AROMETRIX

Arometrix Technology Overview

DON'T JUST DO YOUR PROCESS.

KNOW YOUR PROCESS.

TOPICS TO COVER

- Our Vision
- Trends
- R&D
- Fundamentals
- Core Products
- Applications
- Future Roadmap

OUR VISION

TO BE THE STANDARD

for **quality monitoring**, **compliance**, and **purity** of life-transforming plant extracts

CURRENT TRENDS

CONSUMER DEMAND FOR EXTRACTS

Concentrate sales increased by over 40% in 2020, and prices are rising in the face of the increased demand.

- MJBizDaily, 2021

Marijuana Concentrates on the Rise Across Industry

SHIFT TOWARD IN-HOUSE ANALYTICS

Extractors are breaking their reliance on outside testing, and acquiring equipment to get a faster idea of quality. - Analytical Cannabis, 2019

Why Cannabis Extractors Are Bringing Testing In-house

FDA CANNABIS-GMP GUIDELINES ARE COMING...

The FDA does not have any guidelines specific to the Cannabis industry... ***yet***. Companies want to stay ahead of CFR 21.

- CS&T, 2020

Engineering Considerations for the cGMP Manufacture of Hemp and Hemp Products

System prototype at proof of concept

RESEARCH & DEVELOPMENT

The vision soon turned into a platform...

- **Sensor:** The “eyes” of the system
- **Display:** The “brains” & "face"

In Situ Fluorescence Spectroscopy for In-Line Distillation Process Monitoring

Currently, cannabis distillation requires specialized personnel, which raises costs and lowers yields. Furthermore, process monitoring is dependent on indirect controls, such as temperature, flow, and color. Here, fluorescence spectroscopy was investigated as an in-line process monitoring tool for cannabis distillation to alleviate these challenges. First, excitation emission matrix spectroscopy (EEMS) was utilized to determine optimal excitation wavelengths for various stages of fractional distillation. Based on these results, a benchtop fluorometer that could use various excitation wavelengths was developed. Samples of extract, distillate, and pure laboratory grade cannabidiol (CBD), cannabidiolic acid (CBDA), delta-8 tetrahydrocannabinol (Δ^8-THC), and delta-9-tetrahydrocannabinol (Δ^9-THC) standards were measured with the benchtop system. The measurements from the extract and distillate samples exhibited several fluorescence peaks. These measurements depended on the processing conditions and product quality of the tested samples. Measurements of the chemical standards exhibited similar fluorescence to the extract and distillate samples. Finally, an in-line sensor was developed and installed on a short path distillation system (SPD). Measurement from the in-line sensor showed distinct differences between distillation fractions validating its capability as a cannabis distillation process monitoring tool.

Jonathan Kenneth Bunn, Christopher Jason Metting, and Hasso von Bredow

The rising commercial interest in cannabis extract and distillate is increasing the need for more rapid and precise extraction and distillation methods. This need is especially critical for more precise dosing of compounds derived from cannabis for medical applications. While many common distillation methods exist (short path distillation, wiped film distillation, column separation, and so on) the techniques are highly technical and often can only be carried out by specialized personnel. This leads to lower production volumes and higher costs. To help reduce costs and increase purity of cannabis distillation, more precise and intuitive process control tools are needed.

Historically, fluorescence spectroscopy has been used for inline process control and quality control in several industries, including pharmaceuticals and food safety (1–8). Furthermore, studies on cannabinoids and their metabolites indicate that many of the compounds derived from cannabis will have unique spectroscopic properties, including fluorescing under ultraviolet (UV) light and Raman signal (9–15). While some literature exists, very little work has been published on using these unique optical properties to provide a process control system that can help improve product safety and purity.

Distillations of cannabis extract are carried out at temperatures reaching over 165 °C and under vacuum pressure. Vacuum distillation is utilized because desired cannabinoids chemically degrade into undesired compounds at temperatures below their boiling point under atmospheric pressure. This degradation is either decelerated greatly or completely halted under vacuum pressure.

The required vacuum pressure and temperature make the process of selecting and adding an in-line sensor challenging. The sensor must be robust enough to function under harsh conditions without creating undue risk of vacuum leaks during operation. This challenge is only exacerbated when considering a sensor that can be retrofitted onto existing distillation systems. Optical metrology methods are a promising approach for process control because they can probe processed material through a sight-glass or glass tube positioned away from the heat source. Specifically, fluorescence spectroscopy is a promising method to investigate the presence or absence of auto-fluorescing compounds within the distillate throughout the process.

In this work, fluorescence spectroscopy is investigated as a process monitoring technique for short path distillation (SPD).

Experimental

Excitation Emission Matrix Spectroscopy

A portable benchtop excitation emission matrix spectrometer (EEMS) was developed to determine the optimal excitation wavelength that could be used for monitoring fluorescence during the distillation of cannabinoids. Figure 1 shows the EEMS system used to investigate the approach.

For the excitation components of the instrument, the EEMS system used a Lambda LS Xenon Arc Lamp (Sutter Instrument)

R&D ARTICLE

PEER-REVIEWED AND PUBLISHED ARTICLE

Cannabis Science and Technology

(Volume 2, Issue 5) in 2019.

cannabis science and technology

FUNDAMENTALS

FLUORESCENCE SPECTROSCOPY

Our patent-pending technology utilizes a scientific method of measuring how molecules respond to light.

- **Spectroscopy:** The broad study of how light interacts with other light, surfaces, molecules, etc.
- **Fluorescence:** The light produced after a wavelength is exposed to it.

