

# Supercritical Carbon Dioxide (CO<sub>2</sub>) Extraction Method

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## Introduction

With the increasing rate of legalization, cannabis has been rapidly entering the U.S. market, and extracts are an essential component to the booming industry. In 2018, billions of dollars were invested into the cannabis industry in the United States. Cannabis is sold in a number of forms including flower, oil extracts, and edibles. Supercritical carbon dioxide extraction is a commonly used method to separate various components from the plant due to it producing a pure, clean, and safe product. Carbon dioxide reaches a supercritical state at 1071 psi and 31.1°C. When a molecule is in a supercritical state, it has properties of both liquid and gas. This is advantageous because CO<sub>2</sub> can reach into small spaces like a gas but can also dissolve and act like a liquid solvent. The physical properties of supercritical CO<sub>2</sub> are easily manipulated, which allows it to bond to any molecule the producer chooses.



## Extraction Equipment and Method

The size of the extraction system will vary depending on the batch size. Samples can be as small as 10 grams, and as large as hundreds of kilograms. Some systems have the option to be automated, so the producer does not need to be present during the batch. Supercritical CO<sub>2</sub> extraction takes longer to complete than other methods, due to the continuous fluctuations in temperature and pressure. For example, the extraction of 20 lbs. of plant material can take 4 to 6 hours.

To perform an extraction, the plant material must be ground and placed into an extraction vessel. CO<sub>2</sub> gas undergoes high temperature and pressure. A pump then forces supercritical CO<sub>2</sub> into the extraction vessel where it meets the plant and breaks the trichomes allowing it to dissolve part of the plant material. A pressure release valve then allows the material to flow into a separate vessel, where an internal compressor and heater are used to adjust pressure and temperature. By changing the temperature and pressure as well as flow rate, certain molecules will bond to CO<sub>2</sub>, allowing them to be separated from the plant. Many systems will reroute CO<sub>2</sub> back into the tank to be used during the next batch. The extract is then moved to a collection jar, such as a beaker.

# Benefits of Supercritical CO2 Extraction

By using supercritical CO2, the producer has total control over the procedure, CO2 can be recycled, making this method more environmentally friendly compared to others. Further, the Federal Drug Administration (FDA) has labeled CO2 safe for industrial extractions. CO2 acts as a cleaning agent, so microbial bacteria, molds, and mildews are killed during the process. The yield using supercritical CO2 is higher than other extraction methods; however, the yield and quality of product can easily be varied by adjusting the physical properties.

If there is residue on the extract, it will evaporate, as CO2 is a gas at room temperature. Extracts obtained from supercritical CO2 extraction are appealing to the food and beverage and medical industries, because it is guaranteed there is no residual solvent present on the product. Because there is no residual solvent on the product, the extract will be purer than many solvent-based extraction methods. Additionally, the plant is not subjected to extreme temperatures, so it does not experience degradation as it does during other extraction methods.

## Summary

Supercritical carbon dioxide is a widely used extraction method in the cannabis industry due to it effectively purifying the crude plant material. When CO2 is used in a supercritical state, it allows the producer to always be in control of the process by manipulating its physical properties to isolate certain molecules. Sources:

- Legal marijuana industry had banner year in 2018 with \$10B worth of investments
- Supercritical Carbon Dioxide and Its Potential as a Life-Sustaining Solvent in a Planetary Environment.
- CFR - Code of Federal Regulations Title 21

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