

# Flavor

Subjects: Others

Contributor: HandWiki Huang

A food flavoring or food flavouring, [lower-alpha 1] in short flavoring or flavouring, or alternatively aroma is a food additive used to improve the taste or smell of food. It changes the perceptual impression of food as determined primarily by the chemical senses of the gustatory and olfactory system. The trigeminal nerves, which detect chemical irritants in the mouth and throat, as well as temperature and texture, are also important to the overall perception of food. Of the three chemical senses, smell is the main determinant of a food item's flavor. Aromas are the volatile components of the food. The aroma of a food is determined by the aroma compounds it contains and the personal ability to detect them. While an aroma primarily acts through the olfactory system, it also affects the taste at the same time. Along with additives, other components like sugars determine the taste of food. Five basic tastes – sweet, sour, bitter, salty and umami (savory) are universally recognized, although some cultures also include pungency and oleogustus ("fattiness"). The number of food smells is unbounded; a food's flavor, therefore, can be easily altered by changing its smell while keeping its taste similar. This is exemplified in artificially flavored jellies, soft drinks and candies, which, while made of bases with a similar taste, have dramatically different flavors due to the use of different scents or fragrances. The flavorings of commercially produced food products are typically created by flavorists. A flavoring is defined as a substance that gives another substance taste, altering the characteristics of the solute, causing it to become sweet, sour, tangy, etc. Although the term, in common language, denotes the combined chemical sensations of taste and smell, the same term is used in the fragrance and flavors industry to refer to edible chemicals and extracts that alter the flavor of food and food products through the sense of smell. Owing to the high cost, or unavailability of natural flavor extracts, most commercial flavorants are "nature-identical", which means that they are the chemical equivalent of natural flavors, but chemically synthesized rather than being extracted from source materials. Identification of components of natural foods, for example a raspberry, may be done using technology such as headspace techniques, so the flavorist can imitate the flavor by using a few of the same chemicals present. In the EU legislation, the term "natural-identical flavouring" does not exist. The legislation is specified on what is a "flavouring" and a "natural flavouring". A flavor is a quality of something that affects the sense of taste.

Keywords: natural flavor ; food flavoring ; unavailability

---

## 1. Definition

A flavoring or aroma is a volatile additive that improves the taste or smell of food. They work primarily via the sense of smell. In legislation, substances that exclusively have a sweet, sour or salty taste are not considered flavorings. These usually include flavor enhancers, sweeteners, acidulants and salt substitutes.

Flavorings can be divided into three principal types: "natural flavoring", "nature-identical flavorings", and "artificial flavorings".<sup>[1]</sup> In the United States they are traditionally divided into natural and artificial flavorings, where the latter includes nature-identical flavorings.<sup>[2]</sup> In contrast, European legislation does not distinguish natural and nature-identical flavorings, while only the term "natural" is subject to some regulation.

## 2. Types of Flavorings

### 2.1. Natural Flavorings

Natural flavorings are edible aroma compounds that are found in nature, not made by man. In nature they always occur with other natural substances that also may be flavorings. By means of non-chemical technology, natural flavorings can be isolated on industrial scale, to be used as an additive.

Technics to obtain natural flavorings include the use of enzymes and/or micro organisms. European legislators have accepted flavorings produced by manmade genetically modified organisms (GMO's) – not found in nature – as natural flavorings.

## 2.2. Nature-Identical Flavorings

Nature-identical flavorings are human-made aroma compounds that are chemically identical to some substance that can be found in nature. They are synthesized from chemicals or isolated by means of chemical processes.

Because nature-identical flavorings can be produced at low costs, the food industry will argue that nature-identical and natural flavorings are exactly the same. They have the advantage to be chemically pure, without allergens that may be coupled with natural flavorings. On the other hand, they are missing the synergy of other substances present in their natural origin, so they may lack subtlety.

