

Cannabis Safety in California's Regulated Market

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California's legal cannabis industry faces regulatory challenges that affect public health and market stability. Accurate potency labeling and contamination prevention are critical to consumer safety, yet evidence suggests that the existing regulatory framework falls short. Practices such as "lab shopping," where cannabis suppliers use testing labs known to report inflated THC levels, undermine consumer trust (Zoorob, 2021; Schwabe et al., 2023). Contaminants like pesticides and heavy metals and pesticides in the cannabis supply show problems in enforcement efforts (Jameson et al., 2022). These shortcomings pose risks to consumers, especially to medical cannabis users. These regulatory and enforcement gaps also threaten economic stability by damaging consumer confidence and increasing the potential for legal disputes (Silver et al., 2020).

A comprehensive literature review identified three emergent themes: THC inflation, cannabis contamination, and economic and market pressures. These themes serve as a focal point for the analysis for a more detailed problem exploration. The research question will be explored by examining the Department of Cannabis Control's (DCC) effectiveness in mitigating risks associated with potency inflation and cannabis contamination and the broader implications for public health, economics, and industry integrity. The goal is to better understand the current regulatory framework and learn how it can be improved to support a safe, fair, and financially stable cannabis industry.

Research question: Are the regulatory controls and systems in place at the Department of Cannabis Control sufficiently protecting the safety of cannabis consumers, particularly regarding the safety of the cannabis and cannabis products that are being consumed?

Hypothesis: The safety and reliability of cannabis products in California are compromised by insufficient enforcement of contamination standards and economic pressures that incentivize inaccurate THC labeling. Simply put, regulatory gaps at the DCC allow practices to prioritize market competition over public safety.

Background

History of the DCC

The Bureau of Cannabis Control (BCC) was established when cannabis was legalized for both adult and medical use in California in 2016, overseeing the industry across the supply chain, with a primary focus on retail and lab testing. It was one of three state agencies responsible for regulating cannabis under the new laws, alongside the California Department of Public Health (CDPH) and the Department of Food and Agriculture (CDFA). In 2021, the cannabis regulatory functions of these agencies were consolidated into the DCC (DCC, 2021). The DCC now oversees cannabis testing laboratories, cultivators, manufacturers, distributors, transporters, retailers, and licensed event organizers.

Comprehensive licensing and operational regulations were developed to regulate cannabis lab testing. However, these regulations have significant gaps, leading to lab testing results rife with THC inflation and contaminant deflation. The state established a reference testing lab at the Center for Medical Cannabis Research (CMCR) as part of the regulatory framework (CMRC, 2024). This lab allows the DCC to test any cannabis product in California at any stage of its lifecycle, growth, production, or sale and compare the results from private cannabis testing labs to verify THC content and contaminants. Enforcement activity has been lax despite this capability over the last six years. However, efforts to enforce cannabis safety have recently increased with more frequent recalls for non-compliance (DCC, 2024b).

Fundamental Concepts

Potency and contamination are essential concepts to define when examining California's cannabis industry. Potency refers to the concentration of the main psychoactive component in cannabis, tetrahydrocannabinol (THC). This is important as higher THC levels are associated with more potent effects (Smart et al., 2017). The potency of cannabis flowers and products like edibles and concentrates impacts both product pricing and consumer preference, as higher THC products sell more and for higher prices (Smart et al., 2017). A concern is recent studies that suggest potency levels are inflated due to the practice known as "lab shopping" (Zoorob, 2021), where cannabis wholesalers and retailers seek out testing labs known to provide higher THC results.

Contamination includes pesticides, heavy metals, solvents, and microbial contaminants that pose consumer health risks. Inconsistencies in testing and enforcement have raised safety concerns, including reports of unapproved pesticide use in California's cannabis supply chain (Jameson et al., 2022). In the state, every batch of cannabis must be tested for over 100 contaminants, including 66 pesticides, with stricter limits than those for food products (Valdes-Donoso et al., 2019). Rigorous testing creates costs that affect the price of legal cannabis, especially when batches fail and must be destroyed. These economic burdens showcase the tension between regulations and market viability and might explain the lab shopping problem.

The DCC's regulatory challenge is to balance consumer safety with economic considerations, which is difficult in this relatively new, high-demand, and competitive market. DCC policies must mitigate health risks associated with inaccurate potency labeling and product contamination while allowing the industry to flourish financially. The situation is made more

complicated as financial incentives for higher THC potency create pressures that may undermine regulatory goals (Zoorob, 2021). After all, the tax revenue generated from sales was a key motivator in legalizing cannabis across California (Silver et al., 2020).

