

What are the Differences Between CBD and THC?

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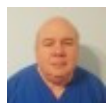
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CBD vs. THC: Read on to learn more about these compounds. While they may have a lot in common, they have some key differences that determine how they're used.



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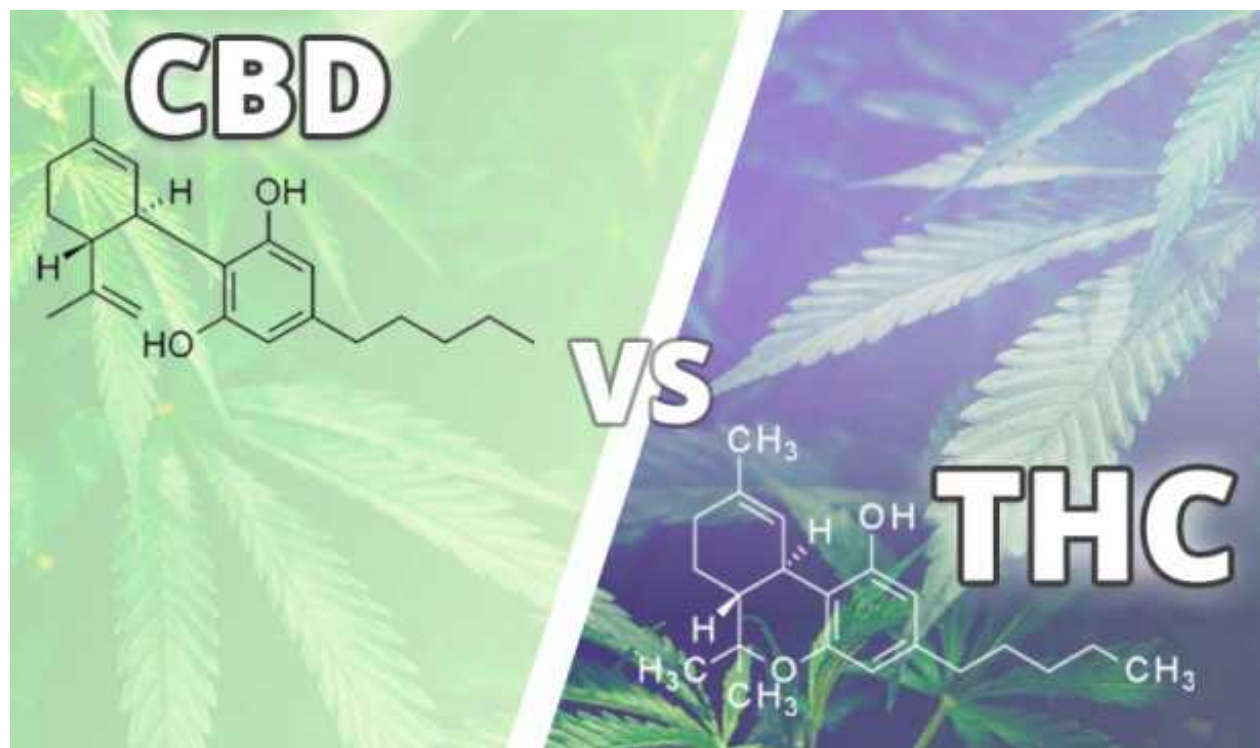


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There has been lots of information, and misinformation, about CBD, THC and other phytocannabinoids for many, many years. The reactions to CBD and THC over the years have been overhyped and over wrought, though the reasons for these extreme reactions

may differ. Some people cannot give up the “Reefer Madness” concept of marijuana and other products related to marijuana while others are constantly on the lookout for either the next big money maker, or the long awaited “miracle” cure.

One of the main differences between CBD and THC, though there are quite a few, is that THC is intoxicating, ie. THC has significant psychoactive effects including euphoria while CBD is **non**-intoxicating and does **not** induce a “high”. CBD can have effects on mood, but these effects are considered calming, mildly relaxing and non-intoxicating.

What is the Difference Between Hemp and Marijuana?

