

# Analytical workflows in cannabis testing

**Supelco Product offerings for your customers**

Kathy Stenerson, Analytical Sciences Liaison  
Distributor Training, Sept. 10, 2021



**Supelco®**  
Analytical Products

The life science business of Merck KGaA, Darmstadt, Germany  
operates as MilliporeSigma in the U.S. and Canada.

**Millipore  
Sigma**

# Agenda

- 01** Why test cannabis?
- 02** Regulatory landscape
- 03** Workflow overviews
- 04** Technology highlights
- 05** Collateral

# why test cannabis?

01

# What is Cannabis?

## Three species

*Cannabis sativa*

*Cannabis indica*

*Cannabis ruderalis*

## Usage

Medicinal

Industrial

Recreational

## Qualifying Condition

Cancer

Glaucoma

HIV/AIDS

Multiple sclerosis

Epilepsy

PTSD



Supelco Products for Analytical Cannabis Testing WFS Distributing Sept. 10, 2021

## Commercial Formats

Plant material

Oils/Extracts

Edibles

Creams

Pharmaceuticals



# Why Test Cannabis?

## Patient & Consumer Health



### Purity

- Safety
- Impurities

Pathogens, pesticides, heavy metals, residual solvents, fungal toxin



### Potency

- Label Claim
- Correct dosage?
- Correct Strain?
- Hemp vs Cannabis

Cannabinoids, terpenes

## Optimize Production



### Agriculture & Genetics

- Sex identification
- Strain integrity
- Selective breeding
- Cannabinoid profile

Cannabinoids, Pesticides



### Potency

- Timing for harvesting
- R&D, QC of strain characteristics
- Processing

Cannabinoids, terpenes



\* Terpenes are the aromatic compounds in Cannabis that are believed to have an important influence on the effects of cannabis through what is known as the "entourage effect". They are also crucial to strain identification.

# regulatory Landscape

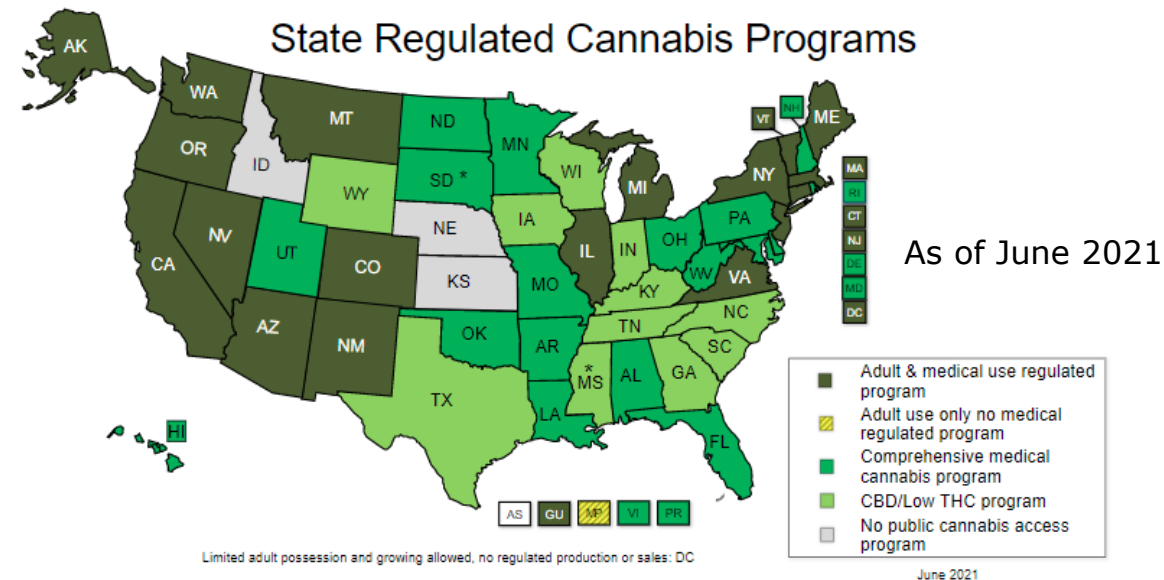
02

# Current Legal Environment

Highly fragmented legal and regulatory environment globally



**Canada –**  
Legal both for medical and recreational use



United States	
Category	# States Legal
Medical & Recreational Marijuana	18 States, + Washington DC
Medical Marijuana	18 States
CBD/Low THC (hemp)	Federally legal

# Regulatory Landscape

## **Cannabis still listed under Schedule 1 of the Controlled Substance Act**

- reserved for drugs that have “no currently accepted medical use”
- Under jurisdiction of DEA (DoJ)

## **No national regulatory policy in place for the Cannabis industry**

- Quality control
- Safety

## **Possession of Cannabis has been decriminilized by many states & municipalities**





# Potency

## Regulated Cannabis testing

### Cannabinoids

- Major therapeutic and psychoactive chemical component of cannabis
- >100 cannabinoids present, mainly in extremely minute amounts
- State regulations range from 3– 6 different compounds, most states require THC, CBD and CBN (cannabinol)



### Optional: Terpenes

- Strong aromatic component to Cannabis
- Potential for synergistic effects with cannabinoids – “Entourage effect”
- Useful in strain identification



# Purity

## Regulated Cannabis testing

Impurities are further concentrated in the extraction process

### Pesticides

- Many states have developed own lists (Ex: OR = 47, NV = 33 required)
- Fungicides are particularly important

### Heavy Metals

- Uptake of trace levels of heavy metals such as arsenic, cadmium, mercury, and lead from soil and through the use of certain fertilizers
- Some states following United States Pharmacopeia (USP) <232> for elemental impurities

### Filth/Foreign Materials

- Hair, insects, feces, packaging contaminants, and manufacturing waste and by-products

### Residual Solvents

- Extracting solvents and processing chemicals left over from cannabinoid extraction process (butane is quite common)

### Microbiology Impurities

- Morphology of medical cannabis makes it especially vulnerable to fungal infections
- Microorganisms can be introduced through handling, transportation and processing

