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Off-the-Shelf Product Testing of Cannabis Products from Colorado's Regulated Market

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SUMMARY OF FINDINGS

This study evaluates the quality and safety of cannabis products in Colorado's adult-use marijuana market, and focuses on microbial and pesticide contamination, potency accuracy, and adherence to safety standards. The results highlight systemic issues in regulatory compliance, with significant implications for consumer safety and market integrity.

1. MICROBIAL CONTAMINATION

- 4 of 15 samples tested positive for Coliform bacteria, with three failing standards across all 17 regulated markets that mandate such testing (Colorado does not mandate).
- 4 of 15 products failed microbial safety standards, including yeast and mold counts exceeding 10,000 CFU/g and aerobic plate counts as high as 780,000 CFU/g based on hemp regulation standards.
- These findings point to inadequate facility hygiene and manufacturing practices, and pose significant health risks to consumers.

2. PESTICIDE CONTAMINATION

- 4 of 15 samples detected Pyrethrins, all exceeding legal thresholds for hemp, including one sample at 128x the permissable limit.
- Piperonyl butoxide (PBO) was identified in ten samples, with three exceeding hemp regulatory standards by 1.5x to 4.5x the permissible limit.
- Colorado's inconsistent standards between marijuana and hemp indicate a failure of regulators to prioritize consumer safety in rulemaking. Stricter requirements on hemp set by the Colorado Department of Public Health and Environment (CDPHE), based on federal standards, were not implemented by Colorado's Marijuana Enforcement Division (MED) for marijuana.

3. POTENCY VARIANCE

- 12 of 15 samples exceeded Colorado's ±15% potency variance threshold, with discrepancies ranging from -0.76% to -66.18%.
- On average, products deviated: shake by -66.18%, pre-rolls by -57.96%, and buds by -34.65%.
- These shortfalls represent a potential $275 million in consumer fraud annually in flower sales, eroding trust in label accuracy and regulatory oversight.

4. REGULATORY GAPS

- Colorado lacks 1) a single set of health and safety standards based in human safety 2) as well as a monitoring system for evaluating regulations, leaving substantial opportunity for non-compliance. The state's reactionary "investigation-based" model has proven a public health failure.
- The absence of routine facility inspections contributes to deteriorating food safety and sanitation standards.

RECOMMENDATIONS

1. **Mandate and prioritize immediate, surveillance — based recalls for all violations of mandatory labeling claims (i.e. THC content levels, absence of contaminants).**
2. **Implement stringent product surveillance, standardized testing protocols, and educational initiatives for industry stakeholders.**
3. **Prioritize enforcement against contaminated facilities to ensure consumer safety and maintain market credibility.**
4. **Establish a state-managed reference laboratory with an estimated annual budget of <$1 million to conduct 500 monthly surveillance tests and set/promote shared standards and practices across the industry.**

Objective

Proactive regulatory actions are essential to protect public health, restore consumer trust, and set a standard for sustainable market practices. This project aimed to evaluate the quality and safety of commercially available cannabis products in the largest market segment of Colorado's regulated adult use marijuana market. By testing a selection of pre-rolls, shake, and buds purchased from licensed recreational dispensaries, we sought to assess whether cannabis products that account for $540 million in annual sales in Colorado (~50.3% of total sales in 2023) are safe for consumption and accurately labeled.[1] This study was inspired by the Colorado Marijuana Enforcement Division's (MED) recent regulatory updates regarding remediation practices and consumer safety, which raised questions about potential missteps by manufacturers attempting to meet compliance standards.[2] This study focused on Denver — Colorado's most populous metropolitan area and its largest cannabis market, with the largest number of licensed retailers and dispensaries of any city in the state. Denver attracts a diverse consumer base, including locals and tourists, and serves as a representative sample of the state's adult-use market trends and consumer preferences. This diversity provides insights into product quality and safety standards that impact a broad demographic.

A secondary but no less important objective of this project was to demonstrate that product market surveillance is an effective and cost efficient means to identify hazardous and fraudulent products in a closed marketplace like Colorado. To that end, we include the commercial costs involved in executing this study, as well as an estimate of what the work would cost if performed by a state reference lab rather than a profit-making third-party lab.

Methodology

SAMPLE COLLECTION

- **Product Types:** Pre-rolls, shake, and flower (bud)
- **Quantity:** 5 samples of each product type were purchased, totaling 15 samples
- **Retail Source:** All samples were purchased from five separately licensed retail establishments within a 5-mile radius of Denver, CO.
- **Protocol:** Buyers were told to go to dispensaries where they normally shop and purchase products they would normally purchase — not the best, not the worst, but the "mid-grade" products at the core of the market experience.

