TECHNICAL REPORT:

Evaluating Compliance, Potency, and Pesticides in Oregon's Marijuana and Hemp Markets Ten Years after Legalization

Primary Authors

David Standiford
OLCC Laboratory
Compliance Coordinator

Steven Crowley
OLCC Hemp
Compliance Coordinator

Rodger Voelker, PhD
ODA
Lead Chemist

Rev. 5/9/2025

TECHNICAL REPORT:
Evaluating Compliance, Potency, and Pesticides in Oregon's Marijuana and Hemp Markets Ten Years after Legalization*

Authors:

OLCC-David Standiford (Laboratory Compliance Coordinator), Steven Crowley (Hemp Compliance Coordinator), Anthony Geltosky JD (Packaging and Labeling Specialist), Larry Brown (Hemp Testing/Reference Lab Inspector)

ODA-Rodger Voelker PhD (CRL Chemist III - Cannabis Reference Lab Program)

ACKNOWLEDGMENTS

OLCC would like to thank the following individuals for their valuable contributions to the development of this report:

Coleen Neumann
CRL Chemist II
Oregon Department
of Agriculture

Kathleen Wickman
Laboratory Manager
Oregon Department
of Agriculture

Kalen Khang
CRL Chemist I
Oregon Department
of Agriculture

Rich Evans
Senior Director of Licensing and
Compliance
Oregon Liquor & Cannabis Commission

Virginia Tarango
Quality Assurance Officer
Oregon Department
of Agriculture

Toby Primbs, PhD
Pesticide Compliance Program Manager
Oregon Department
of Agriculture

Melissa Jackson
Environmental & Cannabis Laboratory
Assessor & Policy Developer
Oregon Health Authority

DaNette Wernette
Hemp Program Manager
Oregon Department
of Agriculture

For information about this report, contact OLCC.Labs@olcc.oregon.gov.

---

*Please cite this publication as follows: "Standiford, Crowley, & Voelker. Technical Report: Evaluating Compliance, Potency, and Pesticides in Oregon's Marijuana and Hemp Markets. OLCC. 2025 May."

EXECUTIVE SUMMARY

The Oregon Liquor and Cannabis Commission (OLCC) conducted a review of an array of current regulatory concerns in the context of a look back at the last 10 years since legalization of marijuana. The review primarily focused on THC levels in hemp flower and edibles, packaging and labeling of hemp products, and pesticide and potency testing of hemp and marijuana flower. In collaboration with the Oregon Department of Agriculture (ODA), OLCC collected 151 samples of cannabis products to conduct a survey of hemp and marijuana products currently being sold in Oregon. OLCC staff compared the current packaging and labeling of hemp products to the marijuana products OLCC currently regulates. ODA's Cannabis Reference Laboratory (CRL) conducted pesticide and potency testing on the samples collected to assist the OLCC in investigating concerns of contamination and product misrepresentation.

- OLCC staff successfully purchased a large amount of high THC cannabis flower and edibles, online and in-person, that are prohibited for sale to Oregon consumers.
- Based off the sellers' label and website claims, 78% of hemp flower samples OLCC purchased were prohibited for sale to an Oregon consumer:
    - 8% contained "artificially derived cannabinoids" (defined below)
    - 73% exceeded 0.3% total THC
- **All 51 samples of hemp flower tested by the CRL exceeded 0.3% total THC.** Based on these tests results, all this cannabis flower is prohibited for sale to Oregon consumers, ranging from 0.4% to 30.5% total THC.
- 74% of hemp edibles were prohibited for sale to an Oregon consumer based on the amount of delta-9-THC they contained, the presence of artificially derived cannabinoids, or both.
- Only 10% of hemp edibles purchased have clear potency on the label that were traceable to test results.
- Hemp edibles frequently misrepresented their weight or potency. Only 25% of potency claims on hemp edible labels were within 10% of the amount actually detected by the CRL. Only 57% of edibles that listed a weight on the label were within 10% of the claimed weight.
- The vast majority of products purchased online were sold without adequate age verification: 79% of hemp edibles and 84% of hemp flower.
- When testing marijuana from the OLCC market on average, the third-party laboratory results were 13% higher relative to the CRL results with a standard deviation of ±19.4%. In absolute percentage points, the average difference and standard deviation between the CRL results and third-party results was +2.4% ±4.1% total THC.
- Pesticide testing resulted in the discovery of a batch of marijuana being found to have a pesticide **nearly 10× the action level** that was being sold to consumers. OLCC worked with the licensee to immediately recall the product.