## 2.3. Artificial Flavorings

Artificial flavorings are synthesized from chemical substances by man and are not found in nature. Their sensory characteristics mostly resemble that of natural or nature-identical flavorings.

# 3. Working

Flavors from food products are usually the result of a combination of natural flavors, which set up the basic smell profile of a food product, while artificial flavors modify the smell to accent it.<sup>[3]</sup>

Unlike smelling, which occurs upon inhalation, the sensing of flavors in the mouth occurs in the exhalation phase of breathing and is perceived differently by an individual. In other words, the smell of food is different depending on whether one is smelling it before or after it has entered one's mouth.<sup>[4]</sup>

# 4. Taste

The taste of a food product is not only determined by the aromas present in the original material and added flavorings, but also by accompanying substances like flavor enhancers, sweeteners, acidulants and salt substitutes. Polyols like sorbitol and maltitol, are carriers in flavorings, but they themselves also have a sweet taste.

Even the color of food can affect one's experience of the taste significantly.<sup>[5]</sup> In one study, adding more red color to a drink increased the perceived sweetness, with darker colored solutions being rated 2–10% better than lighter ones, though it had 1% less sucrose concentration.<sup>[6]</sup> Food manufacturers exploit this phenomenon; for example, different colors of the US products Froot Loops cereal and most brands of Gummy Bears often use the same flavorings.<sup>[7][8]</sup>

## 4.1. Flavor Enhancers

Flavor enhancers or taste enhancers, which are umami or "savory" flavorants, are themselves not flavorings, but they intensify the taste of the food. They are largely based on amino acids and nucleotides. These are typically used as sodium or calcium salts.<sup>[9]</sup> Umami flavorants recognized and approved by the European Union include:<sup>[10]</sup>

Acid salts	Description
Glutamic acid salts	This amino acid's sodium salt, monosodium glutamate (MSG), is one of the most commonly used flavor enhancers in food processing. Mono- and diglutamate salts are also commonly used.
Glycine salts	Simple amino acid salts typically combined with glutamic acid as flavor enhancers
Guanylic acid (GMP) salts	Nucleotide salts typically combined with glutamic acid as flavor enhancers
Inosinic acid (IMP) salts	Nucleotide salts created from the breakdown of AMP, due to high costs of production, typically combined with glutamic acid as flavor enhancers
5'-ribonucleotide salts	A blend of GMP and IMP salts ("I+G"), generally in the disodium ribonucleotides form, typically combined with other amino acids as flavor enhancers

# 5. Regulations

## 5.1. In Australia and New Zealand

In Australia and New Zealand regulation of flavorings is covered by the Australia New Zealand Food Standards Code of November 2000, entered into force in December 2002.<sup>[1]</sup>

Natural flavorings are obtained from plant or animal raw materials, by physical, microbiological, or enzymatic processes. They can be either used in their natural state or processed for human consumption, but cannot contain any nature-identical or artificial flavoring substances.

Nature-identical flavorings are obtained by synthesis or isolated through chemical processes, which are chemically and organoleptically identical to flavoring substances naturally present in products intended for human consumption. They cannot contain any artificial flavoring substances.

Artificial flavorings are "flavouring substances not identified in a natural product intended for human consumption, whether or not the product is processed."

## 5.2. In Europe

Under the EU legislation, substances which have exclusively a sweet, sour or salty taste are not considered flavorings (Article 2, Regulation (EC) No 1334/2008.<sup>[11]</sup>

Also flavor enhancers are not considered flavorings under the EU legislation but additives (Point 14 of Annex I of Regulation (EC) No 1333/2008).<sup>[12]</sup>

EU legislation defines several types of flavorings:<sup>[13]</sup>

- flavoring substances (including "natural flavoring substances");
- flavoring preparations (by definition always natural);
- thermal process flavorings
- smoke flavorings
- flavor precursors
- other flavorings

