

Analytical Testing Instruments - Cannabis and Hemp



*Rod Finney
Technical Sales and Support
Product Manager for SFC/SFE*



Discussion Points

- **Prominence-I Plus potency HPLC**
- **Service Plans for HPLC**
- **Terpene Profiles**
- **Nexera UC SFE/SFC**
- **Residual Solvents**



Cannabis – Active Ingredient Definition

- **An active ingredient is a therapeutically active component in the medicines final formulation that is responsible for it's physiological or pharmacological action (Section 4 of TGO 93).**
- **In addition, the following ingredients are considered to be active ingredients in section 4(2) of TGO 93 for the purposes of TGO 93:**

Cannabis - Active Ingredient Definition

- **Any tetrahydrocannabinol (Including any corresponding acid) greater than or equal to 1.0% w/w or w/v of the product**
- **Any other cannabinoids (Including any corresponding acid) greater than or equal to 2.0% w/w or w/v of the product**
- **Ref: TGA Standard for Medicinal Cannabis (TGO 93) Order 2017, Version 1.2, May 2019**

Right Tool for the Job? Wood Screw?



One Tool or Multiple Tools in the Tool Box



“Comprehensive” Cannabis Analysis by LC-MS/MS

- **Merriam-Webster Dictionary**
 - covering **completely** or broadly
- **Cambridge Dictionary**
 - **Complete** and **including everything** that is necessary
- **Dictionary.com**
 - broad, wide, extensive, **full**
- **Oxford Dictionary**
 - **Including or dealing with all or nearly all** elements or aspects of something



Cannabis Analytical Testing

Potency profiling

Terpene Profiling

Extraction with SFE

Pesticide screening

Residual solvents

Heavy metals

Mycotoxin/aflatoxin

Moisture content



Cannabinoids

In cannabis, cannabinoids are the target compounds of potency testing.

There are at least 113 different cannabinoids isolated from cannabis, exhibiting varied effects.

THC and CBD are known as key compounds.



Tetrahydrocannabinol

- Uplifting and energetic
- Psychotropic compounds
- Recreational/Medicinal



Cannabidiol

- Relaxing and calming
- Non-psychotropic compounds
- medicinal



Certificate of Analysis for CBD Oil



Certificate of Analysis November 10, 2017

Sample ID: FP-17-0981

Product name: Plus cbd oil ps80 free spray peppermint

Batch/Lot#: 7305319

Strength: 2oz 500mg

Cannabinoid:	mg:	Method:
CBD	497.69	HPLC
CBDV	10.40	HPLC
CBDa	15.56	HPLC
CBG	5.35	HPLC
CBGa	0.00	HPLC
CBC	20.13	HPLC
CBN	3.64	HPLC
Δ ⁹ -THC	8.96	HPLC
THCA	0.00	HPLC

Total cannabinoids: 561.7 mg
Sample size: 54 g
THC by mass: 0.0166 %

NOV 10 2017

Analyst _____ Date _____

Vandana Kothari, M.S., B.Pharm.
Analytical Chemist



Sample Name: (FP-17-0981) Plus CBD Oil 2oz Extra Strength Peppermint Spray PS80 Free Lot: 7305319
Tested for: CV Sciences
Sample ID: 171109Q093
Date Submitted: 11/09/2017
Sample Type: Infused

Total Sample Weight: 54.0000 Grams

Cannabinoid Test Results

Cannabinoid analysis utilizing High Performance Liquid Chromatography (HPLC, QSP 5.4-4.4)

Cannabinoid Summary

Total THC Δ9THC+THCa 11.34 mg
Total CBD CBD+CBDA 480.06 mg

Full Canabinoid Profile

THC	0.21 mg/g
THCa	ND
CBD	8.85 mg/g
CBDA	0.04 mg/g
CBN	0.05 mg/g
CBDV	ND
CBDA	ND
CBG	ND
CBGa	ND
THCV	ND
Δ8 - THC	ND
CBC	0.41 mg/g

Total Active Cannabinoids: 9.56 mg/g

Pesticide Test Results

Pesticide, Fungicide and plant growth regulator analysis utilizing HPLC-Mass Spectrometry

	Reporting Limit
Acequinocyl	Not Detected 1
Abamectin	Not Detected 0.25
Bifenthrin	Not Detected 0.1
Daminozide	Not Detected 0.5
Fenoxycarb	Not Detected 0.1
Imidacloprid	Not Detected 0.2
Myriobutanil	Not Detected 0.1
Permethrin	Not Detected 0.2
Pyrethrin	Not Detected 0.5
Spinosad	Not Detected 0.1
Spinosyn	Not Detected 0.1
Spirintranil	Not Detected 0.1

NOV 10

Reviewed By _____

Dalia Chandler, M.S., B.
QA/QC Manager

Certificate of Analysis

*Amendment to CoA 171109Q093-001

Microbiological Test Results

3M Petrifilm and plate counts for microbiological contamination

Total Yeast and Mold	<1,000 cfu/g	E. coli	ND
Pseudomonas	ND	Coliforms	<100 cfu/g
Total Aerobic Plate Count	<1,000 cfu/g	Salmonella	ND

Terpene Test Results

Terpene analysis utilizing Gas Chromatography - Flame Ionization Detection (GC - FID)

	mg/g / %	mg	
α Bisabolol	N/A	α Terpinene	N/A
α Pinene	N/A	Linalool	N/A
3 Carene	N/A	Limonene	N/A
Borneol	N/A	Myrcene	N/A
β Caryophyllene	N/A	Fenchol	N/A
Geraniol	N/A	α Phellandrene	N/A
α Humulene	N/A	Caryophyllene Oxide	N/A
Terpinolene	N/A	Terpinol	N/A
Valencene	N/A	β Pinene	N/A
Menthol	N/A	R(+)-Pulegone	N/A
Nerolidol	N/A	Geranyl Acetate	N/A
Camphene	N/A	Citronellol	N/A
Eucalyptol	N/A	p-Cymene	N/A
α Cedrene	N/A	Ocimene	N/A
Camphor	N/A	Guaiol	N/A
(-)-Isopulegol	N/A	Phytol	N/A
Sabinene	N/A	Isoborneol	N/A
γ Terpinene	N/A		

Total Terpene Concentration:

Residual Solvent Test Results

Residual Solvent analysis utilizing Gas Chromatography - Flame Ionization De (GC - FID)

Propane	N/A	Ethanol	N/A
Methanol	N/A	Isopropanol	N/A
Isobutane	N/A	Mercaptan	N/A
2,2-Dimethylbutane	N/A	2-Methylpentane	N/A
3-Methylpentane	N/A	Cyclohexane + Benzene	N/A
Neopentane	N/A	n-Pentane	N/A
n-Butane	N/A	n-Heptane	N/A
n-Hexane	N/A	n-Pentane	N/A

Sample Certification



Scan to verify at sclabs.com

Josh Welter, President



chemical solutions ltd.
trace elemental analysis

Analytical Report November 14, 2017

Vandana Kothari
CV Sciences
3030 Hammer Hill St.
Suite 107
San Diego, CA 92108

Client: CV Sciences
Client #: C2962
Sample Type: Liquid Product Mass
Collector: Client

CSL#: 17K1653
Parameter: Arsenic, Cadmium, Lead, Mercury

Plus CBD Oil Extra Strength Peppermint Spray 2oz PS80 Free (FP-17-0981) - Lot#: 7305319

Result	PQL	Method	Date	Analyst
<0.50 ppm	0.50	ICP MS	11/13/17	HG
<0.25 ppm	0.25	ICP MS	11/13/17	HG
<0.020 ppm	0.020	ICP MS	11/09/17	AW
<0.10 ppm	0.10	ICP MS	11/13/17	HG

Respectfully Submitted,
Chemical Solutions, Ltd.
Michelle D. Doyle
QA Representative

Notes:
CONFIDENTIAL REPORT. This report is confidential and is for the sole use of the addressee.
This report can only be reproduced in full.
The units for the PQL are the same as those shown for the result.

931 north seventh st harrisburg, pa 17102 phone 717/697-7536 fax 717/697-4400
www.chemicalsolutionsltd.com

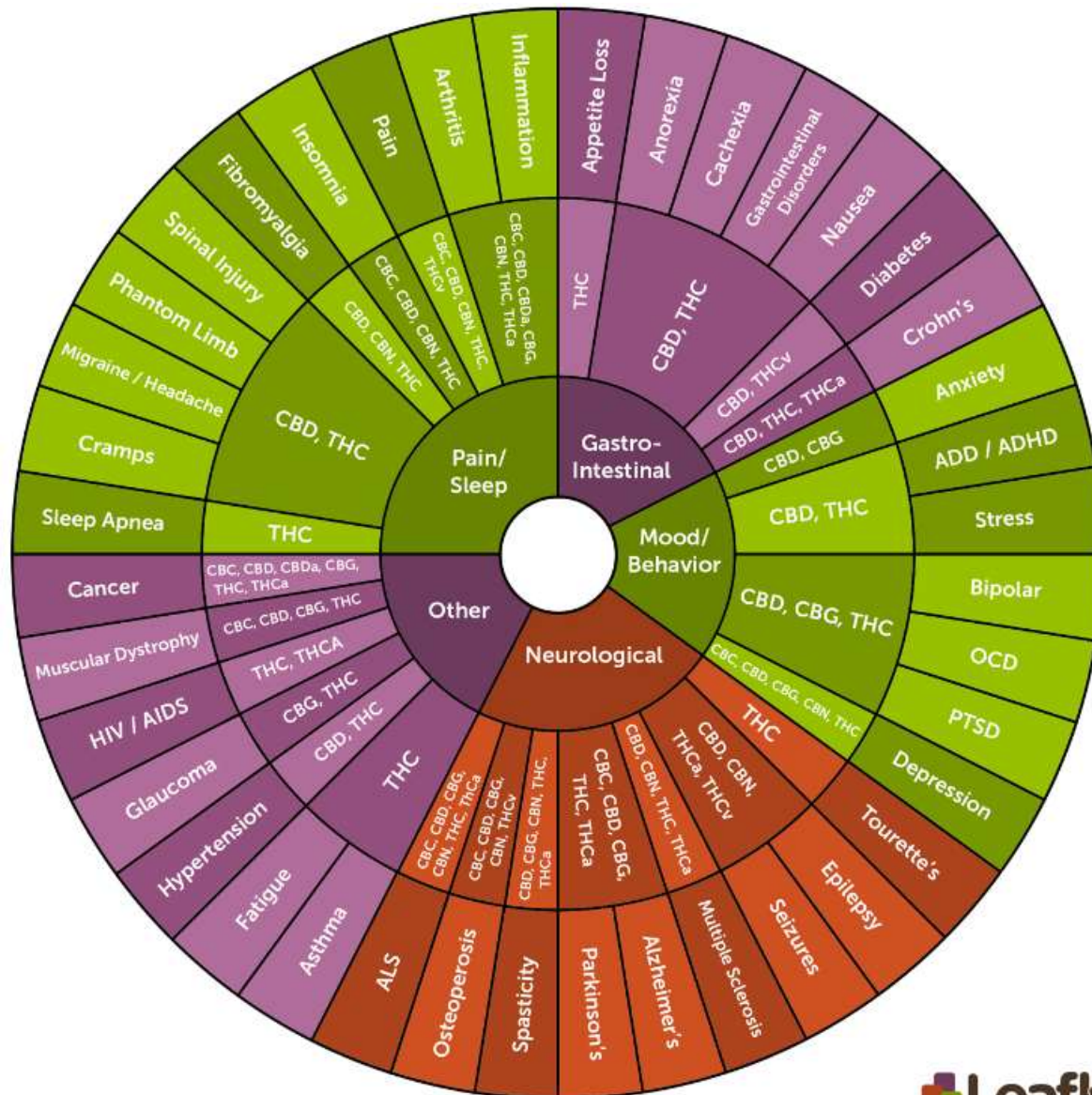
SC Laboratories - 100 Pioneer Street, Santa Cruz, CA 95060

CoA ID: 171109Q093-002 - Page 1 of 1

These results relate only to the items tested. This test report shall not be reproduced except in full, without written approval of the laboratory.
The uncertainty of measurement associated with the measurement result reported in this certificate is available from SC Laboratories upon request.

Potency, Pesticides, Micro, Terpenes, Residual Solvents, Heavy Metals

Cannabinoids for Medical Treatment

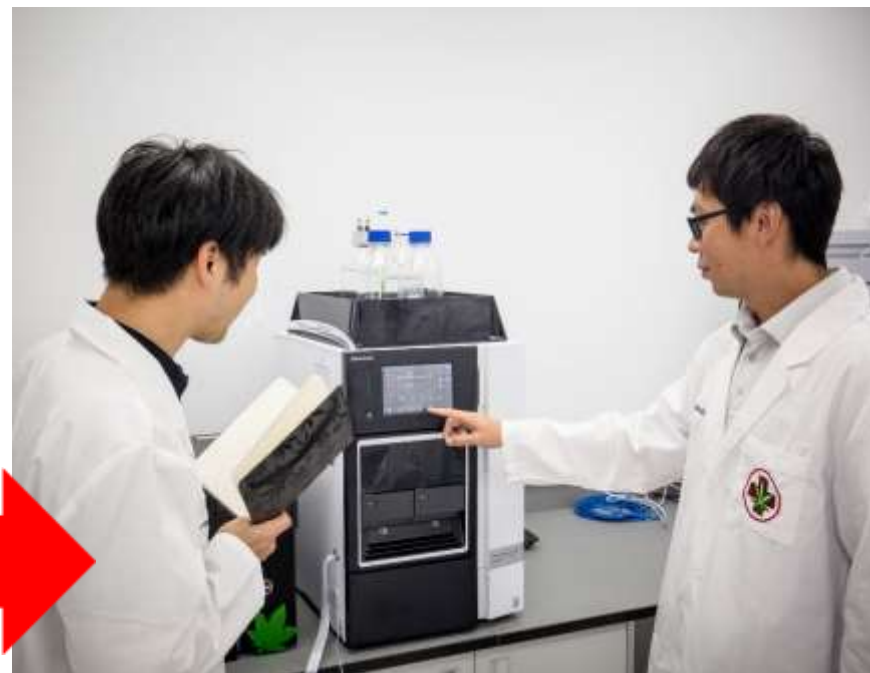
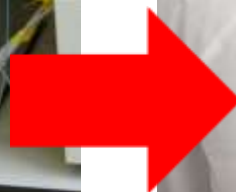


- CBD Treatment
- Mood/Behavior
 - Anxiety
 - ADD/ADHD
 - PTSD
 - Depression
- Neurological
 - Epilepsy
 - Seizures
 - Alzheimer's
 - Parkinson's
- Gastrointestinal
 - Nausea
 - Crohn's
 - Diabetes
- Pain/Sleep
 - Pain/Arthritis
- Other - Cancer

