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Application of D.I.C. technology for the extraction of high added value compounds from Cannabis Sativa L. buds according to the bio-refinery concept.

Dounia Bouchekioua, Dounia Bouchekioua, Houcine Mhemdi, Mohammed Benali, Victor Lefrançois, Tanguy Bauffe

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A close-up photograph of cannabis buds, showing the intricate structure of the flowers and the dense covering of white trichomes. The buds are surrounded by green, serrated leaves. The lighting is soft, highlighting the texture of the plant.

**D.I.C. technology for the
transformation of Cannabis
Sativa L. buds**

D.I.C. technology for the transformation of Cannabis Sativa L. buds

Bouchekioua Dounia ^(1,2), Mhemdi Houcine ⁽¹⁾, Benali Mohammed⁽¹⁾, Bauffe Tanguy⁽¹⁾, Lefrançois Victor⁽²⁾

⁽¹⁾ *Université de Technologie de Compiègne, ESCOM, TIMR (Integrated Transformations of Renewable Mater), Centre de recherche Royallieu - CS 60 319 - 60 203 Compiègne Cedex*

⁽²⁾ *Abcar DIC Process SAS, 11 Rue du Four Saint-Jacques, 60200 Compiègne*



Context : Cannabis Sativa L.



Historical use



Textile
Construction
Medicines



Legal and Regulatory Changes

- THC: **0.2% to 0.3%**
- CBD cannabis : Approval for sale



French CBD market:

- €1B in 2022
- projected €2.5B by 2025

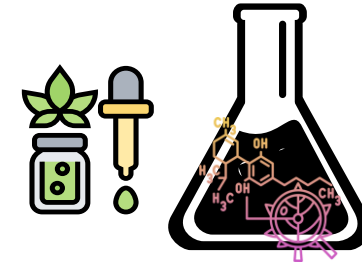


Context : D.I.C.

Instant Controlled Pressure Drop (D.I.C.)



Extraction



Debacterization

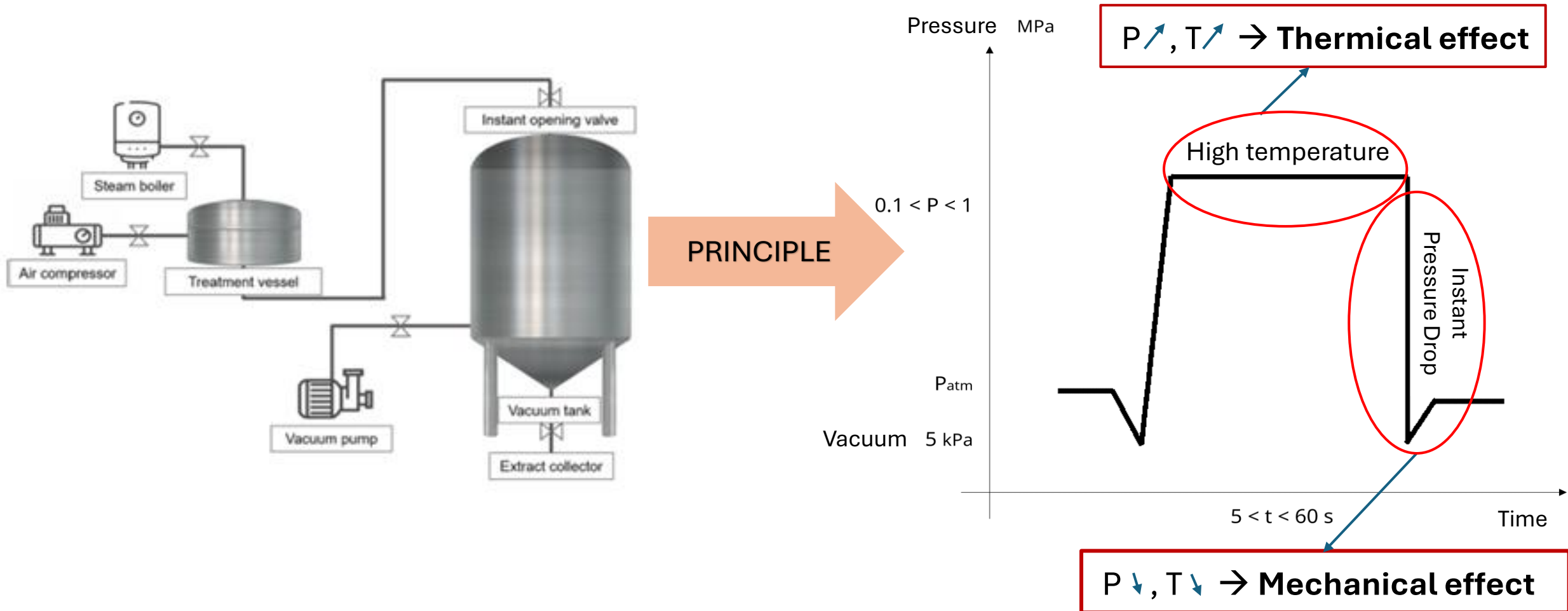


Texturization & Drying



Context : D.I.C.

Instant Controlled Pressure Drop (D.I.C.)



