Accounting for Moisture in Fresh Cannabis: What You Need to Know

April 2024

Overview

Traditional cannabis potency testing can result in significant lag time between harvesting and knowledge of potency results, impeding the flow of production. Currently, the product first needs to be harvested, dried, and cured over multiple days before it can be entered into sample queues at third-party testing facilities, which can then take days or weeks to move through.

Testing freshly-harvested cannabis material with a third-party laboratory is logistically more complex than testing cured flower samples. The plant material is more pliable, requiring modified grinding and processing procedures. Additionally, the high moisture content provides the perfect growth environment for mold and bacteria, so it is essential to minimize delays between harvesting and sample extraction for accurate analysis.

Ekidna's As-Is Fresh Bud Potency test enables growers to accurately test their product immediately at harvest in approx. 7 minutes – no drying, grinding, or additional processing required. Identical to HPLC measurements performed at third-party testing facilities, the Ekidna test provides as-is potency results. This means the cannabinoid potency value is calculated without accounting for water, so the value will appear dramatically reduced compared to the cured potency that is normally reported. For example, fresh bud tested at harvest might yield an as-is potency value of 9%, but after curing to 13% moisture content this same sample could yield a potency value of 26%. The total amount of cannabinoid was the same at harvest and after curing, the only thing that changed was removal of water during the drying and curing process.

In theory, it is very easy to convert as-is cannabinoid potency at harvest to an adjusted cured potency. As we demonstrated in a case study with Sunrise Cannabis, all you need is your as-is potency value and the moisture content of the bud that was tested. The critical part of this process is obtaining an accurate measurement of the moisture content. The amount of water in cannabis plants can vary dramatically, not only between different strains, but also between samples harvested from different areas in the grow room, or even different locations on the plant.

For more information on techniques that can be used to accurately measure moisture content please see our Options for Measuring Moisture Content in Fresh Cannabis discussion.

The Math

THCa potency is calculated using a simple mass ratio, where the mass of cannabinoid measured by the experimental technique ($Mass_{THCa}$) is divided by the total mass of the sample ($Mass_{Sample}$):

$$THCa\ Potency = \left(\frac{Mass_{THCa}}{Mass_{Sample}}\right) \times 100\% = \left(\frac{Mass_{THCa}}{Mass_{THCa} + Mass_{NonCannabinoid} + Mass_{H2O}}\right) \times 100\%$$

In the above equation $Mass_{Sample}$ is a sum of all components in the weighed sample, where $Mass_{NonCannabinoid}$ is all of the non-cannabinoid plant material and $Mass_{H2O}$ is the amount of water present in the sample. In theory, after harvesting $Mass_{NonCannbinoid}$ should remain relatively consistent, but $Mass_{H2O}$ will vary dramatically, particularly during the curing process.

Regulations surrounding how the water term is treated in the above equations can vary between jurisdictions and even between testing labs in the same regions. Some report potency "as-is", which means

the lab tests the cannabis material exactly how it receives it and does not factor out or account for the water variable. The onus is on the grower to recognize how the amount of water present at testing may impact the reported potency value; the greater the mass of water that is present during testing the "lower" the reported potency value will be. Other labs may measure the moisture content along with the potency and report cannabinoid potency at "0% moisture" or "dry plant material." Some markets and growers prefer this format as it represents the "true" cannabinoid potency, independent of the amount of water present, as the amount of water could fluctuate between testing and final consumption.

Why is Accurately Measuring Moisture Content So Important?

The amount of water present in a cannabis sample is often reported as moisture content, which is the weight percentage of water in the sample:

$$Moisture\ Content = \left(\frac{Mass_{H2O}}{Mass_{Sample}}\right) \times 100\%$$

In cured bud, water will only comprise approx. 5 – 15% (by mass) of the sample. However, with fresh bud there is a significant amount of water present around the time of harvest; approx. 60 – 85% by mass. The exact moisture content value can be impacted by various factors: cannabis strain, length of grow cycle, indoor vs outdoor growing conditions, frequency of watering, and location of flower on both the plant and within the grow facility. Furthermore, the moisture content can fluctuate daily. All of this means that if you want to convert the as-is fresh-bud potency to predicted post-curing potency it is crucial to accurately measure the moisture content on a representative bud sample; the potency and moisture content tests should be performed on buds that came from the same location on the same plant, harvested at the exact same time.

