Taste and Aroma in Flavor Sensory

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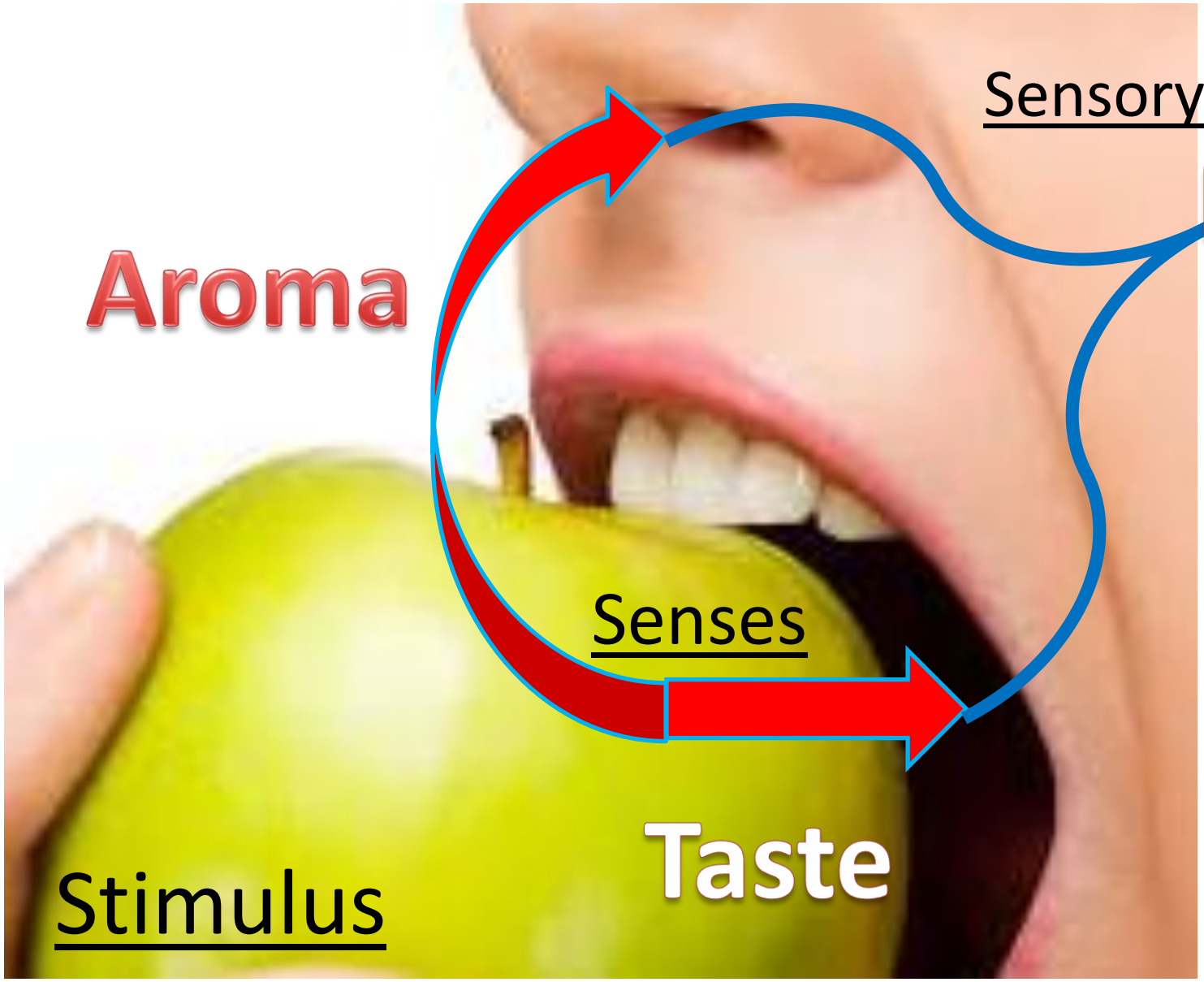
Indera apa yang digunakan?


Sensory Response
Flavor
Aroma
Senses
Taste
Stimulus

mekanisme

Bahan Pangan

Senyawa

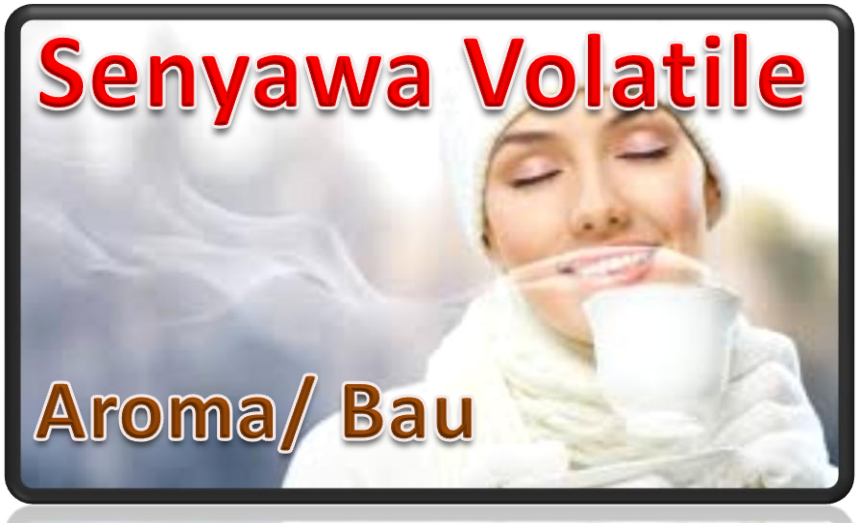
Interaksi dg Reseptor bau&rasa

sinyal

Sistem syaraf pusat

Flavor

Flavor


Senyawa Volatile
Aroma/ Bau


Senyawa Non volatile
Taste/ Rasa

Taste/ Rasa

Manis (sweet)