In the EU, Regulation (EC) No 1334/2008 on flavorings and certain food ingredients with flavoring properties for use in/on foods, i.e. the EU Flavouring Regulation, was adopted on 16 December 2008 and entered into force on 20 January 2009. It applies from 20 January 2011. Regulation (EC) No 1334/2008 lays down general requirements for safe use of flavorings and provides definitions for different types of flavorings. The Regulation sets out substances for which an evaluation and approval is required. The Union list of flavoring substances, approved for use in and on foods, was adopted on 1 October 2012 and was introduced in Annex I of this Regulation<sup>[14]</sup>

### Regulations on natural flavoring

In the EU, in order to be labelled as natural flavoring substance, many conditions have to be fulfilled: "Natural flavouring substance" shall mean a flavoring substance obtained by appropriate physical, enzymatic or microbiological processes from material of vegetable, animal or microbiological origin either in the raw state or after processing for human consumption by one or more of the traditional food preparation processes listed in Annex II. Natural flavoring substances correspond to substances that are naturally present and have been identified in nature (Article 3).<sup>[11]</sup>

More detailed information on the Production of Natural Flavouring Substances and (Natural) Flavouring Preparations can be found on the European Flavour Association (EFFA) Guidance Document<sup>[15]</sup>

UK Food Law defines a natural flavor as:

A flavouring substance (or flavouring substances) which is (or are) obtained, by physical, enzymatic, or microbiological processes, from material of vegetable or animal origin which material is either raw or has been subjected to a process normally used in preparing food for human consumption and to no process other than one normally so used<sup>[16]</sup>

The UK follows the above EU legislation which remains in force until 31 December 2020. The European Union (Withdrawal) Act 2018 provides that from 1 January 2021, this directly applicable EU legislation will be converted into UK law with minor corrections to enable it to operate effectively as UK law. These corrections have been made by Statutory Instrument 2019 No. 860.

The UK Food industry, in collaboration with the flavoring industry, has developed guidance on what to consider when declaring a pictorial representation of a food ingredient on the label of a pre-packed product.

The U.S. Code of Federal Regulations describes a "natural flavorant" as:

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 any other edible portions of a plant, meat, seafood, poultry, eggs, dairy products, or fermentation products thereof, whose primary function in food is flavoring rather than nutritional<sup>[17]</sup>

## 6. Dietary Restrictions

Food manufacturers are sometimes reluctant to inform consumers about the source and identity of flavor ingredients and whether they have been produced with the incorporation of substances such as animal byproducts. Some flavor ingredients, such as gelatin, are produced from animal products. Some, such as glycerin can be derived from either animal or vegetable sources. And some extracts, such as vanilla, may contain alcohol. Many groups such as Jews, Jains, Hindus, and Muslims, as well as vegans follow dietary restrictions which disallow the use of animal byproducts and/or alcohol in certain contexts. In many Western countries, some consumers rely on a Jewish kosher pareve certification mark to indicate that natural flavorings used in a food product are free of meat and dairy (although they can still contain fish). The Vegan Society's Sunflower symbol (which is currently used by over 260 companies worldwide) can also be used to see which products do not use any animal ingredients (including flavorings and colorings).

Similarly, persons with known sensitivities or allergies to food products are advised to avoid foods that contain generic "natural flavors" or to first determine the source of the flavoring before consuming the food.<sup>[18]</sup> Such flavors may be derived from a variety of source products that are themselves common allergens, such as dairy, soy,<sup>[19]</sup> sesame,<sup>[20]</sup> eggs, and nuts.<sup>[21]</sup> In the EU, nevertheless, this information is available in the labelling. Regulation (EU) No 1169/2011 on the provision of food information to consumers, states in article 9 that any ingredient or processing aid listed in Annex II (of the aforementioned Regulation) or derived from a substance or product listed in Annex II causing allergies or intolerances used in the manufacture or preparation of a food and still present in the finished product, even if in an altered form must be included in the labelling.<sup>[22]</sup>

