USING DEPTH FILTERS FOR CANNABIS OIL PRODUCTION

FOR THERAPEUTIC USE

1 Background

1.1 Hemp or Marijuana?

Hemp and Marijuana are both varieties of the same plant species (Fig. 1). Cannabis sativa contains over 400 chemical compounds. 113 of these compounds are known as cannabinoid and have an influence on the human body through cannabinoid receptors on the cells. The human body itself produces endocannabinoids which play a crucial role in regulating our physiology and mood. The Cannabinoids found in plants are called phytocannabinoids. The best known is THC (**T**etra**h**ydro**c**annabinole) which is mainly contained in Marijuana. Another major cannabinoid is CBD (**C**anna**b**i**d**iole) found in female hemp. CBD has not the psychotropic properties as THC. For the production of CBD / Cannabis oil plants with a THC content of less than 0.3 % are cultivated.

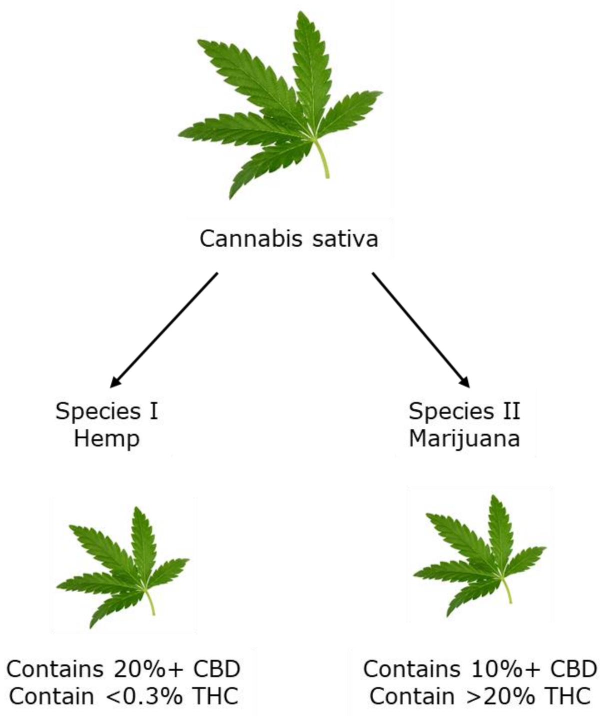
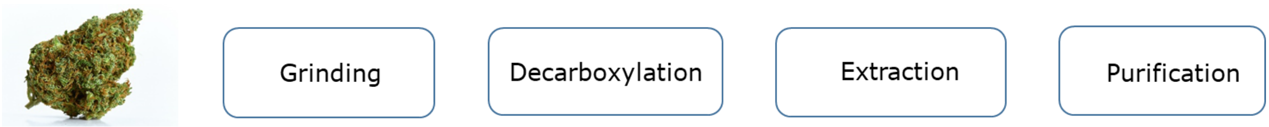


Fig. 1: Cannabis sativa split

1.2 Production of CBD Oil

For the production of the CBD oil only the female hemp buds are used. After around 105 days growth, the buds are harvested and dried at 25 °C / 77 °F e.g. in an air flow chamber. The dried buds first go through a grinding process, to get the optimal fineness. The particle size is important as it determines the percentage of extracted cannabinoids from the plant. Besides the particle size the temperature and pressure during the extraction process influences the percentage of cannabinoids too. An overview is shown in figure 2.

The Cannabis plant itself does not produce the volitional THC and CBD, but their acidic alternates THCA and CBDA. During the decarboxylation step, also known as decarbing, introduced heat transforms the acidic structure into their active forms THC and CBD. This is necessary because only the active forms can bind onto the cannabinoid receptors in human bodies. The more detailed description of extraction and purification procedure is in chapter 2 and 4.



Dried Cannabis bud

Fig. 2: CBD production process overview

2 Extraction Process

2.1 Extraction

There are several ways to extract the CBD rich oil from the dried and heated cannabis buds. All of them have their pros and cons. Some of them are safer and more effective than others. The use of neurotoxic solvents like butane and hexane may leave unsafe residues, which can compromise immune function and affect health. Therefore we will take a closer look at the most common extraction methods.

The most common extraction methods are ethanol and CO_2 extractions. The following chapters will explain how these methods work.