CONTENTS

INTRODUCTION: TEN YEARS OF LEGALIZATION

In 2014, the citizens of Oregon voted to pass Ballot Measure 91,[1] legalizing the possession and use of marijuana by adults. This ballot measure tasked the Oregon Liquor and Cannabis Commission (OLCC) to create a well-regulated adult use market for marijuana. In the ten years since legalization, the laws and rules that govern cannabis within Oregon and nationally have continued to evolve at a rapid pace.

With the passage of the Agriculture Improvement Act of 2018 (also known as the 2018 Farm Bill),[2] hemp products have experienced a surge in market size and popularity across the United States. While the intent of this legislation was to legalize hemp and launch an industry for non-intoxicating products made from hemp grain and fiber, the language of the Act opened the door for a wide variety of intoxicating cannabis-derived products to be sold nationwide by claiming to fall under the federal definition of "hemp."

The growing popularity of hemp-derived edible products has led to a proliferation of new products in Oregon's market. Among these, hemp gummy edibles stand out as one of the most widely available and consumed products. As the industry has expanded, so too has the need for regulatory oversight to ensure that these products do not pose unnecessary risks to public health and safety. In 2024, Oregon House Bill 4121[3] tasked OLCC with overseeing the establishment of a hemp product registry. Among other things, the hemp product registry requires the establishment of certain labeling standards and verification of compliance with existing testing requirements for hemp products sold in the "general market" (i.e. not at an OLCC-licensed marijuana retailer).

Despite legalizing marijuana, illegal cultivation of cannabis has continued to be a persistent issue in Oregon. In 2021 OLCC and the Oregon Department of Agriculture (ODA) worked with many other state and local agencies to combat a significant number of illicit marijuana grows, particularly in Southern Oregon, which were discovered to be operating under the guise of legal hemp cultivation (OLCC, 2021).

OLCC is continuing to identify and work proactively on addressing regulatory challenges in the cannabis industry, including concerns about monitoring pesticide use in cannabis cultivation, the emergence of intoxicating hemp products, and claims of potency fraud in marijuana testing. These challenges highlight the complexity of ensuring public safety, product transparency, and consumer trust in this rapidly expanding and evolving industry. Operation Clean Leaf was designed to further investigate these concerns.

GENERAL MARKET VS OLCC MARKET

There are two separately regulated markets in which hemp products may be sold to Oregon consumers. For clarity, we refer to these as the "OLCC market" and "general market" throughout this report.

The OLCC market refers to products sold by OLCC-licensed marijuana retailers. In addition to marijuana items, OLCC-licensed marijuana retailers can sell hemp items to adults age 21

[1] Oregon Laws 2015, Chapter 1
[2] Agriculture Improvement Act of 2018 (H.R. 2)
[3] Oregon Laws 2024, Chapter 16

and over and to Oregon Medical Marijuana Program (OMMP) cardholders age 18 and over. To be sold in the OLCC market, the hemp must be tracked in Oregon's Cannabis Tracking System (CTS) prior to being transferred to an OLCC marijuana licensee, and the finished hemp product must comply with OLCC rules for packaging, labeling, testing, and cannabinoid serving and concentration limits. Regulatory authority over the OLCC market rests primarily with OLCC.