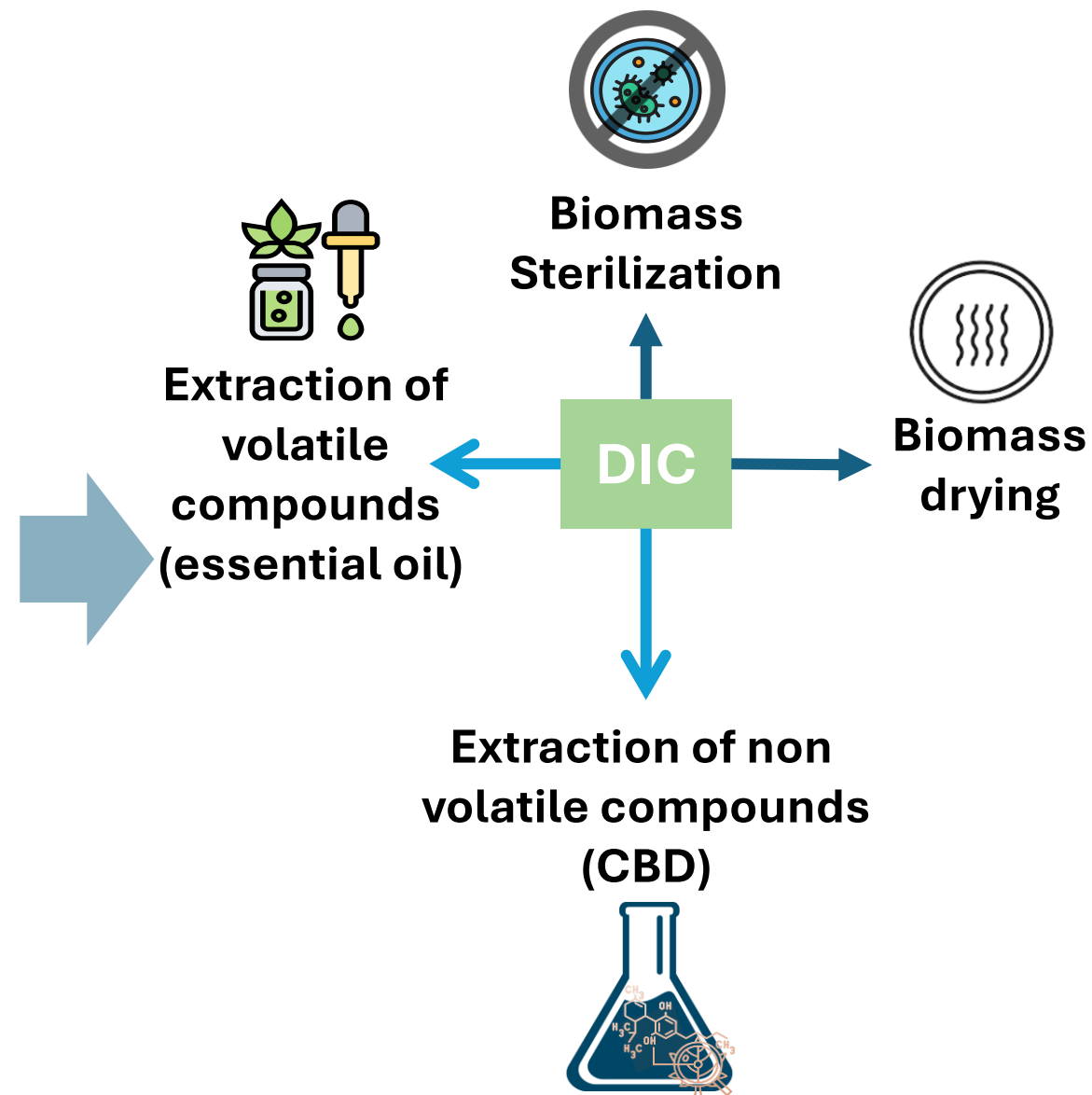
Objectives



Improve the shelf life

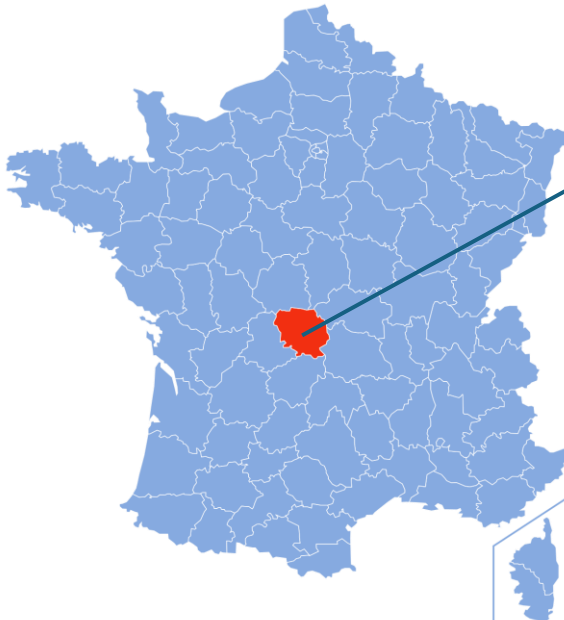
Reduce the loss of bioactive compounds

Improve the final product quality



Material & Methods : Plant material

Cannabis Sativa L. var. Kompolti



Fresh hemp buds
60-80% water content

For extraction application
and CBD extraction

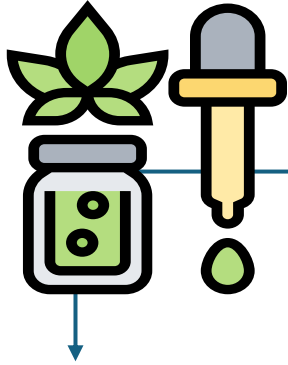


Dried hemp buds (under ambient
conditions)
Under 12% water content

For sterilization application

Material & Methods : Pre-treatment (D.I.C.)