Potency by LC-MS/MS or HPLC/UV

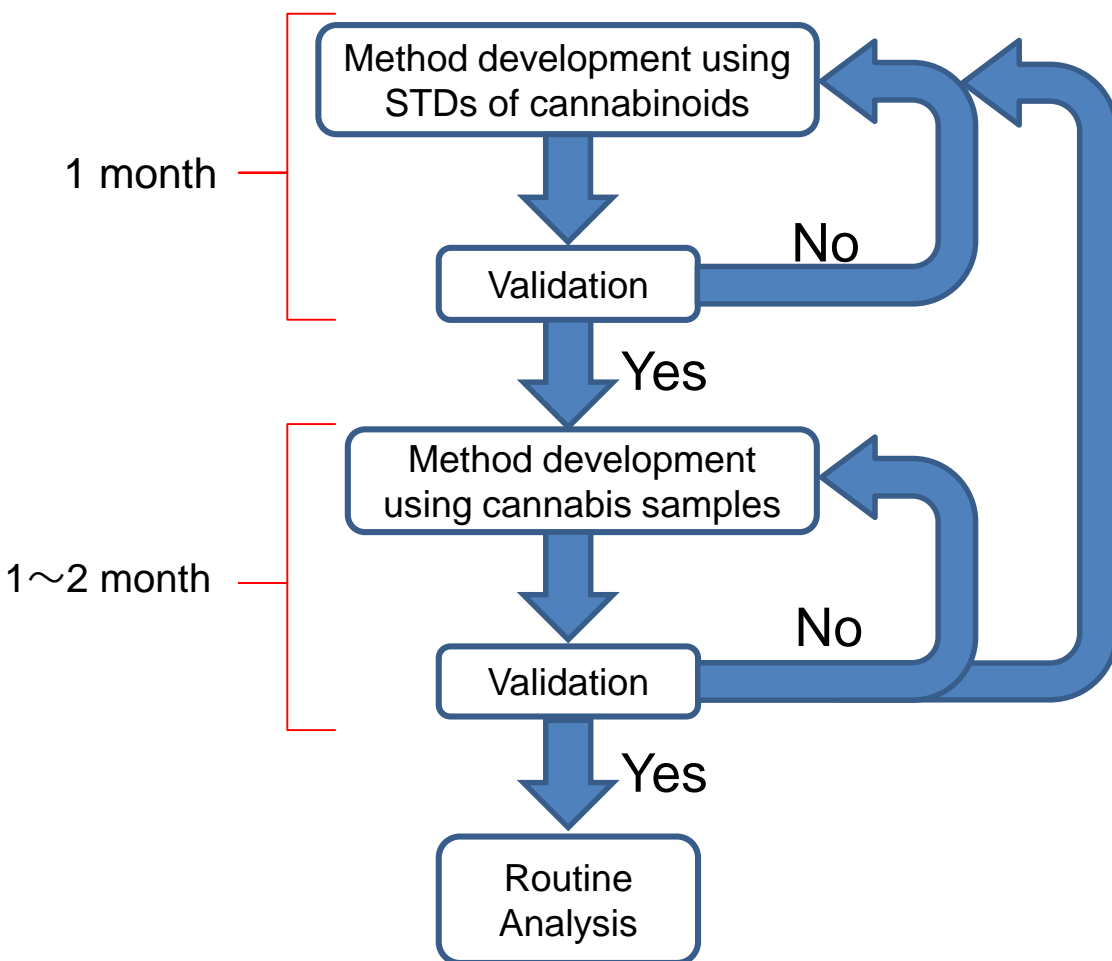
- **LC-MS/MS**
 - **Cannabinoids: 1-30**
 - **Cost: \$350,000**
 - 7-9x more cost
 - **Level of Expertise: Experience MS (Higher)**
 - Higher Salary
 - **Linear Dynamic Range**
 - Less than HPLC/UV
 - **Calibration Frequency**
 - 2-3 Days maximum
 - **Detector Stability: Lower**
 - **Source Switching (3 types)**
 - ESI to APCI time consuming
 - **Research Labs**
- **HPLC/UV**
 - **Cannabinoids: 1-17**
 - **Cost: \$40,000-\$50,000**
 - 7-9x less cost
 - **Level of Expertise: Technician Level (Lower)**
 - Lower Salary
 - **Linear Dynamic Range**
 - 0.1% -100% Flower or Concentrates
 - **Calibration Frequency**
 - QC Check in the morning
 - **Detector Stability: Higher**
 - **Source Switching**
 - Not Required
 - **QA/QC Labs**

Cannabis Analyzer for Potency



Method Development and Validation

Method Development and validation are tedious and challenging...



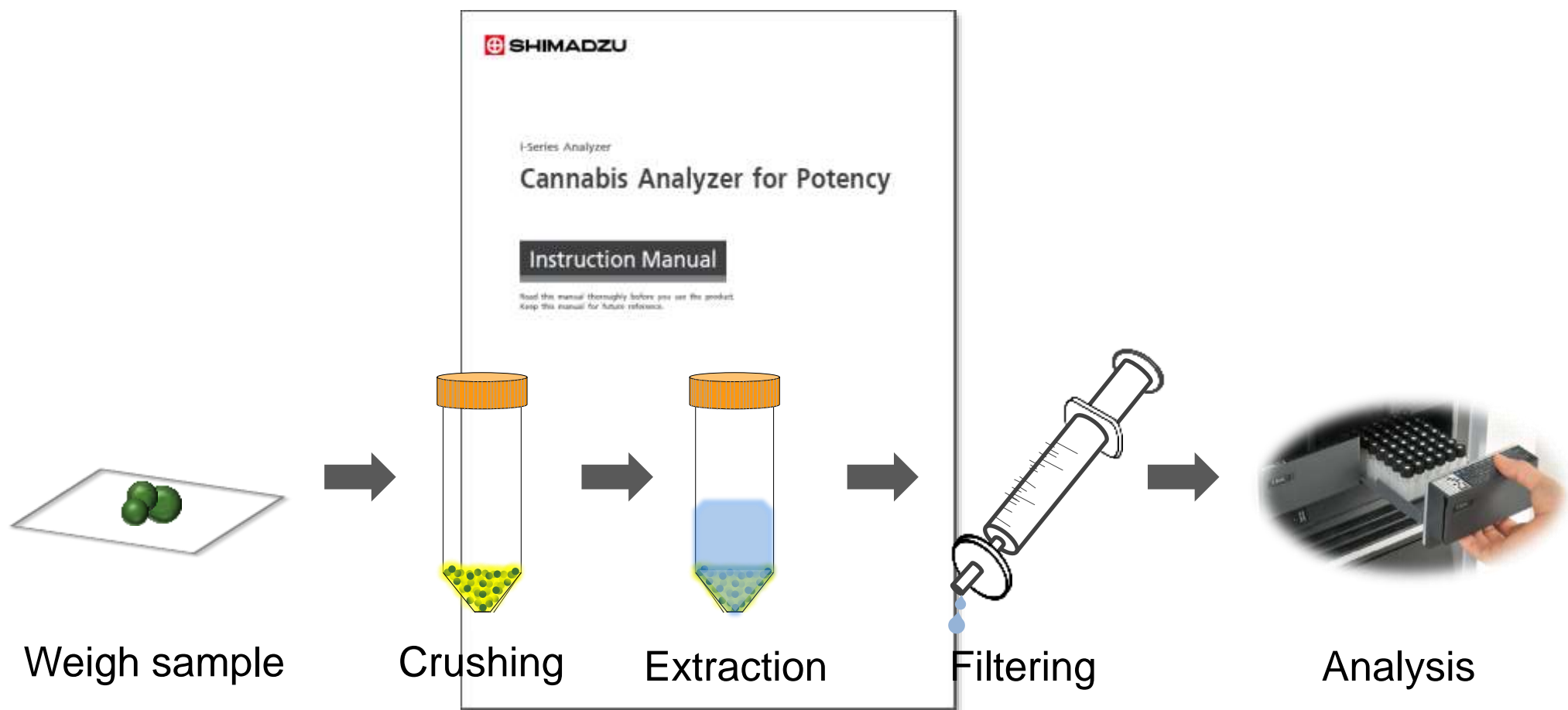
Introducing Cannabis Analyzer for Potency

1. Easy to Use
2. Low Cost
3. USP Guideline Methods
4. Service Plans
5. Turn-Key, All-In-One

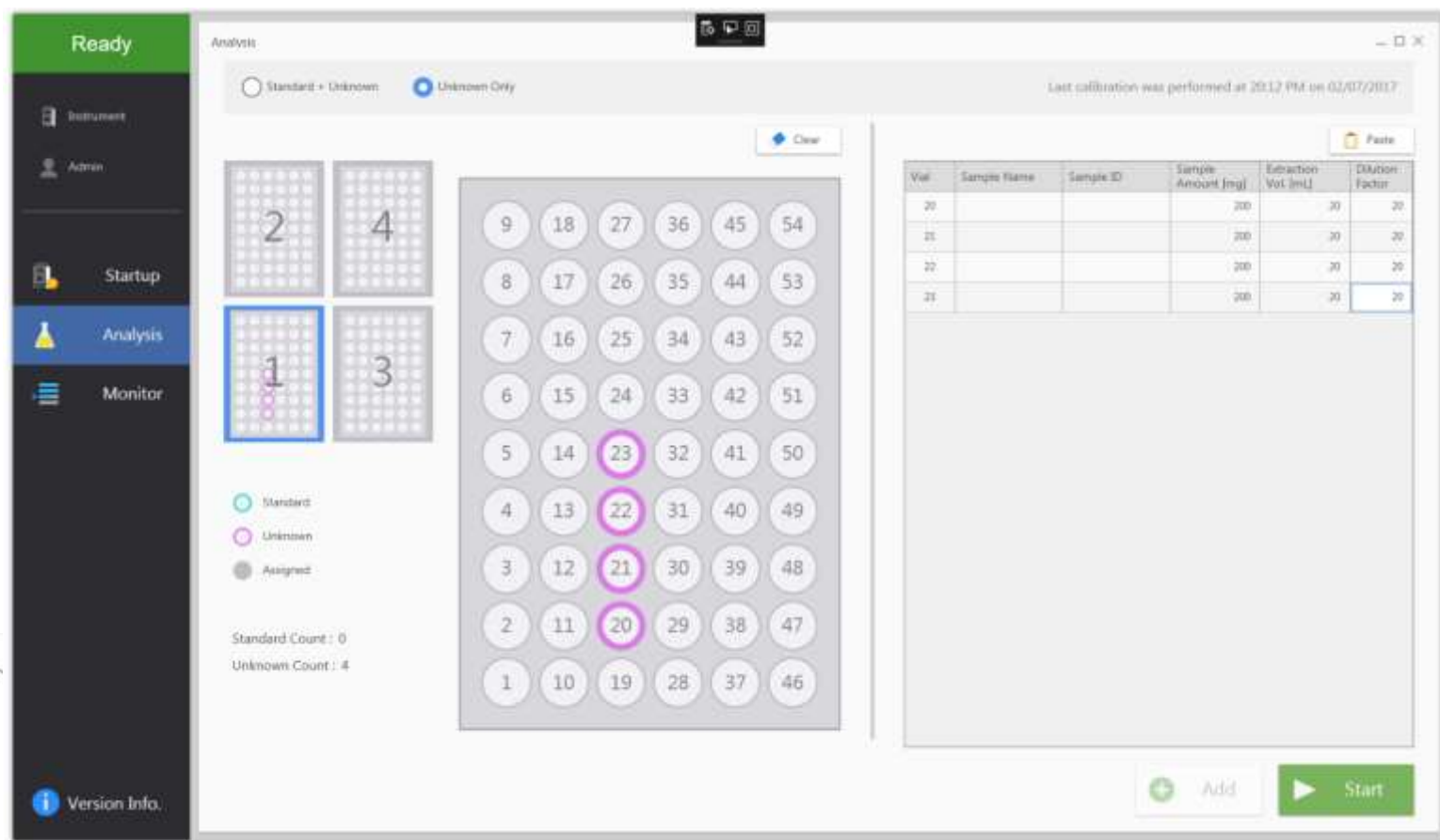


1. Easy to Use (Sample Prep)

Pretreatment Procedure



1. Easy to Use (Software)



Cannabis Analyzer for Potency

Version 1.00

▲ WARNING 警告

This is a CD-ROM disc. Do not play this on an audio CD player, as the high volume may damage your hearing or the audio speakers.