The general market refers to hemp sold to Oregon consumers by anyone other than an OLCC-licensed marijuana retailer. This includes grocery and convenience stores, bars, restaurants, smoke shops, CBD stores, and online retailers. Some general market retailers may hold alcohol licenses issued by OLCC, but these are considered general market retailers because they are not subject to the regulations that apply to hemp products sold by an OLCC-licensed marijuana retailer. Regulatory authority over the general market is shared between OLCC and ODA.

CANNABIS: HEMP OR MARIJUANA?

"Hemp" and "marijuana" are different legal categories of the same plant, *Cannabis sativa* L. (the cannabis plant). The term marijuana (or "marihuana" as it is spelled in federal law) has a problematic origin, but it is the legally defined term in Oregon so that will be the term used in this paper.[4] Both terms – "hemp" and "marijuana" – can also refer to products made from the cannabis plant, in addition to referring to the plant itself. Under federal law in the United States, hemp and marijuana are distinguished based on the concentration of one of the active ingredients, delta-9-THC.[5] If the concentration exceeds 0.3%, it is marijuana; otherwise it is hemp.[6] Federal law also generally requires that legal hemp crops pass testing for "total THC"[7] prior to harvest. Total THC includes delta-9-THC in addition to another active ingredient, THCA,[8] which can convert into delta-9-THC when heated. Federal law does not require that a commodity or product be manufactured from a legal hemp crop in order to be considered "hemp." As long as the product is made from cannabis and contains no more than 0.3% delta-9-THC, it is considered "hemp" under federal law.[9]

In Oregon, hemp and marijuana are differentiated based on provenance. Cannabis grown under a marijuana license or registration is marijuana. Cannabis grown under a hemp license that passes pre-harvest testing is hemp. Commodities and products made from marijuana plants remain marijuana, regardless of delta-9-THC concentration. Likewise, commodities and products made from hemp remain hemp, regardless of the concentration of delta-9-THC. Higher-THC hemp products are subject to additional regulation, and exporting high-THC hemp products is still prohibited even if those products are "hemp" under Oregon law.

---

[4] Some states have redefined terms so "cannabis" refers to the kind of cannabis that is called "marijuana" in Oregon law. This creates additional confusion by excluding "hemp" from the legal definition of "cannabis" despite hemp also being cannabis in the ordinary and botanical sense of the word.
[5] Delta-9-tetrahydrocannabinol, CAS # 1972-08-3 (see Appendix E)
[6] 7 USC 1639o(1)
[7] Total THC is calculated as: [Total THC] = [delta-9-THC] + (0.877 × [delta-9-THCA]). It does not include delta-8-THC or other THC isomers. Total THC for useable marijuana is calculated on a dry weight basis:
$P_{\text{Total THC (dry)}} = P_{\text{Total THC (wet)}} \div [1-(P_{\text{moisture}}/100)]$
[8] Delta-9-tetrahydrocannabinolic acid, CAS # 23978-85-0 (see Appendix E)
[9] There is some ambiguity about the exact meaning of delta-9-THC in this context; see footnote 22 (page 20).

Throughout this report, we use the term "cannabis" when referring to the plant generally, including both hemp and marijuana. We use the terms "hemp" or "marijuana" when referring to a specific subcategory of cannabis. In general, we defer to the category assigned by manufacturers and retailers when referring to cannabis and cannabis products, though the results of testing by the CRL may show that a product has been miscategorized.

ARTIFICIALLY DERIVED CANNABINOIDS

The market for intoxicating hemp-derived cannabinoids[10] has risen dramatically in the last several years. The Brightfield Group estimates the market size to be $2.8 billion as of 2023 (Brightfield Group, 2023), driven by the growth of delta-8-THC,[11] "hemp-derived" delta-9-THC, and "THCA hemp" products.

One of the steps that Oregon has taken to regulate cannabis generally, and especially intoxicating hemp products, was to define the term "artificially derived cannabinoid"[12] (ADC) and place limitations on their use in products sold to Oregon consumers. Oregon law uses the term artificially derived cannabinoid to refer to semisynthetic cannabinoids: cannabinoids made synthetically using a starting material derived from cannabis. For example, some businesses take CBD[13] extracted from hemp and synthetically convert it into delta-9-THC, delta-8-THC, or CBN[14].

