



Flavorings are used to augment the innate flavor of food and beverage products and, in some cases, are used to provide the entire flavor of the product. Some examples of foods and beverages that use flavors are cakes, cookies, crackers, sauces and sauce mixes, breakfast cereals, alcoholic beverages, carbonated beverages, and confections. Flavors are also used in pharmaceuticals and tobacco products.

**A) The U.S. Food and Drug Administration (FDA) divides flavor additives into three general categories:**

**1. Natural Flavors:**

The term natural flavor or natural flavoring means the essential oil, oleoresin, essence or extractive, protein hydrolysate, distillate, or any product of roasting, heating or enzymolysis, which contains the flavoring constituents derived from a spice, fruit or fruit juice, vegetable or vegetable juice, edible yeast, herb, bark, bud, root, leaf or similar plant material, meat, seafood, poultry, eggs, dairy products, or fermentation products thereof, whose significant function in food is flavoring rather than nutritional.

**2. Artificial Flavors:**

The term artificial flavor or artificial flavoring means any substance, the function of which is to impart flavor, which is not derived from a spice, fruit or fruit juice, vegetable or vegetable juice, edible yeast, herb, bark, bud, root, leaf or similar plant material, meat, fish, poultry, eggs, dairy products, or fermentation products thereof.

**3. Natural and Artificial Flavors:**

These flavorings can be defined as simply a combination of natural flavor constituents and artificial flavor constituents.

**B) NATURAL FLAVORS AND WONFS**

As the industry has evolved and consumer interest in “clean label” products has increased, the demand for natural flavors has expanded dramatically in the US. In most cases, it should be noted that natural flavors will be used at higher levels than their artificial counterparts.

**Natural Citrus Flavors:**

The exception to this is in natural citrus flavors. The reason that natural citrus flavors can be produced at similar strength to artificial flavors is because the essential oils of citrus fruits are relatively strong flavor components. Removal of the terpenes can further increase the strength of these flavors, if necessary, so that most natural citrus flavors in liquid or dry forms can be used at levels as low as 0.2-0.5%, and in some cases even lower.

**Natural Fruit Flavors:**

Natural fruit flavors represent a real contrast in strength in comparison to their artificial counterparts simply because the flavor constituents are generally found at much lower levels in non-citrus fruits and are much more difficult to efficiently extract due to their greater volatility and water solubility. Concentrated fruit juice essences are currently the most concentrated sources of true natural fruit flavor. These essences are produced as fruit juices and are concentrated. Most of these essences, if captured, are added back or sold with the juice concentrate and represent a very small fraction of the concentrated juice. With the exception of apple and grape essence, there are



few concentrated essences available for use in flavor manufacturing. Thus, the raw materials available for making natural fruit flavors are usually only a fraction of the strength of artificial compounds and also, generally, much weaker than most of the essential oils.

### **WONF Flavors:**

In order to boost the strength of a natural flavoring, other flavor ingredients can be added during the development process. This results in a flavor that is referred to as a WONF (With Other Natural Flavors). Essential oils and botanical extracts generally comprise these added ingredients. In some cases, there are essential oils available that closely simulate the natural flavor of the fruit. Bitter Almond Oil has traditionally been used to boost the flavor of natural cherry extracts and juices. If the blend of other natural ingredients is characterizing and particularly strong (as is in the case of almond oil in a cherry flavor), the flavor strength can be boosted significantly without sacrificing quality. The resultant flavor can be used at a relatively low usage level.

Strawberry, peach, and raspberry are examples of flavors where there are few, if any, essential oils or extracts available that are particularly characteristic of these fruits. These other natural ingredients can be used to boost the flavor of desired fruit flavors but are used at lower levels in order to keep the flavor profile in balance. The resulting WONF tends to be lower in flavor strength, thus requiring generally higher usage levels.

### **Vanilla Extracts and Vanilla Flavors:**

Vanilla extract has its own standard of identity, defined in CFR 21 Part 169.175 as "the solution in aqueous ethyl alcohol of the sapid and odorous principles extracted from vanilla beans." A minimum of 13.35 ounces of vanilla beans are required to yield one gallon of vanilla extract containing at least 35% alcohol. Various sources and types of beans can be used and a variety of processing conditions can be employed by manufacturers to produce their own desired flavor characteristics providing these basic requirements are met. Various folds of vanilla extracts are produced either by concentrating the basic extract or by increasing the weight of beans extracted, or both. Pure vanilla extracts are manufactured in strengths ranging from single fold to "oleoresin" vanillas.