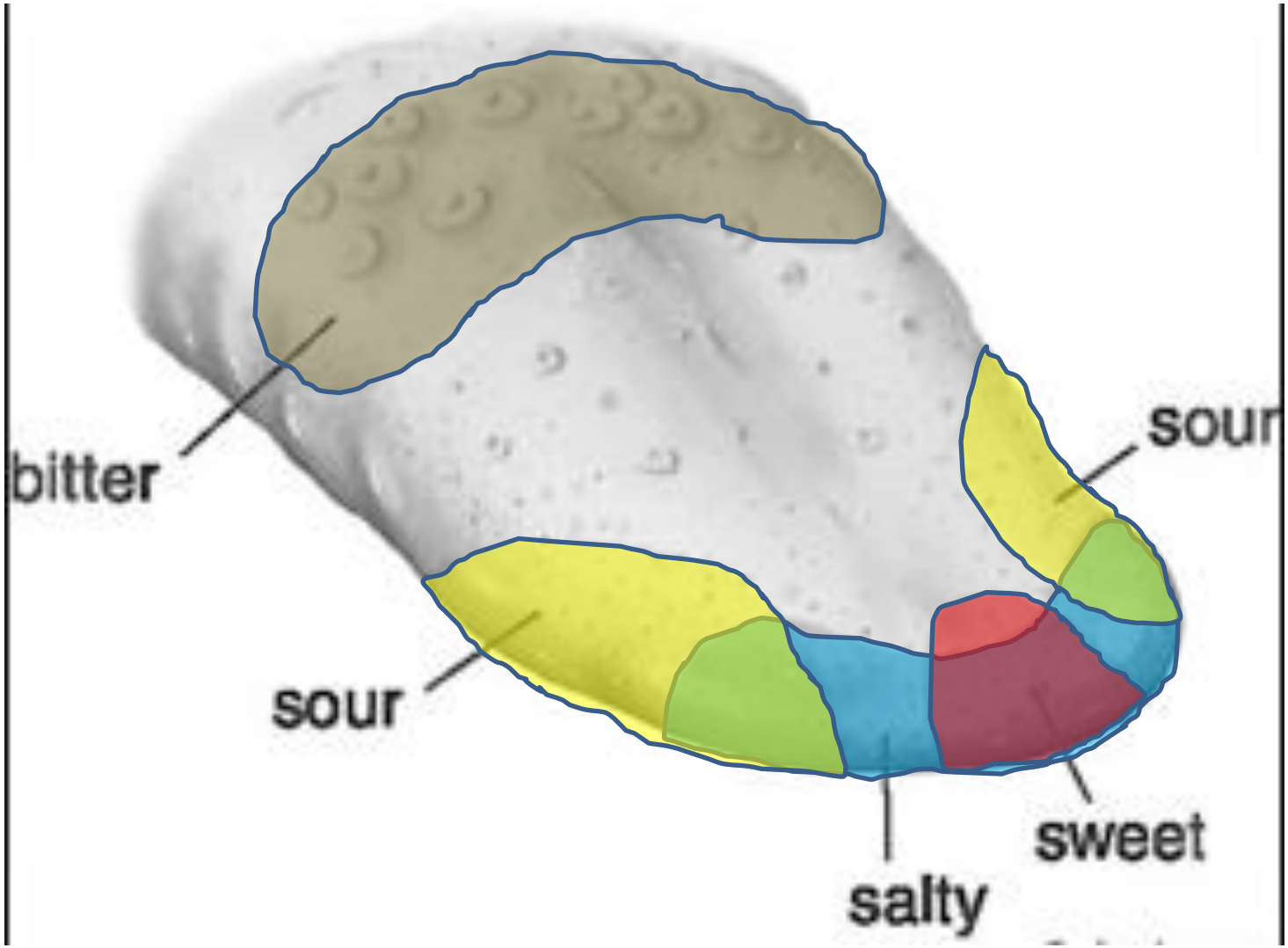
Asam (Acid/ sour)

Pahit (bitter)

Asin (Salty)

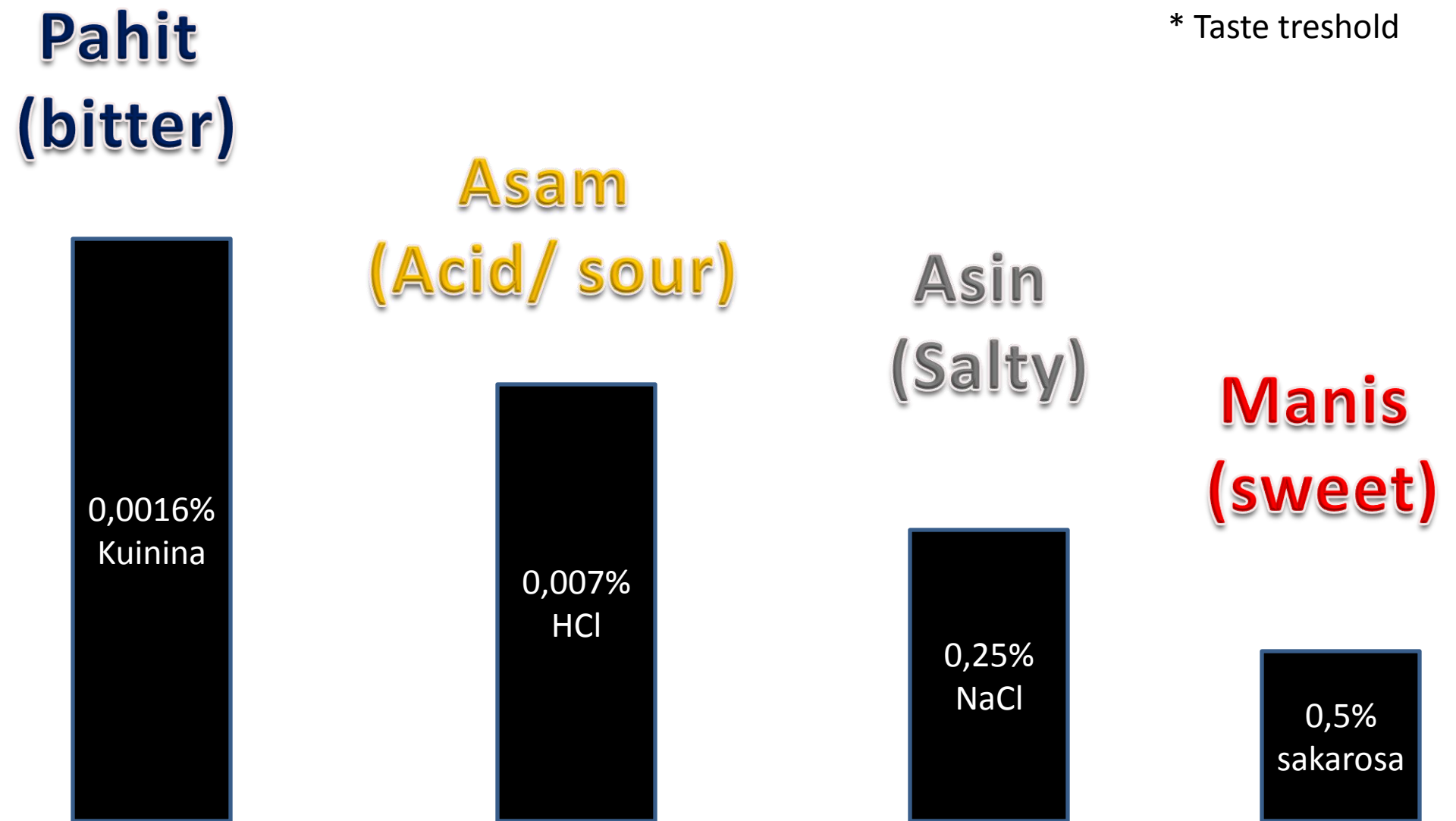
Umami (gurih)