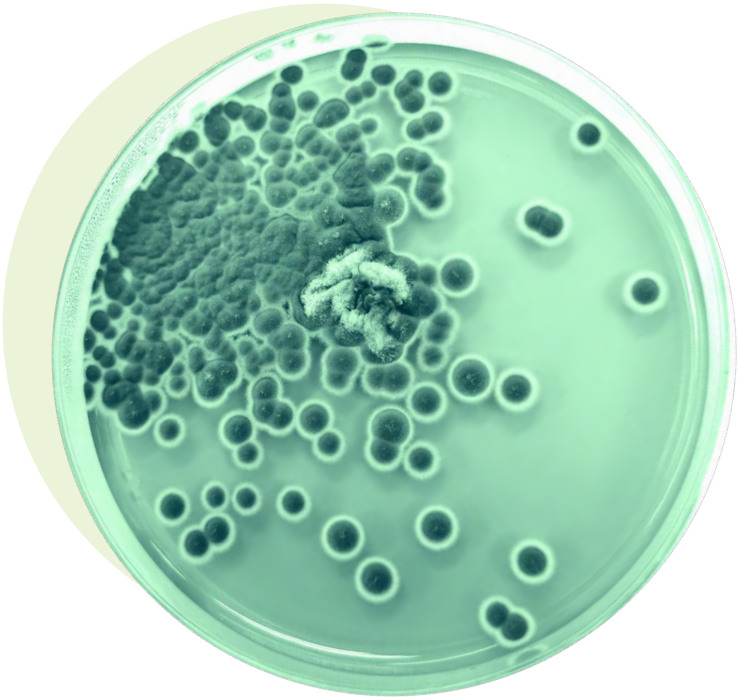
			Content (% THC)			Microbial (CFU/g)			Pesticides (ppb) [1]	
Product	ID	Result	Labeled THC	Total THC	Variance	Total Yeast & Mold	Total Coliform	Total Aerobic	Pyrethrins	Piperonyl Butoxide
Pre-rolls	001	FAIL	15.9%	13.1%	-17.5%	1,100	ND	ND	ND	3
Pre-rolls	002	FAIL	25.0%	10.5%	-58.0%	500	ND	ND	6,412	481
Pre-rolls	003	FAIL	27.2%	18.0%	-33.7%	500	1,300	7,000	213	296
Pre-rolls	004	FAIL	17.8%	15.0%	-15.8%	250	ND	ND	ND	ND
Pre-rolls	005	FAIL	15.6%	13.2%	-14.9%	37,000	12,000	780,000	54	7
Shake	006	FAIL	27.1%	13.7%	-49.4%	ND	ND	ND	ND	13
Shake	007	FAIL	23.4%	8.8%	-62.3%	ND	ND	500	ND	14
Shake	008	FAIL	32.8%	11.1%	-66.2%	ND	ND	ND	ND	12
Shake	009	FAIL	22.3%	9.5%	-57.4%	ND	170	1,500	ND	19
Shake	010	FAIL	24.3%	9.9%	-59.1%	62,000	3,000	41,000	1,584	907
Buds	011	FAIL	30.8%	20.1%	-34.6%	56,000	ND	6,300	ND	2
Buds	012	PASS	22.9%	22.7%	-0.8%	ND	10	ND	ND	ND
Buds	013	FAIL	23.3%	19.2%	-17.6%	ND	10	ND	ND	ND
Buds	014	PASS	16.8%	15.2%	-9.6%	ND	ND	ND	ND	ND
Buds	015	FAIL	19.1%	15.9%	-16.8%	ND	ND	ND	ND	ND
				Action Limits	15.0%	1,000	100	10,000	50	200

Figure 1.1 Results per sample, indicating potency, yeast & mold, coliform, aerobic plate count, and pesticides.

1. Colorado Department of Revenue. "Marijuana Sales Reports." Colorado Department of Revenue
2. Colorado Department of Revenue - Marijuana Enforcement Division. 230602 Final Compliance Tip-Third Party Contamination. 2023. 230602 FINAL Compliance Tip_Third-Party Decontamination

DOCUMENTATION

- Each product was photographed for visual reference
- **Key data points recorded for each sample:**
  - **Product Net Weight**
  - **Product Price**
  - **Unique Identifier:** Including the METRC (Marijuana Enforcement Tracking Reporting Compliance) number for traceability
  - **Label Details:**
    - Stated potency (% THC)
    - Manufacturer/Cultivator license number
    - Retailer license number
  - **Label Compliance**
    - Cultivation batch number
    - Cultivation license number
    - THC symbol



SAMPLE PREPARATION

To ensure anonymity and eliminate bias, all identifying information was removed or concealed prior to testing. Samples were submitted in original, unopened packaging.

