LECTURE 10: AROMA COMPOUNDS IN FOOD & FLAVOUR ENHANCERS -MONOSODIUM GLUTAMATE, NUCLEOTIDES

10.1 Introduction

When food is consumed, the interaction of taste, odour and texture provide an overall sensation, known as flavour". Flavour results from compounds that are classified in to two classes:

1. Those responsible for taste
2. Those responsible for odour

The latter are often designated as aroma substances. However, there are compounds, which provide both the sensations.

Compounds responsible for taste are generally non-volatile at room temperature. Therefore they interact only with taste receptors located in taste buds of tongue. Aroma substances are volatile compounds, which are perceived by the odour receptor sites of smell organ. i.e. the olfactory tissue of the nasal cavity.

Flavour enchancers are substances that enhance desirable flavours or depress undesirable flavours in foods.

10.2 Classification of Odours

According to the site-fitting theory of odour perception, there are seven primary odours:

1. Camphoraceous
2. Ethereal
3. Musky
4. Floral
5. Minty
6. Pungent
7. Putrid

There are specific receptor sites for each of these above classes. The first three classes of odour perception depend primarily on the size of the molecule, the fourth and fifth classes on shape, the sixth on electrophillicity and the seventh on nucleophillicity.

A given odour is a mixture of appropriate primary odours e.g. almond aroma is a mixture of camphoraceous, floral and minty while garlic odour is mixture of pungent and putrid odours.

10.3 Odour Threshold

The lowest concentration of a compound that is just enough for the recognition of its odour is called odour threshold value. When the detection threshold is lower i.e. the concentration at which the compound detectable for the aroma quality still can't be unambiguously established.

Compounds with high aroma value may contribute to the aroma of foods. The "aroma value" Ax of a compound is calculated according to the definition.

$$A_x = C_x / a_x$$

Here, C_x is concentration of compound x in food.

a_x is order threshold of compound x in food.

10.4 Impact Compounds of Natural Aroma

The amount of volatile substances present in food is extremely low (10-15 mg/kg). In general, however, they compromise a large number of components, all of which are not important to food aroma. To be considered an aroma compound, the compound of volatile fraction must be present in a food in a concentration higher than its threshold value. A characteristic odour in a food can mainly be attributed to the combination of numerous volatile compounds, each of which smells differently. The difference in character of certain aroma partially due to varying proportions of these many widely distributed volatiles such as esters, acids, alcohols, aldehydes and ketones that occur in all foods.

These volatiles are called "contributory flavour compounds". However, most substances contain trace amounts of a few unique volatile compounds, which possess the characteristic essence of the odour. Such potentially important aroma compounds, which provide the characteristic aroma to the food, are "character impact compounds".

Based on the occurrence of such key compounds, foods can be divided into four groups:

(1) It includes those foods in which the aroma is decisively carried by one compound. The presence of other aroma compounds serves only to round off the characteristic aroma of the food. e.g. bananas-isopentyl acetate; Almond-benzaldehyde; Lemon-citral.

(2) Foods included in this group contain several aroma compounds, one of which may play a major role to create or determine the typical aroma of the food.

(3) The aroma of this group may be closely simulated or reproduced only with a large number of compounds. Usually character impact compound is not present e.g. processed foods like roasted coffee and some fruits like pineapple, peach, watermelon.

(4) The aroma of foods included in this group cannot be satisfactorily reproduced even with a large number of volatile compounds e.g. foods processed by fermentation like cocoa, beer and fruits like strawberry.

10.5 Flavour Enhancers - Monosodium Glutamate, Nucleotides

Flavour enhancers have little or no favour of their own but small additions to a food product modify its flavour usually in desirable manner. An enhancer's effect is apparent to the senses as "feeling ", " volume", "body" or "freshness" (particularly in thermally processed foods) of the aroma, and also by the speed of the aroma perception.

10.5.1 Monosodium Glutamate (MSG)

It has long been recognized as a flavour enhancer and is now been considered a primary taste, 'Umami' (derived from the Japanese for delightfulness).

The action of MSG was first observed by Japanese workers who were attempting to explain edible sea-weeds impart flavour enhancing properties to many foods. Although glutamic acid was first isolated in 1066, the flavour enhancing properties of sodium were not discovered until 1909 by the Japanese chemist Ikeda. He found that MSG is the beneficial component of the algae L*aminaria japonica* used for a long time in Japan as a flavour improver of the soup and similarly prepared foods. The L- form the amino acid has the flavour enhancing property while the D-form is inert. MSG is now prepared from wheat gluten, beet sugar waste and soy protein.

Pure MSG is odorless. It is now generally agreed that glutamate flavour is unique. Pure MSG is detectable in concentrations as low as 0.03% and at 0.05% the taste is very strong. It is claimed that the compound intensifies the flavour of meat and vegetable through a rounding or blending effect. In addition glutamate is said to cause a "tingling" feeling of satisfaction or fullness. Apparently, glutamates stimulates our tactile sense as well as our taste receptors. The presence of salts is required to produce the glutamate effect. Glutamate taste is most effective in the pH range of 6-8 and decreases at a lower pH value.

MSG improves the flavour of many food products and is therefore widely used processed foods. Products benefited from the addition of glutamate include meat and poultry, soups, vegetables and sea foods. It does not have any effect on fruits or fruit juices or sweet spicy foods. It also suppresses undesirable flavour like sharpness of onion, rawness of many vegetables, earthiness of potatoes, bitterness in canned products of fish, meat, stews, soups etc.

The intake of large amounts of MSG by some hypersensitive persons can trigger a "Chinese restaurant syndrome". This is characterized by temporary disorder such as drowsiness, headache, stomach ache and stiffening of joints. As a result, its use has been under scrutiny. It is argued that relatively high levels of MSG are naturally produced in certain foods such as well-aged cheese and tomato paste. Thus, the basic scientific question is why individuals who claim to experience adverse reactions to intentionally added MSG apparently do not experience similar reactions to naturally MSG.

10.5.2 5- nucleotides

The 5'- nucleotides especially 5'-insoniate and 5'-guanylate have enhancement properties similar to Mono Sodium Glutamate. Their flavour enhancing ability at 75-500 ppm is good in all foods. Sourness and sweetness are not affected. Additionally they improve the viscosity of liquid foods. There are three types of inosinic acid, 2'-,3'-,5,' – isomers has flavour activity. Both riboside 5'-phosphomonoester linkages are required for flavour activity. They also show a synergistic effect in the presence of glutamate.

10.5.3 Other

A different type of flavour enhancer is Maltol; (3-hydroxy-2-methyl-4-pyrone) has a caramel-like odor. It has the ability to enhance the perception of sweetness in carbohydrate rich food. e.g. fruit juices, marmalade, fruit jelly. It is useful as a flavour enhancer in chocolates, candies, ice cream, baked products, liquors and flavourings. It is used in concentration of 50-250 ppm. It is able to mask the bitter flavor of hops and cola. Addition of 5-75 ppm maltol allows a decrease of sugar content by about 15%, while retaining the sweetness intensity. Moreover maltol is reported to have antioxidant properties also. It has been found to prolong storage life of coffee and roasted cereal products.

Ethyl maltol [3-hydroxy-2-ethyl-4H-pyran-4-one] enhances the same aroma but is 4- to 6-times more powerful than maltol. It has not been detected as a natural constituent in food. Nevertheless, it is used for food aromatization.