

Availability of information in relation to the concentrations of flavourings in foods

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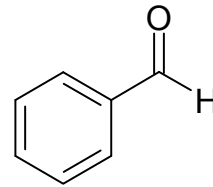
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- One (or a few) substances determine the aroma
→ “character impact compounds”

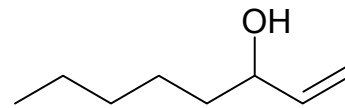
- Aroma is determined by a combination of many substances (100 - 400)
→ defined qualitative and quantitative distribution
responsible for odour impression

benzaldehyde



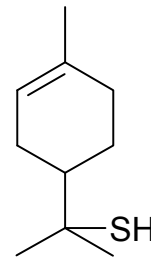
almond

1-octen-3-ol

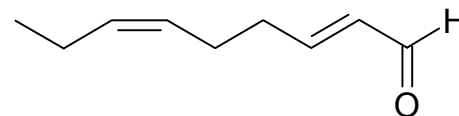


mushroom

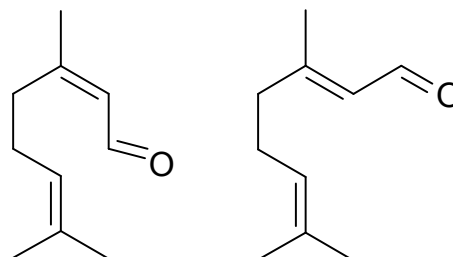
1-p-menthen-8-thiol



grapefruit

(E,Z)-2,6-nonadienal

cucumber

neral/geranial
(citral)

citrus

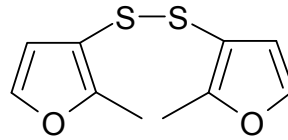


- Odour quality
 - description (dependent on concentration)
- Odour potency
 - odour threshold ($\mu\text{g/L H}_2\text{O}$)
(ng/L air)
- Odour contribution
 - odour activity value

$$\left[\frac{\text{concentration in food}}{\text{odour threshold}} \right]$$

compound	odour threshold (mg/L)
pyrazine	300
ethanol	100
maltol	35
hexanol	0.7
butanoic acid	0.2
hexanal	0.02
vanillin	0.02
ethyl butanoate	0.001
(+)-nootkatone	0.001
(-)-nootkatone	1.0
ethyl 2-methylbutanoate	0.0001
4-hydroxy-2,5-dimethyl-3(2H)-furanone	0.00004
methyl mercaptane	0.00002
1-p-menthen-8-thiol	0.00000002

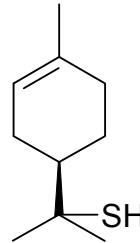
bis(2-methyl-3-furyl)disulfide



thiamine odor

$2 \cdot 10^{-6}$

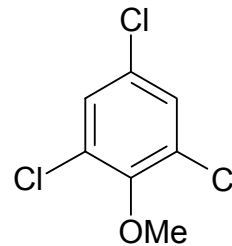
(+)-(R)-1-p-menthen-8-thiol



grapefruit juice

$2 \cdot 10^{-5}$

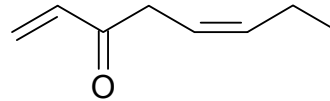
2,4,6-trichloroanisole



cork odor

$3 \cdot 10^{-6}$

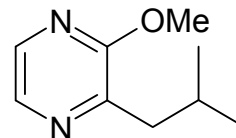
(5Z)-octa-1,5-dien-3-one



butter

0.001

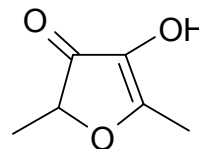
2-methoxy-3-isobutylpyrazine



pepper

0.002

2,5-dimethyl-4-hydroxy-3(2H)-furanone (Furaneol®)



strawberry

0.04

compound	concentration ($\mu\text{g}/\text{kg}$)	odour threshold ($\mu\text{g}/\text{L}$ water)	odour activity value
(Z)-3-hexenal	12000	0.25	48000
β -ionone	4	0.007	571
hexanal	3100	4.5	689
β -damascenone	1	0.002	500
2-penten-3-one	520	1	520
(Z)-3-hexenol	150	70	2.1
2-phenylethanol	1900	1000	1.9
geranial	12	32	< 1
linalool	2	6	< 1
pentanol	120	4000	< 1
isobutyl cyanide	13	1000	< 1