LABORATORY TESTING

Samples were submitted to a licensed third-party hemp testing laboratory for the following analyses:

- **Microbial Panel Testing:** Assessment for contaminants including bacteria, mold, and yeast.
- **Aspergillus Screening:** Specific identification of Aspergillus species, a known health risk.
- **Pesticide Screening:** A broad panel of screens for pesticides used in cannabis production that are known to cause harm.
- **Potency Testing:** Verification of THC, CBD, and and other cannabinoid concentrations relative to label claims.

REGULATORY STANDARDS

The following thresholds, as defined by Colorado's Department of Revenue, Marijuana Enforcement Division (MED) Colorado Marijuana Rules (1 CCR 212-3 Section 4-115)[3] were applied for evaluation:

1. Microbial Contaminants: Products must pass specific microbial safety standards to ensure consumer health:

- Total Yeast and Mold Count: < 10,000 CFU/g (Colony Forming Units per gram).
- Total Coliform: 100 CFU/g*
- Total Aerobic Bacteria Count: < 1,000 CFU/g**

2. Aspergillus Screening: The following Aspergillus species must be absent in cannabis products: *Aspergillus fumigatus, Aspergillus flavus, Aspergillus niger, Aspergillus terreus*.

3. Pesticide Screening: Pesticide regulation in the cannabis industry is essential to protect consumer health, ensure environmental safety, and uphold industry credibility. Unlike traditional crops, cannabis consumption methods, such as inhalation, bypass conventional pesticide breakdown processes, increasing the risk of exposure to harmful residues. Unregulated pesticide use can result in acute or chronic health effects, including respiratory irritation, neurotoxicity, or carcinogenicity.

State regulations for pesticides vary between marijuana and hemp, creating challenges for

**Based on EPA limits for drinking water. Colorado MED does not have a requirement for cannabis products to be tested for coliform.*

***Colorado only requires aerobic testing for Marijuana products that are nasally, vaginally or rectally administered. However, all Hemp products, including flower, are required to pass aerobic testing. As far as we're aware, Colorado regulators have never explained why they require aerobic bacteria testing for Hemp flower but not Marijuana flower, nor have they explained why aerobic bacteria are acceptable in Marijuana Flower, but not Marijuana Suppositories.*

3. Colorado Department of Revenue - Marijuana Enforcement Division, 1 CCR 212-3, 2010. Final Adopted Rules

producers cultivating both crops. Hemp, classified as a food and feed crop, is subject to stricter residue limits to mitigate ingestion risks. Given the potential for similar consumption methods, this study assessed pesticide residues in marijuana samples using hemp's stricter thresholds. For example, pyrethrins, piperonyl butoxide (PBO), and azadirachtin—approved for marijuana but prohibited on hemp—were analyzed due to their known health risks. Pyrethrins and PBO can cause respiratory irritation, allergic reactions, and neurotoxicity, with PBO also classified as a possible human carcinogen. Azadirachtin, while less toxic, poses risks of gastrointestinal distress and cumulative exposure effects.

4. Potency Variance: Colorado law allows a ±15% variance between the stated potency on the product label and the actual laboratory results.

For example: If a product claims 20% THC, acceptable results range from 17% to 23% THC. (20% x 15% = 3%. 20% +/- 3% = 17-23%)

Products exceeding these thresholds are deemed non-compliant with Colorado's cannabis safety standards. In cases where cannabis products exceed MED's safety thresholds, immediate action is mandated to protect consumers. Non-compliant products are quarantined, and licensees may pursue remediation, such as sterilization or re-labeling, pending re-testing. If remediation fails, products must be destroyed following strict MED disposal protocols. MED would have the authority to investigate regulatory violations and may impose penalties, including fines or license suspensions. For severe risks, public health advisories and recalls are initiated. These protocols underscore the importance of rigorous testing and enforcement in maintaining consumer trust and product safety.

Results

The following results highlight instances of product failures. Any analyte not specifically mentioned indicates a "non-detect". Microbial testing highlighted critical safety concerns (**Figure 1.2**) with several products surpassing the yeast and mold threshold of 10,000 CFU/g. For example, a bud sample (011) recorded 56,000 CFU/g, and a shake sample (010) exceeded 62,000 CFU/g. Furthermore, aerobic plate counts in certain products reached alarming levels, such as 780,000 CFU/g in a pre-roll sample (005). Coliform bacteria were detected in four products. Based on the standards in the 17 state-regulated marijuana markets where coliform is tested, three would fail in all 17 markets, and the fourth would fail in five markets, which further underscores the safety concerns inherent to Colorado's lax regime.[4]

Pesticide (**Figure 1.3**) screening showed Pyrethrins were detected predominantly in pre-roll samples, with

