FOOD CHEMISTY

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Aroma Compounds in Food

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- **Food** => interaction of **taste**, **odour** and **texture** => provide an overall sensation => “ **flavour** ”
- Flavour compounds => classified into two gps :
- responsible for **taste**
- responsible for **odour** => designated as **aroma substances**.
- However, some compounds => **both** the sensations.
- **Compounds responsible for taste** are generally **non-volatile** at room temperature => they interact => with taste receptors in taste buds of tongue.
- **Aroma substances** are **volatile** compounds => perceived by the odour receptor sites of smell organ => olfactory tissue of nasal cavity.
- **Flavour enchancers** => **enhance desirable** flavours or **depress undesirable** flavours in foods.

- **CLASSIFICATION OF AROMA COMPOUNDS :**
- based on **functional groups** –
- 1.**Alcohols** – imp aroma alcohols – furaneol (strawberry) , menthol (peppermint)
- 2.**Aldehydes** – acetaldehyde (pungent), benjaldehyde (almond), citral (lemon oil)
- 3.**Amines –** indole (jasmine flowery), trimethyl amine (fish)
- 4.**Esters –** ethyl acetate (fruity), octyl acetate (orange)
- 5.**Ketones –** octenone (mushroom), acetyl pyrroline (fresh bread)
- 6.**Lactones –** sweet coconut odor
- 7.**Terpenes -** limonene (orange), nerol (sweet rose)

CLASSIFICATION OF ODOURS

A/c **site-fitting theory** of odour perception => **seven** primary odours:

- **Camphoraceous**
- **Ethereal**
- **Musky**
- **Floral**
- **Minty**
- **Pungent**
- **Putrid**

- **Each olfactory nerve ending => specific receptor sites => whose shape and size corresponds to one of the mol. Style** (for each of the classes).
- first 3 classes of odour perception depend => **size** of the molecule,
- the fourth and fifth classes => on **shape**,
- the sixth class => on **electrophillicity** and
- the seventh class => on **nucleophillicity**.

A subs whose mol. occupy > **one site –** may indicate a complex odour → brain.

Given odour is a mixture of **appropriate primary odours** e.g.

- **almond aroma** is a mixture of
- camphoraceous,
- floral and
- minty

- **garlic odour** is mixture of
- pungent and
- putrid odours.

THRESHOLD VALUE :

- **Odour threshold value :** lowest concentration of a compound => just enough for the **recognition** of its **odour**.

- **Lower detection threshold** => the concentration at which the compound detectable for **aroma quality** still can't be unambiguously established.

- Compounds with **high aroma value** => contribute => aroma of foods.

- The "**aroma value**" A_x of a compound is calculated :
- $$A_x = C_x / a_x$$
- Here, C_x is **concentration** of compound x in food.
- a_x is **odour threshold** of compound x in food.

IMPACT OF NATURAL AROMA COMPOUNDS

- Amount of volatile substances => extremely low (10-15mg/kg)in foods.
- They compromise large number of components => some of which are important => food aroma.
- compound of volatile fraction must be present => in a concentration > its threshold value => considered an aroma compound .
- A characteristic odour in a food => attributed to the combination of numerous volatile compounds => each of which smells differently.

Difference in character of certain aroma => partially due to varying proportions => widely distributed volatiles such as

- esters,
- acids,
- alcohols,
- aldehydes and
- ketones → occur in all foods => known as

"contributory flavour compounds"

However, most substances contain => trace amounts of a few unique volatile compounds => which possess the characteristic essence of the odour → **"character impact compounds"**.

Based on **occurrence** of such **key compounds**, foods => **4 groups**:

(1) Foods => aroma is decisively carried by **one compound**. 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 => contain **several** aroma compounds, **one** of which may play a major role => typical aroma of the food.

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

(4) Foods => aroma **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.

FLAVOUR AND FLAVOUR ENHANCERS

- **Flavour** is the sensory impression of a food and is determined by the chemical senses of taste and smell.
- **Flavorant** is defined as a subs that gives flavour, altering the characteristics of the solute and causing it to become
- Sweet, sour, tangy etc.
- **Flavorings** are focused on altering or enhancing the flavours of natural food products ,e.g., meat and veg. or, creating flavour for food products that don't have the desired flavours,e.g., candies and other snacs.

- **Three principal types of flavorings** → foods :

- **Natural Flavoring subs**
- **Nature- identical Flavoring subs**
- **Artificial Flavoring subs**

- **Flavour enhancers** are **amino acid** or **nucleotide** derivatives => capable of enhancing the odour of food – savory flavorants or umami.

- These → manufactured as Sodium or Calcium salts.

- **Imp types** of Flavour enhancing subs :

- Glutamic acid salts
- Glycine salts
- Guanylic acid salts
- Inosinic acid salts
- Organic acid

- **Flavour enhancers** => little or no flavour of their own but small additions => food product => **modify** its flavour => desirable manner.