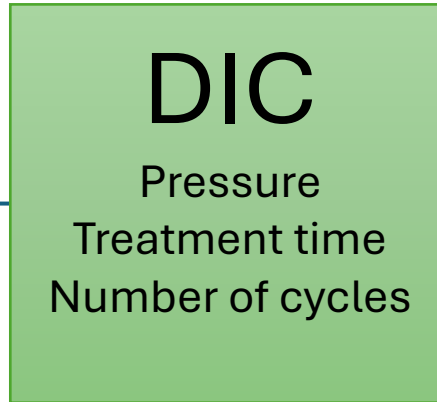
Extraction



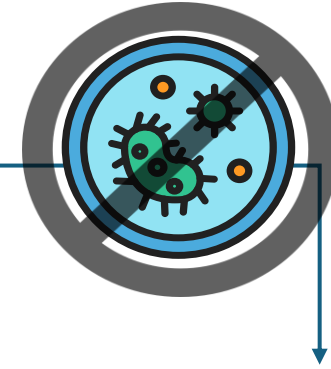
- Multiple DIC cycles :
 - Repeated **expansion** and **contraction**
→ Increased **porosity** :
 - **Enhances** the **diffusion** of volatiles
 - Easier **release** of volatile active compounds : **Solubilization in steam**



1 set of parameters :
8 cycles, 6 bar, 1s



Sterilization

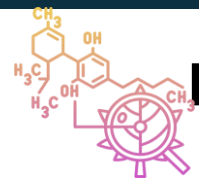


- A single DIC cycle :
thermomechanical effect
 - **Thermal effect** → eliminate bacteria
 - **Mechanical** → disrupts bacteria cells walls



Pressure : 1 to 6 bar
Treatment time : 5 to 35s

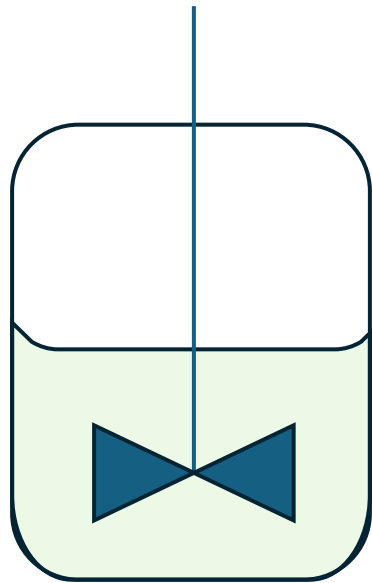
Material & Methods : Extraction & Analysis



Extraction Methods

Dynamic maceration (DM)

