Cuminaldehyde

A distinctive ingredient with the spicy essence of cumin

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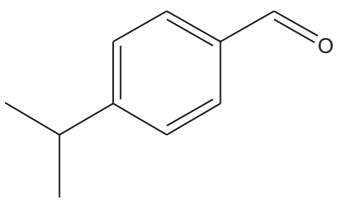
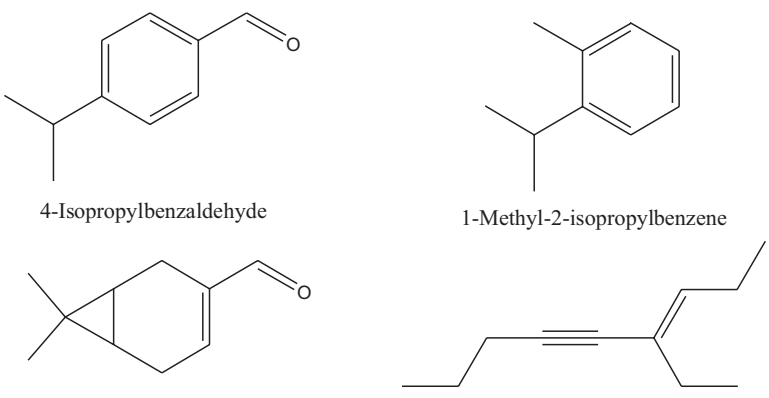
Cuminaldehyde (**F-1**) is found in cumin oil, anise, clove, parsley, thyme, beef, brandy and grape[a]. It has a green, herbal and spicy characteristic cumin odor and flavor. It is also described as having a pungent, green-herbaceous odor with notes of animal and vegetable character. Although it's generally described as unpleasant in high concentration, the odor appears more attractive, warm-spicy, vegetable, condiment-picklelike at concentrations well below 1%. It is directly applied in herbal, spicy flavor modifications as well as caraway, dill, vegetable, cookies and cake flavors.

F-1. 4-Isopropylbenzaldehyde; syn: cuminic aldehyde; $C_{10}H_{12}O$; CAS# 122-03-2; FEMA# 2341



F-2. Main ingredients in *Cuminum cyminum* L. seed essential oil



Physical Data for Cuminaldehyde[1b]

Appearance:	Colorless to pale yellow clear liquid
M.W.:	148.2
Boiling point:	235°C
Specific gravity:	0.973–0.981 (25°C)
Refractive index:	1.5270–1.5340 (20°C)
Flash point:	200°F TCC
LogP(o/w):	3.17 (estd.)

Cuminum cyminum L., the plant that contains cuminaldehyde, is a flowering plant of the family *Apiaceae*, which is native from the east Mediterranean to India. The oil (CAS# 8014-13-9) prepared from this plant has a strongly sweet aromatic, spicy odor—a cuminlike characteristic.

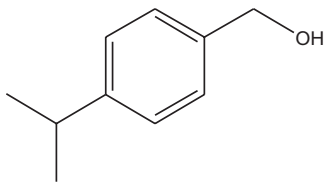
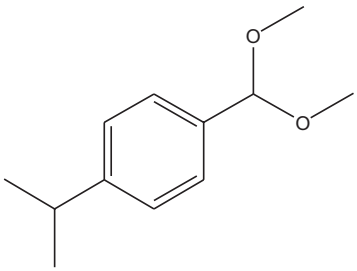
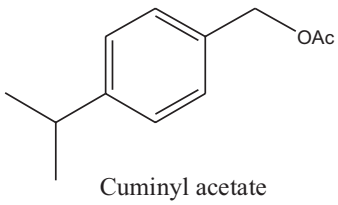
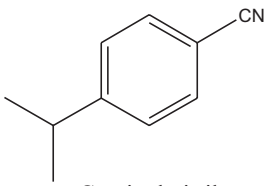
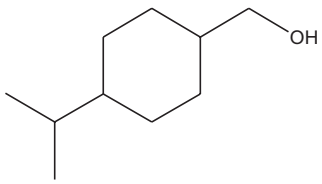
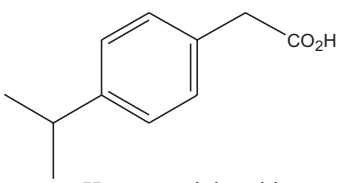
In a study of the essential oil of *C. cyminum* L. seeds, an oil was obtained through steam distillation and the chemical compounds were analyzed by GC/MS. Researchers detected 48 compounds and identified 38 that accounted for 98.53% of the total volatile oil. The most abundant compounds were: cuminaldehyde (39.03% of the total oil), 1-methyl-2-isopropylbenzene (12.85%), 3-caren-10-al (9.15%) and 4-ethyl-3-nonen-5-yne (8.28%).[1] The structure similarity of the first three of these ingredients clearly shows the biochemical relation between them **(F-2)**.

