10. COMPOUNDS INFLUENCING FOOD TASTE

perception of gustation

4 (5) basic tastes

- sweet end of tongue
- salty upper surface of tongue
- acid sides of tongue
- bitter root of tongue, roof of the mouth
- umami whole oral cavity

- further perceptions
  adstringent taste, ....

properties
polar, water-soluble, non-volatile

formation

- primary compounds
- secondary compounds
  enzymatic reactions (damage of tissues on storage and processing)
  chemical reactions (storage, processing)

off-taste

factors influencing taste perception

- thresholds of perception
  stimuli threshold
  threshold of recognition

Sweet compounds

classification
according to origin

- natural
- synthetic, identical with natural
- modified natural and synthetic

according to importance in nutrition (energy value)

- nutrients (source of energy)
- non-nutrients (they are not source of energy)

according to possibility to influence the blood sugar level

- contraindicated to diabetes
- without any influence

according to influence on caries

- cariogenic
- non-cariogenic

artificial sweeteners
taste quality
sweeteners (book 2, tab. 8.26, 8.27)

- saccharides
- natural sweet compounds

- synthetic compounds

glycyrrhizine

Salty compounds

Inorganic salts, mostly NaCl
threshold concentration (book 2, tab. 8.28)
natural content of NaCl (book 2, tab. 8.29)
some salts of organic acids
taste quality, further attributes (bitter, metallic)

food classification

- with very low content
  milk, fruits, vegetables  < 0,4 g/kg Na
- with low content
  meat, poultry, fish  0,4-1,2 g/kg Na
- with high content
  bread, some bakery products, pickled vegetables  1,2-4,0 g/kg Na
- with very high content
  some meat and fish products, olive, salty condiments  > 4,0 g/kg Na
Acidic compounds

non-dissociated carboxylic acids >>

- aliphatic monocarboxylic volatile aroma, taste,
- aliphatic dicarboxylic non-volatile taste
- aliphatic hydroxy acids non-volatile taste
- alicyclic non volatile taste
- aromatic some non-volatile aroma, taste

threshold concentration (book 2, tab.8.30)

mineral acids, H₃O⁺ (pH)
taste quality, further attributes (fruity)

food classification

- very sour pH < 4,0 fruits
- little sour pH 4,0-6,5 vegetables (fruits), cereals
- neutral pH > 6,5 meat, milk, egg

fruits citric, malic, quinic, ascorbic
vegetables citric, malic, oxalic
meat lactic
milk (vegetables) fermented products lactic

apple unripe quinic
apple ripe, pulp malic
apple ripe, skin citric, malic

aliphatic monocarboxylic acids
formic side product of fermentation, degradation of saccharides preservative compound
acetic acetic acid fermentation (Acetobacter), vinegar preservative compound
propionic propionic acid fermentation (Propionibacterium) preservative compound

aliphatic dicarboxylic acids
oxalic metabolism, antinutritive compound
succinic metabolism
fumaric, (E)-but-2-enic metabolism

\[
\begin{align*}
\text{formic} & : & \text{HCOOH} \\
\text{acetic} & : & \text{CH₃COOH} \\
\text{propionic} & : & \text{CH₃CH₂COOH} \\
\end{align*}
\]

aliphatic hydroxyacids
lactic milk fermented products (Lactobacillus and others), meat

\[
\begin{align*}
\text{lactic} & : & \text{CH₃CHOHCOOH} \\
\text{D(-)-lactic} & : & \text{CH₃C(=O)OH} \\
\text{(R)-2-hydroxypropionic} & : & \text{CH₃COOH} \\
\text{L(+)-lactic} & : & \text{HOCH₂C=H} \\
\text{(S)-2-hydroxypropionic} & : & \text{CH₃} \\
\end{align*}
\]
milk fermented products 0.5-1.0 %
sauerkraut 1.5-2.5 %
sour olive 0.8-1.2 %
meat 0.2-0.8 %

L-malic acid  
fruits, vegetables, additives (acidulant)

\[
\text{COOH} \\
\text{HO-C-H} \\
\text{CH}_2 \\
\text{COOH}
\]

tartaric acid  
fruits, vegetables, additives (acidulant)

\[
\text{COOH} \\
\text{H-C-OH} \\
\text{HO-C-H} \\
\text{COOH}
\]

L-tartaric, (2R,3R)-tartaric, L-threarcic  
D-tartaric

grapy acid (racemic mixture, racemate, K-H salts = tartar), mesotartaric (erythraric)

citric acid  
fruits, vegetables, additives (acidulant)

\[
\text{CH}_2\text{-COOH} \\
\text{HO-C-COOH} \\
\text{CH}_2\text{-COOH}
\]