Daerah kepekaan rasa di lidah



Urutan kepekaan rasa

* Taste treshold



Kualitas rasa yang timbul pada seseorang pada perbedaan konsentrasi NaCl dan KCl

Konsentrasi (mol/l)	NaCl	KCl
0.009	No taste	Sweet
0.01	Faintly sweet	Strongly sweet
0.02	Sweet	Sweet, faintly bitter
0.03	Sweet	Bitter
0.04	Salty, faintly sweet	Bitter
0.05	Salty	Bitter, salty
0.1	Salty	Bitter, salty
0.2	Purely salty	Salty, bitter, sour
1	Purely salty	Salty, bitter, sour

Rasa Manis

Table 4.10. Relative sweetness of sugars and sugar alcohols to sucrose[a]

Sugar/ sugar alcohol	Relative sweetness	Sugar/ sugar alcohol	Relative sweetness
Saccharose	100	D-Mannitol	69
Galactitol	41	D-Mannose	59
D-Fructose	114	Raffinose	22
D-Galactose	63	D-Rhamnose	33
D-Glucose	69	D-Sorbitol	51
Invert sugar	95	Xylitol	102
Lactose	39	D-Xylose	67
Maltose	46		

[a] 10% aqueous solution.

Sugar replacer	Function*	Relative sweetness (compared to sugar)[1,2]	Energy (kcal/g)**
Sugar (Sucrose)	**Many**	**1**	**4**
Acesulfame K	Low-calorie sweeteners	200	0
Aspartame		180-200	4***
Cyclamates		30-50	0
Neotame		7000-13000	0
Saccharin		300-500	0
Glycyrrhizin		30-50	0
Stevia (steviol glycosides)		200-480	0
Sucralose		600	0
Thaumatin		2000-3000	4***
Inulin	Bulking agents	0.1	2
Polydextrose		0	2
Lactitol	Bulk sweeteners	0.5	2.4
Maltitol		1.0	2.4
Mannitol		0.7	2.4
Sorbitol		0.5-1.0	2.4
Erythritol		0.6-0.8	0
Xylitol		1	2.4
Pectin	Gum/ Thickeners	0	2
Starch		0	4
Guar		0	2

Amino acid

Sweet taste

Glycine

Alanine

Threonine

Proline

Serine

Glutamine

Rasa Masam

Rasa asam dipengaruhi:

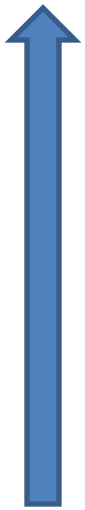
Sifat gugus asam

- pH
- Keasaman tertitrasi
- Efek dapar (buffer)
- Adanya senyawa lain (khususnya gula)

Threshold senyawa asam

Salty	equiv/l
HCl	0.0009
Acetic acid	0.0018
Tartaric acid	0.0012
Citric acid	0.0023
Malic acid	0.0005

Sifat beberapa asam, disusun berdasarkan urutan rasa asam yg makin menurun (acuan asam tartrat)



	Properties of 0.05N Solutions					
Acid	*Taste*	*Total Acid g/L*	*pH*	*Ionization Constant*	*Taste Sensation*	*Found In*
Hydrochloric	+1.43	1.85	1.70	—	—	—
Tartaric	0	3.75	2.45	1.04×10^{-3}	Hard	Grape
Malic	−0.43	3.35	2.65	3.9×10^{-4}	Green	Apple, pear, prune, grape, cherry, apricot
Phosphoric	−1.14	1.65	2.25	7.52×10^{-3}	Intense	Orange, grapefruit
Acetic	−1.14	3.00	2.95	1.75×10^{-5}	Vinegar	—
Lactic	−1.14	4.50	2.60	1.26×10^{-4}	Sour, tart	—
Citric	−1.28	3.50	2.60	8.4×10^{-4}	Fresh	Berries, citrus, pineapple
Propionic	−1.85	3.70	2.90	1.34×10^{-5}	Sour, cheesy	—

Source: From J. Solms, Nonvolatile Compounds and the Flavor of Foods, in *Gustation and Olfaction*, G. Ohloff and A.F. Thomas, eds., 1971, Academic Press.