			Microbial (CFU/g)		
Product	ID	Result	Total Yeast & Mold	Total Coliform	Total Aerobic
Pre-rolls	001	FAIL	1,100	ND	ND
Pre-rolls	002	PASS	500	ND	ND
Pre-rolls	003	FAIL	500	1,300	7,000
Pre-rolls	004	PASS	250	ND	ND
Pre-rolls	005	FAIL	37,000	12,000	780,000
Shake	006	PASS	ND	ND	ND
Shake	007	PASS	ND	ND	500
Shake	008	PASS	ND	ND	ND
Shake	009	FAIL	ND	170	1,500
Shake	010	FAIL	62,000	3,000	41,000
Buds	011	FAIL	56,000	ND	6,300
Buds	012	PASS	ND	10	ND
Buds	013	PASS	ND	10	ND
Buds	014	PASS	ND	ND	ND
Buds	015	PASS	ND	ND	ND
		Action Limit	1,000	100	10,000

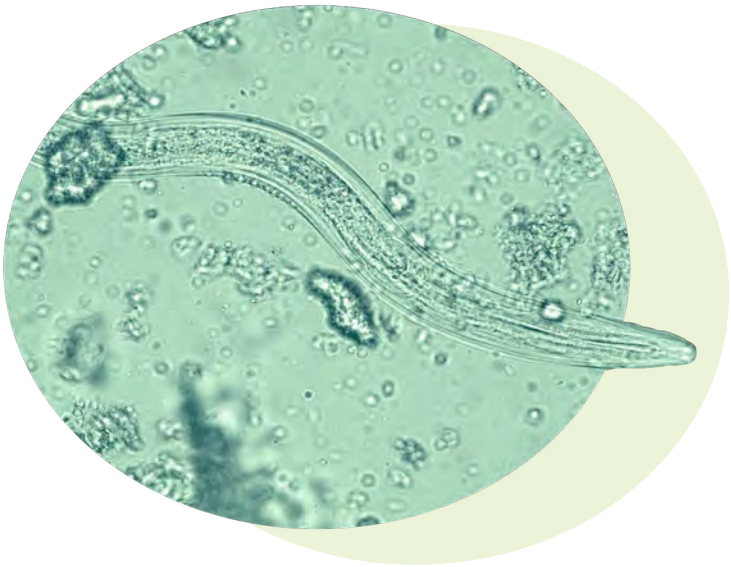
Figure 1.2 *Microbial test results*

			Pesticides (ppb) [1]	
Product	ID	Result	Pyrethrins	Piperonyl Butoxide
Pre-rolls	001	PASS	ND	3
Pre-rolls	002	FAIL	6,412	481
Pre-rolls	003	FAIL	213	296
Pre-rolls	004	PASS	ND	ND
Pre-rolls	005	FAIL	54	7
Shake	006	PASS	ND	13
Shake	007	PASS	ND	14
Shake	008	PASS	ND	12
Shake	009	PASS	ND	19
Shake	010	FAIL	1,584	907
Buds	011	PASS	ND	2
Buds	012	PASS	ND	ND
Buds	013	PASS	ND	ND
Buds	014	PASS	ND	ND
Buds	015	PASS	ND	ND
		Action Limit	50	200

Figure 1.3 *Pesticide contamination results*

4. Total Coliform Microbial Cannabis Testing By State, *Cannabis Microbial Testing Regulations by State, 2024*

three exceeding statutory limits, including one sample measuring 6,411 ppb — 128 times the action limit. Piperonyl butoxide (PBO) was identified in ten samples, three of which exceeded permissible levels by 1.5 to 4.5 times the regulatory threshold. The screening confirmed compliance with all samples based on the state's regulatory standards for marijuana. At present, there is no known safe level of pesticides for combusted, inhaled flower.



The data results reveal significant discrepancies between labeled and tested THC potency across the 15 sampled cannabis products, with variances ranging from -0.76% to -66.18%. Out of the samples, 12 products exceeded the acceptable 15% potency variance threshold set by Colorado's Marijuana Enforcement Division (MED). Notably, pre-rolls exhibited variances up to -57.96%, while shake and buds showed variances as high as -66.18% and -34.65%, respectively.

			Content (% THC)		
Product	ID	Result	Labeled THC	Total THC	Variance
Pre-rolls	001	FAIL	15.9%	13.1%	-17.5%
Pre-rolls	002	FAIL	25.0%	10.5%	-58.0%
Pre-rolls	003	FAIL	27.2%	18.0%	-33.7%
Pre-rolls	004	FAIL	17.8%	15.0%	-15.8%
Pre-rolls	005	PASS	15.6%	13.2%	-14.9%
Shake	006	FAIL	27.1%	13.7%	-49.4%
Shake	007	FAIL	23.4%	8.8%	-62.3%
Shake	008	FAIL	32.8%	11.1%	-66.2%
Shake	009	FAIL	22.3%	9.5%	-57.4%
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Buds	011	FAIL	30.8%	20.1%	-34.6%
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Buds	014	PASS	16.8%	15.2%	-9.6%
Buds	015	FAIL	19.1%	15.9%	-16.8%
				Action Limits	15.0%

Figure 1.4 *Sampled potency variance of label vs tested*

Figure 1.4 shows the analytical values, whereas **Figure 1.5** provides a visual representation of the discrepancies between stated potency on the label and tested potency.