High-Quality Digital Display

Miniature Optical Sensor

PROCESSES WE SERVE NOW

Growing & Grinding

Extraction

Winterization & Filtration

Solvent Recovery& Decarb

Distillation

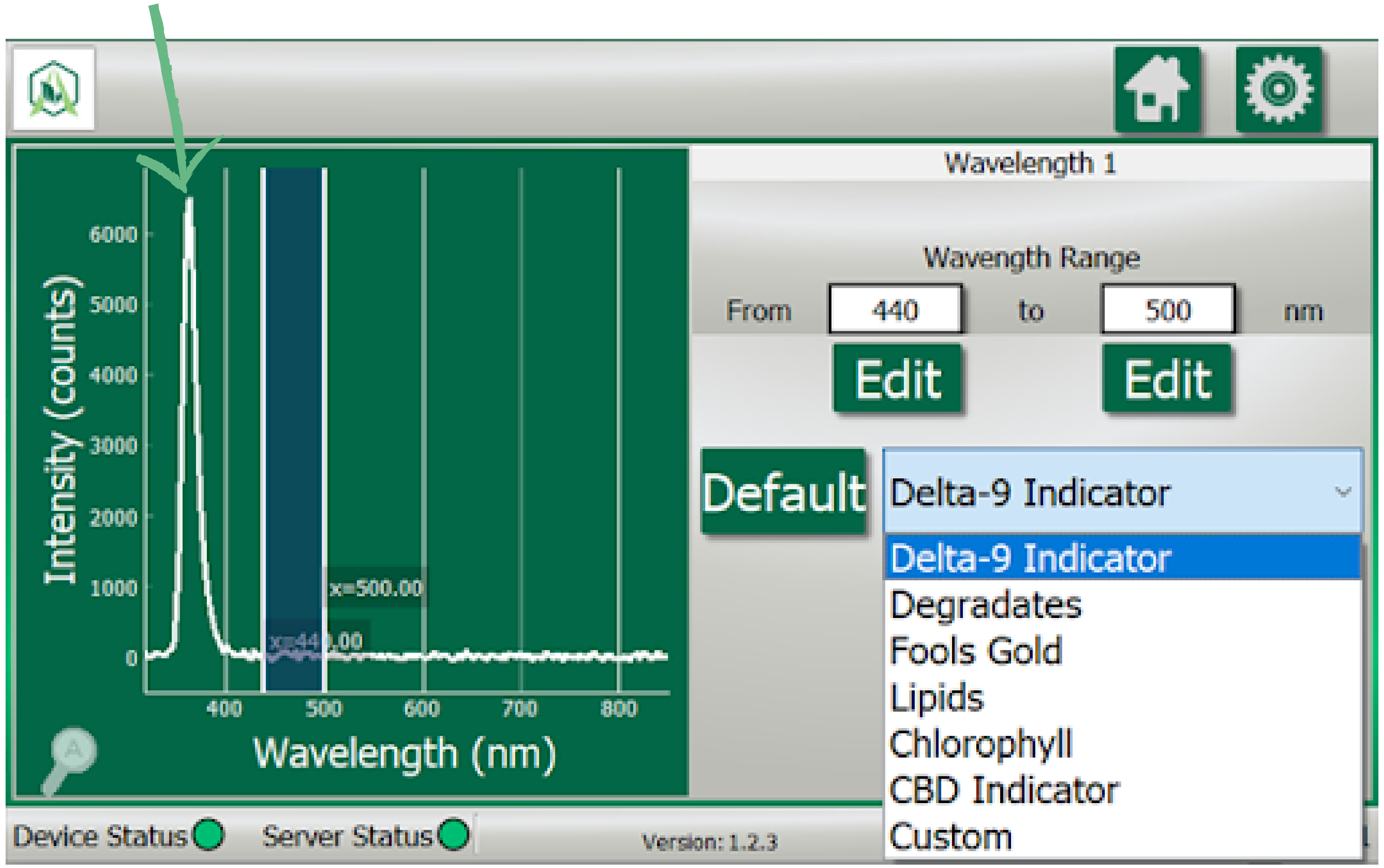
Chromatography

MOLECULES

Molecules respond to light differently. The way that an extract responds tells us which molecule(s) — and how much of said molecule(s) — are present.

