Evaluation of trichome gland coloration change using the Vaportrol Technology versus traditional drying

Cannabis Research Coalition

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Trichomes are external, delicate structures on the cannabis flower which produce secondary metabolites. They arise from a series of anticlinal and periclinal divisions of epidermal cells to form globular and non-glandular appendages which protect the leaf from UV, water loss, and insect or animal destruction. Though many compounds are produced in this structure, the ones most valued in the cannabis industry are terpenes and cannabinoids.

In our quest to explore and understand this microscopic world of oil producing plant structures, each result yields more questions. The delicacy of the structures make evaluation difficult as each handling step can alter the data. Additionally, trichome glands are microscopic, necessitating advanced microscopy equipment for visualization and specialized software tools to quantify visual differences. In our previous research using Vaportrol Technology (Cannatrol, North Springfield, VT) read the latest research, we found that some secondary metabolites were altered, while others remained unchanged. In the present study, our aim was to observe and quantify physical differences between flower dried and cured with Vaportrol Technology versus traditional methods on the microscopic level.

Methods

Growing conditions

This trial was conducted in a walk-in growth chamber at the Cannabis Research Coalition facility in South Carolina. A type III cultivar, 'Sunset', was used in this study. The flower was grown hydroponically from clonal mother stock. Plants were grown vegetatively at an 18 hour photoperiod. Clones were allowed to propagate in Oasis Wedges (Kent, OH) for two weeks with a temperature range of 76-78 F under 300 µmol m^{-2} s^{-1} Libra LEDs. Then, rooted clones were transplanted into 1 quart pots for two weeks under 400 µmol m^{-2} s^{-1} Libra LEDs (Austin, TX). A switch to a 12 hour photoperiod induced flowering and the plants were allowed 8 weeks to reach a mature stage. Flowering plants were grown under Libra LEDs producing 850 µmol m^{-2} s^{-1} in one gallon pots. Soilless media used was Promix BK25.

Post harvest treatment

Sixteen plants were cut at the soil line and hung upside-down. Plants were dried with Vaportrol Technology and in a traditional manner. We define a traditional set up as a room which contains air conditioning for cooling and a portable dehumidifier for dehumidification. Control points were set to 60 Fahrenheit and 60% relative humidity with no lighting. Plants in the Vaportrol Technology unit were dried at a static dry bulb setpoint of 68 F and 54 F dew point. Temperature and relative humidity data was logged with data loggers (Pulse Pro. Inglewood, CA USA). Evaluation occurred once the flower was dried to a water activity of 0.65. To avoid unintended mechanical damage, the flower was not trimmed or shucked. Stems were placed in Oasis floral foam in sealed containers until removed for microscopy.

Imaging and processing

An Olympus DSX1000 digital microscope (Olympus Czech Group, s.r.o., Prague, Czech Republic) was used for light imaging microscopy. Images were processed with ImageJ (version 1.53m, https://imagej.nih.gov/ij/) to quantify color. Variabilities in color intensities among .TIFF images were checked by analyzing the distribution of RGB color intensities using the Histogram command in ImageJ. Pixel intensity was evaluated for Red to emulate amber of the trichome gland. It was extremely important to standardize the area of flower which was to be investigated further by image processing. Only the exterior calyx of the apical flower was selected. Additionally, colas of similar position from the growing light were used. Stigmas or regions of obvious mechanical damage were avoided (**Figure 1**).

Statistical Analysis

The experiment was a completely randomized design, with two treatments and eight replications. Statistical analysis was performed using JMP (v17.2.0; SAS Institute). Unpaired, two-tailed Student's t-tests were performed between the Vaportrol Technology and Traditional treatments. Statistical significance was determined at the $p \leq 0.05$ level.

Figure 1. Example of selection of flower for evaluation.

Results & Discussion

In this study we quantified amber coloration of cannabis flower dried with Vaportrol Technology versus traditional drying methods. With statistical significance, it was found that flower dried with Vaportrol Technology contained significantly less amber trichomes than flower dried in a traditional manner, **Figure 2**. The most notable difference between treatments is the ability of the Vaportrol Technology to maintain a consistent vapor pressure. Environmental set points are only that, set points. Equipment type, age and sizing can dictate how the set points are achieved. Traditional drying systems (climate cooling and dehumidification) can have large swings over time, causing unknown changes to flower quality. As pressure is manipulated in the drying environment by change in dew point, the cuticle will expand and contract. This constant movement (dictated by the drying environment setpoints and equipment capabilities) alongside the rapid drop in water content can cause rupture of the cuticle or increase metabolic changes. **Figures 3 & 4** graphically displays relative humidity, temperature and dew points achieved with Vaportrol Technology and the traditional room throughout the experiment.