2.2 Ethanol Extraction

Food grade or USP grade ethanol is used to extract the volitional ingredients as shown in figure 3. The cannabis buds soak in chilled alcohol (<–20 °C/–4 °F) for a certain time. The longer they soak the more ingredients can be extracted. Besides the full range of cannabinoids alcohol extracts also chlorophyll, which may lead to some unpleasant side-effects. Afterwards the plants are removed from the liquid by e.g. bag filtration. To remove waxes, oils and fats, ethanol is added again and the mixture is chilled to at least <–20 °C. The undesired substances precipitate. The supernatant is now going through a multistep filtration (see Chapter 3) followed by an activated carbon filtration to remove the chlorophyll and an evaporation step for ethanol recycling.

This method can be performed at atmospheric pressure, but the temperature has to be controlled carefully, especially during evaporation. This process takes time and must be done with caution as ethanol is highly inflammable. One of the biggest benefits of this extraction method is that there is no risk of leaving toxic residual chemicals in the final cannabis extract and, it enables the co-extraction of all compounds of interest, chiefly cannabinoids and terpenoids.

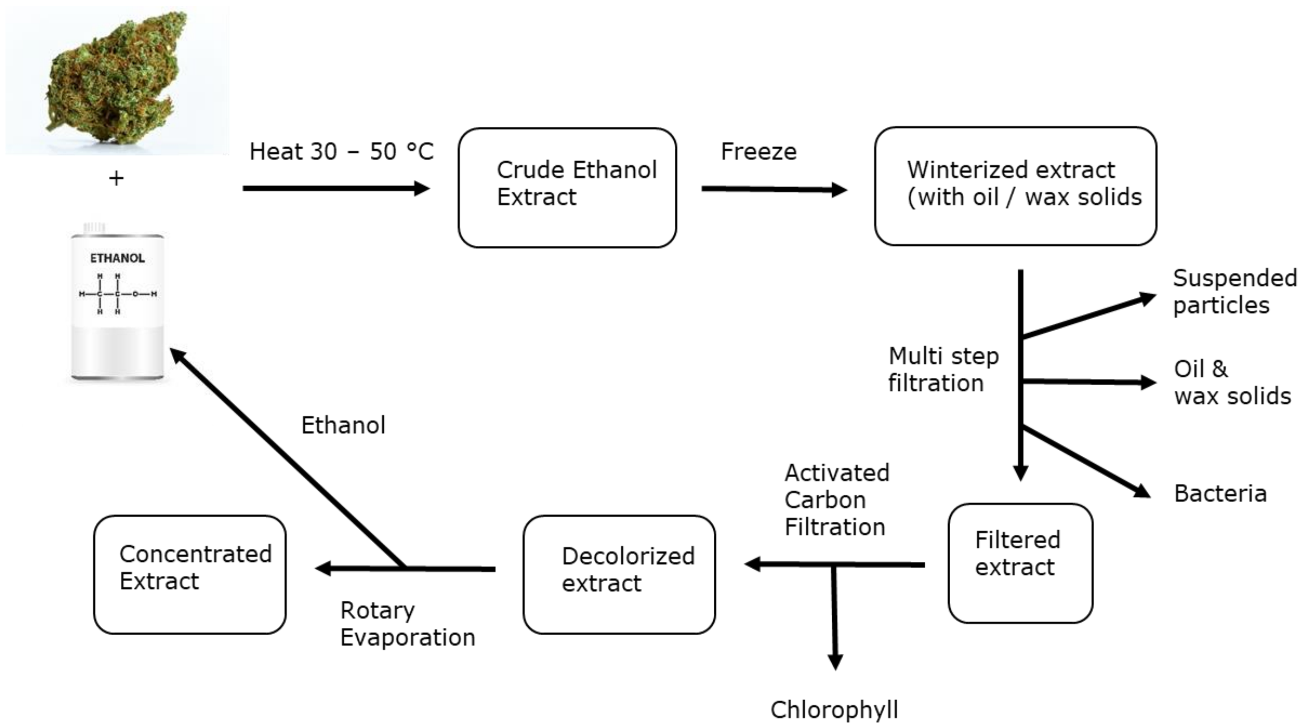


Fig. 3: Ethanol extraction process

2.3 CO_2 Extraction

CO_2 extraction (Fig. 4) provides the cleanest product. This method uses pressurized carbon dioxide to pull out CBD and other ingredients from the cannabis buds. CO_2 acts as a solvent at certain temperatures and pressures. This extraction procedure is divided into two methods: 1. subcritical and 2. supercritical. The supercritical approach is the most common method overall because it is safe and provides a pure end product.

The main difference between the two CO_2 extraction types is mainly the pressure and the temperature. During the subcritical process lower temperatures and pressures are used. The process takes longer, produces smaller yields and it does not extract chlorophyll and other unnecessary ingredients.

