

Cannabis Economics and the Rise of Hemp Derived Cannabinoids



September 10th, 2024
Annual Educational
Conference



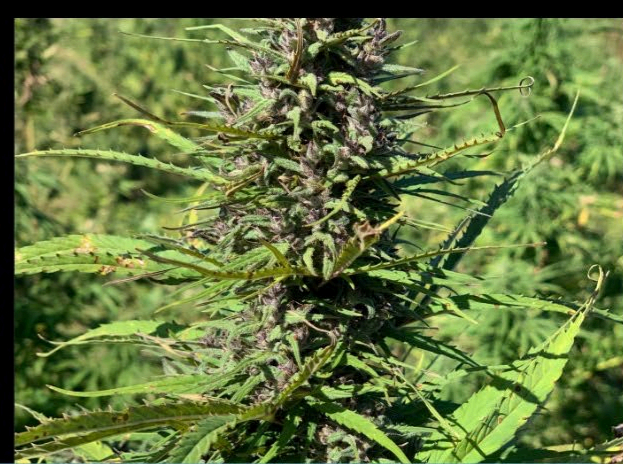
Christopher Hudalla Ph.D.

ProVerde Laboratories • Milford, MA

ProVerde Background

- Ph. D. in Analytical Chemistry
- > 35 years of academic and industrial research
 - 10 years focused specifically on Cannabis
- ISO 17025:2017 Accredited Analytical Testing Laboratory
- Providing Analytical Services for Cannabis and Hemp Industries
 - Growers, Extractors, Processors, Dispensaries, Care Givers, Patients and Adult-Users
 - Full Complement of Potency and Safety/Contamination Testing
- Serving Legal Cannabis Testing Clients in Massachusetts
- Serving CBD/Hemp-Based Testing Clients Worldwide
 - Clients across United States, Europe, Latin America and Asia



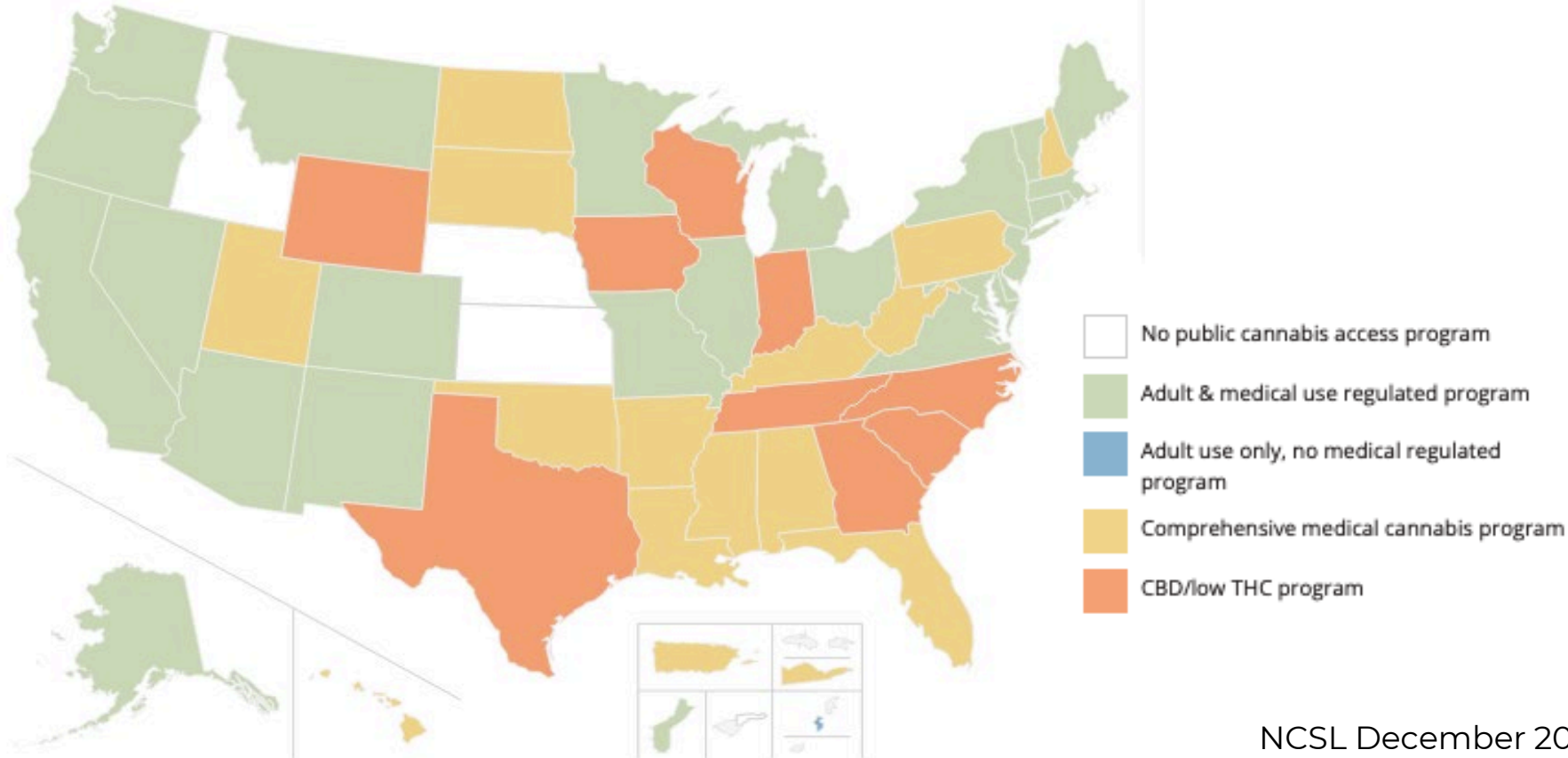


Hemp?

Cannabis sativa L

Marijuana?





NCSL December 2023

State Regulated Cannabis Programs

The Farm Bill "LOOPHOLE"



2014 Farm Bill

The term "industrial hemp" means the plant *Cannabis sativa* L. and any part of such plant, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis.



2018 Farm Bill

The term "hemp" means the plant *Cannabis sativa* L. and any part of that plant, including the seeds thereof and **all derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers**, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis

The 2018 Farm Bill provided different definitions of industrial hemp that included derivatives, extracts, cannabinoids, isomers, acids, salts, and salts of isomers.

Farm Bill Wrecked Havoc on Supply & Demand

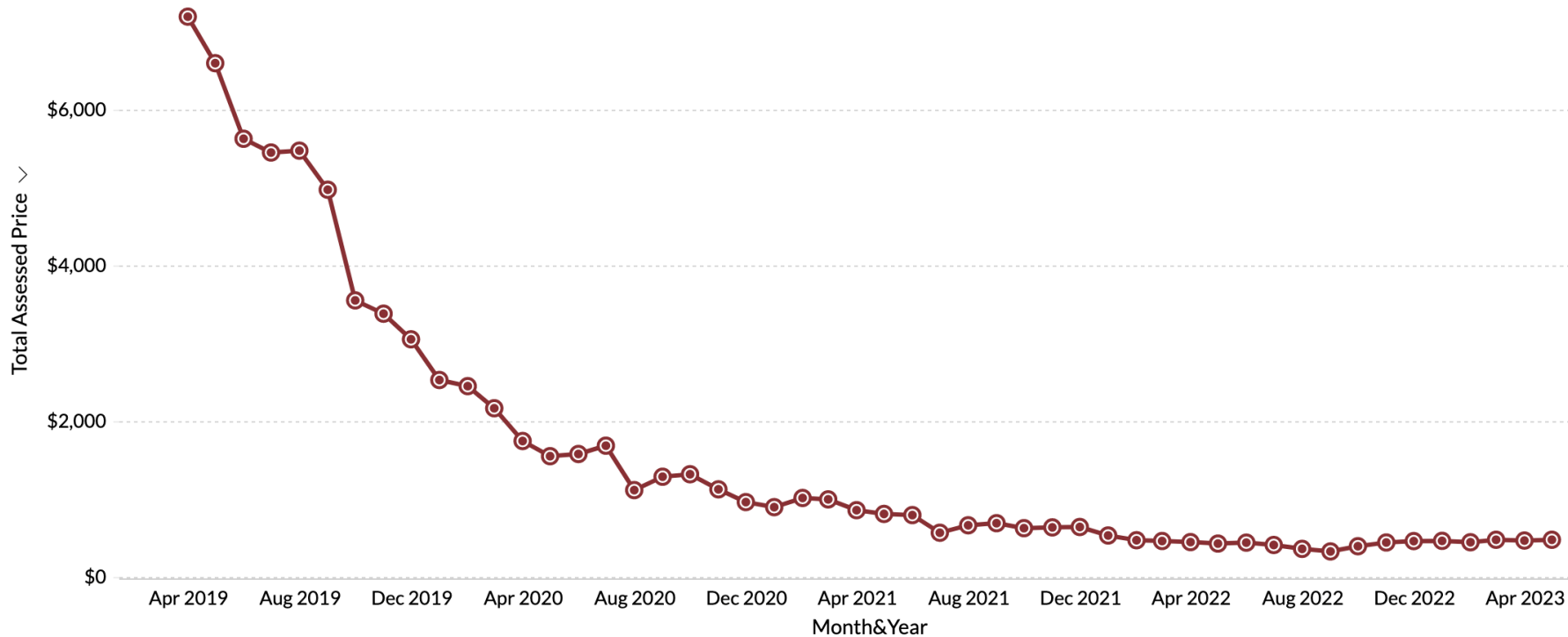
Within 45 days of passing, CBD prices dropped more than 30%

Total hemp planted WENT FROM 32,000 acres to 146,000 acres WITHIN MONTHS

2014 price of single kilo of refined CBD oil could go for up to \$70,000

2022 price of a same kilo average \$750

Farm Bill Wrecked Havoc on Supply & Demand



Forgotten Literature – Found!

Aug., 1941

ISOMERIZATION OF CANNABIDIOL TO TETRAHYDROCANNABINOLS

2209

[CONTRIBUTION FROM THE NOYES CHEMICAL LABORATORY, UNIVERSITY OF ILLINOIS]

Structure of Cannabidiol. XII. Isomerization to Tetrahydrocannabinols¹

BY ROGER ADAMS, C. K. CAIN, W. D. MCPHEE AND R. B. WEARN²

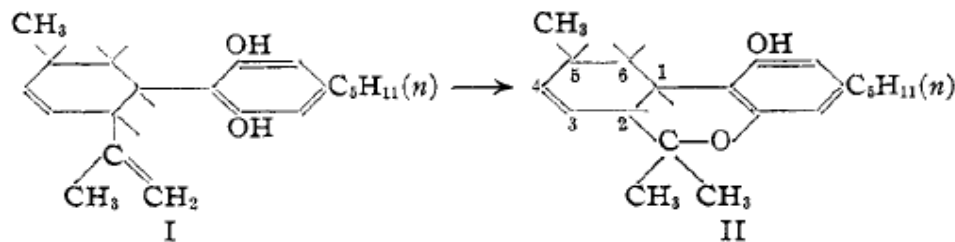
IN COLLABORATION WITH THE TREASURY DEPARTMENT, NARCOTICS LABORATORY, WASHINGTON, D. C.

