critical. Incorporation of inferior dairy ingredients, sweeteners, or other ingredients always will result in a substandard product. Some of the defects likely to be found in ice cream are discussed below.

22.2 Flavor Defects

Flavour is the most important sensory attribute in judging and grading of ice cream and frozen desserts. Even a minor flavour defect in ice cream will affect its acceptability by the consumer. Some of the prominent flavour defects are discussed in this chapter along with their causes and prevention.

Table 22.1 Classification of ice cream flavor defects according to their cause

I. Off-flavors due to the ingredients		
	A. The flavoring system	
	1. Lacks (deficient)	2. Lacks fine flavor (harsh, lacks balance)
	3. High flavor (excessive)	4. Unnatural (atypical)
	B. **Sweeteners**	
	1. Lacks sweetness	2. Too sweet
	3. Syrup flavor (malty)	
	C. **Dairy products**	
	1. Acid (sour)	2. Cooked (rich, nutty, egg-like)

3. Lacks freshness (stale)	4. Old ingredient
5. Rancid (lipolytic)	6. Salty
7. Whey	8. Oxidized (cardboard, metallic)
D. **Other ingredients**	
1. Eggs (egg-like)	2. Stabilizer/emulsifier
3. Non-milk food solids	
II. **Off-flavors due to chemical changes** (in the mix or product)	
1. Lacks freshness (stale, old)	2. Rancid (lipolytic)
3.Oxidized (cardboard, metallic)	4. Storage
III. **Off-flavors due to mix processing**	
1. Cooked (rich, nutty, egg-like)	2. Caramelized/scorched
IV. **Off-flavors due to microbial growth in the mix**	
1. Acid (sour)	2. Psychrotrophic (fruity/fermented, cheesy, musty, unclean)
V. **Off-flavors**	
1. Foreign	2. Neutralizer

22.2.1 High flavor

This flavor condition, when it occurs, is best recognized when the sample is first placed into the mouth. The intensity of the flavoring seems so striking or sharp that the desired, pleasant flavor blend is not achieved due to the harsh tones imparted by the flavoring level observed in the product. Ice cream that is too highly or excessively flavored is not severely criticized as a rule, especially if the quality of the flavoring used is high. An associative ‘‘ethanol-like’’ note may be present.

22.2.2 Too sweet

An ice cream that is observed to be excessively sweet tends to exhibit a candy-like taste sensation; this defect is readily noted upon the first stages of tasting. Too much sugar (or other form of sweetener) tends to interfere with the overall desirable blend of flavor(s). Another unfortunate characteristic of a given ice cream that is perceived as being too sweet is a general lack of

refreshing property.

22.2.3 Lacks sweetness

An ice cream that lacks sweetness is readily noted upon tasting; the product simply manifests a distinct flat or bland taste. The desired or anticipated blend of flavor is missing. An adequate amount of sweetener is required to bring out the full flavor ‘‘bloom’’ in a given flavor, whether it is vanilla, fruit, or chocolate ice cream. Since preferences for the desired level of sweetness vary among individuals, the product is not severely criticized for lacking sweetness, within reasonable limits, if this is the only flavor defect encountered. However, a severe deficiency in sweetener solids may give rise to readily evident defects in body and texture or mouth feel.

22.2.4 Syrupy /Malty flavour

This sweetener off-flavor is still commonly encountered in certain forms of corn syrups and corn syrup solids; hence ‘‘syrup flavor’’ is the common descriptor for this characteristic defect. Frequently encountered descriptions for syrup flavor might be malty,caramel-like, molasses-like or similar to low levels of burnt sugar. Some evaluators distinguish syrup flavor from high sweetness by the ‘‘catch’’experienced in the throat, similar to the feeling after a dose of cough syrup.Certain forms or sources of corn syrup solids, corn syrup, and some liquid sugar blends (with excessive levels of corn syrup), when used in ice cream in high proportion to sucrose, may convey a slight to distinct malty or caramel-like off-flavor.

22.2.5 Lacks fine flavour

This criticism is generally used to describe an ice cream that is basically ‘‘good’’ or ‘‘very good,’’ but for some less than clear reason, it seems to just barely fall short of being ‘‘perfect’’ or ‘‘ideal.’’ experienced ice cream judges are able to recognize the desirable, delicate, balanced flavor notes of a high quality flavor. The novice judge should remember that ‘‘lacks fine flavor’’ is not readily described in more definitive or specific terms.

