8.Week: FLAVOURANTS

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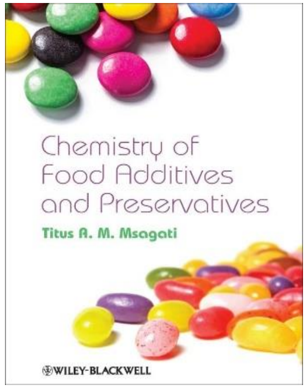

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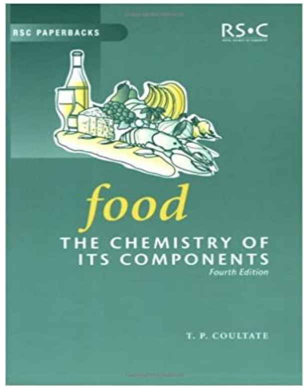

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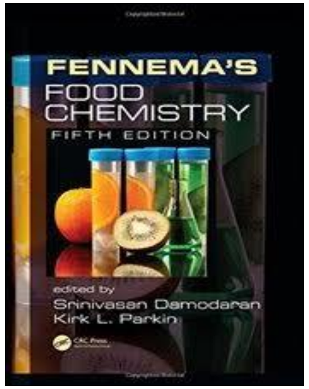

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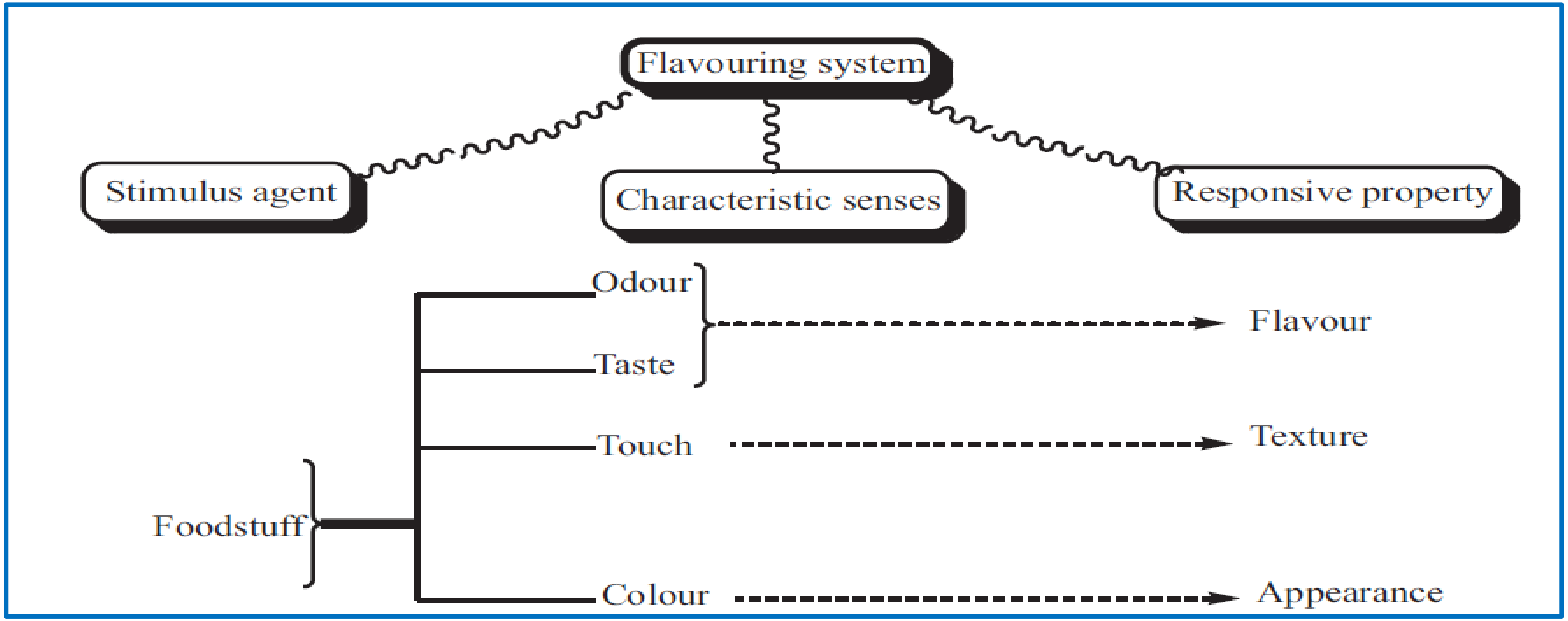
FLAVOURANTS TASTE and FLAVOUR

Relationship between flavour, texture and appearance



Source: Chemistry of food additives and preservatives / Titus A. M. Msagati / 2013 by John Wiley & Sons, Ltd. / ISBN 978-1-118-27414-9

Our response to the food when we consume is a combination of visual, tactile, thermal, taste and aroma. Flavor is the sensation produced by a material taken in the mouth, perceived principally by the senses of taste and smell, and also by the general pain, tactile and temperature receptors in the mouth.

