Technological Approach for the Development and Optimization of Decarboxylation Processes in Dried Flower and Ethanolic Extracts of Cannabis for Medical Purposes

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INTRODUCTION & OBJECTIVES

Cannabis is an annual, dioecious, self-pollinating plant, from the genus of flowering plants belonging to the Cannabaceae family. Three main species of cannabis, are commonly recognized: *Cannabis sativa* spp. sativa L., *Cannabis sativa* spp. indica L. and *Cannabis sativa* spp. ruderalis L.

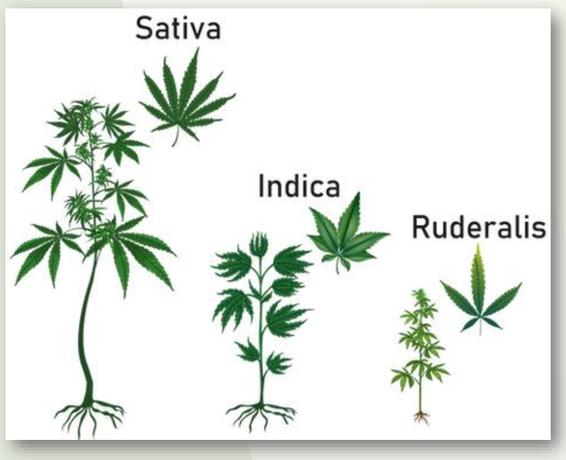


Figure 1. *Morphological differences in species of the genus Cannabis.*

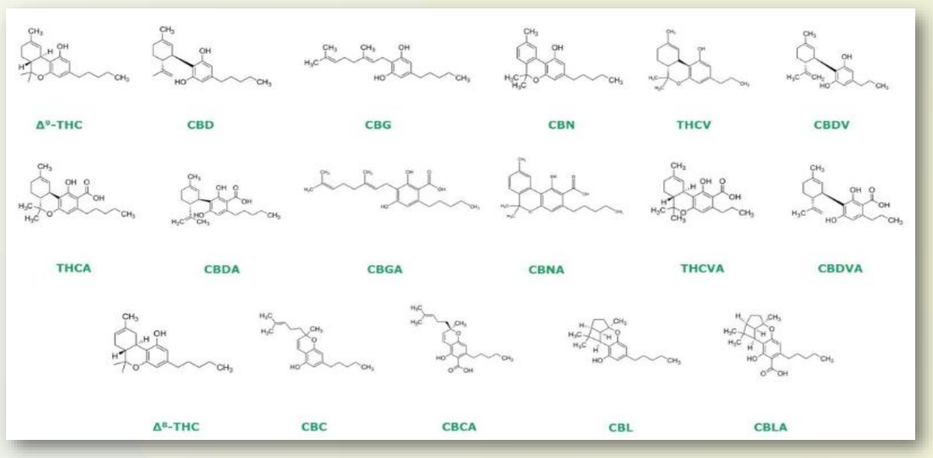


Figure 2. *Chemical structures of the primary cannabinoids isolated from the plant Cannabis sativa L.*

What differentiates THC from THCA, and CBD from CBDA?

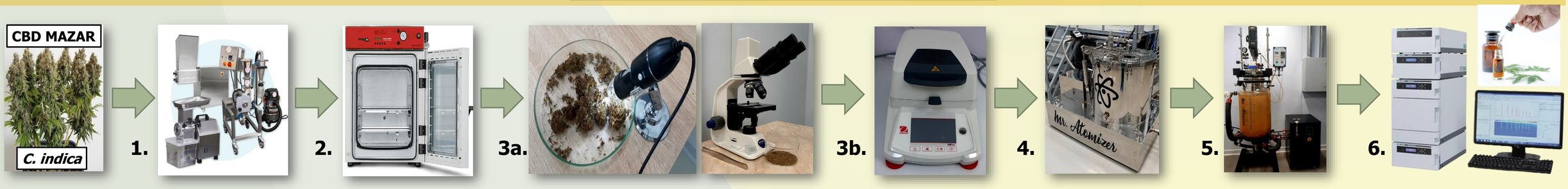
DECARBOXYLATION is a process that converts the chemical structure of the acidic cannabinoids into their neutral (non-acidic), active form.

THC-A decarboxylates to form Δ^9-THC, and CBD-A decarboxylates to form CBD. Exposure to oxygen and light during the decarboxylation process, can cause Δ^9-THC to easily oxidize to cannabinol (CBN), a compound with different properties.

Important parameters and factors that are crucial for achieving quality decarboxylation include temperature, time, fineness and moisture content of the plant material.