## 7. Flavor Creation

Most artificial flavors are specific and often complex mixtures of singular naturally occurring flavor compounds combined to either imitate or enhance a natural flavor. These mixtures are formulated by flavorists to give a food product a unique flavor and to maintain flavor consistency between different product batches or after recipe changes. The list of known flavoring agents includes thousands of molecular compounds, and the flavor chemist (flavorist) can often mix these together to produce many of the common flavors. Many flavorants consist of esters, which are often described as being sweet or fruity.<sup>[23]</sup>

Chemical	Odor
Manzanate	Apple
Diacetyl, acetylpropionyl, acetoin	Buttery
Isoamyl acetate	Banana
Benzaldehyde	Bitter almond, cherry
Cinnamaldehyde	Cinnamon
Ethyl propionate	Fruity
Methyl anthranilate	Grape
Limonene	Orange
Ethyl decadienoate	Pear
Allyl hexanoate	Pineapple
Ethyl maltol	Sugar, cotton candy
2,4-Dithiapentane	Truffle
Ethylvanillin	Vanilla

The compounds used to produce artificial flavors are almost identical to those that occur naturally. It has been suggested that artificial flavors may be safer to consume than natural flavors due to the standards of purity and mixture consistency that are enforced either by the company or by law.<sup>[24]</sup> Natural flavors, in contrast, may contain impurities from their sources, while artificial flavors are typically more pure and are required to undergo more testing before being sold for consumption.<sup>[24]</sup>

Food and beverage companies may require flavors for new products, product line extensions (e.g., low fat versions of existing products), or changes in formula or processing for existing products. In 2011, about US\$10.6 billion were generated with the sale of flavors; the majority of the flavors used are consumed in processed and packaged food.<sup>[25]</sup>

Most flavors represent a mixture of aroma compounds, the raw material that is produced by flavor companies. In rare cases, a single synthetic compound is used in pure form. Artificial vanilla flavors vanillin and ethylvanillin are a notable exception, as well as the artificial strawberry flavor (ethyl methylphenylglycidate). The ubiquitous "green apple" aroma is based on hexyl acetate.<sup>[26]</sup>

The flavor creation is done by a specially trained scientist called a "flavorist", whose job combines scientific knowledge of the chemical palette with creativity to develop new and distinctive flavors. The flavor creation begins when the flavorist receives a brief from the client. In the brief, the clients attempt to communicate exactly what type of flavor is sought, in what application it will be used, and any special requirements (e. g., it must be all natural). The communication barrier can be quite difficult to overcome since most people are not experienced at describing flavors. The flavorist uses his or her knowledge of the available chemical ingredients to create a formula and compound it on an electronic balance. The flavor is then submitted to the client for testing. Several iterations, with feedback from the client, may be needed before the right flavor is found.

Additional work may also be done by the flavor company. For example, the flavor company may conduct sensory taste tests to test consumer acceptance of a flavor before it is sent to the client or to further investigate the "sensory space". The flavor company may also employ application specialists who work to ensure the flavor will work in the application for which it is intended. This may require special flavor delivery technologies that are used to protect the flavor during processing or cooking so that the flavor is only released when eaten by the end consumer. The flavor obtained is determined not just by the simple presence of a flavorant or a mixture of flavorants, but also by their concentrations. Thus, even if a non-flavored ingredient is added/removed to/from a food or beverage, this can noticeably affect the final flavor if it dilutes or otherwise changes the concentrations of the remaining flavored ingredients.

## 8. Determination

Few standards are available or being prepared for sensory analysis of flavors.<sup>[27]</sup> In chemical analysis of flavors, solid phase extraction, solid phase microextraction, and headspace gas chromatography are applied to extract and separate the flavor compounds in the sample. The determination is typically done by various mass spectrometric techniques.<sup>[28]</sup> A flavor lexicon can aid the development of objective language for food.

