

# CBD vs. THC?

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Of the at least **113 cannabinoids** that have been isolated to date, these two are undoubtedly the most well-known and, the most well researched. Cannabidiol (CBD) and tetrahydrocannabinol (THC) are both naturally occurring compounds found in plants in the cannabis genus. Known as **phytocannabinoids**, these compounds interact with CB1 and CB2 receptors found in the endocannabinoid system present in all mammalian species.

CBD was **first isolated in 1940** whilst **THC was isolated** in 1964 by the preeminent cannabis scientist Raphael Mechoulam. At the most fundamental level, THC and CBD are different because of their differing physiological effects. CBD is non-psychoactive and therefore does not illicit a “high” whereas THC is psychoactive and is the only known cannabis-derived compound to illicit a “high”. Here we look at some of the key differences, and similarities, between CBD and THC.

## The structures of THC vs CBD

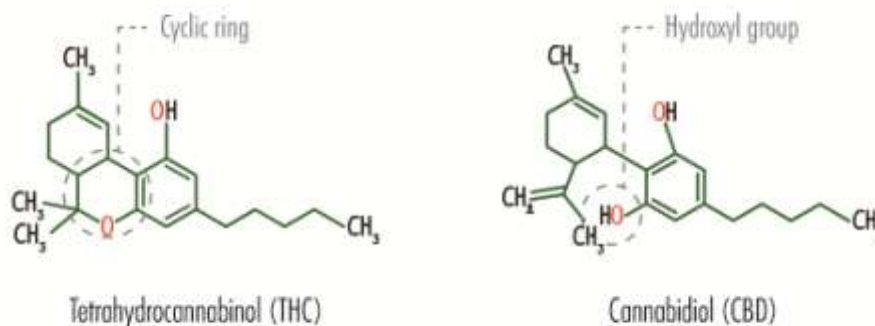
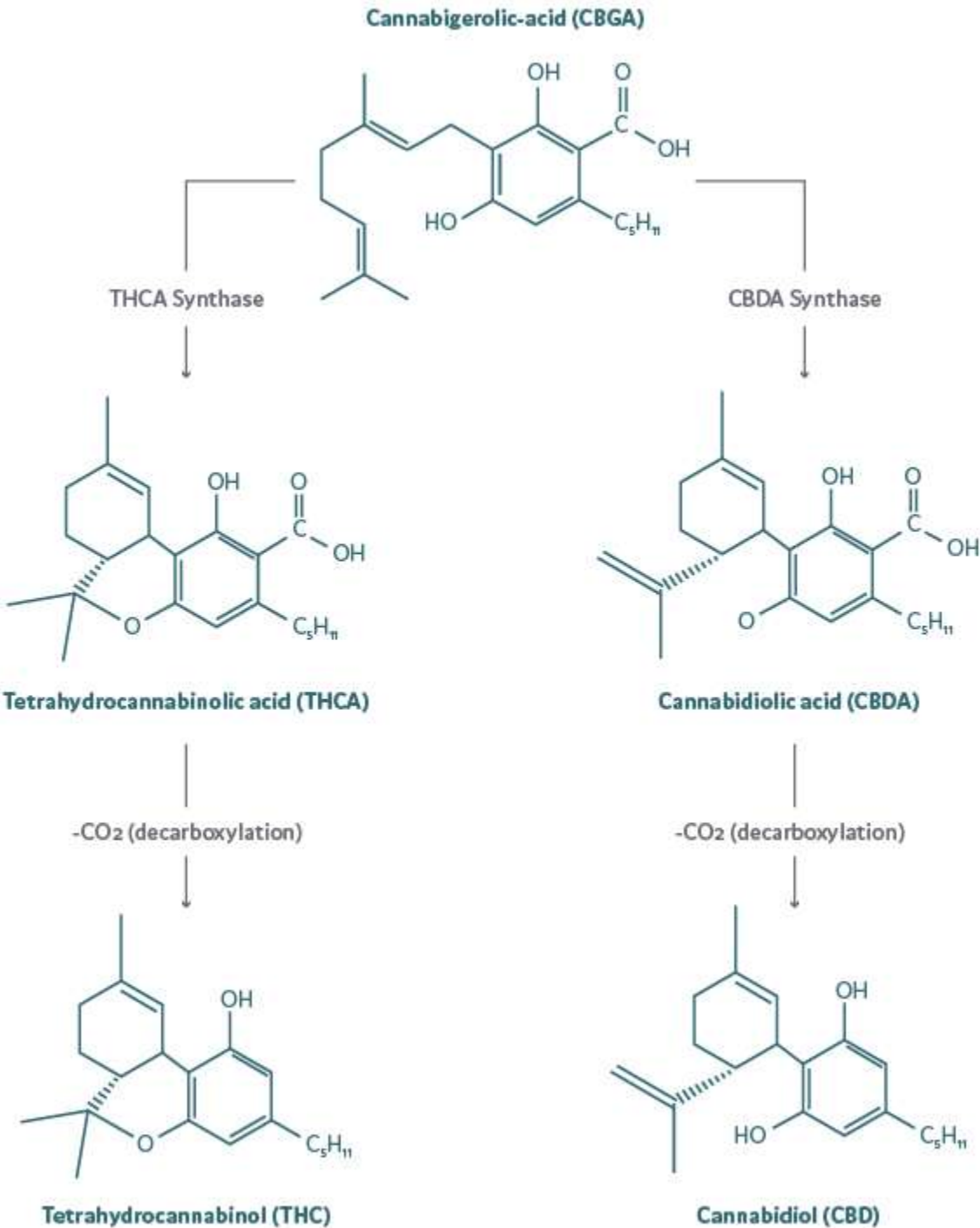


