

Terpines in Cannabis:

A Companion Reference to
Greenhouse Seed Company's
Terpene Analysis

I. Preface

The purpose of this document provide a summary of the terpenes identified in Greenhouse Seeds' terpene analysis and a reliable way for anyone interested to easily research these terpenes further. For each terpene I attempted to list the odor, other plant-based sources, and medical uses. I limited myself to describing the terpenes that the Greenhouse Seed Co. lists and tried to avoid including unnecessary or unverified information.

I decided to go with FlavorNet.org for the odor description since their database is both comprehensive and consistent, though I frequently compared with TheGoodScentsCompany.com and Moellhausen.com. I've also included the CAS number (a unique chemical identifier) with each terpene as there are many names for the same terpene and many terpenes with similar names but different properties. Aside from Wikipedia, the site which I found most informative was PubMed.gov which is packed with studies and articles about terpenes as well as Cannabis in general.

II. Terpenes, Cannabinoids and the Headspace Method

Terpenes are a large class of hydrocarbons and the major constituent of resin. Common examples include Limonene, Pinene and Eucalyptol. The Greenhouse Seed Co. lists sixteen terpenes using headspace gas chromatography which measures the gaseous space, or “headspace” above the sample in a vial. This type of analysis works well with very light volatilesⁱ, like many terpenes.

Cannabinoids are a group of terpenes that bind to either the CB₁ receptors, found mostly in the brain and responsible for the psychological effects of cannabinoids or CB₂ receptors found almost exclusively in the immune system. The Greenhouse Seed Co. list percentages for three cannabinoids exclusive to Cannabis:

1. *delta-9*-Tetrahydrocannabinol (THC; CAS: 1972-08-3) attaches to both the CB₁ and CB₂ receptors, having the well known effects of relaxation, euphoria, altering sensual perception, anxiety, appetite stimulation and so on.
2. Cannabidiol (CBD; CAS: 13956-29-1) also binds to both the CB₁ and CB₂ receptors, with a preference for CB₂, that is an antiinflammatory, antianxiety agent, antinauseant, antipsychotic and inhibits cancer growthⁱⁱ.
3. Cannabigerol (CBG; CAS: 2808-33-5) is non-psychoactive, presumably only attaching to the CB₂ receptor and has been reported to lower blood pressureⁱⁱⁱ. Both CBD and CBG are found in higher levels in Indica or Hybrid strains than in Sativa strains^{iv}.

III. Greenhouse Seeds' Terpenes

1. *alpha*-Pinene (CAS: 80-56-8)

Odor: Pine, Turpentine

alpha-Pinene has a woody-green pine-like odor and is found in the oils of many coniferous trees and rosemary.

Pinene is used as an antibiotic^v, to treat joint problems, respiratory ailments and is believed to have diuretic properties. It has also been identified as a CYP450 2B1 inhibitor^{vi}, helping prevent liver cancer.

2. Camphene (CAS: 79-92-5)

Odor: Camphor

Camphene is a minor constituent of many essential oils such as turpentine, cypress oil, camphor oil, citronella oil, neroli, ginger oil, and valerian.

Camphene has been studied fairly well and has been discovered to be effective as an antibacterial, antifungal, antiinflammatory, cytoprotectant^{vii}, insecticide and in preventing build-up of cholesterol and fat in the aorta^{viii}.

3. *beta*-Pinene (CAS: 127-91-3)

Odor: Pine, Resin, Turpentine

Like *alpha*-Pinene, *beta*-Pinene has a woody-green pine-like odor. It occurs naturally in rosemary, parsley, dill, basil, yarrow and rose. It has very similar if not identical effects and properties to *alpha*-Pinene.

4. Sabinene (CAS: 3387-41-5)

Odor: Pepper, Turpentine, Wood

Sabinene is one of the chemical compounds that contributes to the spiciness of black pepper and is a major constituent of carrot seed oil. It also occurs in tea tree oil at a low concentration.

Despite being fairly common, there is little information available about the effects of Sabinene.

5. *delta-3-Carene* (CAS: 13466-78-9)

Odor: Lemon, Resin

Carene, or *delta-3-Carene*, occurs naturally as a constituent of turpentine. Carene has a sweet and pungent odor.

delta-3-Carene has been shown to constrict the lungs' conductance and compliance even at low levels^{ix}, however has also been described as an effective anti-bacterial and anti-inflammatory agent^x.

6. *alpha-Phellandrene* (CAS: 99-83-2)

Odor: Turpentine, Mint, Spice

alpha-Phellandrene is found in the essential oils of Eucalyptus but only when distilled at particular times of the year, being apparently absent at other periods.

