Flavors

Other Aspects of Taste

- Sugar/acid ratio
- Astringency – More touch than taste, dry puckering sensation
  - higher MW tannins (lower MW are bitter)
  - proline rich proteins (bind with polyphenols), glycoproteins. Oak aging, tea, cocoa.
  - anthocyanins

Other Aspects of Taste

- Coolness – menthol
- Hotness-pungency (aromatic ring, carbonyl groups, alkyl side chains, nonvolatile amides)
  - Hot and black pepper, ginger

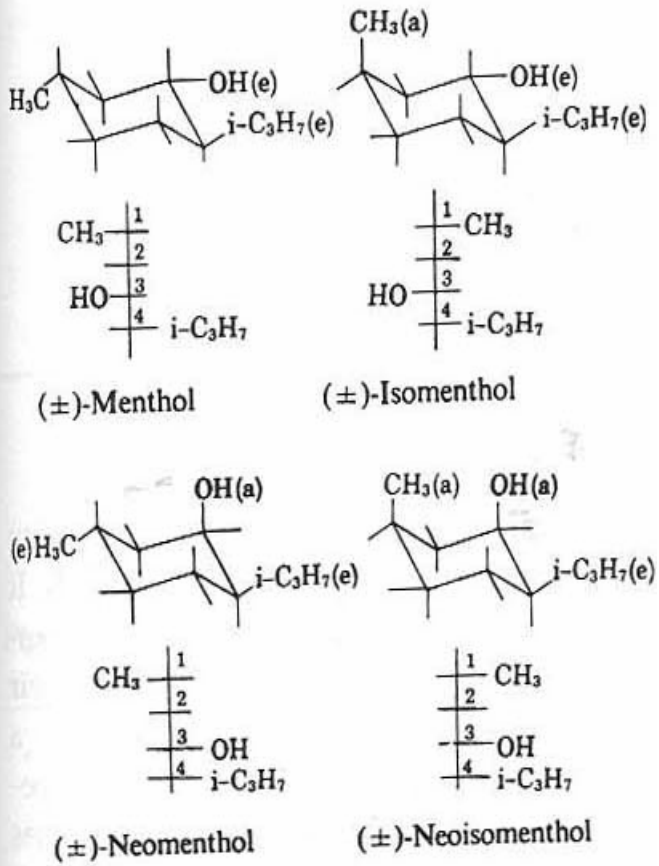


Figure 7–16 Isomeric Forms of Menthol

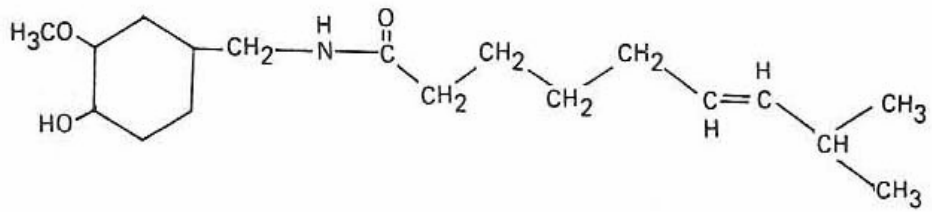


Figure 7–18 Capsaicin, the Pungent Principle of Red Pepper

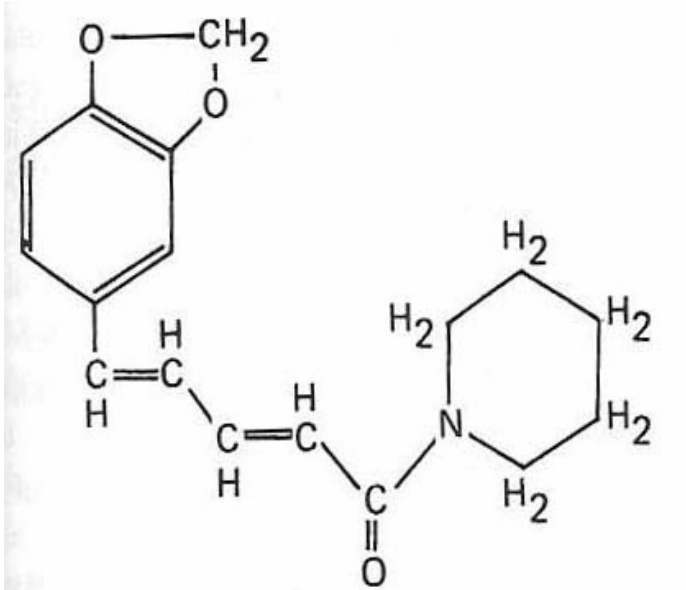


Figure 7–17 Piperine, Responsible for the Hotness of Pepper

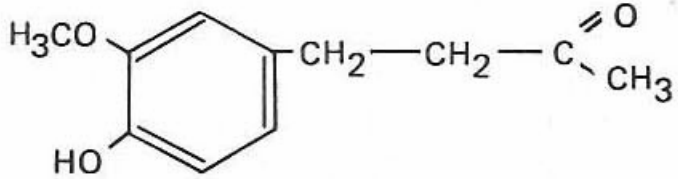


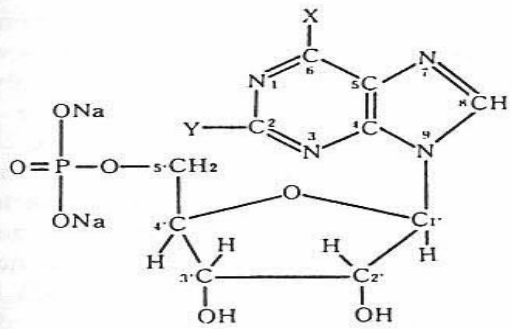
Figure 7–19 Zingerone, the Pungent Principle of Ginger

Other Aspects of Taste

- Metallic taste (saccharin)– not clear set of receptors, perceived over entire tongue surface. Threshold increased by adding salt, sugar, citric acid, alcohol. Tannins lower threshold.

Flavor Enhancement - Umami

- Basic taste response to amino acids. Umami – deliciousness