If the as-is potency ($\%THCa_{As\text{-}Is}$) and the moisture content ($\%MoistureContent$) are known, we can easily calculate the $\%THCa_{Adjusted}$ by combining and rearranging the above equations:

$$\%THCa_{Adjusted} = \left(\frac{100 \times \%THCa_{As-Is}}{100 - \%MoistureContent}\right)$$

Impact of Moisture Content on Calculating Cured Potency

With cured bud samples, small changes in the amount of water present in the sample do not dramatically impact the overall potency calculation.

Consider the theoretical situation where we want to know the fully dried (0% moisture) potency of a bud sample. The cured bud is testing as-is at 20% THCa with an unknown moisture content. Using equation for $\%THCa_{Adjusted}$, and assuming our curing process will result in bud with a moisture content of 5 – 15% (by mass) we will get the following range of possible adjusted potency values:

Table 1. Range of possible adjusted (to 0% moisture content) THCa potency values for a theoretical cured bud sample.

As-Is THCa Potency (%)	Moisture Content (%)	Adjusted THCa Potency (%)‡
20	5	21.1
	7	21.5
	9	22.0
	11	22.5
	13	23.0
	15	23.5

‡To 0% moisture content.

As depicted in the above table, when the amount of water present in the sample is low (5 – 15%) it has a minor impact (range of only 2.4%) on the calculated adjusted to fully dried potency. It is important to note that as the moisture content increases, the impact on the corrected potency also increases. At higher moisture content values, there are larger jumps in sequential adjusted potency values, even though the increase in moisture content was consistent.

The situation with fresh bud is dramatically different. With potentially 3 – 4x more water than cannabinoids by mass, small changes in moisture content can substantially impact the calculated adjusted potency. Ekidna has observed experimentally that moisture content in fresh bud can range from as low as 60% to almost 85% by mass. Again, using a hypothetical situation, consider a piece of fresh bud with an as-is potency of 7% THCa on the Ekidna system, with the potential to have a moisture content between 60 – 85%:

Table 2. Range of possible adjusted (to 0% moisture content) THCa potency values for a theoretical fresh bud sample.

As-Is THCa Potency (%)	Moisture Content (%)	Adjusted THCa Potency (%)‡
7	60.0	17.5
	62.5	18.7
	65.0	20.0
	67.5	21.5
	70.0	23.3
	72.5	25.5
	75.0	28.0
	77.5	31.1
	80.0	35.0
	82.5	40.0
	85.0	46.7

‡To 0% moisture content.

There is a significantly larger range (29.2%) of potential adjusted (to fully dried) potencies when working with fresh bud. Furthermore, a small fluctuation in the moisture content of just ±2.5% could result in a range of ±5% in the calculated adjusted potency value. If the desire is to track grow homogeneity or begin price setting based on projected potencies, it is essential to trust the numbers being calculated, and this is only possible with an accurate measurement of the moisture content.

Impact of Inaccurate Moisture Content on Potency Calculations

The above discussion demonstrates that while the math to adjust as-is cannabinoid potency at harvest into an anticipated cured potency is straightforward, in practice the calculation will only be as accurate as your moisture content value.

Consider the following dataset collected by Ekidna at an indoor grow facility. Ekidna harvested multiple fresh bud samples on the same day, from the same grow room containing a single strain. The samples were cut from different plants, and different locations on the plants, focusing on colas that were at the top or middle part of the plant. Some of these samples were then split into two: half the sample was tested on the Ekidna system using our As-Is Total THC Potency Test (with the Fresh Bud analysis), while the other half was dried (in a vacuum oven at 25°C, below 0.01 atm, with molecular sieves for 48 hours) to determine moisture content.

