VALENVERAS
WHITEPAPER
CANNABINOIDS, TERPENES & WATER

VALENVERAS

Powered by Si-Ware

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Introduction

In the fast-growing cannabis industry, breeders and growers face increasing pressure to produce crops that meet market standards for potency, terpene profiles, and moisture levels. Traditional laboratory testing can be costly and slow, delaying important decisions in cultivation. Near-infrared (NIR) has shown the potential to be used to predict cannabinoids, terpenes, and moisture in cured and dried samples. NIR is a part of the electromagnetic region that takes advantage of the light-matter interaction to obtain the physic-chemical information of the matter. Traditionally, NIR instruments have been limited in their use in the lab or a controlled environment.

The Valenveras Portable Lab utilizes NeoSpectra portable NIR technology by Si-Ware Systems to offer a real-time, non-destructive solution for analyzing cannabis flowers on-site. This whitepaper outlines how Valenveras utilizes this technology to measure key quality parameters—potency, terpenes, moisture, and water activity—and discusses the portable lab system's benefits for cannabis growers and breeders. Valenveras Portable Lab's unique advantages include its broad NIR spectral range and integration with a cloud-based platform, which makes it a comprehensive tool for breeders and growers. The instrument allows for quick decisions, improved harvest timing, better product quality, and lower testing costs, leading to optimized yields and more efficient operations.

Portable NIR Technology Platform

The Valenveras portable NIR spectrometer, NeoSpectra, provides an extended spectral range from 1,350 to 2,550 nm, enabling detailed chemical profiling, especially for small molecular changes. The instrument's resolution is 16 cm^{-1} (2.5 to 8.7 nm – depending on the wavelength range) and the minimum signal-to-noise is 2000. This allows for accurate measurement of cannabinoids (e.g., THC, CBD), terpenes, moisture content, and water activity—critical metrics for determining harvest timing, curing processes, and product quality (figure 1).

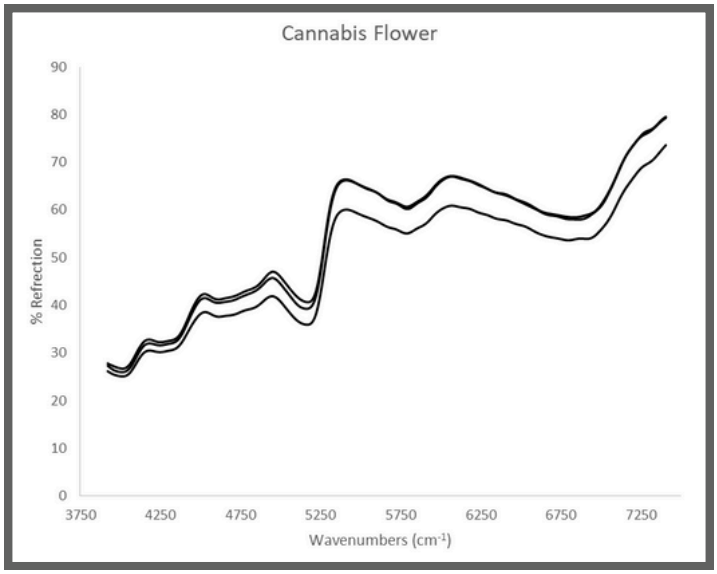

Figure 1. Typical NIR spectra of ground cannabis flower in % reflection and wavenumbers (cm^{-1})

The Valenveras Portable Lab system integrates with a cloud-based platform, making data management seamless. The cloud solution allows breeders and growers to store, access, and analyze their data from any location, centralizing all measurements, reports, and analytical models in one place. This ensures that model updates and new data are easily managed, allowing users to continuously improve their business analytics. Portability is one of its key advantages. The lightweight design enables on-site, real-time testing in fields or greenhouses, significantly reducing the need for external labs and offering immediate feedback. This flexibility ensures that growers can test at different stages of the cultivation process, from early growth through harvest and curing.

Key Cannabis Quality Parameters Measured

Cannabis quality parameters, including potency, terpenes, moisture, and water activity are essential to be controlled for the growers, breeders, and distributors to optimize the crop, production, and batches.

In the laboratory, cannabinoid concentrations of the flowers were obtained using High-Pressure Liquid Chromatography (HPLC) with an ultraviolet and visible detector. In summary, 200 milligrams of the dry and ground flower is placed in 4 mL of ethanol for 20 minutes and mixed every 5 minutes. After that, the sample is filtered through a 0.22 µm syringe tip filter into an HPLC vial and injected into the HPLC (Certified method from modified AOAC Official Method 2018.11 for Quantification of Cannabinoids in Plant Materials, Concentrates, and Oils – ENAC Certification). For terpenes analysis, samples were prepared by extraction of the plant material with ethyl acetate containing n-tridecane solution (100 µg/mL) as the internal standard. The liquid is filtered through a 0.22 µm syringe tip filter into an HPLC vial and injected into the GC. For moisture, >1 g of ground samples were analyzed with a loss-on-drying 100°C oven balance at ambient pressure, while water activity utilized a tunable diode laser (TDL)-based chilled-mirror dew point hygrometer chamber.