本製品はCD-ROM、高音量再生は聴覚障害やスピーカ破損の原因となります。

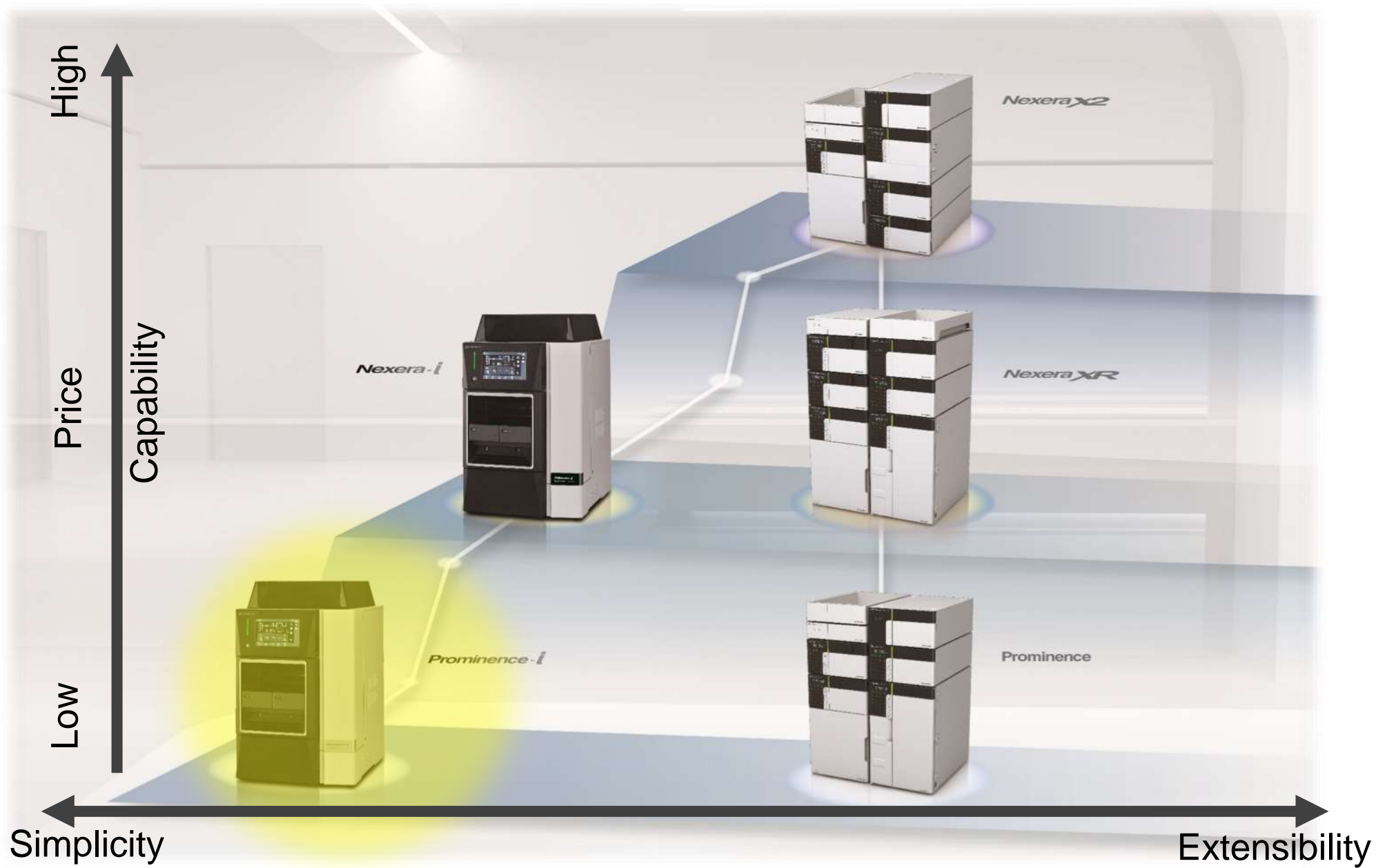
このディスクはCD-ROMです。オーディオ再生用CDプレイヤーでは高音量再生しないようご注意ください。高音量再生は聴覚障害やスピーカ破損の原因となります。



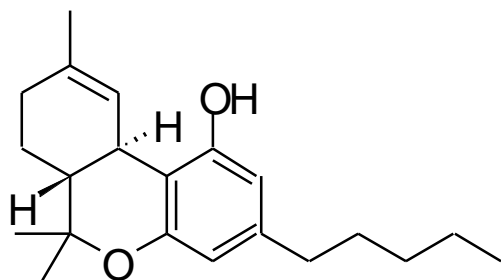
SHIMADZU
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P/N 220-59505-41

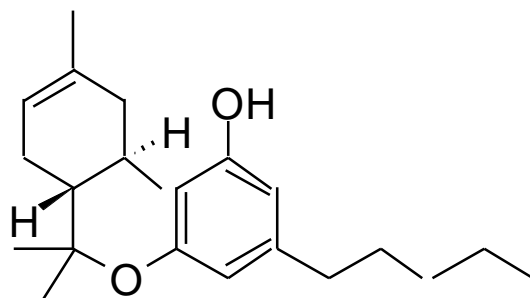
2. Low Cost



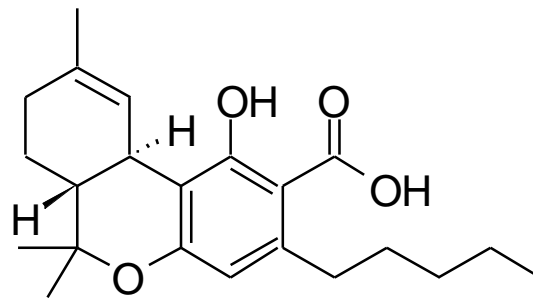
3. Validated Methods: 10 or 11 Cannabinoids



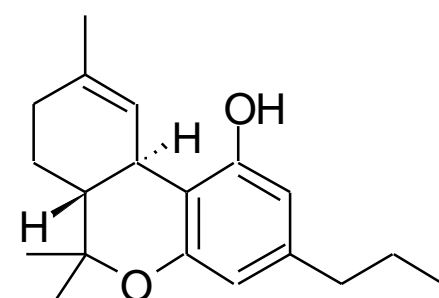
Δ9-Tetrahydrocannabinol
(Δ9-THC)



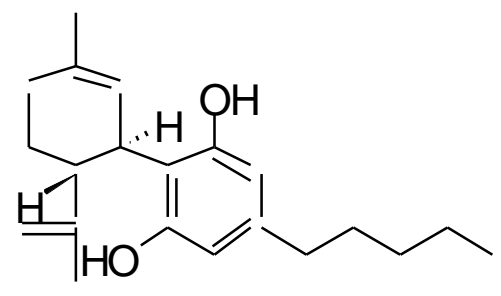
Δ8-Tetrahydrocannabinol
(Δ8-THC)



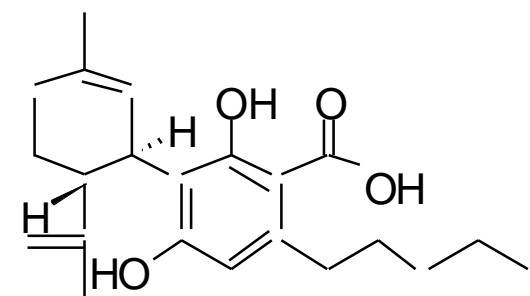
Δ9-Tetrahydrocannabinolic acid
(THCA)



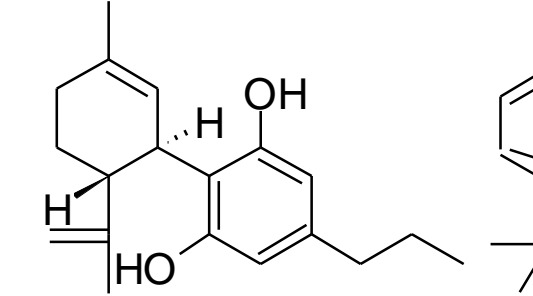
Tetrahydrocannabivarin
(THCV)



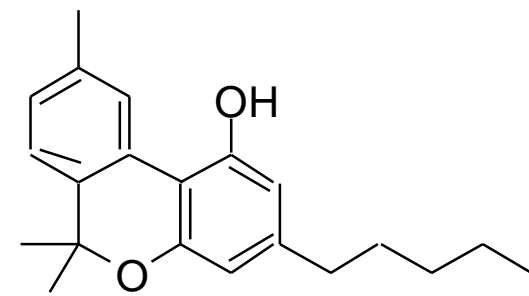
Cannabidiol
(CBD)



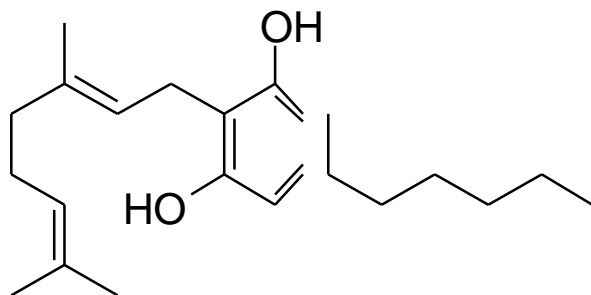
Cannabidiolic acid
(CBDA)



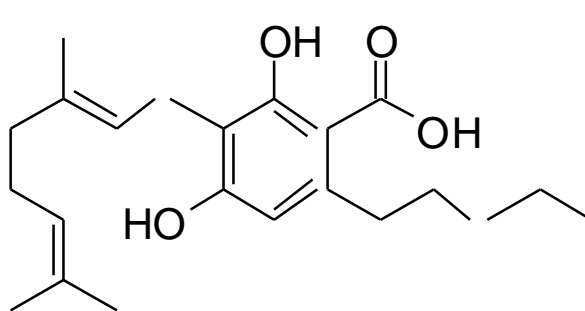
Cannabidivarin
(CBDV)



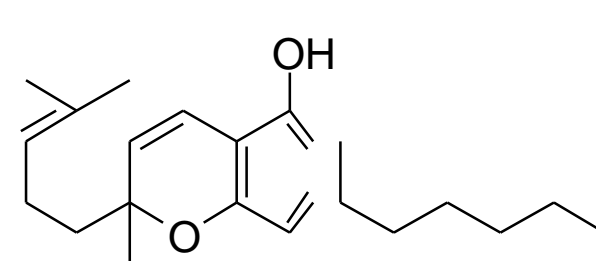
Cannabinol
(CBN)



Cannabigerol
(CBG)

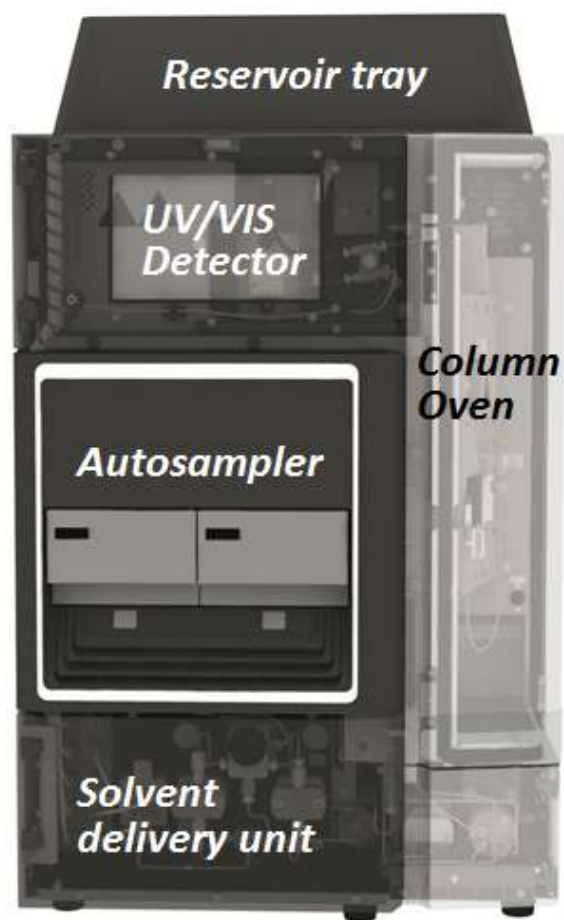


Cannabigerolic acid
(CBGA)



Cannabichromene
19 (CBC)

Service Plans



- Three types of plans offered
- Platinum Plus, Platinum and Gold. PM only also available
- Warranty
- Phone Technical Support



5. “Turn-Key, All-in-One” Package



Methods



Reagents



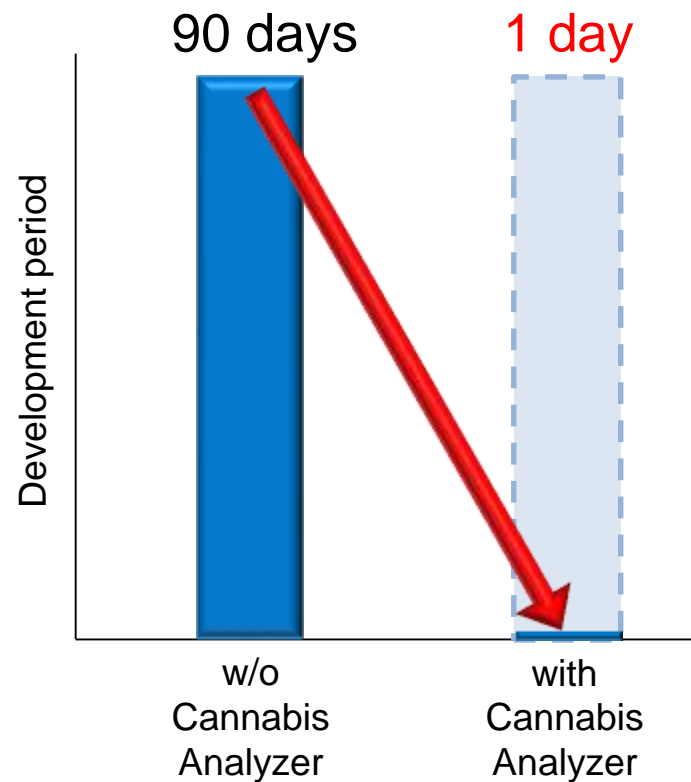
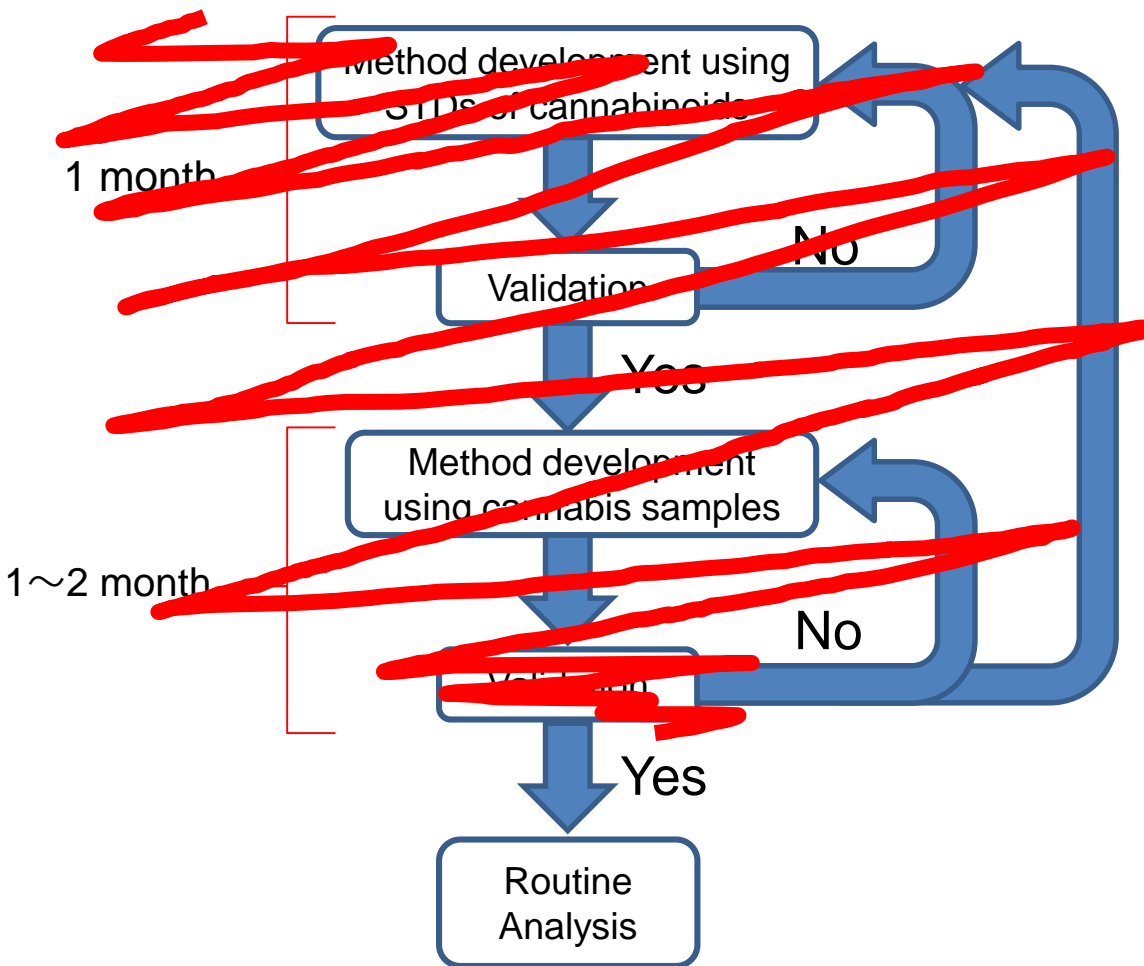
Dedicated Software



