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Short communication

Comparative assessment of decarboxylation temperature in a CBD-dominant cannabis strain under industrial process conditions

Dejan Mihajlovski[1*], Nena Smiljanovska[1], Elena Trajanovska Donev[1]
Irena Slaveska Spirevska[2], Kristina Grncharovska[2]

[1]*Production Department, Replek, Kozle 188, Skopje, North Macedonia*
[2]*Quality Control Department, Replek, Kozle 188, Skopje, North Macedonia*

Introduction

Decarboxylation is a thermally induced reaction in which acidic cannabinoids, mainly cannabidiolic acid (CBDA) and tetrahydrocannabinolic acid (THCA), are converted into cannabidiol (CBD) and Δ^9-tetrahydrocannabinol (THC), respectively, through the loss of carbon dioxide. In CBD-dominant cannabis material, the process should ensure efficient conversion of CBDA into CBD while limiting degradation of the formed CBD. The reaction is temperature-dependent and generally follows first-order or pseudo-first-order kinetics, whereas excessive heating may decrease the final cannabinoid content through degradation and process-related losses (Fućak et al., 2023; Wang et al., 2016).

Efficient CBDA conversion has been reported at approximately 140–150 °C, while higher temperatures or prolonged heating may reduce the final neutral cannabinoid content (Moreno et al., 2020; Reason et al., 2022). This study compared decarboxylation at 135, 145 and 155 °C for 75 min under industrially relevant conditions, with emphasis on CBDA conversion, final CBD content and indicators of excessive thermal exposure.

Materials and methods

Dried *Cannabis sativa* inflorescences, strain Charlotte's Angel, representing a CBD-dominant chemotype processed at the Replek production plant, were used as the starting material. The dried flower was milled for 1 min using an Empero SD-15 cutting mill to obtain a homogeneous batch and was then divided into three portions of equal mass and comparable loading density, expressed as mass per unit tray area.

Each portion was placed in stainless-steel trays and decarboxylated in a preheated Binder FD-720 industrial convection oven at 135, 145 or 155 °C for 75 min. To improve heat distribution within the material bed, each portion was stirred every 10 min according to the established plant procedure. During stirring, the oven was opened briefly, the material was mixed manually and the timer was resumed after the set temperature had been re-established.

Samples were collected after processing. Moisture content was determined by loss on drying before and after decarboxylation, and total mass loss was recorded. CBDA, CBD, THCA, THC and CBN were quantified using a Shimadzu HPLC Prominence-i cannabis analyser and certified

*dejan.mihajlovski@ymail.com

reference standards. The results were expressed on a dry-weight basis.

The theoretical CBD potential was calculated as CBD + 0.877 × CBDA, where 0.877 represents the molecular weight conversion factor accounting for the loss of carbon dioxide during CBDA decarboxylation. The obtained values were used to compare the effect of the three temperatures on CBDA conversion and final CBD content.

Results and discussion

The initial material contained 14.94% CBDA and 1.68% CBD, corresponding to a theoretical CBD potential of 14.78%, calculated using the molecular weight conversion factor of 0.877. THCA, THC and CBN contents were low at 0.43%, 0.10% and 0.10%, respectively, while the moisture content was 11.20%.

After decarboxylation at 135 °C for 75 min, the residual CBDA content decreased to 0.07%, indicating substantial conversion of CBDA into CBD. The final CBD content increased to 13.68%, which was below the calculated theoretical CBD potential and lower than the value obtained at 145 °C. The THC content was 0.36%, THCA was not detected, and CBN remained low at 0.02%. The moisture content decreased to 1.67%, and the recorded mass loss was 10.4%. These results indicate that 135 °C was sufficient to achieve extensive decarboxylation but did not provide the highest final CBD content under the fixed processing time.

At 145 °C, the most favourable cannabinoid profile was obtained. The residual CBDA content was reduced to 0.03%, while the final CBD content reached 14.73%, which was in close agreement with the calculated theoretical CBD potential of the starting material. THC remained low at 0.34%, THCA was almost completely depleted at 0.01%, and CBN was minimal at 0.01%. The moisture content decreased to 0.43%, and the process-related mass loss was 12.0%. This profile indicates efficient decarboxylation, with high CBD recovery and minimal formation of degradation-related markers.

At 155 °C, residual CBDA remained low at 0.05%, confirming extensive decarboxylation. The final CBD content was 13.81%, which was lower than the value obtained at 145 °C despite the higher processing temperature. At the same time, THCA was not detected, while CBN increased to 0.13% and the recorded mass loss reached 13.6%. This combination of slightly lower CBD content, higher CBN level and greater mass loss suggests increased thermal or oxidative stress at the highest tested temperature.

Conclusion

At 135 °C, extensive decarboxylation was achieved, although the final CBD content remained lower than at 145 °C. The 145 °C condition provided the highest CBD content, low residual CBDA and minimal CBN formation, with the CBD content closely approaching the theoretical potential of the starting material. In contrast, processing at 155 °C was associated with higher CBN formation and greater mass loss, indicating increased thermal stress. Therefore, 145 °C for 75 min was considered the most suitable decarboxylation condition for the investigated CBD-dominant material.

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