Literature Review

THC Inflation

THC potency impacts California's legal cannabis market, affecting consumer demand and pricing, leading to practices that prioritize high THC content, as cannabis with higher potency commands higher prices (Smart et al., 2017). A concerning issue is that cannabis businesses select testing facilities known to report inflated higher THC levels to match consumer expectations (Zoorob et al., 2021). For example, in Nevada and Washington, Zoorob's study showed an economically motivated spike in the reported THC levels just above 20%. Further validating these concerns, a side-by-side analysis of THC potency using high-performance liquid chromatography (HPLC) compared reported values with label-reported potency in dispensary products (Schwabe et al., 2023). The findings showed that, on average, THC potency was overstated, with 70% of samples showing more than 15% lower actual THC content than shown on the labels. The discrepancy shows how the combination of poorly implemented lab testing oversight and financial incentives creates THC inflation, affecting medical patients who need precise dosing and recreational users seeking specific effects.

In Washington State, researchers showed that the demand for high-THC products drove price variations, with a statistically significant relationship between THC levels and the price per gram (Smart et al., 2027). This relationship highlights a broader trend of THC inflation as a market strategy created by lapses in regulatory standards. While study authors mostly agree that regulatory oversight must be improved (Schwabe et al., 2023; Smart et al., 2017), Zoorob (2021)

points out that problems are only found across some labs. This suggests that an analytical approach using data analysis, standardized lab audits, and targeted enforcement improvements could ensure accurate THC labeling.

Cannabis Contamination

Contamination in cannabis products is a pressing public health concern in California. Cannabis contamination involves the presence of harmful substances such as pesticides, heavy metals, solvents, and microbial contaminants that can pose significant health risks to users, especially vulnerable groups such as medical patients (Jameson et al., 2022). Jameson's study examined state-level regulations, finding that compliance failures are significant while testing mandates cover over 100 contaminants, with a 2.3% failure rate for flowers and a 9.2% for extracts. These findings indicate a risk of contaminant exposure due to problems with regulations and enforcement across jurisdictions.

A recent study by Arizona State University researchers and California-based cannabis testing labs revealed significant inconsistencies in how cannabis contamination is regulated across 36 states and Washington, D.C (Seltenrich, 2019). The study found significant disparities, especially in pesticide regulation, with some jurisdictions testing for over 400 pesticides while others screened fewer than 100. Analysis of nearly 10,000 cannabis samples showed that regulatory limits for the fungicide myclobutanil varied greatly, putting consumer safety in question. As Seltenrich (2022) noted, state rules vary widely, leading to exposure risks for consumers depending on their location.

Several studies argue for unified, national-level guidelines to harmonize state-level policies and reduce these risks (Jameson et al., 2022; Seltenrich, 2019; 2022). After all, the United States Food and Drug Administration (FDA) regulates lab testing for food, feed,

medicines, and tobacco, so it is logical to place cannabis under its control (FDA, 2024). Moreover, while the DCC testing regulations are thorough, THC inflation and contaminant deflation are clearly shown in the data, confirming the need for regulatory changes and better enforcement.

Economic Issues

The commercial cannabis industry has only been legalized in CA since 2016, and the regulatory scheme did not begin until 2018 (DCC, 2024a). The industry is competitive, and economic pressures influence regulatory compliance. The incentive to inflate THC potency, for instance, is likely rooted in the desire to attract clients and the drive for profitability (Schwabe et al., 2023). The literature review shows that higher THC levels correlate with higher retail prices, leading cultivators, manufacturers, distributors, and retailers to prioritize potency over accurate labeling and product quality (Smart et al., 2017). Economic factors lead to the practice of lab shopping, where cannabis companies seek testing labs that are known to inflate potency and deflate contaminate results (Zoorob, 2021).

There are high costs associated with regulatory compliance, including mandatory contaminant testing and fees for failing batches, which further strain suppliers and retailers, especially smaller operators (Valdes-Donoso et al., 2019). Financial burdens like these incentivize cost-cutting measures that lead to safety and quality control problems, especially in contamination prevention. For example, producers may use unapproved pesticides or fail to ensure clean production environments to save costs (Jameson et al., 2022). These pressures create systemic challenges, as labs that adhere strictly to regulatory standards may lose business to unscrupulous labs.

Taxes and licensing fees add even more financial stress. Studies have highlighted that the cumulative tax burden on legal cannabis can make it significantly more expensive than black-market alternatives, driving some consumers, producers, and sellers away from the legal market (Silver et al., 2020). California's underground cannabis economy is still thriving, and competition from unregulated suppliers further complicates the enforcement of safety standards and the reliability of product labeling. Consumers may be willing to forgo the legal market if the prices are higher due to taxes, fees, and testing costs, especially as many know that testing results are often inaccurate.

By understanding these economic and market pressures, policymakers and regulators can identify trends and solve regulatory shortcomings and enforcement lapses. This is undoubtedly important, as the literature review suggests that while the state's mandatory testing regulations add value to products by promoting safety (Silver et al., 2020), they do not prevent either THC inflation or contamination deflation. At this point, addressing regulatory problems is essential to create consumer trust and market integrity. To do so requires a balanced approach that supports compliance while supporting the cannabis industry's economic development. Without the benefit of FDA oversight, the literature review leads to solutions at the state level, including offering financial incentives for compliance, reducing licensing fees for small businesses, and providing subsidies for cannabis businesses that implement rigorous testing protocols.

