



Chemical Analysis of Cannabis and Cannabis-Derived Products

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Learning Objectives Module 2



- Understand the differences between analytical instrumentation/techniques used for cannabinoids, pesticides, and terpenes
- Understand chemical analysis involving a coupling of chromatography (to separate chemicals in the mixture) connected to a selective detector. The mass spectrometer excels in this property
- Understand that volatile chemicals like terpenes and solvents are best done by GC/MS while less volatile chemicals like cannabinoids, flavonoids, and aflatoxins are best done by LC/MS or LC/MS/MS
- Articulate the roles that GC/MS and LC/MS play in the analysis of samples associated with hemp and cannabis

GC/FID Determination of Residual Solvents in Cannabis Plant Extracts

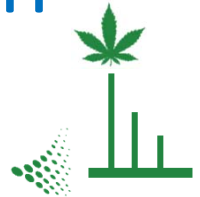


Table of Possible Extraction Solvents

Compound	CA Action Levels (ppm)
Propane	1000
Butane	1000
Methanol	600
Ethylene Oxide	1
Pentane	1000
Ethanol	1000
Ethyl Ether	1000
Acetone	1000
Isopropyl Alcohol	1000
Acetonitrile	80
Methylene Chloride	1
Hexane	60
Ethyl Acetate	1000
Chloroform	1
Benzene	1
1,2-Dichloroethane	1
Heptane	1000
Trichloroethylene	1
Toluene	180
Xylenes total	430

GC/FID Chromatogram of Common Solvents

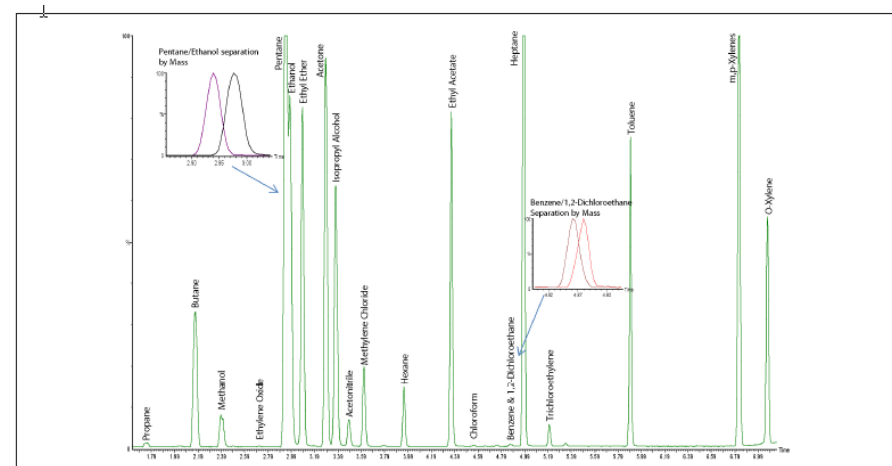
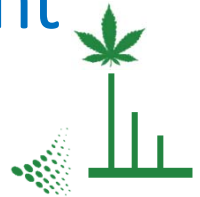


Figure 1. Chromatographic separation of all the compounds listed in Table 1.

Chemical Analysis for Potency of the Cannabis Plant

(Potency: what is the THC and CBD Content?)



The Task

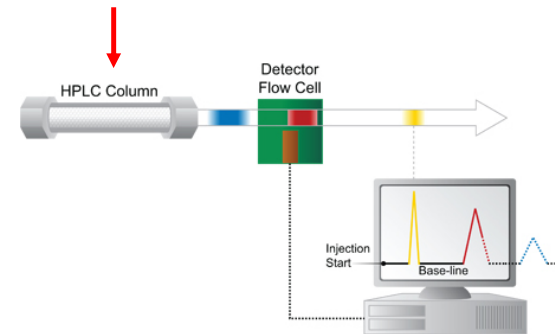
- The cannabis extract is a complex mixture of many different chemicals



- We need to separate these chemicals from each other so they can be quantified without interference from the others

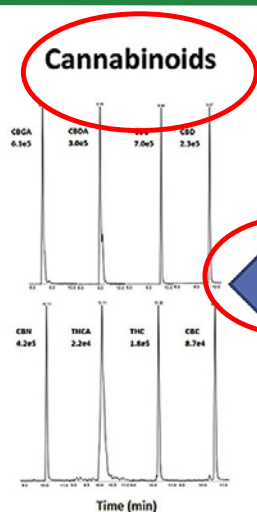
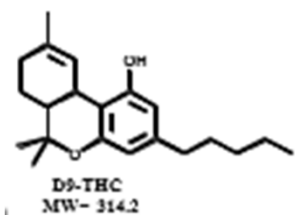
The Method

- The current preferred approach for potency determination is HPLC
 - High-performance liquid chromatography
- Components of the chemical mixture are separated within a 'chromatographic' column.



