



# CANNABIS

IT'S ALL ABOUT THE FLAVOR, AROMA, & TERPENES

## HOW CAN YOU PRESERVE THEM BETTER & LONGER

The cannabis industry is evolving as the demand for craft/ connoisseur products continues to grow. People are becoming more educated. They search for cannabis with a unique aroma and flavor, like finding a fine wine. As a result of this growing trend, cannabis growers realize it's time to start changing the way they produce their products. For it is no longer just about creating a unique aroma and flavor. Moving forward it's also about preserving them now and in the long-term.

Every grower approaches the growing process a little differently. But all strive to have their own unique, nearly proprietary aroma. Why? Because many customers buy cannabis based upon aroma and flavor. It has been one of the top decision factors in purchasing cannabis for decades. Customers expect a consistent experience when using the product each time, every time. Meeting this new demand has prompted some growers to start changing where they invest in their process.

### **Grower's Focus Is Changing**

Traditionally growers have invested their time, money, and muscle in pre-harvest activities for aroma development. That need is still here, but product consistency, stability, flavor, and health have also grown in popularity. Growers moving forward want to learn more about process and production techniques. They also want to grow less and get more out of what they already produce and become more profitable businesses.

Companies in the Cannabis industry are reexamining their processes and outcomes. They have learned if they want to make more money with less, it is time to start investing in post-harvest improvements. Specifically, finding ways to maintain and strengthen their unique aroma and flavor by preserving terpenes. Also, stop losing yields during the curing, packaging, and storage stages. Plus, they want to increase their brand's preference, demand, and sales. All want a better bottom line with more return on investment.

In the post-harvest stages, growers have been relying on traditional techniques for environmental management. Rudimentary examples would be using things like tortillas, orange peels, or wet paper towels for adding moisture into the cannabis. More sophisticated ways to control humidity are done by using food safe aqueous glycerin solution pouches or humidity control pads.

While these methods all provide some level of benefit, they fall short in maintaining cannabis health as well as locking in their plant-specific unique aroma, flavor, and terpene profile. Customers want the same quality experience the first time, and every time they use a cannabis product. Traditional techniques will not deliver the consistency they demand.

Growers are looking for better ways to produce higher quality cannabis to meet customers' expectations. They need something that will lock in that aroma and flavor, reduce terpene loss, and improve shelf life. The answer is finding an approach or system for the post-harvest stages that does a better job at environment management.



**Trichome health is critical to terpene preservation in cannabis.**

## Where Does Aroma & Flavor Come From?

Every strain of cannabis has its own unique aroma and flavor profile. Creating a customer preferred aroma and flavor, requires some investment initially, but it will pay for itself with preference, leads, sales, and repeat customers all the way through the supply chain.

A major contributor to a cannabis plant's aroma and flavor comes from terpenes that are produced in the plant's appendages called trichomes. Keeping trichomes and terpenes in an optimum environment where they are hydrated and healthy leads to a higher product quality and sales. For if trichomes are over-dried, terpenes will evaporate along with aroma, flavor, and your bottom line. Overhydrating can lead to mold growth, potentially putting customer health at risk.

## Variables That Affect Terpene Aroma & Flavor

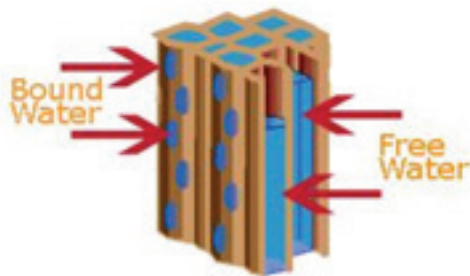
There are several variables that affect trichome (and therefore terpene) health, quality, aroma, flavor during curing, and storage. Two key ones are moisture content and water activity (aW). Managing them not only enables growers to get more out of every crop, it ensures the product is safe for consumption.

Inhibiting water activity has been established as an effective way to hinder the growth of microbes and metabolism of microbe associated toxins according to ASTM D37 D8197 from the American Society of Testing & Materials (ASTM).

## Moisture Content

There are two kinds of water present in plants:

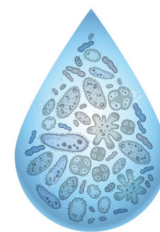
1. Free Water
2. Bound Water



Free water is the water within the plant that can be extracted by squeezing, cutting, or pressing your product. Bound water is water that is found within the plant cells and is bound to the cell walls. It cannot be easily removed without incurring damage to the trichome and terpene.

