A Guide to Common Terpenes in Cannabis

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A Guide to Common Terpenes

At Confidence Analytics we test for over 20 terpenes commonly found in cannabis. There are many questions surrounding these chemicals and why they matter in the market. What exactly are terpenes? How do you test for them? What are the terpenes that show up on my certificate? Lets take a look at these common questions and shed some light on these elusive chemicals.

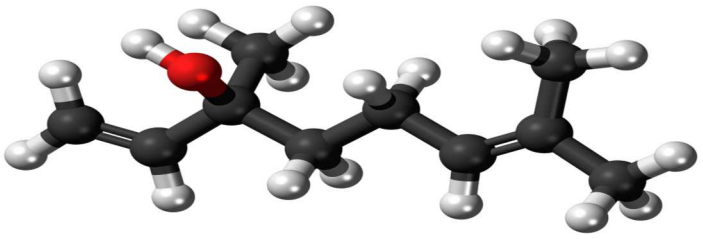
What are terpenes?

Whenever you open a fresh bag of cannabis, you probably note a variety of smells that come forth. It might smell like skunks, flowers, or berries. The cornucopia of aromas found in the many phenotypes of cannabis out there are numerous and varied. Terpenes are not limited to just marijuana. Terpenes are naturally present in a wide variety of plants and they can also be created by and synthesized by living organisms.

Plants utilize terpenes to attract pollinators, such as the monarch butterfly pictured above, and also to repel predators. The terpene profile of a plant can play an important role in propagation of the plant's species.

Terpenes are organic hydrocarbons. There are literally thousands of terpenes and terpene isomers. We smell them because they are highly volatile and evaporate in the air at room temperature. A few parts per million can go a long way in changing the smell of something. Even 1% terpene content in a cannabis flower could provide a significant odor and flavor. Their volatility can also make them difficult to preserve. The way marijuana is cured can make a big difference in how much of a strain's terpene profile shows up in the final packaged product.

While terpenes can smell good or bad, it's interesting to note in small concentrations many terpenes have been shown to have useful properties, from medicines to pesticides. In larger concentrations they can reach levels that can be toxic. Toxicity is a concern with any form of hydrocarbon molecule in high concentrations.

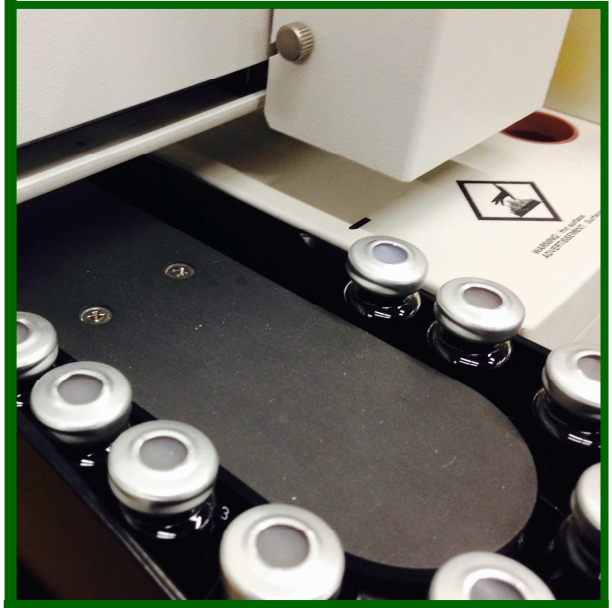


The linalool terpene molecule is present in many everyday body products, like the little soaps they provide in hotels.

Much research is happening within the scientific community with regards to terpenes. Work is being done to find additional commercial value for these chemicals. Researchers are also looking for new an improved methods of synthesizing and purifying many of these chemicals on large scales, as they are frequently difficult to get in high purity and high yield.

How are terpenes measured?