These products have become especially popular in states that lack a legal adult use marijuana market. They provide an economical way to create intoxicating cannabis products that arguably fit within the definition of hemp in the 2018 Farm Bill. Some states have prohibited or attempted to prohibit ADCs, but in the states that do not prohibit their sale there are typically no age restrictions to prohibit the sale of intoxicating ADCs to minors.

DEFINING POTENCY, PSYCHOACTIVE, AND INTOXICATING

Cannabinoid concentration refers to the amounts of specific cannabinoids, such as delta-9-THC or CBD, present in a cannabis product. Cannabinoid concentration is colloquially referred to within the cannabis industry as "potency."

---

[10] "Cannabinoid" is a difficult term to define. Hanuš, et al. (2016) summarize the situation as follows: "Originally coined in a phytochemical context to refer to a structurally homogenous class of meroterpenoids typical of cannabis (*Cannabis sativa* L.), the name "cannabinoid" has then been associated to the biological profile of the psychotropic constituent of marijuana (Δ^9-THC), substantially losing its structural meaning and being growingly associated, in accordance with the rules of pharmacological research, to compounds showing affinity to the two GPCR known as cannabinoid receptors (CB_1 and CB_2), independently from any structural or biogenetic relationship with the cannabis meroterpenoids." In this paper, we are primarily addressing cannabinoids in the context of the structural class of meroterpenoids that occur in cannabis, as well as their derivatives (structurally-related compounds), whether naturally occurring in cannabis or manufactured synthetically.

[11] Delta-8-tetrahydrocannabinol, CAS # 5957-75-5 (see Appendix E)

[12] OAR 845-025-1015(3): (a) "Artificially derived cannabinoid" means a chemical substance that is created by a chemical reaction that changes the molecular structure of any chemical substance derived from the plant Cannabis family Cannabaceae. (b) "Artificially derived cannabinoid" does not include: (A) A naturally occurring chemical substance that is separated from the plant Cannabis family Cannabaceae by a chemical or mechanical extraction process; (B) Cannabinoids that are produced by decarboxylation from a naturally occurring cannabinoid acid without the use of a chemical catalyst; or (C) Any other chemical substance identified by the Commission, in consultation with the authority and the department, by rule.

[13] Cannabidiol, CAS # 13956-29-1 (see Appendix E)

[14] Cannabinol, CAS # 521-35-7 (see Appendix E)

Delta-9-THC is the primary psychoactive cannabinoid responsible for the "high" or intoxicating effects commonly associated with cannabis use. The term "intoxication" describes the physical and mental changes caused by consuming substances like THC or alcohol that impair cognitive or motor functions. However, not all cannabinoids are intoxicating; for example, CBD is generally considered non-intoxicating and does not produce such effects. Having accurate cannabinoid concentration information is essential for consumers to ensure safe use and appropriate dosing.

The term "psychoactive" refers to any substance that affects the brain and alters mood, perception, cognition, or behavior. This is a very broad term that includes substances like caffeine, melatonin, delta-9-THC, and CBD. CBD is psychoactive but not intoxicating. Delta-9-THC can be psychoactive and intoxicating. As with all potential intoxicants, the concentration and total amount consumed will affect the level of intoxication.

Many ADCs such as delta-8-THC or HHC[15] that have become commercially popular are generally considered to be intoxicating. However, due to the novel and legally complex status of ADCs, there has been comparatively little research on this topic.

OPERATION CLEAN LEAF

OLCC undertook this operation to study several separate, interlocking elements of Oregon's cannabis ecosystem to better-inform data-driven regulation. OLCC teamed with ODA's Cannabis Reference Laboratory (CRL) to investigate three major regulatory areas of concern:

- Pesticide contamination within the OLCC market compared to hemp products sold to consumers in the general market.
- Packaging and labeling currently being used for hemp products in the general market compared to products in the OLCC market.
- Cannabinoid concentration claims from product manufacturers, distributors, and retailers compared with the results of testing conducted by Oregon's CRL.