These extracts can be plated on suitable dry carriers to yield vanilla powders. Vanilla powders are also required to meet a standard identity as defined in CFR 21 Part 169.179.

Artificial vanilla flavors, which have no standard of identity, are found in a very wide range of strengths and flavor profiles and are less expensive than the natural extracts.

## **C) FLAVOR PERCEPTION**

Flavor perception is really the sense of smell simultaneously integrated in the brain with the taste sensations of sweetness, sourness, saltiness, umami and bitterness. While there is variation among normal individuals in flavor acuity, in general, we are all experts in this area; after all, it is something that we have been doing with great discernment since birth. The average person is capable of discriminating among virtually thousands of flavor compounds, many of these at levels below the detection limits of modern



analytical instrumentation. And while we are constantly adding to our mental library of familiar flavor components and profiles, it seems that we are born with a fundamental trait that causes flavor acceptability to be the virtual core of our food selection habits.

### **D) FLAVOR PROFILE**

Flavor profile is a term used by many in the food industry to describe the multiple characteristics perceived as a flavor is evaluated in the mouth. Various “descriptors” are used to define flavor profile in order to communicate what is being perceived. For example, terms such as “fruity,” “spicy,” “floral,” “green, jammy,” are commonly used to describe fruit and berry flavors.

For any method of flavor profiling to be effective, agreement upon the terminology becomes the most critical factor. Flavor profiling can also be used to define imbalances in flavor, off-notes, and portions of a flavor that may need to be increased or decreased. In many cases, defining the profile of a base material or blend can be the first step in developing a flavor to provide the desired flavor profile of the finished product.

### **E) TOP NOTE**

Top note commonly refers to the highly aromatic and volatile portion of a flavor. This is the part of the flavor that is initially perceived through either smelling or tasting. In reality, the aromatic strength of a flavor compound is related more to the chemical structure than to the boiling point. Chemical structure not only affects how a component smells and tastes, it also affects its organoleptic threshold.

### **F) CHARACTERIZING COMPOUND**

A chemical component which provides a major portion of a flavor’s organoleptic identity. Citral is the characterizing compound of lemon flavor. Vanillin is the characterizing component of vanilla. Many flavors, such as strawberry, chocolate, and nutmeg, have no single characterizing compounds but rely on the blend of components to generate the typical flavor profile.

### **G) FLAVOR ENHANCER**

This is a food ingredient or blend of ingredients used to increase the organoleptic effect of the flavor. Enhancers generally are non-volatile ingredients that affect taste properties more so than odor properties of a flavor. Monosodium glutamate and 5’ nucleotides are examples of enhancers used in savory flavors. Maltol and ethyl maltol are considered as enhancers in many fruit and berry flavors. Salt, citric acid, and caffeine can also act as flavor enhancers in foods.

### **H) CARRIERS**

Modified food starch, maltodextrin, and/or gum acacia are used as carriers in spray dried flavors. In addition to these, dextrose, sucrose, salt, and corn starch are used as carriers in dry blended flavors. In the case of liquid flavor the carrier is usually propylene glycol, alcohol, glycerin, water, liquid sugar, or vegetable oil. Carriers can control the solubility of the flavor, the flavor profile and in some cases can affect the flavor release in the food product. In addition, they can reduce mixing time needed to insure the flavor’s adequate distribution in a food product. While carriers are, in many cases, thought of as only diluents, they can be, in fact, quite important to the success of the flavor in the finished product.



### I) FLAVOR TYPES - Methods of Manufacture and Major Applications

#### 1. Compounded Flavors:

A compounded flavor is a liquid flavor that is made by admixing the flavor components in a tank until the components are adequately dispersed and/or dissolved. This is the simplest and least costly method of flavor manufacture. Compounded liquid flavors find application in practically all food product categories with the exception of dry mixes, where their use, in many cases, is not appropriate. Usage levels generally range from less than 0.1%, in the case of concentrated flavors, to as high as 2-3%. Many flavors are produced in this manner. Water or oil soluble flavors can be produced by the selection of the proper type and amount of solvent.