Figure 1. The structural formulas of Tetrahydrocannabinol (THC) and Cannabidiol (CBD).

THC and CBD are just two compounds from a family of around **113 bi- and tri-cyclic compounds** cannabinoid compounds found naturally in cannabis. Both **CBD** and **THC** share the exact same molecular formula, C<sub>21</sub>H<sub>30</sub>O<sub>2</sub>, containing twenty-one atoms of carbon, thirty of hydrogen and two of oxygen. Their molecular mass is practically identical with THC and CBD having masses of 314.469 g/mol 314.464 g/mol, respectively.

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Figure 2. The biosynthesis of THC and CBD from CBGA.

The biosynthesis of THC and CBD in cannabis also follows a very similar pathway. **Cannabigerolic acid** (CBGA), the precursor to all natural cannabinoids, is cyclized into tetrahydrocannabinolic acid (THCA) and cannabidiolic acid (CBDA) by THCA and CBDA synthase, respectively. The final products of THC and CBD are formed via decarboxylation of these acidic forms. Structurally, however, there is one important difference. Where THC contains a cyclic ring (see Figure 1), CBD contains a hydroxyl group. It is this seemingly small difference in molecular structure that gives the two compounds entirely different pharmacological properties.

### The chemical properties of THC vs CBD

As with many of the cannabinoids, **THC and CBD** have low solubility in water, but good solubility in most organic solvents, particularly lipids and alcohols. Both THC and CBD are present in cannabis in a mixture of acidic forms, which are readily de-carboxylated and chemically altered upon heating, important when you consider that smoking cannabis is the most common form of consumption. THC is also well known for its ability to bind to glass and plastic. Therefore, THC preparations are typically stored in basic or organic solvents in amber silicate glassware to avoid loss, especially during analytical testing procedures.

### The physiological effects of CBD vs THC

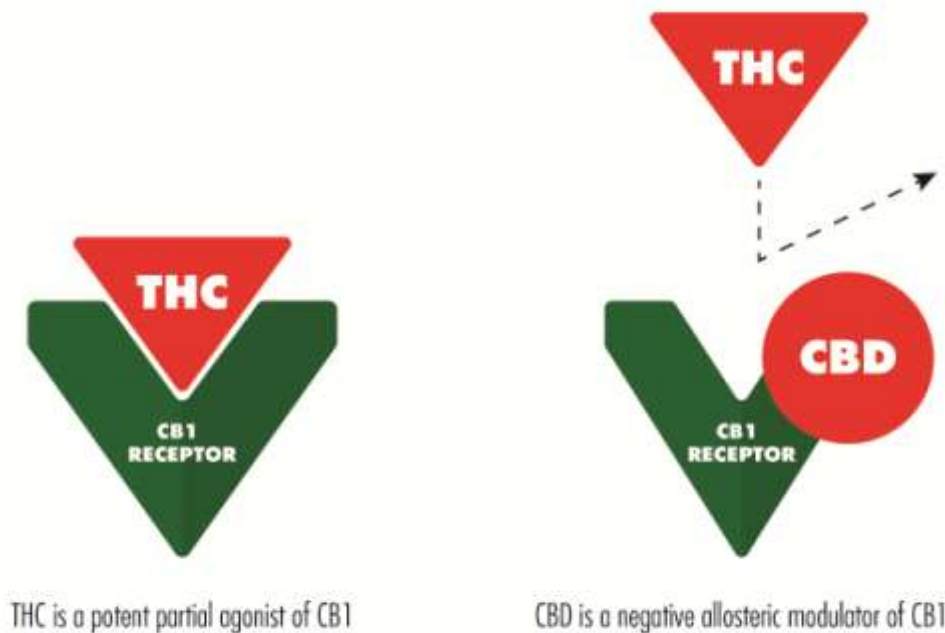


Figure 3. Left: THC is a potent partial agonist of CB1. It is this stimulation which leads to the major psychotropic effects of cannabis consumption. Right: CBD is a negative allosteric modulator of CB1 so it changes the shape of the CB1 receptor weakening its ability bind to THC.

