

Cannabidiol (CBD) in Hair Oil

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ABSTRACT

On December 20, 2018, The Farm Bill was passed legalizing cannabidiol (CBD) to be sold and used for different compounds such as medicine, hair products, and skin treatments. CBD has become very popular since its legalization; there were over \$967.2 million sales of CBD products sold in the US. Cannabidiol (CBD) is known as a compound extracted from hemp plants. Hemp comes from a section of the Cannabaceae family known as *Cannabis Sativa*. *Cannabis Sativa* breaks off into two categories, hemp and marijuana. Hemp has less than 0.3% of THC in it, as opposed to marijuana where THC is a psychoactive ingredient. Due to the increasing popularity of CBD, it is important to understand how CBD affects the body. Currently, CBD is only approved by the FDA for the treatment of certain types of epilepsy, primarily in children. Researchers have investigated CBD for its benefit to strengthen hair growth, relieve anxiety, seizures, and skin conditions. Our interest is focused on hair products, such as the inclusion of CBD (or hemp oil) in hair oil; thus far, little is known about how CBD affects hair, though there is evidence that it can both increase hair growth and prevent unwanted hair growth by using different types of CBD/hemp oils, which is interesting because those are opposite effects. More research is necessary to better understand the effects CBD has on different elements like hair and how to differentiate CBD and hemp because of their strong similarities.

Cannabidiol (CBD) is a compound extracted from hemp plants that is being added to a number of consumer products due to its potential health benefits. The market for CBD products has exploded in the past two years due to the passing of the 2018 Farm Bill that allows the mass production of hemp plants with THC content below 0.3% and the transfer of hemp-derived products across state lines for commercial or other purposes (1). Cannabidiol (CBD) is extracted from hemp plants and has a variety of uses. Many cosmetic manufacturers are making acne treatments, lotions, sunscreen, and now even hair oil, hair lotion, shampoo, and conditioner with CBD (2). Individuals are also experimenting with adding CBD to their own formulations, such as homemade hair oil. In fact, the original focus of this capstone was to compare store-bought CBD hair oil to a family member's homemade CBD hair oil. The concentration of CBD in each was to be determined using high-performance liquid chromatography (HPLC). Due to COVID-19 restrictions, however, laboratory studies were no longer an option. Instead, this paper provides background information about cannabidiol, briefly highlights the known health benefits of CBD, and summarizes recent research published about the impact CBD has on hair.

CBD Basics

CBD is an abbreviation for cannabidiol. Cannabidiol has a formula of $C_{21}H_{30}O_2$. The structure of CBD is shown in Figure 1.

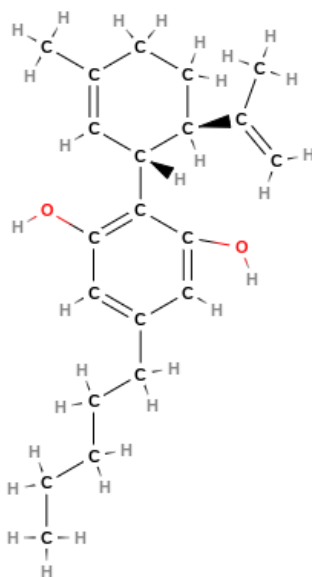


Figure 1. Structure of cannabidiol (CBD)

CBD comes from the cannabis plant, *Cannabis Sativa*. All hemp, marijuana, and CBD is derived from cannabis sativa. Cannabis Sativa is also in a family with two other cannabis plants named, Cannabis Indica and Cannabis Ruderalis. They all come together under the cannabaceae family (1). The difference of CBD and other cannabis-stemmed products is the amount of THC involved. Many describe CBD as the good healing cannabinoid, and THC as the bad psychoactive or high cannabinoid (2). Marijuana is a recreational drug that has above a 0.3% of THC in it. CBD has a THC level below 0.3% which is one of the reasons why it has been approved by the FDA to use in commercialized products (3). Now hemp seed oil and CBD oil both have levels of THC below 0.3%, but they are quite different. Hemp plants and marijuana plants come from the same species with different THC levels. Marijuana is used usually for recreational purposes unless prescribed by a doctor. Medical marijuana helps with pain management for cancer patients, people with AIDS, alzheimer's, epilepsy, and glaucoma (4). Hemp seed oil is extracted from seeds while CBD oil is extracted from buds of low THC cannabis plants (4). When hemp seed oil is in the making, CBD is also present due to hemp oil containing traces of CBD in it (4). Hemp seed oil contains fatty acids and nutritional antioxidants like omega-6 and 3, also gamma-linolenic acid (4). Hemp is a popular remedy for conditions like skin disorders, stress, and inflammation in the body.

