

An Introduction to Cannabis Lab Testing



Yasha Kahn

Co-founder

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Co-founder

MCR Labs



-
- 13+ years working in cannabis testing
 - Operate laboratories across multiple states

Current focus: data-informed approaches to regulating cannabis testing labs and protecting cannabis consumers.

Today's Discussion

Chapter 1: The value of testing

Chapter 2: Testing infrastructure

Chapter 3: The problem

Chapter 4: The policy mess

Chapter 5: Recommendations

Chapter 1

The value of testing

(why might a state want testing of cannabis in their program?)

**Cannabis is used
by patients who
need it.**

And many others.



And most have the option: tested and untested cannabis

Untested:
May be perfect for
the patient.

Or, may have the
wrong compounds or
be contaminated.



Tested:
Patient can select
the product that
best fits their need.

**Accurate labels
allows informed
selection.**



Chapter 2

Testing infrastructure
(in the lab)

Test panels, instruments, and costs

Analyte group	Typical primary instrument	Typical new instrument cost	Common analytes or targets
Pesticides	LC-MS/MS (triple quad), frequently supplemented by GC-MS/MS	LC-MS/MS: \$350,000-\$500,000; GC-MS/MS: \$200,000-\$350,000	Abamectin, acephate, acetamiprid, aldicarb, azoxystrobin, bifenthrin, boscalid, carbaryl, carbofuran, chlorantraniliprole, chlorpyrifos, clothianidin, cyfluthrin, cypermethrin, daminozide, diazinon, dichlorvos, dimethomorph, dinotefuran, etoxazole, fenhexamid, fenoxycarb, fipronil, flonicamid, fludioxonil, hexythiazox, imazalil, imidacloprid, kresoxim-methyl, malathion, metalaxyl, methiocarb, methomyl, myclobutanil, naled, oxamyl, paclobutrazol, permethrin, propiconazole, propoxur, pyraclostrobin, pyridaben, spinetoram, spinosad, spiromesifen, spirotetramat, spiroxamine, tebuconazole, thiabendazole, thiamethoxam, and trifloxystrobin
Heavy metals	ICP-MS; microwave digestion system used for sample preparation	ICP-MS: \$150,000-\$250,000; microwave digestion: \$25,000-\$60,000	Arsenic, cadmium, lead and mercury; some states also require chromium, nickel, copper, barium, selenium, silver, antimony, beryllium, cobalt, molybdenum, tin, or zinc
Residual solvents	Headspace GC-MS or headspace GC-FID	\$90,000-\$180,000	Acetone, acetonitrile, benzene, butane, chloroform, dichloromethane, ethanol, ethyl acetate, ethyl ether, ethylene oxide, heptane, hexane, isopropanol, methanol, pentane, propane, toluene, trichloroethylene, and xylenes
Microbiological contaminants	PCR/qPCR for specified pathogens and molds; culture/plating for indicator counts	qPCR system: \$20,000-\$70,000; complete culture setup: \$15,000-\$50,000	Salmonella spp.; Shiga toxin-producing <i>E. coli</i> ; <i>Aspergillus fumigatus</i> , <i>A. flavus</i> , <i>A. niger</i> , and <i>A. terreus</i> ; total yeast and mold; total aerobic microbial count; coliforms; bile-tolerant Gram-negative bacteria; generic <i>E. coli</i>
Mycotoxins	LC-MS/MS, generally the same platform used for pesticides	Dedicated system: \$350,000-\$500,000	Aflatoxin B1, aflatoxin B2, aflatoxin G1, aflatoxin G2, and ochratoxin A
Cannabinoids	HPLC	\$60,000-\$120,000	Δ^9 -THC, THCA, CBD, CBDA, CBG, CBGA, CBN, CBC, Δ^8 -THC, THCV, THCVA, CBDV, CBDVA, CBL, and CBLA
Terpenes	GC-MS or GC-FID	\$80,000-\$160,000	α -Pinene, β -pinene, β -myrcene, limonene, linalool, terpinolene, α -terpinene, γ -terpinene, α -terpineol, borneol, camphene, camphor, eucalyptol, geraniol, ocimene, valencene, fenchol, nerolidol, bisabolol, β -caryophyllene, caryophyllene oxide, α -humulene, and guaiaol

Certificate of analysis

COA
ANALYTICS



www.BudsGoods.com

OFFICIAL CERTIFICATE OF ANALYSIS

WATER CONTENT % (w/w)

Result: 8.85

Analytical Method: Karl Fischer Titration

Date: 9-15-2022

CANNABINOIDS

LOQ = 0.0433 % (w/w)

Cannabinoid	% (w/w)	mg/g
CBDV	NOT DETECTED	NOT DETECTED
CBD	NOT DETECTED	NOT DETECTED
THCV	NOT DETECTED	NOT DETECTED
THCVA	0.184	1.84
CBN	NOT DETECTED	NOT DETECTED
D9 THC	0.653	6.53
D8 THC	NOT DETECTED	NOT DETECTED
CBC	NOT DETECTED	NOT DETECTED
THCA	23.5	235
Total	25.2	252

Analytical Method: LC-UV

Date: 9-15-2022

AOAC % Water Content: 12.6

This tells you which cannabinoids are in the product and how much of each.

COA
ANALYTICS



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METALS (ppb)			LOQ = All Use Limit		
Metal	All Use Limit	Ingest Limit	Result	All Use (P/F)	Ingest Limit (P/F)
Arsenic	200	1500	NOT DETECTED	PASS	PASS
Cadmium	200	500	NOT DETECTED	PASS	PASS
Lead	500	1000	NOT DETECTED	PASS	PASS
Mercury	100	1500	NOT DETECTED	PASS	PASS

Analytical Method: ICP-MS

Date: 9-15-2022

MICROBIALS (CFU/g)		LOQ = Limit	
Microbial	Limit	Result	(P/F)
Total Aerobic Bacteria	100000	NOT DETECTED	PASS
Total Yeast and Mold	10000	NOT DETECTED	PASS
Total Coliforms	1000	NOT DETECTED	PASS
Bile Tolerant Gram Negative Bacteria	1000	NOT DETECTED	PASS
E. Coli	NOT DETECTED	NOT DETECTED	PASS
Salmonella spp.	NOT DETECTED	NOT DETECTED	PASS

Analytical Method: qPCR

Date: 9-15-2022

MYCOTOXINS (ppb)		LOQ = 20 ppb	
Mycotoxin	Limit	Result	(P/F)
Sum of Aflatoxins B1,B2,G1,G2	20	NOT DETECTED	PASS
Ochratoxin A	20	NOT DETECTED	PASS

Analytical Method: LC-MS

Date: 9-15-2022

Chapter 2.1

Testing infrastructure
(It's place in the industry)