### Moisture Content & Water Activity

- Evaluated in dried plant material, various techniques applied



# California cannabis regulations

## Spotlight on CA required testing

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### 6 Cannabinoids

- THC
- THCA
- CBD
- CBDA
- CBG
- CBN



### 4 Heavy Metals

- Cadmium, Lead, Arsenic, Mercury

### Mycotoxins

- Aflatoxins B1, B2, G1, G2 plus Ochratoxin

### Microbiological Impurities

- E-coli, salmonella, aspergillus

### 22 Residual Solvents and Processing Chemicals

### Moisture Content & Water Activity

### 66 Residual Pesticides

### Filth/Foreign Materials



Optional: Terpenes

**Certificate of Analysis**

# Pennsylvania cannabis regulations

## Spotlight on PA required testing

### Cannabinoids

- THC
- CBD
- THCA
- CBDA
- CBG
- CBN

### Terpenes

- No specific list

### 2 Residual Solvents and Processing Chemicals

- Butane, Ethanol

### 62 Residual Pesticides

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### 4 Heavy Metals

- Cadmium, Lead, Arsenic, Mercury

### Mycotoxins

- Aflatoxins B1, B2, G1, G2 plus Ochratoxin

### Microbiological Impurities

### Moisture Content & Water Activity

### Filth/Foreign Materials

Millipore  
Sigma

# Types of customers

## 3 Government



Steep Hill

## 4 Testing Labs



## 2 Cannabis Product Manufacturers



## 1 Growers with in-house QC

Growers with in-house QC



## 5 Research Institutions



## 6 Pharma

Pharma

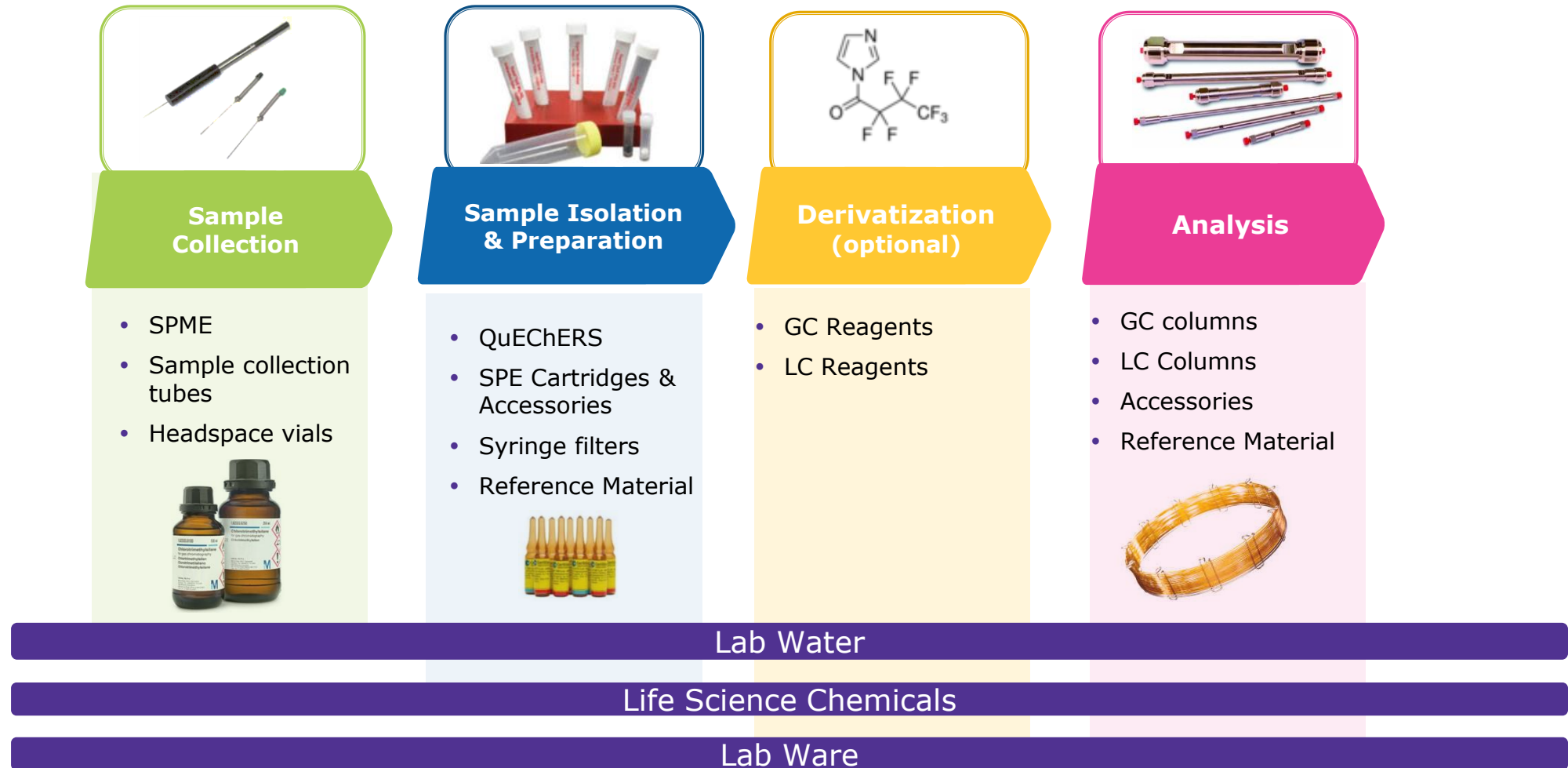


# WORKFLOW OVERVIEWS

03

# What is an analytical workflow?

## LC, LC-MS, GC, GC/MS





# Main Analytical Workflows in Cannabis Testing Labs

Cannabis Facts	
 <b>CERTIFIED</b> <b>CANNABACEUTICALS™</b> Tested On: October 12, 2010 Tested By: The Werc Shop	
Strain Name: <b>Bubba Kush (KB)</b>	<small>May cause drowsiness. Alcohol may intensify this effect. Do not use while operating a car or heavy machinery. Keep out of reach of children. FOR MEDICAL USE ONLY. IN COMPLIANCE WITH HHS CODE 11362.5 IN ACCORDANCE WITH CA HHS CODE SEC. 11362.5(b)(1)(A) &amp; 11362.7(b)</small>
Strain Type: <b>Indica</b>	WL %
<b>Δ<sup>9</sup>-THC Maximum:</b>	<b>16.1 %</b>
Δ <sup>9</sup> -THCA	17.4 %
Δ <sup>9</sup> -THC	0.82 %
<b>CBD Maximum:</b>	<b>0.25 %</b>
CBDa	0.04 %
CBD	0.22 %
<b>CBN:</b>	<b>0.33 %</b>

## Cannabinoids

- THC, CBD, etc.



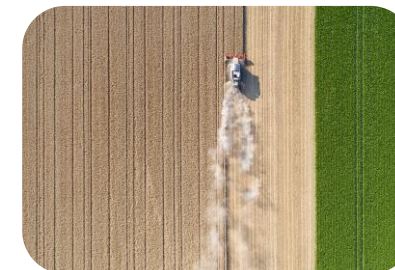
## Terpenes

- Limonene, pinene, etc.



## Residual solvents

- Butane, isobutane, ethanol, etc.



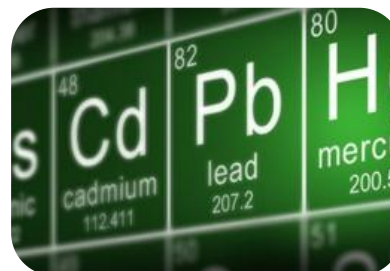
## Pesticides

- Insecticides, herbicides, anti-fungals



## Mycotoxins

- Aflatoxins, Ochratoxin



## Heavy Metals

- Cd, As, Pb, Hg

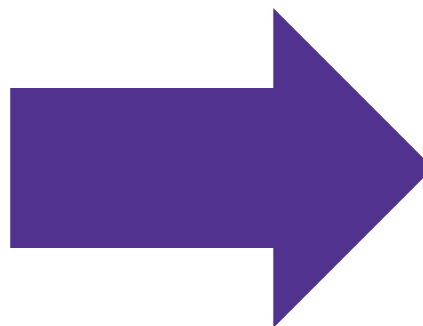


## Microbiology

- Mold, yeast, bacteria



# Cannabinoids



Cannabis Facts		Little Amsterdam
	CERTIFIED	<p>May cause drowsiness. Alcohol may intensify this effect. Do not use while operating a car or heavy machinery. Keep out of reach of children. <b>FOR MEDICAL USE ONLY.</b> IN COMPLIANCE WITH H&amp;S CODE 11362.5 IN ACCORDANCE WITH CA H&amp;S CODE SEC. 11362.5(B)(1)(A) &amp; 11362.7(H)</p>
	CANNABACEUTICALS™	
	Tested On: <b>October 12, 2010</b> Tested By: <b>The Werc Shop</b>	
Strain Name: <b>Bubba Kush (KB)</b>		
Strain Type: <b>Indica</b>	Wt. %	
<b>Δ<sup>9</sup>-THC Maximum:</b>	<b>16.1 %</b>	
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Δ <sup>9</sup> -THC	0.82 %	
<b>CBD Maximum:</b>	<b>0.25 %</b>	
CBDA	0.04 %	
CBD	0.22 %	
<b>CBN:</b>	<b>0.33 %</b>	
<small>Cannabaceuticals™ and the "CC" are trademarks of The Werc Shop, Inc.</small>		

Most common test –required by all states!