These findings suggest systemic issues with product consistency and safety, and raise serious concerns about consumer protection and adherence to regulatory standards within Colorado's cannabis market.

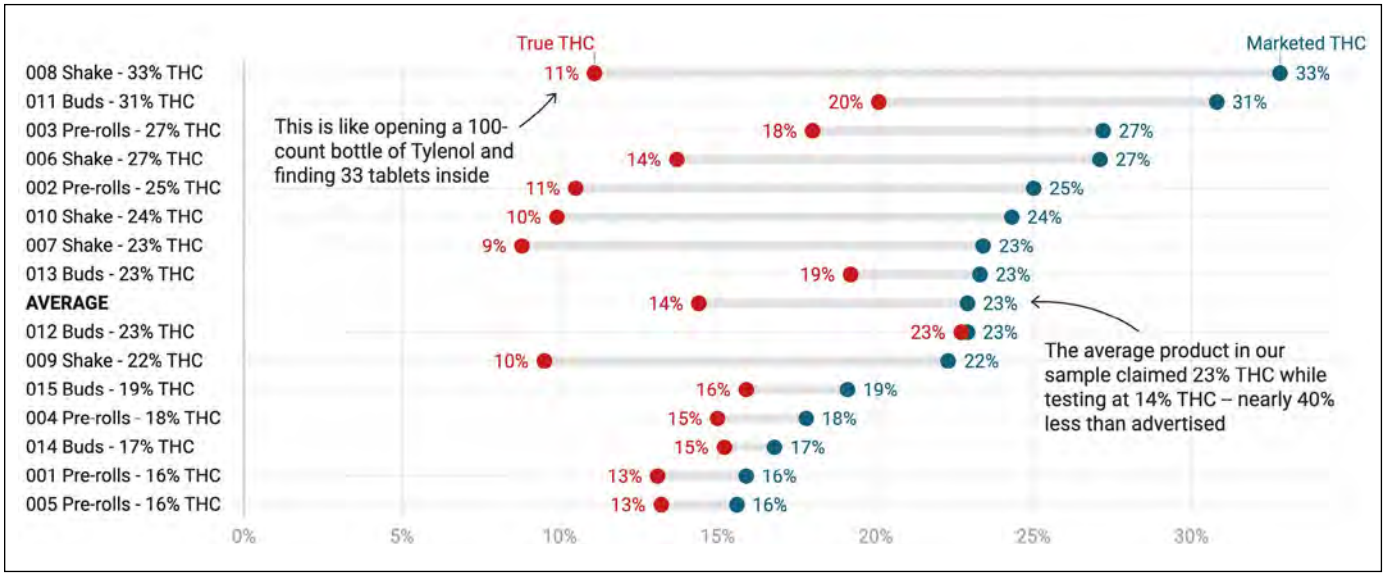


Figure 1.5 *Results are based on a blinded study of 15 products purchased at licensed adult-use dispensaries in Colorado in November 2024. Testing was provided by a Colorado-licensed cannabis laboratory.*

Discussion

Colorado became the first state to allow recreational cannabis retail sales in 2014, setting a precedent for the cannabis industry across the United States. Over the past decade, states legalizing cannabis have often adopted aspects of Colorado's regulatory framework. With this experience, there is an inherent expectation for cannabis products in Colorado to meet the same standards for safety and quality that are seen in other regulated consumer goods industries.

To ensure consumer safety, effective market surveillance programs are crucial. These programs should routinely monitor product quality, enforce established safety thresholds, and take corrective action when products fail to meet standards. In the event of non-compliance, products must be recalled, destroyed, and suppliers must implement corrective measures to address deficiencies. Mark Kleiman's "Swift, Certain, and Fair" architecture for deterring recidivism is a model worth pursuing.[5] Corporations respond to incentives and boundaries, and we believe these results demonstrate that corporations in Colorado are responding to incentives and a complete lack of boundaries. It's reasonable to assume that companies without a food safety culture would drift in their practices if left unchecked, especially during a time of industry downturn.

Drawing from the food industry, a well-established sector for consumer safety, approximately 1 in 6 Americans suffer from foodborne illness annually, with 128,000 hospitalizations and 3,000 deaths.[6] Despite robust surveillance programs, recalls for contaminants like E. coli, Salmonella, and Listeria occur regularly. These recalls highlight the importance of proactive monitoring systems that identify and mitigate risks before products reach consumers. By comparison, the cannabis industry in Colorado currently lacks a comprehensive, state-led surveillance program for product quality and safety, prompting the need for independent assessments such as this study.