Although cuminaldehyde is the chief constituent of cumin oil, there is a marked difference between the odors of the two materials; the oil has a softness and mellowness in which the high aldehyde content is presented in a very acceptable manner. The cumin absolute again is strikingly reminiscent of the aroma of the cumin seed, and will remind many observers of Indian curry or other spices and condiments. In brief, the aldehyde represents the sharp nucleus of power and pungency in the aroma of the oil, the absolute and the seed of cumin.

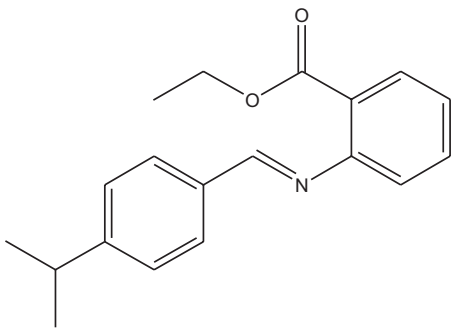
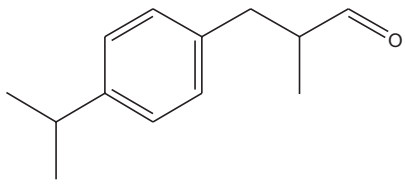
[a] Some of the information on occurrence and uses are taken from *FRM 2001* and *PMP 96 Databases of Perfumery Materials & Performance*, Boelens Aroma Chemicals Information Services, The Netherlands

[b] Some of the information on occurrence and uses are taken from *www.thegoodscentscompany.com/*

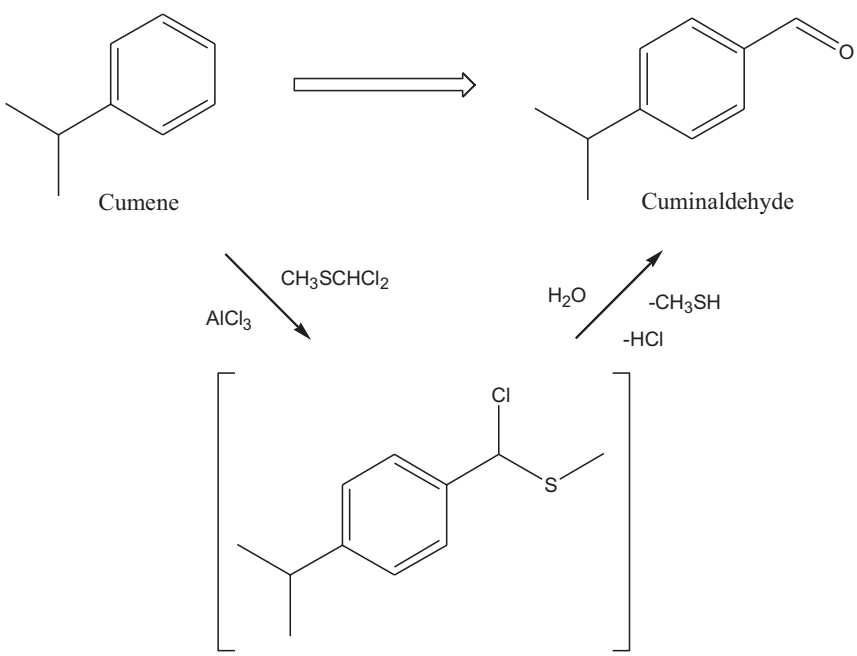
F-3. Aroma ingredients related to cuminaldehyde