22.2.6 Lacks flavouring

An ice cream with this defect is often criticized as flat, bland, or deficient in the amount of added flavoring. Even though the ice cream may be pleasantly sweet and free from any dairy ingredient off-flavor, it seems to lack the characteristic delicate ‘‘bouquet’’ of excellent vanilla; the desired intensity is missing. The obvious cause of this defect is failure to use sufficient quantities of flavoring. However, there are instances when certain ingredients mask (or hide) the vanilla flavor, thus invoking the ‘‘lacks flavor’’ criticism, even though the added quantity of flavoring seemed adequate to the manufacture.

22.2.7 Acid (Sour)

An acid or sour off-flavor in frozen dairy desserts may be distinguished from other off-flavors by a sudden, tingly, taste sensation (on the tip or top of the tongue), plus an associated ‘‘clean and refreshing’’ mouth feel. This flavor defect may be caused by the use of acid whey in the ice cream mix. The off-flavor may also result from uncontrolled bacterial activity at elevated temperature; other bacterial off-flavors may also be present. In such cases, the flavor defect(s) may be more appropriately described as a combination acid (sour) and psychrotrophic bacteria-

caused off-flavor (unclean, fruity, or putrid).

22.2.8 Cooked flavour

The ‘‘cooked’’ flavor of ice cream is commonly experienced.It is also referred to as ‘‘rich,’’ ‘‘egg-like,’’ ‘‘sulfide,’’ ‘‘custard,’’scalded milk, condensed milk, or caramel-like. Cooked (or rich) flavor is not considered a serious defect in ice cream, unless it is so intense as to be perceived as caramel, scorched, or burnt. Quite commonly, the dairy ingredients incorporated into ice cream which has been pasteurized already; regulations require that the blended or final ice cream mix must also be re-pasteurized. Additional heat treatment is likely to produce some degree of cooked flavor in the mix. As indicated earlier, this is not typically objectionable in ice cream; in fact,it may be quite desirable or preferred in many instances. An excessive cooked off-flavor usually results from using ingredients that have received such severe heat treatment that a scorched or burnt effect is attained. Mix pasteurization, under some adverse conditions, may also develop a cooked off-flavor.

22.2.9 Lacks freshness (Stale)

The descriptor, ‘‘lacks freshness,’’ or ‘‘stale,’’ refers to a moderate off-flavor of ice cream and related frozen desserts. This flavor defect is generally assumed to result from either a general flavor deterioration of the mix during storage, or from the use of one or more marginal quality dairy ingredients in mix formulation. For instance, some old milk or old cream, or stale milk powder (nonfat milk solids), may have been incorporated as an ingredient. If the off-flavor imparted by the ‘‘marginal’’ ingredients were quite intense, then ‘‘old ingredient’’ would probably be the most appropriate criticism. However, if the other milk components and/or mix ingredients dilute the adverse sensory aspects of the dairy ingredient(s) in question, a lacks freshness (or stale) descriptor is more applicable.

22.2.10 Oxidized (Cardboard, Metallic) flavour

In dairy products, the oxidized off-flavor may vary so widely in character and intensity that several terms or descriptors are used to distinguish between the various stages. In ice cream or low fat ice cream, this off-flavor may be encountered to such a slight intensity that the product flavor seems flat or ‘‘missing.’’ a further development of this off-flavor may be described more accurately as astringent, metallic, or puckery (with an associated mouth feel of shrinking of the mucous membranes). Other, more moderate intensities of the off-flavor might be described progressively as oxidized, papery, or cardboard. In the most intense stages of the oxidation of milk products, oily, tallowy, paint, or fishy are common descriptors. The oxidized off-flavor is usually noted soon after the sample is placed into the mouth; if intense, it may persist long after the sample has been expectorated. Depending on the intensity, such an ice cream may not been tirely repulsive to the evaluator (or consumer). However, an oxidized defect definitely conveys the idea that the product is not made from high-quality ingredients, is not refreshing, or may be stale or old.

22.2.11 Rancid flavour

Fortunately, a rancid off-flavor is infrequently observed in ice cream. A specific, delayed, reaction time of perception is characteristic of rancidity, and it has an attendant persistent repulsiveness.

However, the sweeteners and flavoring may tend to mask any potential rancidity to the extent that unless the defect is quite pronounced, this off-flavor may not be recognized for what it actually is. If rancidity were to occur in ice cream,the peculiar blend of flavors and off-flavors would typically terminate as anun clean or unpleasant aftertaste, which is characteristic of the rancid defect. Rancidity is severely criticized, since it indicates either utilization of mishandled dairy ingredients or serious processing errors that led to mixing raw milk or cream with homogenized milk ingredients.

