

White Paper

Analytical Chemistry Evaluation of Terpene Change Throughout Pre and Post- Harvesting Processes

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Executive Summary

Eybna Technologies Ltd. performed an analytical chemistry evaluation on several cannabis cultivars' terpene profiles in 3 different processing stages of the cannabis cultivar. The cultivars were bred by Seach Medical Group and carefully monitored by Eybna's analytical chemistry team throughout a period of 5 weeks. Seach is an Israeli based medical cannabis group focused on growing, developing and producing top-grade medical cannabis products. Eybna and Seach are partners involving cannabis related medical research, clinical trials and product development.

The goal of the study was to assess the changes that occur in the composition of the cannabis terpene profile before harvest, at harvest and after drying and curing time. The analytical chemistry analysis was done by Prof. Lumir Hanus at Lumir Lab Ltd. whereby cannabis samples were analyzed using high-end analytical methods, identifying the volatile compounds including more than 70 different terpenes per sample.

There was a clear change in the terpene profile at every stage of the process whereby a reduction in certain monoterpenes post harvest both after drying and after curing was observed consistently. Due to monoterpenes' nature of volatility, sesquiterpenes became more dominant and composed a larger portion of the terpene profile post harvest.

These observations make it clear that the terpene profile at point of harvest is ephemeral and hard to sustain during cannabis processing. The unique terpene make-up of fresh flowers holds a one-of-kind aromatic fingerprint reported to be highly desirable by cannabis consumers.

Today, most cannabis preparations are dried and cured to make the plant combustible for smoking as well as for logistical aspects like transportation, shelf life and storage. Unfortunately, a significant amount of terpenes are lost in these processes, decreasing the terpene potency in the plant.

Using extensive chemical analysis, Eybna studies the terpene changes that occur in the cannabis plant from seedling to flower to uncover the phytochemical trend that occurs throughout cannabis processing. By sampling cannabis cultivars before harvest, at the point of harvest, and 2 weeks after harvest after curing - Eybna is able to collect data and new knowledge about the peak of terpene production and the loss of terpenes in the process.

Experimental Results

Preliminary results points to a drastic change that occurs in the major terpenes found in the cultivars prior to harvest, at harvest, and after harvest and after curing. Figure 1 shows the terpene profile of a single cultivar, named 'Silverado', at 3 weeks before harvest, at the point of harvest, and 2 weeks after harvest within 'Silverado's' essential oil (EO).

The cultivar Silverado's dominant terpenes include Beta-Myrcene, Alpha-Pinene and Beta-Caryophyllene. Monoterpenes such as Beta-Myrcene and Alpha-Pinene, show reductions in their percentage out of the overall EO terpene composition while sesquiterpenes such as Beta-Caryophyllene and Alpha-Humulene show an increase in their percentage in overall EO terpene composition. This observation is expected due to monoterpenes' structure, 10 carbon skeleton, that leads to lower molecular weight and higher volatility. On the other hand, sesquiterpenes, that are composed of 15 carbon skeletons, have higher molecular weight and lower volatility.