Crystalline cannabidiol (I) isomerizes readily in the presence of a number of acidic reagents to give a tetrahydrocannabinol (II or III).³ The general structure of the latter was established by dehydrogenation to cannabinol (IV), a product

nabidiol, at least more than partially, in ten to twenty hours of boiling in benzene solution.

Unlike the previous conversions, these forms could be duplicated at will and it is believed that each represents an essentially pure product. It

was reported previously that the reagents which convert cannabidiol to the high-rotating tetrahydrocannabinol also convert a low-rotating tetrahydrocannabinol to the same form. However, further experimentation has demonstrated that it is never possible





Hemp Derived
Synthetic
Cannabinoids Are
Available Everywhere

Hemp Derived Synthetics Often Mistaken as CBD by Unsuspecting Consumers



Vitamax Hemp Gummies -
Great for Peace & Relaxation -
2,500,000 - Natural Fruit
Flavors Tasty Relief - Made in
USA - Relaxing Gummies -
100ct



amazon



BARELY LEGAL

THC RICH CANNABIS PRODUCTS

NO MEDICAL CARD NEEDED

TINCTURES VAPES EDIBLES LOTIONS DEVICES

HHC
Δ9-THC
Δ8-THC

CBD
Δ10-THC
THCO

ELEVATE YOUR LIFE!
\$4.20 COUPON

TWO LOCATIONS TO SERVE YOU

SCAN TO SHOP NOW

VALLEY FAIR MALL
Center Court
Kiosk

THE SHOPS AT SOUTH TOWN
2nd Floor
East Entrance

DEMAND SUBSTITUTION

Regulatory Costs & Tax Burden
Drive Consumers to the Illicit Market

Regulation has not equated to quality products, so consumers are substituting



Regulated Marijuana PreRoll

\$10.00 and up

plus up to 50% in taxes



THC-a or Hemp Flower PreRoll

\$3.00

NOT taxed

Hemp Derived Synthetic Cannabinoid Market

2022

\$2.4 Billion

2023

\$4 Billion

2031

\$16 Billion

Hemp Derived Cannabinoids Create Different Risks

However, cannabinoids themselves are not dangerous



Uncontrolled Practices

With no post harvest regulations, it is difficult to know the true composition of these products



Chemical Byproducts

Chemical conversions accidentally create chemical byproducts that are not identified or tested for.



Long Term Safety

Without understanding the composition, we are unable to assess how or when these cannabinoids and byproducts are excreted from the body.

Synthetic cannabinoids pose significant health and safety risks due to uncontrolled manufacturing practices that create unknown biproducts.

State Level Synthetic Battles

Alaska

- Federal judge rejects bid to set aside ban on intoxicating hemp products.
- New limits on products not pre-empted by 2018 Farm Bill, making them illegal.

Arkansas

- U.S. District Court rules state law banning delta-8 conflicts with 2018 Farm Bill.
- Unconstitutional to criminalize certain hemp-derived cannabinoid products.

State Level Synthetic Battles

California

- California cannabis companies sue competitors for selling hemp-derived delta-8 THC.
- Accused of flooding the market with illegal designer drugs.

Georgia

- DEA sends letter to Georgia prohibiting sale of cannabis in pharmacies
- Georgia Court of Appeals: Hemp-derived delta-8 THC and delta-10 THC not controlled substances.

State Level Synthetic Battles

Kentucky

- Kentucky committee approves emergency rules for delta-8 THC and hemp-derived products.
- Rules include a CBD to THC ratio, revising facility regulations.

Maryland

- Circuit Court Judge suspends enforcement of law restricting hemp and CBD shops.
- Allegations of violating equal protection and anti-monopoly clauses.

State Level Synthetic Battles

Missouri

- State lawmakers working on legislation prohibiting intoxicating hemp products.
- DCR revokes largest manufacturers license due to use of hemp in products, citing federal legality.

New York

- NY Supreme Court issues injunction against emergency measures halting hemp-derived THC sales.
- Criticized for heavy-handed approach to legal cannabis market.

State Level Synthetic Battles

Oklahoma

- Oklahoma Medical Marijuana Authority seeks power to regulate hemp-derived products.
- Aims for rules and age restrictions without making products illegal.

Tennessee

- New state rules make Agriculture Department responsible for regulating hemp and marijuana.
- Focus on cannabinoid profiles, THC standards, edible foods program, and a new 6% tax.

State Level Synthetic Battles

Texas

- Third Court of Appeals sets aside ban on delta-8 THC and THC isomers.
- Conflicts with Department of State Health Services and 2018 Farm Bill.

Virginia

- Federal judge upholds rules with fines for businesses selling delta-8 and exceeding THC limits.
- Rules not in conflict with federal law, credible threat to public health.

State Level Synthetic Battles

Wyoming

- Lawmakers work on bill to ban synthetic substances in hemp, limit THC in products.
- Challenges in differentiating between synthetic and natural compounds.

State Level Synthetic Battles

Common Themes

- Difficult to define what is to be regulated
- Terminology gets complicated
 - Synthetic? Natural? Intoxicating?
- Courts/Legislators often do not understand
- What did lawmakers mean when writing the 2018 Farm Bill?
- With ambiguity, courts often side with producers

Federal Level Synthetic Battles

- DEA Position
 - Delta-8-THC, if extracted from hemp is exempt from CSA
 - Delta-8-THC, synthesized from CBD is not exempt from CSA
 - THCO, not occurring naturally, is not exempt from CSA
- 9th Circuit Court (May 2022)
 - Delta-8-THC products qualify for trademark protection
- 4th Circuit Court (September 2024)
 - Wrongful termination case for consumption of synthetics
 - Ruled that THCO and other derivatives are exempt from CSA

Recognizing Products of Concern

D6-THC

D8-THC

D10-THC

HHC

HHC-O

THC-B

THC-P

HHC-P

THC-V

THC-X

THC-OH

THCO
THC-O-Acetate

THC-JD

THC-A
OIL

THC-A Flower

*“The public welfare outweighs the right to private gain . . .
No man may poison the people for his private profit.”*

— President Theodore Roosevelt.

President Theodore Roosevelt, Special Message to Congress, (Jan. 22, 1909)
available at <https://www.presidency.ucsb.edu/documents/special-message-368>

Delta-8-THC (D8-THC/ Δ 8-THC)



Industry thought process:

- Hemp is legal under farm bill
- CBD extracted from hemp is natural and legal
- Trace levels of Δ 8-THC has been observed in biomass and therefore is a natural product
- Since Δ 8-THC is naturally occurring, a derivative pathway from CBD for production is legal

Problem:

- Conversion of CBD to Δ 8-THC is not a natural process
- Many isomers formed are not naturally occurring
- There are both legal questions and consumer safety issues arising from these unknown contaminants

Natural $\Delta 8$ -THC

- $\Delta 8$ -THC is only found in trace amounts in natural cannabis biomass
- It would require 55,000 kilo of hemp to produce 1 kilo of natural Delta-8-THC
- At \$400 per kilo for biomass, raw plant material alone would be \$22,000,000
- Estimated market value for natural $\Delta 8$ extract would be somewhere between \$200,000,000 and \$500,000,000 per kilo
- Economically impractical

Rationale for Production/Distribution

Different rationales for positive positions on Delta-8

- High potential for therapeutic/recreational applications
 - Especially in markets where marijuana is not yet legal
- Scientifically interesting and relevant
 - Like many minor cannabinoids
- Relatively easy to produce, currently without regulatory oversight
 - Minimal capital investment for production equipment and supplies
- Oversupply of CBD isolate resulted in lower margins
 - Conversion to THC represents significant value add to products
 - Provides salvation for investors waiting for FDA approval of CBD

Delta-8-THC Concerns

Different rationales for negative positions on Delta-8

- Potential for intoxication with Delta-8 use
 - Much of hemp legislative success is based on absence of intoxicants
 - Could have negative consequences to future cannabis legislation
- Unregulated products cutting into regulated cannabis profits
- Consumer safety
 - Produced without regulatory oversight
 - Many unidentified contaminants observed in consumer products
 - No efficacy or toxicity information available for these contaminants

Regulatory and Consumer Safety Groups

Regulatory, Safety and Industry Groups Have Issued Statements

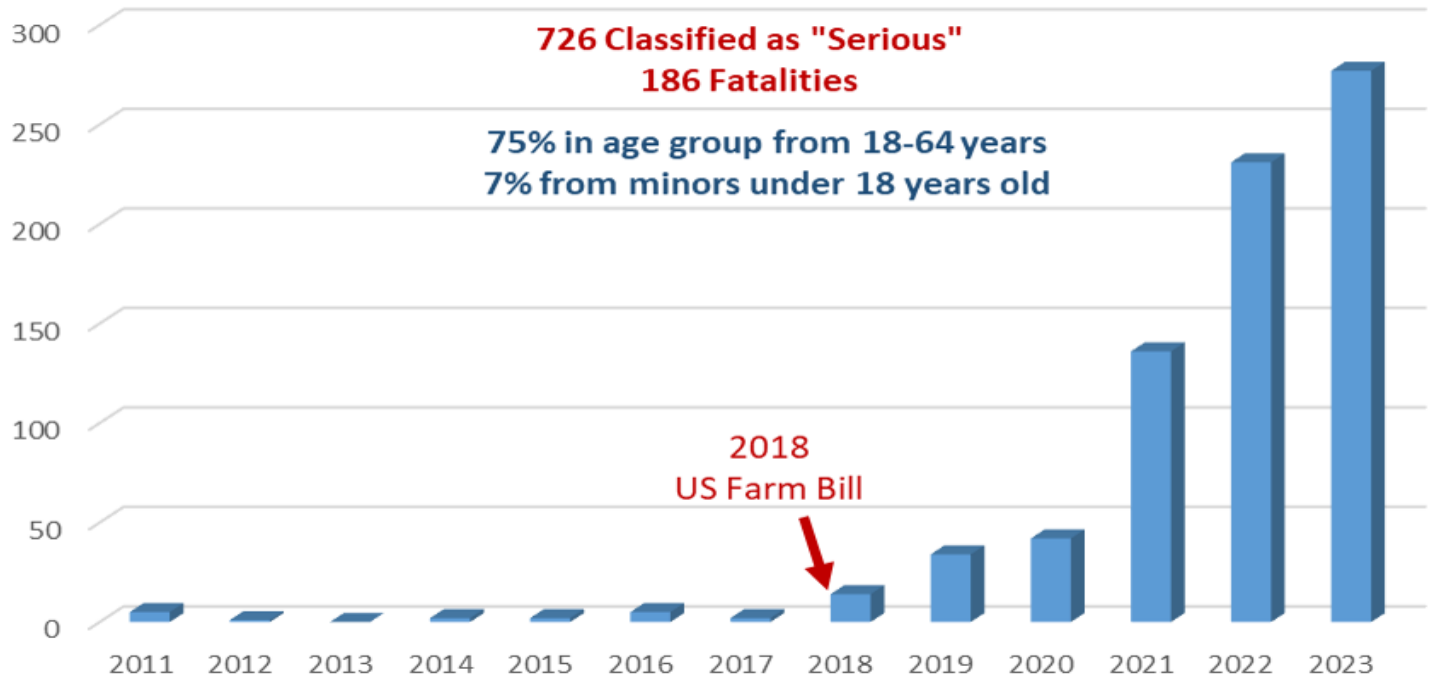
- US Food & Drug Administration (FDA)
- Centers for Disease Control and Prevention (CDC)
- FOCUS
- United States Pharmacopeia (USP)
- American Herbal Products Association (AHPA)
- US Hemp Authority
- Hemp Industry Association (HIA)