Taste is defined as a series of different feelings that occur in the mouth and especially in the tongue with the intake of food.

There are four classic flavors of salty, sweetness, bitterness and sourness, usually associated with different parts of the tongue. Apart from these four main flavors, there are three other flavors: astringency, pungency (i. e. hotness), and meatiness (known as umami).

Each taste quality has a specific role in the detection of nutritious as well as poisonous substances:

* sweet taste for carbohydrate sources of calories
* salty for mineral contents
* sour for fruits ripeness and spoiled foods
* bitter for harmful compounds
* umami for protein and amino acid contents

Chemical Structure and Taste

A first requirement for a substance to produce a taste is that it be water soluble. The relationship between the chemical structure of a compound and its taste is more easily established than that between structure and smell.

Minor changes in chemical structure may change the taste of a compound from sweet to bitter or tasteless.

Sweet Taste

Sweetness is the most popular taste for consumers. It improves the palatability and certain properties of foods. The intensity of sweetness is expressed in relative sweetness by using 10 % sucrose solution as reference.

Bitter Taste

The bitter taste is unpleasant on its own, but its combination with other tastes can provide foods with special flavor, such as in tea, coffee, beer, and balsam pear. Naturally occurring bitter compounds are alkaloids, terpenoids, and glycosides in plants and bile in animals.

- **Caffeine, theobromine, theophylline:** caffeine, theobromine and theophylline are derivatives of purine and are important bitter substances in foods. Caffeine occurs in tea, coffee and cacao, and theophylline is found in cacao and tea. All the three alkaloids can stimulate the central nervous system.

- **Naringin and neohesperidin:** naringin and neohesperidin are main bitter taste compounds in citrus fruits and are mainly distributed in the peel of the fruits. Both the two compounds are flavanone glycosides and are water soluble.

- **Bitter substance in beer:** The bitter taste of beer is contributed by the bitter substances originally contained in hops and those generated during brewing. The major bitter substances in beer are α-acids, such as humulone, cohumulone, adhumulone. Hops are often added as the mashed malted barely (or malt extract) is boiled in water. During this boiling process the modestly bitter α-acids undergo thermal isomerization to form extremely bitter iso-α-acids.

- **Bile acid:** Bile acid is an extremely bitter fluid secreted by the liver of most vertebrates. It is involved in the digestion of lipids in the small intestine and the adsorption of fat-soluble vitamins. The major bitter compounds in bile acid are chenocholic acid, deoxycholic acid, and cholic acid. If bile acid leaks from gallbladder during the processing of livestock, poultry and aquatic products, the bitter taste cannot be removed even after repeated washing.

Sour Taste

The sour taste is produced by hydrogen ion of organic acid, inorganic acids and acidic salts. Moderate sour intensity yields pleasant sensation and enhances appetite. Generally, the intensity of the sour taste is positively related to the concentration of hydrogen ion in solutions. When the H+ concentration is too high (pH <3.0), the sour taste becomes intolerable and sour intensity changes can no longer be perceived. The sensation of the sour taste is affected by counter ion species and the buffering capacity of food medium. For example, the sour intensities of five common acids in the same pH are in the following decreasing order: acetate acid > formic acid > lactic acid > oxalate acid > hydrochloride yield. Anions decide the characteristics of the sour taste, which is why the sour taste of sour compounds differs.

Acidulants are important additives in food processing. The compounds not only impart foods with desired sour taste, but also inhibit the growth of microorganisms. The most commonly used acidulant in food industry is acetic acid, followed by citric acid, lactic acid, tartaric acid, gluconic acid, malic acid, fumaric acid and phosphoric acid.

Salty Taste

The salty taste is contributed by neutral salts and it is an indispensable and the most fundamental taste in foods. This taste is the compromise of the effects of dissociated anions and cations. Cations produce salty taste, while anions suppress the sensation of salty taste and elicit other undesirable tastes. Whether an inorganic salt is bitter or salty depends on the diameters of cations and anions. Sodium chloride is the only substance known to evoke a purely salty taste in any concentration that is suprathreshold.