Analytical Column



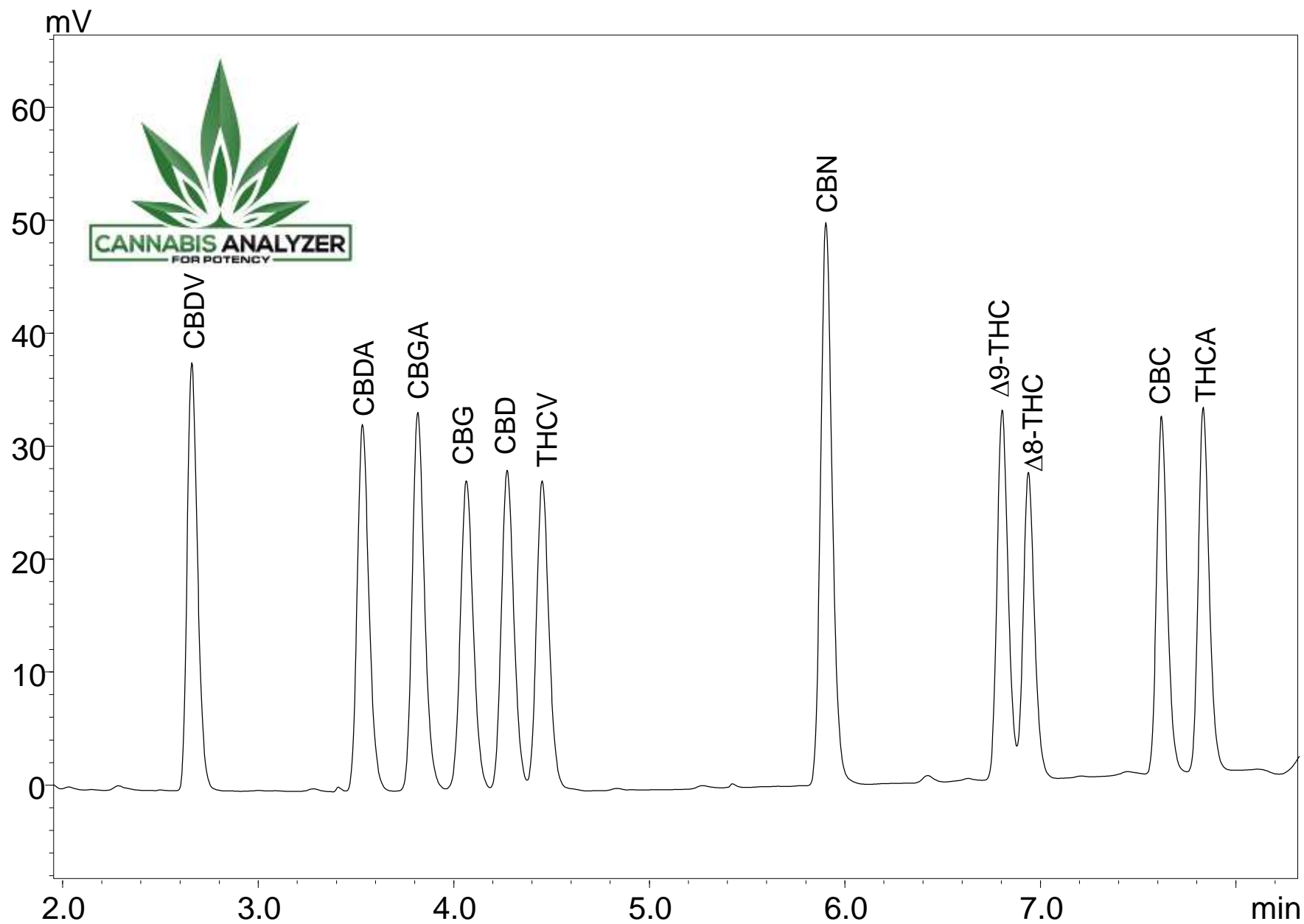
Cannabis Analyzers



“Turn-key” system

No need to spend time on method development or validation!

High-Sensitivity method

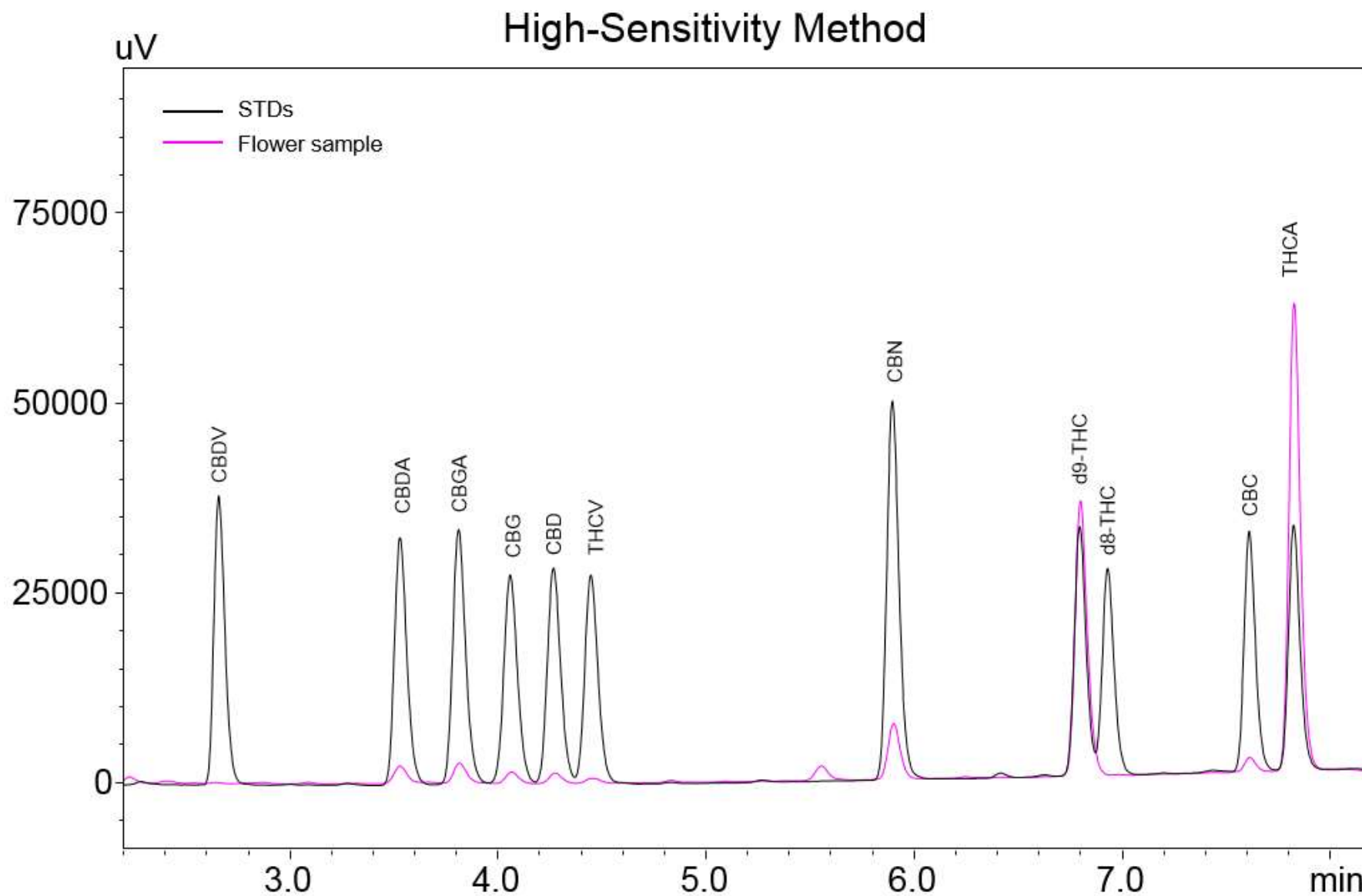


Farm Bill – Passed December 2018

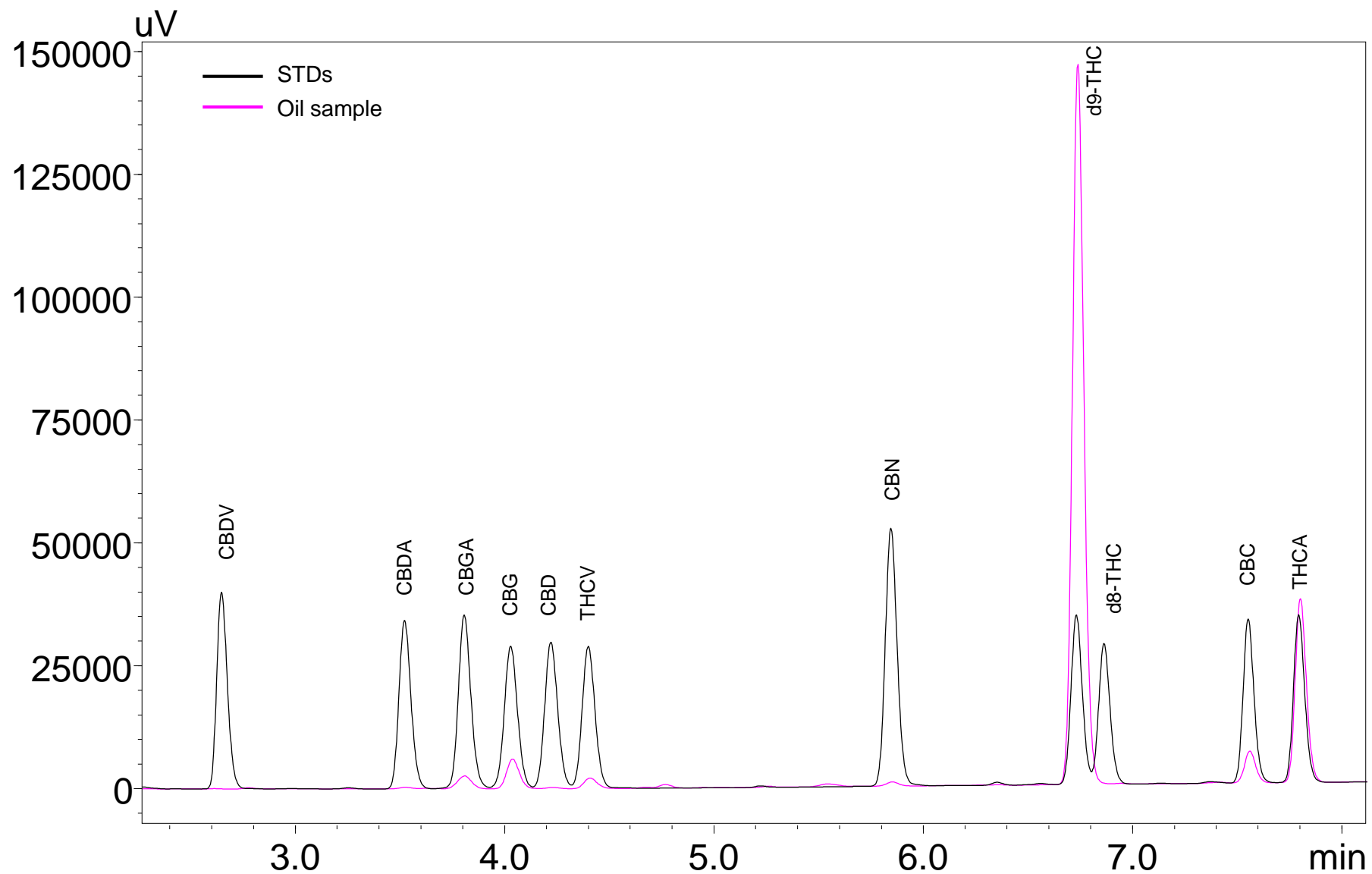
- Cannabis Sativa L. is removed from the Controlled substances act if:
 - Plant contains no more than (NMT) 0.3% THC on a dry-weight basis