Rasa Asin

Identik dg NaCl

Rasa garam bergantung sifat kation dan anion.
Jika BM kation/ anion / keduanya bertambah besar → berasa Pahit

Table 7–4 Taste Sensations of Salts

Taste	*Salts*
Salty	LiCl, LiBr, LiI, $NaNO_3$, NaCl, NaBr, NaI, KNO_3, KCl
Salty and bitter	KBr, NH_4I
Bitter	CsCl, CsBr, KI, $MgSO_4$
Sweet	Lead acetate,[1] beryllium acetate[1]

[1]Extremely toxic

Threshold senyawa asin

Salty	Mol/l
NH_4Cl	0.004
NaF	0.005
$MgCl_2$	0.015
KCl	0.017
NaCl	0.03

Gillette (1985)

NaCl

→ memperkuat rasa mulut (mouthfeel), kemanisan, keseimbangan, & keasinan

→ menutupi/ mengurangi ciri khas menyimpang (off-notes)

Penggantian garam meja yg didasarkan **KCl** =

- tidak memperkuat rasa mulut/ keseimbangan,
- meningkatkan ciri khas pahit/ ciri khas logam (metallic off-notes)

Rasa Pahit

Bisa disebabkan senyawa organik/ anorganik.
Banyak senyawa dari tumbuhan berasa pahit.

Rasa Pahit:

- Beberapa garam anorganik
- Beberapa asam amino
- Senyawa alkaloid
- Senyawa glikosida
- Kuinina
- dll

Threshold senyawa pahit

Bitter	equiv/l
Strychnine hydrochloride	0.000 0016
Quinine	0.000 008
Nicotine	0.000 019
Caffeine	0.000 7
$MgSO_4$	0.0046

Garam

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Salty and bitter	KBr, NH_4I
Bitter	CsCl, CsBr, KI, $MgSO_4$

Asam amino/ peptida

Bitter taste

Phenylalanine
Tyrosine
Arginine
Leucine
Isoleucine
Valine
Methionine
Histidine

Table 7–5 Taste of Some Selected Peptides

Taste	*Composition of Peptides*
Flat	L-Lys-L-Glu, L-PhE-L-Phe, Gly-Gly-Gly-Gly
Sour	L-Ala-L-Asp, γ-L-Glu-L-Glu, Gly-L-Asp-L-Ser-Gly
Bitter	L-Leu-L-Leu, L-Arg-L-Pro, L-Val-L-Val-L-Val
Sweet	L-Asp-L-Phe-OMe, L-Asp-L-Met-OMe
Biting	γ-L-Glutamyl-S-(prop-1-enyl)-L-cystein

Source: From J. Solms, Nonvolatile Compounds and the Flavor of Foods, in *Gustation and Olfaction*, G. Ohloff and A.F. Thomas, eds., 1971, Academic Press.

Senyawa yg paling dikenal rasa pahit= golongan Alkaloid dan Glikosida

Alkaloid

Senyawa organik yg mengandung Nitrogen & bersifat basa, merupakan turunan dari piridina, pirolidina, kuinolina, isokuinolina atau purina

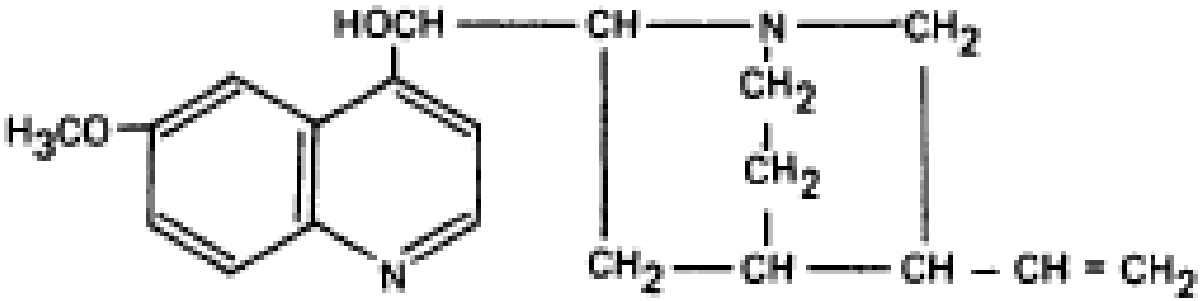
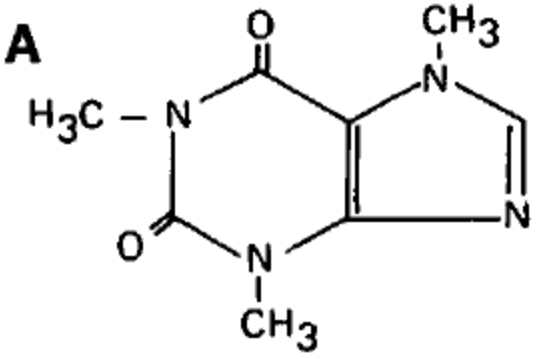


Figure 7–13 Structure of Quinine. This has an intensely bitter taste.

Kuinina→ standar pengujian kepahitan.

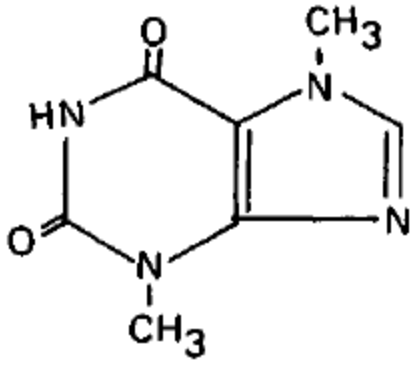
Kepahitan kuinina hidroclorida dapat dideteksi dalam larutan sangat encer (0,0016% atau 4 x 10^{-5} mol)

A



caffeine

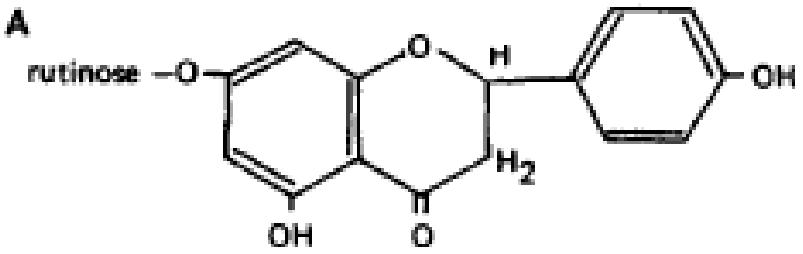
B



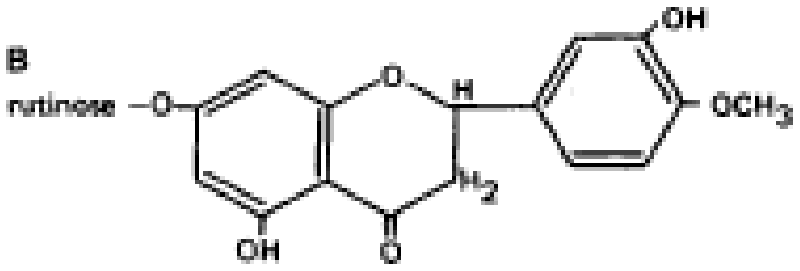
theobromine

Glikosida

Naringin → pada anggur dan jeruk
Lebih pahit daripada quinine
Dapat dideteksi < 0,002%