## 9. Scientific Resources

- *Flavour and Fragrance Journal*
- H. W. Schultz (editor): *Symposium On Foods: The Chemistry and Physiology of Flavors. The Fourth in a Series of Symposia On Foods Held in Oregon State University*, AVI Pub, Co., Westpoint Conn. 1967, LCCN 66024813.LCCN-permanent link

---

## References

1. Flavourings and Flavour Enhancers — User Guide, August 2002. The Australia and New Zealand Food Standards Code (archived)  
[https://web.archive.org/web/20080720091222if\\_/http://www.foodstandards.gov.au/\\_srcfiles/flavourings\\_user\\_guide\\_0802.pdf](https://web.archive.org/web/20080720091222if_/http://www.foodstandards.gov.au/_srcfiles/flavourings_user_guide_0802.pdf)
2. Code of Federal Regulations, Title 21. U.S. Food and Drug Administration (version of 6 January 2022)  
<https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm?fr=101.22>

3. Amy Fleming (8 December 2014). "Fake flavours: why artificial aromas can't compete with real food smells". The Guardian. <https://www.theguardian.com/lifeandstyle/wordofmouth/2014/dec/08/fake-flavours-artificial-aromas-real-food-smells-aromafork>.
4. Masaoka, Yuri; Satoh, Hironori; Akai, Lena; Homma, Ikuo (2010). "Expiration: The moment we experience retronasal olfaction in flavor". *Neuroscience Letters* 473 (2): 92–6. doi:10.1016/j.neulet.2010.02.024. PMID 20171264. <https://dx.doi.org/10.1016%2Fj.neulet.2010.02.024>
5. Shankar, Maya U.; Levitan, Carmel A.; Spence, Charles (2010). "Grape expectations: The role of cognitive influences in color–flavor interactions". *Consciousness and Cognition* 19 (1): 380–90. doi:10.1016/j.concog.2009.08.008. PMID 19828330. <https://dx.doi.org/10.1016%2Fj.concog.2009.08.008>
6. Johnson, J.; Clydesdale, F. M. (1982). "Perceived Sweetness and Redness in Colored Sucrose Solutions". *Journal of Food Science* 47 (3): 747. doi:10.1111/j.1365-2621.1982.tb12706.x. <https://dx.doi.org/10.1111%2Fj.1365-2621.1982.tb12706.x>
7. Stevens, Ashlie (8 January 2018). "Are Gummy Bear Flavors Just Fooling Our Brains?". NPR. <https://www.npr.org/sections/thesalt/2018/01/08/575406711/are-gummy-bear-flavors-just-fooling-our-brains>.
8. Locker, Melissa (21 January 2014). "Breaking Breakfast News: Fruit Loops Are All the Same Flavor, after the Mandela effect now known as Froot Loops". Time. <http://time.com/1477/breaking-breakfast-news-froot-loops-are-all-the-same-flavor/>.
9. "Monosodium Glutamate & Umami". International Glutamate Information Service. [http://www.glutamate.org/history/100\\_years\\_of\\_taste.html](http://www.glutamate.org/history/100_years_of_taste.html).
10. "Flavorings". Food Additives. <http://www.foodadditivesworld.com/flavorings.html>.
11. Regulation (EC) No 1334/2008 of the European Parliament and of the Council of 16 December 2008 on flavourings and certain food ingredients with flavouring properties for use in and on foods and amending Council Regulation (EEC) No 1601/91, Regulations (EC) No 2232/96 and (EC) No 110/2008 and Directive 2000/13/EC (consolidated version of 24 November 2021). The preamble is reproduced here <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008R1334-20211124>
12. Regulation (EC) No 1333/2008 of the European Parliament and of the Council of 16 December 2008 on food additives (consolidated version of 8 August 2021). The preamble is reproduced here <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02008R1333-20210808>