One thing to be said about *alpha-Phellandrene* is that it has been in cigarettes for a number of years, and the Expert Committee of FEMA and the joint FAO/WHO Expert Committee concluded that the *alpha-Phellandrene* “does not increase the overall toxicity of cigarette smoke^{xi}.”

7. *beta-Myrcene* (CAS: 123-35-3)

Odor: Balsamic, Must, Spice

Myrcene is found in mangoes, lemon grass and hops, as well as many other plants.

A study on the effects of *beta-Myrcene* on rats found that although it is an potent pain-killer it had no effect on anxiety, seizures, or hypnosis as previously thought^{xii}. Myrcene does however synergise the antibiotic potencies of other terpenes, such as *alpha-Pinene*, against *Staphylococcus aureus*, *E. Coli* and several other infections^{xiii} as well as being a CYP450 2B1 inhibitor.

8. *alpha-Terpinene* (CAS: 99-86-5)

Odor: Lemon

Terpinene is found in cardamom and marjoram oils and is used in flavor and fragrance for reconstitution of citrus oils. *alpha-* is more lemony than *gamma-Terpinene*, but not as warm.

alpha-Terpinene is a CYP450 2B1 inhibitor and, recently, *alpha-* and *gamma-Terpinene* were found to have antioxidant properties^{xiv}, with *gamma-Terpinene* being almost twice as effective. Both are also acetylcholinesterase (AChE) inhibitors^{xv}, which are used to treat Alzheimer's and other similar diseases.

9. Limonene (CAS: 5989-27-5)

Odor: Lemon, Orange

Limonene takes its name from the lemon, as the rind of the lemon and other citrus fruit contain considerable amounts of it. It is used extensively in the food and fragrance industries.

As well as being an AChE and CYP450 2B1 inhibitor, Limonene has chemopreventive activity against mammary, skin, liver, lung, forestomach and pancreatic cancers^{xvi}

10. 1.8-Cineol (CAS: 470-82-6)

Odor: Minty, Sweet

1.8-Cineol, also known as eucalyptol, is used in flavorings, fragrances, cosmetics and in many brands of mouthwash and cough suppressant.

1.8-Cineol has been demonstrated to be an analgesic, antibacterial, antiinflammatory, an AChE inhibitor and fatal to leukaemic cells in vitro. As well as being a antibacterial, antifungal, antiinflammatory and analgesic, it also has the effect of increasing cerebral blood flow and enhancing cortical activity^{xvii}. What makes this terpene more interesting is its ability to prevent transmission of HSV-2, which often goes hand in hand with HIV, and its use has since been suggested as a way to lower the risk of HIV transmission^{xviii}.

11. γ -Terpinene (CAS: 99-85-4)

Odor: Gasoline, Turpentine

gamma-Terpinene has a characteristic lemon odor of lower tenacity than *alpha*-Terpinene, but warmer and slightly bitter.

Similar to *alpha*-Terpinene, *gamma*-Terpinene is both an antioxidant and an AChE inhibitor.

12. *cis*-Ocimene (CAS: 3338-55-4)

Odor: Citrus, Herb, Flower

beta-Ocimene exists in two stereoisomeric forms, *cis*- and *trans*-Ocimene. The Ocimenes are often found naturally as mixtures of the various forms which is used in perfumes.

Both *cis*- and *trans*-Ocimene have been implicated as having antibacterial^{xix} and antimicrobial^{xx} effects as well as an inhibitory effect on HIV-1^{xxi}.

13. *trans*-Ocimene (CAS: 3779-61-1)

Odor: Sweet, Herb

See *cis*-Ocimene for description.

14. *alpha*-Terpinolene (CAS: 586-62-9)

Odor: Pine, Plastic

Information on Terpinolene is sparse and many tests use essential oils which contain other potent terpenes, however it has been implicated as an antiinflammatory^{xxii} and HIV-1 inhibitor^{xxiii}.

15. *trans*-Caryophyllene (CAS: 87-44-5)

Odor:

trans-Caryophyllene is one of the chemical compounds that contributes to the spiciness of black pepper and a constituent of many essential oils, especially clove, hemp, and rosemary. It is usually found as a mixture with Isocaryophyllene and *alpha*-Humulene.

Recently *trans*-Caryophyllene was shown to selectively bind to the CB₂ receptor and to exert significant antiinflammatory effects, however, does not bind CB₁ receptor and thus has no hallucinogenic effects^{xxiv}.