The two combined are called moisture content of the cannabis. Moisture content is how most cultivators test their product.

While it works to a point, it is not the most precise way to manage cannabis efficacy. Using it can result in having a contaminated product not safe for consumption.



**Free Water grows microbes that can lead to mold.**

## **Water Activity (aW)**

A more precise way to determine moisture content is Water Activity (aW). Monitoring aW is the industry standard set in ASTM D37 D8197, and endorsed by the American Cannabis Institute. It states for consumption safe cannabis you need to maintain an aW between 0.55 aW – 0.65aW

The aW relates directly to the water available (in liquid form) to microbes. An aW measurement tells you how much water is not chemically bound within the product. Monitoring it is important to keep trichomes and terpenes healthy.

If kept too high, mold and fungus can begin to grow, compromising customer safety. Kept too low, aroma, flavor, and your bottom line will evaporate and leave you with a low-quality product.

## **Creating The Best Environment**

The marketplace is getting more and more competitive, with new growers every day entering the market. A new approach to environmental control is the only way for growers to boost demand and sales without growing more cannabis. Incorporating technology that keeps cannabis within recommended storage guidelines delivers a higher quality product with your unique aroma and flavor sealed into the terpenes. For the customer this it's a more unique and memorable experience.

The two approaches used most often during the curing and storage stages of cannabis production are called 1-way and 2-way RH Control. The 1-way approach either adds too much water or removes too much water.

## **Environmental Control Challenges Still Alive In Today's Cannabis Industry**



Often growers do not have the time or workers available for the necessary continuous monitoring, measuring, adding, and removing. The cannabis environment during curing and storing is an ever-changing environment caused by moisture fluctuations. Keeping up with changes and managing them manually is a slow process that fails to bring the product into an RH equilibrium.

To gauge the level within the Cannabis industry on how well growers maintain the Cannabis Safety Institute guidelines, random samples were collected from dispensaries/cultivators and tested from 2018 to 2020. Boveda tested 143 cannabis product samples and found the following:

- Of the 143, only 18% were safely protected from mold growth and over-drying.
- An additional 7% were minimally protected from over-drying.

## **2-way RH Control**

A more precise advanced way to approach cannabis environment control is by 2-way RH Control. The idea, technology, system of 2-way RH Control was created and patented by Boveda, by creating the new system, Boveda solved the issues with 1-way humidity control.

Boveda packets provide environmental control by allowing water to go two ways. The packets either add or remove water to maintain the optimum RH.

The product controls RH so precisely, it strengthens the aroma and flavor by producing a monolayer of water on the plant. This in effect creates a shield around the trichomes and terpenes present inside. When this shield is broken, the terpenes are released when a person uses the product.

The patented design allows water vapor to pass through a special film very quickly. While it moves through, moisture is added or removed as needed to reach equilibrium. This approach keeps the environment at the ideal RH, whereby terpenes are preserved.

Boveda will reach its designated RH within 24-48 hours, depending on the container. Other 2-way systems can take as long as 72 hours. How does it work? Inside Boveda is salt, pure water, and a food-safe thickening agent. The salt-based solution is sealed in Boveda's patented vapor phase osmosis membrane.

As water vapor is released from or absorbed into the membrane, the water to salt ratio changes. The salt dissolves when more water is absorbed. The salt precipitates or becomes a solid again when more water is released.

As water vapor is released from or absorbed through the membrane, Boveda dials-in and precisely maintains your container's humidity levels, much like a thermostat. Boveda may cost a little more than traditional methods, but in the long-term, it will pay for itself by increasing the amount of sellable yield and locking in your unique aroma that leads to preference.

In summary, to achieve your goal of creating more demand, preference, sales, profits without growing more crops, changes will need to be made along with investment in the post-harvesting stages of the process. Techniques used in your process will also need to focus on better environmental control to improve trichomes and terpenes' health. The combination will lead to a better return on your investment.