Our system excites fluids with light,

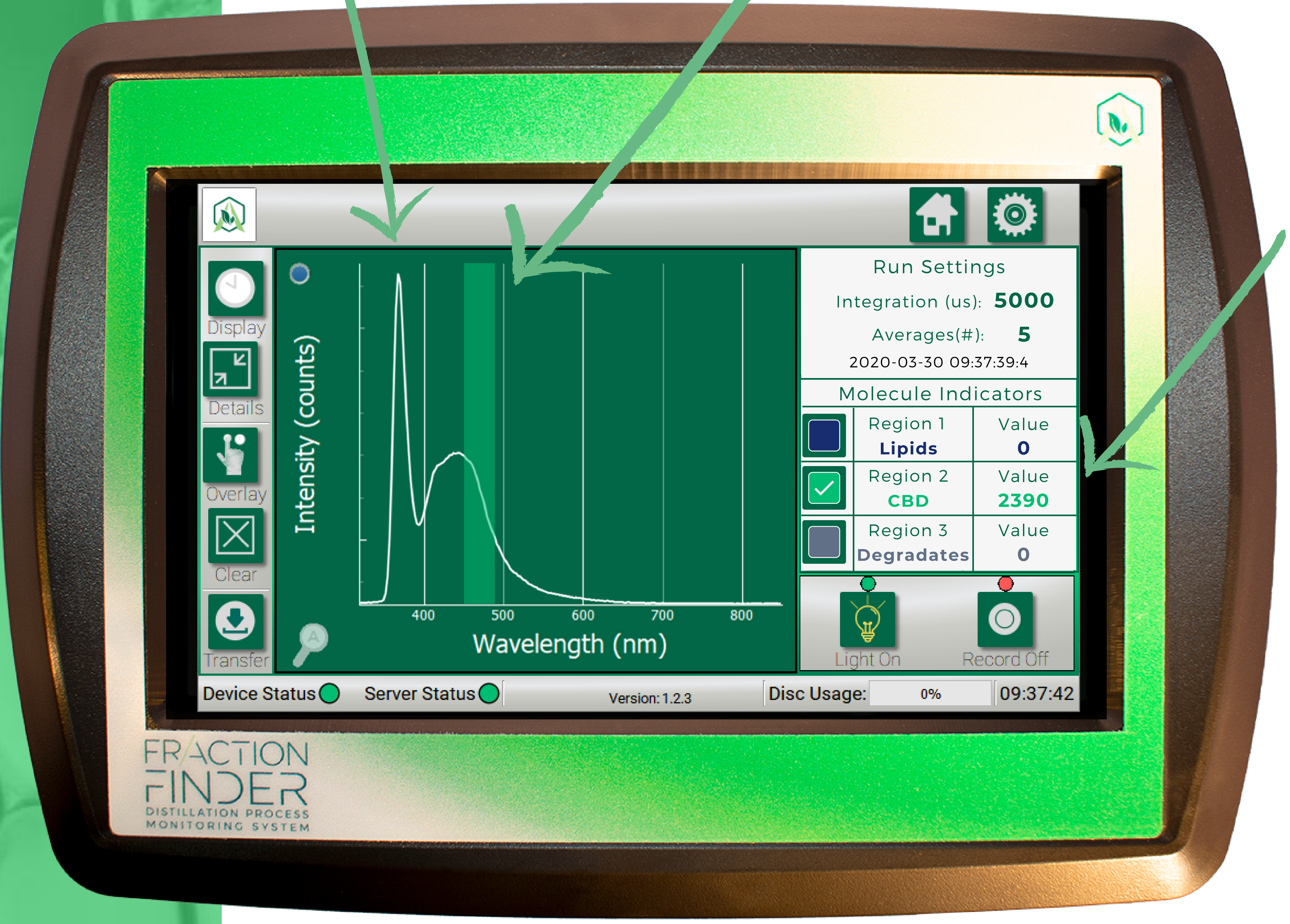
while simultaneously waiting for, and measuring, the response.