- CBD extraction
- Solvent : Ethanol
- 3 x 15 min



Extracts Analysis



HPLC

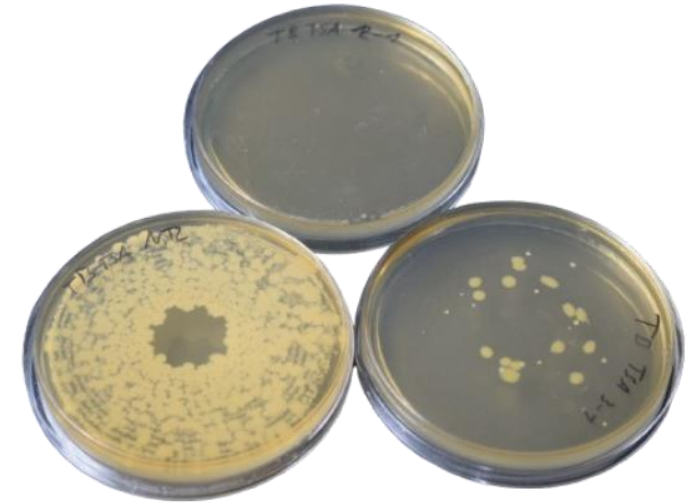
CBD quantification

GC

Essential Oils



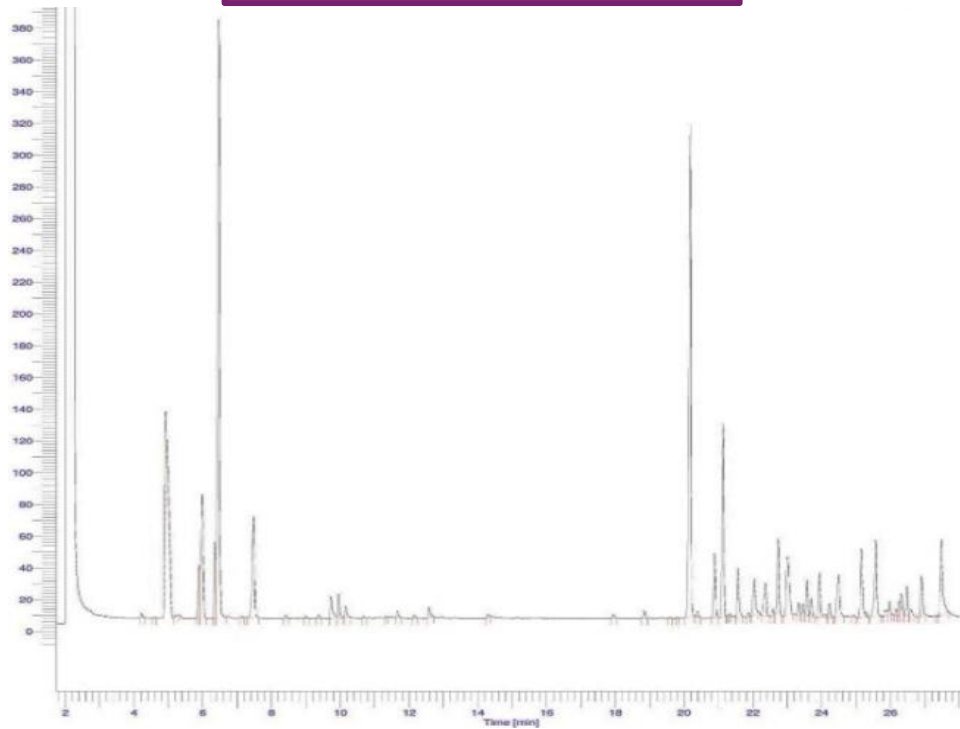
Bacteriological Analysis



- Bacterial culture (PDA, TSA)
- Colony counting (Colony Forming Unit per gram of Cannabis : CFU/g)

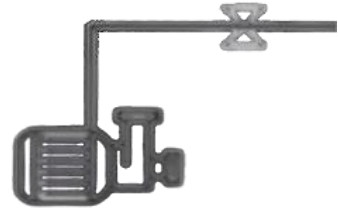
Results : Essential oils (EO) extraction

Reference method :
Steam Distillation
(SD)

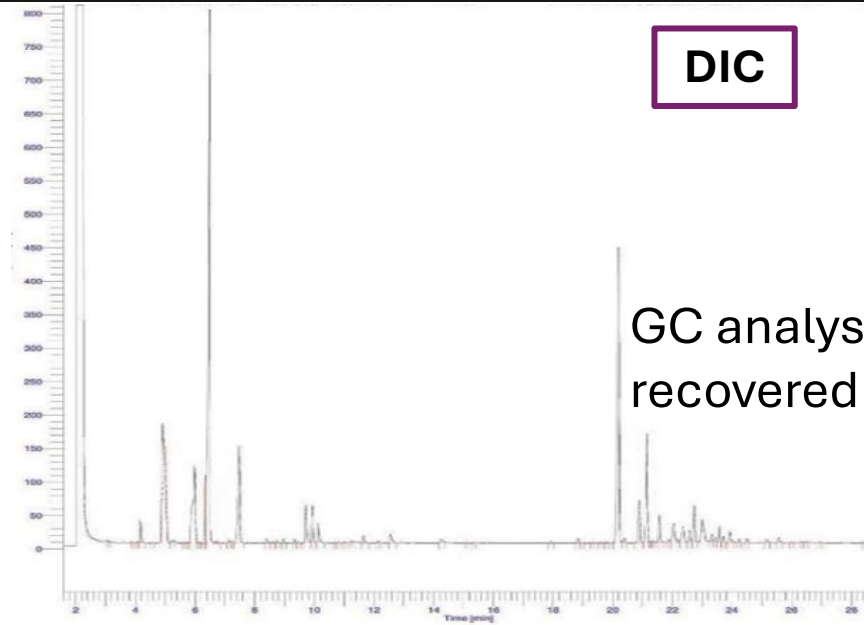


GC analysis of essential oils
(non pre-treated cannabis flowers)