- Can’t be reproduced by mixing chemicals of different primary tastes
- Difficult to describe – meaty, savory
- Glutamic acid (MSG). Does not affect 4 primary taste.
- Umami compounds in protein hydrolysates, soy sauce, nucleotides (disodium 5-inosinate is 16x stronger than glutamate)



X = OH	Y = H	IMP
	$Y = NH_2$	GMP
	Y = OH	XMP

Figure 7–21 Structure of Nucleotides with Flavor Activity

Table 7–9 Threshold Levels of Flavor Enhancers Alone and in Mixtures in Aqueous Solution

	Threshold Level (%)		
Solvent	*Disodium 5′-Inosinate*	*Disodium 5′-Guanylate*	*Monosodium L-Glutamate*
Water	0.012	0.0035	0.03
0.1% glutamate	0.0001	0.00003	—
0.01% inosinate	—	—	0.002

Source: From A. Kuninaka, Recent Studies of 5′-Nucleotides as New Flavor Enhancers, in *Flavor Chemistry*, I. Hornstein, ed., 1966, American Chemical Society.

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.

Flavor Enhancers

- Maltol – browning reactions -roasting malt, coffee, cocoa, grain. Produced during baking
- Casein-lactose heating (chocolates, candies, dairy foods)
- Antioxidant properties. Can extend shelf life of coffee and roasted cereals