16. *alpha*-Humulene (CAS: 6753-98-6)

Odor: Wood

alpha-Humulene or *alpha*-Caryophyllene, is a naturally-occurring terpene found in the essential oils of hops and many other plants.

alpha-Humulene has potent antiinflammatory effects, whether administered orally or in gaseous form^{xxv} and has also been suggested as treatment for neurodegenerative diseases^{xxvi} such as Alzheimer's.

- i “What is Headspace Gas Chromatography?”, <http://www.labhut.com/education/headspace/>
- ii “Non-psychotropic plant cannabinoids: new therapeutic opportunities from an ancient herb”, <http://www.ncbi.nlm.nih.gov/pubmed/19729208>
- iii “Cannabinoids in clinical practice”, <http://www.ncbi.nlm.nih.gov/pubmed/11152013>
- iv “What are the differences between Cannabis indica and Cannabis sativa, and how do they vary in their potential medical utility?”, <http://medicalmarijuana.procon.org/viewanswers.asp?questionID=638>
- v “Cannabis therapeutics in HIV/AIDS”, <http://books.google.ca/books?id=qUMQqa1PT4QC&pg=PA118>
- vi “Cannabis therapeutics in HIV/AIDS”, <http://books.google.ca/books?id=qUMQqa1PT4QC&pg=PA115>
- vii “Plant derived antioxidants – Geraniol and camphene protect rat alveolar macrophages against t-BHP induced oxidative stress”, <http://www.ncbi.nlm.nih.gov/pubmed/19135518>
- viii “Nutmeg And Derivatives”, <http://www.fao.org/docrep/v4084e/v4084e00.HTM>
- ix “Does airway responsiveness increase after skin sensitisation to 3-carene: a study in isolated guinea pig lungs”, <http://www.ncbi.nlm.nih.gov/pubmed/14581172>
- x Alaskan Klondike Gold Seasoning, http://www.alaskangoldseasoning.com/Health_Benefits.html
- xi “Evaluation of alpha-Phellandrene for Use as a Cigarette Ingredient ”, <http://www.pmintl-technical-product-information.com/global/downloads/ingredients/Alpha-phellandrene.pdf>
- xii “Neurobehavioral study of the effect of beta-myrcene on rodents”, <http://www.ncbi.nlm.nih.gov/pubmed/1797273>
- xiii “Cannabis therapeutics in HIV/AIDS”, <http://books.google.ca/books?id=qUMQqa1PT4QC&pg=PA115>
- xiv “Unusual antioxidant behavior of alpha- and gamma-terpinene in protecting methyl linoleate, DNA, and erythrocyte”, <http://www.ncbi.nlm.nih.gov/pubmed/19326866>
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- xvi “Prevention and therapy of cancer by dietary monoterpenes”, <http://www.ncbi.nlm.nih.gov/pubmed/10082788>
- xvii “Cannabis therapeutics in HIV/AIDS”, <http://books.google.ca/books?id=qUMQqa1PT4QC&pg=PA117>
- xviii “Cannabis therapeutics in HIV/AIDS”, <http://books.google.ca/books?id=qUMQqa1PT4QC&pg=PA118>
- xix “Antibacterial activity and composition of essential oils from flower, leaf and stem of Chaerophyllum macropodium Boiss. from Iran”, <http://www.ncbi.nlm.nih.gov/pubmed/19634338>
- xx “Composition and antimicrobial activity of the essential oil of Dicyclophora persica Boiss. from Iran”, <http://www.ncbi.nlm.nih.gov/pubmed/16869485>
- xxi “HIV-1-Inhibiting Activity of the Essential Oil of Ridolfia segetum and Oenanthe crocata”, <http://www.ncbi.nlm.nih.gov/pubmed/19347799>
- xxii “Evaluation of anti-inflammatory-related activity of essential oils from the leaves and resin of species of Protium”, <http://www.ncbi.nlm.nih.gov/pubmed/10432208>
- xxiii “HIV-1-Inhibiting Activity of the Essential Oil of Ridolfia segetum and Oenanthe crocata”, <http://www.ncbi.nlm.nih.gov/pubmed/19347799>
- xxiv “Beta-caryophyllene is a dietary cannabinoid”, <http://www.ncbi.nlm.nih.gov/pubmed/18574142>
- xxv “Preventive and therapeutic anti-inflammatory properties of the sesquiterpene alpha-humulene in experimental airways allergic inflammation”, <http://www.ncbi.nlm.nih.gov/pubmed/19438512>
- xxvi “Protective Effects of the Essential Oil of Salvia fruticosa and Its Constituents on Astrocytic Susceptibility to Hydrogen Peroxide-Induced Cell Death”, <http://www.ncbi.nlm.nih.gov/pubmed/19722569>