There are 3 types of *Cannabis*: *C. sativa*, *C. indica* and *C. ruderalis*. Hemp is a strain of *Cannabis* that contains low levels of THC and much higher levels of CBD. It looks different when compared to marijuana which is usually bred to contain high levels of THC along with lower levels of CBD. Hemp is grown for its fiber and the plants are generally tall and thin. Marijuana, grown for its THC primarily, is shorter and bushier than hemp. Think of the difference between a daisy and an aster. They are both members of the same plant family, the Asteraceae, but most people know they are not the same plant. In a similar manner, hemp and marijuana are cousins, members of the same plant genus, but not identical!

Hemp vs Marijuana



Some Basic Information about CBD and THC

The truth about CBD and THC is that these are long ignored substances that have the potential to be very useful for human health. Neither one of these substances is likely to cure anything, but they are more than likely to benefit certain diseases and conditions. The truth lies between the extremes of hype and doom. Read on to learn more about what we know of CBD, THC, the endocannabinoid system and how these substances may benefit human health.

CBD (cannabidiol) and THC (tetrahydrocannabinol) are both phytocannabinoids, but are different in their chemical structure, different enough so that there are significant differences in the way CBD and THC act on the body. They are derived from the same precursor, cannabigerolic acid (CBGA).

CBD vs THC

CBD and THC often work somewhat differently partly because they interact with different receptors in different ways and partly because they often work on different parts of the body. Keep the following table of information in mind as you read through.



The phytocannabinoids are plant substances and are believed to be part of a natural defense system against stress caused by infections and damage caused by insects, bacteria, viruses and fungi. The phytocannabinoids also play a role in the defense against the sun's UV radiation and against dehydration. Overall, the phytocannabinoids appear to protect the plant against biological and environmental stressors. (1) (2) The phytocannabinoids, and there are well over 100 of them, are produced and stored in plant structures called glandular trichomes found mainly on the leaves of the plants. (3) Evidence that this biochemical system is important lies in the fact that it evolved over 500 million years ago and is likely present in all organisms with a backbone or spine.

The phytocannabinoids bind fortuitously to receptors within the mammalian endocannabinoid system. This is an important regulatory system that has numerous significant functions.

The Endocannabinoid System

The endocannabinoid system in humans plays an important role in modulating and regulating processes including appetite, pain perception, the immune system, mood, memory, sleep, inflammation, sensitivity to the effects of insulin and both fat and energy metabolism. Overall, the endocannabinoid system helps maintain homeostasis.

Homeostasis is a term that describes physiological balance. Think of it as a seesaw. Just as it was in the schoolyard, you need to balance the seesaw with equivalent "weights" for the seesaw to move up and down smoothly. The endocannabinoids help keep the body's regulatory seesaws (aka homeostatic processes) balanced.

There are two known receptors in the endocannabinoid system. Receptors are surface structures that bind to ligands, in this case, the ligands can be the endocannabinoids naturally produced by the body or phytocannabinoids, derived from cannabis.

- The endocannabinoids in humans are primarily 2-arachidonoylglycerol (2-AG), homo-gamma-linoleoyl ethanolamide, docosatetraenoyl ethanolamide (DEA), and anandamide (N-arachidonylethanolamine or 2-AGE). These endocannabinoids play a critical role in mood, memory, the brain "reward system" and addiction, as well as various metabolic activities and energy homeostasis (balance).

- There are two main endocannabinoid receptors, CB1 and CB2. CB1 and CB2 have distinct locations in the body and distinct functions.(4)

Think of receptors as the locks of the system and anything that binds to these receptors as the keys.

CB1 Receptors and Function

CB1 receptors are found mainly in the brain and the spinal cord; the central nervous system (CNS). (5) They are found, albeit at lower levels, throughout the body.

The CB1 receptors are associated with cognitive and behavioral functions including effects on:

- Memory
- Cognition
- Emotion
- Control of the muscles
- Control of the appetite
- Perception of pain
- Sleep
- Mediation of the brain's "reward" system

The main endocannabinoid that binds to CB1 receptors is anandamide, which is often called the "bliss" molecule. THC binds to CB1 as well, producing the "high" and associated psychotropic effects.