Astringency

Astringency is the sensation of the aggregation of proteins in oral mucosa. Tannins and polyphenols are major components in foods that cause astringency. Besides, some salts (such as alum), aldehydes, organic acids (such as oxalic acid), and quinine acid are sometimes also involved in astringency sensation. Mature fruits taste less astringent than immature fruits, because polyphenols are decomposed, oxidized, or polymerized during maturation. Tea also contains polyphenols, but their contents vary with processing methods. Red tea is less astringent than green tea, because polyphenols are oxidized during fermentation. Astringency is a characteristic taste of red wine. To obtain an acceptable astringency, measures must be taken to reduce the contents of polyphenols in wines.

Pungency

Certain compounds found in some spices and vegetables cause characteristic hot, sharp and stinging sensations that are known collectively as pungency. Pungent compounds enhance the appetite and increase the secretion of digestive juice of consumers and they are indispensable condiments in daily life. Based on sensation, natural pungent compounds are divided into hot, aromatic and irritative types.

Hot compounds:

Pungent compounds of this type are odorless and can cause the burning feeling in mouth. The pungent compounds in chili, black pepper and zanthoxylum belong to this type.

Chili: Capsaicinoids are the vanillyl amides of monocarboxylic acids with varying chain length (C8~C11) and capsaicin is the active component in chili pepper.

Black pepper: Piperine is the major pungent compound in black pepper. Pepperine is an amide compound and has three isomers, of which the isomers with more cis double bonds possess high pungency intensity.

Chinese prickly ash: The main pungent compound in Chinese prickly ash is suberosin and it also an amide compound.

Aromatic compounds:

Pungent compounds of this type are volatile and aromatic.

Ginger: Zingiberols are the main active components responsible for the pungency of fresh ginger. The carbon chain length on the lateral side of hydroxyl in the side chain on the ring is different (n=5-9). When fresh ginger is dried, zingiberols are converted to more pungent gingerols through dehydration. When ginger is heated, the side chain of zingiberols breaks to produce zingerone, which is a moderate pungent compound.

Cloves and nutmeg: The main pungent components in the two species are eugenol and isoeugenol respectively.

Irritative compounds:

In addition to tongue and oral mucosa, compounds of this type are also irritative to nose and eyes. Mustard, radish, horseradish. The pungency and irritability of these materials are contributed by mustard oil that is generated through the hydrolysis of sinigrin. It is the collective of isothiocyanate.

Welsh onion, garlic, leek, and onion: Disulfides are the major pungent and irritative substances in welsh onion, garlic, leek, and onion. The pungent components of garlic are generated by the decomposition of alliin and include diallyl disulfide and allyl propyl disulfide. The pungent components in leek and onion are also sulfur-containing compounds. These substances are converted to sweet thiol compounds when heated. This is why cooked onion and garlic taste sweet other than pungent.

Umami / Meatiness / Delicious Flavor / Flavor Enhancement

A number of compounds have the ability to enhance or improve the flavor of foods. It has often been suggested that these compounds do not have a particular taste of their own. Evidence now suggests that there is a basic taste response to amino acids, especially glutamic acid. This taste is sometimes described by the word *umami*.

It is suggested that a primary taste has the following characteristics:

- The receptor site for a primary taste chemical is different from those of other primary tastes.
- The taste quality is different from others.
- The taste cannot be reproduced by a mixture of chemicals of different primary tastes.

Flavourants as food additives play an important role in rendering a new taste to foodstuffs or in enhancing the already-existing flavour, if it is not sharp enough. They may be used as substitutes in cases of flavour loss during the processing, or even replace the missing components from the overall flavour of food items. They can also be used to mask undesirable flavours in certain food products.

There are many different methods of classifying flavouring agents:

* according to their mode of formation
* according to their source

Flavouring agents may be classified **according to their mode of formation:** either biological, chemical or physical processes which act on either natural or artificial starting materials. Flavourings can also be subdivided according to starting materials, and includes flavouring molecules formed as a result of the following processes:

* **Natural plant metabolism**
* **Enzymatic reactions**
* **Microbial activities**
* **Heating or cooking processes**
* **Oxidative reactions**

Flavouring agents may be classified **according to their source of formation** into three main classes:

* **natural flavouring systems**;
* **synthetic or chemically isolated molecules** (which chemically possess identical properties to the natural flavouring agents); and
* **artificial flavouring agents** (which possess no identical features to natural flavouring agents).

Within the classification which is based on usage, **artificial flavourants are grouped into three categories**.

The first is the **solid form of flavourants** (these are mostly encapsulated flavourants), and they are advantageous in that they are highly volatile (e.g. dimethyl sulphide, methyl mercaptan) and can therefore only be encapsulated to provide flavours in their solid form.

The second category comprises **semisolid pastes**, mainly oleoresins and fruit concentrates. These are attractive in that they form easy dispersions and provide uniform flavouring.

