

What Are Terpenoids?

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STORY AT-A-GLANCE

- › Terpenoids represent the largest and most diverse class of beneficial plant chemicals; more than 40,000 individual terpenoids exist, and new ones are discovered every year
- › Accumulating research suggests terpenoids may help reduce the risk for metabolic disorders, fight cancer, exert antiaging benefits and more
- › Terpenoids are responsible for the wide variety of plant flavors and aromas, making them a sought-after commodity in the flavor and fragrance industries

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Traditional medical practitioners have known for millennia that plants have the power to prevent, treat or otherwise improve a number of medical conditions. Plants contain bioactive phytochemicals, such as tocopherols, polyphenols and ascorbic acid, which perform important functions in both plants and humans.

Terpenoids (aka isoprenoids) are another beneficial phytochemical – one that many people haven't heard of before. Out of the seemingly countless compounds in plants, terpenoids represent the largest and most diverse class of beneficial chemicals.¹ More than 40,000 individual terpenoids exist, and new ones are discovered every year.²

Plants use terpenoid metabolites to support basic functions like growth, repair and development. However, according to research³ published in *Advances in Biochemical*

Engineering and Biotechnology, they "use the majority of terpenoids for more specialized chemical interactions and protection."

Among humans, terpenoids have long been valued for medicinal purposes in traditional Indian and Chinese medicines, and they've also been used for food, pharmaceutical and chemical purposes. The cancer drug Taxol and the antimalarial drug artemisinin are both terpenoid-based drugs,⁴ but the plant compounds are perhaps most well-known for being the main constituents of the essential oils in many plants.

Because they're responsible for the wide variety of plant flavors and aromas – from flowery and fruity notes to woody undertones – they're a sought-after commodity in the flavor and fragrance industries.⁵ Further, as noted by a study⁶ in the journal *Recent Patents on Food, Nutrition & Agriculture*:

"Terpenoids represent the oldest known biomolecules, having been recovered from sediments as old as 2.5 billion years. Among plant secondary metabolites, they are the most abundant and diverse class of natural compounds. The diversity of terpenoids is probably a reflection of their many biological activities in nature, which has made them a widely used resource for traditional and modern human exploitation."

Eating Terpenoids Daily May Benefit Metabolic Disorders, Including Diabetes

As they pertain to your health, there's evidence that these powerful plant compounds play a beneficial role in metabolism. According to researchers at Kyoto University in Japan,⁷ terpenoids can modulate the activities of ligand-dependent transcription factors, particularly peroxisome proliferator-activated receptors (PPARs).

PPARs help regulate genes involved in the metabolism of fat and glucose, and PPAR activation has a beneficial effect on [blood pressure](#), [cholesterol levels](#), diabetes, [heart disease](#) and stroke.

"Because PPARs are dietary lipid sensors that control energy homeostasis, daily eating of these terpenoids might be useful for the management for obesity-induced metabolic disorders, such as Type 2 diabetes, hyperlipidemia, insulin resistance and cardiovascular diseases," the researchers wrote, adding:⁸

"Dietary patterns rich in vegetables and fruit are associated with a lower prevalence of metabolic syndrome. Because most of the terpenoids are of plant origin and they are contained in vegetables and fruit, dietary terpenoids may contribute to a decrease in risk of metabolic syndrome. Moreover, because the terpenoids constitute one of the largest families of natural products, more potent and useful PPAR activators may exist."

Terpenoids May Be Valuable as Cancer-Fighting Antioxidants and More

Terpenoids are classified into several classes of chemicals including monoterpenes, diterpenes, triterpenes and tetraterpenes, the latter of which contain the more familiar carotenoids, including lutein and lycopene. Many of them are known for their antioxidant properties as well as their potential for fighting cancer. [Lycopene](#), for instance, may play a role in breast and prostate cancer prevention.

A review published in the journal *Vitamins and Hormones* also noted, "The monoterpenes limonene and perillyl alcohol may be promising substances in cancer therapy,"⁹ noting that combinations of antioxidants, in particular, may exert synergistic effects.

Terpenoids have also been singled out as having the potential to prevent and treat liver cancer. According to a study¹⁰ in the *World Journal of Hepatology*, "A large number of terpenoids exhibit cytotoxicity against a variety of tumor cells and cancer preventive as well as anticancer efficacy in preclinical animal models."

Ten new terpenoids, along with 15 known terpenoids, were even shown to reverse multidrug resistance in a multidrug-resistant tumor cell line.¹¹ And nimbolide – a

bioactive terpenoid compound found in neem – may shrink prostate tumors by as much as 70% while suppressing metastasis by about 50% when taken orally for three months.¹² The plant compounds have also shown potential as anti-colon cancer agents, with researchers explaining:¹³

"Anticancer properties of terpenoids are associated with various mechanisms like counteraction of oxidative stress, potentiating endogenous antioxidants, improving detoxification potential, disrupting cell survival pathways and inducing apoptosis."