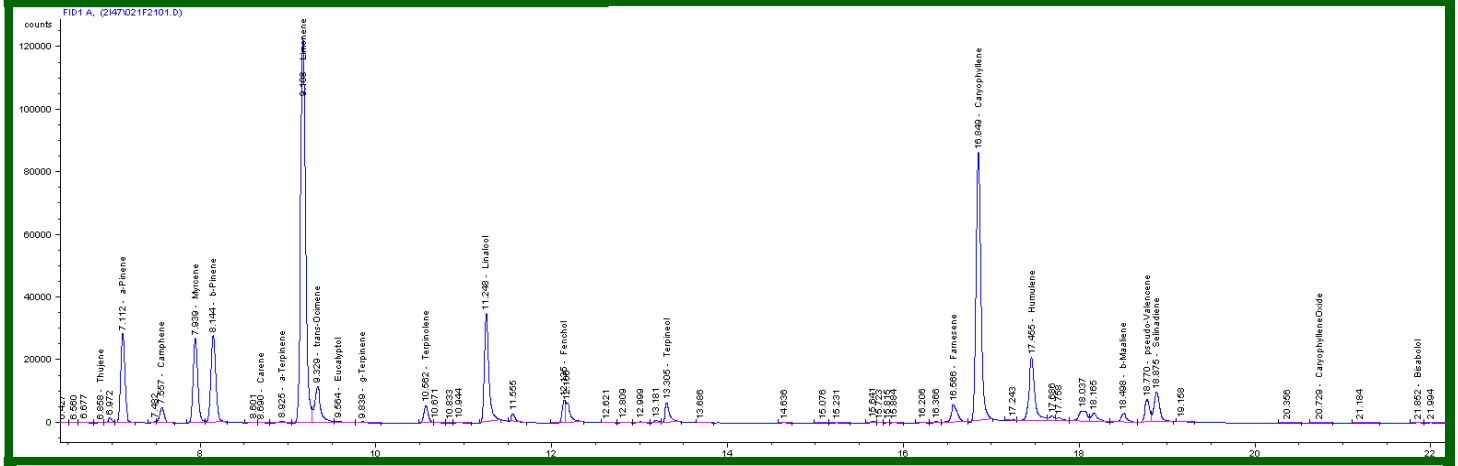
There are multiple methodologies for measuring terpenes. Some are limited in visibility, number of terpenes that can be detected, or level of accuracy. Here at Confidence Analytics we use the gold standard for measuring terpenes, which is GC-FID analysis. With this method we can detect quantities less than 1 part per million.



Samples being ran on a GC-FID machine are loaded using headspace vials. Above are vials waiting their turn to be run for terpene analysis

GC-FID stands for "gas chromatography—flame ionization detector." Organic compounds combust at a high temperature in the headspace of the GC-FID. As they combust they pass through a detector which can quantify the presence of the chemicals the machine is calibrated to detect. Hydrocarbons typically have a response in the instrument that is related to the number of carbons in the molecule.

There are several advantages to using this method for over other available methods. Sample preparation is simple and straightforward. The separation between compounds as they are detected is very good, making the chromatography data not only clean to read, but also able to detect a larger array of terpenes. The instrument's themselves are also very robust and maintain accuracy with regular wear and tear of daily use.



The gas chromatograph above shows the peaks the detector on the GC-FID identifies for terpenes. The separation between the peaks is an example of having good resolution for what is being measured with the instrument. The X axis shows the time when the peak passes through the detector. The Y axis quantifies the size of the peak. Each compound passes through the detector at a very specific time.

Confidence Analytics uses standards from the leaders in the industry, such as Restek, to calibrate our machines. Each compound a GC can quantify passes through the detector at a specific time, so the time a chemical passes though is its unique signature. The purity of these standards helps us quantify more peaks on our chromatograph and ensure the peak times we see match up with a high level of accuracy, down to less than 1 second of a 30 minute run time.

What are these terpenes?

Lets take a brief look at some of these compounds that are commonly found in a variety of cannabis and concentrate samples, their particular odors and flavors, therapeutic benefits, and where else they occur in the natural world.

α and γ Terpinene

Terpinene is one of the chemicals that lends celery its smell and flavor.