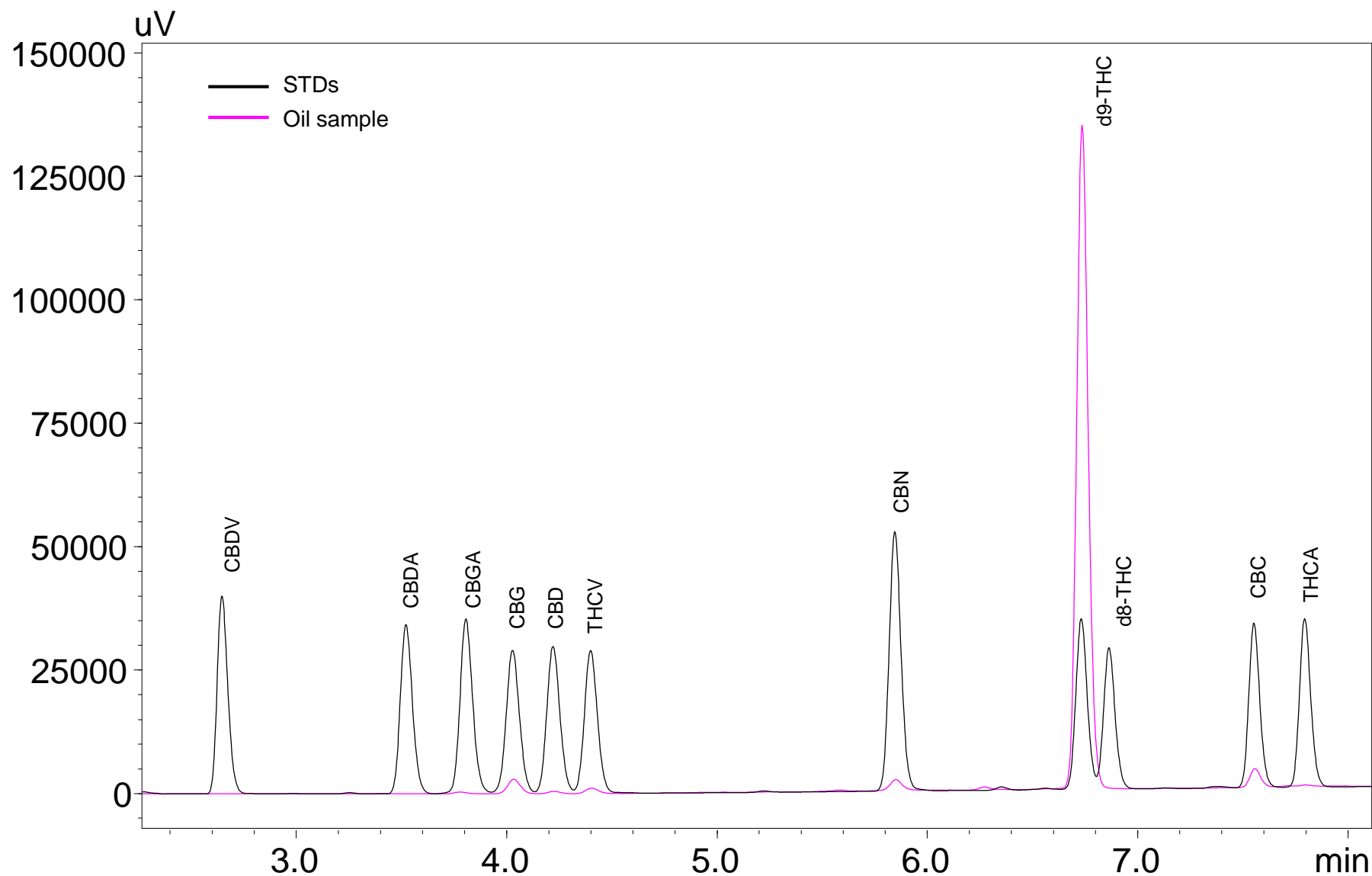
Flower Samples



Oil sample 1 (Raw)



Oil Sample 3 (Refine 2)



CBD in Hemp Oils



Application News

No. HPLC-018

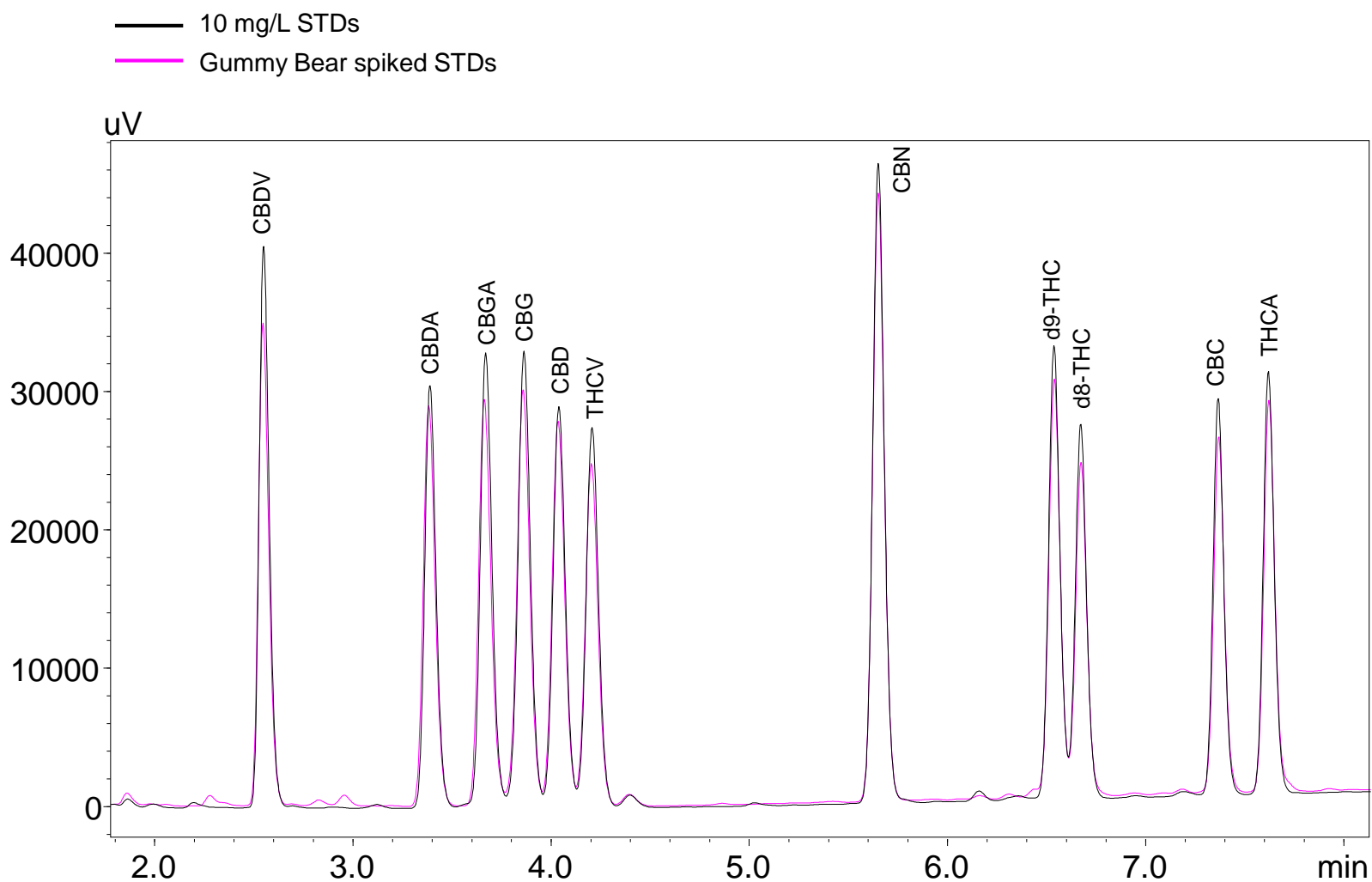
High Performance Liquid Chromatography

The Determination of CBD and General Cannabinoid Content in Hemp Oils Using HPLC with UV Detection



Recovery Results, 100 $\mu\text{g/g}$ spike

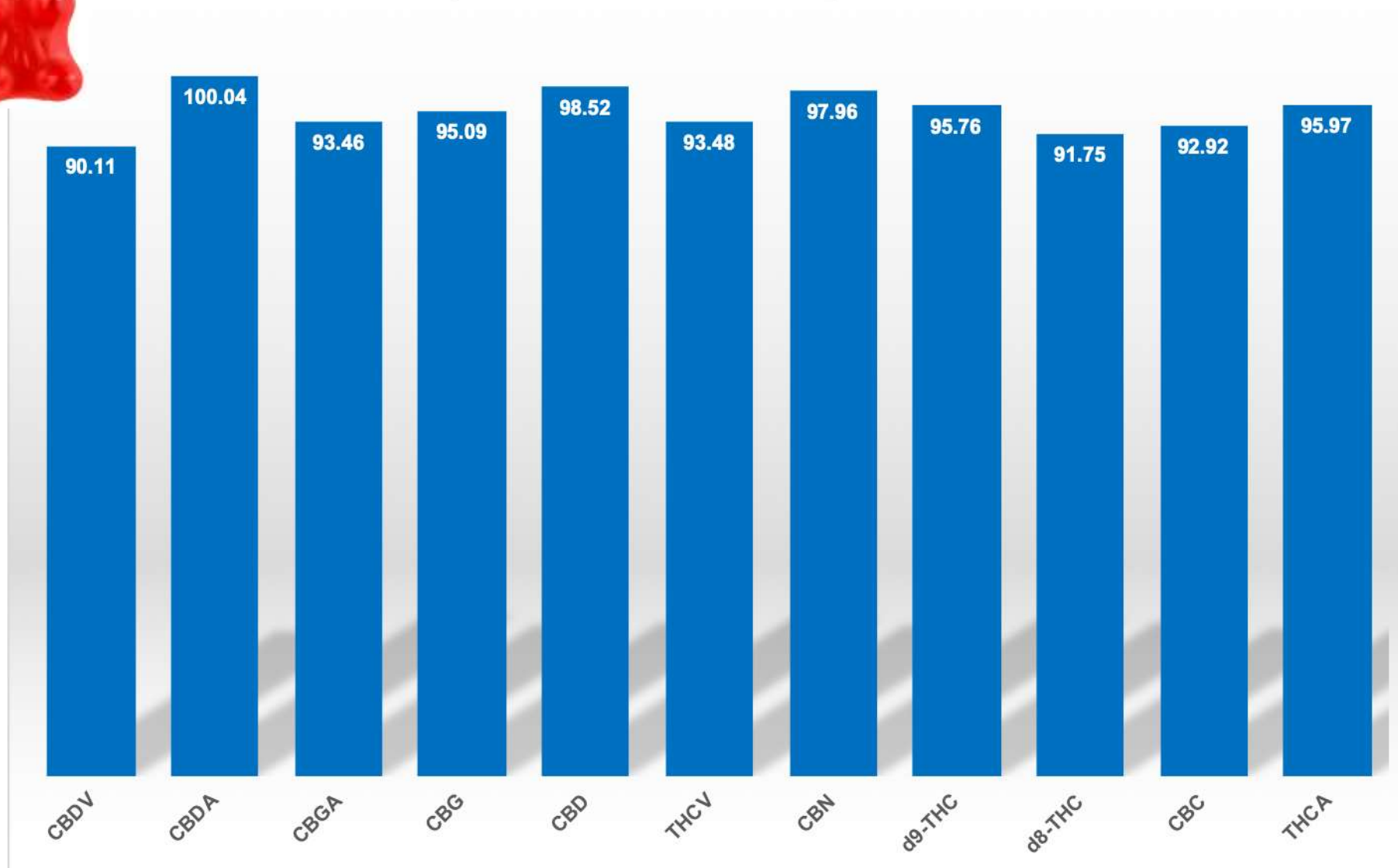
Using Q110 (EN)



Cannabinoid Recovery Results



Recovery % in the Gummy Bear sample



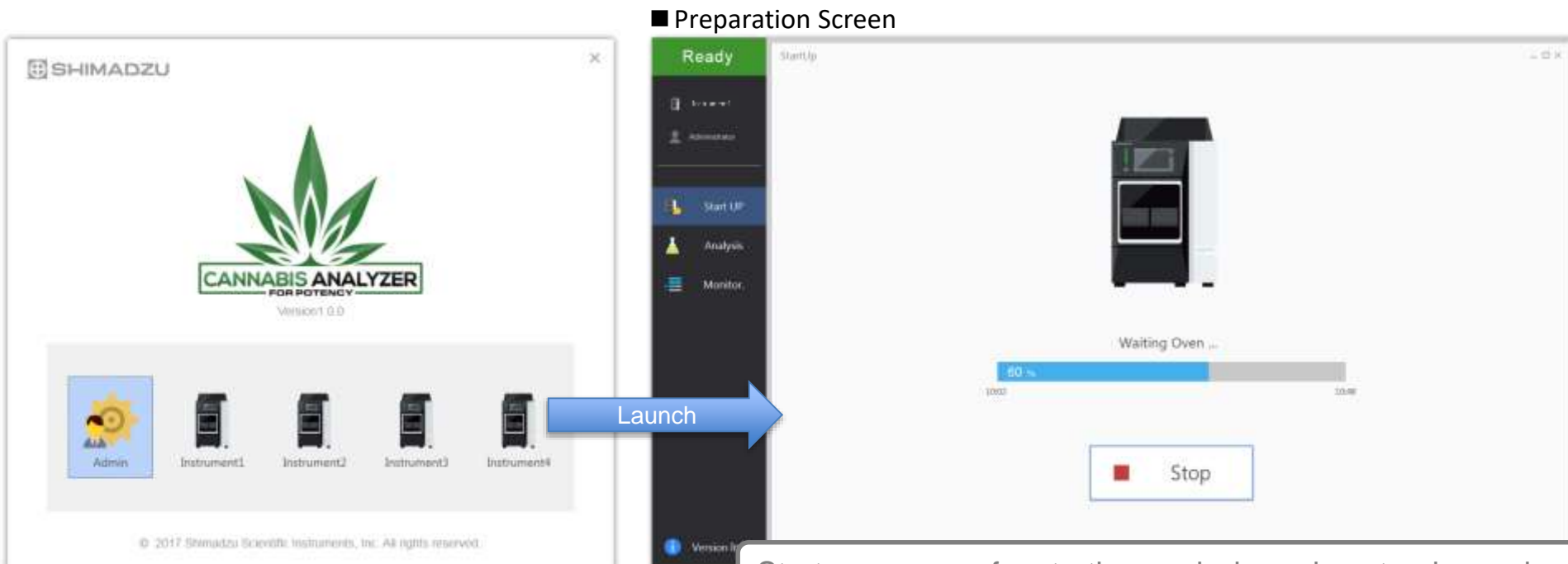
1. Ease of use _ Cannabis Analyzer Software

Outline

- Dedicated software for Cannabis Analyzer with the simple user interface
- Overlay software working on LabSolutions

Features

1. One Click Start-up



The screenshot displays the 'Cannabis Analyzer FOR POTENCY' software interface. On the left, a window titled 'SHIMADZU' shows the application logo and a row of icons for 'Admin', 'Instrument1', 'Instrument2', 'Instrument3', and 'Instrument4'. A blue arrow labeled 'Launch' points from the 'Instrument1' icon to the 'Preparation Screen'. The 'Preparation Screen' is a larger window with a dark sidebar containing 'Ready', 'Start Up', 'Analysis', and 'Monitor' options. The main area shows a 'StartUp' progress bar at 60% with the text 'Waiting Oven' and a 'Stop' button. A text box at the bottom explains the start-up process.

■ Preparation Screen

Start-up process for starting analysis such as turning on i-Series, auto purging, waiting CTO and initial flow are done automatically by one click.

Step 2. Analysis

Ready

Instrument

Admin

Startup

Analysis

Monitor

Version Info.

Analysis

☐ Standard + Unknown
 ☒ Unknown Only

Last calibration was performed at 20:12 PM on 02/07/2017

2

4

1

3

9

18

27

36

45

54

8

17

26

35

44

53

7

16

25

34

43

52

6

15

24

33

42

51

5

14

23

32

41

50

4

13

22

31

40

49

3

12

21

30

39

48

2

11

20

29

38

47

1

10

19

28

37

46

Standard Count : 0

Unknown Count : 4

Clear

Vial	Sample Name	Sample ID	Sample Amount [mg]	Extraction Vol. [mL]	Dilution Factor
20			200	20	20
21			200	20	20
22			200	20	20
23			200	20	20

Paste

+

 Add

▶ Start

Step 3. Monitor

Running

Instrument1

Admin

Startup

Analysis

Monitor

Version Info.

