Orange Carbonyls

Chemistry and application

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Orange carbonyls (orange aldehydes) (FEMA#2826, CAS# 8028-48-6) occur in all citrus fruits, especially in sweet orange. Orange carbonyls are colorless to pale yellow liquids having a natural orange, sweet, juicy, fresh peel odor and flavor.

Orange carbonyls are used in citrus flavors for food and beverage. In flavorings, they are mostly used in orange juice concentrates, chilled and canned drinks, and orange soft drinks, as well as in confectionery. Their level of dosage is 1–10 ppm in final product. This product can be used by itself or in combination with concentrated and terpeneless oils and other flavor complexes derived from citrus fruits. Possessing a very high flavor strength (therefore requiring a low level of use), this product can be easily dissolved in the final product.

Orange carbonyls also impart natural orange notes in perfumes. They are used where long-lasting citrus notes are desired in fragrances. Orange carbonyls impart a distinct aldehyde note with juicy undertones that can be used where a decanal type note is needed.

Orange carbonyls are complex mixtures of high-boiling molecules, containing higher aldehydes, ketones, alcohols and sesquiterpenes. Orange carbonyls are obtained during total fractionation of orange oils. The main ingredients in this product are shown in **F-1**, **F-2** and **F-3**, according to their chemical function and organoleptic characteristics.[1] Not all orange carbonyls products contain all of the ingredients mentioned below. The percentages of these ingredients may vary between different products.

Orange carbonyls are produced mostly from citrus peel oil (CPO) and orange essence oil (OEO). The first production stage involves dewaxing and decolorization of the single oils. Then a concentration process removes the volatiles, containing mainly d-limonene, from the oxygenated molecules, which are responsible for the flavor characteristics. The concentration processes are typically high-vacuum distillations and molecular distillations. A typical carbonyl fraction is shown by the accompanying GC figure (**F-4**).

Reference

1. Most information on organoleptic properties and uses is taken from: PMP 96, *Database of Perfumery Materials & Performance*, Boelens Aroma Chemicals Information Services, Netherlands. Additionally, some of the organoleptic information and uses are cited from suppliers' specification sheets.

Physical Data for Orange Carbonyls (Typical Product)

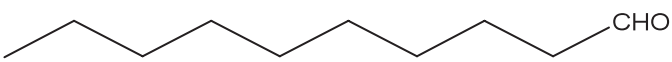
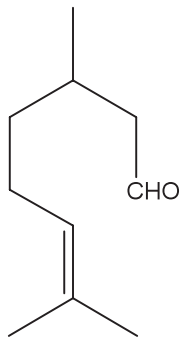
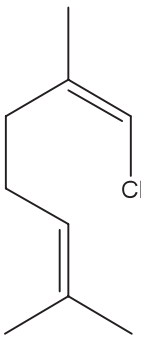
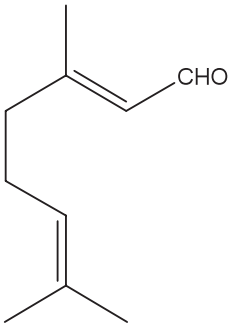
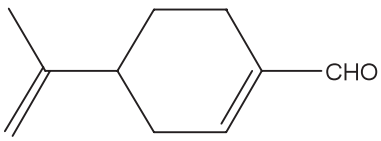
Appearance: colorless to pale yellow liquid

Refractive index n20/D: 1.481–1.485

Specific gravity 25°C: 0.890–0.950

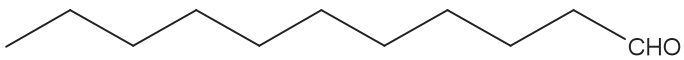
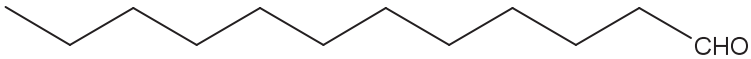
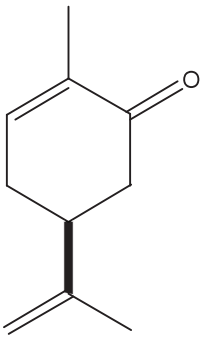
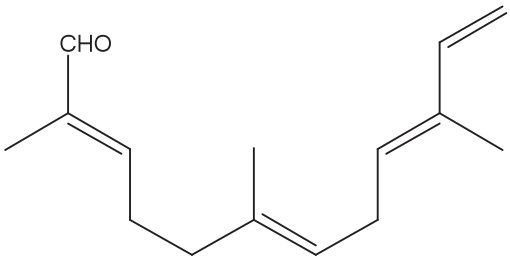
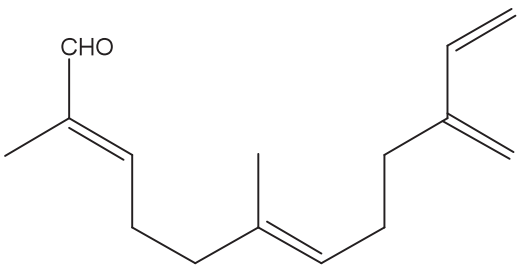
Optical rotation $[\alpha]_D$ 20°C: +20–35°

Aldehyde content (as decanal): 30% min.