CB2 Receptors and Function

The CB2 receptors are found outside the CNS, primarily on peripheral nerves, in the digestive system, on skin cells and on cells of the immune system. These receptors are associated with control of the immune system, inflammation, wound healing, and muscular and joint functions. CBD binds primarily to CB2 receptors, though new research indicates that CBD may also bind to other receptors including serotonin receptors. This binding may also explain some of the effects of CBD. However, the binding of CBD to the CB receptors is not quite direct. It appears to bind in such a way as to modify how it binds to endocannabinoids. CBD can act as a sort of molecular "dimmer" switch. In some circumstances it enhances the effect of the endocannabinoid or other natural "key" while in other circumstances it may diminish the effect. It is a subtler form of action than just turning on or turning off the function controlled by a receptor. (5)



What are the Effects of CBD?

We have to emphasize that research into CBD is really in the earliest stages, but CBD has been found to have a variety of effects including: (6)(7)

- Antispasmodic
- Anti-anxiety
- Anti-nausea
- Anti-arthritis
- Anti-psychotic
- Anti-inflammatory
- Immunomodulation
- Pain relief
- Sleep
- Antioxidant
- Neuroprotection

It has to be emphasized that many of these studies have used synthetic forms of cannabinoids and CBD (eg. Sativex, Epidolex, Marinol, Cesamet) rather than the natural hemp derived CBD. Since these are synthetic drugs and differ structurally from CBD, the results can't always be considered equivalent. In other words, just because a synthetic form or analog of CBD has a particular effect does NOT mean that CBD will have the same effect. The converse is also true., Just because CBD has a particular effect does NOT mean that a CBD analog will have the same effect. The same applies to adverse effects. For one thing, synthetic cannabinoids are highly purified and unless you are only using a CBD isolate, the same is not true for CBD derived from hemp. Both the full spectrum and the broad spectrum CBD products contain terpenes, other cannabinoids and additional plant substances.

Pain Relief

The pain relieving effects of CBD appear to be related to the anti-inflammatory and anti-arthritis properties of CBD. Inflammation is a major contributor to pain, and when a substance can reduce inflammation, it is likely going to reduce pain.

CBD has been mostly studied for its effects on treating pain in cancer patients. Again, the research is in early stages and is still complicated by political, legal and ideological problems. Overall, the general consensus that CBD can be effective in treating certain types of chronic pain is growing. (8) There is also a growing consensus that CBD is promising and that more studies need to be done.(9)

As stated, the anti-inflammatory properties of CBD may be most important for its pain relieving effects. As an anti-inflammatory substance, it appears to function via CB2 receptors but also via a variety of other receptors involved in inflammation. CBD appears to reduce the production of inflammatory cytokines, substances that signal the immune system to increase the inflammatory response. (10)

Antispasmodic/Anti-convulsive Effects

One of the first effects of CBD that “hit” the news were the anti-convulsive effects and the rapid improvement of children with otherwise untreatable seizures associated with certain types of epilepsy like Dravet syndrome (and Lennox-Gastaut syndrome (LGS). (11),(12)

Sleep and Insomnia

While there is loads of anecdotal evidence for CBD as a sleep aid, there are just a few scientific reports, Any sleep benefits are often reported almost as an afterthought or as a “side effect”.

CBD appears to hold the greatest promise for helping those with REM (rapid eye movement) sleep disorders, though other sleep disorders such as insomnia appear to benefit with most studies reporting improvement in sleep quality. People tend to report falling asleep more quickly, staying asleep longer and decreased sleep disturbances. (13)

Anxiety and Depression

A recent study of 72 adults with anxiety and sleep problems found that anxiety scores decreased in 79% of patients and sleep scores improved in almost 67% of patients. (14) A review on the effects of CBD on anxiety stated that “Overall, current evidence indicates CBD has considerable potential as a treatment for multiple anxiety disorders, with need for further study of chronic and therapeutic effects in relevant clinical populations.” (15)

Animal studies have indicated that CBD shows antidepressant properties. While there are not very many clinical studies, people tend to use CBD to combat depression. One recent study indicated that “Prolonged CBD treatment appears to have promising therapeutic effects for improving psychological symptoms and cognition in regular cannabis users.” (16) This study had some limitations, but it used natural sources of CBD with participants reporting fewer depressive and psychotic like symptoms after CBD use.