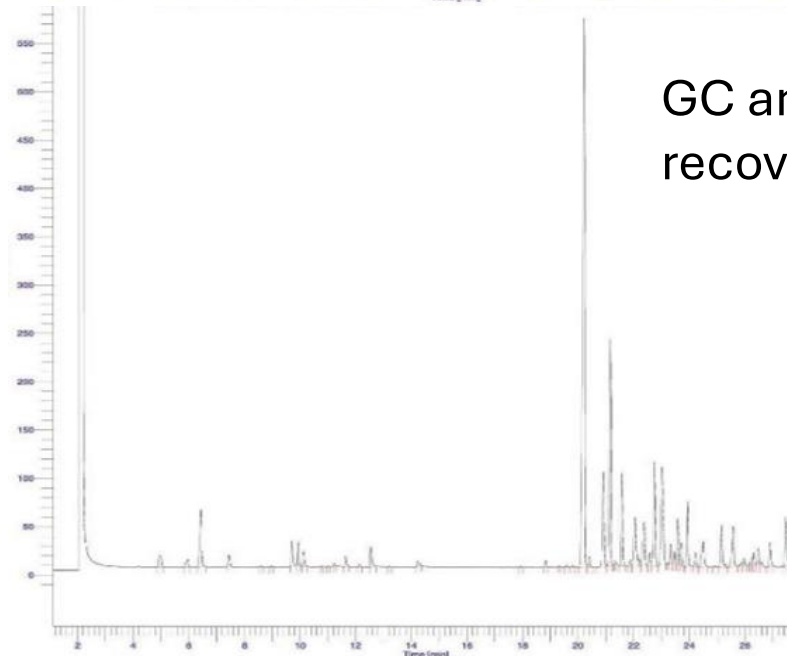
DIC



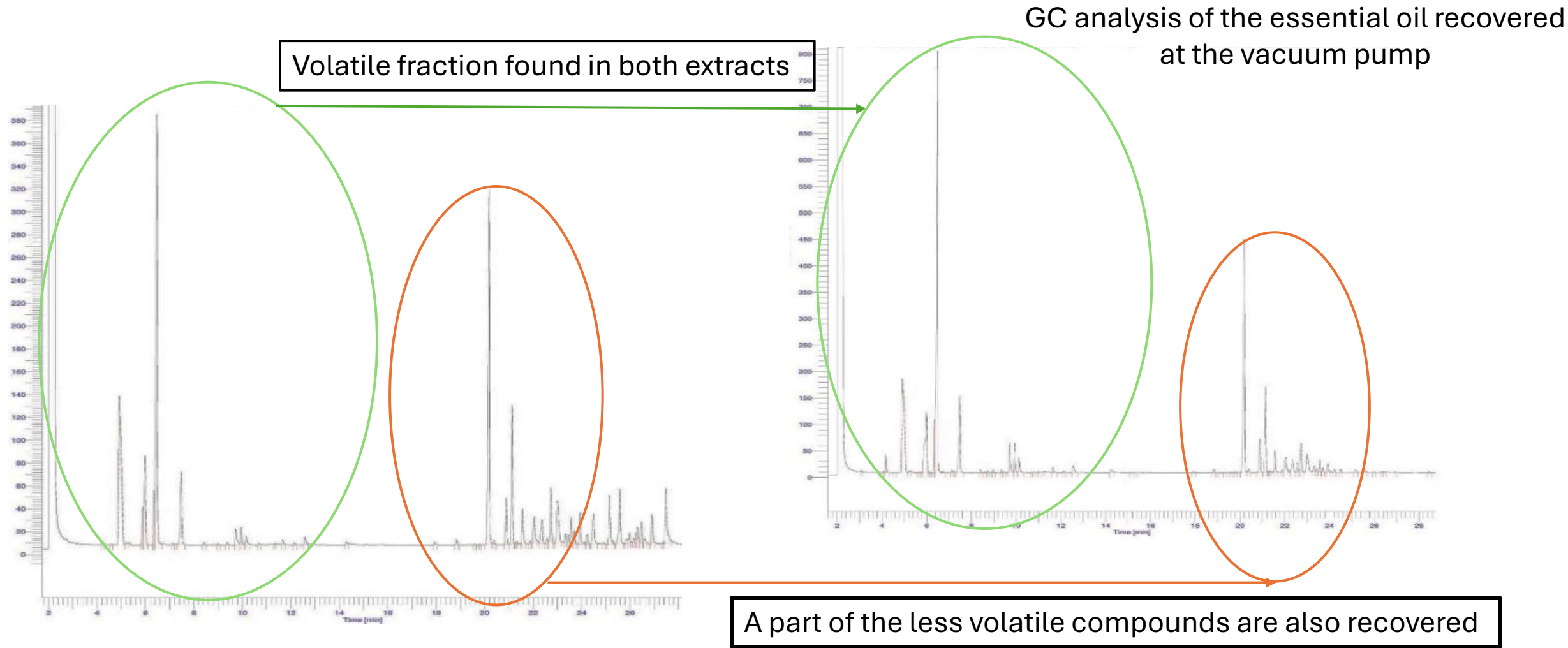
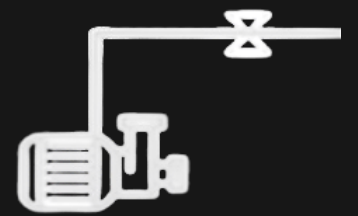
GC analysis of the essential
recovered at the **vacuum pump**