**CB1** is a G protein-coupled cannabinoid receptor located primarily in the central and peripheral nervous system with a particularly high abundance in the brain. As part of the endocannabinoid system it is activated by the endogenous neurotransmitters, anandamide and 2-

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arachidonoylglycerol, as well as other naturally occurring compounds including the phytocannabinoids found in cannabis. As a **potent partial** agonist of CB1, THC stimulates the CB1 receptor leading to the psychotropic effects experienced when consuming cannabis. CBD on the other hand, is classified as a **negative allosteric modulator** of CB1, meaning it effectively alters the shape of the CB1 receptor. This change makes it more difficult for CB1 agonists, like THC and other endogenous CB1 agonists, to stimulate the receptor. The fact that CBD does not bind to, or stimulate, CB1 is also the reason it does not produce the psychotropic effects associated with THC.

## How CBD vs THC interact with each other

Through its interactions with the CB1 receptor, CBD is thought to **modulate the psychotropic effects of THC** by inhibiting its ability to bind to and stimulate the receptor. Which is why people don't feel as "high" when using CBD-rich cannabis compared to when they consume products high in THC. CBD is able to **reduce some of the negative effects of THC** by decreasing anxiety, paranoia and the short-term memory impairment often experienced when consuming cannabis. **Evidence suggests** that a CBD-rich product with little THC can in fact convey therapeutic benefits without having a euphoric or dysphoric effect.

Despite the evidence of positive interactions between CBD and THC, there is still a big drive for THC and CBD only medicines. In broad terms, this reflects the consensus of the traditional pharmaceutical industry that a drug with a single active ingredient is easier to develop, test, produce, prescribe and regulate. As evidence for the beneficial effects of combining cannabinoids in medicine increases this may change. Particularly with the growth in popularity of the concept of whole plant medicine. In brief, advocates of **whole plant medicine** argue that cannabis should be used in the most natural form possible as the various cannabinoids and other active compounds in cannabis have a combinatorial effect, also known as the **entourage effect**.

## The medical Uses of CBD vs THC

### Medical uses of CBD

Anti-seizure

Anti-inflammatory

Analgesic

Anti-tumor effects

Anti-psychotic

Inflammatory bowel disease

Depression

### Medical uses of THC

Analgesic

Anti-nauseant

Appetite stimulant

Reduces glaucoma symptoms

Sleep aid

Anti-anxiety

Muscular spasticity

The use of cannabis as a medicinal plant dates back thousands of years across cultures around the world. However, due to relatively modern restrictions and regulations, the research into the use of cannabis as a medicine in the modern world has been severely limited. As the legalization and decriminalization of cannabis increase around the world, the ability to research its potential uses is opening up.

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In October 2017, the World Health Organization (WHO) published a **pre-review report** which provides the most up to date summation of the current and potential clinical uses of CBD. Unequivocal evidence now supports the use of CBD in the treatment for at least some forms of epilepsy including **Dravet syndrome**, a complex childhood epilepsy disorder that is associated with drug-resistant seizures and a high mortality rate. Other indications are consistent with its neuroprotective, antiepileptic, hypoxia-ischemia, anxiolytic, antipsychotic, analgesic, anti-inflammatory, anti-asthmatic, and antitumor properties. These indications are based on limited clinical and pre-clinical evidence as well as swathes of anecdotal evidence. Sufferers of Alzheimer's, Parkinson's and Huntington's disease as well as multiple sclerosis, psychosis, anxiety, depression, cancer and many more could all benefit from treatment with CBD according to the WHO.

Like CBD, there exists a long list of potential clinical uses of THC. To date, the FDA has approved only **two drugs** containing THC and a synthetic cannabinoid that emulates the activity of THC. Dronabinol is a gelatine capsule containing THC which is administered orally to treat nausea and vomiting caused by cancer chemotherapy as well as weight loss and poor appetite in patients with AIDS. Nabilone contains a synthetic version of THC and is approved for the treatment of the nausea and vomiting caused by cancer chemotherapy when other drugs have not worked. Again, as with CBD, a huge range of scientific and anecdotal evidence supports the use of THC as a medicine. **Potential uses** include the treatment of neuropathic pain, pain caused by injury or accident, depression, sleep disorders, anxiety and many more.

### Source

<https://www.analyticalcannabis.com/articles/cbd-vs-thc-what-are-the-main-differences-297486>