Terpene Composition throughout Cannabis Processing

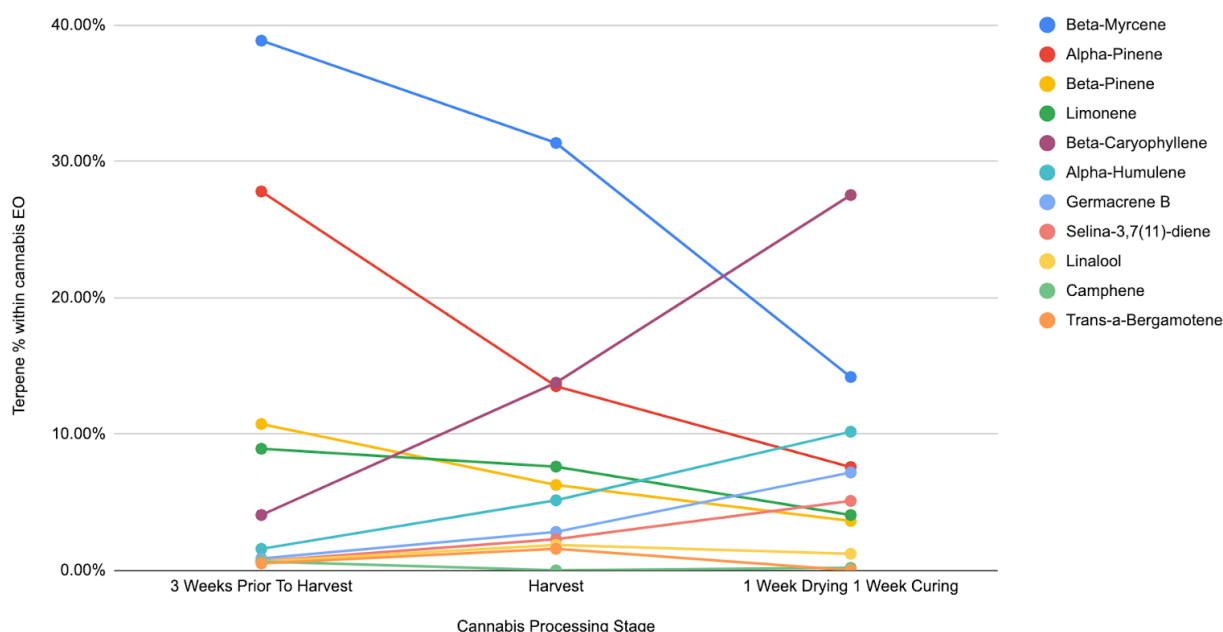


Figure 1: Terpene composition measurement of Silverado's essential oil (EO) collected 3 weeks before harvest; at harvest point; after 1 week of drying and 1 week after curing.

A significant reduction in monoterpenes were observed - causing a relative increase in sesquiterpenes' presence in the final composition.

When looking at the absolute change of terpenes between the stages, Figure 2, most monoterpenes' loss occur in the 2 weeks post harvest. During this period of 2 weeks, both drying and curing steps take place, therefore these are the most critical points for monoterpenes conservation. However, not all monoterpenes behave the same as Alpha-Pinene, for example, had a larger reduction in the 3 weeks prior to harvest and Linalool seems to be the least affected by the processing steps.

A “tradeoff” can be observed between monoterpenes and sesquiterpenes - where monoterpenes decrease, sesquiterpenes' relative portion increases. More specifically, the sesquiterpenes become more dominant during the 2 weeks post harvest period due to monoterpenes' large decrease.

