9. COMPOUNDS INFLUENCING FOOD AROMA

sensory quality
organoleptic properties

perception
- olphactoric  smell  odorous compounds
- gustative  taste  gustatory compounds
- visual  vision  colour compounds (colourants)
- auditorial  hearing
- haptic  tactile

perception of smell + perception of taste = perception of aroma
odorous compounds + gustatory compounds = aroma compounds

ODOROUS COMPOUNDS

key components (book 2, tab. 8.1)
composition of citrus essential oils (kniha2. tab. 8.20), spices (book 2, tab. 8.21)
stimuli thresholds (book 2, tab. 8.22, 8.23, 8.24)

olphactoric perception
~ 10 000 compounds, ~ 50 – 1000 different compounds in individual foods

properties
- low polarity or non-polar compounds
- little soluble and unsoluble in water
- volatile

main groups
hydrocarbons, alcohols, ethers, carbonyl compounds (aldehydes, ketones), acetals (kets), acids,
functional derivatives of acids (esters, lactones), phenols, S- N-aliphatic compounds, O-, S-, N-
heterocycles

formation
- primary compounds
  bound as glycosides, esters
  free
- secondary compounds
  enzymatic reactions (damage of tissues on storage and processing)
  chemical reactions (storage, processing)

non-enzymatic browning reactions
fermentation processes
oxidative reactions
thermal reactions (Maillard reaction)

off-flavours
- processing (undesirable fermentation, preservation, thermal operation)
- storage (microbial contamination, reaction of components, oxidation, packaging material)
factors influencing aroma perception
- thresholds of perception
- stimuli threshold
- threshold of recognition

key components of aroma (book 2, tab. 8.1)
- synergism, antagonism of compounds
- sensitivity of individuals
  - age, sex, physiological and pathological conditions
  - adaptation
  - anosmia

hydrocarbons
primary compounds
- terpenes (derivatives of isoprene)

secondary compounds
- products of oxidation (fatty acids) (book 2, tab. 8.2)
- products of decarboxylation (acids)
- products of dehydration (secondary alcohols, sterols)
- products of pyrolysis (different compounds)

aliphatic
- hexane
- nonadecane

acyclic
- (R)-limonene

aromatic and polycyclic aromatic (PAU)
- benzene, toluene, xylene, benzo[a]pyrene
- contaminants

alcohols
primary compounds
- terpenes (derivatives of isoprene)

secondary compound
- products of esters hydrolysis (methanol)
- products of fermentation (ethanol, fusel oil alcohols)

aliphatic saturated
- methanol
- ethanol

hydrolysis of pectin
- sugar fermentation
pyruvate dehydrogenase

\[
\text{cukr} \rightarrow CH_3C\overset{\text{COOH}}{\text{O}} \rightarrow CH_3CH=O \rightarrow CH_3CH_2OH
\]

- higher alcohols
  - fusel oil (book 2, tab. 8.3)

\[
R-CH-\overset{\text{COOH}}{\text{NH}} \quad \overset{\text{oxidace nebo transaminace}}{\text{oxidace}} \quad R-\overset{\text{COOH}}{\text{NH}} \quad \overset{\text{hydrolyza}}{\text{hydrolýza}}
\]

\[
\overset{\alpha}{\text{amino}} \quad \overset{\alpha}{\text{imin}} \quad \overset{\alpha}{\text{oxo}}
\]

- aliphatic unsaturated
  - oxidation of higher fatty acids

\[
CH_3\{CH_2\}_nCH=CHCH_2CH=CH(CH_2\}_mCOOR
\]

- terpenic and aromatic alcohols
  - menthol
  - cinnamyl alcohol
  - menthol
  - mint, chewing gum
  - cinnamyl alcohol
  - cinnamon

- aldehydes
  - sensory properties (book 2, tab. 8.5)

- primary compounds
  - terpenes
citral and (geranial) citrus essential oils

- other primary compounds: aniseed, badyan, vanilla, cinnamon

anisaldehyde vanillin; cinnamaldehyde

**secondary compounds**
- products of Strecker degradation of amino acids
- oxidation products of fatty acids (book 2, tab. 8.4)