Here's an example

Our system's exciting signal

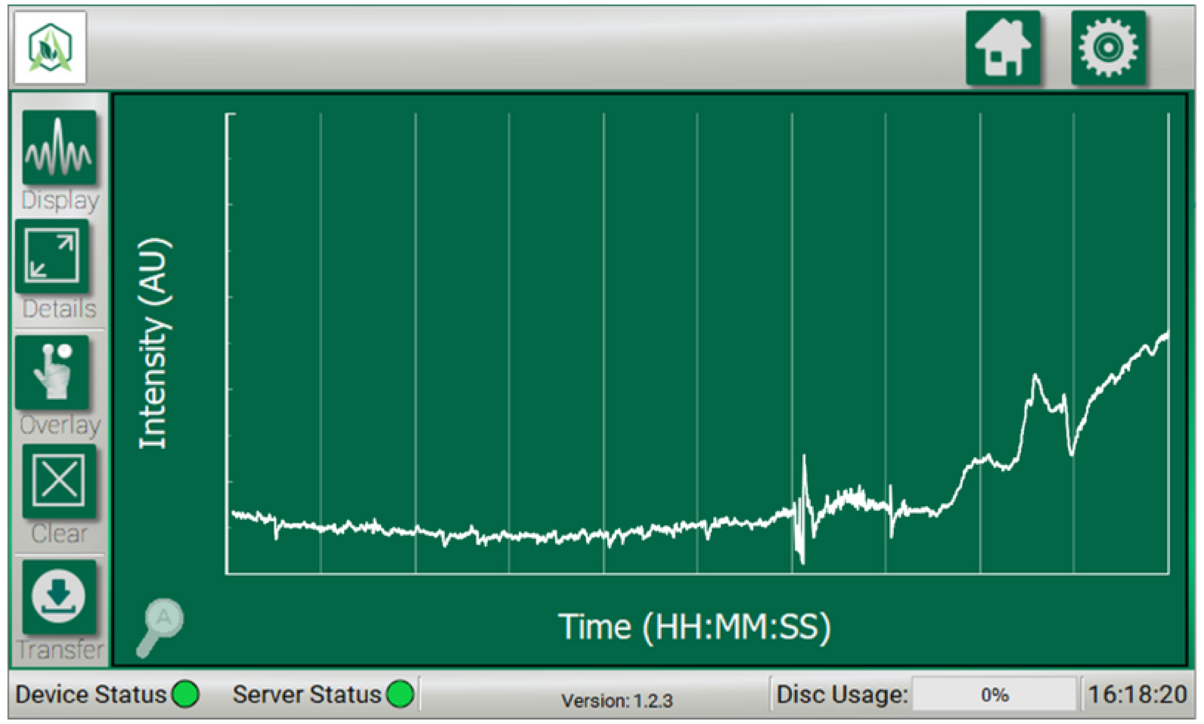
CBD's signal

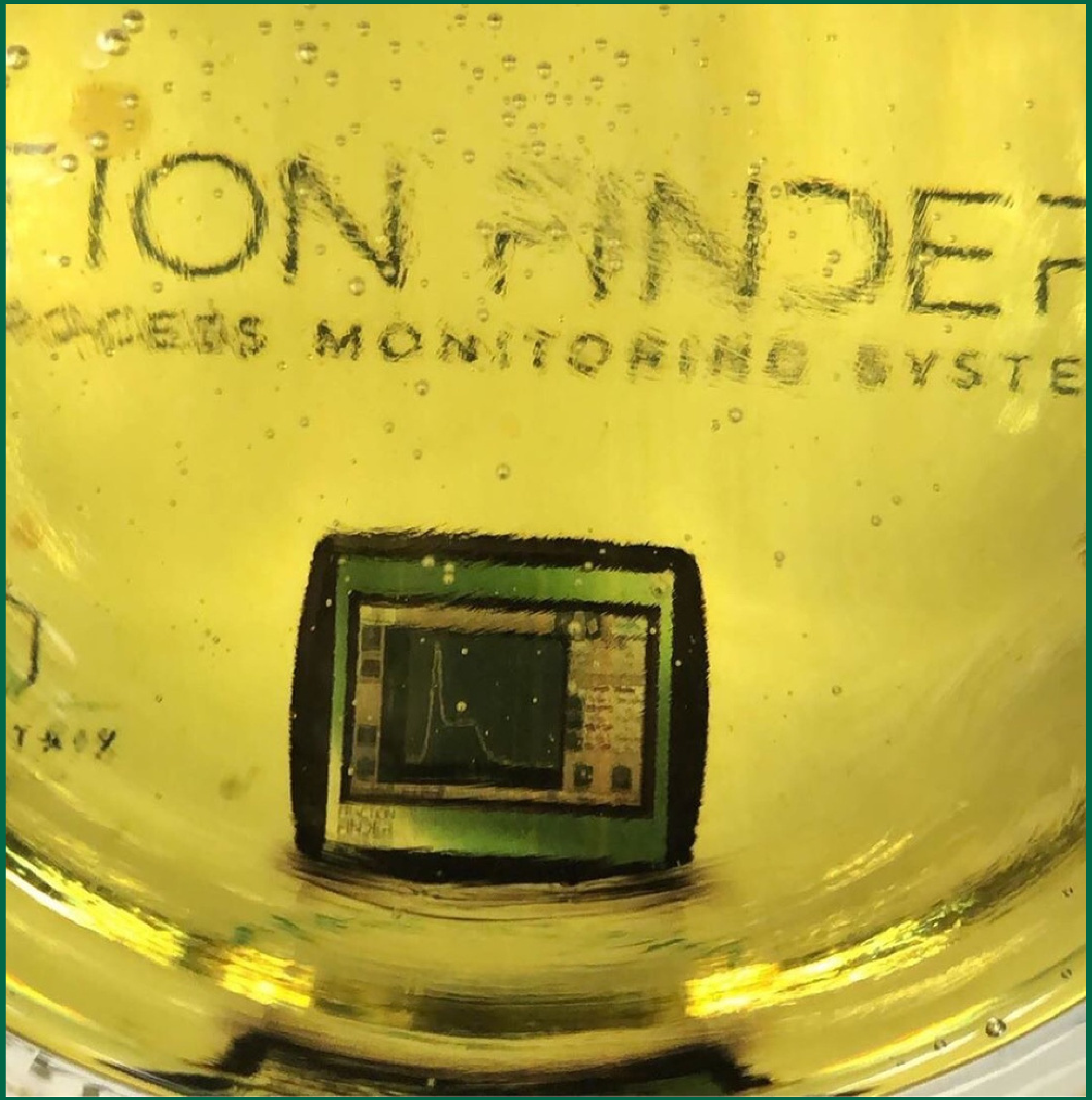


CBD's intensity values

Alternative graphing view

Track signal intensity over time





RETURN ON INVESTMENT

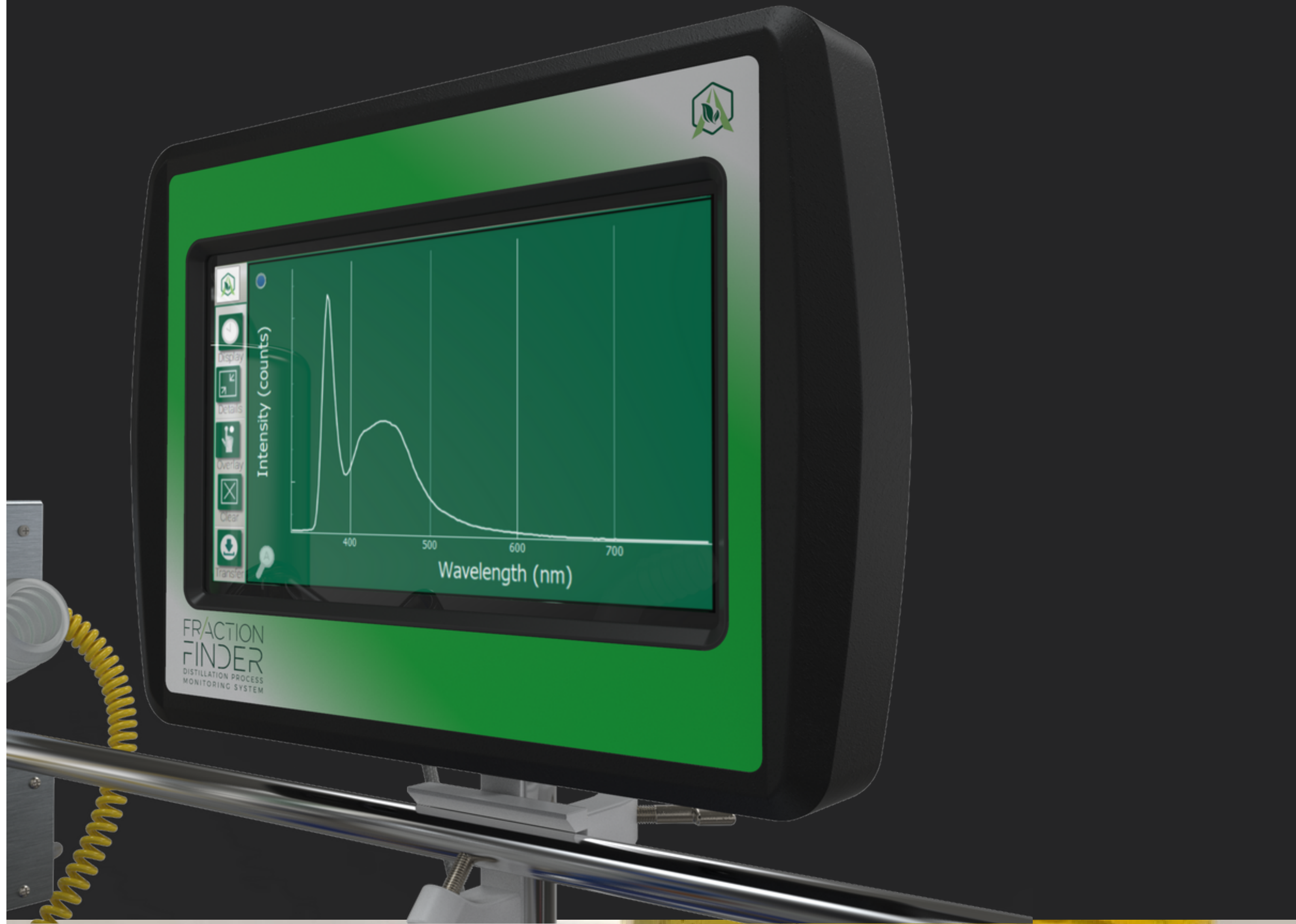
