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# The basics of CO2 extraction

Quality cannabis extracts depend not only on the quality of the source flower, but also on [the extraction technique](#) used. Among the range of extraction technologies now available, carbon dioxide (CO2) extraction stands out as one of the cleanest, safest, and most effective. CO2 extraction exists in two forms: supercritical and subcritical.

Both variations retain the plant's beneficial compounds with no residual solvent contamination, creating a more palatable, high-quality product. In this article, we'll cover how CO2 extraction works and the key factors that distinguish it from other extraction techniques.

## Why use carbon dioxide extraction?

Carbon dioxide is the most common compound used in high-pressure extraction. It boasts a number of benefits compared to other solvents used for botanical extraction.

For starters, carbon dioxide is a non-toxic substance that is readily available commercially for lower costs than other chemical alternatives. In addition, carbon dioxide is environmentally safe, straightforward to work with, and it [creates a superior product typically free of any by-products or residue](#). Temperature, time, flow rate, and pressure can be manipulated to enable the precise extraction of specific cannabis compounds.



Although CO2 is somewhat new in cannabis concentrate processing, the technology is commonplace in the botanical extraction and food industries.

*Photo by: Gina Coleman/Weedmaps*

CO2 has also been [designated generally accepted as safe \(GRAS\)](#) by the Food and Drug Administration (FDA). Although CO2 is somewhat new in cannabis concentrate processing, the technology is commonplace in the botanical extraction and food industries.

## How does CO2 extraction work?

Carbon dioxide extraction uses pressurized CO2 as a solvent to draw desirable compounds from cannabis. It requires specialized equipment that can be expensive. The actual process, however, is relatively straightforward. There are two basic steps in the carbon dioxide extraction method.

First, the ground cannabis solids are placed in the extraction chamber. Pressurized carbon dioxide is pumped into the chamber where it dissolves the plant material and separates compounds such as cannabinoids.

In the second step, a pressure release valve facilitates the release of the material into a separate vessel, where heat and pressure encourage the cannabis compounds to separate from the carbon dioxide. The carbon dioxide is then exposed to a different temperature and pressure. This enables it to restabilize as a gas and flow back into the CO2 tank, leaving behind amber-colored cannabis oil.

## What's the difference between subcritical and supercritical CO2 extraction?

CO2 extraction is available in two forms: supercritical CO2 extraction and subcritical CO2 extraction. They're similar extraction methods with two key differences: temperature and pressure.

### Supercritical CO2 extraction

CO2 reaches [a supercritical temperature](#) at slightly above room temperature, which means it can be converted to a liquid, allowing the safe extraction of volatile active compounds that may be degraded by heat. Supercritical fluid extraction (SFE) utilizes CO2 in this state where it exhibits both gas and liquid properties. In this supercritical phase, it moves through the plant material like a gas but dissolves trichomes like a liquid.

The compound-rich solvent is then delivered into a vessel which lowers the pressure and temperature, separating the cannabinoids and terpenes. SFE captures larger molecules, such as waxes and lipids, resulting in a thicker substance that must be processed or [winterized](#) to remove these unwanted compounds. But due to its relatively low cost and high availability, supercritical carbon dioxide (CO2) has been the

preferred solvent for SFE products.

## Subcritical CO2 extraction

Subcritical CO2 extraction involves a similar process but with a lower temperature and less pressure. The pressure causes the CO2 to liquify but no heat is used, meaning more terpenes and other compounds are preserved. The subcritical extraction method is more lengthy than supercritical extraction and produces a smaller yield. However, it delivers a higher-quality product that retains diverse elements of the cannabis plant, such as essential oils, terpenes, and cannabinoids. Subcritical extraction results in a substance that does not contain fats, waxes, or lipids, so winterization is not as necessary.

Supercritical CO2 extraction is the most common CO2 extraction technique used for cannabis because it offers a higher yield more rapidly. However, subcritical extraction is becoming increasingly popular because it is not as harsh on the plant. Supercritical CO2 extraction can [sometimes be too robust for certain terpenes](#), resulting in the loss of these compounds. Cannabis products that emphasize full-spectrum whole-plant benefits may benefit from subcritical CO2 extraction.

## FAQ about CO2 extraction

Below are answers to the most common questions around CO2 extraction and products derived from this method.

### Is CO2 extraction safe?

When done by trained professionals in properly equipped labs, CO2 is among the safest extraction techniques available. From an environmental and health perspective, it is less toxic than petroleum-based hydrocarbons such as butane or propane.



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*Photo by: Gina Coleman/Weedmaps*

CO2 boasts another feature that also adds to its safety. Any residual CO2 which remains in the extract evaporates, so there is no residual solvent left in the product. Following the [vape-related illness of 2019](#), which was believed to be provoked by additive vitamin E acetate, discerning consumers increasingly avoid products containing solvent residue or cutting agents.

## Is CO2 extraction better than other methods?

The relative safety and non-toxicity of CO2 extraction generally renders it a more appealing option than other extraction methods. The versatility of the technology also offers an edge over other methods. Modification of the temperature and pressure allows different cannabinoids, terpenes, and other compounds to be targeted, allowing the extraction process to be customized for different formulations. Most importantly, the nature of the CO2 extraction process itself tends to result in a superior product.

That being said, these advantages come at a price. CO2 extraction equipment is expensive, which may place it out of financial reach for small-scale cannabis companies.

## Is CO2 extraction better than butane?

CO2 extraction is safer than butane because it is non-flammable, cleaner, and guarantees no chemical residue. Butane offers a quick extraction process, but it is a volatile solvent, and there is little control of how the cannabis compounds are extracted from the plant.

In comparison, CO2 is tunable, allowing the separation of diverse compounds from the plant through a segmented process.

## Is CO2 extraction better than cold-pressed?

Cold-pressing is an extraction technique more commonly used with hemp and CBD. It is carried out at low temperatures, so there is no thermal degradation to the plant's diverse range of potentially beneficial compounds. Cold-pressed methods produce less total oil per batch than CO2 extraction because CO2 requires a little heat to break down the plant material more efficiently.

Cannabis extracted at lower temperatures may boast its own benefits. [According to one study](#) cannabis in an unheated state has a lower rate of pharmacologically adverse effects and may be associated with better tolerability. Cold-pressed oil may also possess more monoterpenes that are sometimes lost during the CO2 extraction process.

## Bottom line

CO2 extraction is increasingly becoming the leading extraction technology used by the cannabis industry. The safety, non-toxicity, and quality associated with cannabis products made via CO2 extraction often give them a perceived edge in the retail market.

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Reviewed by [Carlton Bone](#) on 8/19/20

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