Ultrasound-assisted extraction of cannabinoids from Cannabis sativa for medicinal purpose

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The therapeutic benefits of cannabis are more and more recognized at the scientific level. Moreover, the need to improve expertise on the use of cannabis-based medicinal products and their clinical effects is increasing. Due to the limited availability of industrial products, patients must be treated with pharmaceutical preparations, compounded in a pharmacy in accordance with a medical prescription [1]. At present, cannabinoid extraction performed by pharmacists is mainly based on maceration in oil [2]. Ultrasound-assisted extraction can be a promising alternative to maceration. Even if the method has already been used with cannabis [3], extraction conditions need to be further investigated. In this work, direct sonication at fixed ultrasound frequency of 26kH (Hielscher UP200St Ultrasonic homogenizer, Seneco Srl, I) was considered and the effect of amplitude and sonotrode size (Hielscher Sonotrode 2mm, S26d2, for samples from approximately 2mL up to 50mL; 7mm, S26d7, for samples from approximately 20mL up to 500mL), sonication time (10, 20, 30min) and volume of the solvent (20 or 50mL) were evaluated.

The standardized medicinal cannabis FM2 or Bedrocan and olive oil, as a solvent, were used at the ratio 1:10. To obtain decarboxylated cannabinoids, cannabis inflorescence was heated in an oven at 115°C for 40min before extraction [2]. Analyses of the samples were performed on a HPLC/UV Shimadzu Prominence-i LC-2030C.

Preliminarily, samples of pure oil were sonicated (amplitude 60%, 2mm sonotrode) at different sonication times to monitor temperature changes. The measured temperature was related to solvent volume: after 30 min of sonication, in 20mL samples the oil temperature was over 83°C, while it was near 70°C in the larger volume. 20mL volume was selected to continue the evaluation. At the intermediate time (20min - oil temperature: 80°C), FM2 samples were prepared without decarboxylation step. It was shown that cannabinoids in acidic form were still present (CBDA 0.67±0,03% w/w; THCA 0.24±0,02% w/w). Thus, the effect of ultrasounds on extraction efficiency at the three sonication times were evaluated using FM2 previously decarboxylated in an oven (n=3). After each considered time step, differences in total CBD (T=10, 0.66±0.08% w/w; T=20, 0.64±0.06% w/w; T=30, 0.65 ± 0.04% w/w) and total THC (T=10=20=30, 0.26±0.02% w/w) contents were found to be not statistically significant ($p>0.05$). Considering that CBD and THC were almost completely extracted, the shorter sonication time can be considered suitable to obtain a high level of extracted cannabinoids, comparable to those obtained after a maceration phase of 40min at 100°C (T=10, total CBD: 0.59±0.04% w/w; total THC: 0.26±0.02% w/w; n=3).

The effects of ultrasounds on extraction efficiency were also verified using Bedrocan, one of the most used Cannabis variety, containing high level of THC. 50mL samples (amplitude 30%, 7mm sonotrode) were prepared. Total extracted THC measured after 10min sonication (1.90±0.07% w/w; n=3) was higher ($p=0.02$) with respect to those obtained after 40min maceration (total THC: 1.62±0.18% w/w; n=19).

In conclusion, ultrasound-assisted extraction yielded a cannabinoid content similar or even higher than those obtained after maceration, with the advantage of minimizing extraction time. The decarboxylation step remains necessary to avoid the presence of acidic forms, CBDA and THCA.

References:
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