13. European Commission website, Directorate General for Health and Food Safety. Retrieved on 6 May 2020 [https://ec.europa.eu/food/safety/food\\_improvement\\_agents/flavourings\\_en](https://ec.europa.eu/food/safety/food_improvement_agents/flavourings_en)
14. European Commission website, Directorate General for Health and Food Safety. Retrieved on 6 May 2020: [https://ec.europa.eu/food/safety/food\\_improvement\\_agents/flavourings/eu\\_rules\\_en](https://ec.europa.eu/food/safety/food_improvement_agents/flavourings/eu_rules_en)
15. EFFA Guidance Document for the Production of Natural Flavouring Substances and (Natural) Flavouring Preparations: [https://effa.eu/docs/default-source/guidance-documents/effa-guidance-document-for-the-production-of-natural-flavouring-substances-and-\(natural\)-flavouring-preparations-in-the-eu6c53ae21f98c63ce9dbbff000087830d.pdf](https://effa.eu/docs/default-source/guidance-documents/effa-guidance-document-for-the-production-of-natural-flavouring-substances-and-(natural)-flavouring-preparations-in-the-eu6c53ae21f98c63ce9dbbff000087830d.pdf)
16. "The Flavourings in Food (Amendment) Regulations 1994". [http://www.opsi.gov.uk/si/si1994/uksi\\_19941486\\_en\\_1.htm](http://www.opsi.gov.uk/si/si1994/uksi_19941486_en_1.htm).
17. "Foods; labeling of spices, flavorings, colorings and chemical preservatives.". <http://www.gpo.gov/fdsys/pkg/CFR-2010-title21-vol2/xml/CFR-2010-title21-vol2-sec101-22.xml>.
18. "Attention, Allergy Sufferers: Beware of Natural Flavors". Food Safety News. 2 December 2015. <http://www.foodsafetynews.com/2015/12/attention-allergy-sufferers-beware-of-natural-flavors>.
19. Hidden Allergens in Foods. Allergy Advisor. <http://www.allergyadvisor.com/hidden.htm>. Retrieved 27 December 2011.
20. Sesame Allergy: A growing food allergy. Kids with Food Allergies Foundation. <http://www.kidswithfoodallergies.org/resourcespre.php?id=107>. Retrieved 27 December 2011.
21. Food Allergies. Center for Science in the Public Interest. [http://www.cspinet.org/nah/04\\_01/](http://www.cspinet.org/nah/04_01/). Retrieved 27 December 2011.
22. Regulation (EU) no 1169/2011 of the European parliament and of the council of 25 October 2011
23. "How do artificial flavors work?". howstuffworks. 31 May 2000. <http://science.howstuffworks.com/question391.htm>.
24. R.L. Smitha, S.M. Cohenb, J. Doullc, V.J. Ferond, J.I. Goodmane, L.J. Marnettf, P.S. Portogheseg, W.J. Waddellh, B.M.Wagneri, R.L. Hallj, N.A. Higleyk, C. Lucas-Gavinl and T.B. Adamsm (2005). "A procedure for the safety evaluation of natural flavor complexes used as ingredients in food: essential oils". *Food and Chemical Toxicology* 43 (3): 345–363. doi:10.1016/j.fct.2004.11.007. PMID 15680674. <https://dx.doi.org/10.1016%2Fj.fct.2004.11.007>

25. Ceresana, market study Flavors, December 2012, <http://www.ceresana.com/en/market-studies/chemicals/flavors/>
  26. Luebke, William (31 December 2017). "hexyl acetate, 142-92-7".  
<http://www.thegoodscentscompany.com/data/rw1003201.html>.
  27. e.g. ISO 13301:2002 Sensory analysis – Methodology – General guidance for measuring odor, flavor and taste detection thresholds by a three-alternative forced-choice (3-AFC) procedure, or ISO 6564:1985 Sensory analysis – Methodology – Flavor profile methods.
  28. Use of Ozone Depleting Substances in Laboratories. TemaNord 2003:516. norden.org  
<http://www.norden.org/pub/ebook/2003-516.pdf>
- 

Retrieved from <https://encyclopedia.pub/entry/history/show/76421>