Data collected in these key areas will help to inform public health and regulatory enforcement priorities for cannabis products being sold in Oregon.

SAMPLE SELECTION AND COLLECTION

CANNABIS FLOWER SAMPLES

A total of 101 samples of cannabis flower were purchased for this investigation, consisting of 50 samples of marijuana flower and 51 samples of hemp flower.

The 50 marijuana samples were collected through in-person retail sales from OLCC-licensed marijuana retailers and represent flower from 49 unique OLCC-licensed marijuana producers

[15] Hexahydrocannabinol CAS # 6692-85-9 (occurs in two isomeric forms, 9*S* and 9*R*, both of which have significant binding affinity at the CB_1 receptor) (see Appendix E)

across Oregon, capturing geographic diversity, strain variety, and differences in growing practices among the samples.

The hemp flower samples were collected through in-person retail sales within Oregon as well as orders made from many different online retail sites.

Each flower sample was submitted to the CRL to be tested for cannabinoid concentration and residual pesticides as detailed further in the report.

HEMP EDIBLE SAMPLES

A total of 50 samples of edible products purported to be hemp were purchased from 38 different retailers across 11 states. Of these, 17 samples were purchased through in-person sales from 13 different locations in Oregon. Samples for this survey were selected based on the goal of capturing a diverse range of products within practical constraints. The aim when selecting samples was to purchase them from a variety of online and in-person sources with a broad geographic distribution. OLCC intentionally sought some samples which appeared to contain ADCs because there are specific concerns regarding how those products are manufactured, packaged, and labeled.

PESTICIDES

Pesticides have been a regulatory concern since states began to legalize cannabis products for retail sale to consumers. In 2014, before cannabis testing was required in Oregon under nascent OLCC and Oregon Health Authority (OHA) regulations, a study conducted by an independent cannabis testing laboratory revealed "extraordinarily widespread" pesticide use within the medical cannabis market (Voelker R, 2014). Similarly, in 2015, investigative reporting from the Oregonian raised concerns about pesticide use in Oregon's medical marijuana market (Crombie, 2015).

Currently, the application of any pesticide to cannabis that is not specifically exempted in 40 CFR Part 180 Subpart D[16] is a violation of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA).[17] According to these regulations there are more than 1,000 pesticides that could potentially be applied on cannabis that would be a violation of FIFRA. ODA maintains a guide list of pesticides (Oregon Department of Agriculture , 2025) that are not prohibited for use on cannabis.

Testing requirements for cannabis in Oregon are set by OHA, including setting action levels for required pesticide testing.[18] When establishing the marijuana program in Oregon, the state adopted a strategy of relying upon private laboratories to perform a screen for pesticides that were likely to be applied to cannabis, with a focus on pesticides that would also be a violation of FIFRA. All harvested marijuana within the OLCC-regulated system in Oregon is separated into batches and tested for pesticides by an independent third-party laboratory. Laboratories are licensed by OLCC and accredited by the Oregon Environmental

[16] 40 CFR Part 180 Subpart D -- Exemptions From Tolerances
[17] 7 U.S.C. Chapter 6, §136–136y
[18] OAR 333-007-0400

Laboratory Accreditation Program (ORELAP) to perform this testing. The test results are reported directly to OLCC in CTS as well as to the licensee who ordered the test.

To facilitate the roll-out of this strategy, the state produced a list of 59 compounds that all cannabis sold within Oregon must be tested for (Farrer, 2015). Most of the 59 pesticides on the list are prohibited for application on cannabis. Others (e.g. pyrethrins, piperonyl butoxide) are the active ingredient in some products on the guide list but cannot be present above the action level established by OHA. Many other states adopted similar strategies and some even adopted the same list of 59 compounds that Oregon implemented.