Absolute Change of Terpenes Between Processing Stages

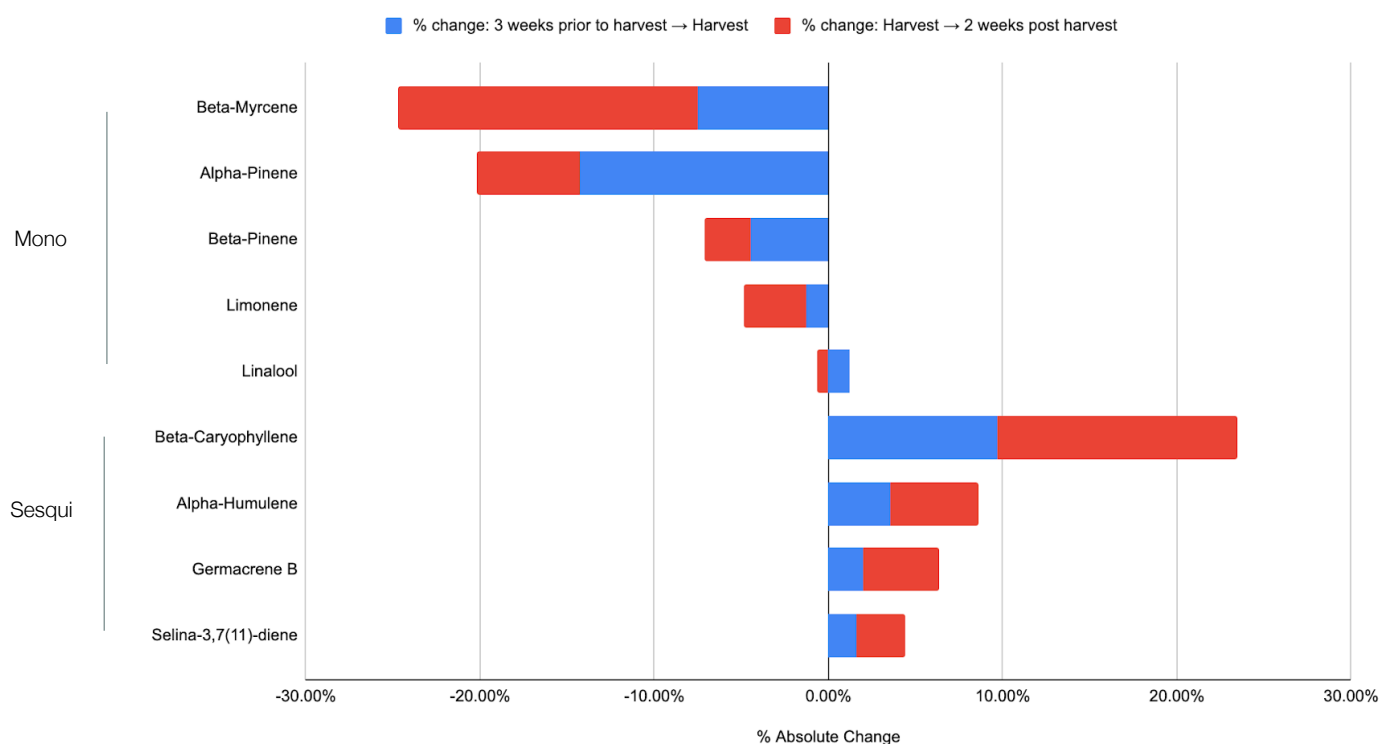


Figure 2: Absolute change of terpene percentage in EO composition between the stages: 3 weeks prior to harvest → Harvest; Harvest → 2 weeks post harvest.

According to Eybna's preliminary findings - the most delicate step throughout the cultivar's processing in regards to monoterpenes, is in the two weeks post harvest period.

Discussion & Conclusion

Monoterpenes contribution to quality perception

Terpenes have long played an important role in users' cannabis preferences, as well as reported in several studies. For example, a project by Avery Gilbert and Joseph DiVerdi involved the assessment of 61 participants on the scents of 11 cannabis cultivars using 48 descriptive words. The researchers grouped the smells into two clusters: Citrus (citrus/lemon/sweet/pungent) and Earthy (woody/earthy/herbal). They found that the Citrus cluster was associated with greater perceived quality, potency, interest, and price compared to the Earthy cluster, highlighting terpenes' importance in quality perception.

In addition, a 1997 study by Vito Mediavilla and Simon Steinemann used *Cannabis Sativa* L. essential oil to classify specific terpenes as "desirable" or not with 15 volunteers. They reported that "oils with high sesquiterpene concentrations received a low rating, meaning that their smell was less preferred. In contrast, oils with high monoterpene percentages got a high rating." This indicates that monoterpene-rich extracts were more attractive and desirable by consumers than sesquiterpene-rich extracts.

Terpenes change from moment of harvest

From Eybna's extensive study, it can be concluded that there are drastic changes in the terpene profile throughout the harvest process of cannabis cultivars. The most prominent change was observed in the two weeks period post harvest, where the major monoterpenes drastically decreased and sesquiterpenes' portion increased. This conclusion sheds light on the prominent differences of the terpene profiles from the cultivars' genetics to the cultivars' consumed by the end-consumer.

Similar findings were reported in a 1996 study by Samir A. Rossi and Mahmoud A. ElSohly who looked specifically at the change of cannabis terpenes between fresh and dried plants. They reported that fresh cannabis was "composed mainly of monoterpenes (92%), with 7% sesquiterpenes." After drying and curing, the findings were a loss of terpenes overall and a "significantly greater loss of monoterpenes than sesquiterpenes." The researchers commented that most of the loss happens after the first week of drying, with the steam-distilled oil content dropping from 0.29% to 0.20% of the original plant material.



Manufacturing the Live Essence of Cannabis

The fresh 'Live' essence of cannabis has a unique metabolic fingerprint, and sensory experience. 'Live Resin' cannabis concentrates have given consumers the ability to experience cannabis at a 'terpene-rich peak-point'.

From the observation of users choosing 'freshly-harvested' cannabis products; Eybna recognizes the importance of bringing these unique terpene profiles to more cannabis products

By using most advanced terpene analytical methods, Eybna measures and takes a "snapshot" of the plant's aromatic profile at the cannabis plant's peak point — capturing the terpene composition at the stage where the plant's terpene output is maximal. The combination of these methods together with the production capabilities, enabled Eybna to introduce a new category of botanical-terpene profiles, called 'Live Line'.

References

Gilbert AN, DiVerdi JA (2018) Consumer perceptions of strain differences in Cannabis aroma. PLoS ONE 13(2): e0192247

Mediavilla V, Steinemann S (1996) Essential oil of *Cannabis sativa* L. strains. Swiss Federal Research Station for Agroecology and Agriculture

Ross SA, ElSohly MA (1996). The Volatile Oil Composition of Fresh and Air-Dried Buds of Cannabis Sativa. Journal of Natural Products 59(1), 49-51.