CBD Market

The sale of CBD and/or CBD oil has grown significantly since the federal legalization of large-scale hemp production in 2018. The global market for CBD oil was at \$967.2 million in 2020 (5). The market has grown over billions of dollars since the Farm Bill was passed and has been recorded by many customers about the good benefits it brings. Researchers have predicted the market will increase by 40.4% to \$5.3 billion by 2025 (5). This is showing that the sale of CBD is growing at a rapid rate and causing CBD usage to increase significantly. There was approximately \$1.9 billion sales of CBD in 2018, after it was legalized. BDS Analytics predicts the CBD market will reach over \$20 billion sales by 2024 (6). CBD has been a clear helpful compound to consumers and continues to grow popular as the years go by.

Clinical Studies of CBD

Over the past few years, many clinical studies and/or trials have been conducted about CBD and its uses. According to ClinicalTrials.gov, there have been over 700 clinical studies about CBD and what it can be used for (7). Many issues common from CBD treatment have been found in these trials. Issues like epilepsy, anxiety, cancer, pain, arthritis, and disorders like stress and alzheimers. CBD is formed into an oil or supplement in order to treat these issues for people to use. In some of these clinical trials, CBD oil was tested in volunteers' hair to see the growth of the hair and its impact on the scalp. Other studies test CBD as a medicine to see if there are effects to it. Researchers have been conducting experiments and studies to test the different effects CBD has on hair and when combined with medications.

CBD in the Treatment of Epilepsy

Some early studies have found that CBD may be an effective treatment for some other types of epilepsy. In some cases, cannabis products may increase seizure frequency. Currently, the Food & Drug Administration in the United States has only approved CBD in its pure form for the treatment of certain types of epilepsy, especially in children. This approval came in 2018 for Epidiolex, a drug prescribed primarily to children no younger than two years old who suffer from Dravet syndrome or Lennox-Gastaut syndrome. These syndromes are very rare forms of epilepsy, 0.0005 percent of children are affected by it and they don't usually have good alternative treatments (8). GW Pharmaceuticals published three clinical trials of Epidiolex. There were two trials published in the New England Journal of Medicine and one published in the Lancet. These trials consisted of more than 50,000 patients which showed young adults and children that have taken the medication, has increased the number of seizures in over 40% (9). Although formal use of CBD has only been in the past couple of years, there was anecdotal evidence of *Cannabis* use as long ago as 2000 B.C. for the treatment of seizures. In fact, perhaps CBD could have been pursued more aggressively decades ago had more attention been paid to a clinical trial in Brazil. Rapheal Mechoulam, a chemist at the Hebrew University of Jerusalem, separated half a kilogram of CBD from hashish and sent it to Sao Paulo, Brazil, where it was used in a small study to test the effects of epilepsy (9). The trial included fifteen people with epilepsy taking the antiseizure medication. Eight people were given two hundred to three hundred milligrams of CBD daily for four and a half months in addition to the antiseizure medication, while the other seven received a placebo, which is a pill that causes you to have no effect when testing new drugs (9). Four people in the CBD group experienced virtually no seizures during the trial, three others reported a partial improvement in their condition, while one other and the placebo group saw no change (9). CBD being used in antiseizure medications has helped people refrain from having a seizure and take the medicine with no bad effects to it.

CBD in hair oil

Despite an increasing number of hair products containing CBD (10), either intentionally or as a contaminant of hemp seed oil, there is a lack of scientific research describing the effect of CBD on hair. Literature searches in PubMed and Google Scholar returned few relevant results and only two studies were identified in a search of ClinicalTrials.gov and those are not yet recruiting participants. Although few research is found on CBD in hair, there is research found that CBD is in hemp seed oil. Hemp seed oil comes from *Cannabis Sativa* which also produces CBD (11). Citi, et al. used HPLC-UV to test thirteen different commercially available hemp seed oils, which are organic hemp seed store-bought oils. In Table 1, CBD was not detected in all samples. CBD was found in nine out of 13 samples (10). According to Kitamura, et al., a liquid chromatography study was performed to measure CBD in hemp seed oils. Seven

samples were tested and six out of the seven were found to have CBD detected (11). Two samples that contained CBD showed higher concentrations of CBD than the others did (11). Application of such hemp seed oils to hair can lead to detectable levels of CBD in hair samples.