The supercritical extraction is more costly and requires special and very expensive equipment. The most expensive part is the equipment to cool down the CO_2 until it becomes a liquid. At standard temperature and pressure CO_2 behave like a gas. It can easily be transformed into a solid state which is called dry-ice. With the appropriate equipment CO_2 can be turned into the liquid state at low temperatures below −56 °C / 69 °F and a pressure over 5.1 bar / 75 psi. When the CO_2 becomes a liquid the temperature and the pressure need to be increased until the CO_2 exceeds the point where the liquid becomes supercritical. That means the CO_2 is somewhere halfway between a gas and a liquid simultaneously. The supercritical CO_2 now is capable to fill a container like gas while maintaining density like a liquid. The supercritical CO_2 is an ideal solvent for extractions.

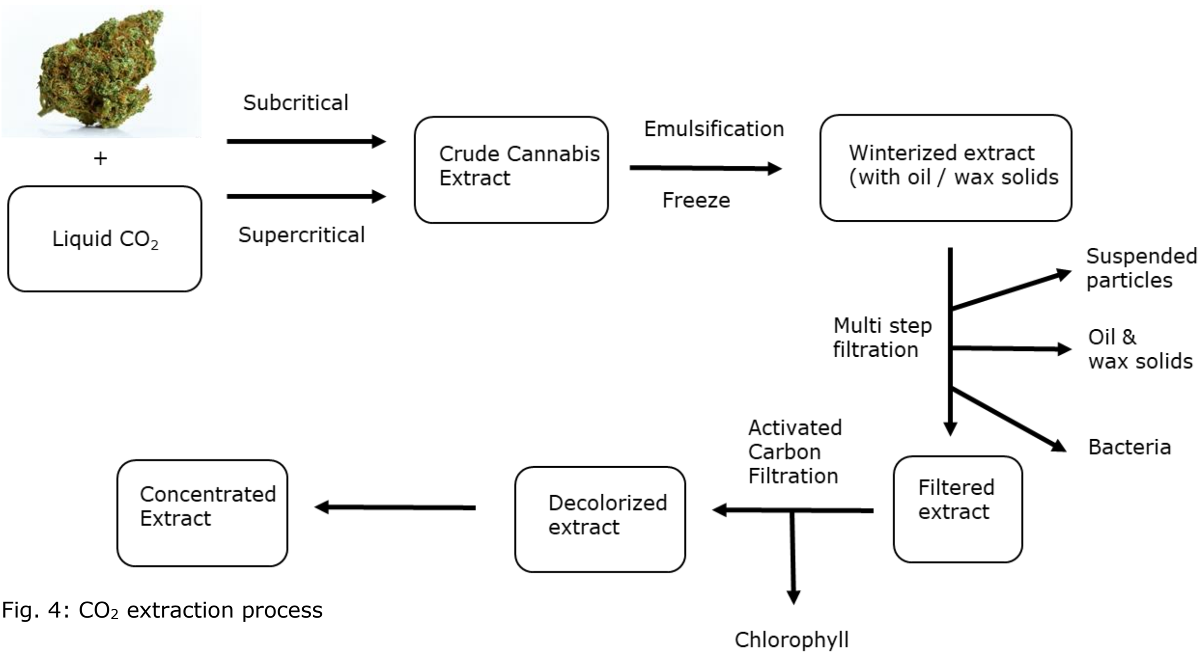


Fig. 4: CO_2 extraction process

3 Winterization

Winterization means that the extract is mixed with very cold ethanol and then frozen down to −40 °C to −80 °C / −40 °F to −112 °F for 12 – 16 hours until all waxes, oils and fats separate. Afterwards a filtration is required. See Chapter 4.

4 Filtration

In the production of stable cannabinoid products filtration is an essential step. To remove the waxes, fats and oil from the winterization a multi-step filtration is recommended. Depending on the batch size different approaches are possible.

4.1. Equipment

a) Small batch sizes

Typically, filter paper and a Nutsch have been used. Meanwhile further equipment is being introduced by several companies like Infinity Manufacturing Concepts from Cypress, CA USA. In their Winterization Filter Table Systems (Fig. 5) depth filter sheets with a much higher dirt hold capacity than filter paper are used. The first step is a filtration with a retention rate of around 20 µm followed by 10 µm filtration. The such filtered product is free of particles but not free of chlorophyll and other odor and color influencing substances. To eliminate those substances an activated carbon treatment is recommended.