Potency is one of the most desired parameters to know in a cannabis flower. The cannabinoids can have two forms the acid form and the neutral form. Each one has different implications for the quality of the flower and its management. Terpenes, give cannabis its aroma and influence its medicinal properties. Terpenes are complex compounds that during the curing process are lost due to their volatility. Water activity is an important measure of how much free water is available for microbial growth. Proper moisture control is crucial for preventing mold and ensuring product longevity. Monitoring moisture levels during the drying and curing process helps growers preserve product quality and avoid spoilage or microbial contamination, which is critical for meeting regulatory standards and consumer safety requirements. Proper water activity management helps ensure the cannabis is safe for long-term storage and consumption, further protecting the final product from spoilage

Near-Infrared Model Development

To create accurate models for Valenveras' cannabis analysis, a large, diverse set of samples is collected and analyzed using NeoSpectra's NIR spectrometer system. The collected spectra are correlated with reference values from traditional lab methods. An ISO-accredited and certified laboratory was used to obtain the reference values to develop the Valenveras models using the NIR spectra.

To ensure the reduction of the unit-to-unit variability spectra of the samples, the spectra are generalized by using a patented algorithm (patent pending) that created synthetic scanners based on real scanners. These synthetic scanners are used to include the small difference between devices due to the production variability. This methodology ensures the seamless transfer of the models between different devices.

Once the spectra are linked with these lab-validated values, multivariate techniques like Partial Least Squares Regression (PLSR) are used to build calibration models. The Valenveras lab platform has a unique feature that allows for hierarchical models, providing the versatility of modeling that permits obtaining the lowest error of predictions in the lower and higher ranges (figure 2). Moreover, the technology can integrate semi-quantitative models that can be used for profiling individual terpenes.

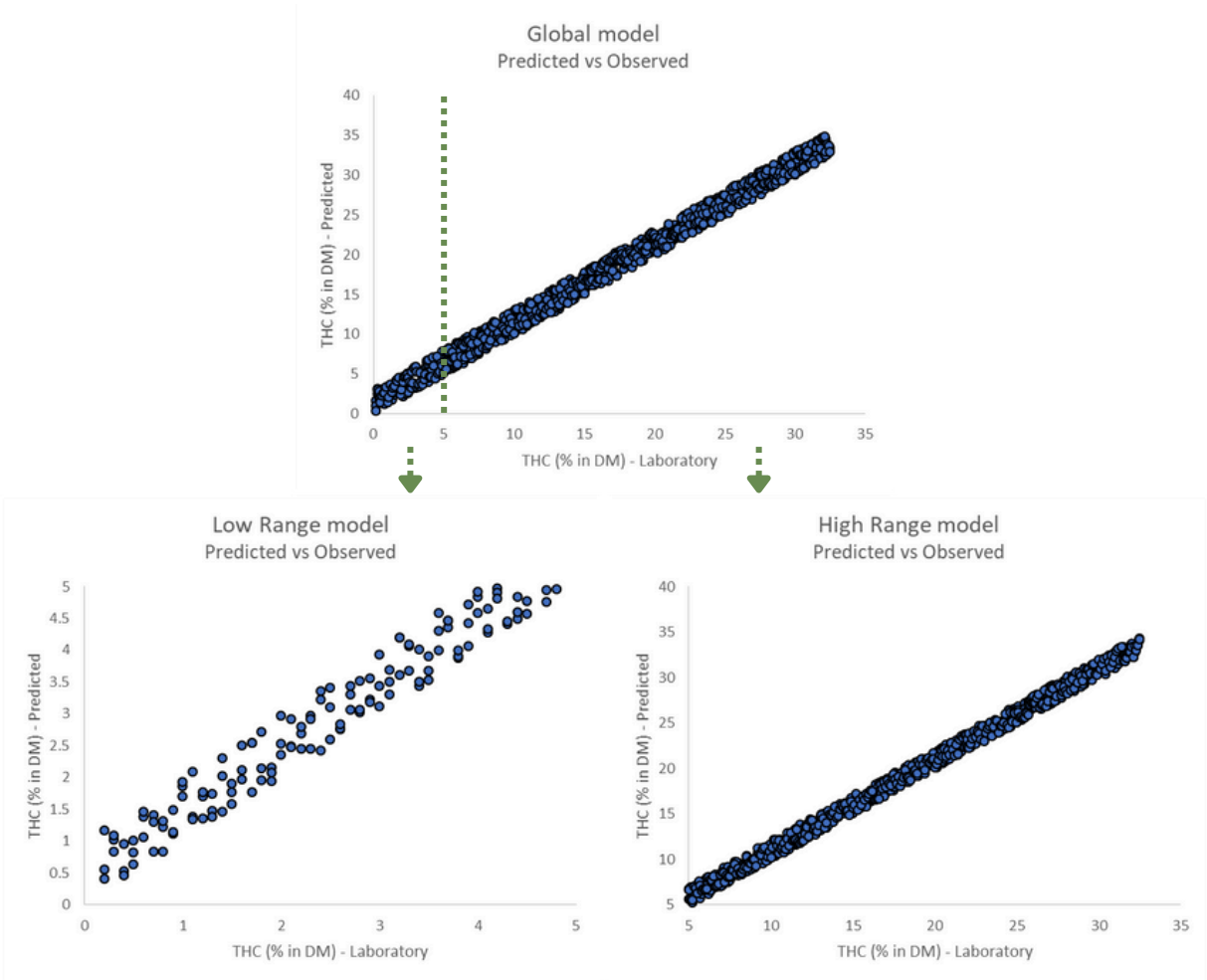

Figure 2. Hierarchical model based on three PLS regressions allows maximization of accuracy for respective measurement ranges