Our customers achieve a rapid ROI from using our technology:

- **Increase potency** by 3-5% points —> increased market value
- **Decreased training time** by 33% —> decreased training costs

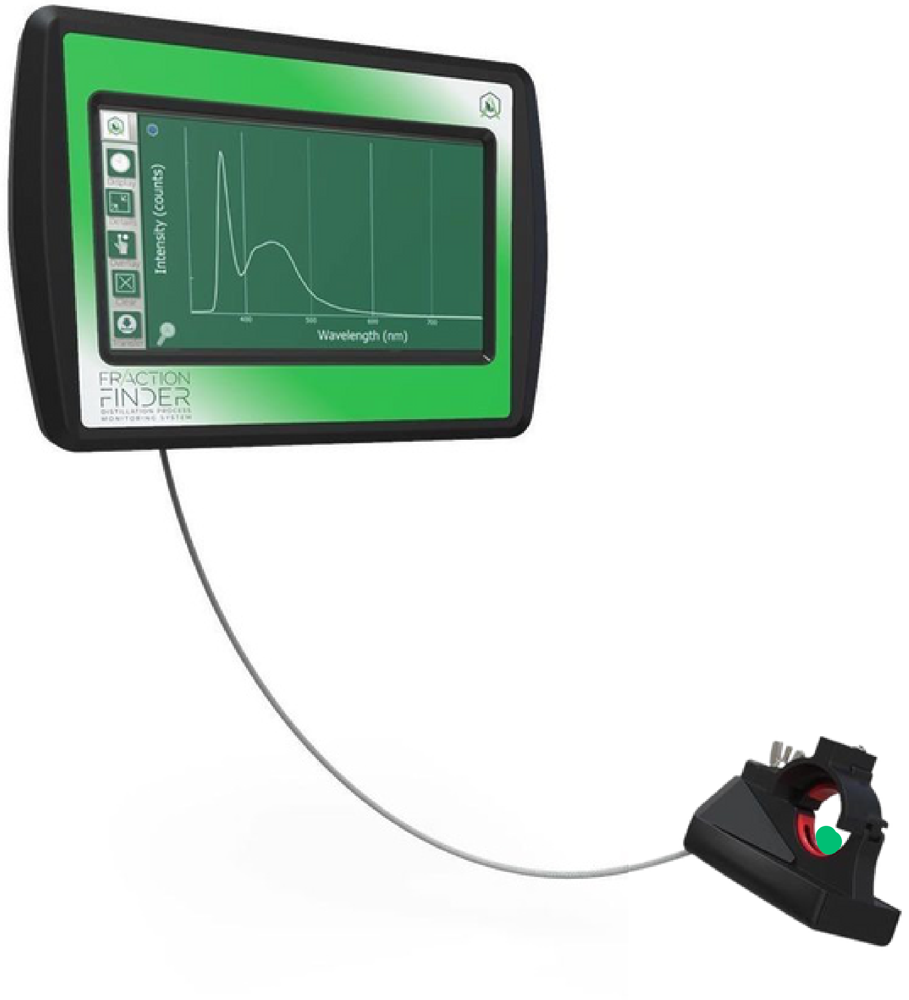
OTHER BENEFITS

EVERY TIME YOU USE OUR TECH, YOU ARE:

- Assuring the highest **quality** possible
- Capturing molecular data for **traceability**
- **Simplifying** and **standardizing** processes



FRACTION FINDER
DISTILLATION PROCESS MONITORING SYSTEM



$4000 USD

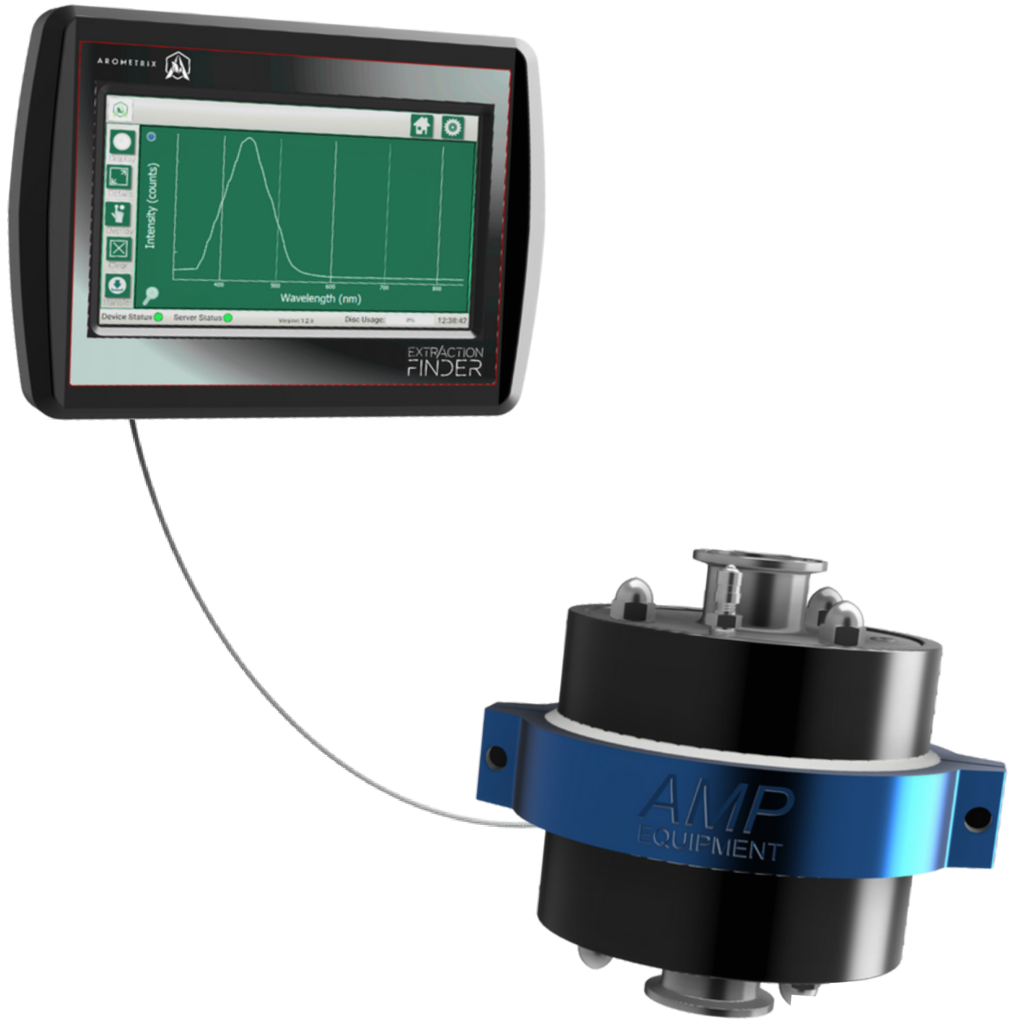
For botanical distillation

FRACTION FINDER
ULTRA