# Typical Cannabinoid Testing Workflow

Supelco®

Homogenize & weigh sample

Solvent Extraction

Dilution

Filter

HPLC analysis



# Cannabinoids

## Identify and Quantitate Cannabinoids

### MilliporeSigma Products:

#### Sample prep

#### Solvents

- Ethanol, methanol commonly used

#### Sample vials

#### Syringe filters

#### Analysis

#### HPLC columns

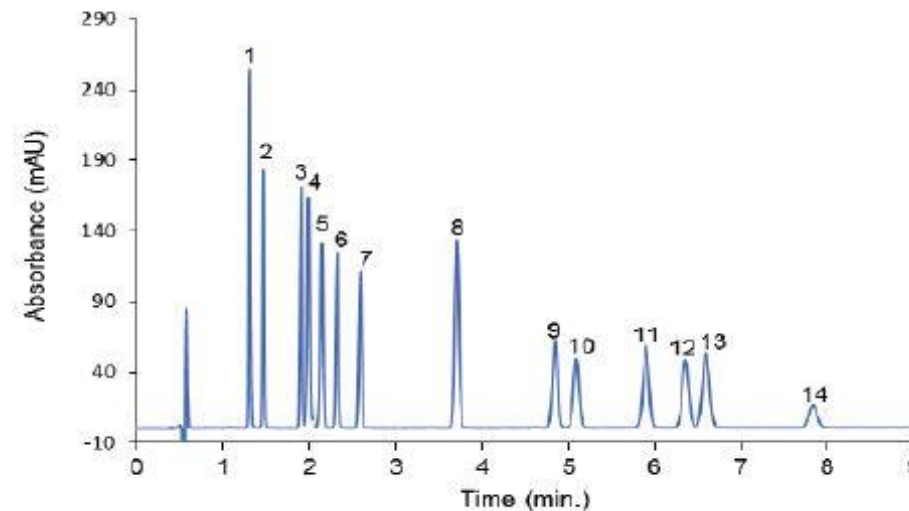
- Ascentis® Express C18
- Chromolith®

#### HPLC grade solvents for mobile phase

- Acetonitrile, methanol, water - LiChrosolv® & OmniSolv®

#### Reference materials

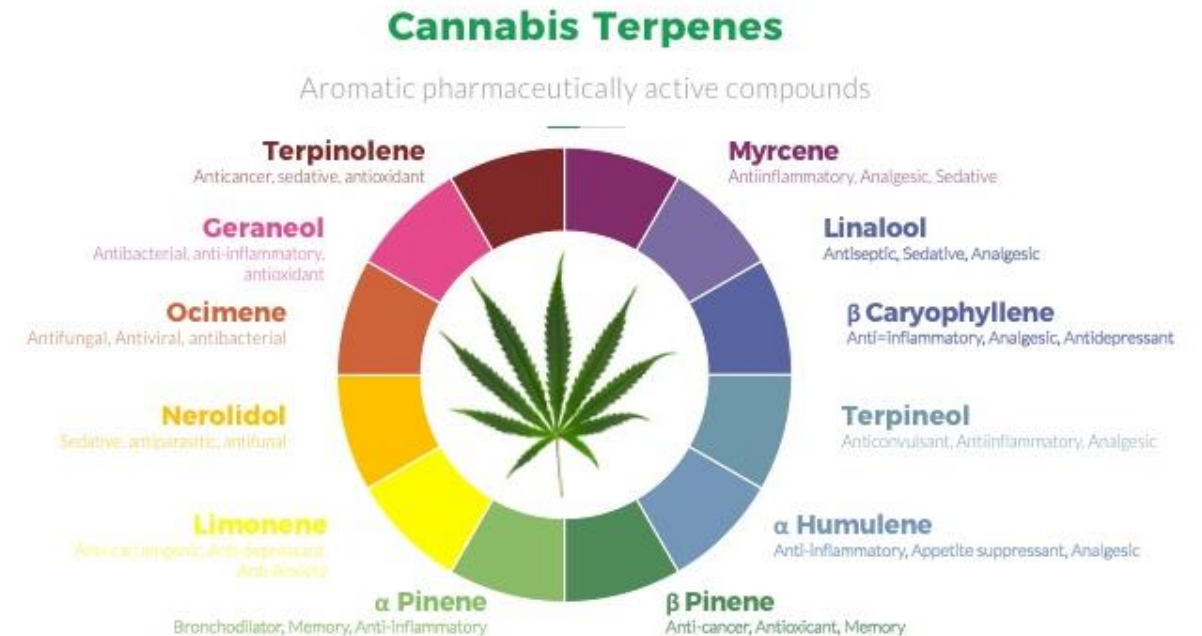
- Cerilliant cannabinoid CRMs (individuals and mixes)



# Terpenes

## Identify and Quantitate Terpenes

Terpenes confer the fragrance of Cannabis and can have pharmacological effects (independent of or possibly in conjunction with, cannabinoids).



Two typical analysis workflows

1. Headspace GC analysis
2. Solvent extraction, GC analysis



# Terpenes

## Identify and Quantitate Terpenes

### MilliporeSigma products for sample preparation:

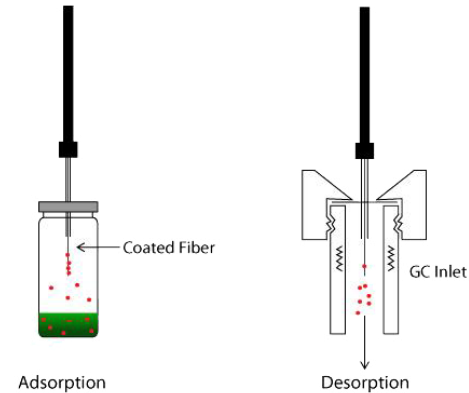
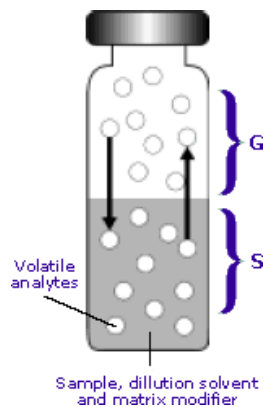
#### Headspace Extraction

- Autosampler Vials & Caps
- SupraSolv® Headspace grade solvents
- SPME

OR

#### Solvent Extraction

- Vials – for extraction and autosampler
- OmniSolv® & SupraSolv® GC grade solvents