<https://www.fda.gov/consumers/consumer-updates/5-things-know-about-delta-8-tetrahydrocannabinol-delta-8-THC>



Regulatory and Consumer Safety Groups

FDA Adverse Events Reporting - Synthetic Cannabinoids



6/1/24 - <https://open.fda.gov/data/faers/>

Definition: Phyto-Cannabinoids

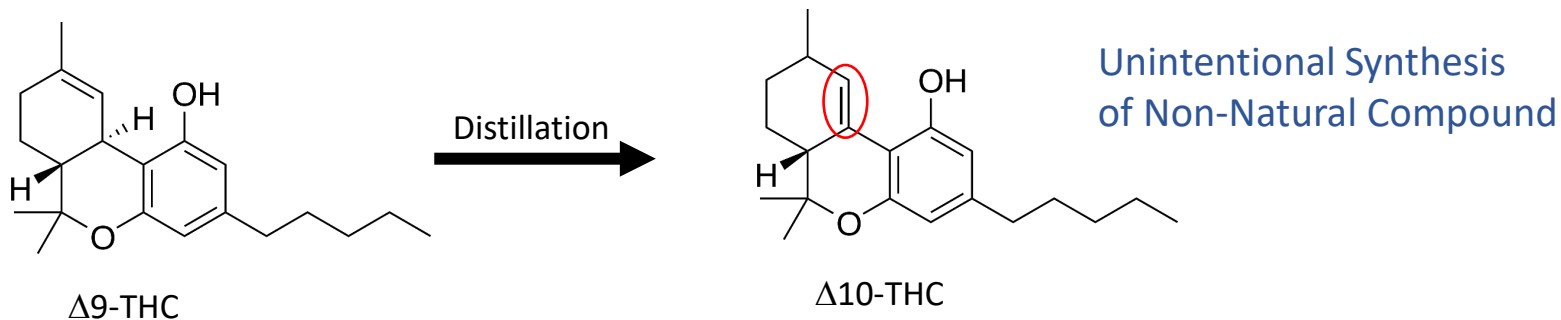
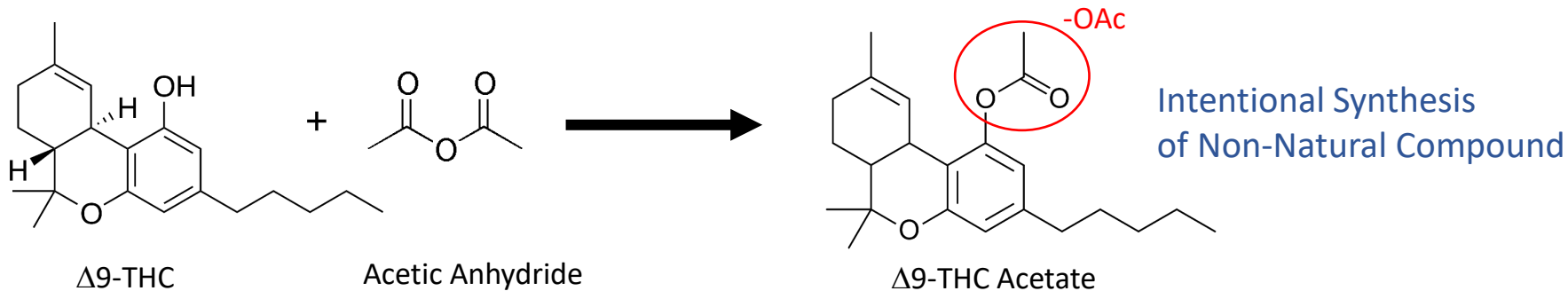
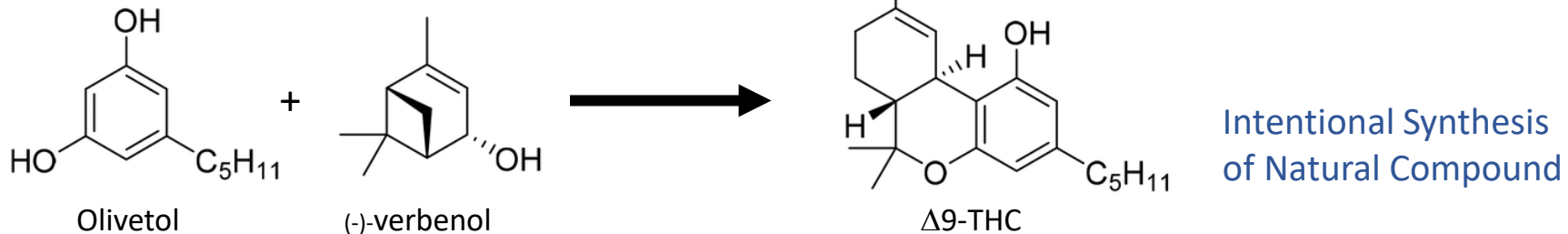
The term “phytocannabinoid” refers to cannabinoids produced by the cannabis plant.

- *Examples include: THCA, CBDA, CBGA*
- *While not produced directly by the plant, natural degradation occurs in the plant producing: Δ 9-THC, CBD, CBG, and CBN*
- *These cannabinoids are often extracted for production of consumer products: gummies, chocolates, vape devices*

Definition: Synthetic Cannabinoids

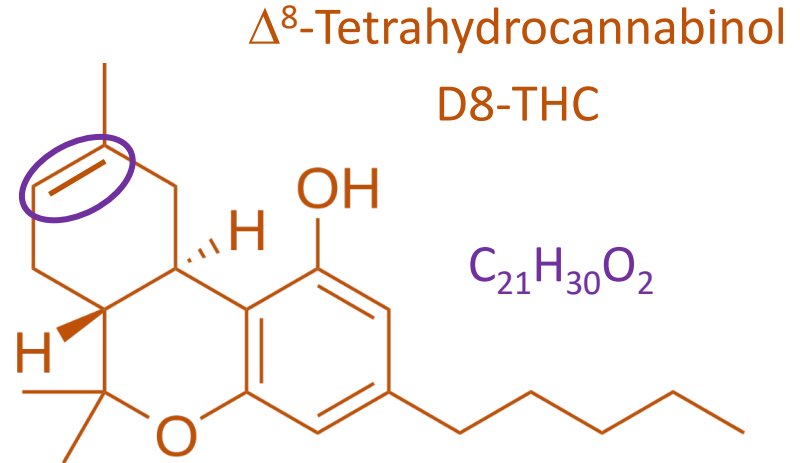
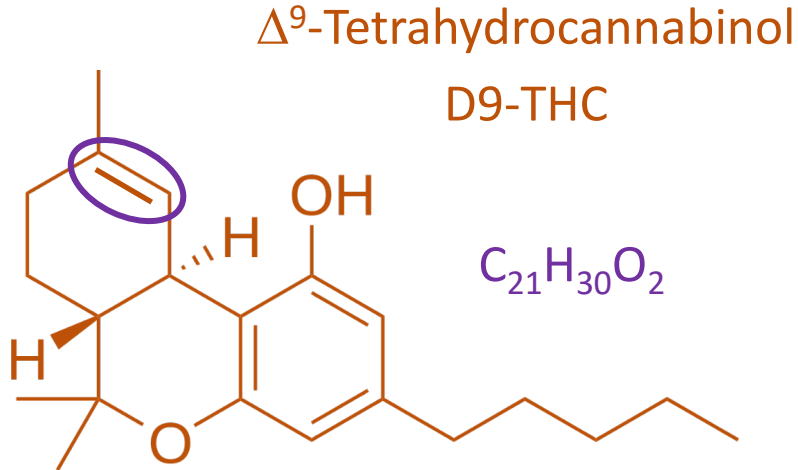
*The term “synthetic” refers to chemical compounds created through a chemical process by **human agency**, as opposed to those of natural origin.*

- *Synthetic compounds may imitate natural products (Marinol)*
- *Synthetic compounds may not found in nature (THC-O)*
- *Synthetic compounds can be intentional or accidental*



Definition: Isomers

The term “isomer” refers to compounds with the same chemical formula but a different arrangement or connectivity of atoms in the molecule.



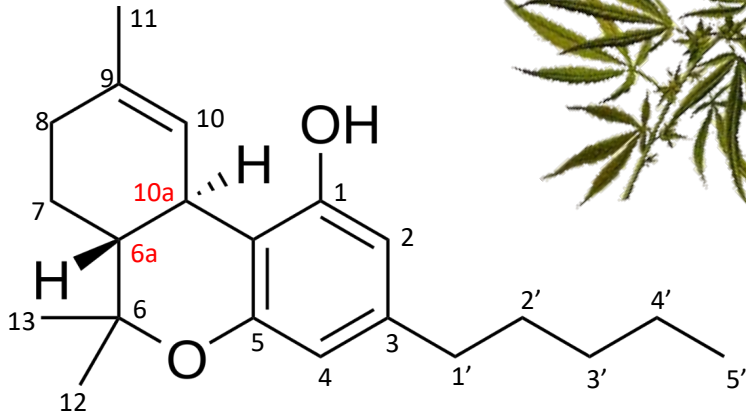
Isomers of THC

(6aR, 10aR)- Δ^9 -Tetrahydrocannabinol

(6aR, 10aR)- Δ^9 -THC

(-)-*trans*- Δ^9 -THC,

Δ^9 -THC, D9-THC

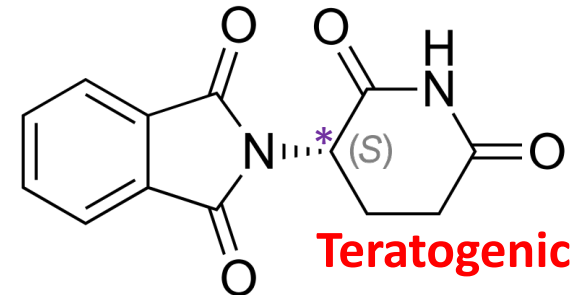
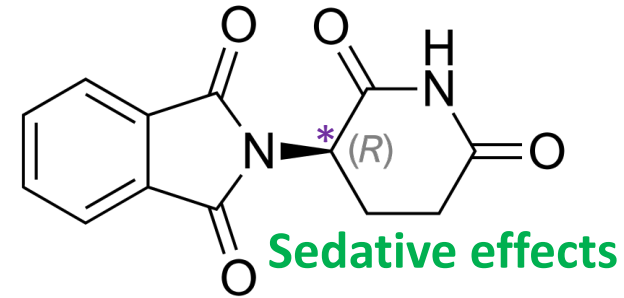