22.2.12 Salty

Occasionally, a salty off-taste may be encountered in frozen dairy desserts. This taste may be readily detected, since the reaction time is relatively short; hence, it is a quickly perceived taste. A salty taste could be due to added salt, the use of salted butter as a milk fat source, or it may be associated with use of a high percentage of concentrated whey, whey solids, or milk-solids-not-fat (MSNF) in the formulation. High replacement of MSNF with whey solids (i.e., in excess of25%) seems to occasionally lead to a slight salty off-taste in ice cream or ice milk. Other sensory defects may accompany the higher usage rates of some sources of dry whey (see the following discussion on the whey off-flavor). To most evaluators, a salty taste in frozen dairy desserts seems distinctly ‘‘out-of-place’’ for this form of product; hence, it is usually criticized in line with the level of intensity and the specific flavor involved.

22.2.13 Storage flavour

The ‘‘storage’’ off-flavor generally refers to flavor that may develop either in the mix or in the frozen ice cream (or low-fat ice cream) during the storage period. When ice cream is stored for an extended period of time, the flavor loses its initial luster, even though no specific defects seem to stand out. In one instance, the product may simply lack the sensation of freshness. Smoke, ammonia, and various chemical odors are but a few examples of absorbed substances that may be responsible. Serious storage flavor defects have been known to develop when odor, absorption, and chemical change or deterioration in storage occurred simultaneously. The storage off-flavor is commonly considered more serious or objectionable than the ‘‘lacks freshness’’(stale) defect in ice cream.

22.2.14 Foreign (Atypical)

As a rule, a foreign off-flavor may be easily detected, but the exact substance or specific contaminant is often difficult to positively identify. This flavor defect is definitely atypical (foreign) for dairy products or the ingredients ordinarily associated with good quality ice cream. Detergents, sanitizers,paint, gasoline, pesticides, and other chemicals of chance contact are some of the possible serious offenders. Unfortunately, chemical substances may not only impart off-flavors but also be nauseating or toxic. Obviously, any products found to contain this defect must be severely downgraded and not marketed for human consumption.

22.3 Body Defects

The various body and texture defects that may be encountered in ice cream are termed or classified as follows

- Crumbly: brittle, falls apart when dipped.

- Fluffy: large air cells, disappears quickly in mouth, very weak.
- Greasy: a distinct greasy coating of the mouth surface after expectoration, a tallowy or Chapstick sensation on the lips after evaluation.
- Gummy: opposite of crumbly, pasty, putty-like; feels some what sticky like gum between tongue and roof of mouth.
- Icy/coarse: most common texture defect, not smooth, ice crystals or particles.
- Sandy: one of the most objectionable defects in ice cream; fine hard particles sand-like, lactose crystals.
- Soggy: heavy, doughy, pudding-like.
- Weak: lacks body and resistance, low solids, watery, more like ice milk.

22.3.1 Crumbly, brittle, friable

Abrittle, crumbly, and friable body is evident by a tendency of the ice cream to fall apart when dipped. The product appears to be dry, open, and sometimes as friable as freshly fallen snow. The particles seem to lack the needed property to stick together or be retained as a common mass. The defect may be aggravated by the use of certain gums, inadequate stabilization, too high overrun, and/or low total solids in the mix. Generally lower fat ice creams (7% and less) tend to develop crumbly defect more readily than an ice cream mix with higher fat content (10% and more).

22.3.2 Flaky, snowy

Flaky, snowy is a similar defect like crumbly. A flaky, snowy textured ice cream manifests itself by a tendency to fall apart when dipped. In this respect, it has the same characteristics as that noted in a crumbly body. The condition seems to be associated with low solids, low stabilizer, and/or high overrun in the product.

22.3.3 Gummy, pasty, sticky, elastic

A gummy or sticky body is the exact opposite of a crumbly body. Such ice cream seems pasty and the ice cream hangs together, so much so that it has a marked tendency to curl just behind the scoop as it is pulled across the surface, which leaves coarse, deep, irregular waves. Frequently, there is a correlation between a gummy body and a high resistance to melting; gummy ice cream often resists melting. If melting does occur, the mass often tends to retain its original shape. Ice cream should only be severely criticized when the stickiness is so severe that it is obviously pasty and would probably be difficult to dip or scoop.

22.3.4 Shrinkage, shrunken

A shrunken ice cream manifests itself by the product mass being with drawn from the sides of the container. This defect is noticed when the package is first opened for examination. This defect may be associated with high overrun, low mix solids, fluctuations in air pressure, or substantial changes in altitude during product distribution. However,under certain storage and/or transport conditions, any ice cream may shrink. Product shrinkage may suddenly be encountered where none existed before, even when no changes were made in the product's composition or manufacturing procedures. Certain environmental conditions, such as season of the year, stage of lactation, feed,etc., may unfavorably affect the normal formation of strong air cell walls(which

contain proteins) in the frozen mix.