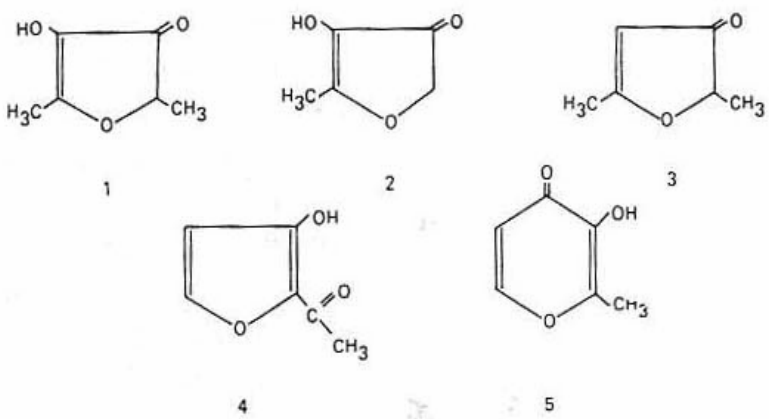
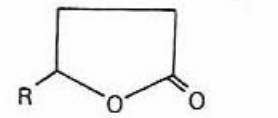


Figure 7–23 Some Furanones (1,2,3), Isomaltol (4), and Maltol (5)

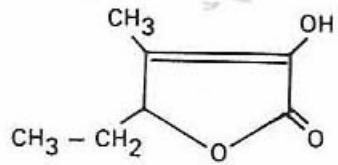


R = C_5H_{11} (coconut)

R = C_6H_{13} (peach)

R = C_7H_{15} (peach)

R = C_8H_{17} (peach-musk)



Beef bouillon

Figure 7–25 Flavor Character of Some Lactones. *Source*: From R. Teranishi, Odor and Molecular Structure, in *Gustation and Olfaction*, G. Ohloff and A.F. Thomas, eds., 1971, Academic Press.

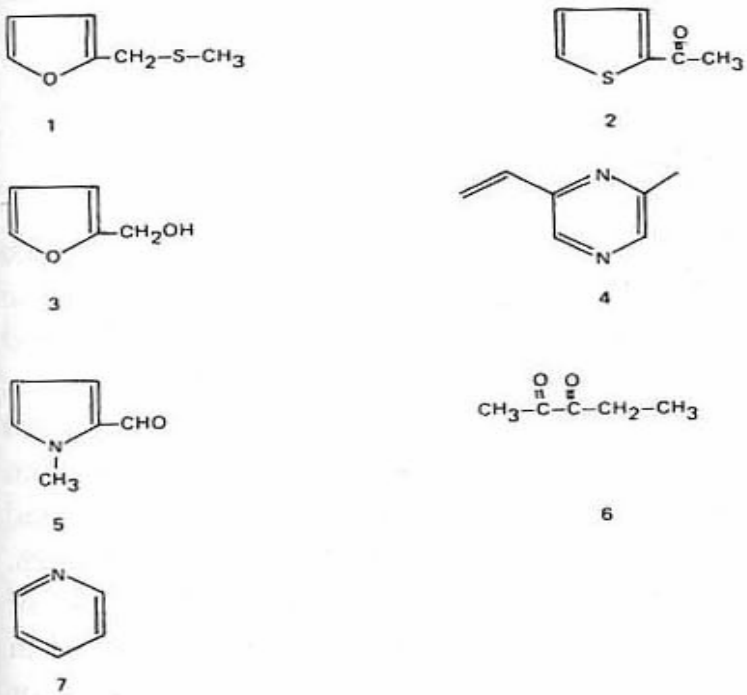


Figure 7–35 Structure of Some Important Constituents of the Aroma of Coffee. (1) Furfuryl-methyl-sulfide, (2) 2-acetylthiophene, (3) 2-furfurylalcohol, (4) 2-methyl-6-vinyl-pyrazine, (5) n-methyl-pyrrole-2-aldehyde, (6) acetylpropionyl, (7) pyridine.