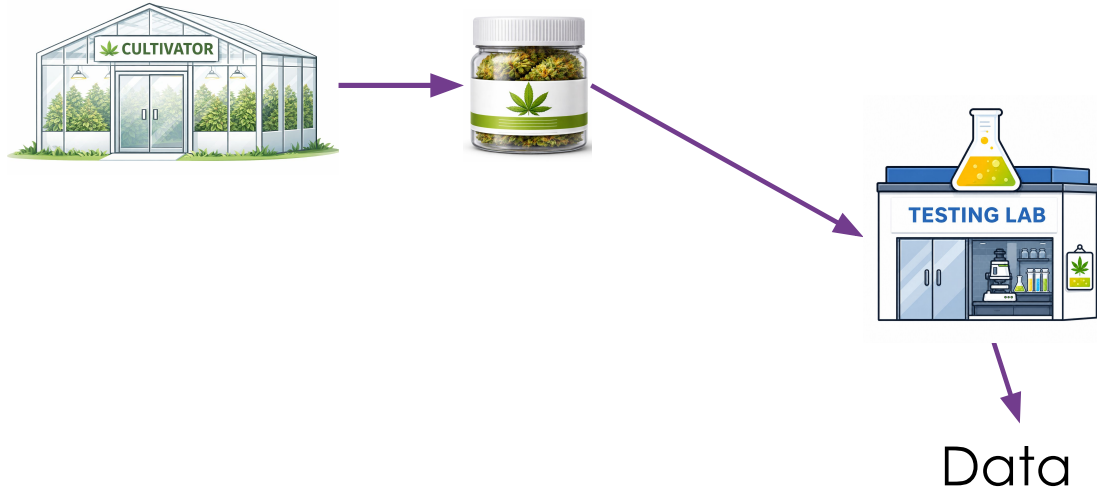
Cultivators grow cannabis



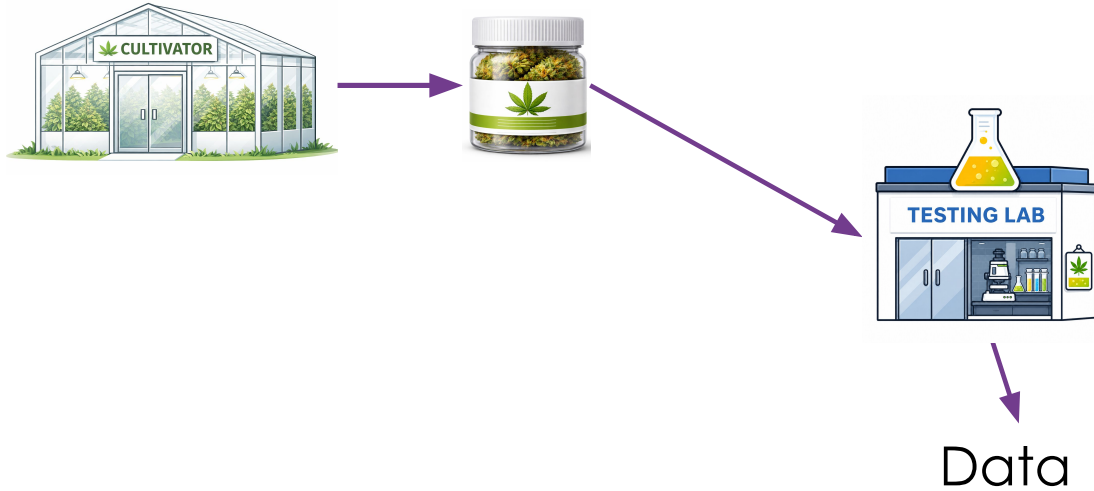
Cannabis is sent to testing labs



Labs test cannabis, produce data

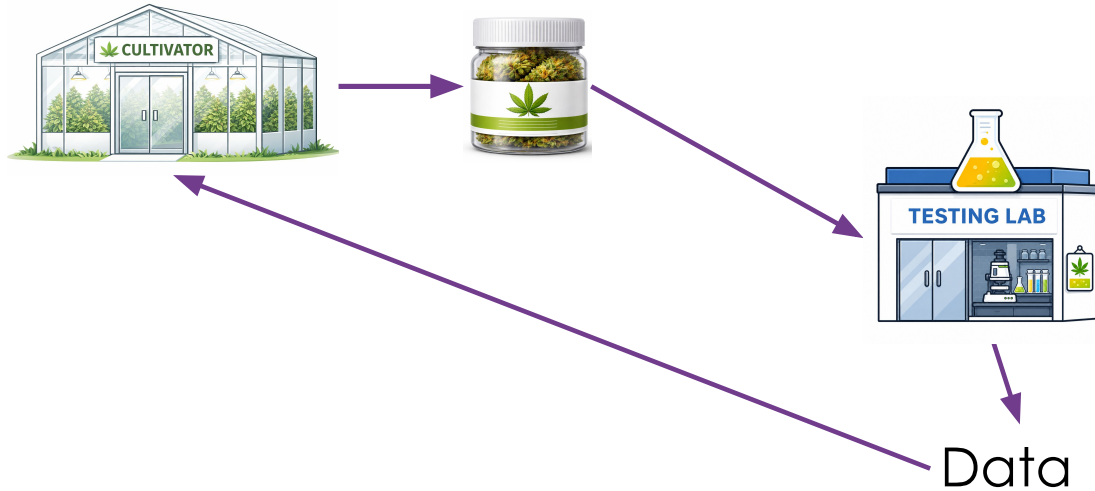


Labs test cannabis, produce a lot of data



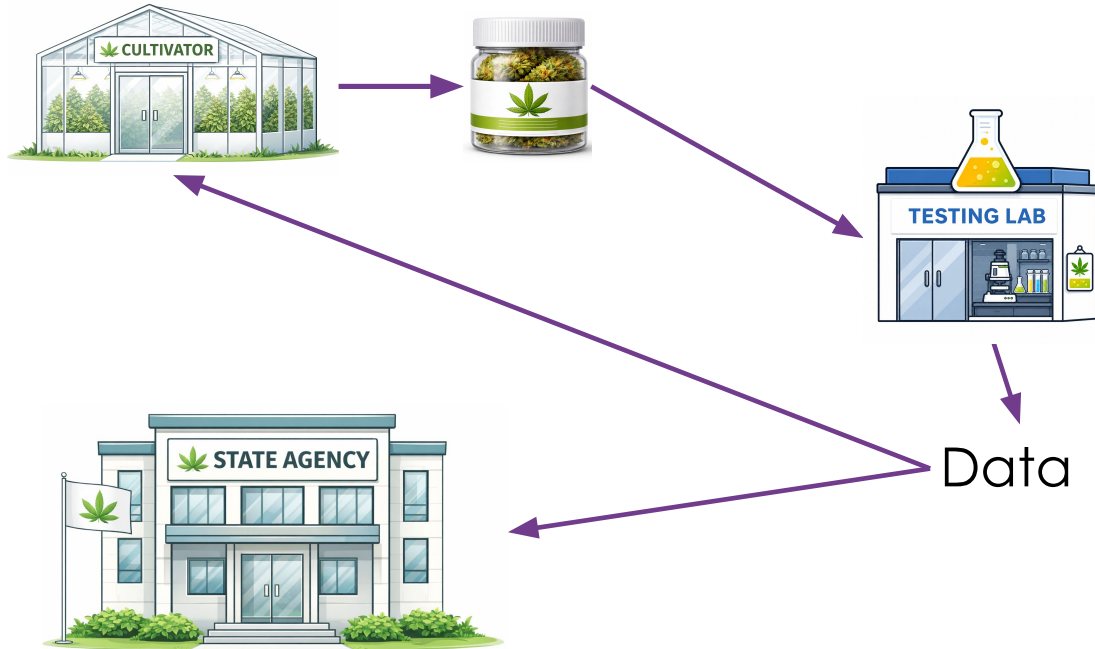
- Pesticides
- Heavy metals
- Residual solvents
- Microbiological contaminants
- Mycotoxins
- Cannabinoids
- Terpenes