GC analysis of the essential
recovered at **vacuum tank**

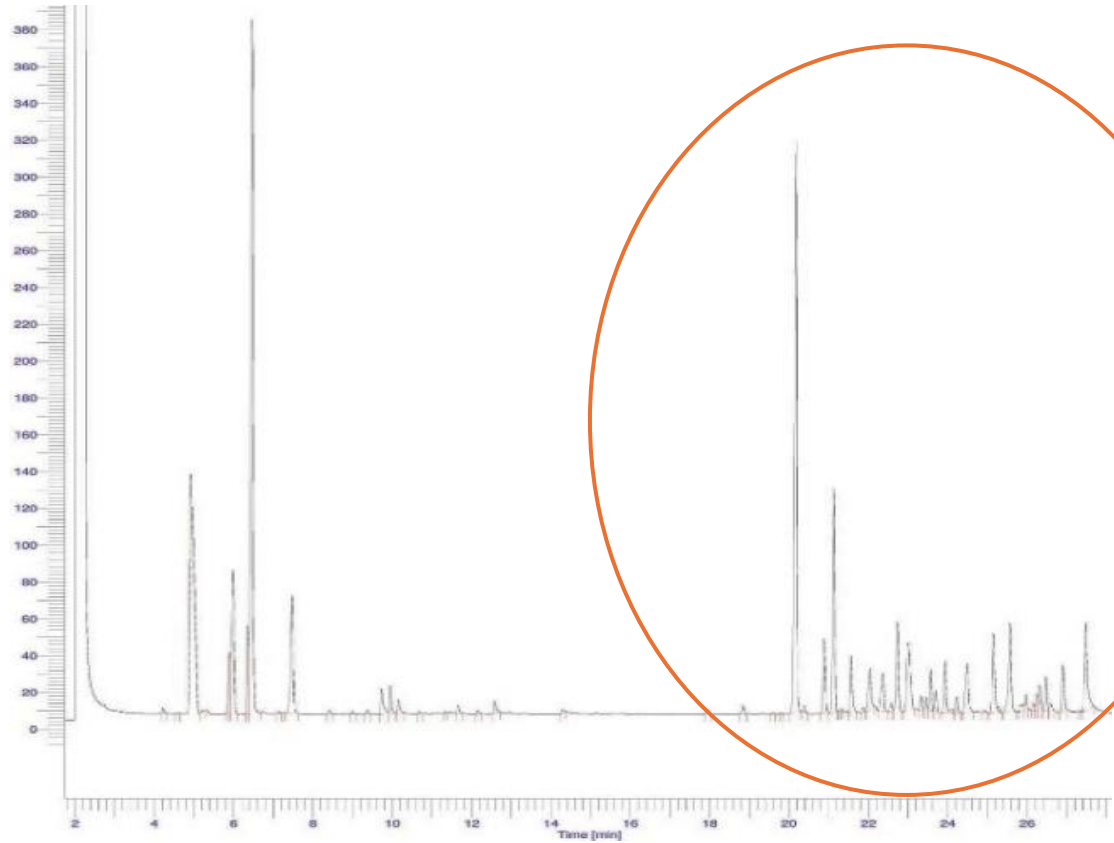


Essential oil : Pump Fraction

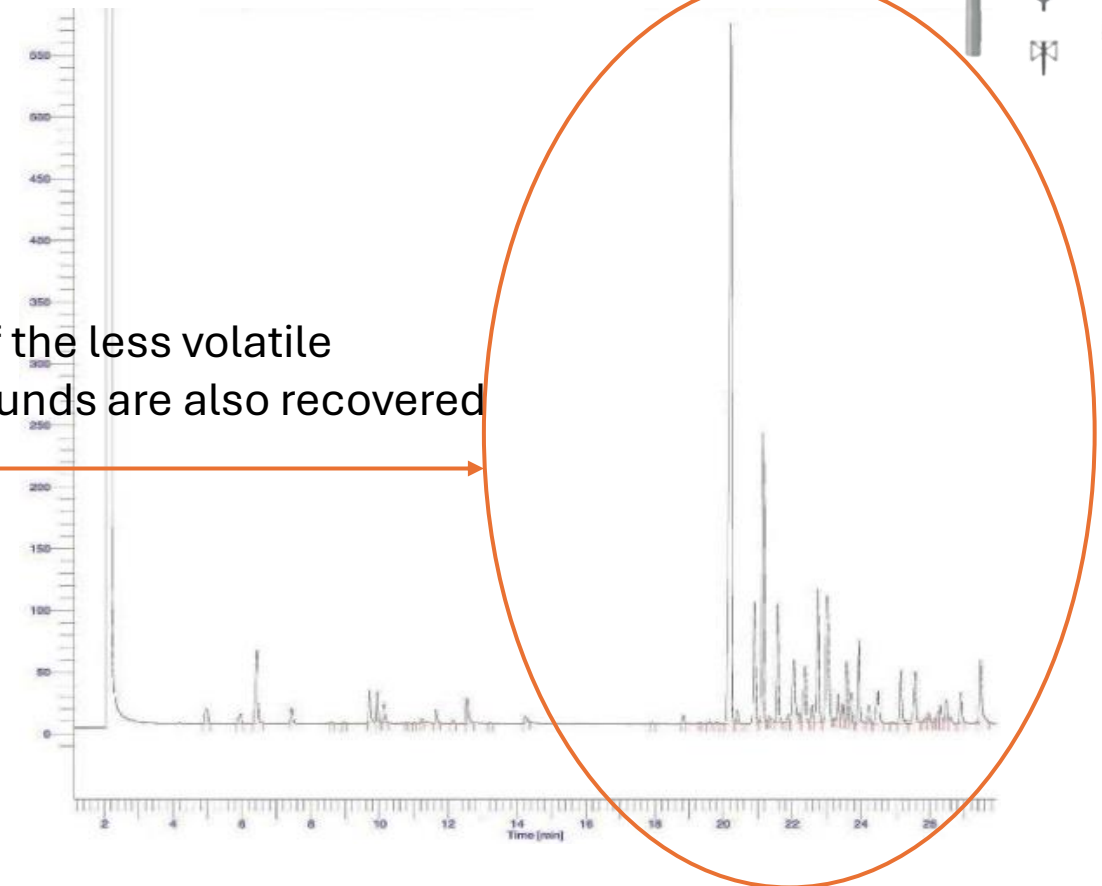


GC analysis of essential oil (non pre-treated cannabis flowers)