Supelco®

# Terpenes

## Identify and Quantitate Terpenes

### Products for Analysis:

#### Standards

- Terpene mixes
- Individual terpenes

#### GC Columns

- Equity® -1, SLB® -1ms
- SLB® -5ms

#### GC accessories

- Inlet consumables
- Gas purification & handling

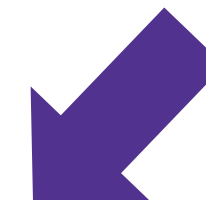
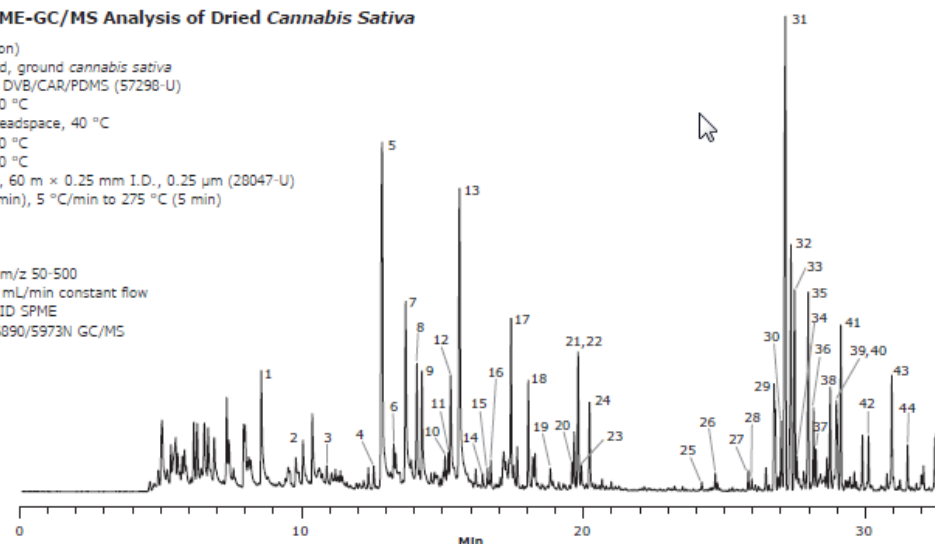
Supelco®



**Figure 1. Headspace SPME-GC/MS Analysis of Dried Cannabis Sativa**

(See Table 1 for peak identification)

sample/matrix: 0.5 g dried, ground cannabis sativa  
SPME fiber: 50/30 µm DVB/CAR/PDMS (57298-U)  
sample equilibration: 30 min, 40 °C  
extraction: 20 min, headspace, 40 °C  
desorption process: 3 min, 270 °C  
fiber post bake: 3 min, 270 °C  
column: Equity®-1, 60 m × 0.25 mm I.D., 0.25 µm (28047-U)  
oven: 60 °C (2 min), 5 °C/min to 275 °C (5 min)  
inj. temp.: 270 °C  
detector: MSD  
MSD interface: 300 °C  
scan range: full scan, m/z 50-500  
carrier gas: helium, 1 mL/min constant flow  
liner: 0.75 mm ID SPME  
instrument: Agilent® 6890/5973N GC/MS



# Typical Pesticide Testing Workflow

Supelco®

Homogenize &  
weigh sample

Extraction

Cleanup

Solvent  
exchange  
and/or dilution

Filter

GC-MS/MS &  
LC-MS/MS  
analysis



Millipore  
SIGMA

# Pesticides

## Identify and Quantitate Pesticide Residues

### MilliporeSigma products for sample prep and analysis

#### QuEChERS supplies

- Salts (for extraction step)
- Sorbents (for cleanup step)

#### SPE

#### Solvents

- For extraction (methanol, acetonitrile, water)
- For MS analysis (LiChrosolv® & Omnisolv®)

#### Reference Materials

#### Labware

#### GC and HPLC columns

- Ascentis Express® HPLC Columns for LC-MS/MS
- SLB® -5ms column for GC-MS/MS

#### Instrument accessories & consumables – GC and HPLC

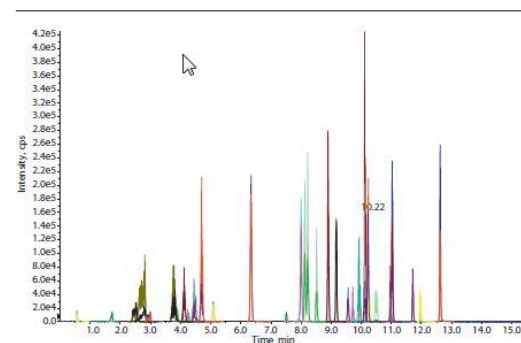


Figure 3 LC/MS/MS chromatogram of spiked group of 29 compounds used in this validation on Ascentis Express RP-Amide





# Residual Solvents

## Identify and Quantitate Residual Solvents

Solvents are used in process scale extraction of Cannabis

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# Residual Solvents

## Identify and Quantitate Residual Solvents

### MilliporeSigma Products for Residual Solvents Analysis:

SupraSolv® Headspace grade solvents

Headspace vials & caps (to fit autosampler)

SPME

Reference materials

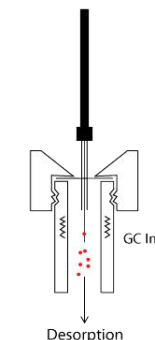
- USP class I, II, III solvent mixes

GC Columns

- SPB® -624
- Vocol®



Adsorption



### Typical Workflow

Weigh sample

Dissolve in solvent

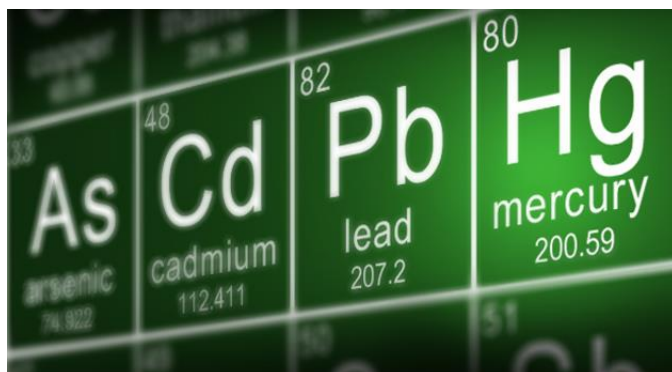
Analyze by HS-GC



# Metals

## Identify and Quantitate Heavy Metals

Heavy metals are in soil and water; arise from atmospheric aerosols, or constituents of fertilizers, pesticides, herbicides, and fungicides; likely toxic; bio-accumulate in Cannabis



33 As arsenic 74.922	48 Cd cadmium 112.411	82 Pb lead 207.2	80 Hg mercury 200.59
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# Metals

## Identify and Quantitate Heavy Metals

### MilliporeSigma products for sample prep & analysis

High purity reagents for digestion & dilution

- Nitric and Hydrochloric Acids – Suprapur®, Ultrapur, EMSURE
- Hydrogen Peroxide - Suprapur®, Ultrapur
- Water – Ultrapur bottled, ultrapure Milli-Q

Certified Reference materials for ICP-MS analysis

- Single element solutions
- Mixes



Typical  
metals  
workflow

Grind & weigh  
sample

Digestion

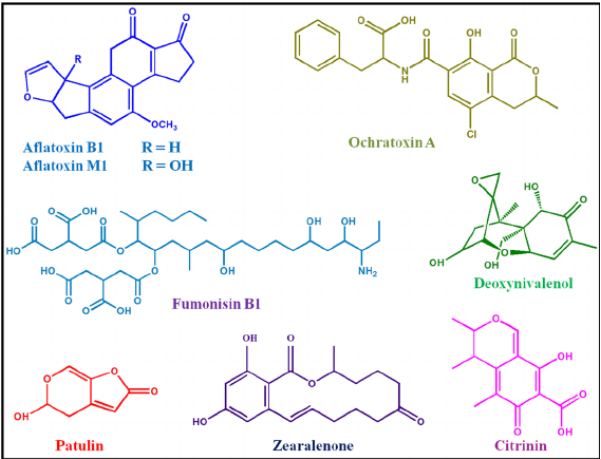
Dilution into  
high purity  
water

ICP-MS analysis

# Mycotoxins

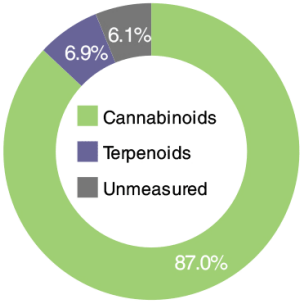
## Identify and Quantitate Mycotoxins

Mycotoxins are natural defense compounds of fungi. Aflatoxins may be present on Cannabis.