- Enhancer's **effect** is apparent to the senses as
- "feeling ",
- "volume",
- "body" or
- "freshness" (in thermally processed foods) of the aroma, and
- speed of the aroma perception.

MONOSODIUM GLUTAMATE (MSG)

- **flavour enhancer** and is now been considered a **primary taste**
- glutamic acid => first isolated in 1866, the flavour enhancing properties of sodium => not discovered until 1909.
- Japanese chemist Ikeda => MSG is beneficial component of algae Laminaria japonica used in Japan as flavour improver of soup & similarly prepared foods.
- L- form amino acid => flavour enhancing property, D-form => inert.
- MSG => from wheat gluten, beet sugar waste and soy protein.

- MSG => odorless.
- glutamate flavour => unique.
- detectable => 0.03% concentrations.
- taste => very strong at 0.05% .
- intensifies the flavour => meat and vegetable => through a rounding or blending effect.
- cause a “tingling” feeling of satisfaction or fullness. It stimulates our tactile sense as well as our taste receptors.
- presence of salts is required => produce the glutamate effect.
- Glutamate taste => most effective in pH (6-8) and decreases => lower pH

- improves flavour => many food products => widely used processed foods.
- Products => meat and poultry, soups, vegetables and sea foods.
- No effect on fruits or fruit juices or sweet spicy foods.
- suppresses undesirable flavour => earthiness of potatoes, sharpness of onion, rawness of many vegetables, bitterness in canned products of meat, fish, soups, stews etc.

- large amounts intake => hypersensitive persons => trigger
- “Chinese restaurant syndrome”.
- characterized by headache, drowsiness, stomachache and stiffening of joints.
- As a result => use has been under scrutiny.
- relatively high levels of MSG are naturally produced => certain foods => well-aged cheese and tomato paste.
- basic scientific question => why individuals who claim to experience adverse reactions to intentionally added MSG apparently do not experience similar reactions to naturally MSG.

5’- **nucleotides**

- 5’- nucleotides (5’-inosinate and 5’-guanylate) => similar MSG.
- flavour enhancing ability => **75-500 ppm** => all foods.
- Sourness and sweetness => not affected.
- improve viscosity => liquid foods.
- three types of inosinic acid, 2’,3’-,5’ – isomers => flavour activity.
- Both riboside 5’-phosphomonoester linkages are required for flavour activity.
- show a synergistic effect in => presence of glutamate.

Maltol

- **Maltol** (3-hydroxy-2-methyl-4-pyrone) => caramel- like odor.
- used in concentration => **50-250 ppm.**
- have antioxidant properties.
- enhance the perception of sweetness in carbohydrate rich food. e.g. fruit juices, marmalade, fruit jelly.
- Addition of 5-75 ppm maltol => 15% decrease of sugar content while retaining the sweetness intensity.
- flavour enhancer in baked products, candies, chocolates, ice cream, liquors and flavourings.
- prolong storage life of coffee and roasted cereal products.
- mask the bitter flavor of hops and cola.

- **Ethyl maltol** [3-hydroxy-2-ethyl-4H-pyran-4-one]
- enhances => same aroma but is 4- to 6-times > powerful than maltol.
- not detected as natural constituent in food.
- used => food **aromatization**.

Flavour enhancers

Number	Name	Comments
E620	Glutamic acid	flavour enhancer, salt substitute; amino acid present in many animal and vegetable proteins, derived commercially from bacteria; might cause similar problems as MSG (E621), young children should avoid it
E621	Monosodium glutamate (MSG)	flavour enhancer derived from the fermentation of molasses, salt substitute; adverse effects appear in some asthmatic people, not permitted in foods for infants and young children; typical products are canned vegetables, canned tuna, dressings, many frozen foods
E622	Monopotassium glutamate	can cause nausea, vomiting, diarrhoea, abdominal cramps; typical products are low sodium salt substitutes
E623	Calcium diglutamate	salt substitute, no known adverse effects
E624	Monoammonium glutamate	salt substitute, no known adverse effects
E625	Magnesium diglutamate	salt substitute, no known adverse effects
E626	Guanylic acid	may trigger gout
E627	Disodium guanylate	isolated from sardines or yeast extract; may trigger gout, not permitted in foods for infants and young children
E629	Calcium guanylate	may trigger gout
E631	Disodium inosinate	may be prepared from meat or sardines; may trigger gout, not permitted in foods for infants and young children
E633	Calcium inosinate	may trigger gout
E635	Disodium 5'-ribonucleotide	may be associated with itchy skin rashes up to 30 hours after ingestion; rashes may vary from mild to dramatic; the reaction is dose-related and cumulative, some individuals are more sensitive than others; typical foods include flavoured chips, instant noodles and party pies; avoid it, banned in some countries
E636	Maltol	derived from the bark of larch trees, pine needles, chicory wood, oils and roasted malt; it may be produced synthetically
E637	Ethyl maltol	derived from maltol
E640	Glycine & its sodium salt	?

THANKS