Isomers	Double Bond	Stereoisomers
$\Delta^{6a,10a}$ -THC	6a-10a	2
$\Delta^{6a,7}$ -THC	6a-7	4
Δ^7 -THC	7-8	8
Δ^8 -THC	8-9	4 (1)
Δ^9 -THC	9-10	4 (1)
Δ^{10} -THC	10-10a	4
$\Delta^{9,11}$ -THC	9-11	4

$\Delta = D$

Isomers Matters: Thalidomide

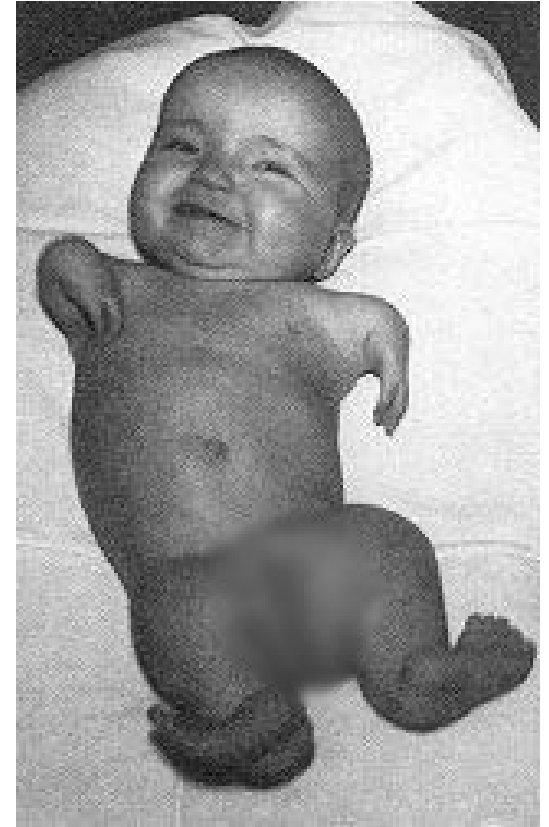
- First marketed in 1957 in West Germany
- Promoted for the treatment of anxiety, sleep disorders, tension and morning sickness
- Thalidomide is a “chiral” molecule
 - “right” and “left” handed isomers
- Use in pregnant women affected ~ 10,000 people
 - Approximately 40% died at time of birth
 - Survivors suffered from significant problems
 - Birth defects (limbs)
 - Eyes, heart, urinary tract



Isomers Matters: Thalidomide



Thalidomide
Birth
Defects



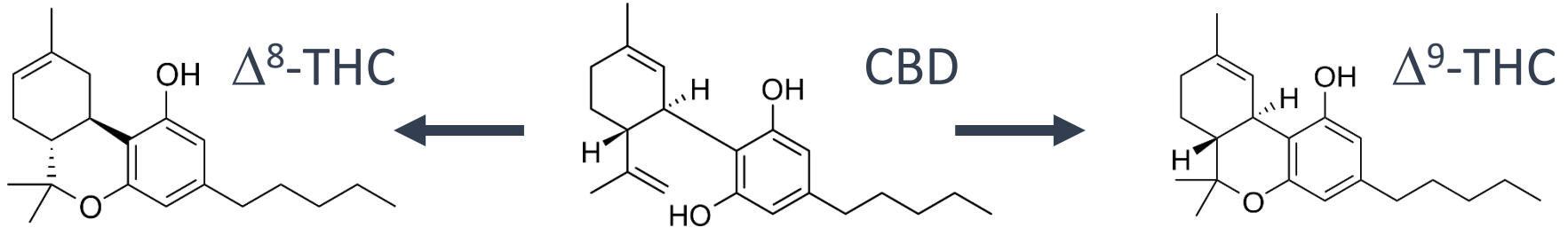
Isomers Matters: Thalidomide



- Used in Canada, Great Britain, West Germany and Australia
- Not approved by FDA for use in the US
- Frances Oldham Kelsey
 - Pharmacologist and Medical Reviewer with the FDA
 - Commented on the application:

“an interesting collection of meaningless pseudoscientific jargon apparently intended to impress chemically unsophisticated readers.”

Conversion of CBD into THC



First published by Roger Adams in 1941



US 20040143126A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2004/0143126 A1**

Webster et al. (43) **Pub. Date: Jul. 22, 2004**

(54) **CONVERSION OF CBD TO DELTA8-THC
AND DELTA9-THC**

Related U.S. Application Data

(76) **Inventors:** G. R. Barrie Webster, Manitoba (CA);
Leonard P. Sarna, Manitoba (CA);
Raphael Mechoulam, Jerusalem (IL)

(60) Provisional application No. 60/273,628, filed on Mar.
7, 2001.