Fig. 5: Winterization Filter Table System with three tables (Infinity Manufacturing Concepts)

b) Medium batch sizes

The use of lenticular modules in a DISCSTAR™ housing is an eligible option for this application. This completely enclosed system enables also the cooling step. The disadvantage is that lenticular modules are not designed for filtration in very cold conditions. The modules are a good option for filtrations over −15 °C / 5 °F. For colder temperatures, a plate and frame filter as described below can be used. With lenticular modules, the DOR adapter would be the right choice, due to is easier handling and closer connection to the housing.

Fig. 6: DISCSTAR™ filter housing in different sizes

c) Medium to large batch sizes

For larger batches a more automatable system is recommended. Depending on the need of a cooled process a plate and frame filter or a sparkler filter can be used. The NOVOX® plate and frame filter is available in different sizes and configurations. Filter sizes from 200 × 200 mm until 1200 × 1200 mm are possible A simple but robust system (NOVOX® ST) as well as a completely closed and robust system like NOVOX® CP is suitable for the filtration. The appropriate system depends on the needs of the customer process. The disadvantage is that it is very difficult to cool down these systems to low temperatures if necessary. An advantage is that a two-step filtration can be done in one system which results in cost and time savings.

The other option are sparkler filters. Here depth filter sheets are put onto round metal meshes and stacked on top of each other. Sparkler filters are available in different sizes. A two-step filtration is not possible but the necessary housings can be cooled during the filtration.

Fig. 7: NOVOX® ST systems (a:400; b:600) and a completely automated NOVOX® system (c) incl. temperature controlled feeding and storage tank

4.2. Consumables

a) Depth filter sheets

The PURAFIX filter sheet line is the right choice to avoid the release of ions into the filtrate. For the first step we recommend the PURAFIX® CH 09P with a retention rate of 30 – 10 µm followed by the PURAFIX® CH 31HP with a retention rate of 12 – 5 µm. These filter sheets are available as flat filter sheets for the NOVOX® systems, as round sheets for e.g. the Winterization Filter Tables as well as for sparkler filters and as lenticular modules. Below –15 °C / 5 °F unfiltrate temperature lenticular modules (FILTRODISC™) are not the first choice for the filtration. The plastic which is used to manufacture the modules are not stable enough at this temperatures.

Fig. 8: PURAFIX® depth filter sheets and FILTRODISC™ lenticular filter modules

Fig. 9: PURAFIX® filter sheet in open filter system

b) Activated carbon sheets

For the removal of chlorophyll and other odor and color influencing impurities an activated carbon treatment is necessary. We recommend to use CARBOFIL™ RW. Other grades available which can be tested for better treatment results.

Fig. 10: CARBOFIL™ activated carbon filter sheets and lenticular modules

Fig. 11: CARBOFIL™ filter sheet in open filter system

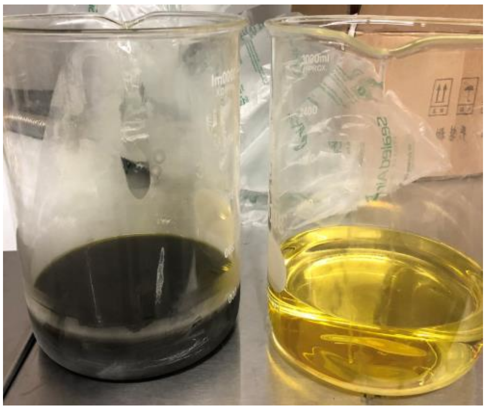


Fig. 12: Filtrate before PURAFIX® filtration (left) and CARBOFIL™ treatment (right)

5 Conclusion

The use of depth filter sheets for the clarification and removal of chlorophyll in the production of CBD and related products has many advantages compared to the use of filter paper. Due to the thickness of the filter sheets the limited capacity to hold particles back increases the filtered volume per m^2 at low costs. The activated carbon treatment takes out the chlorophyll and other odor and color influencing substances. Fig. 13 shows the raw extract (a), after decarboxylation (b) and after filtration and the activated carbon treatment (c). Filtered and treated CBD oil is commonly referred to as Gold CBD Oil.

a b c

Fig. 13: Raw CBD oil (a) compared to filtered and treated CBD oil (c). Picture b shows the oil after decarboxylation. (Pictures from https://www.cannainsider.com/reviews/cbd-oil-color/).

6 Literatur

Understanding the differences between Hemp, CBD and Marijuana; www.winterridgefood.com

Understanding the Cannabis Oil Extraction Process; www.emblemcannabis.com

Cannabis oil extraction; www.projectcbd.org