Substance	Organoleptic characteristics [1,3]
 Cumin alcohol	Oily-spicy odor, suggestive of dill seed or caraway, but not pungent or sharp like carvone. Warm, almost burning, spicy-oily-woody taste. Occasionally used in perfume compositions for its natural and warm-herbaceous-spicy effect, perceptible in the top note and often through the dryout. Also used in the artistic duplication of certain floral notes, such as mimosa and cassie, particularly in connection with methylionones. Finds some use in flavor compositions, mainly berry, fruit, spice and liquor flavors.
 Cuminaldehyde dimethylacetal	Sweet aromatic, spicy; somewhat cuminlike, mild, oily-green, herbaceous-winey odor. More stable than cuminaldehyde and practically free from the pungent-sharp, hydrocarbon-like notes so dominating in the aldehyde.
 Cuminyl acetate	Refreshing-herbaceous, sweet and delicately woody odor of moderate tenacity. This ester offers extremely interesting effects for the imaginative perfumer. Particularly for truly new ideas in perfumery, this ester opens the door to individual creation. Far from being a key material in any existing fragrance, it forms part of many very attractive perfumes.
 Cuminyl nitrile	Sweet aromatic, spicy; reminiscent of cuminaldehyde.
 p-Menthan-7-ol (Mayol)	Fresh clean, floral magnolia, hydroxycitronellal, cumin, grassy.
 Homo cuminic acid	When absolutely pure, the material is virtually odorless, but the scarce commercial lots have shown a distinctly herbaceous odor of considerable tenacity, mildly acidulous and green-herbaceous taste.

F-3. (Cont.)

Substance	Organoleptic characteristics[1,3]
 Cuminaldehyde - ethyl anthranilate Schiff base	Herbaceous-sweet; very tenacious odor. In dilution reminiscent of Mandarin peel oil, but overall rather sharp and not as "orange blossom" like as most of the conventional Schiff bases. The odor is strongly dependent upon the ratio of components and in the condensation, and upon traces of surplus components.
 alpha-Methyl-p-isopropyldihydrocinnamaldehyde (Cyclamen aldehyde)	Fresh, watery, floral, cyclamen-like, cucumber-melon-like notes. Overall resembling the odor of linden blossom.

F-4. Reaction for aromatic aldehydes



The cuminaldehyde may therefore appear more "gassy" kerosene-like to the observer who is familiar with the aroma of cumin.[2]

Cuminaldehyde is useful in minute traces in perfume compositions as part of a top note; however, in most cases, the oil or the absolute are preferred for such delicate creations. On account of its power and very low cost, the cuminaldehyde also finds use in masking odors for industrial purposes.

Several aroma ingredients based on cuminaldehyde are shown in **F-3**.

Rieche, Gross and Hoft described an interesting route for the preparation of cuminaldehyde, which found that dichloromethyl alkyl ether interacts with aromatics in the presence of Friedel-Crafts catalysts, resulting in a good yield of aldehydes.[3] Gross and Mirsch found that reaction of aromatics with dichloromethyl methyl sulfide and aluminum chloride yield aromatic aldehydes (**F-4**).[4]

Antioxidant activity of cumin oleoresin and its main components in vitro were determined by β-carotene-linoleic

acid assay. IC50 value (the concentration of antioxidant when antioxidant activity reached 50%) and a kinetic approach were used to evaluate the efficiency of antioxidant ability. Cumin oleoresin, β-pinene, γ-terpinene, p-cymene and cumin aldehyde showed antioxidant activities with different levels, but their effectiveness was less than butylated hydroxytoluene.[5] Cuminaldehyde is used within insect repellents and spice plant extracts for protection of cereals and dried foods.[6]

Antibacterial activities of some essential oils were tested on *Salmonella typhimurium* CCM 5445, *Staphylococcus aureus* (MRSA) RSKK 95047, *Staphylococcus aureus* ATCC 6538P, *Escherichia coli* ATCC 29998 and *Escherichia coli* O157:H7 RSKK 232 by two different methods. According to results, oregano essential oil showed the highest inhibition (0.0625–0.125 mg/mL) effect followed by cumin (0.0625–2.0 mg/mL) and clove (0.25–1.0 mg/mL), respectively. Laurel, rosemary and anise essential oils did not show antibacterial activity or little activity on tested bacteria.[7] In another study, researchers found that the essential oil obtained by hydrodistillation of the leaves of *Cinnamomum filipedicellatum* Kosterm (*Lauraceae*) contained 24 constituents by GC/FID analysis, of which 19 were identified by GC/MS analysis. The major constituents were cryptone (4-isopropyl-2-cyclohexen-1-one, 36.6%), p-cymene (10.8%), cumin aldehyde (7.7%) and limonene (6.4%). The oil showed moderate activity against some strains of gram-positive and gram-negative bacteria.[8]

References

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