CBD in Psychiatric Disorders

THC is the cannabinoid best known for its psychoactive effects, CBD has been mostly pushed as “non-psychoactive” on the one hand, but on the other hand touted as an anti-anxiety substance and antidepressant when you stop to think about it, it makes little sense. Because it DOES have effects on mood and behavior, CBD is better described as non-intoxicating rather than non-psychoactive.

CBD has been studied to some extent as a remedy for substance abuse, psychosis, anxiety, mood disturbances, cognitive impairment, and for personality, eating, obsessive compulsive, post-traumatic stress/PTSD, dissociative and somatic disorders. A recent review of available studies showed positive results for CBD use particularly for substance abuse, anxiety, PTSD and some forms of psychoses. (17) CBD appears to have antipsychotic, antidepressant, antianxiety, anti-craving and cognitive enhancing effects.

CBD has also been investigated for the treatment of schizophrenia. In one study, patients were given CBD (at 1000 mg/day in addition to their regular antipsychotic medications). These patients had less severe symptoms and were rated as “improved” in their symptoms when compared to a group that did not receive CBD. At these high doses, the authors did not see significant adverse effects. (18)

CBD may also be useful for autism spectrum disorder (ASD) though there have been no significant studies to date. (19)

Antioxidant and Neuroprotective Effects

CBD has important antioxidant effects; effects which may make CBD an effective agent to protect the nervous system, especially the brain, from the damaging effects of oxidizing agents, the most important of which are excess free radicals. (20)

Free radicals are highly reactive substances which are normally produced by the mitochondria. Mitochondria are found in nearly every cell of the body. Natural antioxidants such as vitamin C, vitamin E, glutathione and plant flavonoids and phenols are often recommended for health because these natural antioxidants can “soak up” these free radicals. If the levels of free radicals are too high, they bind to proteins and DNA in the cells and can damage them, leading to cellular, tissue and organ dysfunction. It is believed that several neurologic and other disorders are caused by high levels of free radicals in the cells, tissues and organs of the body. These include the dementias, cancer, asthma, diabetes, degenerative eye diseases (eg. macular degeneration) and cardiovascular disorders. Any substance with significant antioxidant activity should, at least in theory, protect against these diseases.

CBD, with its antioxidant activity, may be useful in the treatment of Alzheimer’s disease, other dementias and diseases such as Huntington’s chorea and Parkinson’s disease. As an

important aside, you should know that in some cases of Parkinson's disease, people have experienced a **worsening** of symptoms with CBD use. (21) We don't know why this might happen and it will be important in the future to understand this effect.

CBD and Cancer

Cancer is actually a cluster of over 800 different diseases with at least one thing in common; cancer cells demonstrate unregulated growth. It is not likely that any single substance will be effective against all cancers. Also, it bears repeating, the studies done to date are very preliminary and limited. These studies have been done in cell cultures (*in vitro*) and in some animal models. There appear to be some apoptotic effects exerted by CBD on tumor cells. In other words, CBD may kill off some tumor cells by a process known as apoptosis, a form of cell initiated self destruction. (22) CBD may also be protective against cancer through its antioxidant activity. You should also know however, that the history of cancer research is littered with stories about how something worked well in a lab or in an animal model but had no positive effects on human cancer. So, while no one wants to be Debbie Downer, we still feel it is necessary to emphasize that we are waiting for more evidence. At this point, there are no rational recommendations to use CBD to combat any form of cancer (23) though it should still be considered for its other benefits.