Some labs analyze mycotoxins together with pesticides

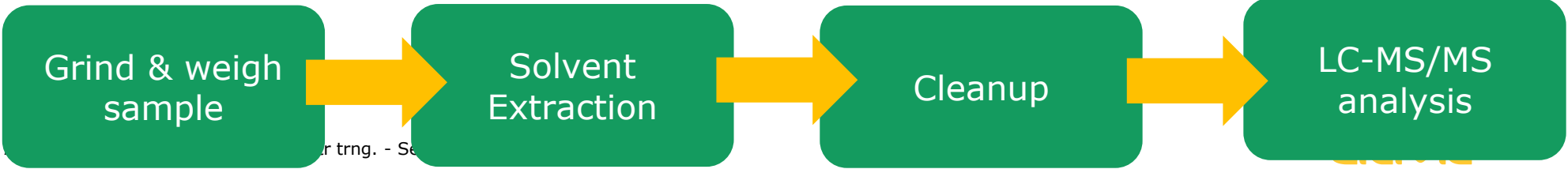
### Sample Overview



### Sample Details

Mycotoxin	Not Detected
Pesticide	Not Detected

For more information about this report, including how to calculate your own approximate post-decarboxylate THC and CBD values, please visit [www.steePhillab.com/FAQ](http://www.steePhillab.com/FAQ).



# Mycotoxins

## Identify and Quantitate Mycotoxins

### MilliporeSigma Products for Sample Prep (mycotoxins only):

Liquid extraction

- LiChrosolv® and OmniSolv® high purity solvents

SPE - Supel™ Tox AflaZea

Reference Materials

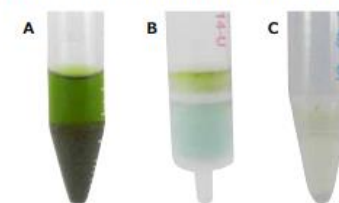
- Individuals & mixes
- Isotopically labeled for use as internal standards



# Analysis



Figure 1. Photos of the Cannabis Samples (A) Before Cleanup, (B) On Supel™ Tox AflaZea SPE Cartridge, and (C) After Cleanup



# Mycotoxins

## Identify and Quantitate Mycotoxins

### MilliporeSigma Products for Analysis:

#### Reference Materials

- ID
- Calibrant

#### HPLC Columns

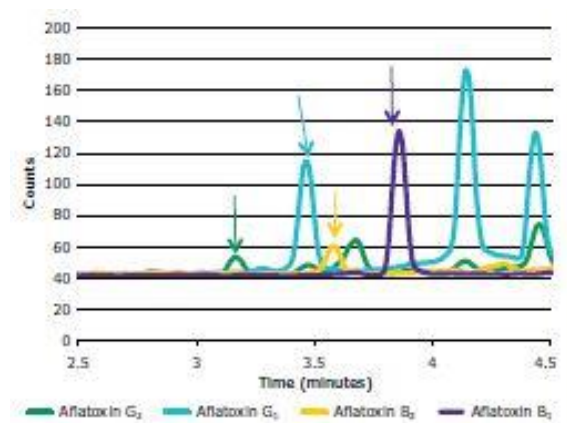
- Ascentis® Express (many different chemistries)

#### LC/MS Grade Solvents

- LiChrosolv®
- Omnisolv®



Supelco®





# Microbiology

## Identify and Quantitate Microorganisms

Cannabis has antimicrobial properties, but microorganisms can be introduced throughout the handling, transporting and processing phase after harvest.

### Microbes of interest:

Aspergillus (4 species)

STEC (Shiga toxin-producing E. Coli)

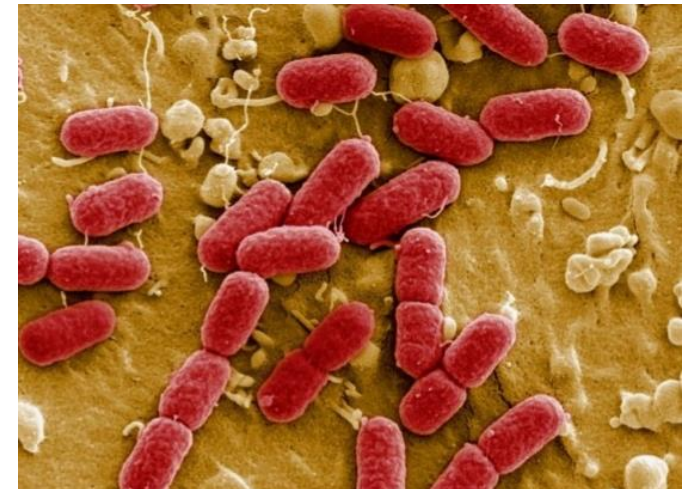
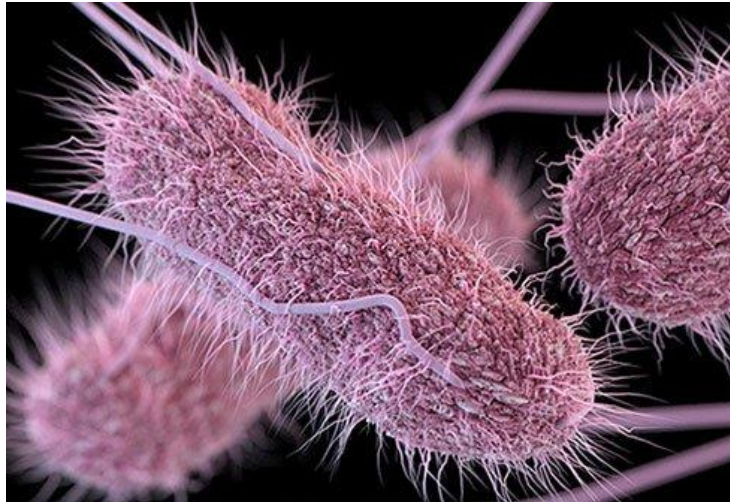
E. Coli

Salmonella

Total Yeast and Molds

Total Aerobic Counts

Total Coliform





# Microbiology

## Identify and Quantitate Microorganisms

### 1. Traditional Plate method

- Dehydrated media (solid granules or powder format)
- Ready to Use media (mostly liquid format; some solid)



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### 2. MC Media pads

- Yeast & mold
- Total aerobic
- E. Coli & coliform



### 3. Assurance GDS – PCR

- Salmonella
- E-coli
- STEC (Shiga-toxin producing E-coli)

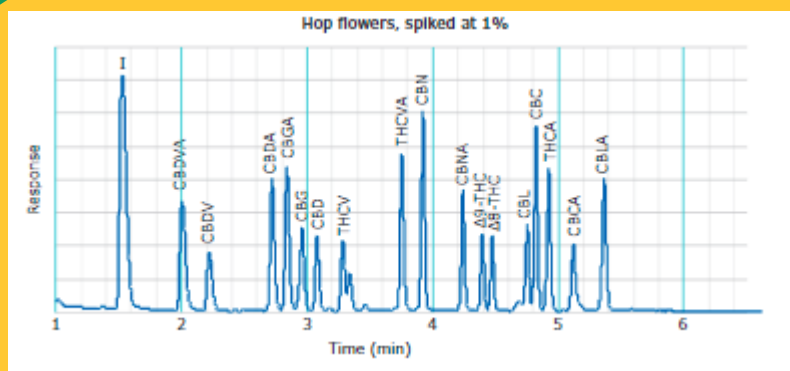


# TECHNOLOGY HIGHLIGHTS

(what makes us different?)