Pesticide presence on a crop can result from either intentional application or unintentional exposure. Intentional application occurs when pesticides are used directly to control pests or enhance the yield of a crop; this can result in a violation of regulatory limits if performed in a non-compliant manner. Unintentional exposure can happen through environmental factors such as drift or overspray from the application of pesticides in nearby areas, cross-contamination during processing or storage, or even contaminated soil or water. Cannabis has been found to be an effective bioaccumulator, removing toxic contamination from soil (Rheay, Omondi, & Brewer, 2021). Both scenarios underscore the importance of rigorous testing and adherence to regulatory guidelines to ensure consumer safety.

OLCC, OHA, and ODA have been working in collaboration to address this ongoing concern. Data from CTS shows a rapid decline in reported pesticide testing failures following the establishment of the adult use market, leveling off to a relatively stable failure rate for the past six years (Figure 1).

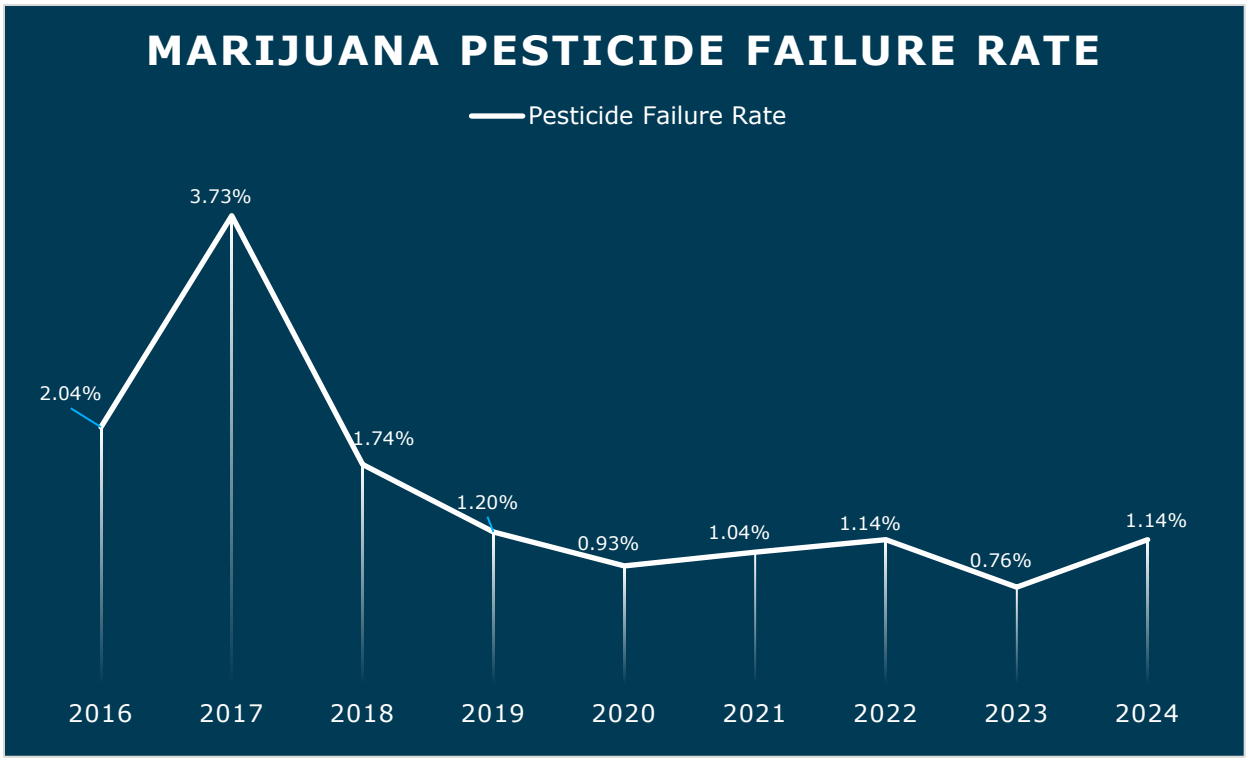


Figure 1. Pesticide failure rate over time within the OLCC market

One possible regulatory concern with this data trend is that OLCC-licensed marijuana producers are aware of which pesticides will be tested for when ordering compliance testing on their harvest lots. It is unclear if pesticide use has actually decreased or if some licensees may have adjusted their cultivation practices by applying pesticides with active ingredients that are not on the required testing panel.