Hesperidin → citrus, orange, lemon



Umami

(Kawamura and Kare 1987)

Senyawa rasa berbasis asam amino khususnya asam glutamat

Menjadi rasa primer karena:

- Reseptor asam glutamat berbeda dengan rasa manis, asam, asin dan pahit
- Asam glutamat tidak mempengaruhi 4 rasa primer lainnya
- Kualitas rasa asam glutamat berbeda dengan 4 rasa primer lainnya
- Umami tidak dapat diproduksi/ ditiru dari campuran 4 rasa primer lainnya

glutamat

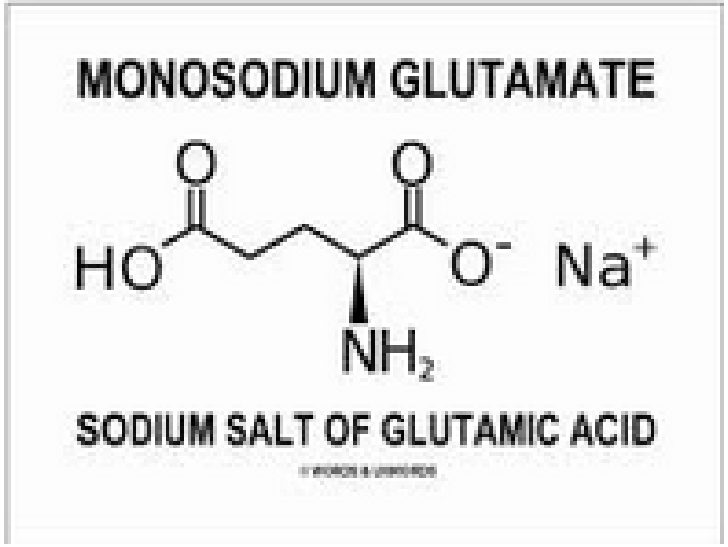
Diproduksi dari :

- Rumput laut
- Gluten gandum
- Limbah gula beet
- Protein kedelai
- Kasein

Table 7–8 Glutamic Acid Content of Some Proteins

Protein Source	*Glutamic Acid (%)*
Wheat gluten	36.0
Corn gluten	24.5
Zein	36.0
Peanut flour	19.5
Cottonseed flour	17.6
Soybean flour	21.0
Casein	22.0
Rice	24.1
Egg albumin	16.0
Yeast	18.5

Source: From L.A. Hall, Protein Hydrolysates as a Source of Glutamate Flavors, in *Monosodium Glutamate—A Symposium*, 1948, Quartermaster Food and Container Institute for the Armed Forces.



Na Glutamat terdeteksi <0,03%,
pada 0,05% rasanya sangat kuat,
tidak bertambah kuat pada konsentrasi diatas 0,05%

Rasa glutamat efektif pada pH 6-8.
Menurun pada pH rendah

Aroma/ Odor/ Bau

Mekanisme pembau (olfactiry) lebih kompleks dari pada perasa (gustation)

Ada ribuan aroma.
Sensitifitas organ pembau 10.000 kali > dari organ perasa.

Jumlah senyawa volatil dalam makanan:
beef (boiled, cooked)—486
beer—562
butter—257
coffee—790
grape—466
orange—203
tea—541
tomato—387
wine (white)—644

Table 7–14 Primary Odors for Humans and Compounds Eliciting These Odors

Primary Odor	*Odor Compounds*
Camphoraceous	Borneol, *tert*-butyl alcohol *d*-camphor, cineol, pentamethyl ethyl alcohol
Pungent (pedas panas)	Allyl alcohol, cyanogen, formaldehyde, formic acid, methylisothiocyanate
Ethereal	Acetylene, carbon tetrachloride, chloroform, ethylene dichloride, propyl alcohol
Floral	Benzyl acetate, geraniol, α-ionone, phenylethyl alcohol, terpineol
Pepperminty	*tert*-butylcarbinol, cyclohexanone, menthone, piperitol, 1,1,3-trimethyl-cyclo-5-hexanone
Musky	Androstan-3α-ol (strong), cyclohexadecanone, ethylene cebacate, 17-methylandrostan-3α-ol, pentadecanolactone
Putrid (busuk)	Amylmercaptan, cadaverine, hydrogen sulfide, indole (when concentrated, floral when dilute), skatole

Source: From J.E. Amoore et al., The Stereochemical Theory of Odor, *Sci. Am.*, Vol. 210, No. 2, pp. 42–49, 1964.

Table 1.1 Cheddar Cheese Lexicon with Identified References

Term	Definition	Reference
Cooked	Aromatics associated with cooked milk	Nonfat milk heated to 85°C for 30 min
Whey	Aromatics associated with cheddar cheese whey	Fresh cheddar whey
Diacetyl	Aromatics associated with diacetyl	Diacetyl
Milk fat/ lactone	Aromatics associated with milk fat	Fresh coconut meat, heavy cream, δ-dodecalactone
Fruity	Aromatics associated with different fruits	Fresh pineapple, canned pineapple juice
Sulfur	Aromatics associated with sulfurous compounds through water, struck match	Boiled mashed egg, H_2S bubbled
Free fatty acid	Aromatics associated with short-chain fatty acids	Butyric acid
Brothy	Aromatics associated with boiled meat or vegetable soup stock	Canned potatoes, commercial low-sodium beef broth cubes, vegetable broth cubes, beef broth cubes
Nutty	Nutlike aromatic associated with different nuts	Lightly toasted unsalted nuts, wheat germ, unsalted wheat crackers
Catty	Aromatics associated with tomcat urine	2 Mercapto-2-methyl-pentan-4-one
Cowy/ phenolic	Aromatics associated with barns and stock trailers	p-Cresol, bandaids, phenol
Bitter	Fundamental taste sensation elicited by caffeine, quinine	Caffeine (0.08% in water)
Salty	Fundamental taste sensation elicited by salts	Sodium chloride (0.5% in water)
Sweet	Fundamental taste sensation elicited by sugars	Sucrose (5% in water)
Sour	Fundamental taste sensation elicited by acids	Citric acid (0.08% in water)
Umami	Chemical feeling factor elicited by certain peptides and nucleotides	MSG (1% in water)
Prickle	Chemical feeling factor of which the sensation of carbonation on the tongue is typical	Soda water