The third category is made up of **liquid forms** which exist in an emulsified state with a compatible solvent base. These are useful in beverages and other liquid foodstuffs.

Functional group responsible for flavour

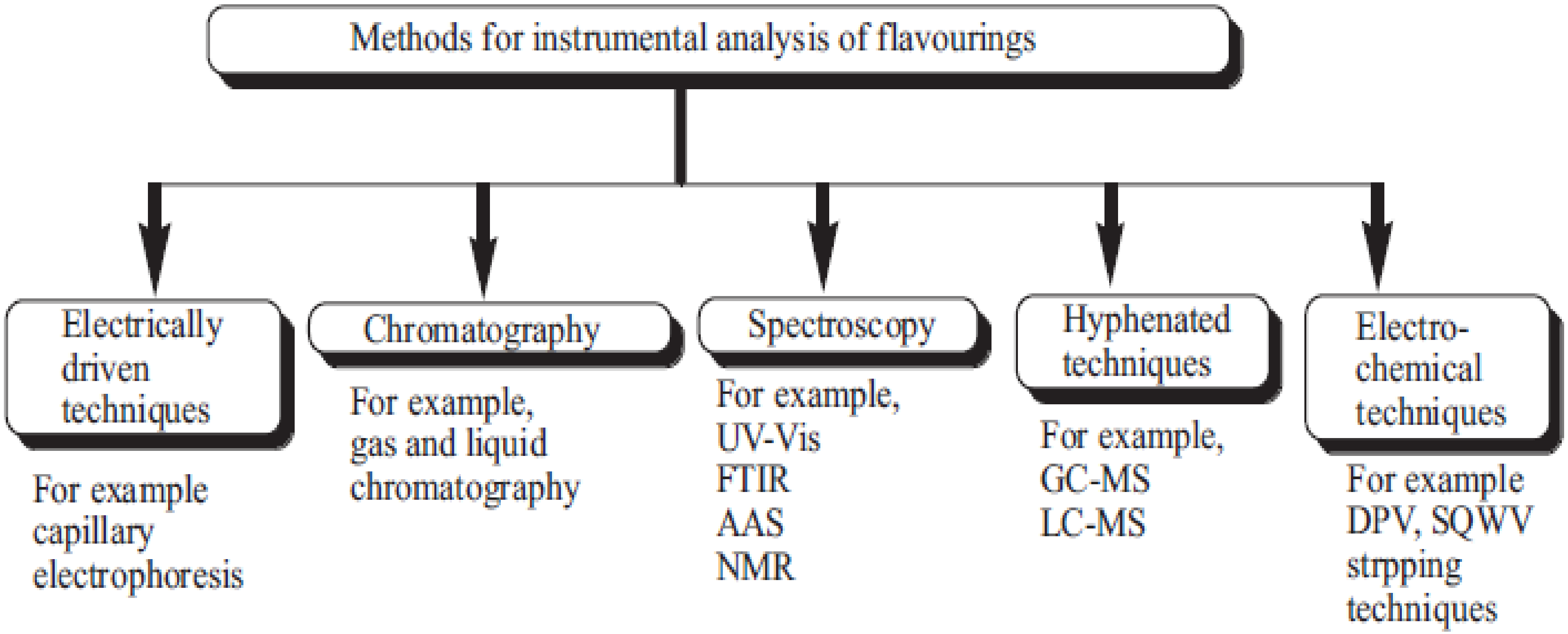
There are a number of functional groups in molecules that provide a characteristic aroma/flavour/taste in various food items. These include benzoaldehyde (almond), 2- methoxy-3-isobutyl-pyrazine (green pepper), pyrazin and thiol functionalities, 4-hydroxy- 3-methoxy-benzoaldehyde (vanilla), 2-trans-6-cis-nonadienol (cucumber) and 2-pentylfuran (a reversal flavour of soybean). There exists a diverse range (although many are esters; such as isoamyl acetate, ethyl propionate, methyl antranilate, methyl salicylate and allyl hexanoate. Other molecules used as flavouring agents are aldehydes such as cinnamic aldehyde and benzaldehyde.

CHEMISTRY OF FOOD FLAVOURINGS

The precursors of flavour compounds are formed through chemical processes, some involving both enzymatic (e.g. those referred to as browning reactions) and non-enzymatic processes. Other types of reactions such as Strecker degradation, pyrazine formation, oxazole formation and thiazole formation are also known to generate flavour precursors.

There are a number of reactions that involve the browning aspect of foodstuffs but also provide characteristic flavours. These include: Maillard browning, caramelisation browning and enzymatic browning reactions.

ANALYTICAL METHODS FOR THE ANALYSIS OF FOOD FLAVOURINGS



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