04

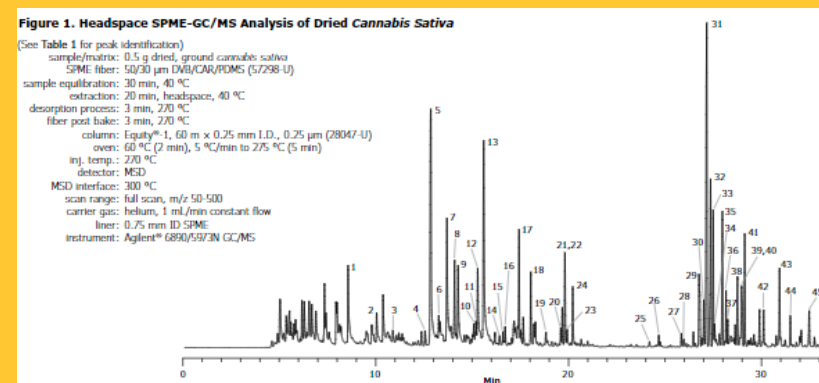
# Differentiating & Key products



## Cannabinoid testing

- Cerilliant® CRMs – trusted name, highest quality, years of experience
- Ascentis® Express HPLC columns – for fast, efficient and rugged separations
- Chromolith® HPLC columns – unique monolithic silica, matrix tolerant, rapid analysis

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## Terpenes

- SLB® -5ms GC column – low bleed, MS grade
- SupraSolv® Headspace grade solvents – ultra clean, suitable for headspace
- SPME – solid phase microextraction; sensitive, reusable, easy to automate. We are the leaders in this.

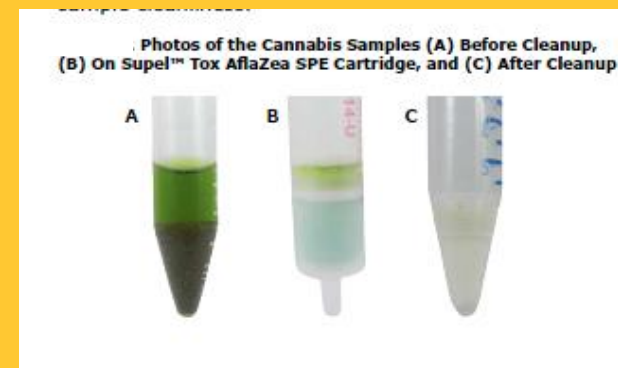
# Differentiating & Key products



## Pesticides

- Ascentis® Express HPLC columns – highly efficient, fast, rugged analyses
- Supel™ QuE Verde sorbent - for QuEChERS cleanup of green samples with improved recovery of planar pesticides
- Pestanal® Isotope labeled pesticides – for use as internal standards

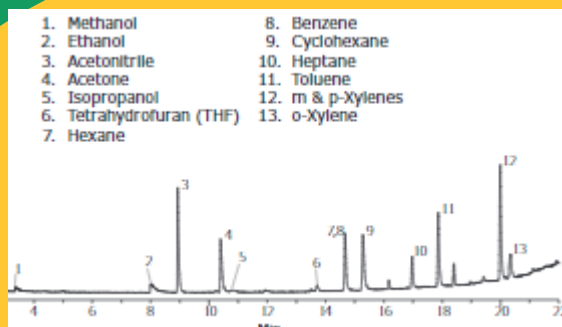
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## Mycotoxins

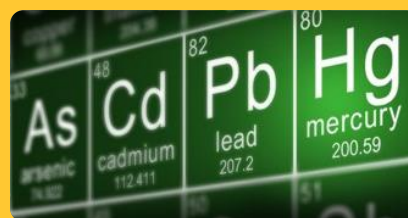
- Supel™ Tox AlfaZea – simple pass-through SPE cleanup for aflatoxins
- Ascentis® Express HPLC columns - highly efficient, fast, rugged analyses
- CRMs – individual mycotoxins and mixes, also isotopically labeled for use as internal standards.

# Differentiating & key products



## Residual Solvents

- Class I, II, III residual solvent CRMs
- Suprasolv® Headspace grade solvents
- SPME – a less expensive alternative to conventional headspace



## Heavy Metals

- CRMs – mixes and individuals
- Emsure, Ultrapure and Suprapur High Purity reagents – customer can choose based on their needs



## Microbiology

- Vitroids™ & Lenticule® Certified Reference Microorganisms – fast, reliable, easy to use
- MC Media Pads® - alternative to traditional plates, simple and easy to use
- Granulated and ready to use culture media

# collateral

05

# Application Notes



- Cannabinoids
  - MS\_AN6577EN
  - MS\_AN2607EN
- Terpenes
  - MS\_AN5192EN

- Pesticides
  - MS\_AN5191EN
  - MS\_AN1655EN
  - MS\_AN7780EN
- Mycotoxins
  - MS\_AN5190EN
- Heavy Metals

**Supelco**  
Application Note

### Optimizing for High Throughput Analysis of Cannabinoids in Cannabis Products

Success with the Ascentis Express C18 Column

Supelco, Inc. | 3801 Kellenburger Road, Bellefonte, PA 16823  
Tel: 814.353.1700 | Fax: 814.353.1701 | Email: [supelco@supelco.com](mailto:supelco@supelco.com)

With increasing cannabis and hemp legislation, there has been increased demand for standardized and reliable methods of analysis and product quality control. Cannabinoids are the primary psychoactive compounds in cannabis, and their analysis is a critical component of product quality control. This application note describes a method for the high-throughput analysis of cannabinoids in cannabis products using the Ascentis Express C18 column.

**Abstract**  
The Ascentis Express C18 column is a high-performance liquid chromatography (HPLC) column that is optimized for the analysis of cannabinoids in cannabis products. This column provides excellent separation and resolution for the analysis of cannabinoids in cannabis products, and it is suitable for high-throughput analysis.

**Keywords**  
Cannabis, cannabinoids, HPLC, Ascentis Express C18 column, high-throughput analysis.

**Introduction**  
Cannabis is a plant that has been used for thousands of years. It contains a variety of compounds, including cannabinoids, which are the primary psychoactive compounds in cannabis. The analysis of cannabinoids in cannabis products is a critical component of product quality control. This application note describes a method for the high-throughput analysis of cannabinoids in cannabis products using the Ascentis Express C18 column.

**Methods**  
The Ascentis Express C18 column was used for the analysis of cannabinoids in cannabis products. The column was optimized for the analysis of cannabinoids in cannabis products, and it provided excellent separation and resolution for the analysis of cannabinoids in cannabis products.

**Results and Discussion**  
The Ascentis Express C18 column was used for the analysis of cannabinoids in cannabis products. The column provided excellent separation and resolution for the analysis of cannabinoids in cannabis products, and it was suitable for high-throughput analysis.

**Conclusion**  
The Ascentis Express C18 column is a high-performance liquid chromatography (HPLC) column that is optimized for the analysis of cannabinoids in cannabis products. This column provides excellent separation and resolution for the analysis of cannabinoids in cannabis products, and it is suitable for high-throughput analysis.

**References**  
1. Supelco, Inc. Ascentis Express C18 column. Bellefonte, PA: Supelco, Inc., 2019.

**Supelco**  
Application Note

### Rapid and Comprehensive Analysis of Cannabinoid Potency by HPLC/UV using the Ascentis Express C18 Column

Supelco, Inc. | 3801 Kellenburger Road, Bellefonte, PA 16823  
Tel: 814.353.1700 | Fax: 814.353.1701 | Email: [supelco@supelco.com](mailto:supelco@supelco.com)

This application note describes a method for the rapid and comprehensive analysis of cannabinoid potency in cannabis products using the Ascentis Express C18 column. The method involves the use of HPLC/UV for the analysis of cannabinoids in cannabis products.