**ketones**

**primary compounds**
- terpenes

carvone caraway

**secondary compounds**
- products fatty acids $\beta$-oxidation
- products of saccharides degradation

methylketones diketones

aroma of butter

**acids and their functional derivatives**

**acids**

content (book 2, tab. 8.8, 8.9, 8.10, 8.11)

**primary compounds**
- aromatic acids aromatic and gustatory compounds
- hydroxycarboxyl acids gustatory compounds
secondary compounds
- fermentation products (book 2, tab.8.7)
  formic, acetic, propionic, higher acids

  \[
  \text{oxidace} \\
  \begin{array}{c}
  \text{CH}_3\text{CH}_2\text{OH} \\
  \text{Acetobacter}
  \end{array} \rightarrow \text{CH}_3\text{COOH}
  \]

  \[
  \text{redukce} \\
  \begin{array}{c}
  \text{CH}_3\text{CH}_2\text{COOH} \\
  \text{Propionibacterium}
  \end{array} \rightarrow \text{CH}_3\text{CH}_2\text{COOH}
  \]

- products of saccharide degradation
  formic, acetic

esters

sensory properties (book 2, tab. 8.14)
content (book 2, tab. 8.13)
primary and secondary compounds

main compounds:
- acetic acid
- formic acid
- propionic acid
- butyric acid
- isoamylactic acid

fruity and flower aroma

alcoholic beverages
- ethyl acetate
- beer
  - ~ 30 mg/l
- wine
  - 10-260 mg/l
- apple acetates, butyrates
- banana isoamylacetate
- pineapple ethyl-3-(methylthio)propionate

lactones

primary and secondary compounds

\[
\text{H}_2\text{O} \\
\begin{array}{c}
\text{R CH}[\text{CH}_2]_n\text{OH} \\
\gamma\text{-hydroxyl acids} \rightarrow \gamma\text{-lactones (butano-4-lactones)}
\end{array} \rightarrow \text{R CH}[\text{CH}_2]_n\text{C COO}
\]

\[
\gamma\text{-hydroxyl acids} \rightarrow \gamma\text{-lactones (butano-4-lactones)}
\]

\[
\delta\text{-hydroxyl acids} \rightarrow \delta\text{-lactones (pentano-5-lactones)}
\]

aromatic hydroxy acids → cumarins, phthalides

\[
\gamma\text{-nonalactone } n = 4 \quad \text{coconut aroma}
\gamma\text{-decalactone } n = 5 \quad \text{peaches aroma}
\gamma\text{-dodecalactone } n = 7 \quad \text{butter aroma}
\]
phenols

content (book 2, tab. 8.16)

**primary compounds**

essential oils

- thymol
- eugenol

- thyme
- clove

**secondary compounds**

- decarboxylation of phenolic acids
- lignin degradation

- vinylphenol

**sulphur containing compounds**

**primary compounds**

- essential oils

- p-meth-1-en-8-thiol
- grapefruit

**secondary compounds**

- degradation products of sulphur-containing compounds
- sulphur amino acids

- methional
- boiled potato
- diallyldisulfide
- garlic

- methional
- boiled potato
- diallyldisulfide
- garlic

- glucosinolates

- allylisothiocyanate
- mustard, horse radish

**nitrogen containing compounds**

primary and secondary compounds

- decarboxylation products of amino acids
• transformation products of other compounds

amines, biogenic amines

precursors (book 2, tab. 8.19
content (book 2, tab. 8.18)

\[
\text{R-CH-COOH} \\
\text{NH}_2 \\
\xrightarrow{\text{redukce}} \\
\text{R-CH}_2\text{-NH}_2
\]

trimethylaminoxide trimethylamine

heterocyclic compounds

\(O-, S-, N\)-heterocycles

primary compounds

2-isobutylthiazole
tomato

2-isobutyl-3-methoxypyrazine
bell pepper

secondary compounds

• products of Maillard reaction
• products of other reactions

isomaltol,
furaneol,
furfurylthiol
(caramel, strawberry and pineapple fruit, coffee)

maltol, 2,4-dimethylthiophene, 2-acetyl-1-pyrroline, 2,6-dimethylpyrazine
(caramel, fried onion, bread, chocolate and nuts)
synthetic compounds

ethymaltol
caramel

ethylvanillin (bourbonal)
vanilla sugar

ethyl-3-fenyl-3-methylglycidate
strawberry (candies)