Data is sent to the cultivators



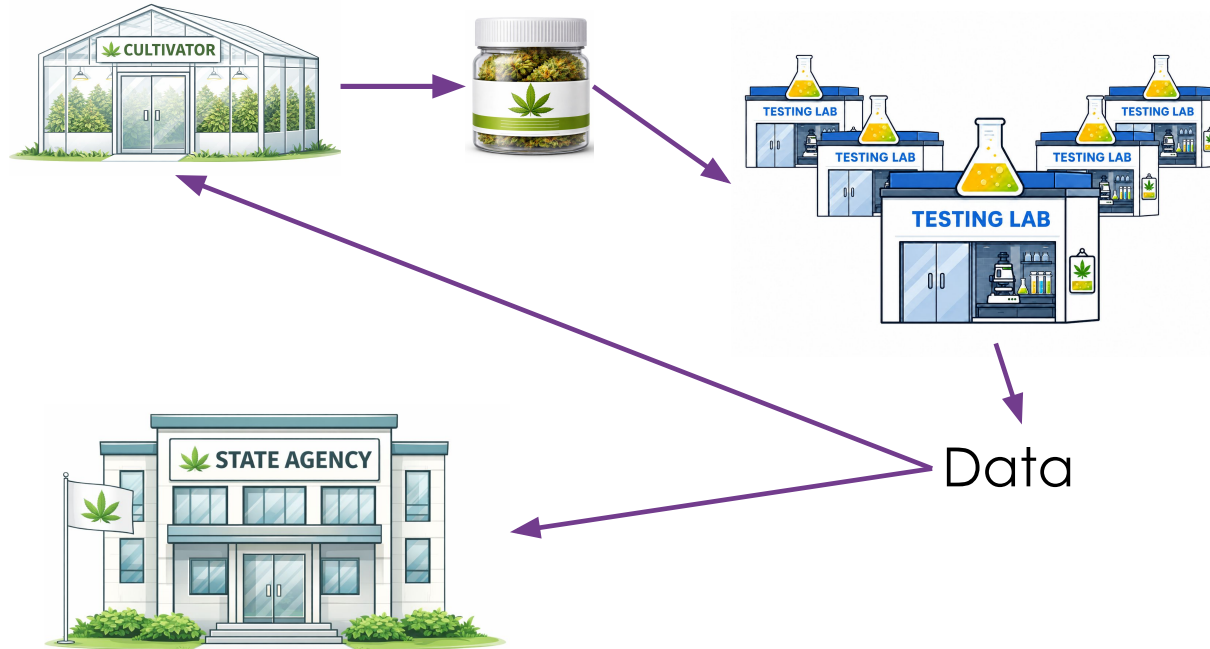
- Pesticides
- Heavy metals
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Data is sent to the cultivators and regulators



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Data is sent to the cultivators and regulators



- Pesticides
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- Mycotoxins
- Cannabinoids
- Terpenes

Chapter 3

Market problems

CANNABIS DISPENSARY

CONSUMER
FRAUD



Marijuana lab-testing analysis finds routine THC inflation, data manipulation



By **Chris Roberts**, Reporter

November 28, 2023 - Updated November 30, 2023

SHARE



Ranks of women, minority cannabis execs rebound to pre-pandemic levels, according to the latest data from the *MJBiz* Diversity, Inclusion and Equity Report. Get your copy [here](#).



Potency Inflation Runs Rampant In Cannabis Industry Despite Measures To Combat It

Benjamin Adams Contributor 
I cover cannabis, health, and politics.

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Aug 15, 2022, 11:00am EDT

In the race to the highest THC potency, the integrity of cannabis lab testing data is at stake.

Consumers can't always trust the labels of cannabis products in states with mature cannabis markets, as the incentives to inflate THC potency numbers reach new proportions. Growers are going selectively to labs known to dish out higher THC numbers—lab shopping—worsening the problem, *Cannabis Business Times* reports.

Newsletter

'THC Inflation' Sparks Questions About What's Really in Some Pot



A worker prepares THC containers to be scanned and tested. *Photographer: Annie Sakkab/Bloomberg*

Potency Inflation Rampant In Cannabis Despite Measures



SHA

Benjamin Adams Contributor @
I cover cannabis, health, and politics.



In the race to the highest THC potency testing data is at stake.

Consumers can't always trust the numbers with mature cannabis markets, and as numbers reach new proportions, some growers are known to dish out higher THC than advertised. *problem, Cannabis Business Times reports.*

That weed you bought might not be as potent as promised, study finds

Colorado researchers found that the THC in cannabis they tested was, on average, 23 percent lower than what was reported on the label



By [Teddy Amenabar](#)

April 13, 2023 at 11:27 a.m. EDT



s Questions in Some Pot



photographer: Annie

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FORBES > LIFEST

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I cover cannabis



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In the race to
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Consumers
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This is an archived site and is no longer being updated. New 538 articles can be found at www.abcnews.com/538.

America's Pot Labs Have A THC Problem

By [Lester Black](#)
Filed under [Marijuana](#)
Published Jun. 29, 2021



Potential
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In the race to
testing data

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Businessweek Equa

Questions
The Pot

How a 'well-known secret' in Massachusetts cannabis testing is obscuring what's in your weed

'No testing would be better than what we do today,' one lab founder said.

By [Diti Kohli](#) and [Scooty Nickerson](#) Globe Staff, Updated September 27, 2024, 6:09 a.m.



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EXCLUSIVE HEALTHCARE

Legal Marijuana Contains Dangerous Mold. States Approve It Anyway.

State-mandated tests frequently find mold just below legal limits, WSJ analysis shows, suggesting that tainted samples are being cleared for sale

Uncomfortably high: Testing reveals inflated THC potency on retail *Cannabis* labels

Anna L. Schwabe , Vanessa Johnson, Joshua Harrelson, Mitchell E. McGlaughlin 

Published: April 12, 2023 • <https://doi.org/10.1371/journal.pone.0282396>

Article	Authors	Metrics	Comments	Media Coverage	Peer Review
					

Abstract

Introduction

Methods

Results

Discussion

Conclusion

Abstract

Legal *Cannabis* products in the United States are required to report THC potency (total THC % by dry weight) on packaging, however concerns have been raised that reported THC potency values are inaccurate. Multiple studies have demonstrated that THC potency is a primary factor in determining pricing for *Cannabis* flower, so it has an outsized role in the marketplace.

Reports of inflated THC potency and "lab shopping" to obtain higher THC potency results have been circulating for some time, but a side-by-side investigation of the reported potency and flower in the package has not previously been conducted. Using HPLC, we analyzed THC

potency in 22 samples from 10 dispensaries throughout the Colorado Front Range and suggesting that tainted samples are being cleared for sale

old.

vs,

PLOS

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

**Uncomforta
on retail Car**

Anna L. Schwabe  Var

Published: April 12, 2023

Article

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Journal of Testing and Evaluation

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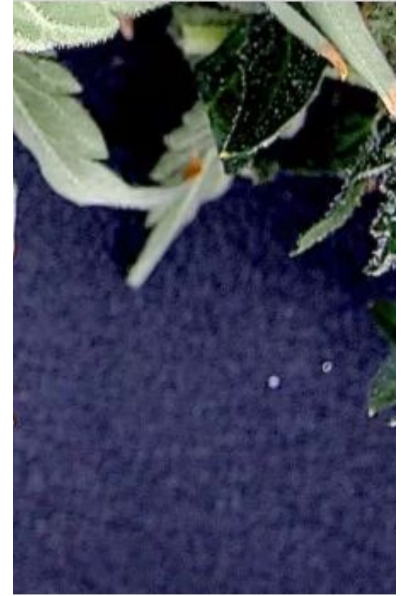
First Look Papers

Journal of Testing and Evaluation

Victoria Turkington,¹ Yasha Kahn,² Lacey Keller,³ John Willis,³
Ava Hamilton,³ Hailey Utech,³ Jamie Toth,⁴ and Jeff Rawson⁵

DOI: 10.1520/JTE20230665

**Market Audits Combat Cannabis
Misinformation**



Id.