Based on previous research, trichome gland color change is attributed to natural aging or mechanical damage (Punja, 2023). It has been documented that during the final few weeks of flower maturation, there is a transition in color of trichome glands from clear to amber. At a certain point in maturation, the presence of an overabundance of amber trichome glands indicates senescence and results in a loss in cannabinoids. This process is most likely due to oxidation. Oxidation can be achieved by a release of internal oxygen reserves or from physical exposure to oxygen. These results correlate with our previous study showing a statistically

relevant increase of decarboxylated cannabinoids and loss of terpenes in the traditionally dried flower. It could be concluded that the Vaportrol Technology stops or slows senescence resulting in a higher quality flower which retains cannabinoids and stops the loss of terpenes.

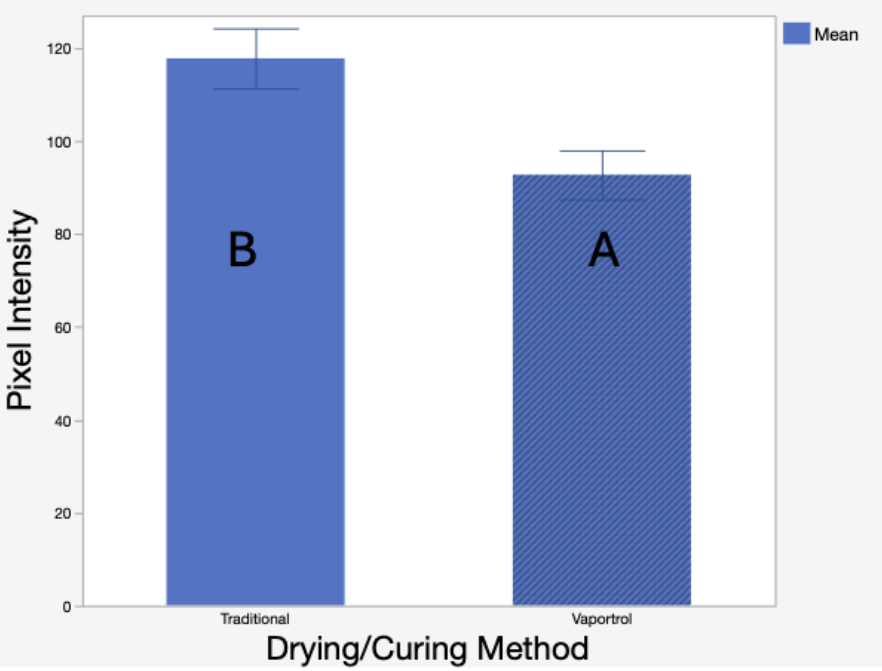

Figure 2. Each error bar is constructed using 1 standard deviation from the mean. Data are mean and statistical significance was determined at the $p \leq 0.05$ level. Differences determined by student's t-test.

Conclusion

In conclusion, it is proposed that variable swings in temperature, humidity and vapor pressure provided by traditional drying leads to a significant difference in the color of trichomes. Moreover, this accelerated senescence leads to greater volatilization of terpenes, degradation of cannabinoids and a more overall brown color of the flower. The results show that by drying with Vaportrol technology, trichome glands are preserved and do not continue to senescence which can lead to loss of quality.