Monitor

2

4

1

3

Selected

Ready

Running

Completed

Duplicated

Interrupted

Task Monitor

Analysis 02/22/2017 - 001

09:19 AM 09:39 AM

Detail

Analysis 02/22/2017 - 002

09:19 AM 09:39 AM

Detail

Analysis 02/22/2017 - 003

09:20 AM 09:40 AM

Detail

Analysis 02/22/2017 - 004

09:20 AM 09:40 AM

Detail

Analysis 02/22/2017 - 005

09:20 AM 09:40 AM

Detail

Start

Stop

Sample Info & Chromatogram

2/21/2017 System Administrator Page 1 / 1

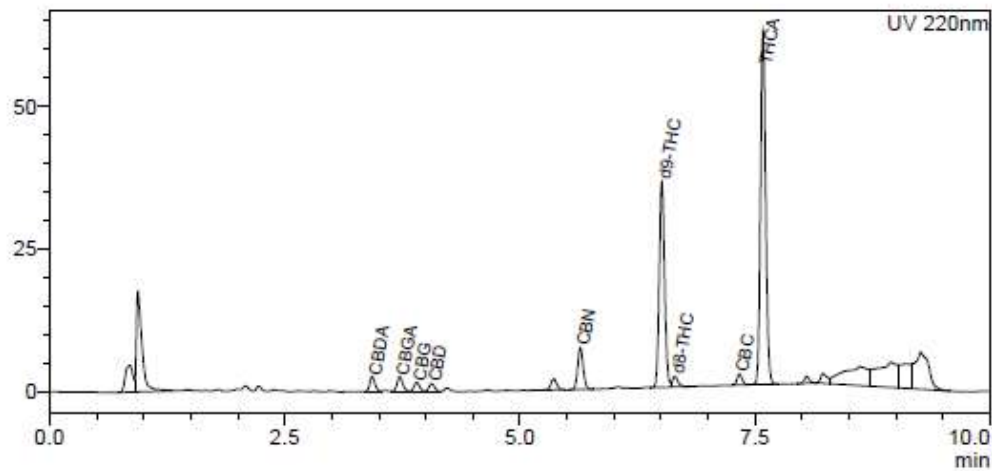


<Sample Information>

System Administrator	
Sample Name	: Flower
Sample ID	:
Data Filename	: Flower_HighSensitivityMethod.lcd
Method Filename	: HighSensitivity.lcm
Batch Filename	: Reporttest.lcb
Vial #	: 1-2
Injection Volume	: 5 uL
Sample Amount	: 200 mg
Extraction Vol.	: xx mL
Dilution Factor	: yy
Date Acquired	: 2016/12/02 18:05:00
Date Processed	: 2017/02/17 19:39:46
Sample Type	: Unknown
Acquired by	: System Administrator
Processed by	: System Administrator

<Chromatogram>

mV



Quantitative Results

<Quantitative Results>

UV

ID#	Name	Ret. Time	Dry weight %
1	CBDV	--	0.00
2	CBDA	3.430	0.13
3	CBGA	3.723	0.13
4	CBG	3.904	0.07
5	CBD	4.063	0.06
6	THCV	--	0.00
7	CBN	5.643	0.27
8	d9-THC	6.509	2.00
9	d8-THC	6.648	0.11
10	CBC	7.335	0.11
11	THCA	7.584	3.74

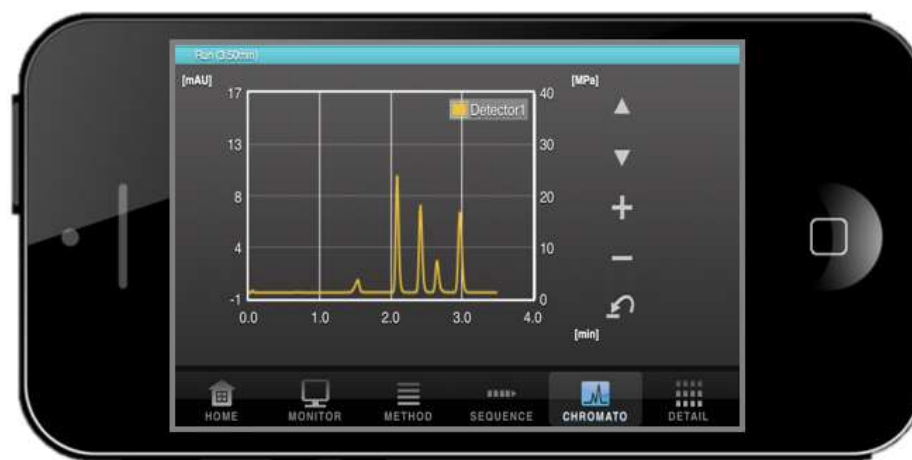
Total THC	5.27	%
Total THC	52.74	mg/g
Total CBD	0.17	%
Total CBD	1.75	mg/g

Smart Phones

System Status



Chromatogram Progress



Terpene Profiling

- Greater than 200 Terpenes found in Cannabis
- Synergistic effect with cannabinoids
- “Entourage Effect”

- Pinene



Linalool



Limonene





Cannabinoid & Terpenes in Trichrome



GI Grow Biomedical Farm Video, Available at Shimadzu's [GrowYourLab.com](https://www.shimadzu.com/growyourlab.com) cannabis microsite.

Different Cultivar have Different Contents



Purple DanX



Purple Erkle



Super Silver Haze



Trainwreck



Bubba Kush



OG Kush



Purple Kush



Sour Diesel


Terpene Profiling

SOUR DOG BIOFUEL BX2
(REZ DOG SOUR DIESEL IBL BX2)

MENDO EXPRESS
(MENDO PURPS X ORIENTAL EXPRESS)
(BILLYGOAT SEEDS)

QUANTITATIVE NETICS™




F1 FIRST GENERATION




THC– 22%

PINENE– 40%


CARYOPHYLLENE– 25%

	<p>Linalool</p> <p>Also found in Lavender</p>	<p>Anesthetic</p> <p>Anti-Convulsive</p> <p>Analgesic</p> <p>Anti-Anxiety</p>
	<p>Pinene</p> <p>Also found in rosemary, pine needles</p>	<p>Anti-Inflammatory</p> <p>Anti-Bacterial</p> <p>Bronchodilator</p> <p>Aids Memory</p>
	<p>Caryophyllene</p> <p>Also found in Echinacea, black pepper</p>	<p>Anti-Inflammatory</p> <p>Analgesic</p> <p>Protects cells</p>