Aroma

- More complex and more sensitive (10,000x) than taste
- Dogs and rodents – 100x more sensitive than humans
- Volatile components, solubility less critical than molecular structure
- Affected by physiological and health condition
- Can ‘remember’ aromas – 1000s of compounds

Table 7–21 Number of Volatile Components in the Essential Oils of Some Spices

Spice	*Number*
Cinnamon	113
Cloves	95
Ginger	146
Nutmeg	80
Pepper	122
Vanilla	190

Source: Reprinted with permission from H. Maarse, *Volatile Compounds in Foods and Beverages*, p. 420, 1991, by courtesy of Marcel Dekker, Inc.

Theory

- Molecules fit into an enzyme-like lock and key receptor (shape size pungent putrid)
- Membrane puncturing model – molecules absorbed across lipid membrane interface. Desorbs, leaving a deformation in membrane that causes a neural response
- Seven primary odors

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	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	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.

Aroma

- Contributory flavor compounds
- Pyrazines
- Esters
- Aldehydes
- 2-trans-enals (cucumber, beany off flavor)
- 2,4-dienals (cardboard, linoleum)
- Dimethylsulfide –canned eat

- Short chain fatty acids (pleasant to some, not others)
- Most individual flavor compounds are repugnant or painful outside their proper formulations
- Off-aromas-transfer of feed components to milk, meat. Heat, oxidation, light, enzyme action.

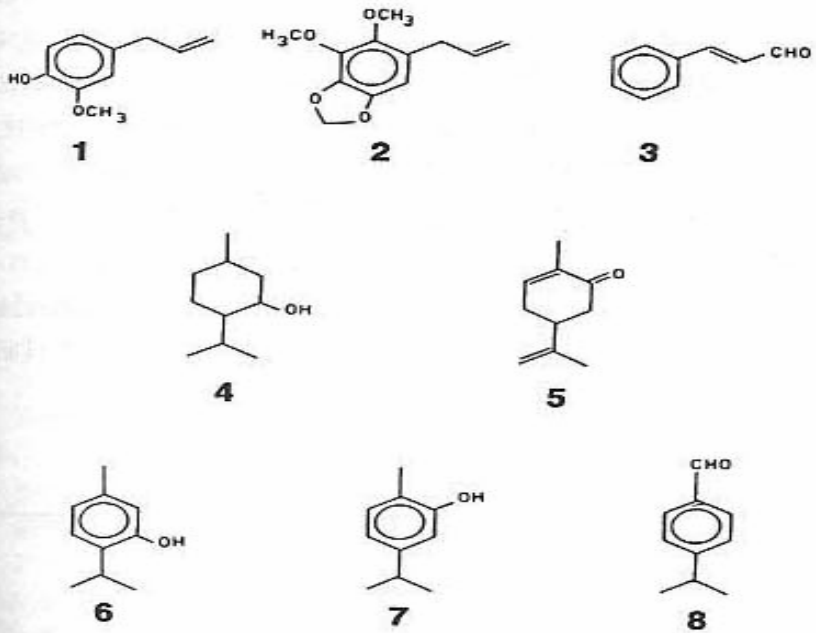


Figure 7–36 Volatile Constituents of Spices and Herbs: (1) Eugenol, (2) dillapiol, (3) cinnamaldehyde, (4) menthol, (5) carvone, (6) thymol, (7) carvacrol, (8) cuminaldehyde

Table 7–10 Odor Threshold Concentrations of Odorous Substances Perceived During Normal Inspiration

Compound	*Threshold Concentration (Molecules/cc)*
Allyl mercaptan	6×10^7
Sec. butyl mercaptan	1×10^8
Isopropyl mercaptan	1×10^8
Isobutyl mercaptan	4×10^8
Tert. butyl mercaptan	6×10^8
Thiophenol	8×10^8
Ethyl mercaptan	1×10^9
1,3-Xylen-4-ol	2×10^{12}
μ-Xylene	2×10^{12}
Acetone	6×10^{13}

Source: From K.B. Döving, Problems in the Physiology of Olfaction, in *Symposium on Foods: The Chemistry and Physiology of Flavors*, H.W. Schultz et al., eds., 1967, AVI Publishing.