- Chemically defined flavouring substances
 - natural
 - nature-identical
 - artificial

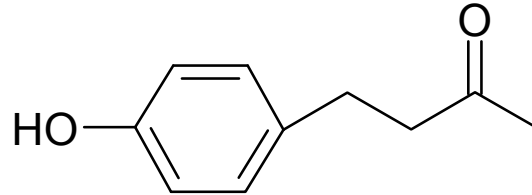
- Flavouring preparations
 - extracts
 - distillates
 - essential oils

- Process flavourings
 - reaction flavours

- Smoke flavourings



- In practice: mixtures of flavouring substances (~ 30 - 100)
- 10 - 20 % flavouring substances
80 - 90 % solvents, carriers, preservatives
- Use levels: 100 – 300 mg/kg food



nature-identical
"raspberry flavourings"

(n=16 samples)

- average number of flavouring substances: 32 $\left[\begin{array}{l} \text{min. 16} \\ \text{max. 46} \end{array} \right]$
- average content of raspberry ketone: 20 % $\left[\begin{array}{l} \text{min. 5 \%} \\ \text{max. 43 \%} \end{array} \right]$



- dosage:
 - 30 g flavouring / kg tea
 - ~ 80 % solvent
 - 6 g flavouring substances / kg tea
 - ~ 20 % raspberry ketone
 - 1.2 g raspberry ketone / kg tea

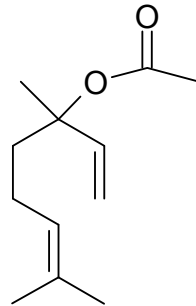
- infusion:
 - 16 g tea + 800 mL water
 - 19.2 mg raspberry ketone / 800 mL water
 - 3.0 mg raspberry ketone / cup
(125 mL water)

Nature-identical
bergamotte flavourings

(n=13 samples)

- number of flavouring substances
 - average: 60
 - minimum: 33
 - maximum: 123

- contents of

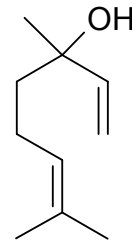


Linalyl acetate

Σ : 74 %

33 %

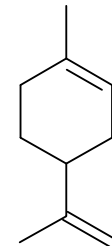
(13 - 50 %)



Linalool

24 %

(10 - 60 %)



Limonene

17 %

(2 - 35 %)



Citral (neral/geranial)		90.5 %
Terpenes, Terpen Alcohols Aldehydes, Ketones, Acids	(Σ : 90)	9.5 %

- - use of essential oil (fraction) as basis
 - addition of key compounds

- - difficulties to differentiate between
 - flavouring substances added as flavouring preparations
 - flavouring substances added as such
 - aroma compounds naturally present in food



- Flavour release dependent on
 - solubility of flavouring substance in food matrix (protein, carbohydrate, fat)
 - interactions with food matrix (chemical reactions; diffusion phenomena)

- Adjustment of use levels/concentrations of flavouring substances



- Patent Unilever (1994)

- high-fat milk products: diacetyl / 5-decanolide >>2 mg/kg

- low-fat milk products: diacetyl 0.5 mg/kg

- < 4 % fat

- 5-decanolide 0.01 -1 mg/kg

- > 50 % water



Öko-Test (2003)

„Strawberry-Yoghurts“ (n = 22)

- labelling: 3.5-24% fruit content
- analysis: concentrations of flavouring substances
14 – 650 fold higher than expected from
naturally occurring amounts



- Broad range of concentrations of flavouring substances in foods depending on odour thresholds
- Addition of flavouring substances mostly not as single substances but as complex mixtures
- Difficulties to differentiate added flavouring substances from naturally present aroma compounds
- Variability of concentrations depending on food matrix
- Loss of flavouring substances owing to food processing