Other cannabis markets have observed ongoing concerns of unlawful pesticide use outside of their regulated systems. Researchers in Canada conducted a large panel pesticide screen of products in the regulated system compared to illicit cannabis products seized in Canada (Gagnon, et al., 2023). They discovered that 6% of products from Canada's regulated system had pesticide residue at the method's lowest calibration level. The illicit cannabis samples "showed a striking contrast with a 92% sample positivity rate covering 23 unique pesticide active ingredients with 3.7 different pesticides identified on average per sample."

Separately, an investigative report by the LA Times discovered many incidents of pesticide contamination in products purchased at marijuana retail stores in California (Fonseca, 2024). Alongside that investigation, the LA Times also reported that California regulatory agencies had discovered unlawful pesticides at illicit grows that appear to have been allegedly smuggled into the country from China (St. John, 2024).

ANALYTE SELECTION CRITERIA

Several thousand compounds have been registered for use as pesticides. Given the technical challenges associated with detecting trace-levels of pesticides in cannabis, it is impossible to perform a comprehensive survey of all possible pesticides. We therefore chose to limit our attention to pesticides for which detections have been reported on cannabis.

The pesticide testing protocol involved two types of testing. The first screen is for a targeted list of pesticides that were chosen from three sources:

- The most common pesticides in compliance test failures in the OLCC market.
- The illicit pesticides that have been discovered to be in use on cannabis in California.
- The pesticides discovered during Canada's testing of illicit cannabis.

From these sources, we settled on a final list of 66 pesticides for targeted analysis (see Appendix A, Table A1). This final list includes 46 compounds that have been reported to OLCC since routine testing of cannabis was established, 14 compounds that have been reported in California, and eight compounds that have been reported in Canada. Reference standards were obtained for all 66 pesticides and were used to establish responses and retention time windows. This means we verified the presence of specific pesticides in a sample and measured how much of each pesticide was in it. This is done by comparing the test results to know reference materials that contain exact amounts of those pesticides. These reference standards help to ensure the test is accurate and reliable.

The second type of testing was a broader survey of additional pesticides for which we did not have reference standards. For this survey we utilized commercially available libraries of MS transitions and retention times. From the list of pesticides in the databases we excluded

most herbicides, defoliants, and fumigants. The HPLC method was based on the Agilent Applications Note: 5991-7193EN and the pesticide library was Agilent PN# 61733-60014. The final HPLC method included 152 pesticides. The GC method and library was based on Agilent PN# G9250-60018 and included 316 pesticides.

PESTICIDE TESTING METHODOLOGY

Cannabis flowers were frozen in liquid nitrogen and then ground to a fine powder using a mortar and pestle. A portion of the ground material was extracted using acetonitrile. The extract was filtered and then passed through a C18 solid-phase extraction cartridge to remove most of the chlorophyll, high molecular weight fats, and waxes. The final extract was analyzed using high-pressure liquid chromatography (HPLC) in reverse-phase mode with a C18 stationary phase and methanol/water as the mobile phase. Detection was performed using tandem mass spectrometry (MS) and MS transitions were chosen from a predefined library of pesticides. A portion of the samples were also analyzed using gas-chromatography (GC) with a DB-5 stationary phase and tandem MS for detection. See Appendix A for further detail regarding extraction and preparation of samples.

The instruments were set up as described in the application note (5991-7193EN for HPLC) and the GC library (G9250-60018 for the GC) and the retention times of the 46 target compounds were compared to the retention times listed in the libraries. The predicted retention times for the non-target compounds were adjusted using a non-linear regression model that was built from the observed versus library retention times for the 46 targeted compounds.