**The 2-way approach brings RH to within 1-2% of an ideal environment**

# Terpene Stability Study

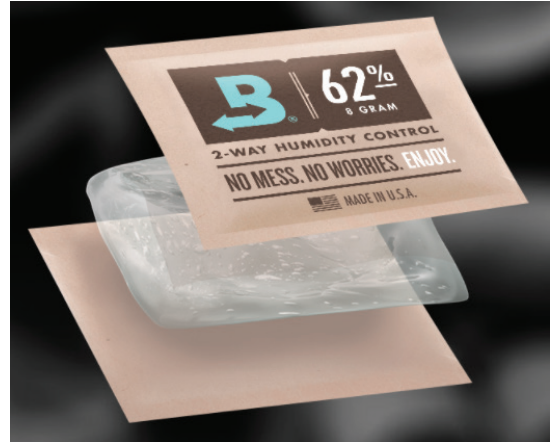
Performance evaluation of Boveda 2-way humidity control for terpene preservation  
October 2020

## Objective

To study how the terpene profile in cannabis flower changes over time when stored with and without humidity control.

## Executive Summary

A terpene stability study was performed by Abstrax Labs. Freshly cured cannabis was carefully dried to have a starting water activity (aW) = 0.50. A baseline terpene profile was determined for comparison. The cannabis was stored with and without Boveda 62% RH for 120 days (4 months), and the total terpene profiles were analyzed throughout the study. Monoterpene concentrations were also monitored.

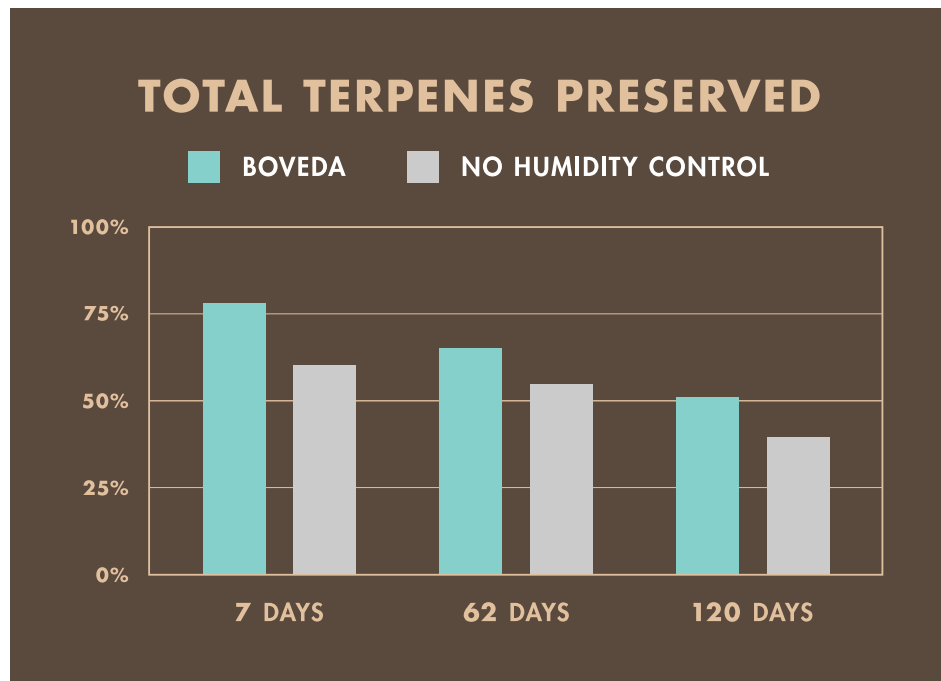


It was found that flower stored with Boveda preserved approximately 18% of total terpenes after 7 days versus without Boveda.

Of that total, Boveda preserved 19% more monoterpenes after 7 days versus without Boveda.

## Key Findings

1. Without Boveda, freshly cured flower lost 40% of terpenes after 7 days and 60% after 4 months.
2. Terpenes were preserved up to 8.5 times longer in flower stored with Boveda versus flower stored without Boveda.
3. After 120 days, Boveda preserves 73% more myrcene versus when stored without Boveda.



## **Terpene Stability Study**

The study was performed by Abstrax Labs, located in Long Beach, California. The cannabis strain used for testing was Bacio Gelato, obtained from Sherbinskis, located in San Francisco, California. The samples were freshly cultivated and cured with an initial aW of 0.56, which is within the optimum range of 0.55 - 0.65 as stated by ASTM D8197.

A portion of the freshly cured sample (210 g) was carefully dried to lower the aW down to 0.50. This was done to accelerate evaporation and to challenge the cannabis samples. Once the aW was lowered, initial moisture content and terpene profiles were measured (n = 5) to establish a baseline for this portion of the study.