$4814 USD

For botanical chromatography and distillation

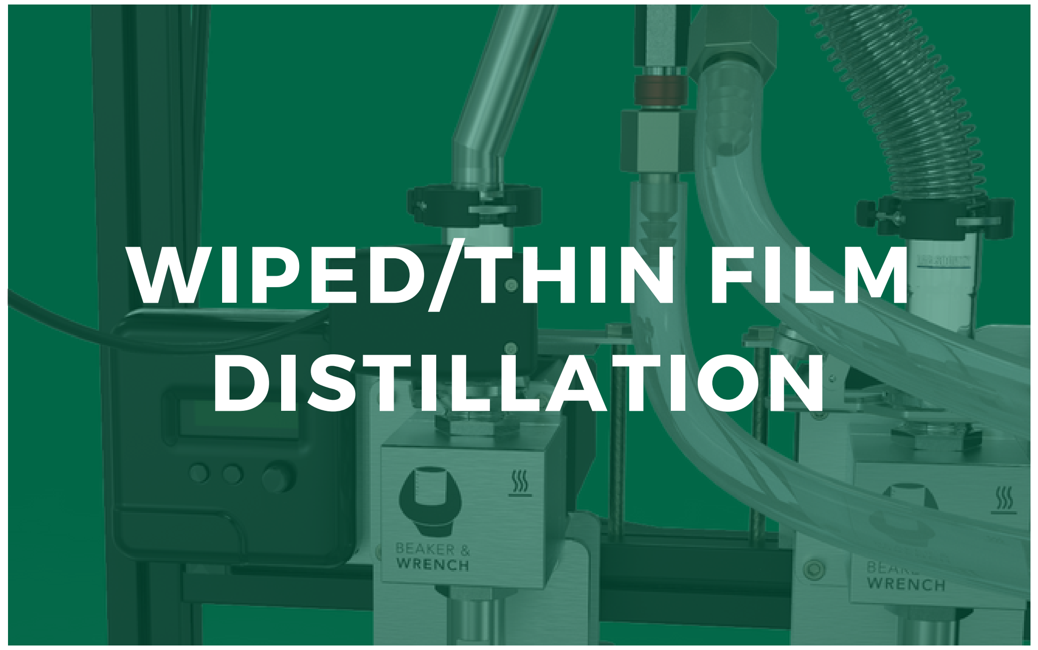
EXTRACTION FINDER

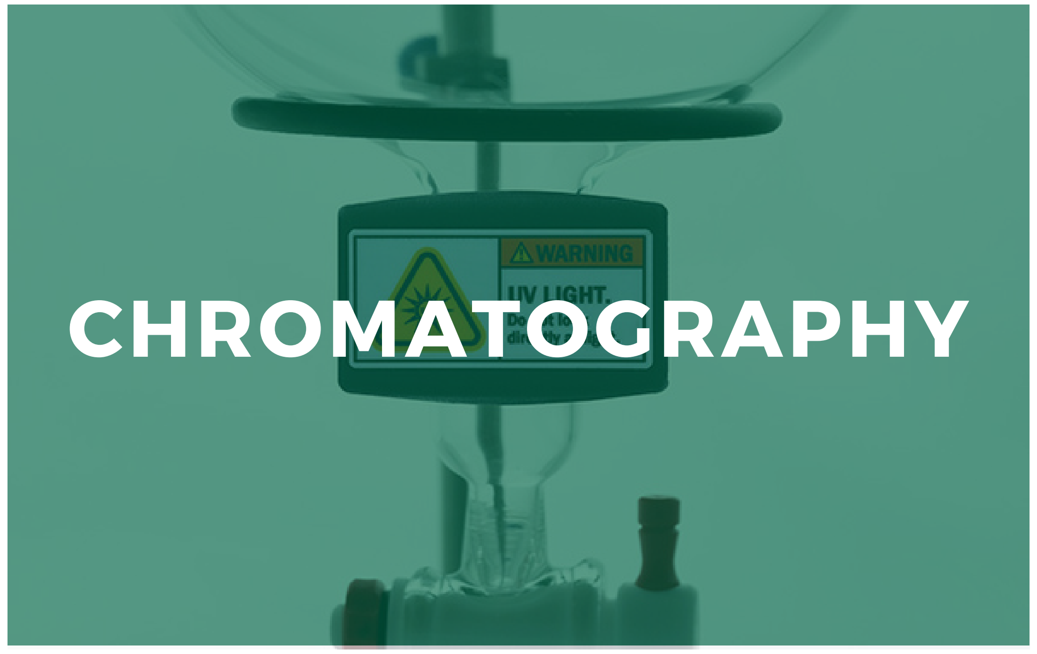


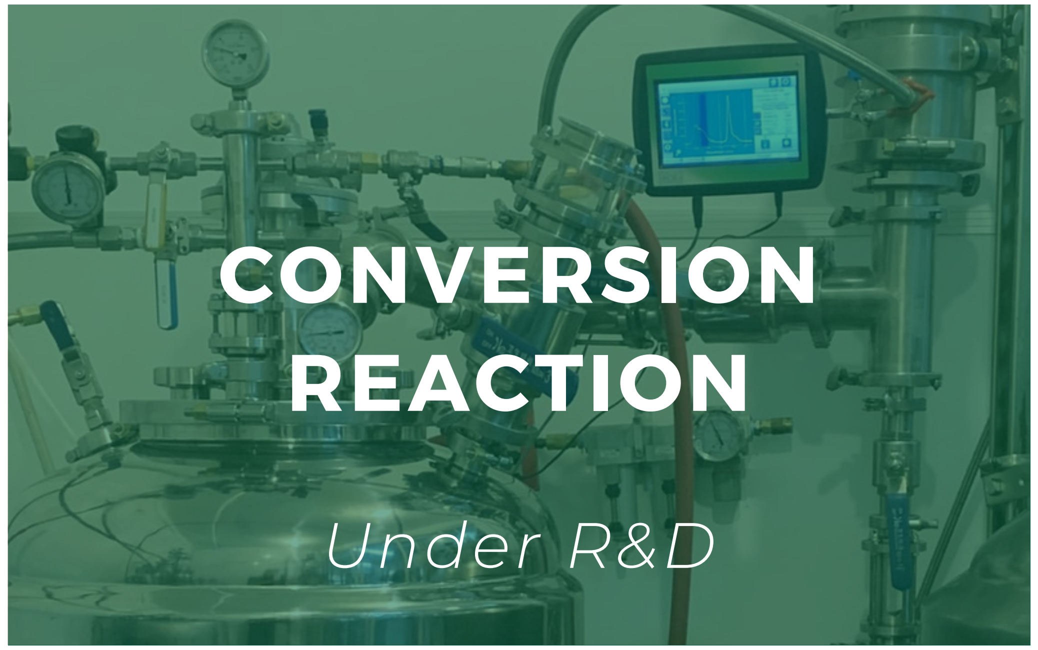
$8450 USD

For botanical extraction

OUR APPLICATIONS







DO YOU HAVE A
NEW APPLICATION?
CONTACT US!