Ingredient / CAS# / FEMA#	Organoleptic characteristics
 Decanal / 112-31-2 / 2362	Strong, fatty; orange-like on dilution
 Citronellal / 106-23-0 / 2307	Citrus, green, fruity, perfumistic, aldehydic, soapy
 Neral / 106-26-3 / 2303	Fresh, natural, citrusy-lemon; slightly fruity-herbal
 Geranial / 141-27-5 / 2303	Fresh lemon-like, citrusy and fruity
 Perilla aldehyde / 2111-75-3 / 3557	Fresh, herbal, cumin-like, slightly citrusy; woody, spicy, waxy, sweet, lime and aldehydic

Carbonyl derivatives

F-1 (cont.)

Ingredient / CAS# / FEMA#	Organoleptic characteristics
 Undecanal / 112-44-7 / 3092	Waxy, aldehydic, fatty
 Dodecanal / 112-54-9 / 2615	Fatty, soapy, woody, fresh, citrusy
 S-Carvone / 2244-16-8 / 2249	Herbal, spicy, minty; characteristic of caraway oil
 α-Sinensal[1] / 17909-77-2 / unavailable	Slightly fatty, citrusy
 β-Sinensal[1] / 60066-88-8 / 3141	Slightly fatty, citrusy

[1] Some orange carbonyls products might not consider sinensals as a part of their composition

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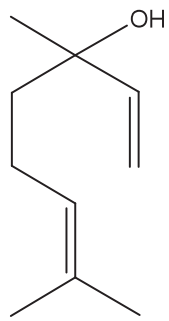
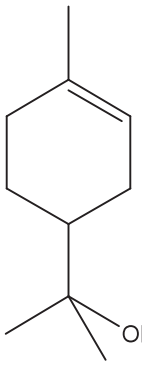
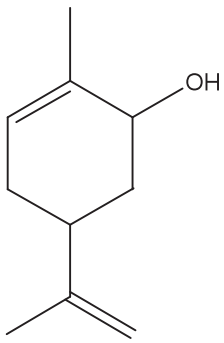
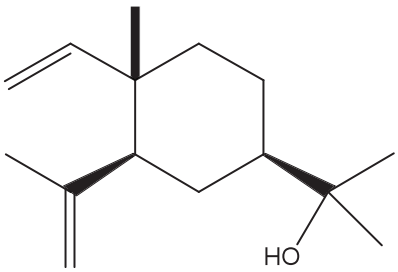
 Linalool / 78-70-6 / 2635	Freshly floral, citrusy, fruity
 α-Terpineol / 98-55-5 / 3045	Floral, earthy, damp
 Carveol / 99-48-9 / 2247	Fresh herbal, somewhat minty; slightly reminiscent of caraway
 α-Elemol / 639-99-6 / unavailable	Mild woody

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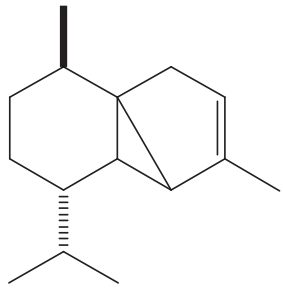
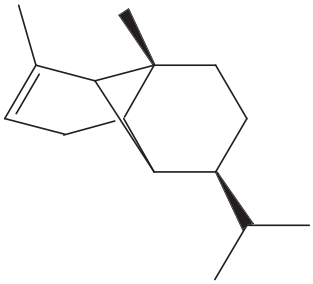
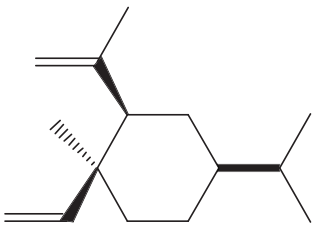
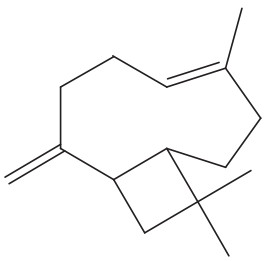
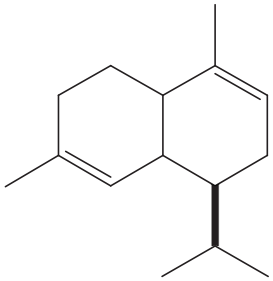
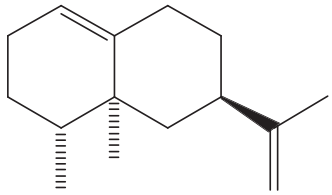
 α-Cubebene / 17699-14-8 / unavailable	Mild, woody, slightly camphoraceous
 α-Copaene / 3856-25-5 / unavailable	Woody, spicy
 β-Elemene / 33880-83-0 / unavailable	Herbal, waxy, fresh
 β-Caryophyllene / 87-44-5 / 2252	Spicy, woody, dusty, oily; pepper-like, camphoraceous, with a citrus background
 Cadinene / 29350-73-0 / unavailable	Harsh, terpene-like

Hydrocarbons and sesquiterpenes

F-3 (cont.)

Ingredient / CAS# / FEMA#	Organoleptic characteristics
 Valencene / 4630-07-3 / 3443	Woody, orange-citrusy aroma

GC of orange CPO

F-4