Essential oil : Tank Fraction



GC analysis of the essential oil recovered at vacuum tank



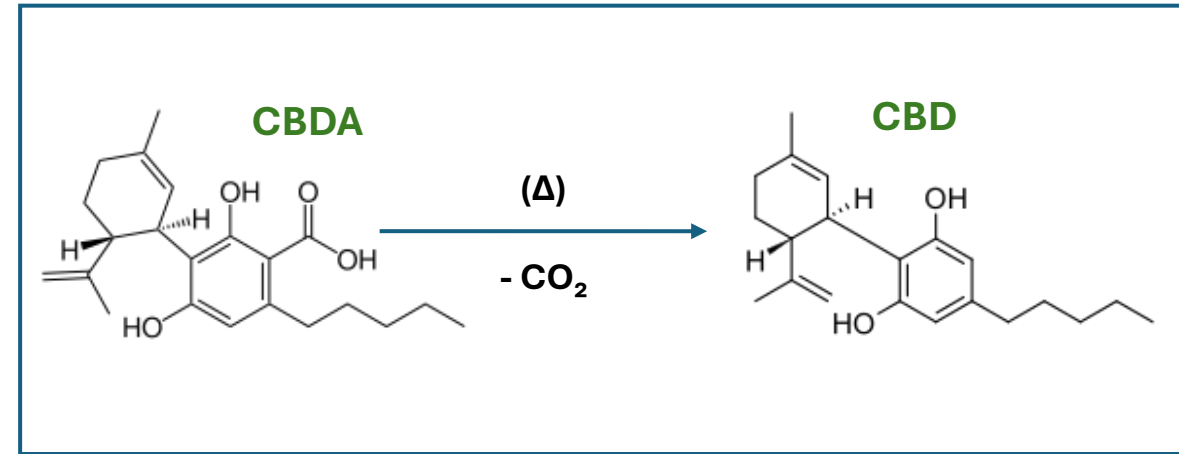
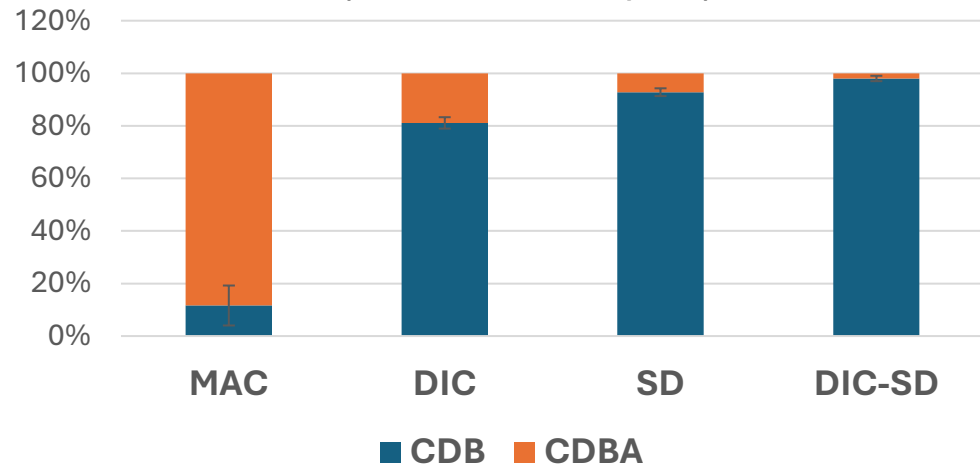
Most of the less volatile compounds are also recovered

GC analysis of essential oil (non pre-treated cannabis flowers)

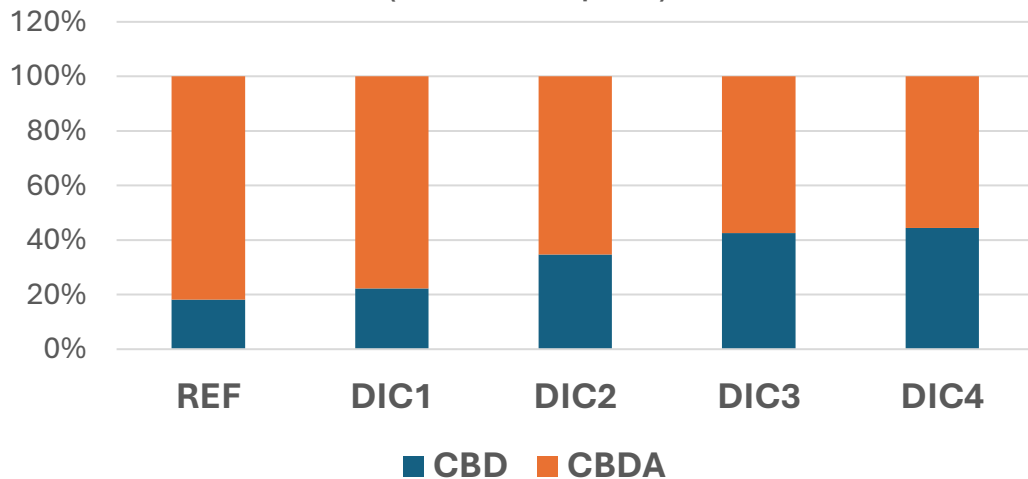
 Fractionation of essential oil extraction

Results : CBD extraction

CBD and CBDA content in different sample
(extraction samples)



CBD and CBDA content in different sample
(dried samples)