This study focused on four key areas: **microbial contamination**, **aspergillus screening**, **pesticide screening**, and **potency variance**. Microbial testing specifically targeted yeast and mold, aerobic plate count (APC), and coliform bacteria. While coliform testing is not required in Colorado, it is mandated in 17 other states with legalized cannabis markets.

- **Coliform Testing:** Coliform bacteria are significant as indicators of fecal contamination and potential pathogens. Among coliform groups, E. coli serves as a critical marker for pollution and potential health risks due to its association with fecal-oral transmission and contaminated water.
- **Aerobic Plate Count (APC):** This widely used method measures the total viable microorganisms in a product, offering insights into overall microbiological quality, spoilage potential, and contamination risks.
- **Yeast and Mold (Y&M):** In the food industry, Y&M levels above 10,000 CFU/g are a red flag for poor safety practices. Some molds can trigger allergic reactions, respiratory issues, and produce mycotoxins like aflatoxin, a carcinogenic toxin impacting grains and other commodities. Aspergillus mold, a known contaminant in cannabis, poses a particular threat, as it can lead to severe health concerns, including aflatoxicosis.
- **Pesticides:** Unlike traditional crops, cannabis is often consumed in ways that bypass conventional pesticide breakdown, such as combustion or inhalation, increasing the potential for direct exposure. Contaminated products can lead to respiratory irritation, neurotoxicity, or long-term effects, including carcinogenic risks.

Additionally, potency testing was conducted to assess label accuracy. Previous studies highlight potency as a quality indicator influencing consumer trust and purchasing behavior.[7] Accurate labeling ensures consumers receive what they pay for and mitigates potential for consumer fraud. This study aimed to identify inconsistencies and potential risks in potency claims and microbial safety, both critical factors for protecting public health and maintaining regulatory compliance.

5. Swift, Certain, Fair Theory Findings // 6. Centers for Disease Control and Prevention. "Burden of Foodborne Illness: Findings | Estimates of Foodborne Illness.
7. Donnan, Jennifer, et al. "Characteristics that influence purchase choice for cannabis products: a systematic review.

Program Cost

One concern with the market surveillance programs is their perceived costs. This study demonstrates that the cost associated with the program provides a significant return on investment. To run the initial stages of this project, we incurred direct costs totaling $8,175: $600 for procuring 15 cannabis samples and $7,575 for laboratory testing panels. Scaling this approach to a statewide surveillance program requires investment in a state reference lab and ongoing operational costs.

ESTIMATED COSTS FOR A STATE REFERENCE LAB

A competent lab of five employees should be able to test 550 samples per month in 50% of their available time. The remaining time should be used to develop, validate, and disseminate shared standards, practices, and methods among industry stakeholders to ensure uniform, accurate measurement practices from seed to sale.[8]

- **Initial Setup:** $413,470 for laboratory equipment and infrastructure.
- **Annual Operating Costs:** $802,192, including staffing, materials, and facility lease.
- **Product Procurement:** varies based on market prices

With the assistance of state-mandated seed-to-sale tracking data, a modest commitment to open data, and a statistician, state regulators could efficiently verify the safety and THC content of the vast majority of product batches consumed by the public every month, and then be in a position to 1) quickly remove nonconforming products from shelves, and 2) notify consumers & retailers of the nonconformance so they might seek recompense from the offending manufacturers.

Monthly Testing Needs

Category	*Samples/Round*	*Rounds/Month*	*Samples/Month*
Concentrates	50	2	100
Vapes	50	2	100
Pre-Rolls	50	2	100
Packaged Buds	50	2	100
Edibles	50	2	100
Miscellaneous	25	2	50
			550

Cost-Benefit Justification

The estimated total annual expense for establishing and running a state reference lab, including product procurement, is approximately $1,000,000. In comparison, Colorado consumers are experiencing $275,000,000 annually in product fraud costs,[9] resulting from mislabeled potency, contamination, or other quality control issues.

Implementing a robust surveillance and reference lab program would significantly mitigate these consumer losses by ensuring accurate labeling, preventing adulteration, and identifying noncompliance early in the supply chain. For every $1 invested in surveillance, the potential exists to save $275 in fraud-related costs, highlighting a substantial return on investment and strengthening consumer confidence in Colorado's cannabis market.

This approach not only protects public health but also fosters market integrity, offering long-term benefits to consumers, regulators, and compliant businesses.