Odor: Bracing woody scent with lemony-citrus notes. Medicinal, slightly camphoraceous

Taste: Flavors of pine and lemon-lime with spicy juicy-berry nuance

Therapeutic Benefits: Terpinene is a major active component of tea tree oil. The activity of terpinene is responsible for the anti-fungal properties of tea tree oil and the antibacterial properties of coriander and fennel essential oils

Naturally Occurring in Nature: Terpinene has been isolated from cardamom and marjoram oils, and from other natural sources. It occurs in celery, coriander, fennel, grapefruit, lemon, lime, orange and mandarin oil, nutmeg, black pepper, and Scotch Spearmint

Terpinolene

Odor: Sweet pine odor, can also be described as smoky or woody. Pleasant aroma.

Taste: Somewhat sweet citrus flavor

Therapeutic Benefits: Anti-bacterial, anti-fungal, anti-proliferative (inhibits cancer cell growth), and antioxidant

Naturally Occurring in Nature: Apple, cumin, ginger, pepper and lilac all contain terpinolene

Terpinolene is one of many antioxidant chemicals found in ginger.

Caryophyllene

Odor: Fruity, citrus, woody, spicy

Taste: Warm moss like, slightly minty, earthy flavor

Caryophyllene

Therapeutic Benefits: Analgesic, anti-bacterial, anti-depressant, anti-inflammatory, anti-proliferative, antioxidant, anxiolytic, and neuro-protective

Naturally Occurring in Nature: Present in the essential oils of many plants, such as rosemary, hops, and black pepper

Caryophyllene plays a role in the spiciness of black pepper.

Caryophyllene Oxide

The bark of Annona squamosal, commonly called the "sugar apple" contains caryophyllene oxide.

Odor: Woody sawdust smell. Somewhat grassy and light

Taste: Very mild and indistinct

Therapeutic Benefits: Some studies show anti-depressant activity in the central nervous system. Is also anti-fungal and an analgesic. Repels some insects and parasites

Naturally Occurring in Nature: Present in small amounts in a very large number of natural substances particularly the bark of Annona squamosa, clove oil, guava leaf, and cinnamon

Farnesene

You may have noticed that when you store apples alongside other types of produce, the things around them ripen and go bad much faster. Apple skins contain a significant amount of farnesene. The farnesene in the apple's skin reacts with the air and as it oxidizes releases ethelyne gas, sometimes called the "ripening hormone." This gas speeds up the ripening process and can reduce the shelf life of the produce around the apples.

Odor: Depending on isomer, may smell like green apples or gardenias, has a woody and spicy note

Taste: Herby and woody

Therapeutic Benefits: Farnesene acts as a natural insect repellent and used in some pesticides, some plants such as potatoes synthesize isomers naturally that resemble alarm pheromones for aphids. It is used as a starting material for commercially manufactured vitamins and a variety of other useful products, from beauty products to biofuels

Naturally Occurring in Nature: Found in the skins of many types of stone fruit, such as apples. Is the main terpene in gardenia flowers. It is also found in German chamomile, and ginger. Can be produced by fermenting sugar cane

Iso-Pulegol

Odor: Medium strength scent that is predominantly minty with medicinal and menthol notes

Taste: Fresh, crisp, and cool sensation. Minty, herbaceous, and bittersweet flavor

Therapeutic Benefits: Studied for its anti-convulsant and bio-protective effects. Studies with mice have shown protection against seizures and reduced mortality for animals suffering from convulsions. Iso-pulegol has also been shown to protect against the formation of gastrointestinal ulcers

Naturally Occurring in Nature: Found in lemongrass, multiple variants of eucalyptus, mint, citronella, and lemon verbena

Iso-pulegol plays a role in the stomach soothing properties of mint tea.

Limonene

Limonene's name is taken from the lemon, which contains considerable amounts of limonene.