Overall, for both CBD and THC, and combinations, it is useful to remember that there ARE quite a few clinical trials currently being conducted. We will just have to wait and see what those results are.

What Are the Effects of THC?

The effects of THC include: (24), (25), (26)

- Inducing a state of calmness and/or euphoria
- Stimulates the appetite
- Reduces nausea
- Reduces muscle spasticity
- Reduces pain
- Reduces inflammation
- Reduces intraocular pressure so it can be used for glaucoma

The research is clear on the efficacy of synthetic THC to reduce chemotherapy associated nausea and vomiting and the National Comprehensive Cancer Network has incorporated these medications, dronabinol and nabilone, into its supportive care guidelines.

Medical cannabis with high THC levels, up to, in theory 30%, is used to treat a wide variety of conditions including:

- Chronic pain
- Muscle spasms
- Glaucoma
- Insomnia
- Anorexia/Bulimia
- Nausea
- Anxiety
- Depression
- Inflammatory bowel conditions such as Crohn's disease and ulcerative colitis

There are currently two synthetic THC analogs; Dronabinol, also known as Marinol which is listed as a schedule III drug and nabilone also known as Cesamet which is listed as a schedule II drug, with FDA approval to treat nausea and vomiting associated with chemotherapy. (27)

One of the problems with the current ongoing research is that in the US, three dosage (potency) strengths are currently recognized:

- Low potency: 1.29% THC
- Moderate potency: 3.53% THC
- High potency: 7% THC

As anyone who has recently been in a dispensary will know, cannabis products are commonly more potent with most medical cannabis at >7% THC. In the end, this means that even when the ongoing research is completed, it will likely not be very well matched with the dosages/potencies of the THC available “on the streets”.

There is also significant and important evidence that adolescents under the age of 18 are at higher risk for developing psychoses with heavy use of cannabis. There is also an increased risk of psychoses developing with use of high potency cannabis at any age. (28)(29)

The Use of Cannabinoids to Taper Opioid Use in Opioid Use Disorder or to Reduce the Need for Opioids in Chronic Pain

Because of the “opioid epidemic”, there has been increased interest in using cannabinoids, usually a combination of THC and CBD, to reduce the need for opioid pain medication in those coping with chronic pain or afflicted with opioid use disorder.(30)(31)

The phytocannabinoids and opioids interact at many levels and it has been found that medical cannabis and combinations of THC and CBD can reduce the need for opioid medications, decreasing the risk of withdrawal and overdose. This is likely to become a very “hot” area for research in the future.

The Entourage Effect

The entourage effect sounds like a sci-fi thriller or maybe a Downton Abbey spin off? Either way, in the world of CBD, it is a concept borrowed from traditional herbal medicine. (32)

In herbal medicine, it has long been hypothesized that plant constituents work synergistically. One constituent's effect moderates or tempers another constituent effect. This does make sense in the botanical world as cannabinoids are not produced in the plant so that humans can benefit. Cannabinoids and other cannabis constituents evolved for the plant's benefit. So, it makes some botanical sense that a plant that has been around for so long has likely evolved groups of molecules that work efficiently together. We see the entourage effect likely in the various ratios of CBD to THC that appear to be more effective in different clinical situations. The more CBD in a mixture, the less the psychoactive effects, for example. So, the entourage effect, though nowhere near a proven effect, is believed to be active when various cannabinoids and terpenes in full or broad spectrum extracts work together as an "entourage" to produce specific or unique effects. (33)

While the entourage effect as a hypothesis has not yet been proven, we do have examples of the synergistic effects of cannabis constituents.

For example, in a meta-analysis of patients given either pure CBD or high CBD extracts in the form of full or broad-spectrum CBD oils, it was clear that those using high CBD extracts required less total CBD to reduce the frequency of seizures. The extracts provided some constituents that added to the anti-seizure effect so that less pure CBD isolate was needed to produce similar effects. (34)

Other studies done in the lab or using animals also indicate that the entourage effect may be active.