By random selection, the cannabis was divided into 6 subsamples each containing 30 g of flower. These subsamples were further divided into 5 replicates containing 6 g of flower each. These replicates were then weighed and placed into their own respective, airtight glass mason jars. Finally, a Boveda pouch was weighed before being placed into the mason jar.

The table below summarizes the samples and time points of this study.

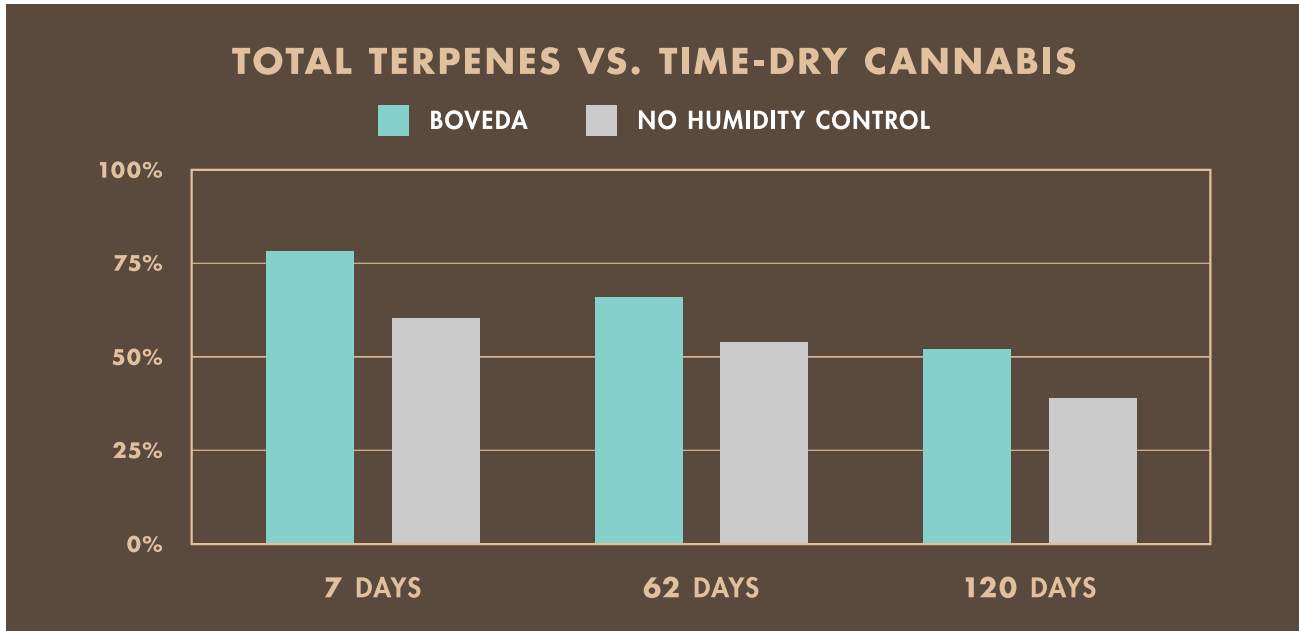
	<b>Sample</b>	<b># of Replicates</b>
<b>DAYS</b>	<b>Baseline</b>	<b>5</b>
<b>7</b>	<b>No Boveda</b>	<b>5</b>
	<b>62% RH Boveda</b>	<b>5</b>
<b>62</b>	<b>No Boveda</b>	<b>5</b>
	<b>62% RH Boveda</b>	<b>5</b>
<b>120</b>	<b>No Boveda</b>	<b>5</b>
	<b>62% RH Boveda</b>	<b>5</b>

Except for the 1 week samples, each sample jar was opened once a week for 30 seconds. This was done to simulate how an end user may open and close the container during normal use and to also refresh the environment inside the jars.