Odor: Strong smell of oranges and fresh citrus

Taste: Fresh citrus taste. Used in food manufacturing and some medications to mask the bitter taste of alkaloids

Therapeutic Benefits: Anti-stress and has sedative properties. Known to be anti-carcinogenic. Consumption of D-limonene in supplemental form or freshly squeezed pulp containing lemonade has been shown to reduce formation of some tumor growths and alleviate fat buildup in the liver induced by diet

Naturally Occurring in Nature: Commonly found in the rind of citrus fruits such as grapefruit, lemon, limes, and oranges

Beta-maaliene

Nardostachyos radix et rhizome is an herb used in traditional Uyghur medicine containing significant amounts beta-maaliene.

Odor: Mild odor that is woody and herby, resembling patchouli

Taste: Spicy, herbaceous, and woody. Not recommended for commercial flavoring uses

Beta-maaliene

Therapeutic Benefits: Has sedative effects. Research being done regarding it's role in the herbs of traditional Uyghur medicine and treatment of depression

Naturally Occurring in Nature: Present in patchouli and tea tree essential oils. Also found in spikenard, ginseng, and radix et rhizome nardostachyos herbs

Geraniol

Geraniol is one of the reasons stopping to smell the roses is so sweet.

Odor: Rose-like scent often used in perfumes, presents citrus and citronella nuances

Taste: Sweet and floral. Flavor of rose water with fruity peach-like notes. Responsible for the floral notes in beer imparted by hops

Therapeutic Benefits: Geraniol is an effective plant based mosquito repellant and is known to have anti-microbial properties. It is also an anti-oxidant and is currently under study for abilities to inhibit cell growth in cancerous tumors

Naturally Occurring in Nature: Geraniol is the primary component of rose, palmarosa, and citronella oils. It is also found in geranium, lemon, bergamot, and many other essential oils. It is a major scent component in aged tobacco

Eucalyptol

Odor: Fresh camphor-like smell

Taste: Pleasant spicy, cooling taste. Used as a flavoring in various food products including baked goods, candies, meat products, and beverages

Therapeutic Benefits: Eucalyptol has been found to control airway mucus overproduction and to reduce headache and runny nose associated with the common cold. It is a common ingredient in cough suppressants. Topical application has been shown to reduce pain and inflammation

Eucalyptol's medicinal properties are part of the reason cough drops are effective at treating cold and flu symptoms.

Naturally Occurring in Nature: Composes up to 90% of the essential oil for some species of eucalyptus. Also found in camphor laurel, bay leaves, tea tree, sweet basil, wormwood, rosemary, and sage

Linalool

Lavender's smell has similar characteristics to linalool.

Odor: Floral with a touch of spiciness, similar to that of bergamot oil and French lavender. Linalool is used as a scent in 60-80% of perfumed hygiene products and cleaning agents, such as shampoos and lotions

Taste: Citrus, floral, and fruity

Therapeutic Benefits: Shown to reduce stress levels in laboratory rats as well as inhibit activity in as many as 200 genes associated with increased stress hormones

Naturally Occurring in Nature: Over 200 plant species produce linalool, including hops and basil

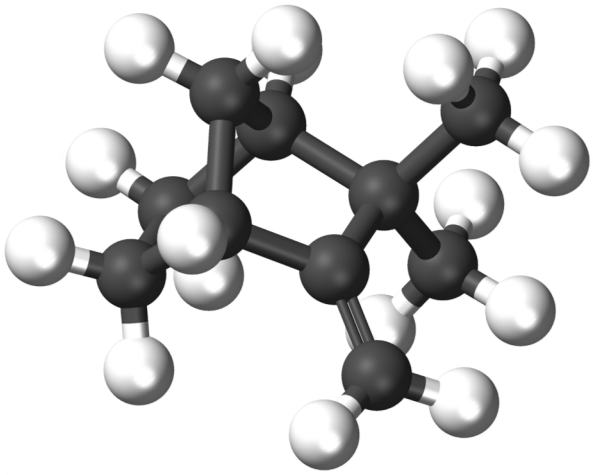
Camphene

Odor: Pungent camphoraceous odor with green minty and green spicy notes. Herbal and woody, reminiscent of pine needles

Taste: Cooling and minty with citrus and spicy green nuance

Therapeutic Benefits: Camphene is being studied for its ability to reduce blood concentrations of cholesterol and triglycerides. It has also been shown to prevent the development of fatty liver and insulin resistance in mice

Naturally Occurring in Nature: A minor constituent in many essential oils including cypress, camphor, citronella, neroli, ginger, parsley, fennel, lavender and valerian



In the 19th century camphene was briefly used as a fuel for lamps, but went out of favor after its explosive properties came to light.