Publication Classification

Most synthetic pathways employ acidic conditions with the addition of catalysts

Conversion of CBD into THC



CBD Isolate

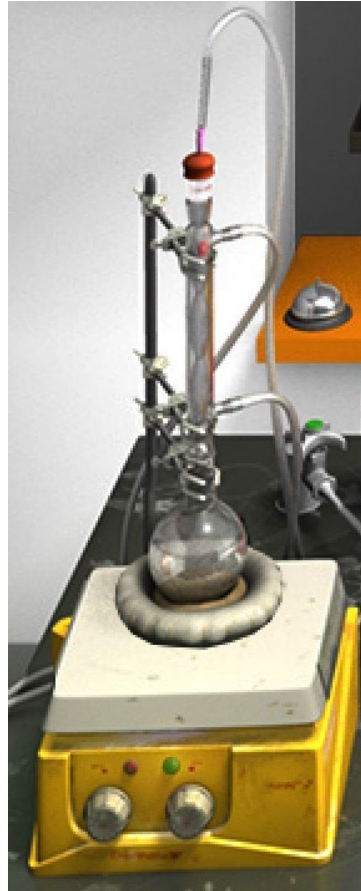
Dissolve in solvent



Add Acid



Reflux
↑Temp



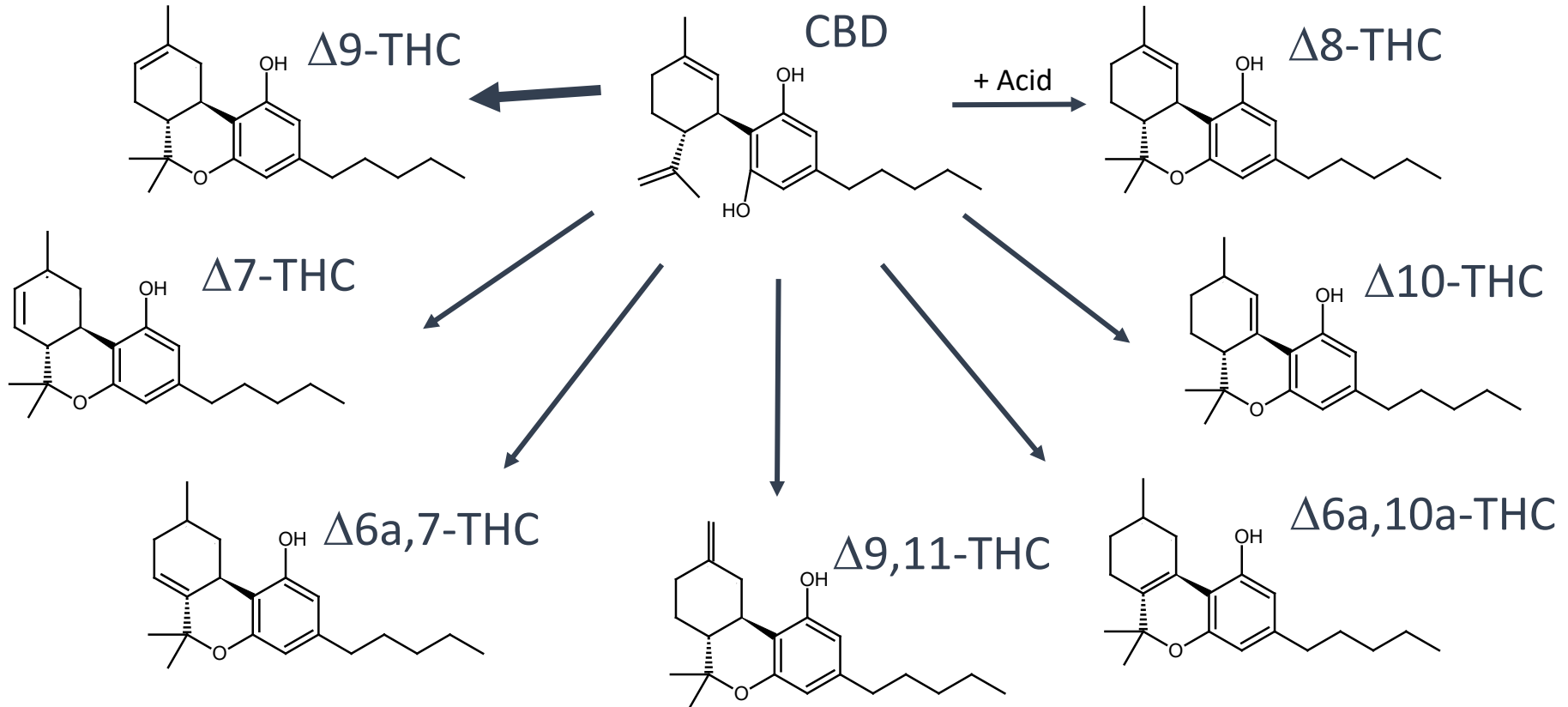
Neutralize
Acid



Remove
Solvent



CBD + Acid \rightarrow THC

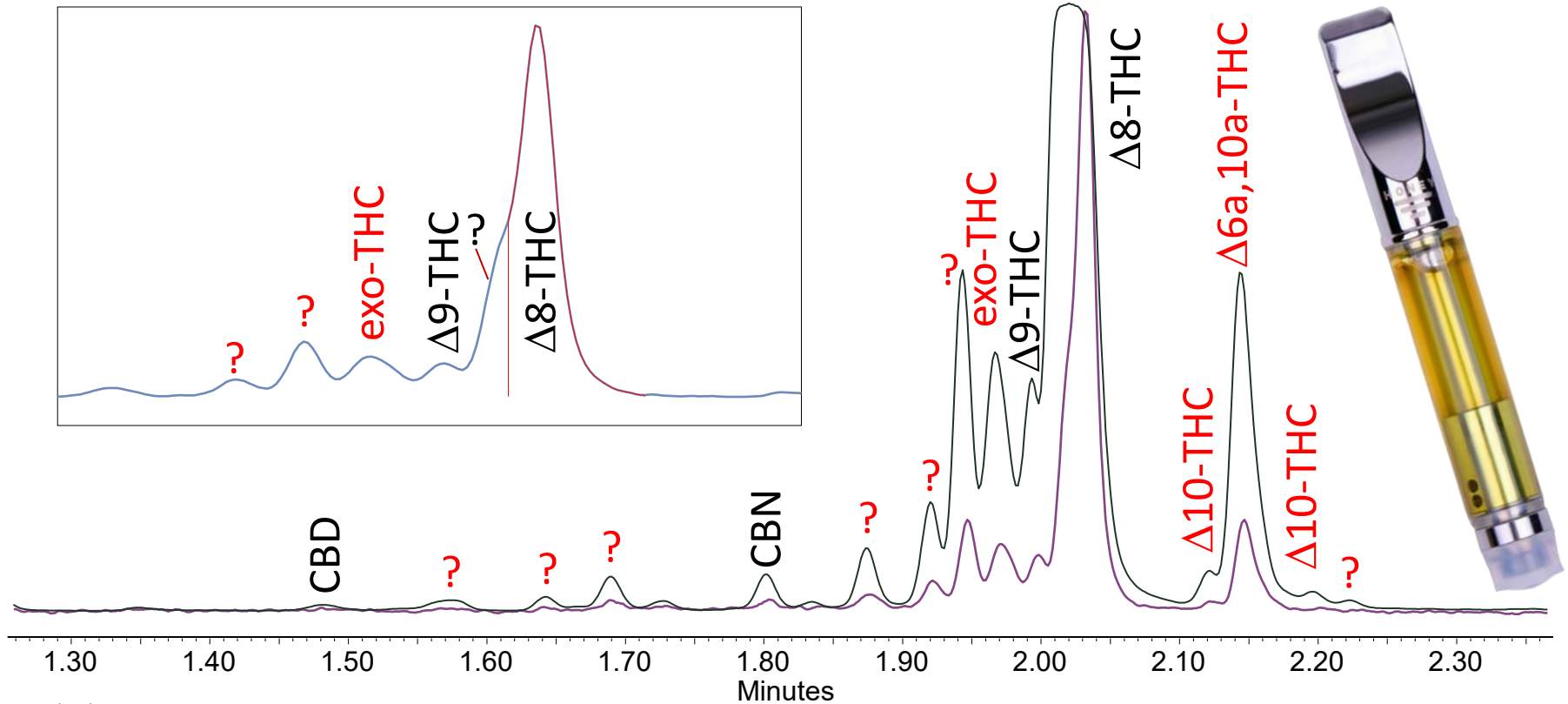


Synthesis: Standard Operating Procedures

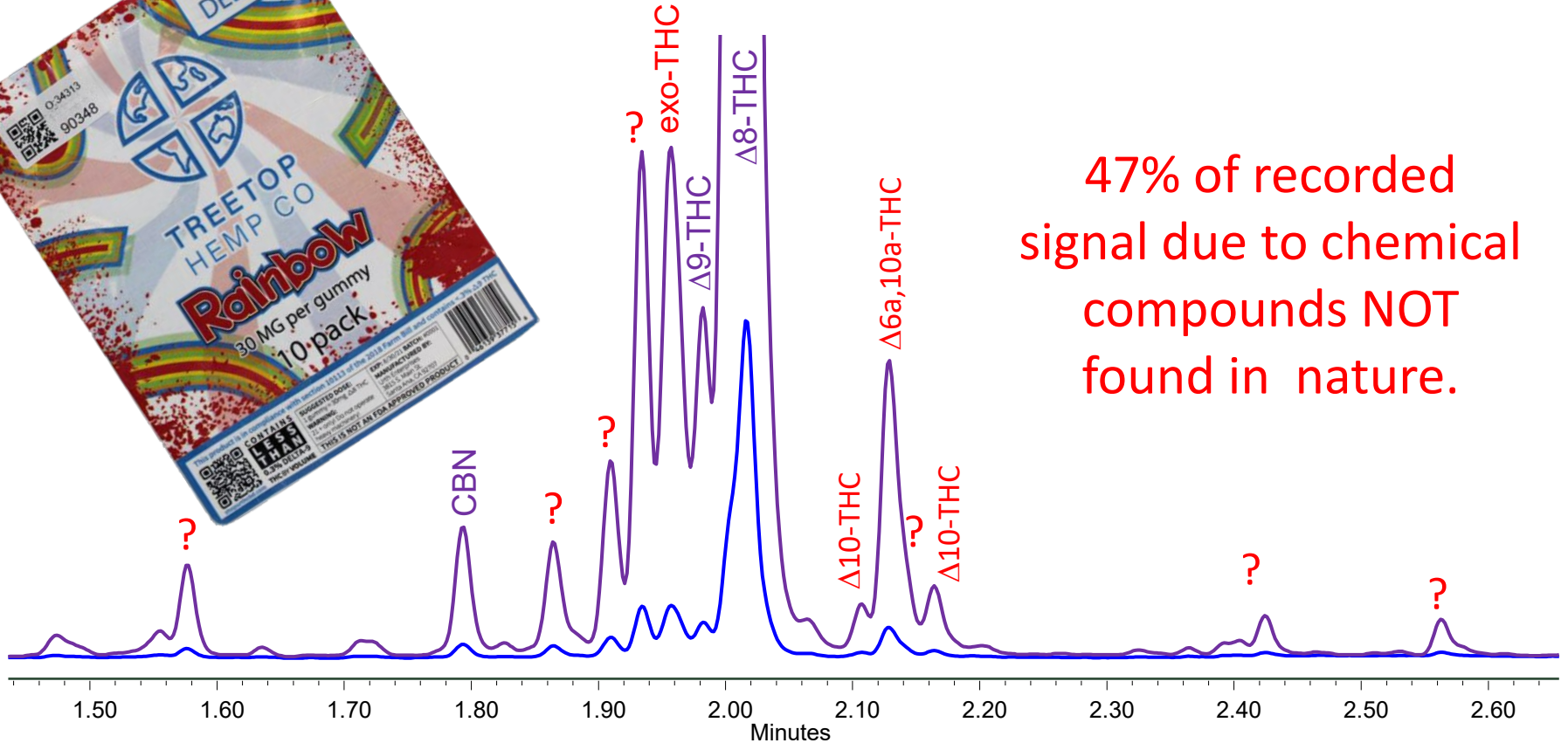


Man-Style
2 lbs. lean beef, cut in 1-in. cubes
2 8-oz. cans Hunt's Tomato Sauce
1/4 t. pepper 1/2 bay leaf
1 c. sliced celery
6 each: sm. carrots, onions, potatoes, parsnips
bag. Drop in beef, a portion at a time
shake until coated. Low heat in hot
pot, brown beef over. Hunt's Tomato Sauce
Stir in water. Add vegetables as done
seasonings. Simmer until vegetables are done
45 minutes. Makes 6 servings

Lemon Drop Vape Cartridge Oil



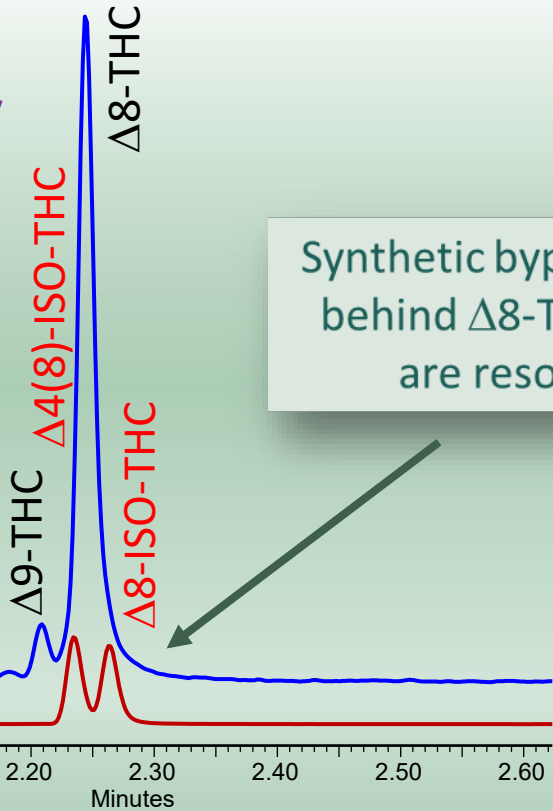
Tree Top Gummies



47% of recorded signal due to chemical compounds NOT found in nature.

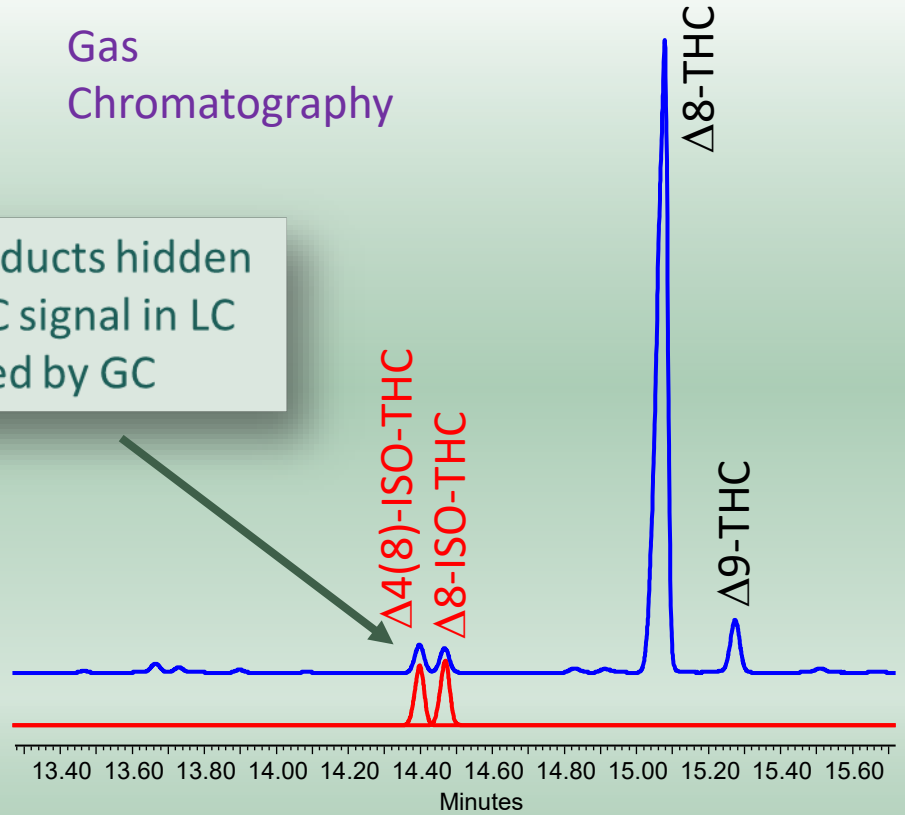
$\Delta 8$ -THC Analysis: LC vs GC

Liquid Chromatography



Synthetic byproducts hidden behind $\Delta 8$ -THC signal in LC are resolved by GC

Gas Chromatography



Δ^x – Wheel of Chance

- Commercially available Δ^8 -THC products represent complex synthetic mixtures
- Most laboratories are not reporting the unknown constituents
 - Certificates of Analysis are often unreliable
- Producers often do not know what they are producing and distributing
- Without regulatory oversight, consumers have no idea what they are consuming



Focus on Consumer Safety

- Isomers: Non-naturally occurring forms of THC
- Synthetic Byproducts: Chemicals not found in nature
- Synthetic Reagents: residual solvents, acids, catalysts
- Lack of Regulation: No labeling/distribution standards,
- Lack of Testing Methods: No appropriate methods
- Widespread Disinformation: Consumers are being misled
- Lack of Boundaries: Other synthetic analogs