For each time point and replicate, the following steps were then followed:

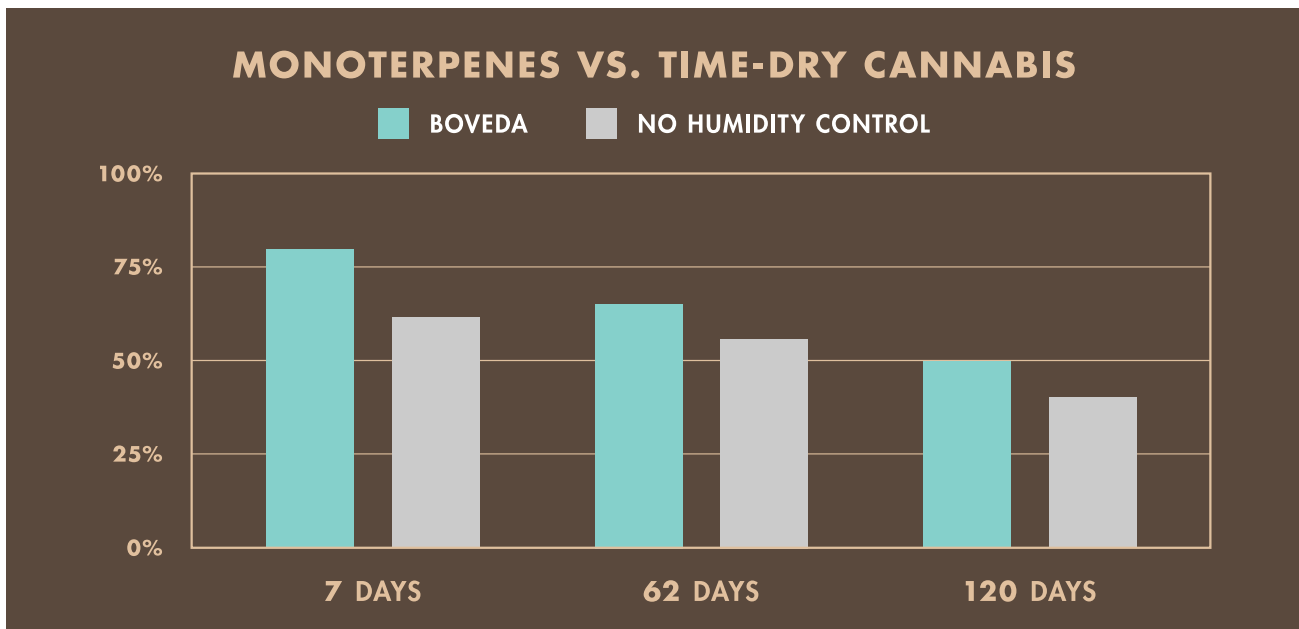
1. The jar was opened and allowed to sit for 30 seconds.
2. The cannabis was weighed.
3. The humidity control pouch was weighed.
4. The cannabis was ground.
5. The aW and moisture content was measured and recorded.
6. The terpene profile was measured and recorded.

## Testing Results & Discussion



**Figure 1 Terpenes Preserved vs Time**

As seen in Figure 1, flower stored with Boveda preserved 78% of terpenes after 7 days. For comparison, flower stored without Boveda only preserved 60%.