Table 3. Summary of individual and average moisture content values measured on 13 unique fresh bud samples from the same harvest. THCa potency was measured on six samples after drying in the vacuum oven.

Sample Name	Sample Mass (mg)‡	Moisture Content (%)	THCa Potency (After Drying)§ (%)
ETFS-009.1	1764	62.78	29.73
ETFS-009.2	1805	61.86	-
ETFS-009.3	1690	73.26	29.02
ETFS-009.4	1470	72.40	29.50
ETFS-009.5	1717	74.69	28.15
ETFS-009.6	1206	74.01	-
ETFS-009.7	1267	74.66	30.78
ETFS-009.8	944	75.32	-
ETFS-009.9	1355	76.66	-
ETFS-009.10	712	63.36	-
ETFS-009.11	1080	74.73	28.15
ETFS-009.12	535	74.50	-
ETFS-009.13	947	75.69	-
AVERAGE	-	71.84	29.22

§%THCa measured on vacuum oven dried cannabis samples using Ekidna As-Is Total THC Potency test, Cured Bud analysis method. The average HPLC value for this data set was 29.63%.

Table 3 lists the moisture content values from 13 samples investigated in this experiment. The lowest measured moisture content was 61.9%, while the highest recorded value was 76.7%, representing a moisture content range of 14.8% from a single harvest. Given the dissimilarity in measured moisture content values it is incorrect to assume that a single moisture content measurement accurately represents the entire grow.

Let's consider the impact of using various values from Table 3 to calculate the adjusted (to 0% moisture content) potency on two different bud samples. A cannabis sample that was harvested from the same bud as ETFS-009.4 tested at 8.22% THCa, while another sample harvested from the same bud as ETFS-009.9 had an as-is potency of 7.01% THCa. In Table 4 we use four different moisture content values to calculated the adjusted (to 0% moisture content) THCa potency: the matched value (moisture content value from a bud sampled from the exact same location as the potency-tested bud), the maximum (76.7%) and the minimum (61.9%) measured moisture content, and the average moisture content (from all 13 samples, 71.8%).

Table 4. Comparison of calculated corrected (to 0% moisture content) THCa potency values for two different cannabis samples using various experimentally determined moisture content values: their matched moisture content values (determined from bud samples harvested from the same location), the maximum, the minimum, or the average moisture contents.

As-Is THCa Potency (%)	Adjusted THCa (to 0% Moisture) (%)				% Relative Difference[β]			
	Match	**Max.**	Min.	Av.	Match	**Max.**	Min.	Av.
8.22	29.78	35.28	21.57	29.15	-	18.5	-27.6	-2.1
7.01	30.09	30.09	18.40	24.86	-	-	-38.8	-17.4

[β] $\%Relative\ Difference = \left(\frac{\%THCa_X - \%THCa_{Matched}}{\%THCa_{Matched}}\right) \times 100\%$, X = %THCa from maximum, minimum, or average.

When the matched moisture content value was used to calculate the adjusted %THCa (to 0% moisture), the resultant values are almost identical (29.78% and 30.09%) and align very well with the average potency measured on six unique samples after drying to 0% moisture content in the vacuum oven (29.22%, Table 3).

Using the minimum moisture content value resulted in a significant underestimation (by approx. 8 – 11%, absolute) of the adjusted potency for both. For the first sample (harvested from the same bud as ETFS-009.4), the average moisture content worked relatively well as it was similar to its matched moisture content value. However, for the second sample the average moisture content value was significantly less and resulted in an adjusted THCa potency that was over 5% lower. Conversely, ETFS-009.9 happened to have the largest measured moisture content, but when this value was applied to the as-is potency of ETFS-009.4 the adjusted potency was calculated to be over 5% higher.

The most accurate post-curing potency estimation will be achieved by testing identical cannabis samples (harvested at the same time from the same location) for both as-is potency on the Ekidna system and moisture content.

Document Revision History

Date	Revision	Changes
March 2024	1.0	Initial release.
April 2024	1.1	Text updates, including revised test kit labels.