#### 2. Dry Blends:

Dry blended flavors represent the simplest and least expensive method of making a dry flavor. These flavors are manufactured by blending a variety of dry ingredients until adequate uniformity is achieved. A small percentage of liquid flavoring materials can be added, or "plated," on the dry constituents during blending if necessary, to create the desired flavor profile. Many of the dry artificial vanilla flavors are made in this manner. Plating of highly volatile liquid components is not a satisfactory practice and can lead to poor flavor stability in most cases due to oxidation and other chemical reactions. In addition to vanilla flavors made by dry blending, a variety of meat and cheese flavors are manufactured in this manner. Dry blended flavors find application in cake mixes, donut mixes, sauce mixes, and a variety of seasoning blends for snack products.

#### 3. Emulsions:

Flavor emulsions can be oil-in-water type or water-in-oil type with the former being the more common and typically used in the beverage industry. Emulsions represent a simple cost-effective method of incorporating oil soluble ingredients into aqueous phase while providing cloudiness and mouthfeel.

Beverage emulsions are a specialized type of flavor emulsions that require careful development and manufacture due to the fact that the final beverage is approximately 85-90% water. The flavor emulsion must provide the necessary stability in the finished beverage to insure optimum physical appearance, flavor quality and stability. Some beverage emulsions are designed to provide a stable cloud appearance in the finished beverage. This is accomplished by "weighting" the flavor oils with suitable weighting agents. These oil soluble materials have a high specific gravity and are added to flavor oils to bring the flavor's specific gravity to approximately that of the finished beverage.

Bakery emulsions are used in finished doughs at levels ranging from 0.2-1.0% while beverage emulsions are usually much stronger flavor emulsions and are used in finished beverages at levels of 0.05-0.25%.

#### 4. Spray Dried Flavors:

Spray dried flavors are produced by first developing a starch, maltodextrin, or gum based emulsion with flavor oils and water. This emulsion is then spray dried at ambient pressure with elevated temperature resulting in a dry flavor that is



approximately 10-30% concentrated flavor oils encapsulated with a relatively impermeable outer shell. Spray drying has enabled good quality, strong flavors to be developed in the dry form. These flavors have outstanding shelf stability.

### **5. Processed Flavors:**

The flavor of any food that is generated by roasting, toasting, or some other form of cookery can theoretically be simulated by careful processing of the required precursors in a manner similar to that found in the cooking process. Although this is a somewhat over simplification, in general this is the way processed flavors are made. Meat, coffee, chocolate and nut-like flavors are examples of flavors being used today that were developed through an understanding of Strecker degradation pathways and Maillard reaction kinetics and the applications of these principles to flavor development. Both natural and artificial flavors can be made in this manner depending upon the starting materials. In general, the natural savory flavors of this type are less concentrated than their artificial counterparts but do supply a much truer flavor profile. Artificial flavors can be used at levels as low as 0.1% while natural flavors of this type may require usages as high as 3-4% in the finished product.

### **6. Enzyme Modified Flavors:**

Enzyme modified flavors use food approved enzymes to intensify the concentration of desired flavor components through the actions of these enzymes upon a variety of precursors. Today many snack products, sauce mixes, processed cheeses, and salad dressings are flavored with these natural cheese flavors. They function primarily as cheese and cheese powder replacers, allowing as much as a 50% reduction in cheese solids in many food products. They are also quite effective in providing intensified natural cheese flavor to those products whose formulations could not allow large quantities of cheese or cheese powder.

Enzyme modified dairy flavors are available in dry or semi-solid paste forms with usage levels ranging from as low as 0.1% for some of the lipolyzed butter oils, to as much as 3-4% for the enzyme modified cheese flavors.

### **7. Extracts:**

Extracts are natural flavorings, or flavor intermediates, produced by percolation or distillation as a means of isolating the desirable flavor constituents of botanical materials or essential oils. Many products are specifically tailored to the physical requirements of the food or beverage products they flavor. Vanilla extract, chocolate extract, various herb extracts, and citrus extracts are examples of this type of flavor. In general, usages tend to be somewhat higher than artificial compounded flavors. Major applications for flavoring extracts are in baked goods, beverages and alcoholic beverages.

#### **References:**

- Citrus & Allied Historical Archives
- FDA website: <https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr=501.22>
- AIB Technical Bulletin, November 1985
- Ames and Matthews, 1968, and Denny, 1991