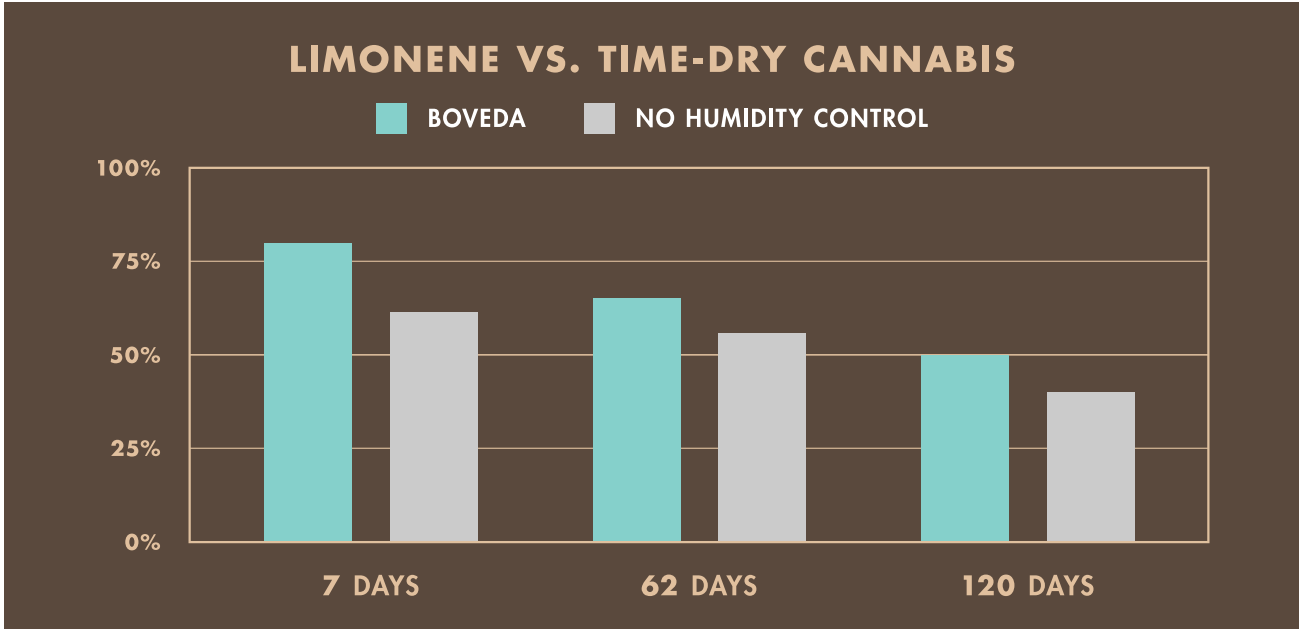


**Figure 2 Monoterpenes Preserved vs Time**

As seen in Figure 2, flower stored with Boveda preserved 78% of monoterpenes after 7 days. For comparison, flower stored without Boveda only preserved 59%.