PLOS

OPEN ACCESS PEER-REVIEWED

RESEARCH ARTICLE

Uncomfortable on retail Cannabis

Anna L. Schwabe  Var

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Article



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About

First Look Papers

First Look Papers

Journal of Testing and Evaluation

Victoria Turkington,¹
Ava Hamilton,³ Haile

DOI: 10.1520/JTE2023

Market Abuse
Misinformation

BMC Part of Springer Nature



Journal of Cannabis Research

Original research | [Open access](#) | Published: 09 March 2024

Evaluation of dispensaries' cannabis flowers for accuracy of labeling of cannabinoids content

[Mona M. Geweda](#), [Chandrani G. Majumdar](#), [Malorie N. Moore](#), [Mostafa A. Elhendawy](#), [Mohamed M. Radwan](#), [Suman Chandra](#) & [Mahmoud A. ElSohly](#) 

[Journal of Cannabis Research](#) 6, Article number: 11 (2024) | [Cite this article](#)

138 Accesses | 5 Altmetric | [Metrics](#)

Abstract

Background

Cannabis policies have changed drastically over the last few years with many states enacting medical cannabis laws, and some authorizing recreational use; all against federal laws. As a result, cannabis products are marketed in dispensaries in different forms, most abundantly as flowers intended for smoking and sometimes vaping. All samples used in this study were obtained directly from law enforcement. The sample collection process was facilitated and funded by the National Marijuana Initiative (NMI), part of the High-Intensity Drug Trafficking Area (HIDTA) program. This initial report focuses on cannabis flowers. Similar studies with other cannabis products will be the subject of a future report.

PL

OPEN ACCESS

RESEARCH ARTICLE

Unconcentrated

Anna L. Scott

Published: 12 May 2021

Article



Abstract

Introduction

Methods

Results

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Conclusion

scientific reports

OPEN Accuracy of labeled THC potency across flower and concentrate cannabis products

Gregory Giordano^{1✉}, Colin P. Brook², Marco Ortiz Torres³, Grace MacDonald³, Carillon J. Skrzynski¹, Jonathon K. Lisano³, Duncan I. Mackie² & L. Cinnamon Bidwell^{1,3}

High total tetrahydrocannabinol (THC) cannabis products are quickly gaining market share across the U.S., but it is unknown whether labeled cannabinoid content accurately reflects true product potency. This study aimed to assess discrepancies between labeled and observed THC content in flower and concentrate products. A representative sample of 277 cannabis flower ($n=178$) and concentrate ($n=99$) products were purchased from 52 Colorado dispensaries and analyzed for THC content. Products were classified as accurately labeled if observed THC was within $\pm 15\%$ of labeled THC, and comparative analysis tested observed versus labeled THC content. Labeling accuracy for THC content depended on product type ($X^2(2, n=277) = 47.44, p < 0.001$), with 96.0% of concentrate products being within $\pm 15\%$ of labeled THC content compared to 56.7% of flower products. Observed THC potency was significantly lower than labeled potency in both flower ($U = 18,971, p = 0.001$) and concentrate ($U = 6095, p = 0.003$) products. Nearly all tested concentrate products met the accuracy threshold for THC content, whereas flower products frequently did not. Both product types had lower observed THC content compared to labeled values. Independent and blinded verification of product labels and testing procedures is needed to protect consumers and patients and ensure rigorous testing standards that apply across various types of cannabis products.