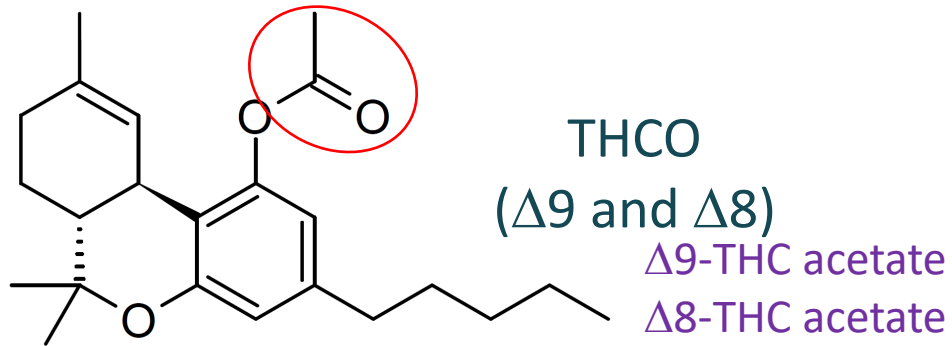
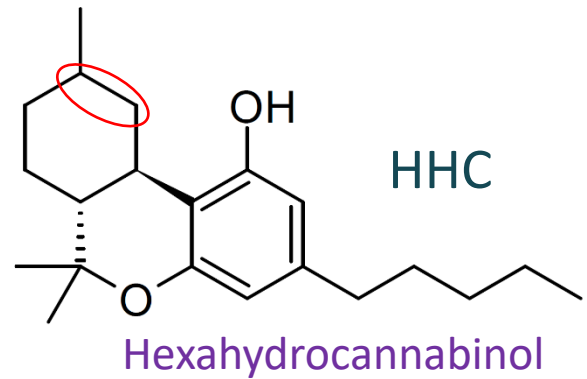
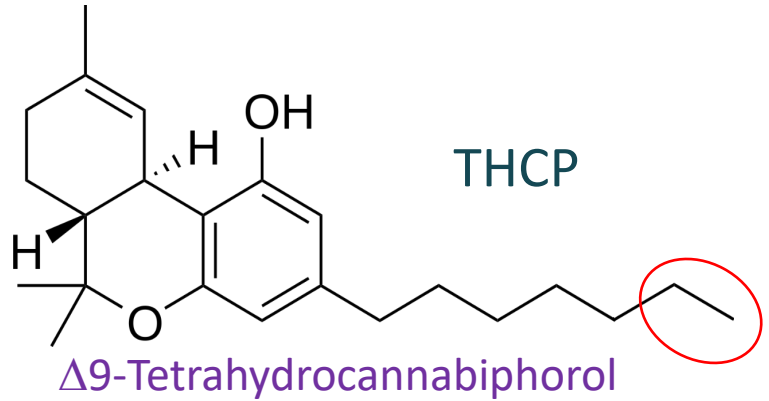
Points to Ponder

For these unknown synthetic contaminants in $\Delta 8$ -Samples:

- Are they doing liver damage because the body does not know how to metabolize these unknown compounds?
- Will they cause cancer with repeated long term exposure?
- Might some of these compounds cause birth defects or miscarriage if consumed during pregnancy?
- Will some of these compounds interact with other medications that a patient may be taking?
- Will use of these products trigger a positive drug test?

What's ~~Next?~~ Now?

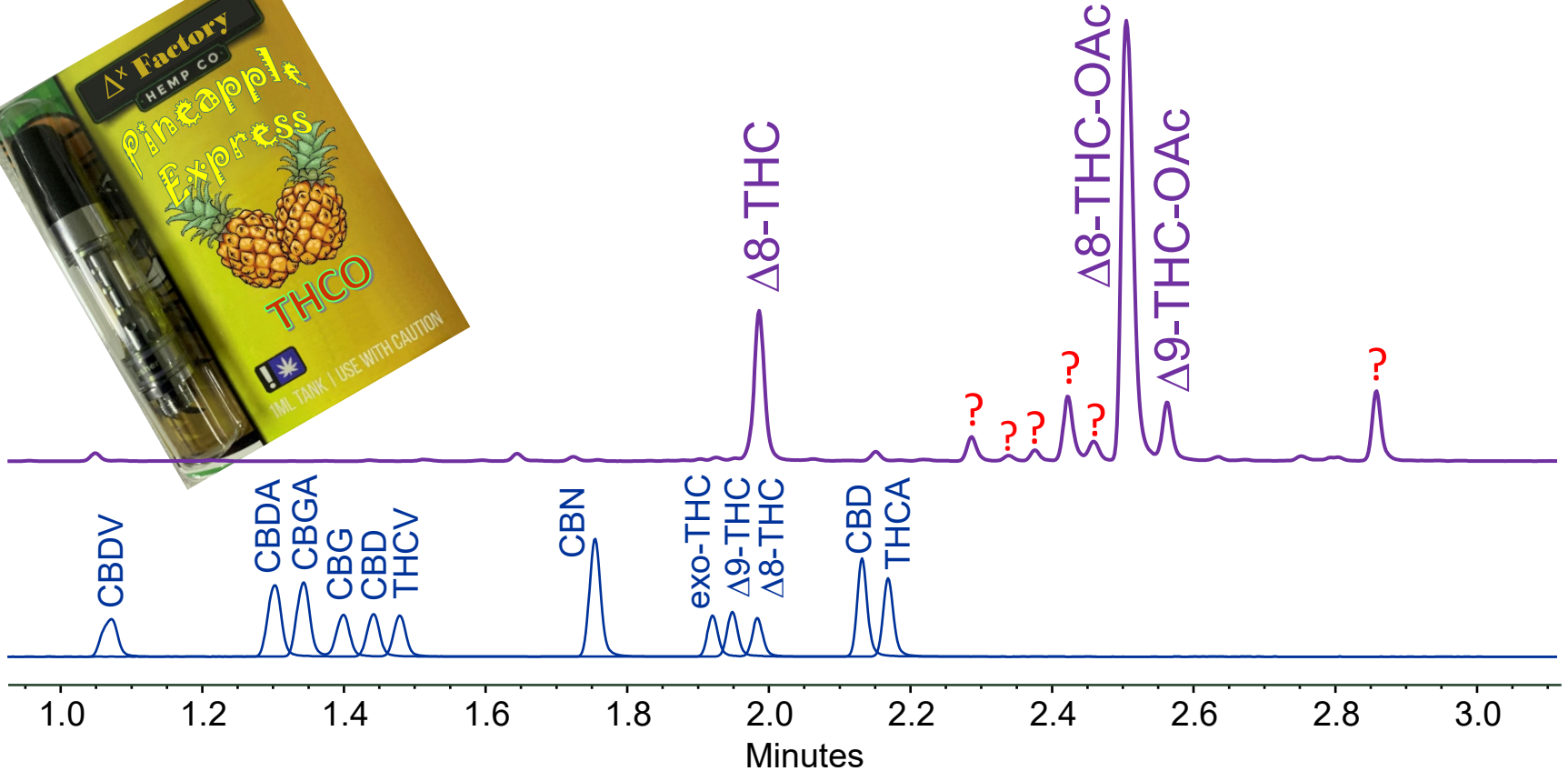
- Other synthetic variants and analogs are already on the market:



- (Δ^9 / Δ^8)
THCb
THCh
THCp
THCO
THCPO
THC-X
PHC

CBNO
HCC
HHCP
HHCO
HHCPO

THC-O-Acetate Vape



Berry Gelato Vape Cartridge

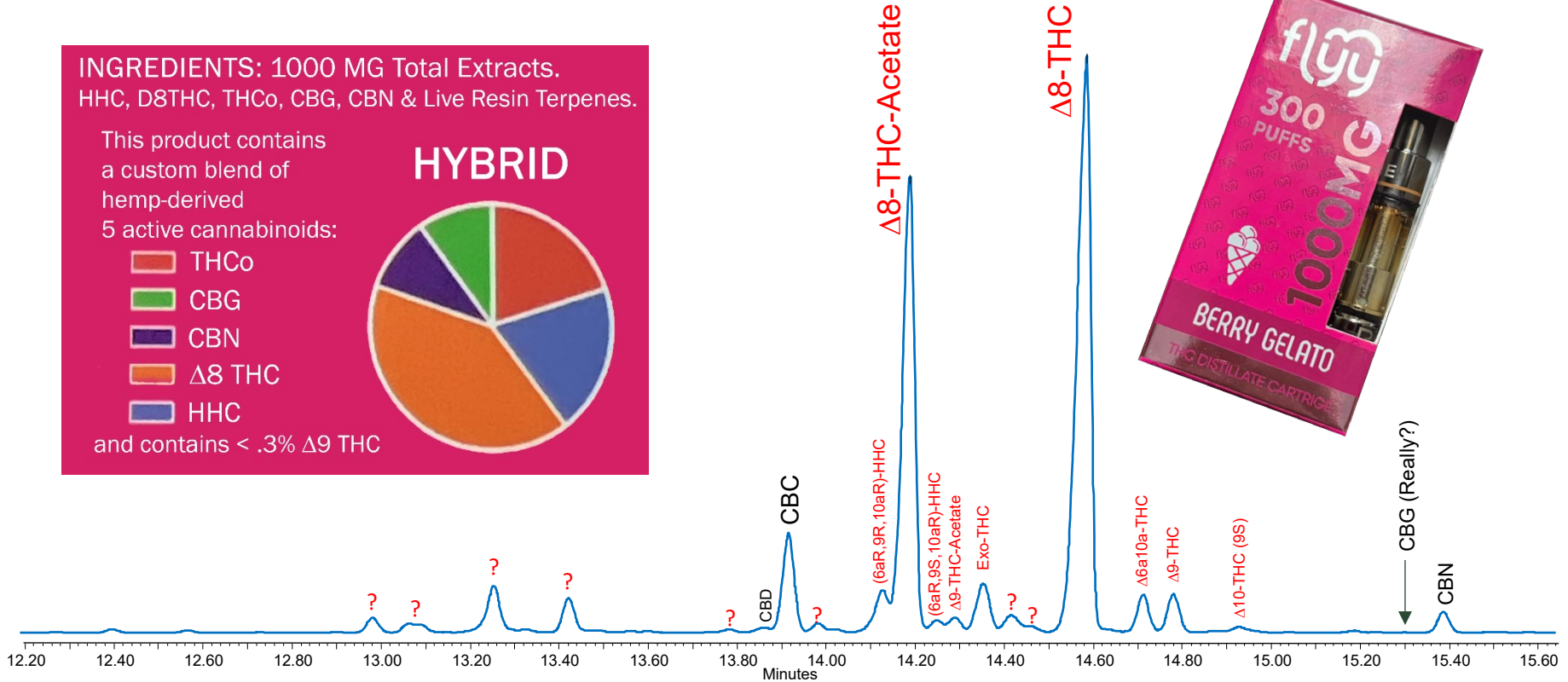
INGREDIENTS: 1000 MG Total Extracts.
HHC, D8THC, THCo, CBG, CBN & Live Resin Terpenes.