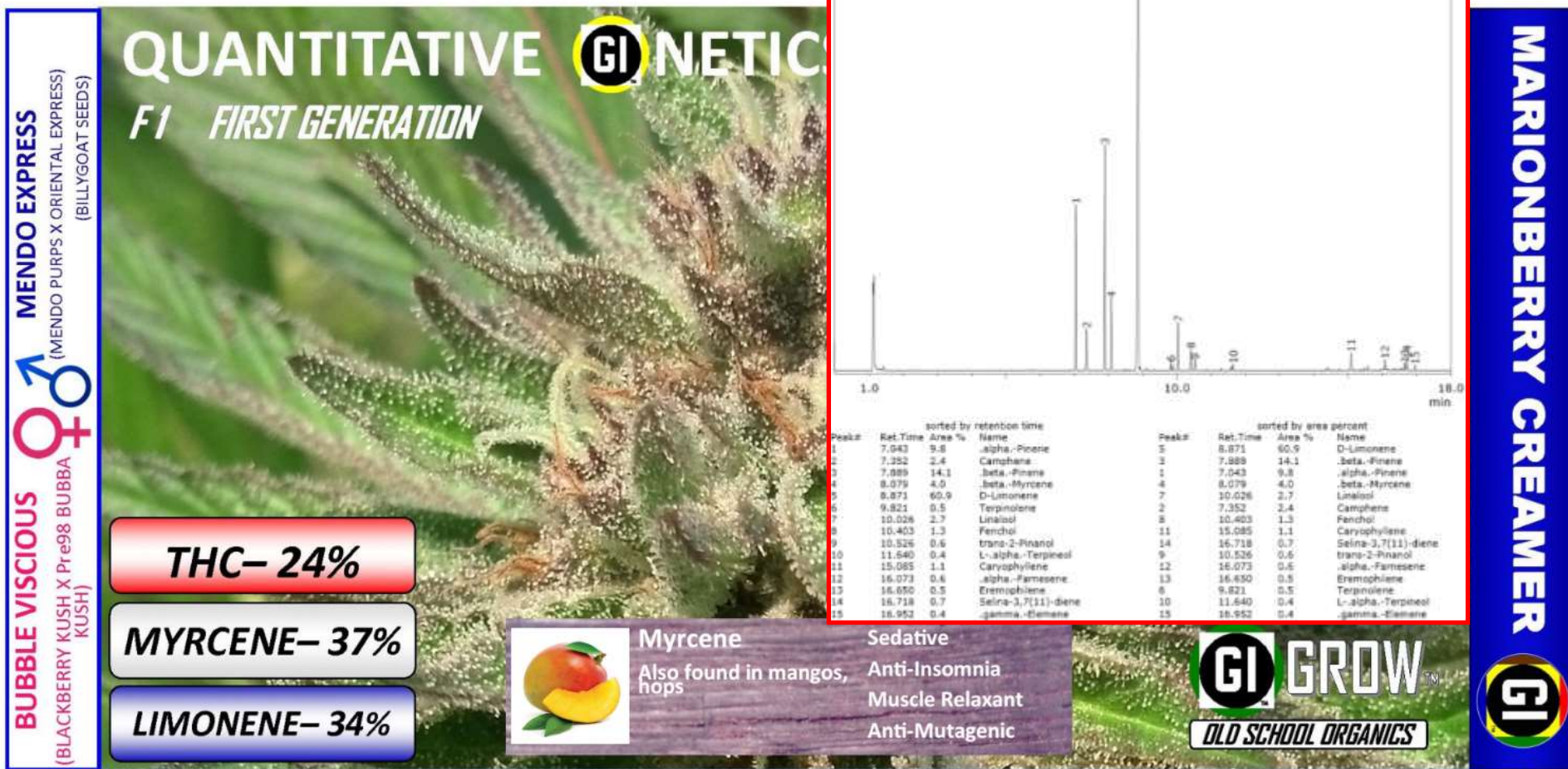


OLD SCHOOL ORGANICS

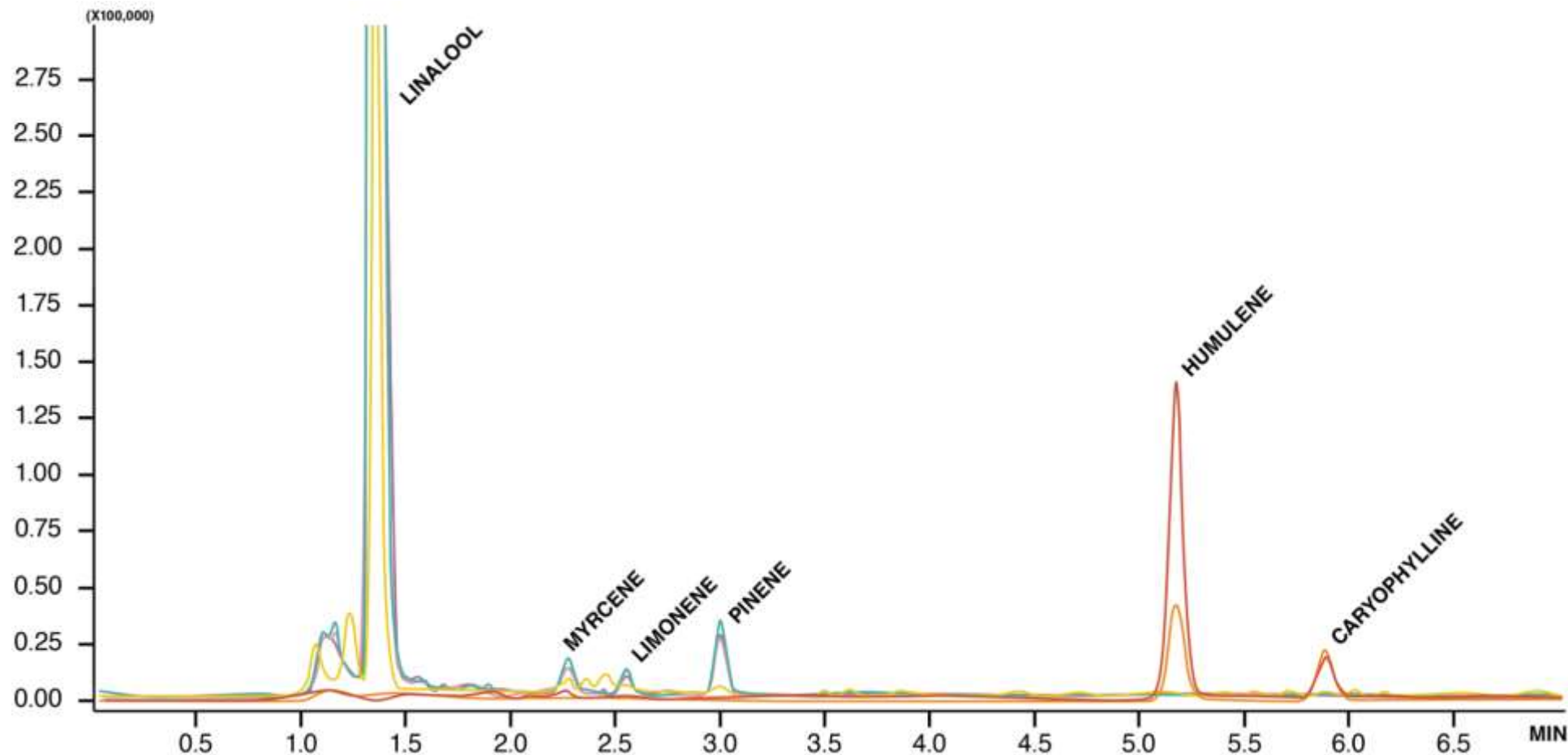
COAL TRAINED



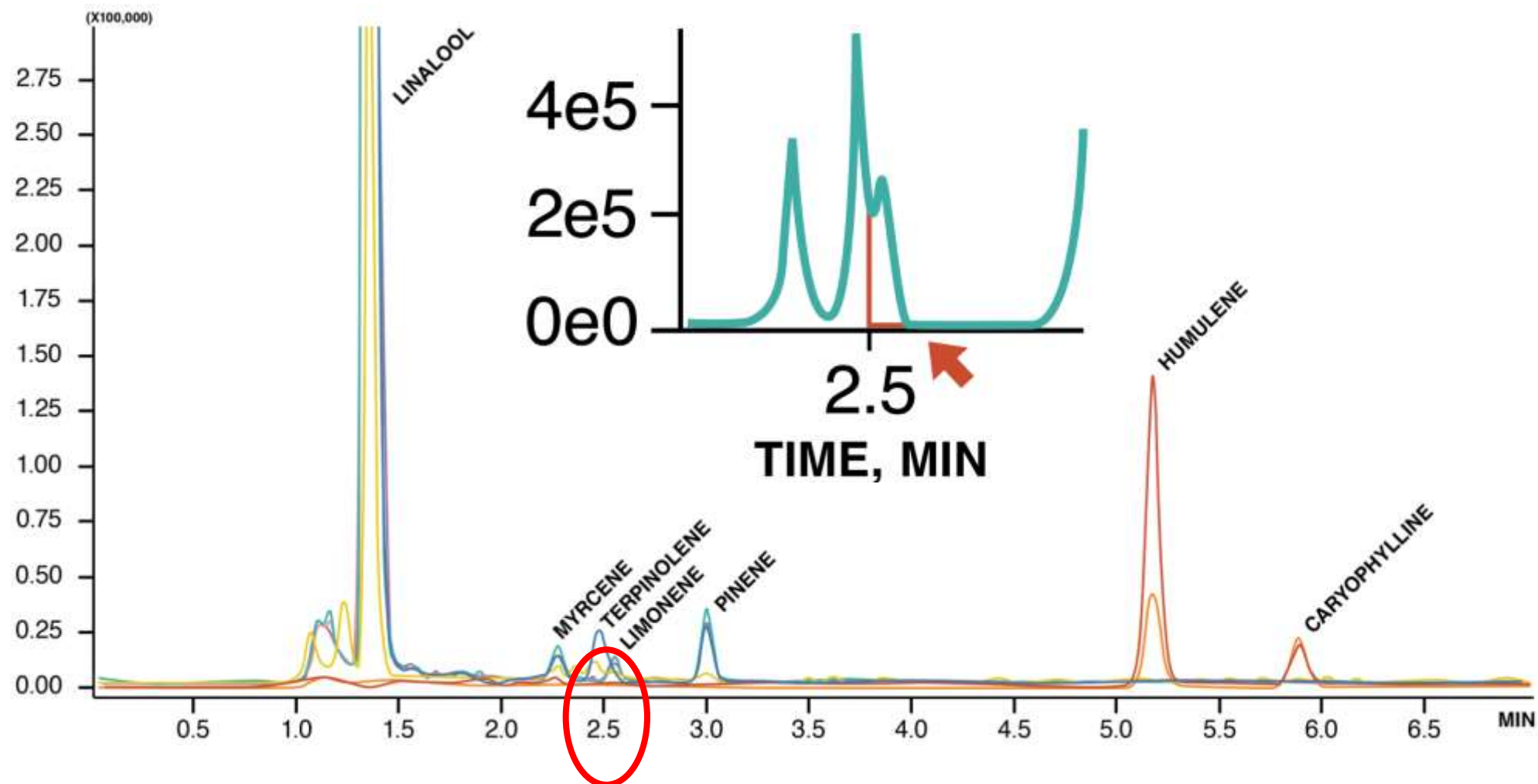
Terpene Profiling



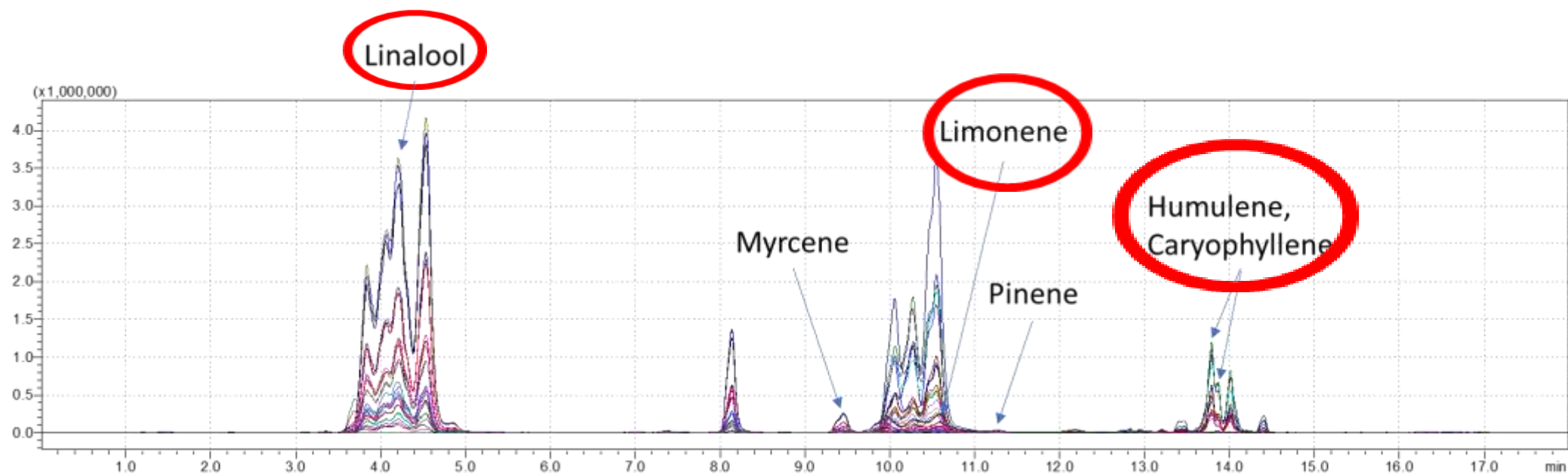
LC-MS/MS Measurement of 6 Terpenes Solvent & Matrix



LC-MS/MS Terpene Analysis with 7 Terpenes



LC-MS/MS Terpene Analysis with 42 Terpene

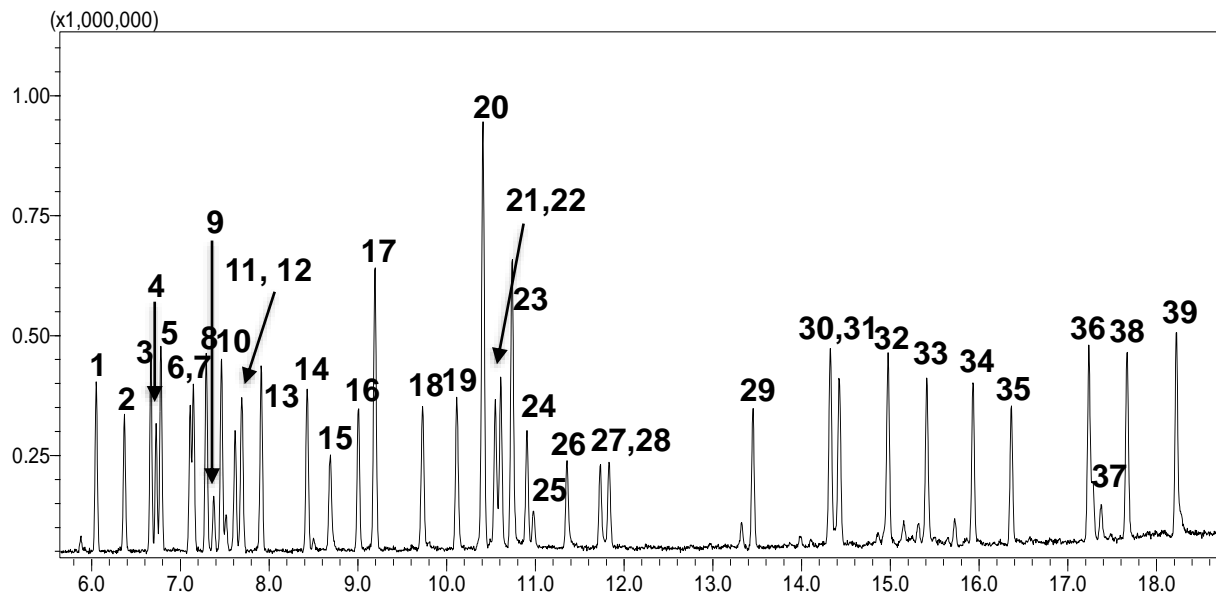


SPEX CertiPrep
Inorganic and Organic Certified Reference Materials

Other Terpenes in cannabis: Caryophyllene Oxide, Nerolidol, Phytol

Russo, Taming THC potential cannabis synergy and phytocannabinoid-terpenoid entourage effects, Br J Pharmacol, 2011

Terpene Analysis by GC-MS



**GCMS-2020NX with HS-20
headspace**



Peak	Terpene	Peak	Terpene
1	α -Pinene	21	Isoborneol
2	Camphene	22	Hexahydrothymol
3	Sabinene	23	Borneol
4	Beta-Myrcene	24	Terpineol
5	Beta-Pinene	25	γ -Terpineol
6	α -Phellandrene	26	Nerol
7	Carene	27	Geraniol
8	α -Terpinene	28	Pulegone
9	β -Ocimene	29	Geraniol acetate
10	Limonene	30	alpha.-Cedrene
11	Ocimene	31	Trans-Caryophyllene
12	Eucalyptol	32	α -Humulene
13	γ -Terpinene	33	Valencene
14	Terpinolene	34	cis-Nerolidol
15	Sabedine Hydrate	35	trans-Nerolidol
16	Linolool	36	Guaiol
17	Fenchone	37	Caryophyllene oxide
18	Fenchyl Alcohol	38	Cedrol
19	Isopulegol	39	α -Bisabolol
20	Camphor		

Cannabis Analytical Testing

Potency profiling

Terpene Profiling

Pesticide screening

Fungicide analyses

Residual solvents

Heavy metals

Mycotoxin/aflatoxin

Moisture content



Nexera UC

Unified Chromatography



Nexera UC

1. Getting to know the terms? SFE/SFC
2. What is a Supercritical fluid?
3. A description of SFE and SFC
4. Where can I use this technology?
5. How has the combined SFE/SFC instrument been received?

Knowing the terms

- SFE – Supercritical Fluid Extraction
- SFC – Supercritical Fluid Chromatography

What is a Supercritical fluid?



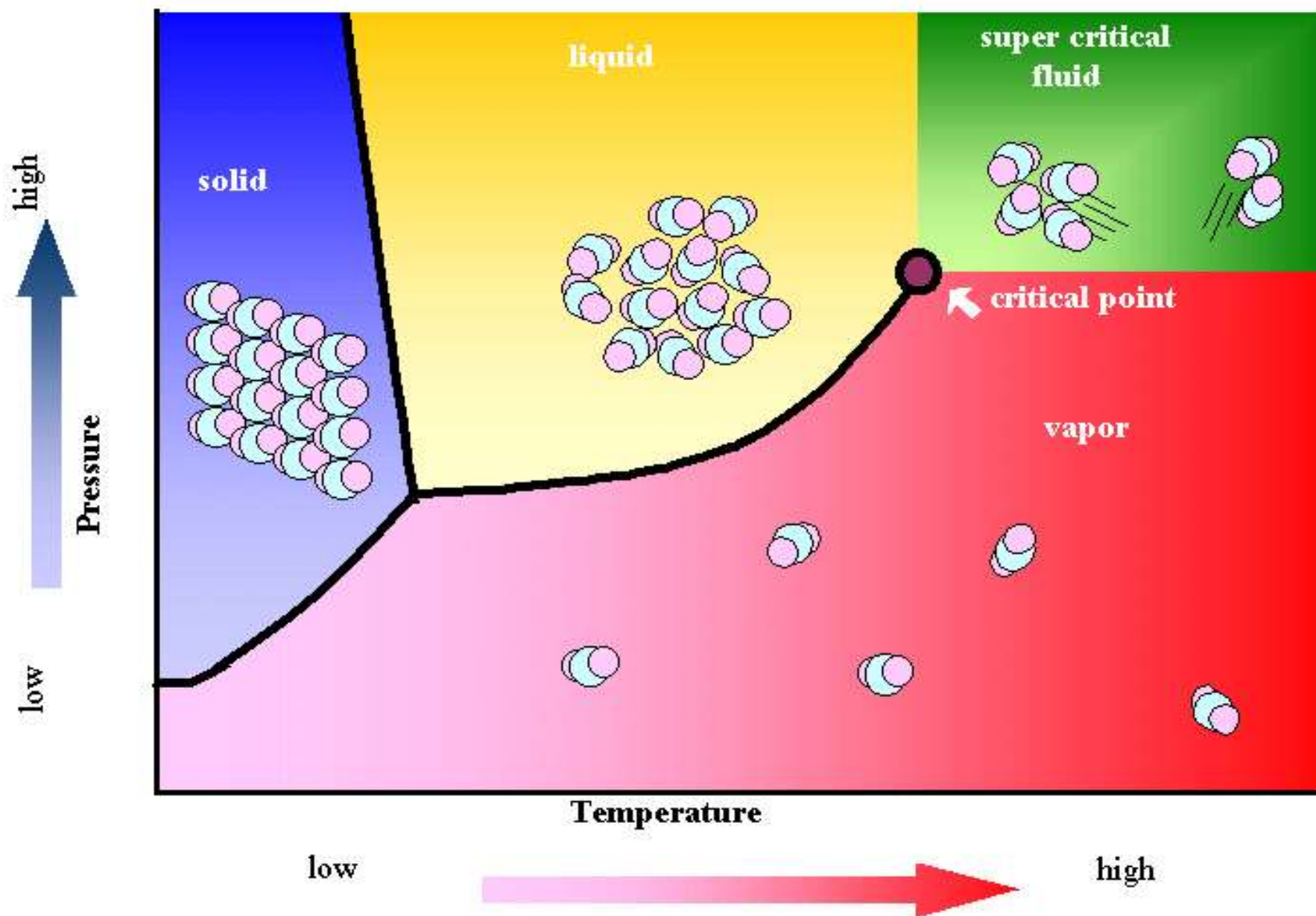
Beer?



Possibly.. However..

- **Supercritical fluid for CO₂ is:** a fluid state of carbon dioxide where it is held at or above its critical temperature and critical pressure. Carbon dioxide usually behaves as a gas in air at standard temperature and pressure (STP), or as a solid called dry ice when frozen

Supercritical Table



Why do we use Carbon Dioxide for Supercritical fluids?

- Easy to handle due to low critical point (31.1 °C, 7.4 Mpa)
- Chemically inert and non-flammable
- High-Purity carbon dioxide can be obtained relatively inexpensively
- Non-toxic and environmentally friendly
- Low polarity: requires adding a solvent (modifier)

Where are Supercritical fluids currently used?

