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## Cannabis Sativa: the plant of the thousand and one molecules

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Publication Review: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4740396/>

Andre, C. M., Hausman, J. F., & Guerriero, G. (2016). Cannabis sativa: the plant of the thousand and one molecules. *Frontiers in plant science*, 7.

Cannabis plants have a lot of different types of chemicals that have been suggested to be beneficial to humans. These include cannabinoids, terpenes, and phenolic compounds.

Research has been limited due the illegality of cultivation, but more and more people are looking at the non-THC active components of the cannabis plant that seem to work together to produce a powerful entourage effect.

Phytocannabinoids are terpenophenolic compounds, meaning part terpene and part natural phenol, and over 90 different types have been found in cannabis plants or as break down products.

The predominant compounds found in the plant in this category are quote THCA, CBDA and cannabinolic acid (CBNA), followed by cannabigerolic acid (CBGA), cannabichromenic acid (CBCA) and cannabinodiolic acid (CBNDA) unquote.

These phytocannabinoid acids go unto a decarboxylation reaction to their corresponding neutral forms, sometimes naturally in the plant, but normally after harvesting with heat.

Most of the medicinal properties of cannabinoids come from their interactions with the endocannabinoid systems in humans.

This system is thought to quote modulate or play a regulatory role in a variety of physiological processing including appetite, pain-sensation, mood, memory, inflammation, insulin, sensitivity and fat and energy metabolism unquote.

THC, the neutral form of THCA, exhibits anti-inflammatory, anti-cancer, analgesic, muscle relaxant, neuro-antioxidative, and anti-spasmodic activities, but also has been associated with a number of side effects including anxiety, cholingeric deficits, and immunosuppression.

CBD, the neutral form of CBDA, has been shown to possess anti-anxiety, anti-nausea, anti-arthritic, anti-psychotic, anti-inflammatory, and immunomodulatory properties, while also reducing THC side effects, increasing the safety of cannabis extracts.

CBC, the third most prevalent phytocannabinoid, has been shown to have anti-inflammatory, sedative, analgesic, anti-bacterial, and anti-fungal properties.

CBG, the neutral form of CBGA, has been linked to possibly be beneficial in patients with inflammatory bowel disease.

Finally CBN, found mostly in aged cannabis due to THC degradation, has similar effects health effects to THC, but focuses more on the immune system rather than the central nervous system.

Terpenes, responsible for the odor and flavor of cannabis, form the largest group of phytochemicals with more than 100 compounds identified in cannabis.

These are split into four different groups, isoprene (5 carbons), monoterpenes (10 carbons), sesquiterpenes (15 carbons), and triterpenes (30 carbons), which are built by multiples of the isoprene unit.

Terpenes easily cross membranes like the blood-brain barrier and have numerous health benefits depending on the compound.

Beta-myrcene is a potent anti-inflammatory, analgesic, and anxiolytic compound, alpha-pinene is an acetylcholinesteral inhibitor which means it may aid in memory abilities which could counteract memory issues arising from THC, pentacyclic tripterpenes have anti-bacterial, anti- fungal, anti-inflammatory, and anti-cancer properties, and the list continues.

The phenol compounds contain flavonoids and lignans in the cannabis plant.

Flavonoids have a wide range of biological effects and share some properties that terpenes and cannabinoids exhibit like anti-inflammatory, anti-cancer, and neuro-protective properties.

Lignans also have a wide array of properties, including having antioxidant, antiviral, antidiabetic, antitumorigenic, and anti-obesity activities.

Altogether, these compounds work together to produce this entourage effect. Some examples is that a full cannabis extract has a stronger muscle-antispastic effect compared to pure THC, or that CBD increases the penetration of THC in muscle cells and reduces cognitive defects, or terpenes modulated the affinity of THC as well as helping with the bioavailability of cannabinoids when transdermally applied.

Due to this synergy, it has been suggested that treatments with phytocannabinoids will contain mixes of specific cannabinoids and terpene extracts to better fight against acne, depression, anxiety, insomnia, dementia, and addiction.