**Abstract**  
The Ascentis Express C18 column is a high-performance liquid chromatography (HPLC) column that is optimized for the analysis of cannabinoids in cannabis products. This column provides excellent separation and resolution for the analysis of cannabinoids in cannabis products, and it is suitable for high-throughput analysis.

**Keywords**  
Cannabis, cannabinoids, HPLC/UV, Ascentis Express C18 column, rapid analysis.

**Introduction**  
Cannabis is a plant that has been used for thousands of years. It contains a variety of compounds, including cannabinoids, which are the primary psychoactive compounds in cannabis. The analysis of cannabinoids in cannabis products is a critical component of product quality control. This application note describes a method for the rapid and comprehensive analysis of cannabinoid potency in cannabis products using the Ascentis Express C18 column.

**Methods**  
The Ascentis Express C18 column was used for the analysis of cannabinoids in cannabis products. The column was optimized for the analysis of cannabinoids in cannabis products, and it provided excellent separation and resolution for the analysis of cannabinoids in cannabis products.

**Results and Discussion**  
The Ascentis Express C18 column was used for the analysis of cannabinoids in cannabis products. The column provided excellent separation and resolution for the analysis of cannabinoids in cannabis products, and it was suitable for high-throughput analysis.

**Conclusion**  
The Ascentis Express C18 column is a high-performance liquid chromatography (HPLC) column that is optimized for the analysis of cannabinoids in cannabis products. This column provides excellent separation and resolution for the analysis of cannabinoids in cannabis products, and it is suitable for high-throughput analysis.

**References**  
1. Supelco, Inc. Ascentis Express C18 column. Bellefonte, PA: Supelco, Inc., 2019.

**Supelco**  
Application Note

### Headspace SPME-GC/MS Analysis of Terpenes in Cannabis

A rapid method to identify cannabis terpenes for forensic and organic applications

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This application note describes a method for the rapid and comprehensive analysis of terpenes in cannabis products using the Headspace SPME-GC/MS method. The method involves the use of Headspace SPME-GC/MS for the analysis of terpenes in cannabis products.

**Abstract**  
The Headspace SPME-GC/MS method is a rapid and comprehensive method for the analysis of terpenes in cannabis products. This method provides excellent separation and resolution for the analysis of terpenes in cannabis products, and it is suitable for high-throughput analysis.

**Keywords**  
Cannabis, terpenes, Headspace SPME-GC/MS, rapid analysis.

**Introduction**  
Cannabis is a plant that has been used for thousands of years. It contains a variety of compounds, including terpenes, which are the primary aromatic compounds in cannabis. The analysis of terpenes in cannabis products is a critical component of product quality control. This application note describes a method for the rapid and comprehensive analysis of terpenes in cannabis products using the Headspace SPME-GC/MS method.

**Methods**  
The Headspace SPME-GC/MS method was used for the analysis of terpenes in cannabis products. The method provided excellent separation and resolution for the analysis of terpenes in cannabis products, and it was suitable for high-throughput analysis.

**Results and Discussion**  
The Headspace SPME-GC/MS method was used for the analysis of terpenes in cannabis products. The method provided excellent separation and resolution for the analysis of terpenes in cannabis products, and it was suitable for high-throughput analysis.

**Conclusion**  
The Headspace SPME-GC/MS method is a rapid and comprehensive method for the analysis of terpenes in cannabis products. This method provides excellent separation and resolution for the analysis of terpenes in cannabis products, and it is suitable for high-throughput analysis.

**References**  
1. Supelco, Inc. Headspace SPME-GC/MS method. Bellefonte, PA: Supelco, Inc., 2019.

**Supelco**  
Application Note

### Improved Recoveries for GC/MS/MS Analysis of Pesticide Residues in Cannabis

Using Supel® Que Verde for QuEChERS and SLUR-Sens GC Column

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This application note describes a method for the improved recoveries for GC/MS/MS analysis of pesticide residues in cannabis products using the Supel® Que Verde for QuEChERS and SLUR-Sens GC column. The method involves the use of Supel® Que Verde for QuEChERS and SLUR-Sens GC column for the analysis of pesticide residues in cannabis products.

**Abstract**  
The Supel® Que Verde for QuEChERS and SLUR-Sens GC column is a high-performance liquid chromatography (HPLC) column that is optimized for the analysis of pesticide residues in cannabis products. This column provides excellent separation and resolution for the analysis of pesticide residues in cannabis products, and it is suitable for high-throughput analysis.

**Keywords**  
Cannabis, pesticide residues, GC/MS/MS, Supel® Que Verde for QuEChERS, SLUR-Sens GC column.

**Introduction**  
Cannabis is a plant that has been used for thousands of years. It contains a variety of compounds, including pesticide residues, which are the primary contaminants in cannabis products. The analysis of pesticide residues in cannabis products is a critical component of product quality control. This application note describes a method for the improved recoveries for GC/MS/MS analysis of pesticide residues in cannabis products using the Supel® Que Verde for QuEChERS and SLUR-Sens GC column.

**Methods**  
The Supel® Que Verde for QuEChERS and SLUR-Sens GC column was used for the analysis of pesticide residues in cannabis products. The column provided excellent separation and resolution for the analysis of pesticide residues in cannabis products, and it was suitable for high-throughput analysis.

**Results and Discussion**  
The Supel® Que Verde for QuEChERS and SLUR-Sens GC column was used for the analysis of pesticide residues in cannabis products. The column provided excellent separation and resolution for the analysis of pesticide residues in cannabis products, and it was suitable for high-throughput analysis.

**Conclusion**  
The Supel® Que Verde for QuEChERS and SLUR-Sens GC column is a high-performance liquid chromatography (HPLC) column that is optimized for the analysis of pesticide residues in cannabis products. This column provides excellent separation and resolution for the analysis of pesticide residues in cannabis products, and it is suitable for high-throughput analysis.

**References**  
1. Supelco, Inc. Supel® Que Verde for QuEChERS and SLUR-Sens GC column. Bellefonte, PA: Supelco, Inc., 2019.

**Supelco**  
Application Note

### Analysis of Pesticide Residues in Cannabis using QuEChERS and HPLC

Katherine K. Stansbury, Jennifer Clark, Gary Olson, Michael Hefner

This application note describes a method for the analysis of pesticide residues in cannabis products using the QuEChERS and HPLC method. The method involves the use of QuEChERS and HPLC for the analysis of pesticide residues in cannabis products.

**Abstract**  
The QuEChERS and HPLC method is a rapid and comprehensive method for the analysis of pesticide residues in cannabis products. This method provides excellent separation and resolution for the analysis of pesticide residues in cannabis products, and it is suitable for high-throughput analysis.

**Keywords**  
Cannabis, pesticide residues, QuEChERS, HPLC.

**Introduction**  
Cannabis is a plant that has been used for thousands of years. It contains a variety of compounds, including pesticide residues, which are the primary contaminants in cannabis products. The analysis of pesticide residues in cannabis products is a critical component of product quality control. This application note describes a method for the analysis of pesticide residues in cannabis products using the QuEChERS and HPLC method.

**Methods**  
The QuEChERS and HPLC method was used for the analysis of pesticide residues in cannabis products. The method provided excellent separation and resolution for the analysis of pesticide residues in cannabis products, and it was suitable for high-throughput analysis.