This product contains
a custom blend of
hemp-derived
5 active cannabinoids:

- THCo
- CBG
- CBN
- $\Delta 8$ THC
- HHC

and contains < .3% $\Delta 9$ THC

HYBRID



Science Summary

- Delta-8-THC has demonstrated potential for both therapeutic and recreational products
- While $\Delta 8$ -THC is found in nature, natural sources are impractical, making synthetic preparation the most economical source
- Currently, most $\Delta 8$ -THC products are synthesized in an unregulated environment, giving rise to multiple contaminants of concern
- Many of these contaminants have not yet been identified, and most laboratories ignore their presence, making COAs unreliable
- Post-synthesis isolation and purification may be used to produce a clean, uncontaminated $\Delta 8$ product

Mythinformation

- 1. (neologism) False information, when seen as having its own mythology or being believed in like a myth would be*
- 2. (neologism) Data or details not founded on factual evidence, intended to exploit the ignorance of others*

$\Delta^8\text{-THC} = \Delta^8\text{-THC}$

“we need to start classifying cannabinoids agnostic to source as the body processes them the same without cause or concern of source”

$\Delta^8\text{-THC}$ is $\Delta^8\text{-THC}$ regardless of whether it is natural or synthetic

WRONG!!!!!!

$\Delta 8$ -THC as an Agricultural Product

“Delta-8-THC, as a Hemp Derivative, under the US Farm Bill, is an agricultural product and should be regulated as such”

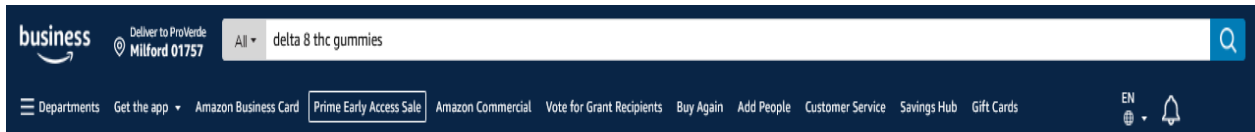
WRONG!!!!!!

With the addition of solvents, acids and other reagents, we leave the realm of agriculture and enter into the world of synthetic organic chemistry, no different from a pharmaceutical environment.

Organic Delta-8-THC? Not a Thing



Synthetic Products are Not Widely Available



Hemp Gummies Delta Premium 500 Milligram High Potency - 25 Per Fruity Gummy - Stress Relief, Inflammation, Pain, Restful Sleep

Brand: Generic

★★★★★ 379 ratings | 17 answered questions

Price: \$29.95 (\$1.50 / Count)

Coupon: Save an extra 15% when you apply this coupon Terms

Get \$150 off: Pay \$0.00 \$29.95 upon approval for the Amazon Business Card. Terms apply.

Brand	Generic
Item Form	Chewable
Flavor	Hemp
Product Benefits	Stress Relief
Unit Count	20.00 Count
Dosage Form	500-1000
Number of Items	1

About this item

- RELAX- Fight the stresses of the day naturally, and feel the calming and relaxing benefits
- SLEEP- Fall asleep and stay asleep. No more tossing and turning.
- ANXIETY- Calm an overactive mind and stop the constant worrying
- NAUSEOUS- Prevent and combat the feelings of nauseous and stimulate a healthy appetite
- MADE IN USA- Proudly made and packaged in the USA

- Available on Amzon.com
- No mention of THC
- No mention of $\Delta 8$
- No waring on psychoactivity
- No Age restriction for purchase

Synthetic Products are Not Widely Available

business Deliver to ProVerde Milford 01757 All ▾ delta 8 thc gummies

Departments Get the app ▾ Amazon Business Card Prime Early Access Sale Amazon Commercial Vote for Grant Recipients Buy Again Add People Customer Service Savings Hub Gift Cards EN

Hemp Gummies Delta Premium 500 Milligram High Potency - 25 Per Fruity Gummy - Stress Relief, Inflammation, Pain, Restful Sleep

Brand: Generic

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Price: ~~\$29.95~~ (\$1.50 / Count)

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Brand: Generic
Item Form: Chewable

- Available on Amzon.com
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- No mention of $\Delta 8$
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nikita paino

★★★★★ **Intense**

Reviewed in the United States on September 9, 2022

Verified Purchase

This stuff will definitely hit you hard! I thought since I am fairly overweight that one whole one wouldn't be too much but I was wrong! I'll be taking 1/8 of a gummy from now on lol.

Helpful

Report abuse

Consumer Safety

LACK OF EVIDENCE OF HARM



SAFETY

While these synthetic compounds have not yet been studied for safety, the CDC has recorded many adverse events associated with synthetic cannabinoid products

Synthetic Products Are Not Harmful



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New Products

News

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VIDEO

Four Dead After Using Synthetic Cannabis Containing Rat Poison

There were a total of 52 cases of people affected with coagulopathy, a bleeding disorder.

By — Ben Munson, Editor, Cannabis Equipment News, Unit 202 Productions, Eric Sorensen

Oct 11, 2022

Four people in Florida died after using synthetic cannabinoids (SCBs) containing brodifacoum, which is typically used as rat poison.

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August 4, 2022



Security Breach: Lessons Learned from DarkSide and the Solar Winds Hack

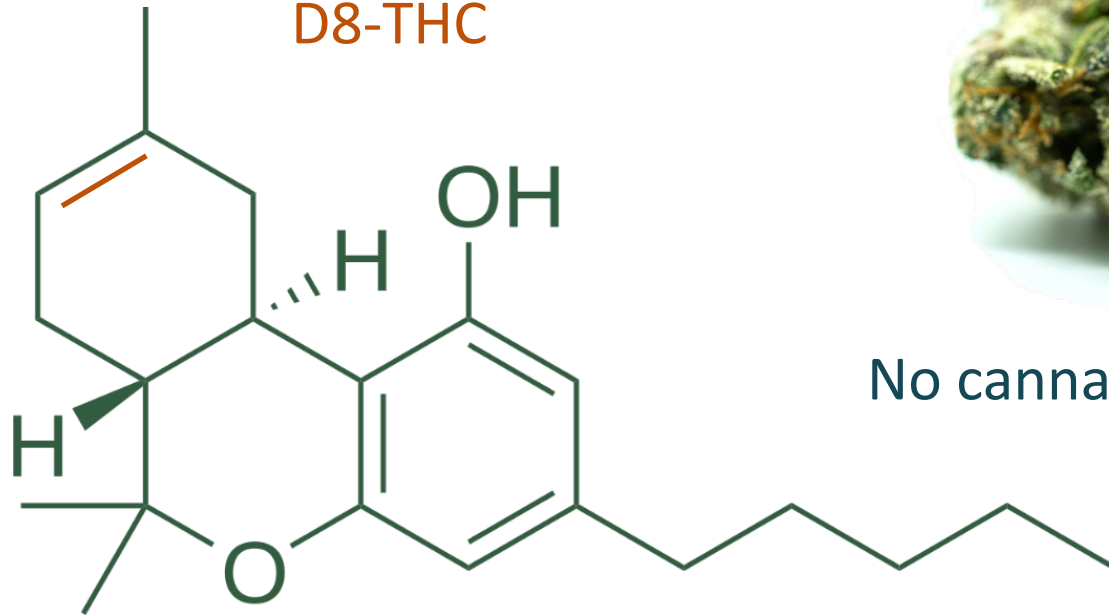
August 26, 2022



Natural Δ^8 -THC Flower

Δ^8 -Tetrahydrocannabinol

D8-THC



No cannabis genetics produce the Δ^8 -THC isomer

High THCA Hemp Flower

THCA HEMP FLOWER



$\Delta 9$ -THC = 0.24% (by weight)

Definition of Hemp



“Hemp” is defined by the 2018 Farm Bill as “the plant species *Cannabis sativa* L. and any part of that plant, including the seeds thereof and all **derivatives**, extracts, cannabinoids, **isomers**, acids, salts, and salts of isomers, whether growing or not, with a delta-9 tetrahydrocannabinol concentration of not more than 0.3 percent on a dry weight basis.”

Definition of Hemp

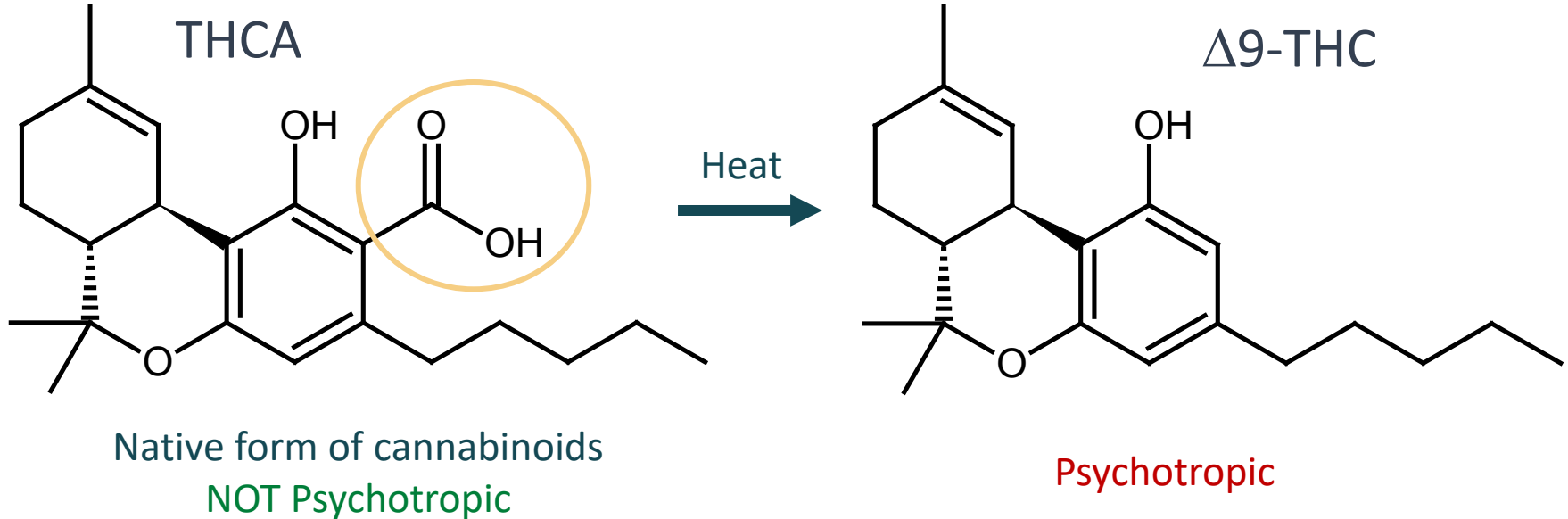


The 2018 Farm Bill mandates testing using **post-decarboxylation or other similarly reliable methods** where the total THC concentration level considers the potential to convert delta-9-tetrahydrocannabinolic acid (THC-A) into delta-9-THC, on a dry weight basis.

What does this mean?

Definition of Hemp

What is decarboxylation?