There has not been a great deal of research with combining known amounts or known ratios of cannabinoids. Sativex is a synthetic drug with a 1:1 ratio of THC and CBD. In the clinical trials that led to the development and approval of Sativex, a number of different ratios were studied but that 1:1 ratio appears to give the best results for control of sleep issues, pain issues and muscle spasms. However, different conditions in different people appear to require specific ratios. The best bet if CBD alone is not fully beneficial is to talk to a physician with experience with different ratios of CBD: THC. Some forms of epilepsy and Crohn's disease respond better with different ratios, usually higher CBD to THC ratios. But, you have to live in a state or country where medical cannabis is legal AND you have to find someone willing to work with you. AND...often it is still a process of trial and error trying to find the best ratio for your particular condition.

But, we can't forget the terpenes! For many years, people were told that *Cannabis sativa*

provided a “head high” with euphoria and increased energy levels while *Cannabis indica* provided a “body high” with relaxation as the principal effect. Indica serves as a sleep aid, provides pain relief and functions as an appetite stimulator. Some of the differences likely had to do with the different levels of THC and CBD. However, the specific terpene profiles are more likely to cause these difference effects. At this point, however, we don’t know what those differences are precisely.

Legal Status of CBD and THC in the US

It is confusing out there. The legal status of CBD, THC, medical cannabis and cannabis products can change almost on a daily basis. Most recently, a number of states including California, Michigan, Washington, Utah, Rhode Island, Montana and Massachusetts banned vaping products from being sold in the state as a response to a lung disease associated with vaping. Some sites that sell vaping products are cooperating but others, well, not so much.

The map below shows the pattern of medical and recreational cannabis laws in the US. In theory, CBD is legal across all 50 states because of the passage of the Federal 2018 Farm Bill. This defined legal hemp as containing <0.3% THC and, since CBD is derived from the legalized hemp, it is believed that it is covered by the 2018 Farm Bill and is legal. However, the FDA is considering bans and has determined that CBD will not be allowed in food and beverage products because this would violate the Federal Food, Drug and Cosmetic Act (FD&C Act) and states that “ According to the [FDA](#).” It is currently illegal to market CBD by adding it to a food or labeling it as a dietary supplement.” The FDA has approved CBD in a single prescription drug to treat two rare forms of epilepsy under the trade name Epidiolex.

Currently, medical cannabis is legal in 30 countries and some US states. This is rapidly changing, though so you should always check for the legal status in your specific country or state. The anecdotal evidence developed over millennia is far out pacing the science based evidence. It can be hoped that this situation will change over time, but for now, it is what it is.

Drug Testing

If you look back at the chemical structures of CBD and THC you will see that there are differences but the difference is not very great. So, if you are looking at issues of drug testing, the fact is that the more common drug tests for THC will give what is known as a false positive if you are using CBD. It may be possible to defeat this effect if you use a CBD isolate which is usually around 99% pure CBD but there is no guarantee. This can

obviously be a problem for some people. Even in states where medical cannabis is legal and you have a recommendation from a physician (ie. have a medical cannabis card), your employer may still require a drug test for hiring or to maintain your position.

Technically, CBD derived from hemp which contains <0.3% THC is legal, according to the Federal 2018 Farm Act. However, a recent study found that CBD products are too often advertised as “THC free” and they are not. This is why we at LeafReport keep stressing the importance of independent, 3rd party testing results. One study showed that 21% of online CBD products tested had more than 0.3% THC and were illegal. (35) The same study showed that 26% of products contained less CBD than the label suggested.

What this boils down to is that you may test positive for THC if:

- The drug test used is not specific enough to reduce the potential for false positives
- You buy CBD from a company that is less than honest and their products come from plants that are not legally qualified as hemp and contain more than 0.3% THC
- You buy CBD from a company that does not efficiently or effectively purify their product.

Broad spectrum CBD should, in theory, contain less THC than a full spectrum CBD product, but if the company doesn't perform essential quality control steps, this may not be true.