**Results and Discussion**  
The QuEChERS and HPLC method was used for the analysis of pesticide residues in cannabis products. The method provided excellent separation and resolution for the analysis of pesticide residues in cannabis products, and it was suitable for high-throughput analysis.

**Conclusion**  
The QuEChERS and HPLC method is a rapid and comprehensive method for the analysis of pesticide residues in cannabis products. This method provides excellent separation and resolution for the analysis of pesticide residues in cannabis products, and it is suitable for high-throughput analysis.

**References**  
1. Supelco, Inc. QuEChERS and HPLC method. Bellefonte, PA: Supelco, Inc., 2019.

**Supelco**  
Application Note

### Complete Workflow for the Analysis of California List of Pesticides in Cannabis

Detailed protocols for sample preparation and analysis of pesticides by GC-MS/MS and GC-MS/MS

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This application note describes a method for the complete workflow for the analysis of California List of Pesticides in Cannabis. The method involves the use of GC-MS/MS and GC-MS/MS for the analysis of pesticides in Cannabis.

**Abstract**  
The GC-MS/MS and GC-MS/MS method is a rapid and comprehensive method for the analysis of pesticides in Cannabis. This method provides excellent separation and resolution for the analysis of pesticides in Cannabis, and it is suitable for high-throughput analysis.

**Keywords**  
Cannabis, pesticides, GC-MS/MS, GC-MS/MS.

**Introduction**  
Cannabis is a plant that has been used for thousands of years. It contains a variety of compounds, including pesticides, which are the primary contaminants in Cannabis products. The analysis of pesticides in Cannabis products is a critical component of product quality control. This application note describes a method for the complete workflow for the analysis of California List of Pesticides in Cannabis.

**Methods**  
The GC-MS/MS and GC-MS/MS method was used for the analysis of pesticides in Cannabis. The method provided excellent separation and resolution for the analysis of pesticides in Cannabis, and it was suitable for high-throughput analysis.

**Results and Discussion**  
The GC-MS/MS and GC-MS/MS method was used for the analysis of pesticides in Cannabis. The method provided excellent separation and resolution for the analysis of pesticides in Cannabis, and it was suitable for high-throughput analysis.

**Conclusion**  
The GC-MS/MS and GC-MS/MS method is a rapid and comprehensive method for the analysis of pesticides in Cannabis. This method provides excellent separation and resolution for the analysis of pesticides in Cannabis, and it is suitable for high-throughput analysis.

**References**  
1. Supelco, Inc. GC-MS/MS and GC-MS/MS method. Bellefonte, PA: Supelco, Inc., 2019.

**Supelco**  
Application Note

### Sensitive, Quick LC/MS/MS Analysis of Aflatoxins in Cannabis

Using Supel® Tox AflaZee SPE and an Ascentis Express Phenyl-Hexyl HPLC Column

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This application note describes a method for the sensitive, quick LC/MS/MS analysis of aflatoxins in cannabis products using the Supel® Tox AflaZee SPE and an Ascentis Express Phenyl-Hexyl HPLC column. The method involves the use of Supel® Tox AflaZee SPE and an Ascentis Express Phenyl-Hexyl HPLC column for the analysis of aflatoxins in cannabis products.

**Abstract**  
The Supel® Tox AflaZee SPE and an Ascentis Express Phenyl-Hexyl HPLC column is a high-performance liquid chromatography (HPLC) column that is optimized for the analysis of aflatoxins in cannabis products. This column provides excellent separation and resolution for the analysis of aflatoxins in cannabis products, and it is suitable for high-throughput analysis.

**Keywords**  
Cannabis, aflatoxins, LC/MS/MS, Supel® Tox AflaZee SPE, Ascentis Express Phenyl-Hexyl HPLC column.

**Introduction**  
Cannabis is a plant that has been used for thousands of years. It contains a variety of compounds, including aflatoxins, which are the primary contaminants in cannabis products. The analysis of aflatoxins in cannabis products is a critical component of product quality control. This application note describes a method for the sensitive, quick LC/MS/MS analysis of aflatoxins in cannabis products using the Supel® Tox AflaZee SPE and an Ascentis Express Phenyl-Hexyl HPLC column.

**Methods**  
The Supel® Tox AflaZee SPE and an Ascentis Express Phenyl-Hexyl HPLC column was used for the analysis of aflatoxins in cannabis products. The column provided excellent separation and resolution for the analysis of aflatoxins in cannabis products, and it was suitable for high-throughput analysis.

**Results and Discussion**  
The Supel® Tox AflaZee SPE and an Ascentis Express Phenyl-Hexyl HPLC column was used for the analysis of aflatoxins in cannabis products. The column provided excellent separation and resolution for the analysis of aflatoxins in cannabis products, and it was suitable for high-throughput analysis.

**Conclusion**  
The Supel® Tox AflaZee SPE and an Ascentis Express Phenyl-Hexyl HPLC column is a high-performance liquid chromatography (HPLC) column that is optimized for the analysis of aflatoxins in cannabis products. This column provides excellent separation and resolution for the analysis of aflatoxins in cannabis products, and it is suitable for high-throughput analysis.

**References**  
1. Supelco, Inc. Supel® Tox AflaZee SPE and an Ascentis Express Phenyl-Hexyl HPLC column. Bellefonte, PA: Supelco, Inc., 2019.

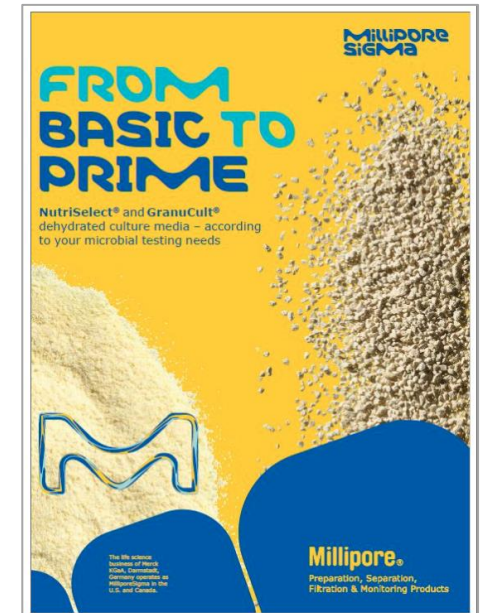
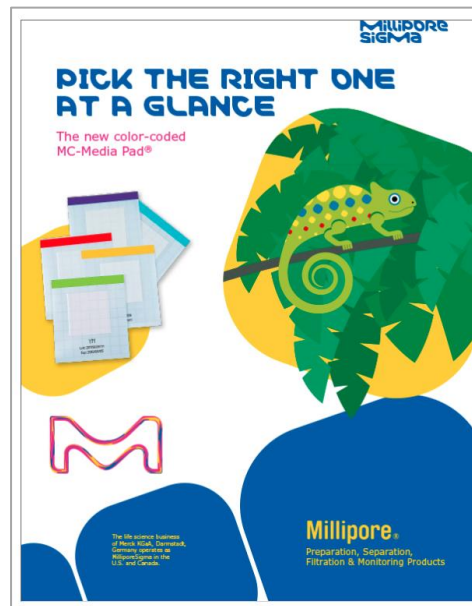




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## Analytical Testing

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- Cannabinoids and Potency
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#### Complete Workflow for Comprehensive Cannabis Terpenes Analysis

Complete workflow for the comprehensive analysis of terpenes in cannabis

#### ICP-MS Analysis of Heavy Metals in Cannabis Sativa

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# Thank You

Supelco Products for Analytical Cannabis Testing WFs, Distr trng. - Sept. 10, 2021



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