In addition, structurally some terpenoids are similar to human hormones, and a diet rich in terpenoids is inversely related to the risk of chronic diseases like cancer, according to research published in Current Drug Targets – including hormone-related cancers like breast and prostate cancers.¹⁴ "[P]re-clinical studies support clinical application of ... naturally occurring terpenoids in treatment of hormone-related human cancers," the researchers noted.

Terpenoids Are Anti-Inflammatory, Pain-Relieving and More

Beyond their cancer-preventive effects, terpenoids also have the following beneficial properties:¹⁵

Analgesic (pain-relieving)	Anti-inflammatory
Antimicrobial	Antifungal
Antiviral	Antiparasitic

They may also help explain why essential oil therapy can be so effective, as terpenoids are known to affect animal and human behavior when inhaled from ambient air.¹⁶ As terpenoids are also found in **cannabis**, it's been suggested that terpenoids may work synergistically with cannabinoids to produce some of the beneficial effects of medical marijuana. According to a study in the British Journal of Pharmacology:¹⁷

"[Terpenoids] display unique therapeutic effects that may contribute meaningfully to the entourage effects of cannabis-based medicinal extracts ... phytocannabinoid-terpenoid interactions ... could produce synergy with respect to treatment of pain, inflammation, depression, anxiety, addiction, epilepsy, cancer, fungal and bacterial infections (including methicillin-resistant Staphylococcus aureus)."

Scientifically Speaking, What Are Terpenoids?

Natural Products Chemistry & Research¹⁸ describes terpenoids as "a large and diverse class of naturally-occurring organic compounds similar to terpenes," and "any group of hydrocarbons that contain terpenes, derived from five-carbon isoprene units." They can form cyclic structures such as sterols. Further:

"Most are multicyclic structures that differ from one another not only in functional groups but also in their basic carbon skeletons. These lipids can be found in all classes of living things, and are the largest group of natural products ..."

Most have a fragrance but no color, are lighter than water and volatile with steam (aka "at steam"), at which point they volatilize or change into a gas. A few terpenoids are solids, such as camphor, but all are soluble in organic solvents and usually insoluble in water. Most of them are optically active and many are open-chain or connected, cyclic unsaturated compounds (that form a ring) with one or more double bonds.¹⁹

Plants Containing the Most Terpenoids

Terpenoids are found in many living organisms throughout nature, especially plants, fungi and marine animals.²⁰ If you want to increase your intake of these beneficial compounds via your diet, eating more whole plant foods is an excellent way to start.

By eating a wide variety, you can be sure you're consuming a variety of terpenoids. For example, a list of dietary terpenoids being evaluated for anticancer activity, and their

dietary sources, was published in the journal *Frontiers in Bioscience*.²¹

- **Monoterpenes** – Lemons, oranges, grapefruit, **caraway**, bergamot, **peppermint**, spearmint, dill, tomatoes
- **Diterpenes** – Carrots, spinach, pumpkin, broccoli, mango, papaya, cherries, tomatoes, oranges, cabbage, watermelon, lettuce
- **Triterpenoids** – Mangoes, strawberries, grapes, figs
- **Carotenoids** – Tomatoes, oranges, carrots, peas, sprouts, greens

In addition, **thyme** and coriander seed oil, which contains up to 70% linalool (a terpenoid), are also good sources, as are mushrooms and chamomile. **Black seed oil**, which is rich in the terpenoid thymoquinone, is another excellent option.

Thymoquinone is known to have anticancer effects.²² Research²³ published in *Drug Discovery Today* concluded thymoquinone has a long history of battling cancer in vitro and in vivo (in "test tube" experiments and animal studies), and modulates 9 of the 10 hallmarks of cancer.

Thymoquinone extract from black cumin appears to be effective against cancers in the blood, lung, kidney, liver, prostate, breast, cervix, colon and skin.²⁴ Black cumin oil is popular in the health food scene, but for optimum nutrition, it may be better to use the seeds because essential fatty acids are easily destroyed by heat or prolonged exposure to air. One problem with extracting oil from seeds is that processing is required, so damage is done.

I soak the seeds overnight, then put them in a smoothie. They're a little on the bitter side, so putting a sweetener in them, such as honey or maple syrup, gives them a tasty boost. Research is ongoing looking into the effects of various terpenoid extracts, such as that from the Siberian fir, a coniferous evergreen tree, which has shown potential antiaging and anticancer effects.²⁵

The bottom line is that terpenoids appear to be phenomenal for your health, and if you'd like to consume more of them, the easiest way to do so is to eat more vegetables, herbs

and fruits.

Beyond that, many plant extracts, essential oils and medicinal plants also contain high concentrations, and working with a holistic health care practitioner who is familiar with some of the different varieties, and their individualized uses, may help you to determine the best sources for you.

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