Decarboxylation

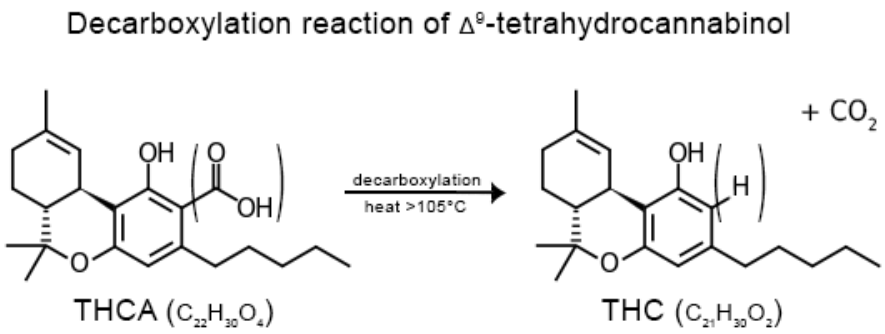
What is decarboxylation?

Decarboxylation is the removal of a carboxyl group when a compound is exposed to light or heat. A carboxyl group is a grouping of carbon, oxygen, and hydrogen atoms in the form of COOH. When a compound is decarboxylated, this group is released in the form of carbon dioxide.

Decarboxylation of cannabinoids

When considering the decarboxylation of cannabinoids, it is important to note that this reaction is what causes the neutral acidic cannabinoids to turn into the active cannabinoids found in most products on the market. Both the neutral and acidic cannabinoids are naturally found in the cannabis plant. The active cannabinoids that have psychoactive properties are what occur after decarboxylation.

Below is the mechanism for the conversion of THCA to THC.



https://www.leafscience.com/2017/04/13/what-is-thca/

Heating THCA converts it to THC by kicking off the carboxyl group seen on the right side of the THCA molecule. Once the carboxyl group is released from the THCA it forms carbon dioxide and the THC compound. The THC is now ready for use in different products and will provide the psychoactive effects that popularized this compound.

This simple reaction is all it takes to convert the acidic cannabinoids to their active counterparts. Cannabinolic acid (CBDA) and CBD are both another example of this process.

Decarboxylation process

Light can start the decarboxylation process after a period of time, but heat is the more common element used. There are different methods to decarboxylate cannabis depending on user preference. In the industry, dabs, vapes and joints decarboxylate instantly when heat is applied to the product. The THC in the dab or cartridge comes into contact with the heat source as the product is inhaled and decarboxylates on contact. However, this is not always an efficient method, so practices in the industry

are refining to bring a higher yield to products. Processers are now decarboxylating concentrated products to provide a higher percentage of THC.

In cannabis extraction, the decarboxylation process can happen accidentally if temperatures are too high during evaporation processes or other post refining stages. However, if decarboxylation is a desired reaction to convert THCA to THC, there are a variety of ways to start this reaction. [1]

The most common technique for decarboxylation is the vacuum oven. The vacuum oven operates under vacuum in order to lower pressure, decrease boiling points and process time. Residual solvent is evaporated off during this process or an extract can be further treated by converting acidic cannabinoids to their active derivatives. The temperature of the oven can be adjusted to start the decarboxylation process. The higher the temperature, the faster the conversion.

Other methods include baking the flower before an extraction process or taking a processed oil and heating the product at atmospheric pressure with something as simple as a hot plate and magnetic stirrer. [2]

According to the literature, the decarboxylation of acidic cannabinoids to their active counterparts can happen rather quickly depending on temperature and time. Several articles have studied the reaction of converting THCA to THC. The methods in these papers involve dried flower material being heated with a vacuum oven or other heat sources at atmospheric pressure and then extracting the cannabinoids with a solvent to examine the concentration of THCA over time. [3,4]

After looking at combined trendlines for the decarboxylation of THCA to THC, a general trend becomes apparent. The literature concludes that the reaction starts at 90 ˚C, but THCA can convert fully to THC after 3 hours at 100 ˚C. [3] The higher the temperatures, the faster the conversion to THC. For example, in one study temperatures as high as 145 ˚C converted THCA fully in only ten minutes. [4]

The literature also studies the rate of reaction for converting THCA to THC. The conclusion is that the reaction of THCA to THC is a first order reaction. This means that this conversion can happen very quickly with complete conversion of THCA to THC over time. [5]

In the industry, multiple patents are published that describe the decarboxylation practices used today. The vacuum oven is the most common equipment used, both pre and post solvent extraction. The dried flower is placed in the oven for several hours at low temperatures and then an extraction with a solvent is done. The other technique is to extract the cannabinoids with a solvent, concentrate the product down by evaporating the solvent and then placing the product in a vacuum oven under reduced pressure. The temperature for both processes is kept low, no more than 40 ˚C. [6]

Some extractors opt to decarboxylate post solvent extraction but keep the isolates in solution. In this practice, common solvents are used and the product is refluxed at the low temperatures (20-40 ˚C) for several hours using amber glassware to avoid any degradation or unwanted decarboxylation of other compounds. [6] Solvent can evaporate off during this process but according to patents of current practices, the decarboxylated solution will need to be further concentrated to achieve a useable end product. [6]

The temperatures in the literature are low, with most patented processes never exceeding 40 ˚C. The pressures remain close to atmospheric, with a variation in extraction, decarboxylation, or evaporation times.

No matter how an extractor chooses to decarboxylate their product, it is still important to follow good manufacturing practices and manufacturer operational guidelines to create a safe extraction process and product.

References:

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