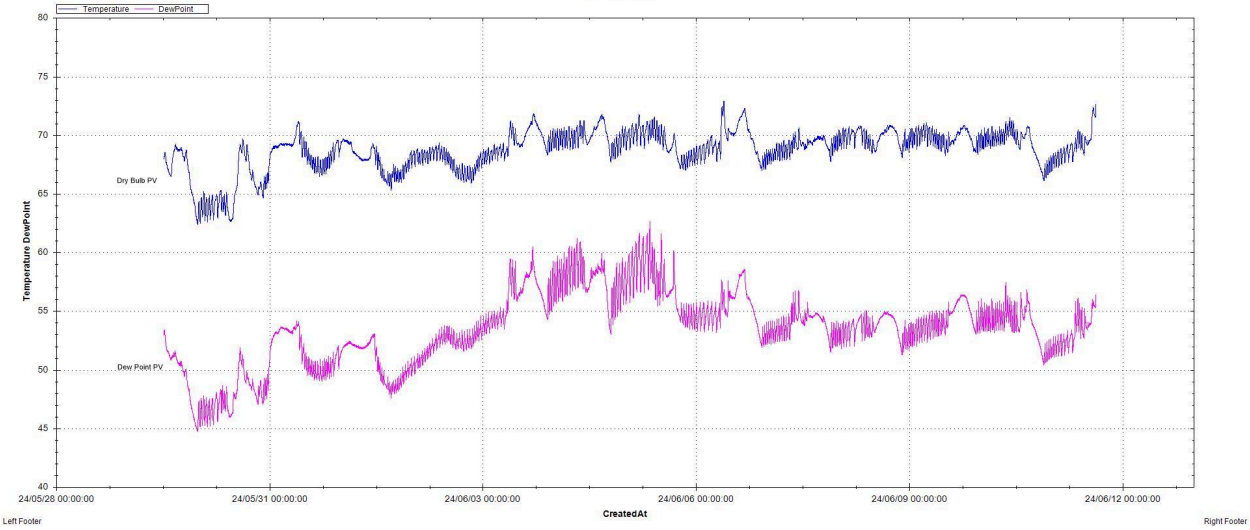

Figure 3. Dew point and dry bulb temperature in traditional drying and curing methods.

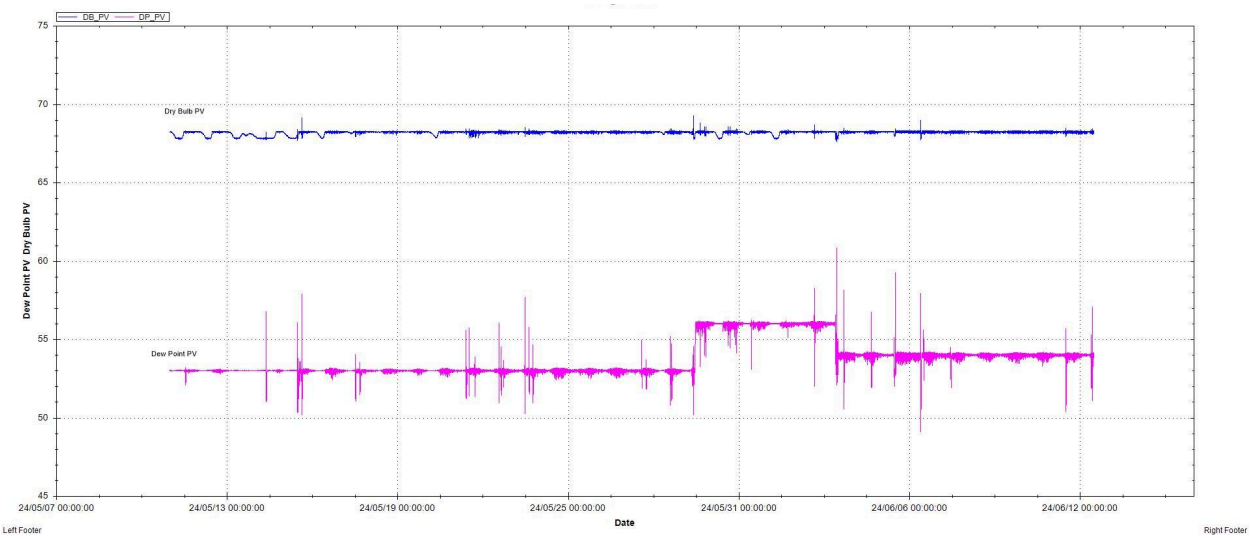

Figure 4. Dew point and dry bulb temperature while drying and curing with Vaportrol technology.

References

Potter, D.J. (2009) The Propagation, Characterisation and Optimisation of *Cannabis Sativa* L as a Phytopharmaceutical. Ph.D. Thesis, King's College, London.

Punja, Z.K., Sutton, D.B. & Kim, T. Glandular trichome development, morphology, and maturation are influenced by plant age and genotype in high THC-containing cannabis (*Cannabis sativa* L.) inflorescences. J Cannabis Res 5, 12 (2023). https://doi.org/10.1186/s42238-023-00178-9