Source: MaryAnne Drake, Department of Food Science, North Carolina State University, Raleigh, NC. With permission.

Table 2.5 Descriptive Sensory Language for Fluid Milk and Rehydrated SMP

Descriptor	Definition	Reference	Preparation
Cooked/ sulfurous	Aromatic associated with cooked milk	Heated milk	Heat pasteurized skim milk to 85°C for 45 min
Sweet aromatic/ cake mix	Sweet aromatic associated with dairy products	Pillsbury white cake mix Vanillin	Dilute 5 mg of vanillin in skim milk
Cardboard/ wet brown paper	Aromatic associated with cardboard	Wet brown paper or cardboard	Soak 2-cm square of brown paper bag or cardboard in warm water for 30 min
Fatty/fried	Aromatic associated with stale oils or old frier oil	2, 4 decadienal	10 ppb in skim milk
Vitamin	Aromatic associated with vitamin supplements or rubber	Enfamil–liquid Polyvisol vitamins	
Free fatty acid	Aromatic associated with free fatty acids	Feta cheese or butyric acid	Crumbled Feta cheese or 20 ppm butyric acid in skim milk
Metallic/ serum-like	Aromatic associated with rare steak juice	Rare steak juice	
Sweet taste	Basic taste associated with sugars	Sucrose	5% Sucrose solution
Salty	Basic taste associated with salts	NaCl	2% NaCl solution
Sour	Basic taste associated with acids	Citric acid	1% Citric acid solution
Bitter	Basic taste associated with various compounds	Caffeine	0.5% Caffeine solution
Astringent	Drying or puckering of oral tissues	Tea	Soak 6 tea bags in water for 10 min

Source: Adapted from Drake, M.A., Karagul-Yuceer, Y., Cadwallader, K.R., Civille, G.V., and Tong, P.S. 2003. Determination of the sensory attributes of dried milk powders and dairy ingredients. *J. Sensory Stud.* 18: 199–216; Carunchia-Whetstine et al., 2003.

Table 1.2 Descriptors Used for Sensory Characterization of Ultrapasteurized Milk

Aroma	Flavor	Texture	Aftertaste
Cooked	Cooked	Viscosity	Drying
Caramelized	Sweet	Drying	Metallic
Grainy/malty	Caramelized	Chalky	Bitter
Other	Bitter	Lingering	Other
	Metallic		
	Other		

Source: From K.W. Chapman, H.T. Lawless, and K.J. Boor, Quantitative descriptive analysis and principal components analysis for sensory characterization of ultrapasteurized milk, *J. Dairy Sci.* 84: 12, 2001. With permission.