The aim of this research was to develop and optimize the decarboxylation processes for dried (ground) cannabis flower and cannabis crude oil / ethanolic extract, using a modern technology and validated methods.

MATERIALS & METHODS



1. Grinding of plant material before decarboxylation; 2. Decarboxylation of ground plant material (dried cannabis flower); 3a. Microscopy and 3b. measurement of moisture content of decarboxylated plant material; 4. Ethanol extraction to obtain Cannabis crude oil; 5. Decarboxylation of crude oil / ethanolic extract; 6. Determination of cannabinoid content (HPLC and/or FT-IR).

Module	Name of the plant material	Quantity of the plant material	Grinding sieve size	Time range for a process	Process temperature range	Temperature gradient
Module #1	THC Glueberry O.G	0,75 kg ± 0,07 kg	8 mm	0 – 50 min	80°C – 145°C	± 10°C
Module #2	THC White Widows	0,5 kg ± 0,1 kg	14 mm	0 – 60 min	85°C – 145°C	± 10°C
Module #3	THC SKUNK #11	0,55 kg ± 0,1 kg	12 mm	0 – 60 min	95°C – 150°C	± 10°C
Module #4	CBD Mazar	0,65 kg ± 0,09 kg	10 mm	0 – 60 min	95°C – 140°C	± 10°C

Table 1. *Modules / methods for the decarboxylation of dried (ground) cannabis flower.*

Module	Name of the crude oil / ethanolic extract	Quantity of crude oil / ethanolic extract	Speed of homogenization / agitation during the process	Time range for a process	Process temperature range	Temperature gradient
Module #1	THC White Widows crude oil	1,9 kg ± 0,1 kg	300 rpm ± 20 rpm	0 – 60 min	105°C – 135°C	± 5°C
Module #2	THC Skunk #11 crude oil	2,3 kg ± 0,3 kg	255 rpm ± 25 rpm	0 – 60 min	100°C – 130°C	± 5°C
Module #3	CBD Mazar crude oil	2,7 kg ± 0,2 kg	450 rpm ± 10 rpm	0 – 60 min	110°C – 145°C	± 5°C

Table 2. *Modules / methods for the decarboxylation of cannabis crude oil / ethanolic extract.*

RESULTS & DISCUSSION

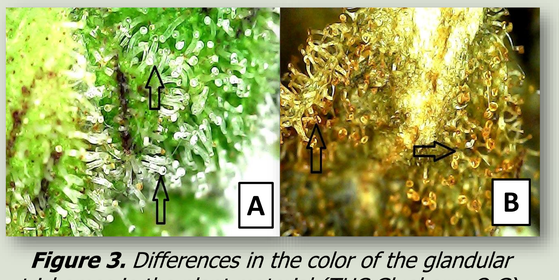


Figure 3. *Differences in the color of the glandular trichomes in the plant material (THC Glueberry O.G), before decarboxylation (A) and after decarboxylation – program 130°C / 40 minutes (B).*

Program / MC%	Program / module				
	80°C / 50 min	95°C / 50 min	110°C / 50 min	130°C / 40 min	145°C / 30 min
%MC before decarboxylation	10,58%	10,32%	11,08%	10,97%	11,07%
%MC after decarboxylation	8,12%	6,85%	5,39%	4,26%	3,87%

Table 3. *Moisture content (%) of plant material during decarboxylation in Module #1.*

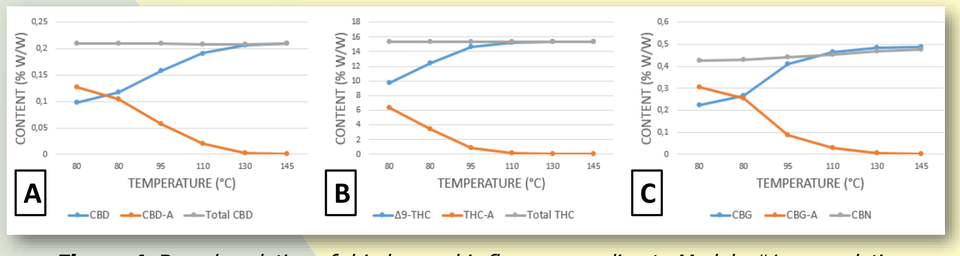


Figure 4. *Decarboxylation of dried cannabis flower according to Module #1 – correlation between the obtained values of: CBD / CBD-A (A); Δ9-THC / THC-A (B) and CBG / CBG-A (C), during the decarboxylations performed on different programs.*