22.3.5 Soggy, heavy, doughy, pudding-like

A heavy, resistant body is best described by the terms heavy, doughy, or pudding-like. This defect can readily be noted when the product is dipped. Portions of an ice cream with this criticism, when placed in the mouth, seem colder than those free of the defect. Apparently, this is due to a greater heat conductivity of heavy bodied products. The body of such products is generally quite resistant, firm, or heavy. This defect is associated with high solids content of the mix,especially increased fat and sugar, too much stabilizer, and/or a low overrun.

22.3.6 Weak, watery

A weak, watery body is usually associated with a low melting resistance and a thin, milky, low viscosity meltdown. A weak-bodied ice cream conveys the impression of having a low proportion of food solids, when a sample is placed into the mouth. The mouth feel of the sample may more likely resemble reduced or non fat ice creams (or the former ice milks) more than ice cream. Such an ice cream may be easily compressed by slight pressure of a spoon or scoop. This defect may also be associated with coarse texture; low solids and high overrun also contribute to causing a weak-bodied ice cream.

22.4 Texture Defects

22.4.1 Fluffy, foamy, spongy

A fluffy texture may be noted in high overrun ice cream. Such an ice cream tends to compress substantially upon dipping or applied pressure with a flat object. This defect is closely associated with a high overrun. A fluffy ice cream usually melts slowly in the dish, yielding a relatively small proportion of liquid, which is often foamy and spongy.

22.4.2 Greasy, buttery, churned

This defect may be noted by the presence of actual butter particles in the mouth after the ice cream has melted, or by a distinct greasy coating of the mouth surface after expectoration. Common causes of a greasy mouth feel are inadequate homogenization, a relatively high milk fat content and over-emulsification of the product. In soft-serve frozen dairy desserts, churning may be due to de-emulsification of milk fat during prolonged agitation in the soft-serve freezer. If fat globule aggregation exceeds a size of 30–50 μm, visible fat particles form in the samples with the associated buttery defect. High fat mixes are more susceptible to this defect.

22.4.3 Icy, coarse, grainy, ice pellets, spiny

This defect is the most commonly encountered texture defect in frozen dairy desserts. Such a product may be characterized by comparatively large ice crystal particles, a feeling of unusual coldness within the mouth, a simultaneous lack of a smooth, velvety character, and a rough visual effect. A coarse texture is due to comparatively large particles of frozen water; each ice crystal is sufficiently large that the coarseness is obvious. When extremely coarse, grainy textures are noted, the product is criticized as being icy or spiny. Among the many possible causes of coarse-textured ice cream are the following:

- Faulty formulation
- Inadequate protection against heat shock
- Ineffective or improper stabilization and/or emulsification
- Inadequate hydration of dry mix constituents
- Incomplete protein hydration
- Inadequate homogenization
- Insufficient aging of the mix
- Too high product temperature coming out of the freezer
- Extended interval between freezing, packaging, and/or transfer to the hardening system
- Slow hardening
- Too high a hardening temperature
- Fluctuating storage temperatures
- Extended storage and distribution times

Ice crystals are unstable because during frozen storage, they undergo changes in number, size, and shape, known collectively as re-crystallization. This occurs due to temperature fluctuations. If the temperature during the frozen storage of ice cream increases, some of the ice crystals, particularly the smaller ones, melt and consequently the amount of unfrozen water in the serum phase increases.

Conversely, as temperatures decrease, water will refreeze but does not re-nucleate. Rather, it is deposited on the surface of larger crystals, so the net result is that the total number of crystals diminishes and the mean crystal size increases. Each time the temperature changes, the smaller ice crystals disappear while the larger ones grow even larger. Re-crystallization can be minimized by maintaining low and constant storage temperatures.

22.4.4 Sandy, gritty

A sandy texture is one of the most objectionable texture defects encountered in frozen dairy desserts, but it is also one of the easiest to detect. Such a texture conveys to the tongue and palate a definite lack of smoothness and an associated distinct form of grittiness. When the sample melts, there remains in the mouth fine, hard,uniform particles that suggest fine sand, and are crystals of lactose. Sandy texture should not be confused with the coarse, icy texture, which results from the presence of comparatively large ice crystals. The lactose crystals dissolve markedly more slowly than ice crystals; therefore, they may be noted even after the ice cream has fully melted. A high percentage of serum solids, high total food solids, product age, and ‘‘heat shock’’ are all related to the development of this defect.

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