According to Paul, et al., applying hemp oil to hair, as cosmetic treatment, can result in the presence of CBD and other compounds that give off quantitative results (12). Hair samples were collected from volunteers and were used to analyze the before and after results of hemp seed oil application. These authors took volunteers to apply 2 ml of hemp seed oil all over their heads, GranoVita organic hemp oil, for a period of six weeks. The oil was applied in the evening and was washed out in the morning. Volunteers 1 and 3 delayed their hair washing by 1 or 2 days. The oil was applied to their scalps to see or measure the detection of CBD and other compounds (12). Before any oil was applied, one out of 10 people had CBD detected in their hair. After the hemp seed oil was applied, six out of 10 people had CBD detected in their hair.

A recent study by Szabo, et al. suggests that CBD can be used to treat unwanted hair growth as well as reduce hair loss depending on its concentration. Different receptors and cannabinoids help modulate hair follicle growth (13). CBD was found to promote hair shaft elongation, which is where hair is growing and getting longer. This study found that CBD may concentration-dependently target different receptors (13). Hair and skin samples were taken from humans and later was encountered with CBD application. The sub-micromolar application of 0.1 μM caused hair to grow and/or get longer. The application of 10 μM caused hair growth to stop or prevent from happening (13). This means that if CBD application and the topical application has a lower micromolar application then it will produce good results potentially causing hair to grow, if the application is larger it will produce negative results causing hair to stop its growth. This study points out the different concentrations used in the amount of applications of CBD is used in their experiments. CBD has been detected and shown that it causes hair to grow.

More research needs to be conducted to better understand how CBD in varying concentrations can affect hair and skin with cosmetic topical application of CBD-containing products. There is an endocannabinoid system in skin that promotes catagens causing the hair not to grow (14). A catagen is when the hair follicle stops producing the fiber and regresses, shrinking dramatically; hair loss. Phytocannabinoids like CBD have been shown to increase the hair growth rate and restore hair follicles. These phytocannabinoids have also been found to repair damaged hair and keep moisture inside the scalp (14).

In addition to better understanding how CBD influences the biology of a person's skin, researchers aim to study how the application of a CBD-containing lotion leads to absorption of CBD into larger body systems. For instance, there is a clinical trial currently recruiting participants that will study

the pharmacokinetics and pharmacodynamics of topical application of CBD, which is the study of how quickly CBD is absorbed and processed by the body, as well as how CBD interacts in the body. Specifically, 100 participants will be monitored in a placebo-controlled study lasting 17 days. Lotions will be applied in the laboratory on the first day and then participants will continue applying lotions twice a day at home for the next nine days, with laboratory testing occurring four more times during that period. Lotion application will cease and a final set of tests will be performed to measure CBD concentration a week later. Testing will involve measuring CBD concentrations in urine, blood, and hair to see how a topical application of CBD leads to its presence elsewhere in the body. To understand how CBD may be influencing cognitive functions and motor skills, participants will also be assessed using the Divided Attention Task test, Paced Serial Addition Task test and the Digit Symbol Substitution Task. It will be enlightening to better understand how topical application of CBD in a lotion may lead to its influence elsewhere, since CBD treatments typically involve oral ingestion of the cannabinoid.

Conclusion

Research has shown cannabidiol (CBD) to be an effective drug for the treatment of rare forms of epilepsy and scientists are continuing to probe other possible positive impacts that CBD may have on other health conditions, such as Alzheimer's disease, ALS, and anxiety. CBD's inclusion in hair products and its effect on hair was of particular interest for this capstone report. Preliminary studies demonstrate that application of submicromolar concentrations of CBD can help strengthen hair growth if applied at low concentrations, whereas higher concentration can cause the hair to not grow. Otherwise, little research has been completed to show how CBD oil affects the hair or studies on CBD and hair. Therefore, we suggest additional research that experiments with both CBD and hair to determine the effects it has on hair, especially due to the rapidly increasing market for CBD products. It is important for consumers using CBD products that they are educated on the effects of CBD and safety.

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