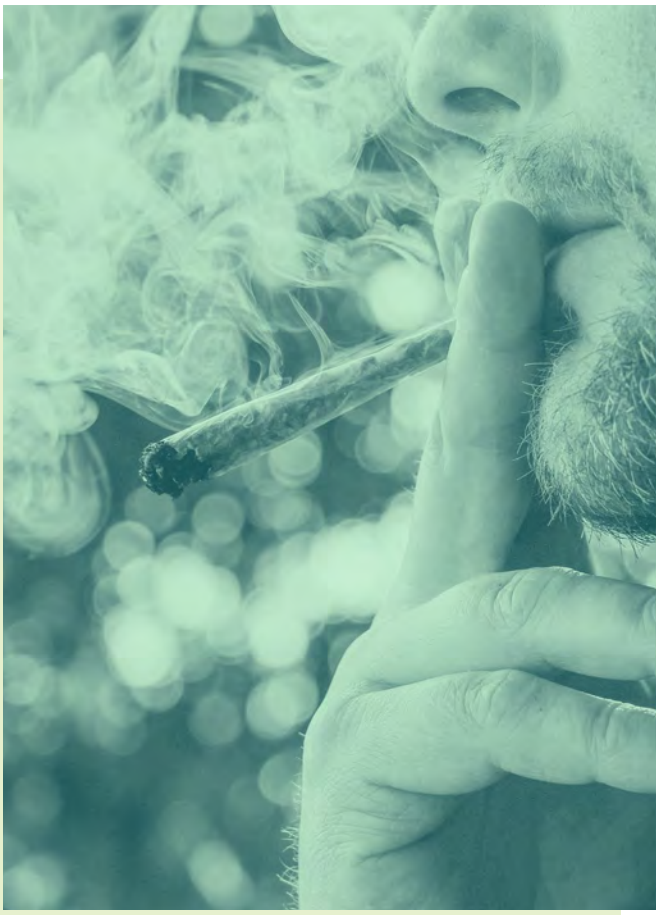
8. Operation BIS - Reference Lab Operating Costs
9. University of Colorado Boulder Business Research Division, and Colorado Marijuana Enforcement Division. "Colorado Marijuana Quarterly Market Update." Colorado Marijuana Quarterly Market Update.

Conclusion

FINDINGS SHOW

Dangerous contaminants were found in one-third of products, generally at levels that imply "infected" facilities that may not be remediable, as well as an absence of oversight stretching back many months, if not years.

- One can presume that Colorado's cannabis industry has a presence of "infected" facilities, those with persistent microbial or contamination issues, which represents a significant risk to public health. Once a facility becomes heavily contaminated, it is notoriously difficult to achieve and maintain compliance with safety standards. In the food industry, case studies such as Mars Pet Food[10] and Boar's Head,[11] illustrate the challenges of remediating facilities with entrenched contamination. These environments can harbor pathogens that resist cleaning, creating ongoing risks for cross-contamination. Food safety principles underscore the importance of preventative measures, including rigorous facility design, routine cleaning protocols, and proactive microbial testing. In the cannabis industry, where similar contamination risks exist, **regulators must act decisively to shutter facilities with unsolvable safety issues to protect public health**.
- Future studies could explore best practices for cultivation and manufacturing environments, focusing on facility design, sanitation protocols, and microbial remediation strategies.



Given the size of Colorado's flower market, these results **imply consumer fraud** on the order of 275 million dollars.

- 12 out of 15 products exceeded the 15% potency variance threshold, raising serious questions about the integrity of label claims and the reliability of laboratory testing practices.
- These inaccuracies not only mislead consumers but also undermine trust in the regulatory framework designed to ensure product consistency and safety. Consumers are making decisions based on severely inaccurate information, which is the definition of consumer fraud.

Colorado's regulatory framework would benefit from a robust **product surveillance program** managed by a state reference laboratory to routinely test cannabis product quality and verify label accuracy.