- Decaffeination of coffee – Has been performed for over 30 years. The extracted caffeine is on sold to pharmaceutical and food industries.



Where are Supercritical fluids currently used?

- Removing cork taint from corks... Over a billion corks annually.



Lets talk about.... Supercritical Fluid Extraction SFE

- Supercritical Fluid Extraction – An extraction method using supercritical fluid. It's also as a pretreatment method for solid sample analysis.



SFE features

- Carbon Dioxide is a non-polar molecule, it readily dissolves hydrophobic compounds, similarly to organic solvents such as hexane etc.
- Density can be varied easily by varying pressure. Allows solubility of the solvent to be varied.
- Polarity can be varied by extracting compounds along with an organic solvent additive such as Methanol. It can be used for extracting a wide range of compounds.

SFE features

We can extract for a wide range of analysis

- Dried blood spots
- Trace additives in polymers
- Pesticide analysis in food
- Drugs of abuse
- Cannabinoids in Cannabis leaf

SFE features

- Reduces time for lengthy sample preparation techniques which include centrifugation and homogenization in conjunction with QuEChERS(Quick Easy Cheap Effective Rugged Safe)
- Nexera UC provides capability for 5 minute sample prep with no intervention



Using SFE

- Extraction performed inline
- Nexera UC is capable of online extraction and analysis under supercritical conditions
- SFE is gentle to the analytes it extracts

How are the samples introduced into the instrument



SFE Extraction tray with either 0.2 ml or 5ml vessels



SFE Extraction Vessel 0.2 ml



SFE Extraction Vessels 0.2 ml and 5.0 ml



That's a intro in SFE, lets talk about SFC?



SFC

- SFC – Supercritical Fluid Chromatography- It's the chromatographic technique using supercritical fluids as mobile phases.
- It has unique properties, It enables high-speed, high-resolution analysis and improved efficiency

SFC - Using a super critical fluid as mobile phase

- Straight CO₂ is not the perfect mobile phase but adding a modifier like methanol or ACN, this is performed via the modifier pump.
- Environmentally friendly CO₂ is collected from existing fermentation processes and bottled

SFC – Mobile phase benefits

- Very fast separation speed due to relatively low viscosity of supercritical fluid
- Improved separation and detection capabilities from the low viscosity and high diffusion coefficient of supercritical fluid
- Replaces dreaded normal phase chromatography using toxic solvents e.g. hexane

SFC - Benefits

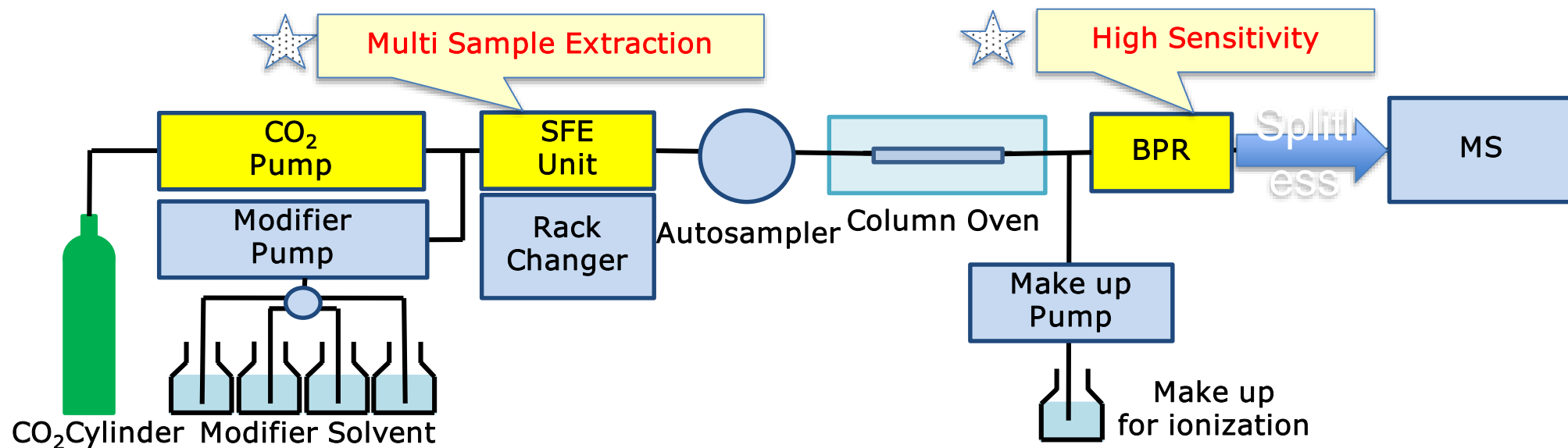
- Supercritical fluid has unique properties different from liquid solvents
- Using SFC as a inlet to a mass spectrometer offers greater sensitivity than achieved by LC/MS/MS
- Reduction of environmental impacts and costs by reducing amount of organic solvents needed

So what is Unified Chromatography?

- It unites the sample preparation and chromatography into one instrument – Nexera UC
- SFE, SFC and LC/MS/MS in one instrument
- Extraction to chromatography performed under supercritical conditions

Nexera UC system configuration

Online SFE-SFC System



Extraction Vessel



Summary: True Comprehensive Cannabis Analysis

Ease of Compound Measurements by Instrument Type (★★★★= Easiest)

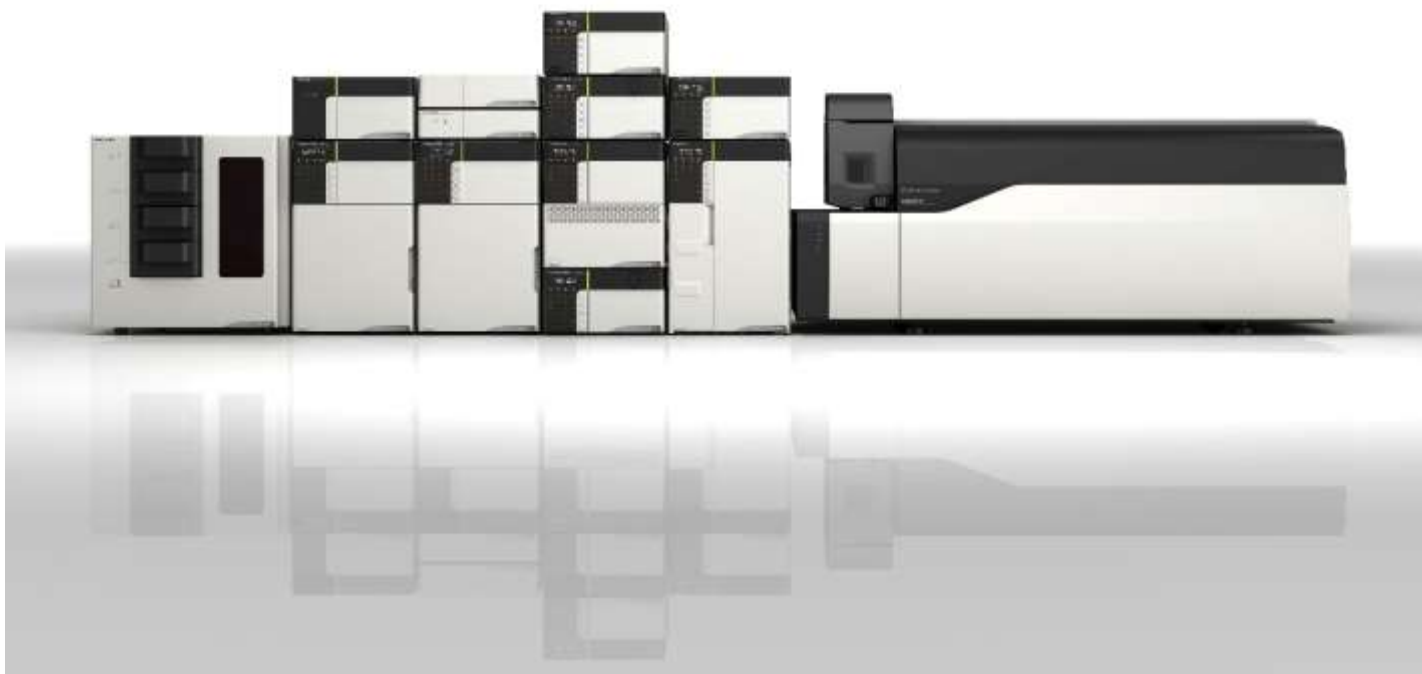
		LCMS	GCMS	HPLC	HS-GCMS	HS-GC	ICP-MS
	Potency	★		★★★★			
	Terpenes	★	★★		★★★★	★★	
	Mycotoxins	★★★★		★			
	Residual Solvent		★★		★★★★	★★	
Pesticides	Imidacloprid	★★★★					
	Myclobutanil	★★★★					
	Malathion	★★★★					
	Pyrethrin1	★★★★	★★				
	Cyfluthrin	★★★★	★★				
	MGK-264	★★	★★				
	Cypermethrin	★★	★★★★				
	Captan	★★	★★★★				
	Methyl parathion	★	★★★★				
	Chlordane	★	★★★★				
	Endosulfan	★	★★★★				
	Heavy Metals						★★★★

Summary: True Comprehensive Cannabis Analysis

Ease of Compound Measurements by Instrument Type (★★★= Easiest)

		LCMS	GCMS	HPLC	HS-GCMS	HS-GC	ICP-MS	MALDI-TOF
	Potency	★		★★★				
	Terpenes	★	★★		★★★	★★		
	Mycotoxins	★★★		★				
	Residual Solvent		★★		★★★	★★		
Pesticides	Imidacloprid	★★★						
	Myclobutanil	★★★						
	Malathion	★★★						
	Pyrethrin1	★★★	★★					
	Cyfluthrin	★★★	★★					
	MGK-264	★★	★★					
	Cypermethrin	★★	★★★					
	Captan	★★	★★★					
	Methyl parathion	★	★★★					
	Chlordane	★	★★★					
	Endosulfan	★	★★★					
	Heavy Metals						★★★	
	Microorganism							★★★
	CultivarType							★★★

Nexera UC – Unified Chromatography



Fraction Collection?



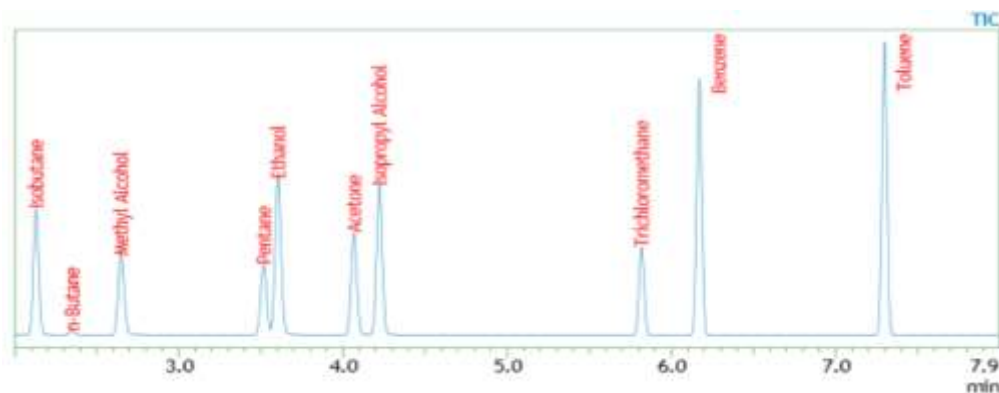
LH-40 Liquid Handler



FRC-40 Fraction Collector

Residual Solvents

- Applicable to cannabis extracts
- Low level analysis of solvents left over from extraction production
- Relatively inexpensive
- Requires very little sample prep



Residual solvents – Nexus GC-2030

- **Nexus GC-2030 Dual FID**
- **HS-20 Headspace Auto-sampler**
- **USP <467> Residual solvent in Pharmaceuticals**



Types of Compliant LabSolutions Software

Products		Form	Data Management
LabSolutions	File Management edition	Standalone	File Management
LabSolutions DB	DB edition	Standalone	Database Management
LabSolutions CS	CS edition	Network	Database Management

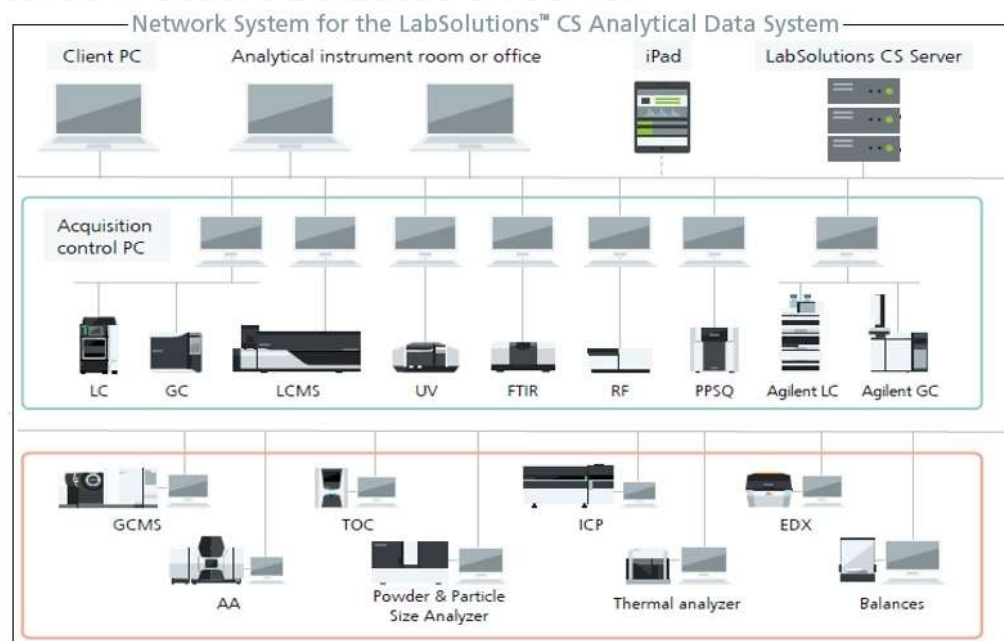
【Standalone】

Management on 1 PC



【Network】

Client - Server type. Data and System information are stored in secure Database on Server.



Summary

- **Terpene analysis – GCMS with HS-20**
- **Potency – Prominence-I HPLC**
- **Extraction of Cannabinoids - Nexera UC for SFE**



Summary

- Heavy Metal Analysis – ICP-MS
- Residual Solvents – GC with Dual FID
- Pesticides - GCMS and LCMS
- Mycotoxins - LCMS
- Moisture content – Moisture Balance
- Delivery – Yes





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Shimadzu Cannabis Testing Solutions

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- Technical Inquiry
- Other Inquiry
- Order Samples

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