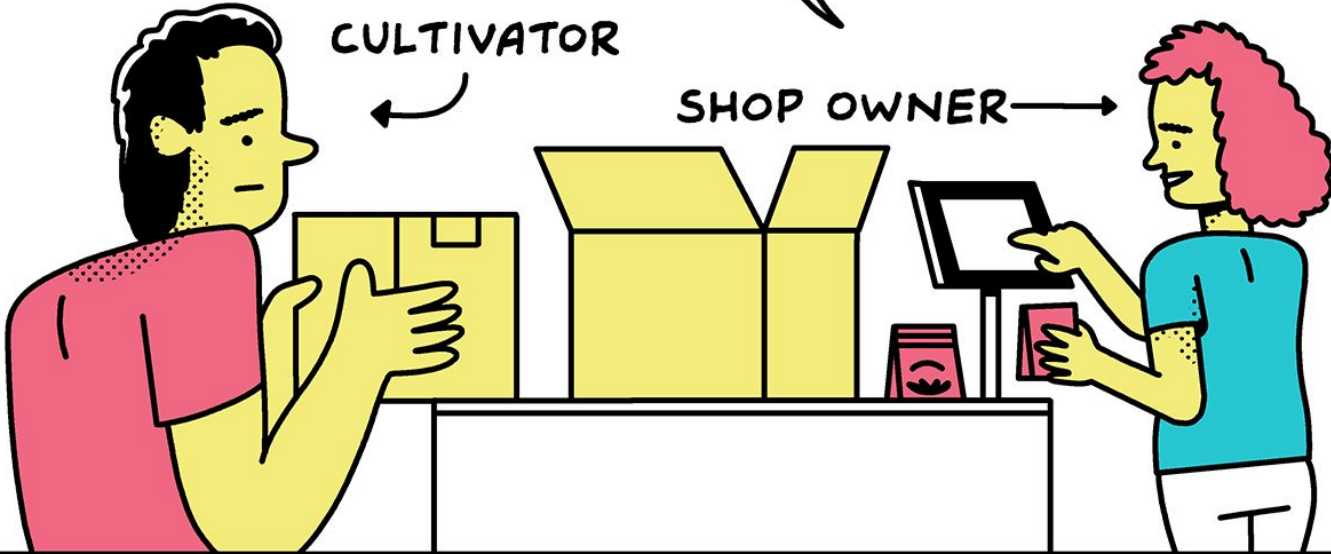


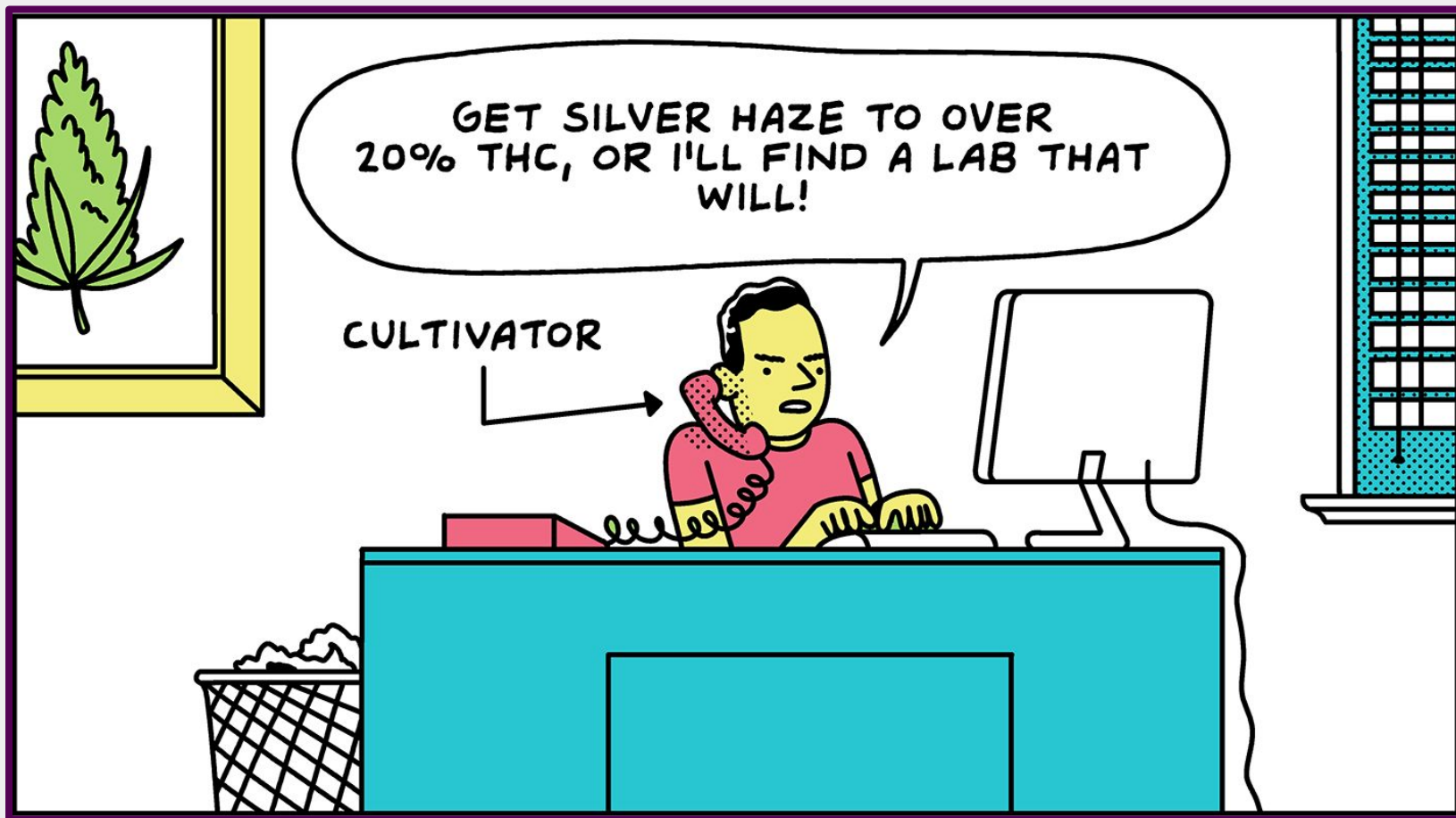
Brian Box Brown

I'LL TAKE THE HIGH THC
FLOWER - I CAN'T SELL THE
OTHER STUFF

CULTIVATOR

SHOP OWNER

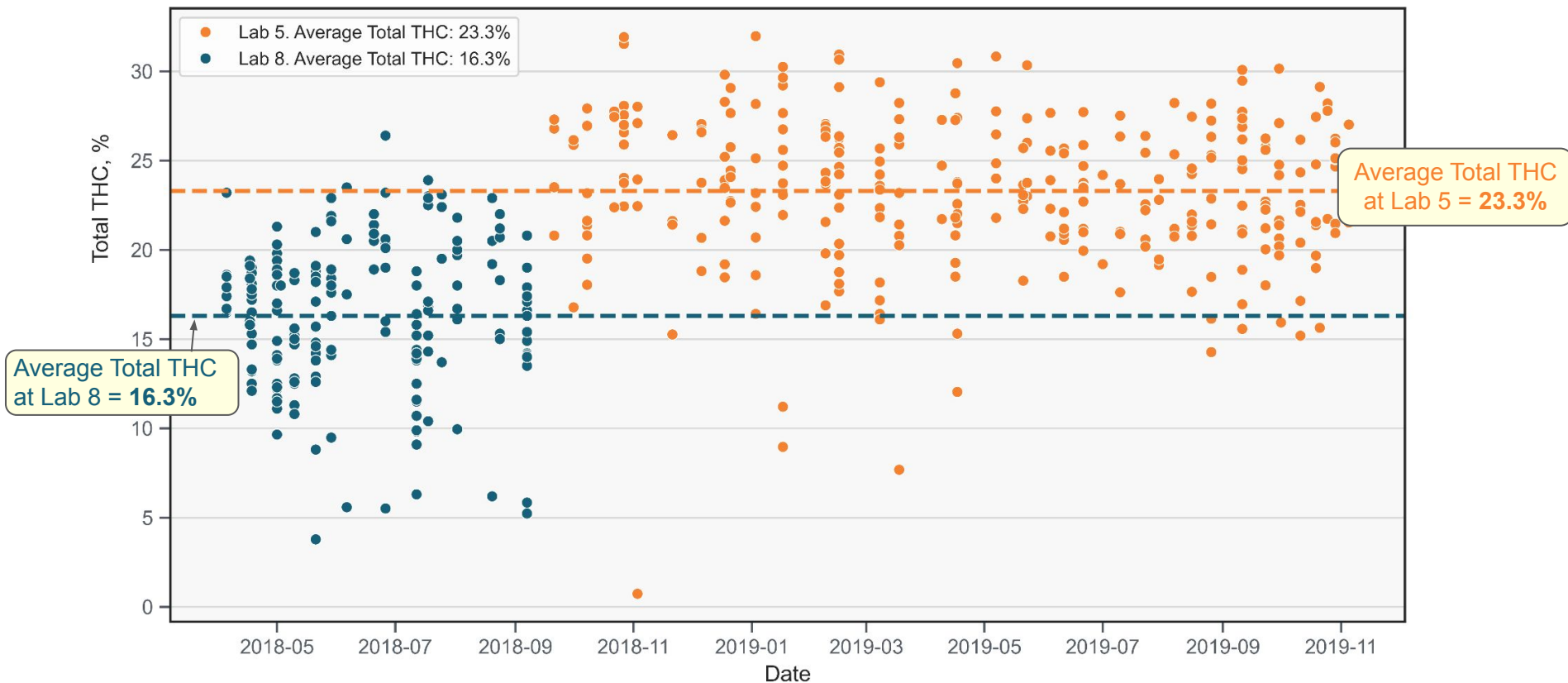




Brian Box Brown

What does that
look like with **data**?