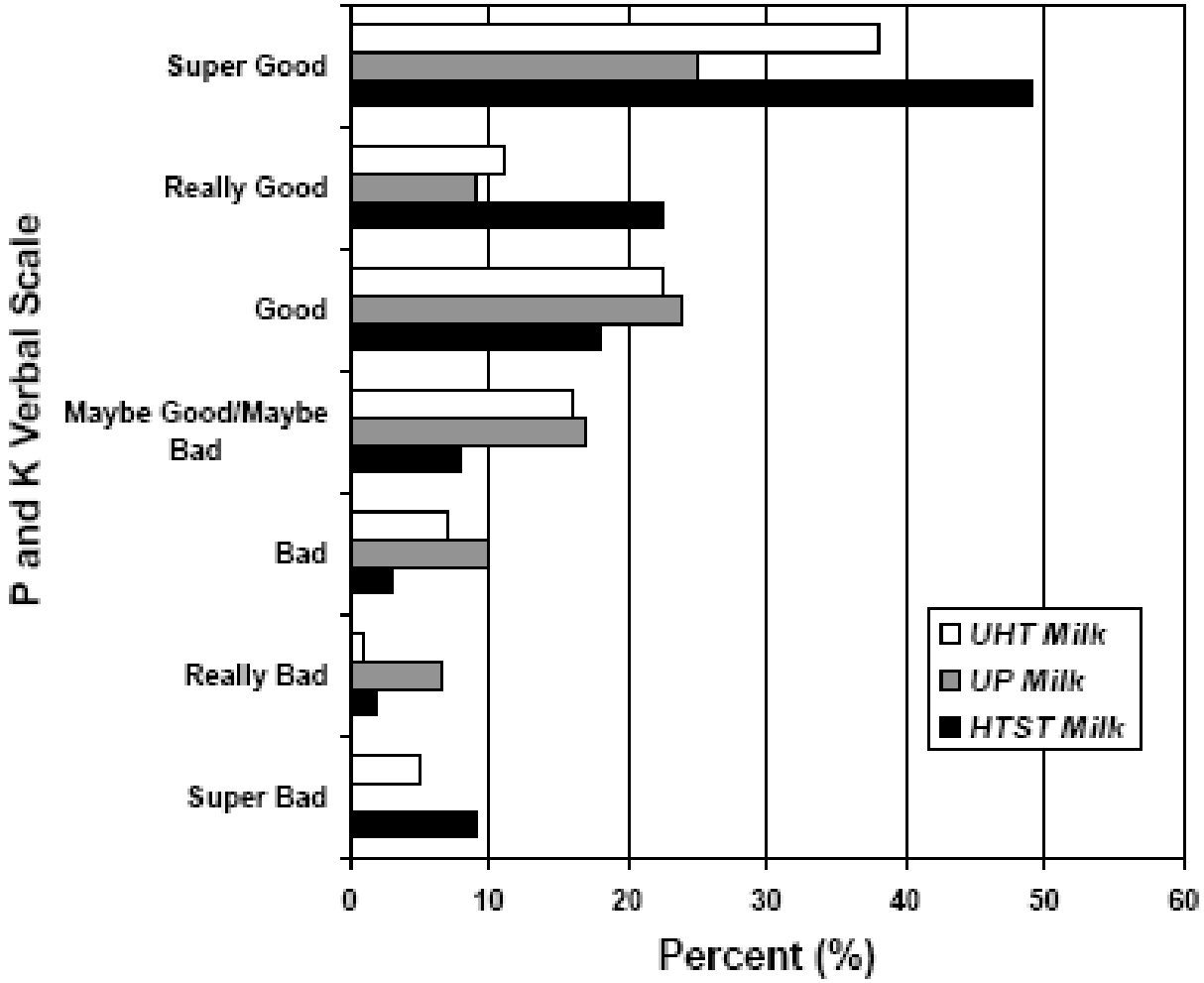


Figure 1.5 The distribution of ratings of milk, using a seven-point hedonic scale. (Black bar represents HTST milk, grey bar represents UP milk, and white bar represents UHT milk.) (From K.W. Chapman and K.J. Boor, Acceptance of 2% ultrapasteurized milk by consumers, 6 to 11 years old, *J. Dairy Sci.* 84: 951, 2001.With permission.)

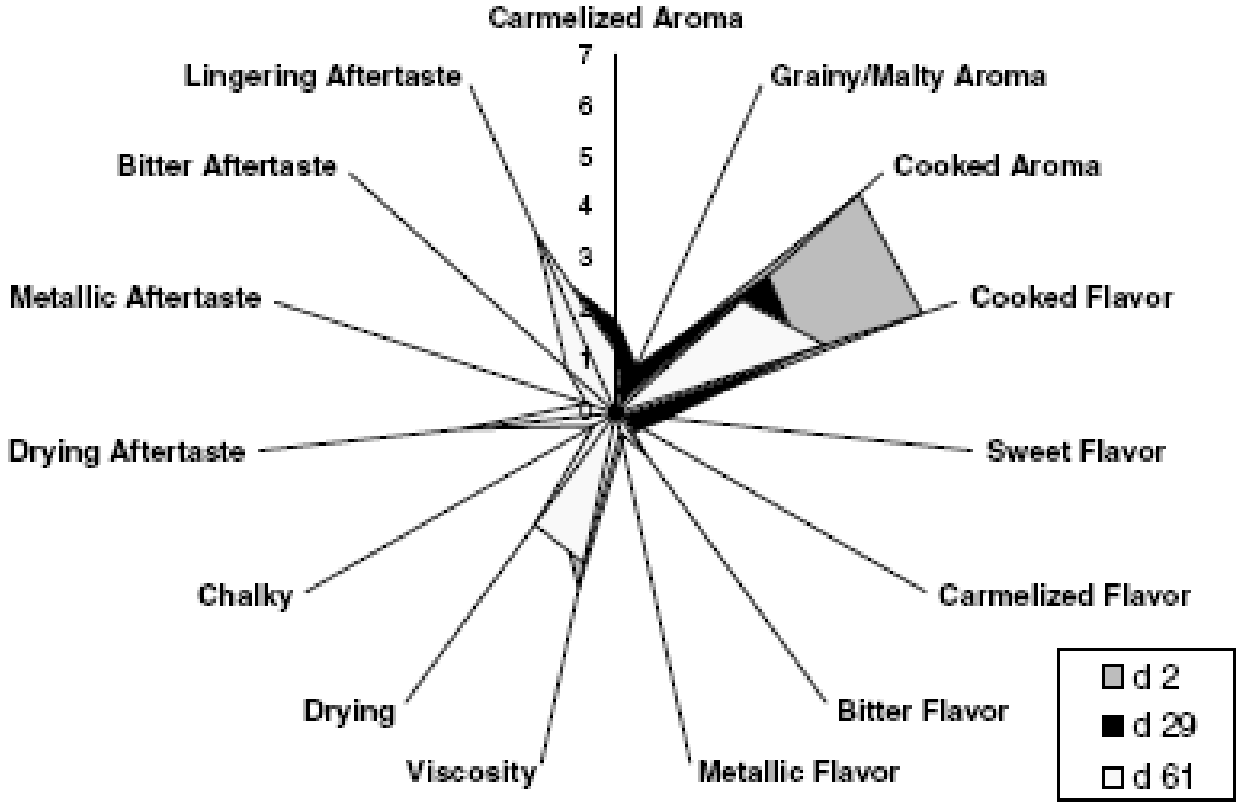


Figure 1.4 Sensory profile for a reduced-fat UP milk sample stored at 6°C for 2 d (dark-grey area), 29 d (black area), and 61 d (light-grey area). (From K.W. Chapman, H.T. Lawless, and K.J. Boor, Quantitative descriptive analysis and principal components analysis for sensory characterization of ultrapasteurized milk, *J. Dairy Sci.* 84: 12, 2001. With permission.)

Tidak semua senyawa volatil berpengaruh terhadap penentuan aroma suatu produk.

Hanya sejumlah sedikit senyawa tertentu dalam produk yang menentukan karakteristik aromanya

TABLE 1. VOLATILE FLAVOURING COMPOUNDS OF DURIAN

Hydrogen sulphide		Methyl acetate	(1)
Methanethiol	*	Ethyl acetate	(3)
Ethanethiol	*	Methyl propionate	(3)
Propanethiol		Ethyl propionate	(1)
Dimethylthioether	*	*n*-Propyl propionate	(1)
Diethylthioether	*	Ethyl *iso*-butyrate	(1)
Diethyldisulphide	(1)	Ethyl butyrate	
Methanol	(2)	Methyl α-methylbutyrate	(2)
Ethanol	(5)	Ethyl α-methylbutyrate	(5)
n-Propanol	(4)	*n*-Propyl α-methylbutyrate	(1)
3-Methylbutan-1-ol		Ethyl iso-valerate	(1)
Acetaldehyde	(1)	Ethyl methacrylate	(1)
Propionaldehyde	(2)	Ethyl benzene	(1)

The relative proportions are based on the height of the GLC peaks as a percentage of recorder full-rate deflection: (1) 10; (2) 10–30; (3) 30–60; (4) 60–100; (5) over 100%. Compounds marked * were identified by TLC in one solvent. All other compounds were identified by their MS obtained from condensed headspace vapours. Identifications were confirmed by comparing MS and chromatograms with those of authentic specimens.