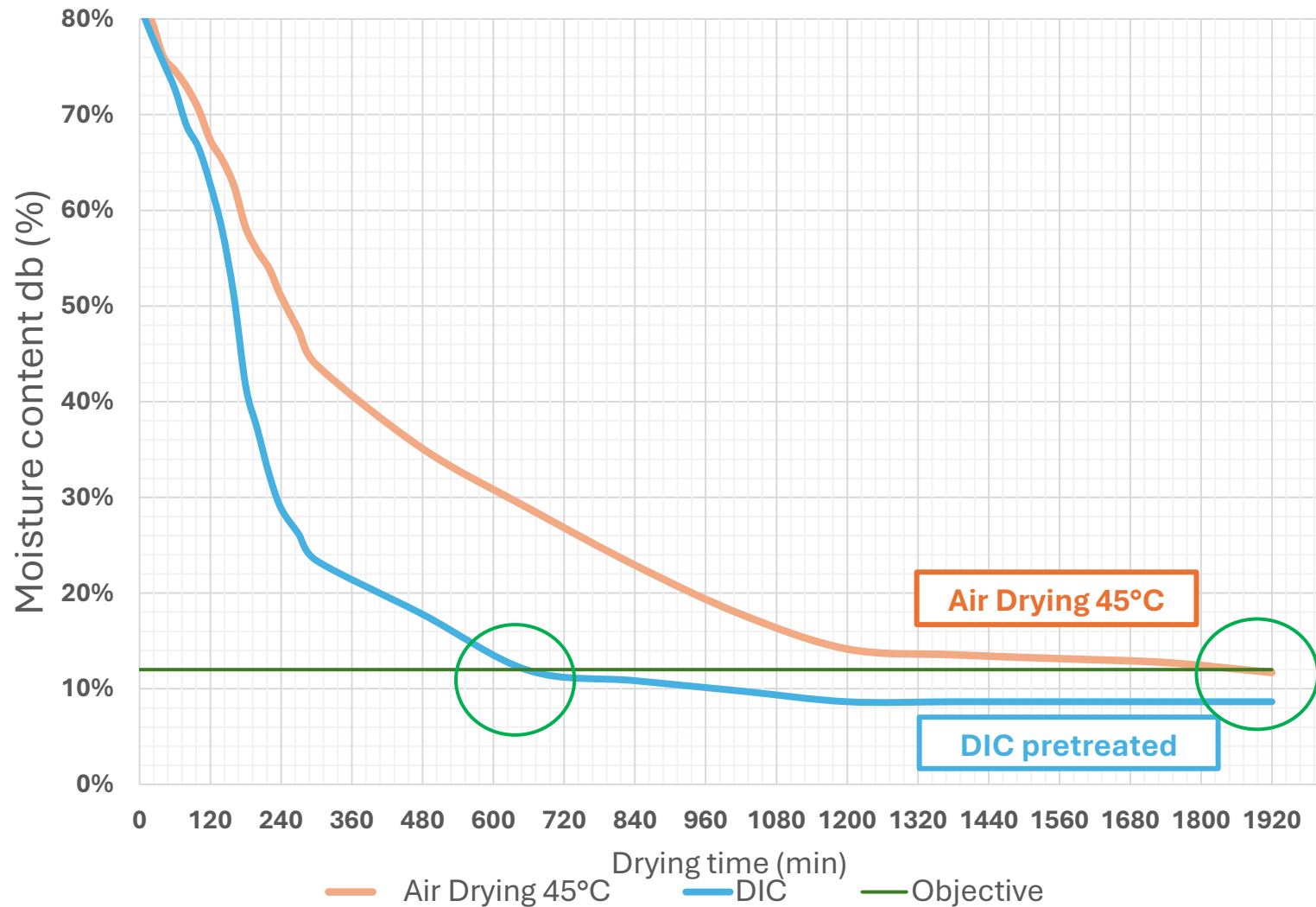


The CBD content extracted
increased with DIC treatment
(+70%)

**Reduction of the treatments
steps of hemp buds**

Results : Drying

CANNABIS DRYING CURVE



➔ Drying **target** : **12%** moisture content

➔ **DIC 3** : 4 bar, 14 showed the **best drying time**



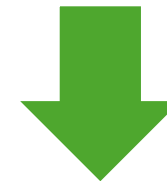
DIC enables drying **3 times faster** compared to the control

Results : Sterilization



▶ **Non sterilized** shows bacteria > 6 log cfu/g

▶ Best sterilization results at 4 bar, 25s : 100 cfu/g



**Reduction of 4 log CFU/g
+
Ultra-fast sterilization : 25s
treatment**

Perspectives

Application of DIC does...



- **Fractionate** EO extraction
- **Decarboxylate**
- Enhance **drying** kinetic
- Improve **sterilization**



- ✓ **Shelf life**
- ✓ **quality** of product

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Will...



- Be **optimized**
- Confirm its ability to **sterilize**
- Treat **different parts** of the plant
- Be **scaled** for **industries**

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For many applications...



- **Cosmetics**
- **Perfumes**
- **Nutraceuticals**
- **Pharmaceuticals**
- **Agronomy**

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Many applications :

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- **Pharmaceuticals**
- **Agronomy**

Research Project : PhD Thesis



utc





Thank you for your attention !