Analysis

The literature on cannabis safety in California highlights the problems of THC potency inflation and contamination risks. Economic incentives for producers to inflate THC levels have led to lab shopping (Zoorob, 2021; Schwabe et al., 2023), showing the need for stronger regulatory oversight to ensure reported THC levels reflect reality. Studies suggest that comparing

lab-reported THC levels with actual measurements using high-performance liquid chromatography (HPLC) could help uncover the extent of the issue (Schwabe et al., 2023). Interviews with lab operators, producers, and retailers could also explain why these practices occur and the pressures driving noncompliance.

While DCC regulations feature strict contaminant testing protocols, a lack of enforcement has created potential health risks (Jameson et al., 2022; Sullivan et al., 2013). Future research could analyze compliance reports, failure rates, and enforcement activity to identify regulatory gaps. In the future, a case can likely be made for increasing enforcement and audit activities, including random sampling and testing for pesticides, heavy metals, and microbial impurities to show the extent of contamination. These studies could provide insight into regulatory shortfalls and their impact on product safety and point to potential solutions.

More rigorous enforcement of contamination standards and testing protocols could reduce public health risks if they are adequately enforced, especially for vulnerable groups like medical cannabis users. California's regulatory framework needs stricter, more consistent enforcement. Regular lab procedural audits, meaningful penalties for noncompliance, and using a state reference lab to compare sample results are all essential steps to ensure lab compliance (CMRC, 2024). Transparency would promote accountability, too, by making lab compliance reports publicly available. It would give consumers the information they need to know when choosing which cannabis products are safest for use. DCC must also invest in technological advancements, like AI-powered tools, that improve their ability to provide lab oversight and implement enforcement actions.

Finally, California should continue to prioritize research on health effects and social impacts that support ongoing policy improvements (CMRC, 2024). Long-term studies on the

health effects of inaccurate THC dosing and cannabis contaminants are needed, especially for medical cannabis consumers. Additional research will help the DCC solve these issues on the regulatory and enforcement sides and develop solutions to root out profit-driven rulebreakers.

Conclusion

Insufficient lab testing regulations and slack regulator enforcement undermine the safety of California's cannabis market. When paired with economic incentives to cheat, these issues lead to the joint problems of THC inflation and contamination deflation. This has fueled practices like lab shopping, where cannabis producers and retailers seek testing labs that report inflated THC levels (Zoorob, 2021; Schwabe et al., 2023), creating consumer distrust in the legal cannabis industry. False labeling impacts medical users, who may require precise dosing for effective treatment, and medical patients may be more harmed by contaminants like molds and heavy metals. Recreational consumers also face negative experiences due to misleading potency information, further eroding trust in the industry. However, contamination risks from pesticides, heavy metals, and microbial impurities continue despite the state's rigorous testing requirements, with research showing noncompliance rates of up to 9.2% for some products (Jameson et al., 2022).

DCC's regulatory framework only works if adequately enforced, and right now, the safety and reliability of the California cannabis stream are not reliable. The problem is proven by research showing significant flaws with lab testing and a correlation between sales and THC levels. These problems threaten the well-being of cannabis consumers and the trustworthiness of the industry. They also open the door to lawsuits and reputational damage, which is problematic as this new industry lifts itself out of the underground.

DCC must address the testing variables found in the California cannabis stream. Several cost-effective steps can be taken to improve accountability, including using the state testing lab in San Diego to verify test results more frequently. Each lab must follow standardized procedures by DCC; however, audits to ensure compliance can be stepped up. DCC or third-party auditors can accomplish this by finding labs using lab-based techniques to manipulate findings. Penalties for noncompliance would encourage operators to follow the rules, as would publicly sharing information like results of audits and product failure rates. DCC or the state legislature could introduce financial incentives for compliant labs, producers, and sellers, including tax breaks and reduced licensing fees. These savings may encourage operators to follow, rather than break, for financial gain.

DCC should encourage FDA-led national testing standards, using processes created in other industries like tobacco and medicine. There would likely be several important outcomes from this change, including lowered costs for tests with increased accessibility and a more dependable and trustworthy cannabis marketplace for cannabis users. Consumer education campaigns could focus more on explaining the importance of lab testing and cannabis potency and purity. Informed customers can also force market improvements, so DCC should expose consumers to these concerns and share information and solutions. Funding long-term health research on contaminants' effects and labeling inaccuracies would motivate consumers to demand better products, as informed consumers will choose safe cannabis. It will also generate valuable data to guide future policy decisions, which is needed in this emerging space. Lawmakers, the DCC, and stakeholders from the cannabis industry must collaborate to close existing gaps and build a cannabis market that is safe, equitable, and sustainable and should strive to create a globally recognizable and profitable cannabis marketplace.

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