THC Test Results: Cultivator Over Time by Lab

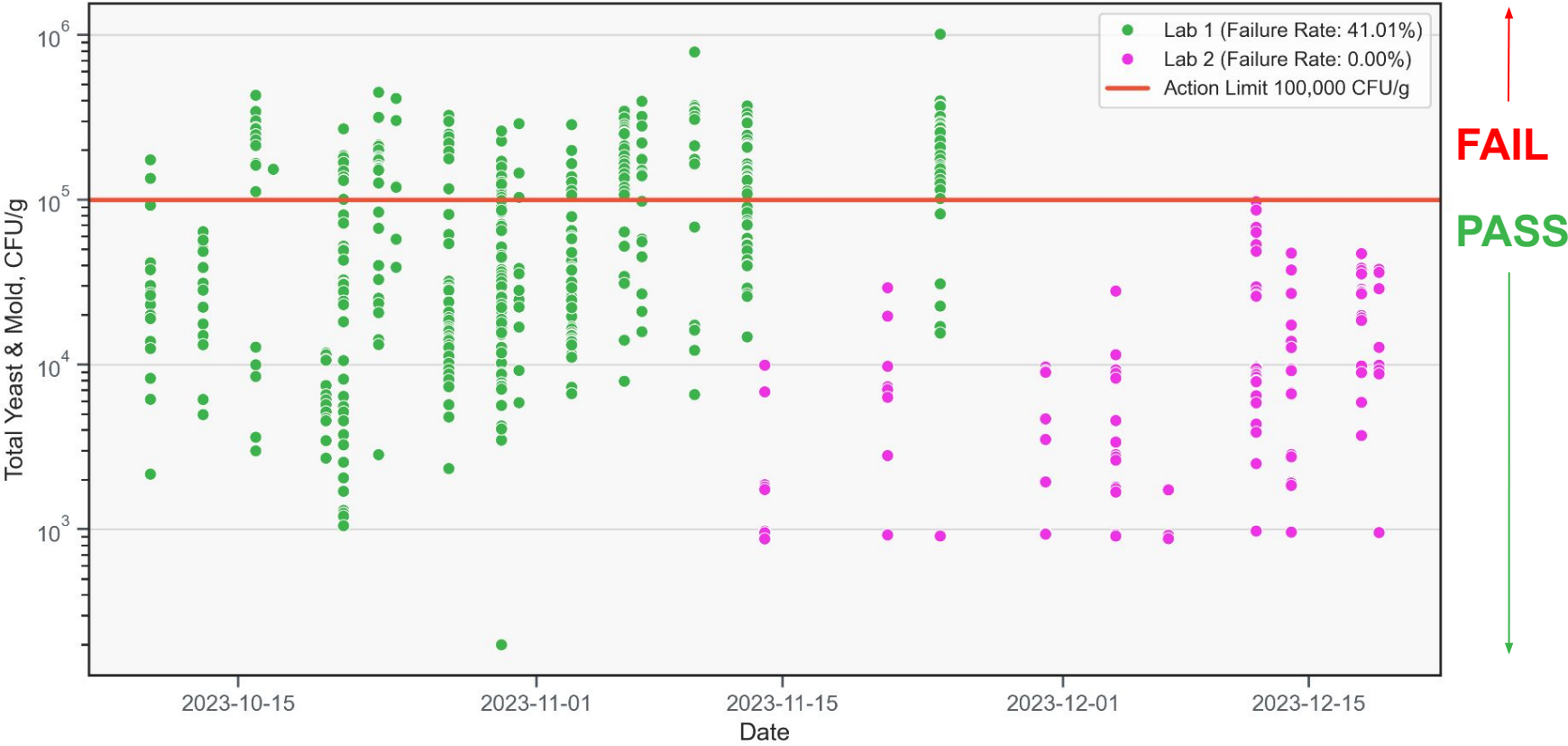


A cultivator *switches labs*.

Suddenly, potency **increases by 43%**.

What about
contaminant screens?

Total Yeast and Mold: Cultivator Over Time by Lab



A cultivator ***switches labs.***

Suddenly, they **never fail again.**

A cultivator ***switches labs.***

Suddenly, they **never fail again.**

Consumers, patients, and industry employees
believe the products are contaminant free.

Insufficient testing leaves consumers underinformed.
Too much testing is expensive.

The fix is **sufficient** testing
and **good** oversight.

Poor oversight will reward those
who don't follow the rules.

Chapter 4

The policy mess

The War on Drugs

1937

Marijuana tax act prohibited recreational use.

1950s

Boggs Act & Narcotics Control Act set mandatory sentences for drug related offenses, including Cannabis.

1970s

Controlled substances act classified cannabis as a Schedule 1 Drug,

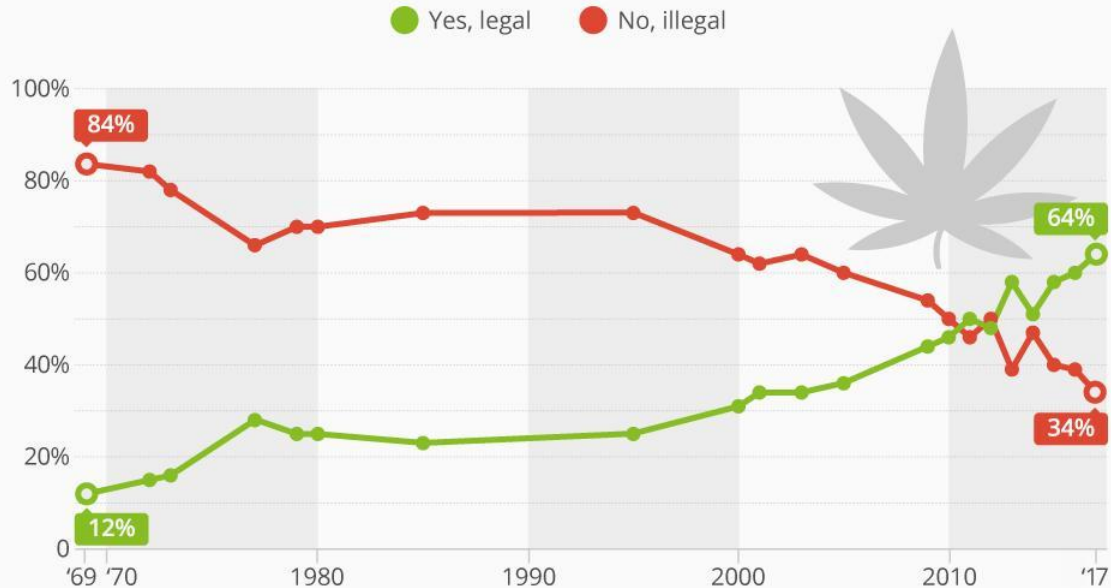
1980s

War on drugs intensified, increasing mandatory sentences.

Approval Increased

U.S. Support For Legalizing Marijuana Hits All-Time High

"Should the use of marijuana be made legal or not?"

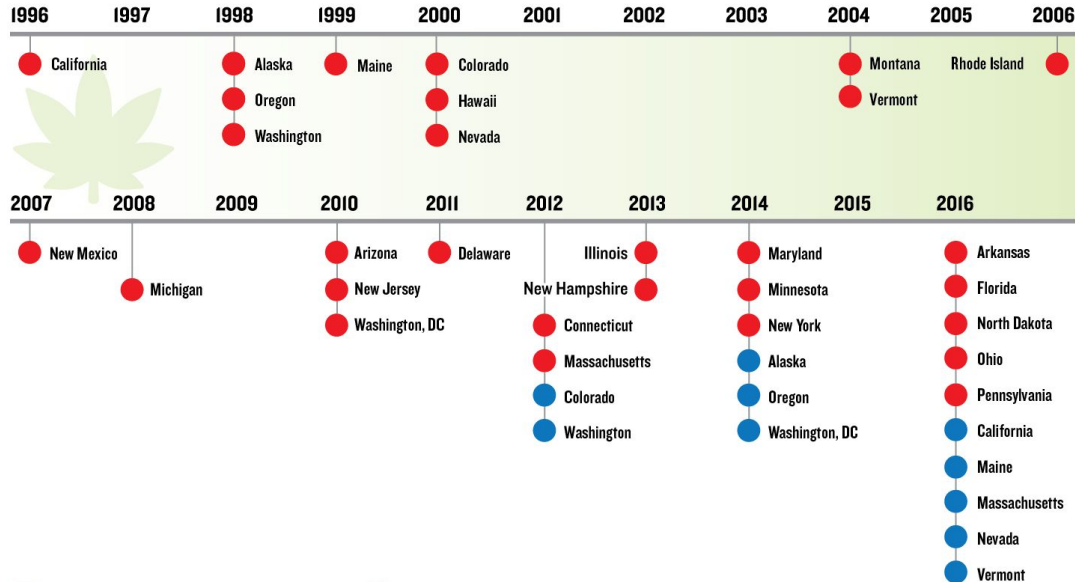


Legalization Was a Hard-Fought Compromise



THIRD WAY

Timeline of State Marijuana Legalization Laws



● Recreational (9 states & DC) ● Medical (28 states & DC)