Featured:

Lab Society 12L Short Path Distillation

SHORT PATH DISTILLATION

KNOW WHEN TO CHANGE FLASKS

Track the start & end of the main distillation fractions:

- **"Heads":** Terpenes and "Fool's Gold"
- **"Main Body" (aka "Heart"):** Cannabinoid of interest
- **"Tails":** Degradates & darker pigments

Featured:

Lab Society HVE Thin Film Distillation

WIPED / THIN FILM DISTILLATION

KNOW THE QUALITY OF EACH LINE

Track exactly what is passing through your line(s):

- **Collection line:** Prevent the collection of trace amounts of "undesirables" (ex: Degradates)
- **Rejection line:** Prevent the rejection of trace amounts of "desirables" (ex: CBD)

Featured below:

Summit Research Chroma Column

CHROMATOGRAPHY

KNOW WHEN EACH FRACTION ELUTES

Track the emergence of individual Cannabinoids:

- **Normal Phase:** Track THC, then track CBD
- **Reverse Phase:** Track CBD, then track THC
- **Color Remediation:** Tracks levels of dark pigments, such as Chlorophyll, Lipids, and Degradates

EXTRACTION

KNOW WHEN TO END THE EXTRACTION

Track the progress of the extraction to its end:

- **Monitor molecular levels over time:** Acidified Cannabinoids, Chlorophyll, and Lipids
- **Know when it's complete**: Know when the solvent has extracted all the plant's Cannabinoids

Featured below:

Delta Separations CUP 30 Extractor

CONVERSION REACTION

Under R&D

KNOW WHEN CONVERSION OCCURS

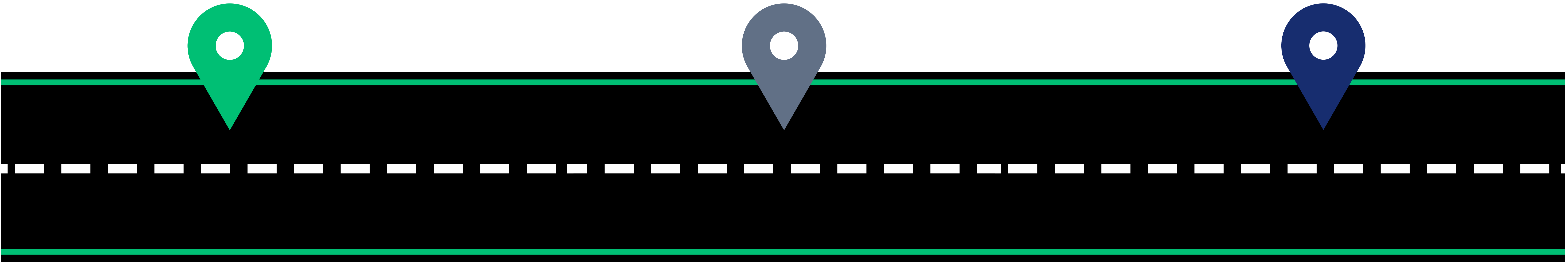
Track the conversion for a precise synthesis:

- Detects when the first Cannabinoid appears
- Monitor one Cannabinoid's conversion/synthesis (ex: CBD) to another Cannabinoid (ex: THC)

Featured below:

HXLabs SR-300 Synthesis Reactor

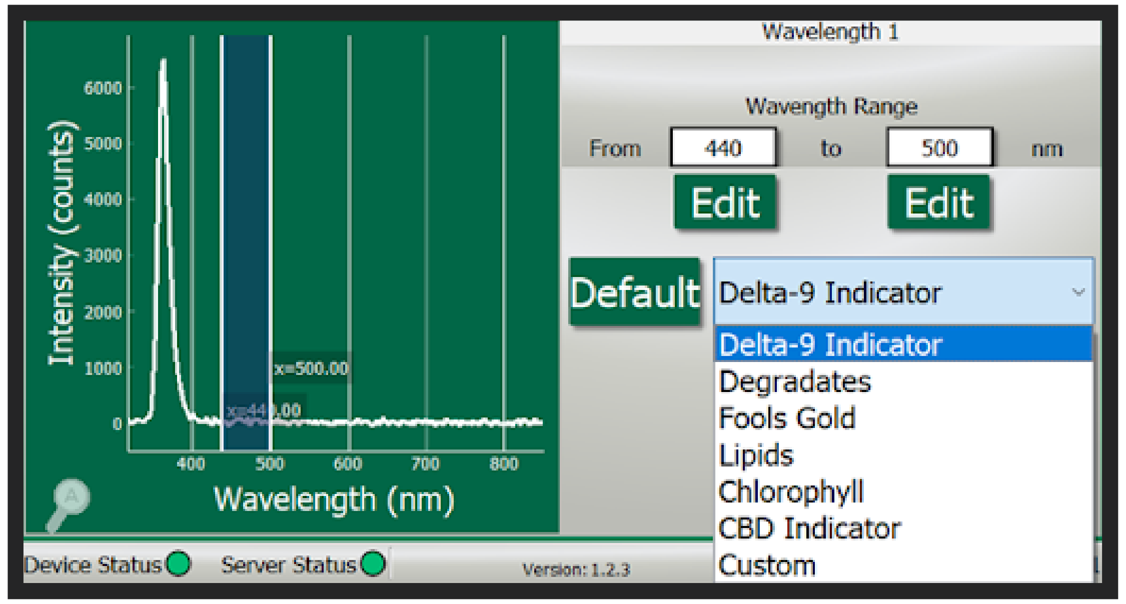
NOW ## NEXT ## FUTURE



Unprecedented real-time monitoring for distillation

The standard for all distillation AND extraction systems across the world

The ultimate source of batch traceability for gMP compliance



DAB APP

API

AROMETRIX APPROVED