Figure 5. *Differences in the color of the glandular trichomes in the plant material (CBD Mazar), before decarboxylation (A) and after decarboxylation – program 140°C / 50 minutes (B).*

Program / MC%	Program / module			
	95°C / 60 min	115°C / 50 min	125°C / 50 min	140°C / 40 min
%MC before decarboxylation	10,17%	10,72%	10,83%	10,21%
%MC after decarboxylation	8,66%	6,52%	4,39%	3,88%

Table 4. *Moisture content (%) of plant material during decarboxylation in Module #4.*

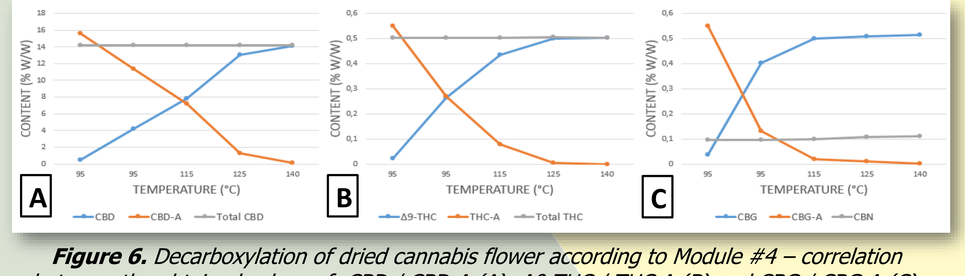


Figure 6. *Decarboxylation of dried cannabis flower according to Module #4 – correlation between the obtained values of: CBD / CBD-A (A); Δ9-THC / THC-A (B) and CBG / CBG-A (C), during the decarboxylations performed on different programs.*

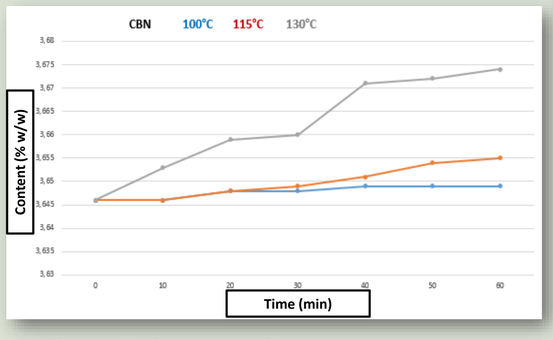


Figure 7. *Changes in CBN concentrations during cannabis crude oil decarboxylations performed on different programs in Module #2*

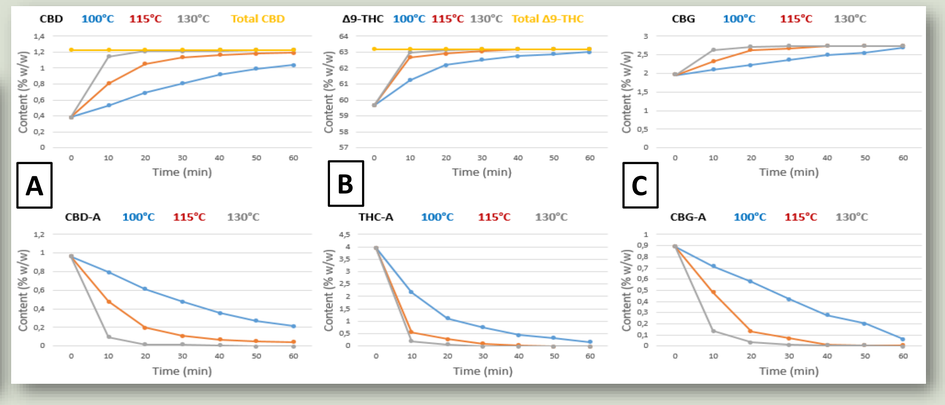


Figure 8. *Decarboxylation of crude oil / ethanolic extract of cannabis according to Module #2 (decarboxylation of THC Skunk #11 crude oil) – correlation between the contents of: (A) CBD / CBD-A; (B) Δ9-THC / THC-A, and (C) CBG / CBG-A*

CONCLUSION

After performing the decarboxylation processes according to the different modules and process programs, no significant increase in the CBN concentrations was observed in the products after their decarboxylation (0.293% *w/w* before decarboxylation and 0.309% *w/w* after decarboxylation). This suggests that the set temperature and time intervals are appropriate for maintaining the stability of CBN levels, as well as the sensitivity of THC to its degradation. Based on these findings, it is recommended that the decarboxylation process not exceed a temperature of 145°C, and should not last longer than 60 minutes.

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