Odor Threshold (OT)

Compounds	Threshold (μg/L)
Alcohols	
1-Pentanol	80,000[a]
1-Propanol	306,000[b]
Isobutyl alcohol	40,000[c]
1-Butanol	150,000[d]
Isoamyl alcohol	30,000[c]
4-Methyl-1-pentanol	50,000[e]
2-Heptanol	70[f]
1-Hexanol	8000[c]
(*E*)-3-hexen-1-ol	400[c]
(*Z*)-3-hexen-1-ol	400[c]
(*E*)-2-hexen-1-ol	400[a]
(*Z*)-2-hexen-1-ol	400[a]
1-Octan-3-ol	–
1-Heptanol	1000[a]
2-Ethyl-1-hexanol	8000[a]
2-Nonanol	58[f]
Levo-2,3-butanediol	120,000[g]
Meso-2,3-butanediol	120,000[g]
1-Octanol	120[c]
3-(Methylthio)-1-propanol	500[c]
1-Decanol	400[c]
Citronellol	100[c]
Benzyl alcohol	200,000[h]
2-Phenylethanol	14,000[c]
1-Dodecanol	1000[g]
Linalool	25.2[i]
Subtotal	
Proportion (%)	
Esters	
Ethyl acetate	7500[c]
Isoamyl acetate	30[c]
Ethyl hexanoate	5[c]
Ethyl butanoate	–
Hexyl acetate	670[b]
Ethyl lactate	154,636[d]
Heptyl acetate	1400[a]
Methyl octanoate	200[j]
Ethyl octanoate	2[c]
Isoamyl hexanoate	–
Ethyl nonanoate	–
Ethyl decanoate	200[c]
Diethyl succinate	500,000[d]
Phenethyl acetate	250[c]
Ethyl dodecanoate	1500[a]
Subtotal	
Proportion (%)	
Acids	
Acetic acid	200,000[c]
Propanoic acid	8100[h]
Isobutyric acid	200,000[c]
Hexanoic acid	3000[c]
Heptanoic acid	3000[k]
Octanoic acid	500[c]
Decanoic acid	15,000[c]
Subtotal	
Proportion (%)	
Aldehydes and ketones	
Nonanal	1[l]
Furfural	14,100[c]
Decanal	1000[e]
Benzealdehyde	2000[b]
Benzylethylaldehyde	–
Geranylacetone	60[a]

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Character impact compound (CIFACs)

Table 1. Integrated and analyzed volatile compounds recovered by solid phase microextraction, gas chromatograph-mass spectrometry in developing and mature cantaloupe, and characteristic impact flavor and aroma compounds [CIFACs (*in italics*)] reported in the *Cucumis melo* literature.[z]

Compound class Compound
Esters (nonacetate)
methyl 2-methylpropanoate
ethyl propanoate
ethyl 2-methylpropanoate
methyl 2-methylbutanoate
ethyl butanoate
ethyl 2-methylbutanoate
ethyl pentanoate
methyl hexanoate
butyl butanoate
ethyl hexanoate
methyl heptanoate
2-methyl butylbutanoate
ethyl (*E*)-4-heptenoate
propyl hexanoate
ethyl heptanoate
3-methylbutyl hexanoate
pentyl hexanoate
Acetates
2-methylpropyl acetate
butyl acetate
3-methylbutyl acetate
2-methylbutyl acetate
unknown alkyl acetate
(*Z*)-3-hexenyl acetate
hexyl acetate
(*E*)-3-hexenyl acetate
(Z) 6-nonenyl acetate
(Z, Z) 3,6-nonadienyl acetate
benzyl acetate
phenylethyl acetate
ethyl phenylacetate
Alcohols
2-methyl 1-butanol
eucalyptol
benzyl alcohol
phenyl ethyl alcohol
(Z)-6-nonenol
(Z, Z)-3,6-nonadienol
nonanol
benzenepropanol
Aldehydes
hexanal
(E)-2-hexenal
(Z)-3-hexenal
benzaldehyde
octanal
benzeneacetaldehyde
(*E*)-2-octenal
(Z)-6-nonenal
nonanal
(E, Z)-2,6-nonadienal
(E)-2-nonenal
(*E, Z*)-2,4-nonadienal
(*E, E*)-2,4-nonadienal
(*Z*)-citral
(*E*)-citral
(*E*)-2-undecanal
Sulfur-compounds and other
S-methyl thiobutanoate
3-(methylthio)propanal
S-methyl 3-methylbutanethioate
ethyl 2-(methylthio)acetate
methyl 3-(methylthio)propanoate
ethyl 3-(methylthio)propanoate
3-(methylthio)propyl acetate
(Z)-1,5-octadien-3-one

Odor description

Compound	Odour description [a]
Isoamyl alcohol	Alcoholic
Ethyl hexanoate	Fruity
Unknown	Burnt, plastic
Cis-3-hexen-1-ol	Green plant
Acetic acid	Vinegar
Ethyl octanoate	Fruity
Benzaldehyde	Almond, spicy
Ethyl-3-hydroxy-butanoate	Fruity, grape
Linalool	Floral, rose
Unknown	Chemical, plastic
γ-Butyrolactone	Sweet, caramel
Hotrienol	Floral
Butanoic acid	Chemical, mouldy
Unknown	Floral
α-Terpineol	Floral
Ethyl-4-hydroxy-butanoate	Fruity
Geraniol	Floral
2-Phenylethanol	Floral
Pantolactone	Burnt
4-Vinylguaiacol	Smoky

Odor active value (OAVs)

Aroma reference

Terimakasih