Positive tests for THC depend on a variety of factors including:

- When you are tested. The half life of THC in the human body is 1.3 days for an infrequent or casual user but 5 to 13 days for frequent or heavy users. That means that for a casual user, half of the THC is detectable after 1.3 days while for a heavy user, half is detectable after 5 to 13 days.
- What test is used to determine THC levels and what the cutoff point is. That is most commonly known as the Level of Detection or LOD.
- How the CBD or THC is taken eg. by mouth, inhalation or topically
- Whether the testing is done by sampling urine or blood
- The presence of other drugs, prescription or otherwise, that can either raise or lower the levels of detectable THC and its metabolites or degradation products

CBD versus THC: Which One?

For the most part, if you have a condition that may benefit from THC including chronic pain, muscle spasms, nausea and vomiting after chemotherapy, weight loss associated with HIV/AIDS, IBS or Crohn's disease, you need to work with a physician to find the best ratio of CBD:THC that works for you. If you live in a state or country where medical cannabis is legal, then it is a matter of finding someone to work with and having the patience to find your best combination.

CBD can be effective for many of these conditions and many people try CBD first. If they find relief that meets their goals, that is great though if they work in any position that may involve drug testing, their best bet is to use CBD isolate **and** buy from a reputable source that performs 3rd party testing.

CBD alone is useful for some forms of seizures. It can provide pain relief, ease depression and anxiety and alleviate insomnia. For most conditions, the best approach is to start low and go slow, a process of trial and error pursued by slowly adjusting your dose until you find the right one for you.

Basic Facts about CBD and THC

CBD	THC
Effects	
Derived mainly from hemp, a “cousin” of cannabis	Derived mainly from marijuana (cannabis) plants
Non-intoxicating. CBD acts on the brain but without a “high” or an intoxicating effect.	Psychoactive and intoxicating (produces a high)
Suppresses appetite, reduces nausea and vomiting	Stimulates appetite
Reduces pain	Reduces pain
CBD reduces pain perception by several different mechanisms: <ul style="list-style-type: none"> • by indirectly binding to endocannabinoid receptors (CB2>>CB1) AND • by binding to other receptors in the body AND • It increases natural endocannabinoid levels by decreasing endocannabinoid breakdown 	THC binds directly to endocannabinoid receptors, CB1 and CB2 (CB1>>CB2), reducing the perception of pain
Anti-inflammatory	Anti-inflammatory
Acts to reduce the effects of stress	
Nootropic	Euphoria
Relieves depression/anxiety	

Anticonvulsant/anti-spasmodic	Anticonvulsant
Side Effects/Adverse Effects	
<p>Usually minimal over a wide therapeutic range. Some side effects may actually serve as therapeutic effects.</p> <p>Side effects can include:</p> <ul style="list-style-type: none"> • Dry mouth • Sedation • Decreased blood pressure • Lightheadedness/dizziness 	<ul style="list-style-type: none"> • Can relieve depression/anxiety but, in some, can increase paranoia/anxiety • With vaping, can be associated with decreased lung function • Altered social behaviors including possible psychological addiction (Cannabis use disorder) • With adolescent use, potential impairment of learning, memory, decision making • With adult use, potential cognitive impairment, memory loss • Possible increased risk of psychoses, including schizophrenia.

Evidence Based Medical Uses

*** Synthetic forms of cannabinoids (Epidiolex, Marionol, Syndros, dronabinol, Cesamet) approved for some uses by the FDA**

- | | |
|---|---|
| <ul style="list-style-type: none"> • Insomnia • Pain • Inflammatory disorders <ul style="list-style-type: none"> ◦ Inflammatory Bowel Disease (IBD) ◦ Irritable Bowel Syndrome (IBS) • Seizure disorders* (epidiolex) • Anxiety • Depression | <ul style="list-style-type: none"> • Glaucoma • Pain • Anxiety • Depression • Appetite stimulation • Multiple sclerosis* • Chemotherapy induced nausea (cancer, HIV/AIDS)* (Marinol, Syndros, dronabinol, Cesamet, nabilone) • Tapering opiate use* |
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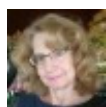
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