Post-Decarboxylation Methods

(1) Analysis is performed using Gas Chromatography (GC)

- Injection of sample into hot GC inlet decarboxylates THCA to neutral $\Delta 9$ -THC prior to analysis, such that measured value represents total possible $\Delta 9$ -THC

(2) Sample is heated prior to analysis by Liquid Chromatography (LC)

- Heating sample decarboxylates THCA to neutral $\Delta 9$ -THC prior to analysis by LC, which is performed at moderate temperatures

(3) Analysis is performed using Liquid Chromatography (LC)

- Results provide separate quantitation of THCA and THC
- Total THC is calculated by a mathematical, theoretical decarboxylation

$$\text{Total THC} = (0.877 \times \text{THCA}) + \text{THC}$$

This last method is used most widely and is accepted by all Federal and State regulatory bodies

High THCA Hemp Flower



Δ 9-THC = 0.24% (by weight)

THCA = 32.8% (by weight)

**THCA HEMP
FLOWER**

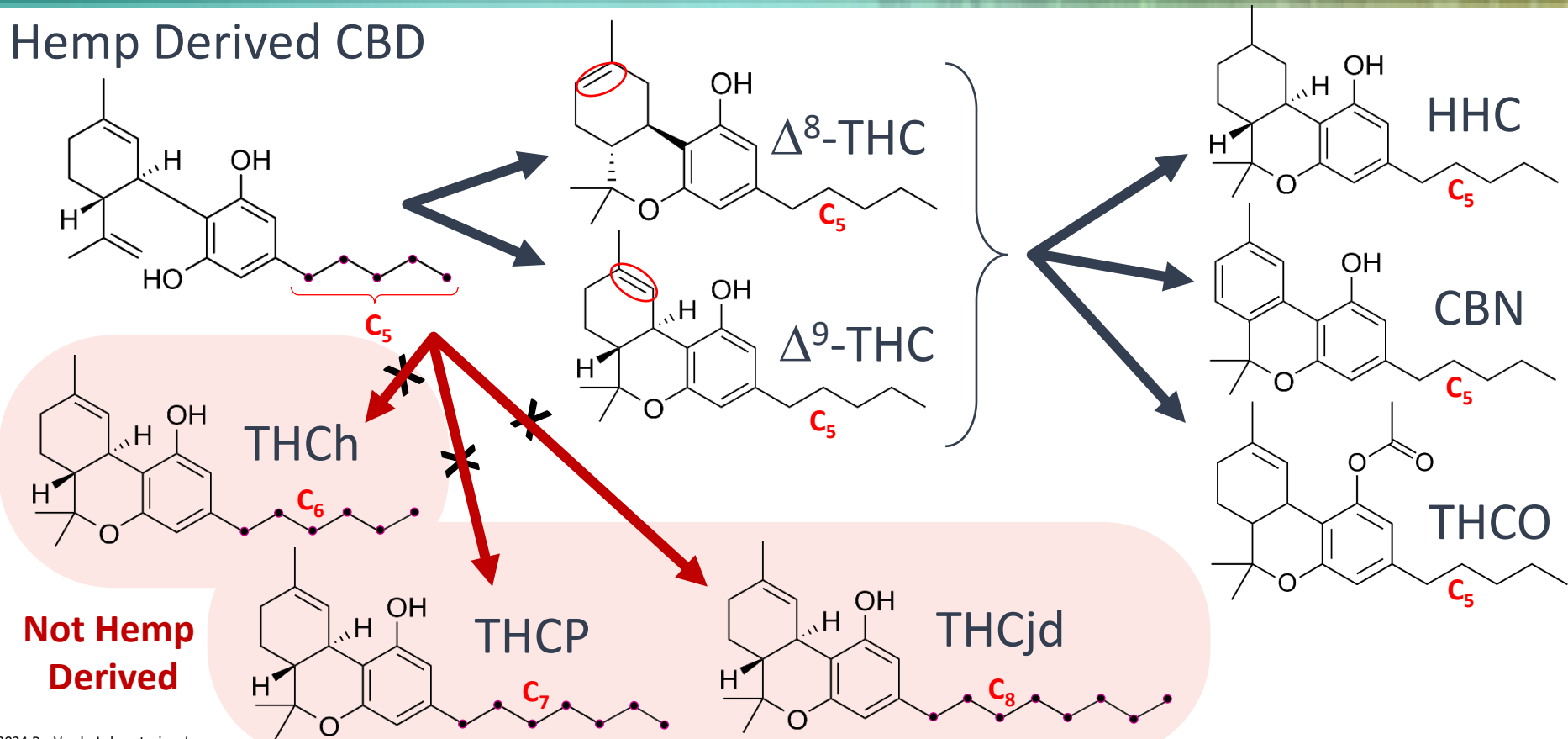


**BLACK
MARKET**

MARIJUANA

Hemp Derived Intoxicants

Hemp Derived CBD



Economics of THC Production

Starting Material	Current price	\$/g of THC	\$ per 5mg dose	Comment
Marijuana Flower	\$1,400/lb	\$15 per gram	\$0.08 per 5mg dose	Natural Δ 9-THC, Marijuana
Hemp CBD Flower	\$266/lb	\$29 per gram	\$0.15 per 5mg dose	Natural Δ 9-THC, Hemp Derived
Hemp Distillate	\$355/kilo	\$12 per gram	\$0.06 per 5mg dose	Natural Δ 9-THC, Hemp Derived
CBD Isolate (from ?)	\$440/kilo	\$0.55 per gram	\$0.0028 per 5mg dose	Synthetic Δ 9-THC, Hemp Derived
CBD Isolate (from China)	\$250/kilo	\$0.31 per gram	\$0.0016 per 5mg dose	Synthetic D9-THC, Hemp Derived
Raw Chemicals	\$110/kilo	\$0.14 per gram	\$0.0007 per 5mg dose	Synthetic Δ 9-THC, Purely synthetic

All estimates are crude, approximate estimates, based on average market prices, and estimated extraction/synthetic yields.

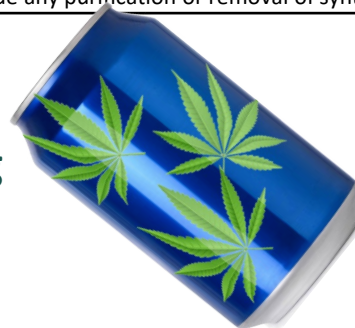
The estimates for synthetic THC are based solely on the estimated cost for raw ingredients, and do not include any purification or removal of synthetic impurities.

5mg



\$1.45/gummy

5mg



\$8.00/can

Inclusion of Synthetics in Current Regulation

- Current State by State cannabis regulations pertain to agricultural products and processes.
- Synthetic organic chemistry utilizes a significantly different skill set – Not typically found in Cannabis Operations.
- Regulatory discussions on inclusion of synthetics in a regulatory program typically include the statement:

“We’ll just have laboratories test for the contaminants”



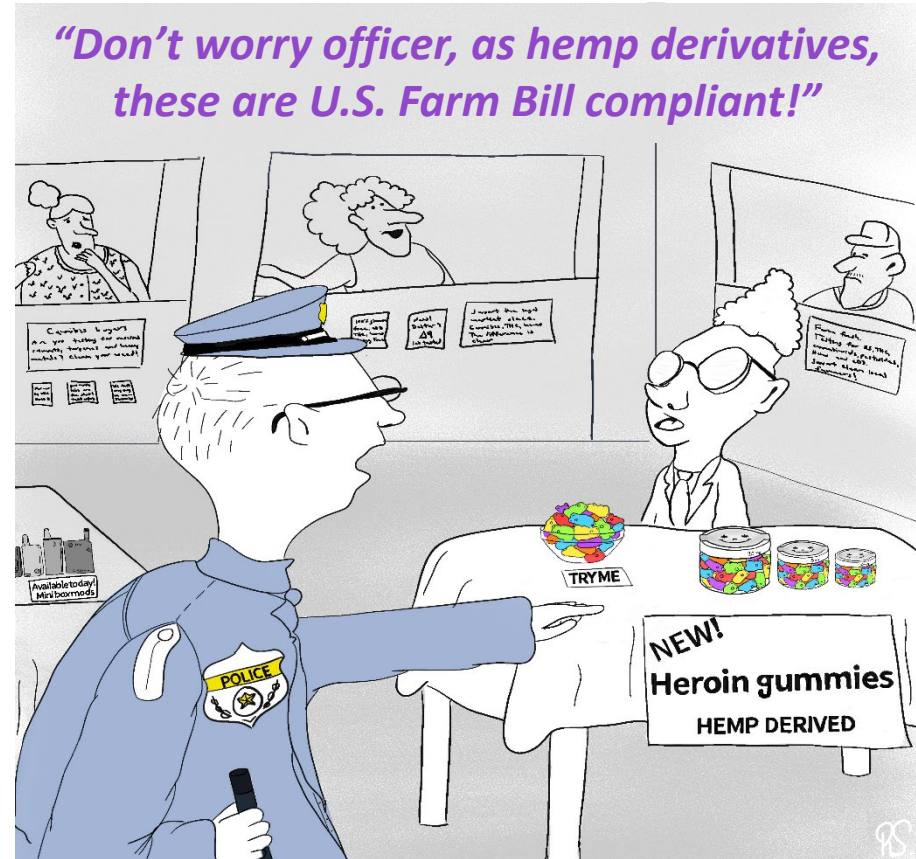
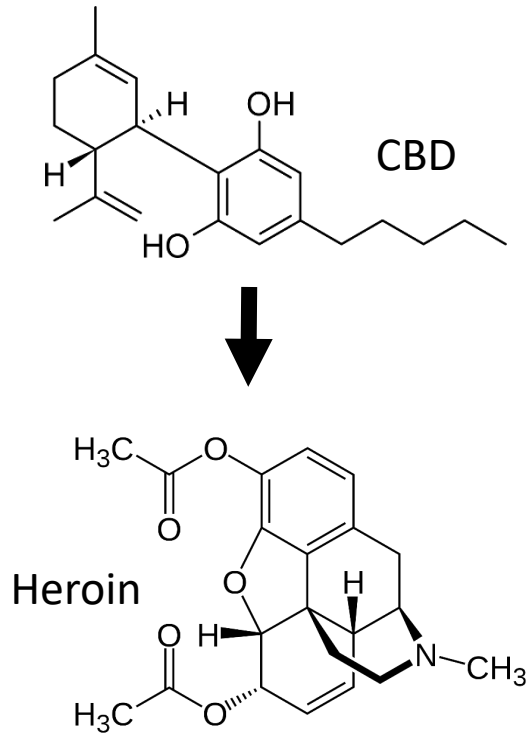
Inclusion of Synthetics in Current Regulation

Several problems with that statement:

- Many contaminants have not yet been identified
 - Their structures and toxicity are unknown
- Every recipe (SOP) will have a different contaminant profile
 - Which contaminants do the labs test for?
- Methods do not yet exist to test effectively for many of these contaminants
 - Typical lab instrumentation often cannot resolve contaminants
 - Specialized instrumentation is prohibitively expensive
- Certified reference standards do not exist for those standards



Legal Hemp Derivatives





Questions?

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