Myrcene

Up to 70% of the essential oil of hops may be myrcene.

Odor: Pleasant odor but unstable in air. Has been described as grape, woody, vegetable, peach, sweet vanilla and wine-like as well as balsamic and peppery. Pungent in high concentrations

Taste: Fruity clove-like taste, sometimes described as earthlike or metallic

Myrcene

Therapeutic Benefits: Myrcene has a plethora of positive effects such as pain relief, anti-bacterial, antidiabetic, anti-inflammatory, anti-insomnia, anti-mutagenic, anti-psychotic tranquilizing effects, and antispasmodic

Naturally Occurring in Nature: Found in many plants including basil, hops, lemongrass, mango, rosemary, and thyme which contains up to 40% myrcene by weight

Humulene

Odor: Robust aroma with woody, earthy, and herbal

Taste: Woody organic flavor. Humulene is responsible for the earthy and spicy flavors found in noble hops

Therapeutic Benefits: Analgesic, anti-bacterial, anti-inflammatory, anti-proliferative, and appetite suppressant

Naturally Occurring in Nature: Basil, clove, some evergreen trees, ginseng, and sage

Scientific studies using sensory panels and gas chromatography have linked the "hoppy" odor in beer to high concentrations of humulene.

Thujene

Frankincense essential oil is created by steam distilling the resin from the tree. The Boswellia serrata species from India contains the most Thujene out of the various types of frankincense. The oil has many traditional medicinal uses; antiseptic, astringent, clotting agent, digestive and respiratory aid.

Odor: Woody, green, herbaceous

Taste: Has a very pungent spicy herbal flavor

Therapeutic Benefits: Has already known insecticidal and anti-microbial properties. Currently being researched for its potential anti-inflammatory benefits, particularly with regards to arthritis

Naturally Occurring in Nature: Very prevalent in Frankincense essential oil, for some frankincense species Thujene can be over 60% of the oil's constituents. It is also found in eucalyptus and black cumin.

α and ß-Pinene

Odor: Characteristic odor of pine, like Pine-Sol

Taste: Piney, turpentine-like taste

Therapeutic Benefits: Analgesic, antibacterial, anti-inflammatory, anti-proliferative, and antioxidant. Some studies show it as an aid in memory retention

Naturally Occurring in Nature: Many species of coniferous trees, notably the pine, as well as rosemary , cumin, and hops

The piney odor of fresh rosemary can be attributed to pinene.

Fenchol

Fenchol is a terpene that is readily available in bulk quantities for industrial use. Fenchol is commonly used in perfumery. It is found in many antiperspirants, fabric softeners, and detergents.

Odor: Camphoraceous, piney, woody, and rooty smell with a sweet lemon note

Taste: Bitter, cool, minty, earthy, and medicinal taste. Lasting citrus after tone

Therapeutic Benefits: Is known for antibacterial and antifungal properties and is currently being researched for its potential uses as an anti-inflammatory pain reducer

Naturally Occurring in Nature: Basil, grape, fennel, rosemary, nutmeg, and celery seeds

Bisabolol

Odor: Subtle sweet floral aroma that is used in many fragrances

Taste: Slightly floral flavor

Therapeutic Benefits: Known to have anti-irritant, anti-inflammatory, and antimicrobial properties. Enantiomer a-bisabolol has recently been shown to induce apoptosis (programmed cell death) in models of leukemia

Naturally Occurring in Nature: Bisabolol is the main constituent of the essential oil of chamomile

Bisabolol is a major terpene in chamomile, which is approved by the German government as a treatment to reduce swelling, fight bacteria, or help with cramps.

Further Reading

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