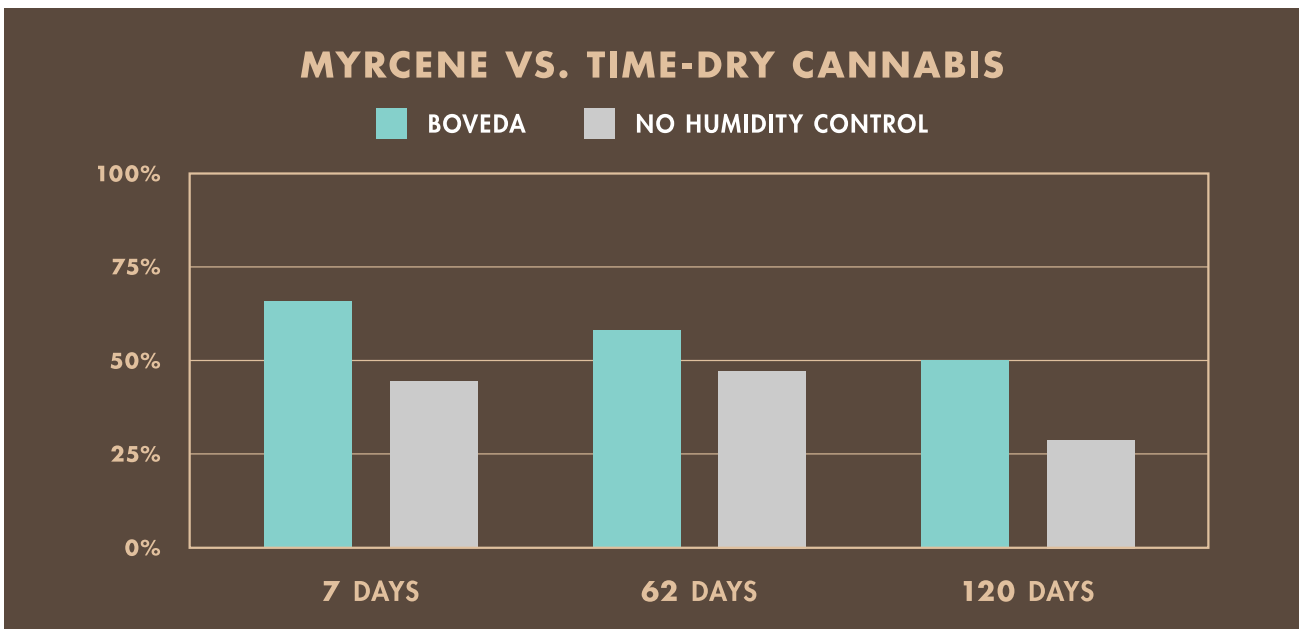


## Testing Results & Discussion



**Figure 3 Limonene Preserved vs. Time**

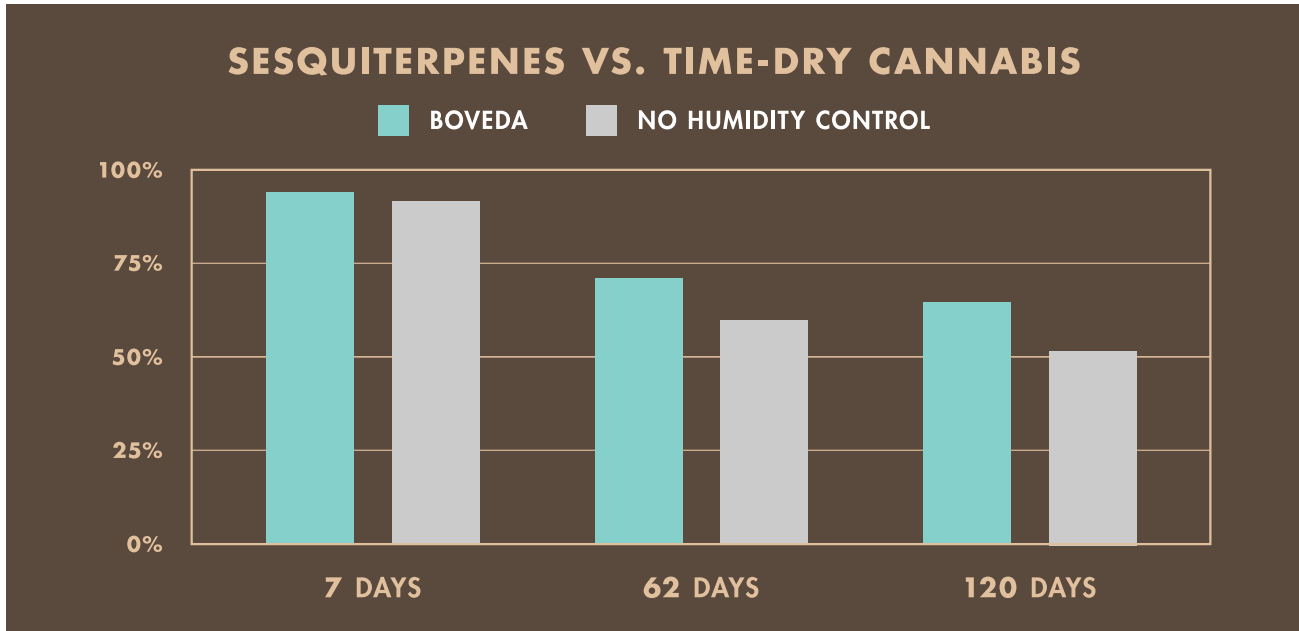
As seen in Figure 3, flower stored with Boveda preserved 80% of limonene after 7 days. For comparison, flower stored without Boveda only preserved 60%.



**Figure 4 Myrcene Preserved vs. Time**

As seen in Figure 4, flower stored with Boveda preserved 66% of myrcene after 7 days. For comparison, flower stored without Boveda only preserved 45%.

## Testing Results & Discussion



**Figure 5 Sesquiterpenes Preserved vs. Time**

As seen in Figure 5, flower stored with Boveda preserved 59% of sesquiterpenes after 120 days. For comparison, flower stored without Boveda only preserved 51%.

Figures 1 - 5 all show that flower stored with Boveda consistently preserved a greater amount of terpenes over the course of the study versus flower stored without Boveda.

DAYS	Total Terpenes Preserved		Total Monoterpenes Preserved		Total Sesquiterpenes Preserved	
	No Boveda	62% Boveda	No Boveda	62% Boveda	No Boveda	62% Boveda
7	60.2%	78.2%	58.9%	77.6%	93.4%	94.2%
62	54.8%	65.3%	54.6%	65.2%	59.4%	69.9%
120	39.7%	51.2%	39.3%	50.8%	51.4%	59.3%

**Table 1 Summary of Stability Study**

As summarized in Table 1, flower stored without Boveda loses nearly half of all its terpenes around 60 days. Comparatively, flower that was preserved with Boveda took twice as long (120 days) to reach that point.

## Why Boveda is Different

This and previous studies show that not all humidification products are not created equal. Only Boveda uses a patented, all natural, salt solution to precisely protect cannabis and more. Below are some simple points which we believe will help you understand the important differences between the various types of humidification on the market.



- Absorbs excess humidity if needed
- Available in multiple RH levels
- Works quickly to establish humidity equilibrium
- Won't over humidify, preventing mold
- No maintenance or refilling
- High capacity to maintain humidity over a long period of time
- No activation required
- Proximity & direct contact won't hurt cannabis
- Emits purified water vapor