BY: Infinity Supercritical Staff EG TAGS: Supercritical CO2 Oil Extraction, Cannabis, Marijuana Extraction

Supercritical carbon dioxide extraction of cannabinoids from Cannabis sativa

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Supercritical fluid extraction with CO2 is already used on a large scale for botanical extraction due to its low cost, generally safe nature, and well known properties.

Reference science pdf article:

Rovetto, Laura J., and Niccolo V. Aieta. "Supercritical carbon dioxide extraction of cannabinoids from Cannabis sativa L." The Journal of Supercritical Fluids (2017)

Supercritical (SC) CO2 properties, like density, and thus solvent power, change with temperature and pressure allowing for selectivity via tuning.

One can also use more polar co-solvents, like ethanol, to expand the extraction range of the low-polarity CO2 to include more polar components.

Previous research has shown two different optimal extraction parameters with SFE for terpenes and cannabinoids.

This study did not find a significant difference in extraction rate from 313-333 Kelvin (104-140 F).

During the extraction time (during the linear trend before exhaustion), a yield of 0.00243g of extract/g of CO2, 0.00455g of extract/g of CO2, and 0.00666g of extract/g of CO2 was found for 17 MPa, 24 MPa, and 34 MPa respectively at 328K. 16.63 percent THC plant potency.

At 34 MPa, 0.0066g of extract/g of CO2, 0.01361g of extract/g of CO2, 0.00431g of extract/g of feed, and 0.00186g of extract/g of feed for the potencies 16.63 percent, 14.03 percent, 10.11 percent and 6.05 percent THC cannabis respectively.

Comparing using SC CO2 at 328K between 17, 24, and 34 MPa, the higher the pressure, the higher the yield, but lower the THC potency of the final mixture. 7.4 percent, 17.2 percent, 18.5 percent extract yield in comparison to total start weight; 76.23 percent, 70.63 percent, 69.41 percent THC potency for over 2 hours. 16.63 percent THC potency starting material and S/F ratios of 50 for high pressures, 100 for low.

At these temperature and pressures, partial decarboxylation takes place on the THCA to THC.

Higher Pressure = Lower Potency

They used a multi-stage depressurization chillers to precipitate the extract. Most of the THC (and highest extract amount) was found in the first stage at 13 MPa (1,885 psi) and 328K (130 F), but was waxy, pasty, and darker in color. In the second and third separator MPa (1,305 psi) and 328K (130 F) and MPa (870 psi) and 298K (77 F), more fluid yellow color extract appeared.

Compared different potency cannabis (A 16.63 percent, B 14.03 percent, C 10.11 percent, and D 6.05 percent), leading to potencies of extract of A 69.41 percent, B 61.21 percent, C 57.86 percent, and D 56.06 percent total THC. Thus the more originally potent, the more potent the extract.

Extraction efficiency (in relation to THC) rises slightly as potencies decreases (A 89.89 percent, B 89.17 percent, C 90.31 percent, D 92.23 percent).

Extraction efficiency increases as potency decreases.

They attempted to use ethanol as a co-solvents. This would cause more additional process steps, unless you want to use winterization, in which case it does not heavily modify your process line.

No major difference between using 5 percent and 10 percent ethanol by weight in extraction, but noticeable decrease dropping to 2.5 percent. Thus 5 percent is an efficient amount of co-solvents. (328K 131 F, 34 MPa 4,931 psi, S/F 20)

If ethanol is used, use 5 percent.

With the conditions in 12, the plant material was exhausted within 50 minutes of extraction.

Ethanol pulses versus constant flow was compared and pulses either performed better, or the same as constant flow. (2 hour extraction, 5 percent by weight ethanol divided into 3 pulses at 0 minutes, 50 minutes and 110 minutes.)

Since plant material was at exhaustion by the 50 minute mark, only the first pulse was needed to be applied, meaning minimal ethanol is necessary.

Ethanol drastically decreases the SF ratio necessary for lower potencies cannabis to be extracted (only 60 percent of the mass of extract gained using ethanol achieved at 2 hours, compared to the 100 percent gained in 50 minutes).

Something not mentioned in the article, the residual THC in the exhausted plant material is about the same for the lower potency cannabis, implying that the 2 hour extraction extracts all the THC and the extra mass accumulated with the ethanol comes from additional cannabinoids.

Summary:

Higher Pressure = Lower Potency

Extraction efficiency increases as potency decreases.

Ethanol cosolvent increases extraction, optimized at 5 percent ethanol added.

Pulsing performs better than constant flow.