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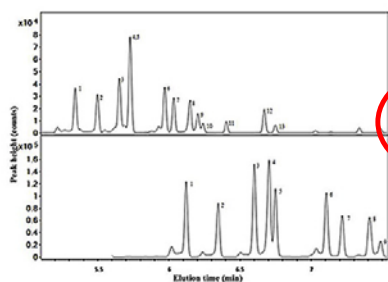
Use the Optimal Technique for the Compound Class in Cannabis



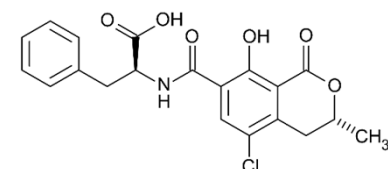
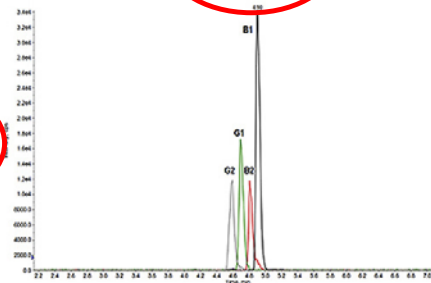
← LC-MS/MS

→ LC-MS/MS

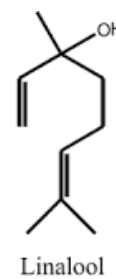
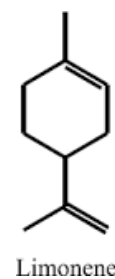
↓ GC/FID, GC/MS or GC/MS/MS



Aflatoxins



Ocratoxin A



Mycotoxins in Cannabis



- Mold and Fungi on Cannabis Produce Toxic Chemicals called mycotoxins
- These can cause adverse health effects and pose a serious health threat
 - Health effects range from acute poisoning to cancer
- Most mycotoxins are chemically stable and can survive food processing
 - Thus, they are persistent poisonous chemicals
- Aflatoxins are amongst the most poisonous of the mycotoxins
 - They are genotoxic which means they cause DNA damage and liver cancer in humans.



Cannabis Sample Preparation for Heavy Metal Determination



Dry Cannabis Plant



Cannabis Plant Grinder



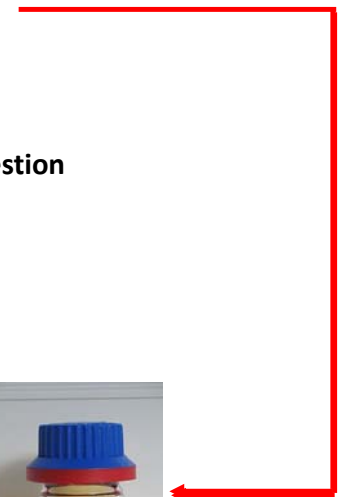
Sieved Cannabis Powder



Conc. HNO₃

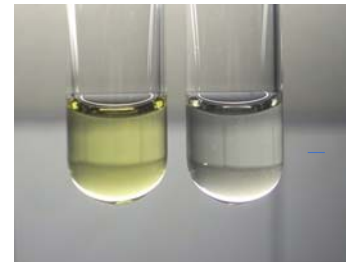


Microwave sample digestion



Conc. Nitric Acid Solution

Dilute with Ultra-Pure Water



Ready for Analysis



ICP/MS Analysis

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Heavy Metal	BCC Action Levels (µg/g)	
	Inhalable Cannabis and Cannabis Products	Other Cannabis and Cannabis Products
Cadmium	0.2	0.5
Lead	0.5	0.5
Arsenic	0.2	1.5
Mercury	0.1	3.0

ICP/MS Results