L-citromalic  
D-isocitric

alicyclic acids

L-quinic  
fruits, vegetables (free, depsides)

\[
\text{COOH} \\
\text{OOH} \\
\text{OH}
\]

aromatic acids

fruits, vegetables, cereals, (free, esters, glycosides,)

seeds germination inhibition, antibacterical properties
sensory properties (phenols, non-enzymatic browning reactions)
benzoic acid, cinnamic acid and derivatives

\[
\begin{array}{c}
\text{4-OH} \\
\text{3,4-diOH} \\
\text{4-OH, 3-MeO} \\
\text{4-OH, 3,5-diMeO} \\
\text{3,4,5-triOH}
\end{array}
\]

\[
\begin{array}{c}
\text{benzoic} \\
p\text{-hydroxybenzoic} \\
\text{protocatechuic} \\
\text{vanillic} \\
\text{syringic} \\
\text{gallic}
\end{array}
\]

\[
\begin{array}{c}
\text{cinnamic} \\
p\text{-cumaric} \\
\text{caffeic} \\
\text{ferulic} \\
\text{sinapic}
\end{array}
\]

- benzoic, \( p \)-hydroxybenzoic
- caffeic
- vanillic
- gallic

- food preservative
- substrate oxidoreductases
- component of alkaloids
- component of tannins

apple, potato, coffee (chlorogenic = caffeic + quinic)
dates (dactylipheric = caffeic+ shikimic)

**Bitter compounds**

**primary compounds**

- characteristic compounds of plants

**secondary compounds**

- formation during processing and storage
  - (reaction products, metabolites of microorganisms)

**threshold concentration** (book 2, tab.8.31)

**additives**

- alkaloids
  - quinine (true alkaloids, quinolinic alkaloids), tonic water
  - caffeine (protoalkaloids, purine alkaloids)
    - coffee, tee, cocoa, maté, guarana, cola drinks

**fruits**

- grapefruits (bitter oranges)
- flavonoids (flavanones)
naringin = naringenin (R = H) + neohesperidose, α-L-Rha-(1→2)-β-D-Glc
neohesperidin = hesperetin (R = CH$_3$) + neohesperidose

oranges
terpenes (limonoids)
production of orange juices

olive
phenols

vegetables
lettuce, endive, chicory (lactucin)

spices and other plant materials
wormwood (absinthin)
hops
derivatives phloroglucinol (1,3,5-benzenetriols)
bitter acids (18 % dry matter)
content (book 2, tab. 8.32)
- α-bitter acids (homologues humulone)
- β- bitter acids (homologues lupulone)

beer
isobitter acids
- iso-α-bitter acids (isohumulone)
- iso-β- bitter acids (isolupulone)

Adstringent compounds
perception = protein interaction of saliva with polyphenolic compounds → denaturation (loss of protective role)

tannins
- hydrolysed polymers of gallic acid esters
  additives, little in food
- condensed polymers of flavan-3-ols (3,4-diols)
  food (fruits, wine)

hydrolysed tannins
- gallotannins

- ellagotannins

hexahydroxybiphenylic acid (C-C dimer) ellagic acid (lactone)
gallotannins
Chinese tannin
mixture of galloylestes and \( m \)-digalloylestes \( \alpha \)-glucose
elimination of turbidity caused by proteins (vinegar, beer, wine)

ellagotannins

**condensed tannins** (proanthocyanidins, flavolans)

dimers and higher oligomers (2-10 units)
  - flavan-3-ols (catechins)
  - flavan-3,4-diols (leucoanthocyanidines)

monomers do not have the properties of tannins
oxidised oligomers are coloured

oxidase

\[
\begin{align*}
  \text{afzelechins} & \quad (R^1 = R^2 = H) & \text{leucopelargonidin} \\
  \text{catechins} & \quad (R^1 = H, R^2 = OH) & \text{protocatechuic} & \text{leucocyanidin} \\
  \text{gallocatechins} & \quad (R^1 = R^2 = OH) & \text{gallic} & \text{leucodelphinidin}
\end{align*}
\]

geometric isomers
  - H2 a H3 \textit{trans} = catechins, gallocatechins
  - H2 a H3 \textit{cis} = epicatechins, epigallocatechins

esters with gallic acid
  - catechingallates
  - gallocatechingallates

examples
fruit and wine tannins

tea tannins
non-enzymatic browning reaction
Bitter compounds

primary compounds
- characteristic components of plants

secondary compounds
- enzymatic reactions

alkaloids

true alkaloids: piperine (black pepper)

protoalkaloids: capsaicin (bell pepper, chilli)

phenols

eugenol (clove)

gingerol (ginger)

isothiocyanates

allylisothiocyanate (mustard, horse radish)

allylisothiokyanát

allylkyanid