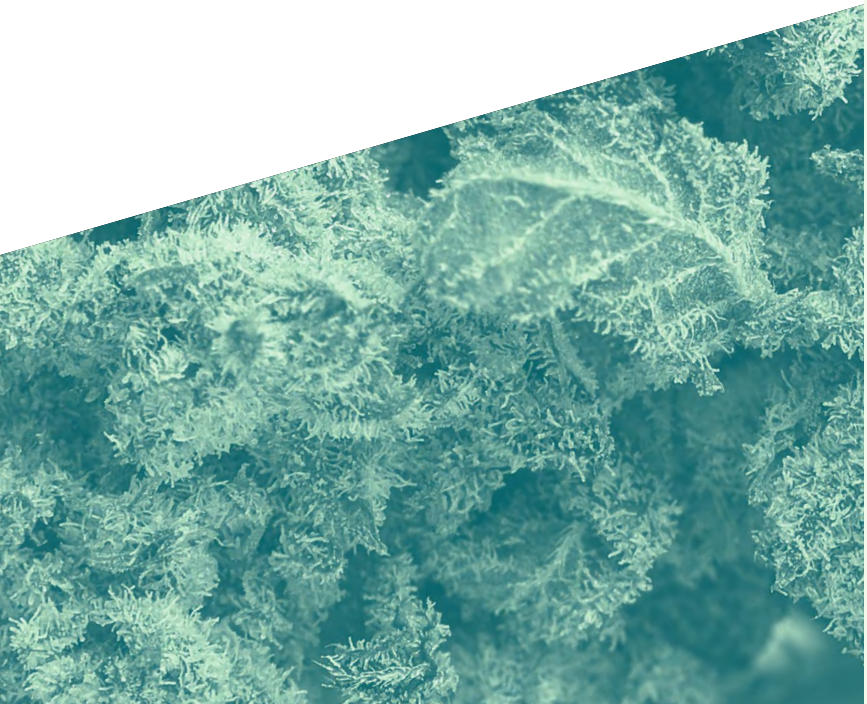
- This centralized system should establish clear industry testing standards, including standardized operating procedures (SOPs), while providing education and training to licensed cannabis laboratories serving the regulated industry. Such a program ensures consistency, reduces sampling bias by testing products as they are encountered by consumers, and closes the loop on quality assurance.
- This proactive approach protects public health, enhances trust in the cannabis market, and aligns with practices observed in well-regulated industries such as food safety.

10. Roos, Robert. "More Salmonella cases linked to dry pet food." University of Minnesota CIDRAP.
11. CBS News. "Bugs, mold and mildew found in Boar's Head plant linked to deadly listeria outbreak".

- Based on our analysis, Colorado could conduct approximately 550 shelf tests per month, leveraging METRC data to prioritize the most popular and fastest-growing brands. This approach would ensure the safety and accuracy of products consumed by the majority of the market.
- By allocating $1 million annually for a state reference lab (4% of MED budget), the program could effectively protect consumers while creating a strong deterrent against lab shopping and negligent business practices, fostering greater integrity within the cannabis industry.

In conclusion, this study underscores the critical need for **enhanced regulatory oversight** and **robust product surveillance programs** within Colorado's cannabis industry. The findings reveal significant gaps in product quality, labeling accuracy, and safety standards, highlighting risks to consumer health and the potential for industry-wide credibility challenges. By establishing a state-managed reference laboratory, implementing rigorous testing standards, and proactively monitoring products through a structured surveillance program, Colorado can set a benchmark for consumer safety and industry accountability.

These measures would not only protect public health but also solidify the state's leadership in shaping a trustworthy, sustainable cannabis market.



Alison Bosworth holds a Bachelor of Science in Forensic Science and a Master of Education from Waynesburg University. Her early career combined academia and applied research, serving as a microscopy instructor and research coordinator in partnership with a materials characterization laboratory and an industrial forensics consulting firm. Bosworth later joined the Federal Bureau of Investigation, where she led tri-state outreach initiatives and public relations for the Criminal Justice Information Services Division before transitioning to the role of Mission Support Analyst in Denver. In this capacity, she oversaw Colorado and Wyoming's Threat Review and Prioritization Program and contributed to the development of the Field Office Strategic Plan. In 2019, Bosworth entered the cannabis industry, spearheading the operations and launch of the nation's first licensed, event-based cannabis consumption space. Currently, she serves as Chief of Staff for Caliper Holdings, where she applies her analytical and regulatory expertise to manage compliance, mitigate threats, and enhance consumer safety in the cannabinoid-infused product space. With a diverse background spanning forensic science, federal law enforcement, and regulated industries, she brings a unique perspective to complex challenges in public policy and consumer protection.

Keith Woelfel joined Caliper in 2016 following 20 years at Mars/Wrigley. He has led in the development, launch and full commercialization of over 50 new products, from established billion-dollar CPG brands to novel Health and Wellness incubators. Keith has a passion for developing and commercializing functional food and beverage products that are safe and efficacious. He has authored over 7 patents in the areas of functional foods, beverages, and confectionery products. In addition, he has led novel basic research programs on cannabinoid pharmacokinetics in THC and CBD based edibles. Keith holds a BS in food science and an MS in analytical chemistry/food science from Rutgers University.

Caliper is a consumer packaged goods company specializing in standardized, clinically validated soluble cannabinoids for consumers and manufacturers. We are deeply committed to product integrity and consumer safety, which drives our dedication to rigorous research and innovation. Our partnership with Colorado State University has yielded peer-reviewed, published clinical studies on human subjects, reinforcing the credibility of our products and setting a higher standard for the cannabinoid industry.

Caliper is affiliated with Ripple, Colorado's largest locally owned edibles manufacturer, producing over 1.5 million servings each month for consumers who value honesty and potency in their cannabis products. Since entering the Colorado cannabis industry in 2015, we have remained passionate advocates for cannabinoids, consumer protection, and effective governance, striving to propel the industry forward with transparency and integrity.