After calibration, the models are validated with new sets of samples to ensure accuracy before being deployed on the Valenveras Portable Lab system. The system's cloud platform allows for easy model deployment and updates, ensuring users have access to the most accurate, up-to-date models without the need for extensive retraining.

The instrument provides a semi-quantitative analysis of terpene ratios within a sample, helping growers identify and select strains with desirable profiles. The system enables breeders to track terpene trends over time, allowing for the refinement of strain-specific characteristics that are important for consumer preferences and product differentiation.

Table 1. Summary of the models for the parameters of interest.

		Low Concentration 0-3%				High Concentration 3-32%			
	# samples	RMSECV	R^2_{cv}	RMSEP	R^2_p	RMSECV	R^2_{cv}	RMSEP	R^2_p
CBD Total (v5)	898	0.19	0.80	0.16	0.91	1.6	0.89	1.7	0.91
THC Total (v7)	1099	0.15	0.85	0.10	0.93	1.9	0.91	1.2	0.98
CBG Total (v5)	898	0.15	0.71	0.11	0.72				
Total Terpenes	659	0.20	0.70	0.30	0.65				
THC acid (v6)	1099	0.16	0.84	0.11	0.91	2.2	0.9	2.2	0.89
CBD acid (v5)	898	0.20	0.79	0.18	0.90	1.6	0.88	1.3	0.97

		Min	Max	RMSECV	R^2_{cv}
a_w	355	0.42	0.65	0.02	0.82
Moisture	355	4.3	11.8	0.91	0.75

Legend: RMSECV: Root Mean Square Error of Cross-Validation; RMSEP: Root Mean Square Error of Prediction; R^2_{cv}: Determination Coefficient of Cross-Validation; R^2_p: Determination Coefficient of Prediction; a_w: Water Activity; (vX): Model Version

Sample Handling and Preparation

For accurate readings, cannabis samples should be dried and ground before being analyzed with the Valenveras Portable Lab. This preparation ensures that the samples are uniformly scanned, leading to more precise and consistent results. Proper sample preparation also helps ensure that the full chemical composition of the cannabis is captured, allowing for accurate predictions of potency, moisture, and terpene content.

Third-party validation

Several external labs have validated the performance of the Valenveras Portable Lab for several parameters. In summary, these external labs found accuracies (± in absolute %) of their parameters of interest as follows:

Table. 2. Third-party validation for the parameters of interest (± absolute %)

	Total Terpenes	Moisture	THCa	Total THC	Total CBD	CBG
Lab. A		0.26		1.21	0.47 (**)	
Lab. B	0.25			1.2	0.52 (**)	0.28
Lab. C				0.7		
Lab. D				1.1		
Lab. E				1.1		
Lab. F	0.18			1.4		
Lab. G				0.17 (*)	1.4	
Lab. H			0.89	0.86		

(*) Low range THC (**) Low range CBD

The table shows that the accuracies for the third-party lab validations are consistent with the predicted model performance in Table 1.

Discussion

The Valenveras Portable Lab system offers breeders and growers significant advantages by providing real-time, on-site analysis of key cannabis quality parameters such as potency, terpenes, moisture, and water activity. This enables more informed decision-making throughout the cultivation process, allowing for timely adjustments in irrigation, nutrient management, and harvest timing.

The system reduces the need for expensive, time-consuming lab testing, saving both time and costs. Moreover, allows the users to analyze the batches in a higher frequency providing more control of the batches and better compliance with the different requirements.

Additionally, the Portable Lab's cloud-based platform streamlines data management and model deployment, ensuring that growers have access to the most up-to-date information for optimizing crop quality. This combination of fast, accurate analysis and cloud integration helps breeders and growers enhance strain development, ensure product consistency, and meet market demands more effectively.

Conclusion

The Valenveras Portable Lab, built on the Si-Ware Systems NeoSpectra platform, is a powerful tool for cannabis breeders and growers, offering a fast, non-destructive method for analyzing key quality parameters like potency, terpenes, moisture, and water activity. With its broad NIR range, portability, and cloud-based integration, the portable lab provides an efficient, cost-effective solution for real-time cannabis analysis. By reducing reliance on external labs and speeding up the decision-making process, Valenveras helps breeders and growers optimize their operations, improve product quality, and meet regulatory requirements more easily. As the cannabis industry continues to expand, advanced technologies like the Valenveras Portable Lab will play an increasingly important role in ensuring the success of breeders and growers.

Acknowledgement

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