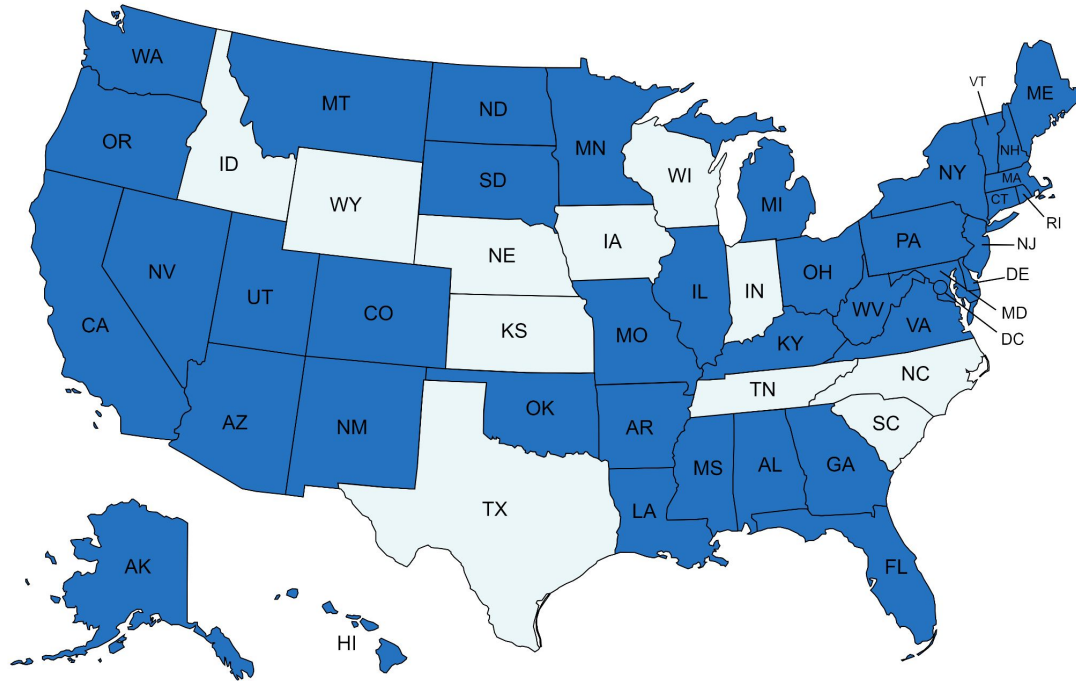
State Policymakers Set Regulations

They did so without:

- Federal support
- Access to research or data on cannabis
- Experience, like the decades that other industries have

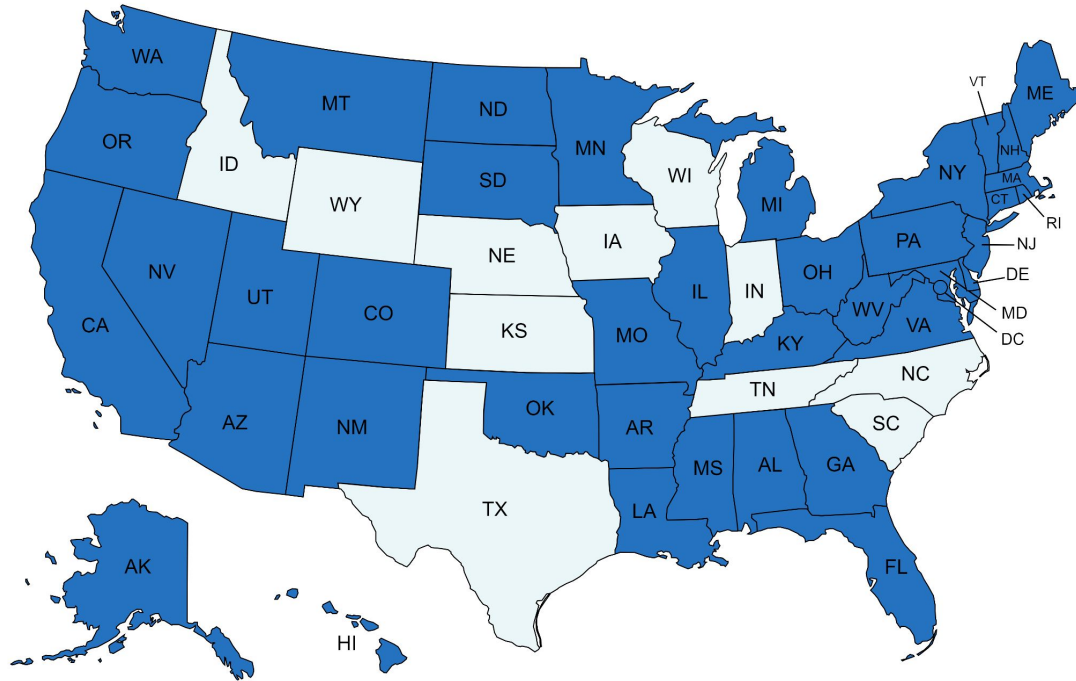
But, they did it.

39 states have cannabis regulations



unique

39 states have cannabis regulations



39 states have ^{unique} cannabis regulations

Each state has *unique testing requirements* for ~24 screens

- 12 microbio tests
- Cannabinoids
- Moisture
- Water Activity
- Terpenes
- Heavy Metals
- Pesticides
- Mycotoxins
- Vitamin E Acetate
- Residual Solvents
- Filth and Foreign Material

39 states have ^{unique} cannabis regulations

Each state has *unique testing requirements* for ~24 screens

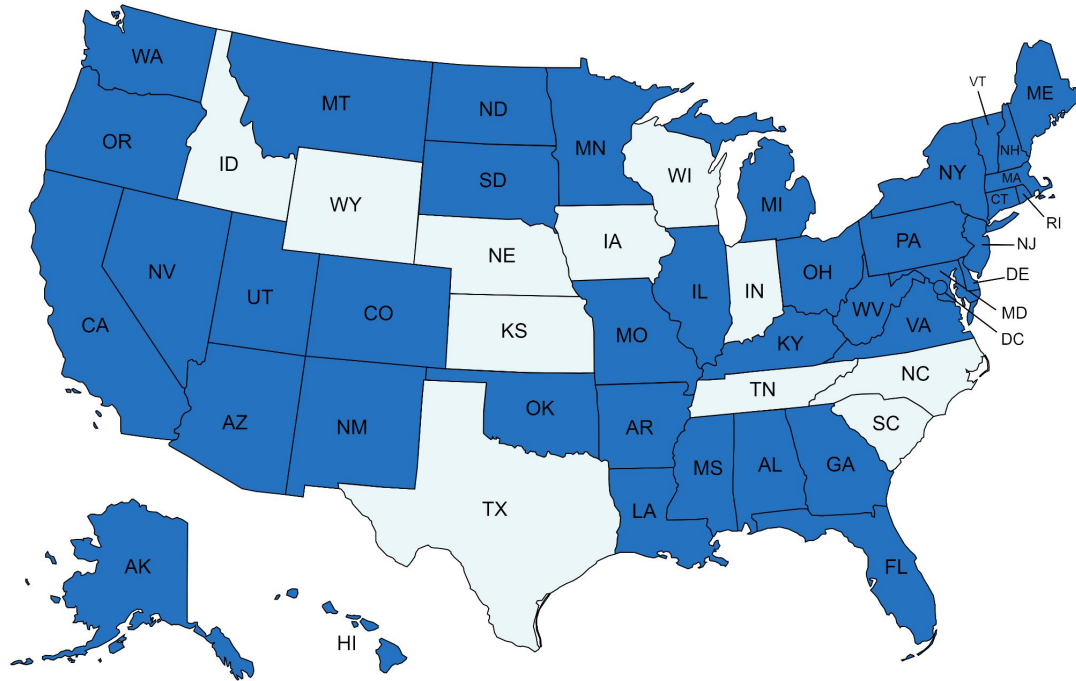
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Each state has unique approaches to the following:

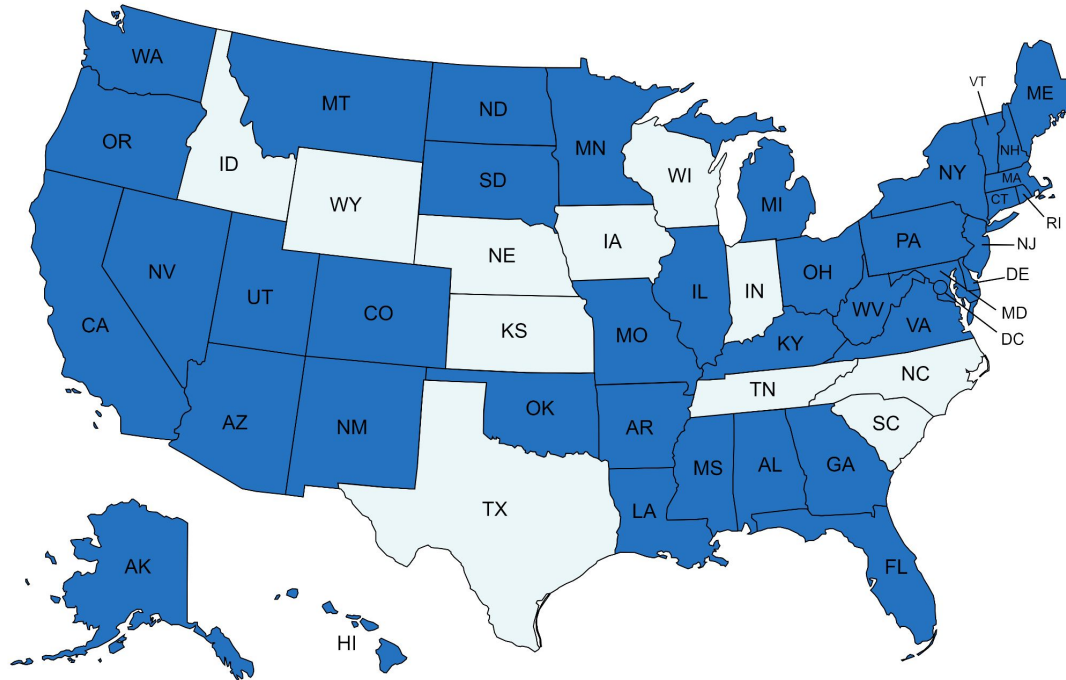
- Post or pre-packaging testing
- Sampling Approaches
- Batch Sizes
- Total THC Definitions
- Moisture Adjustment
- Validation Criteria
- Regulatory Audits
- Product Names
- Product Categories
- Rec vs Medical
- Stability Testing

unique

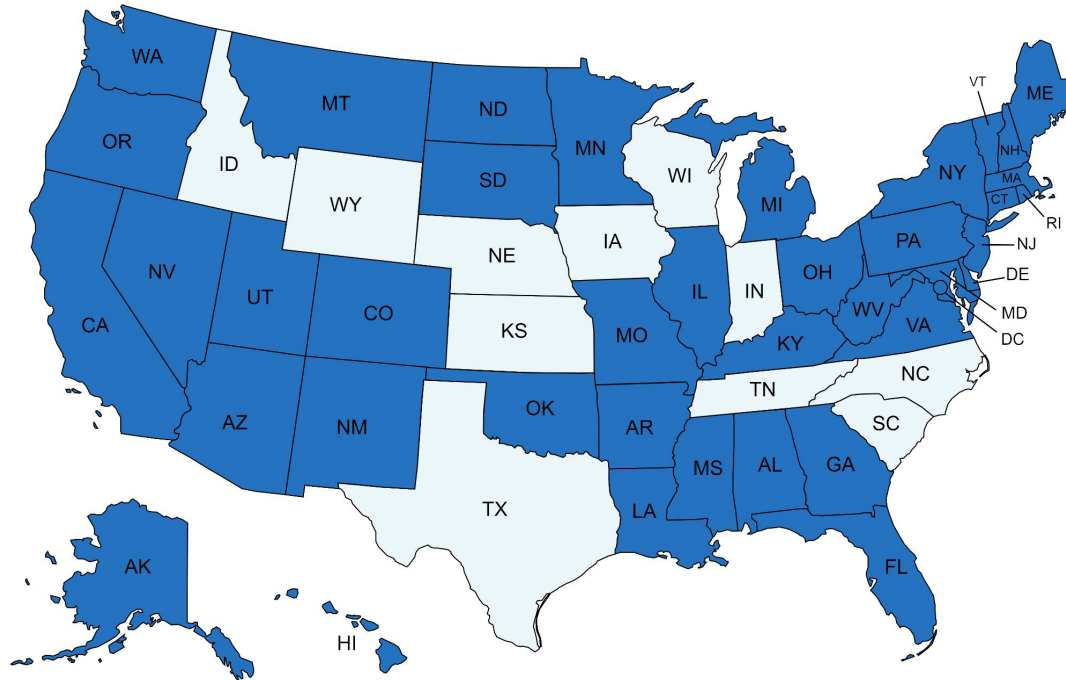
39 states have cannabis regulations



39 individual experiments



39 individual experiments



All **well documented** because of the track and trace requirements.

Chapter 5

Recommendations

(for a soon to be multi-billion dollar industry)

Recommendations - testing



1. Work with other states. Align with others and lean on their lessons learned.

Recommendations - testing

1. Work with other states. Align with others and lean on their lessons learned.
2. Start with minimal testing requirements (relative to other states)
 - a. All products are to be tested for:
 - i. Cannabinoids
 - ii. Yeast and Mold
 - iii. Bacteria
 - iv. Heavy metals
 - v. Pesticides
 - vi. Residual solvents in concentrates

Recommendations - testing

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 - b. Consider not having action limits at first.
3. Mandate that all test results be shared by labs with state agencies.

Recommendations - testing oversight



Baseline

1. All labs must be accredited to ISO/IEC 17025:2017.
 - a. State agency should receive all audit reports, per lab, from Accreditation agencies.

Recommendations - testing oversight



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Oversight

4. Quarterly transparent off-the-shelf testing program.

Recommendations - testing oversight



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5. Invest in data analytics to monitor the market.

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5. Invest in data analytics to monitor the market.
6. Oversight agency to hire a chemist to oversee product safety, labeling, and testing.

Recommendations - testing oversight



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Additional information collection

7. Adverse events submission process.

Recommendations - testing oversight



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Additional information collection

7. Adverse events submission process.
8. Whistleblower complaint submission process.

Thank you. Let's discuss!

Yasha Kahn

yasha@mcrlabs.com