The samples were screened using the final method conditions and putative hits were identified using two MS transitions. Putative hits were confirmed or excluded after comparing retention times and MS transitions to reference standards that were purchased for each of the putative hits. It is important to note that, since we did not have reference standards for all the compounds in the survey, we could not demonstrate that all the compounds could be recovered from and detected in cannabis extracts. Therefore, there is a distinct possibility that, for some of the pesticides, we obtained a false negative where the compound may have been present, but we failed to detect it.

Although the original plan was to analyze all the samples by both HPLC and GC, we found that the GC analysis was heavily plagued by fouling of the instrument due to high levels of matrix related interferences. Ultimately, only a subset of the samples were analyzed by GC (Appendix A, Tables A2 and A3). For future work we plan on refining the sample cleanup to make them more amenable to analysis by GC.

PESTICIDE TESTING RESULTS

The most prominent finding was a cannabis sample having 3800 ppb of the insecticide imidacloprid. This level was well over the current State of Oregon action level of 400 ppb for cannabis. Except for this sample, the only detections on cannabis were for more innocuous compounds (DEET and PBO). In contrast, seven different pesticides were detected on the hemp samples. These compounds include six pesticides that are currently on the Oregon

analyte list and one pesticide, spirodiclofen, that is not on the current Oregon list but was included in the Canadian screen referenced above.

One of the more surprising observations was the widespread detection of the insect repellent DEET (*N*,*N*-diethyl-*meta*-toluamide) which was detected in 84% of the marijuana samples and in 73% of the hemp samples. The levels of DEET ranged from 1–48 ppb.

Table 1: Pesticide detected at levels ≥ 1 ppb excluding DEET (*N*,*N*-diethyl-*meta*-toluamide)

Sample ID	Type	Pesticide	Concentration (ppb)	Oregon Action Limit (ppb)
24B-667	Marijuana	Piperonyl butoxide	1	2000
24B-681	Marijuana	Piperonyl butoxide	27	2000
24B-705	Marijuana	Imidacloprid	3800	400
24B-651	Hemp	Bifenazate	27	200
24B-651	Hemp	Malathion	42	200
24B-710	Hemp	Chlorantraniliprole	76	200
		Spinosad	40	200
24B-711	Hemp	Spiromesifen	169	200
24B-713	Hemp	Spirodiclofen	2	NA
		Azoxystrobin	73	200

PESTICIDE TESTING CONCLUSIONS

Overall, the results of this study demonstrate the feasibility of performing survey screens for pesticides in marijuana and hemp. The majority of compounds that were detected are already on the current Oregon list. The only compounds that were detected and are not on the current Oregon list were spirodiclofen and DEET.[19] The DEET findings finding seems to corroborate a report in the Cannabis Industry Journal that found DEET present on all medical marijuana samples they tested (Mackowsky, 2016).

Considering the large number of pesticides that were not included in the survey and given that the current approach cannot prevent false negatives, the lack of detection of other pesticides should not be interpreted to mean that pesticides other than those on the current list are not being applied.

The CRL is implementing changes and improvements that will improve our ability to perform similar studies in the future. Such changes include improving the sample cleanup to minimize background interferences and incorporating use of HRAM (high resolution accurate mass) spectrometry. The observation of the spirodiclofen suggests that it may be prudent to consider whether to add spirodiclofen to the analyte list for compliance testing.

[19] Note: OHA periodically considers whether any analytes need to be added to or removed from Oregon's list. They may consider whether there is a basis to include these analytes in the future. See OAR 333-007-0400(3).

CANNABIS FLOWER POTENCY

The accuracy of labels on cannabis products is a national concern. OLCC has received many complaints, formally and informally, regarding concerns of products misrepresenting their cannabinoid concentration. A typical consumer likely equates higher THC results with cannabis flower being of higher quality or having a stronger intoxicating effect. However, intoxication from cannabis use is a complex phenomenon that is still being studied. There are many other chemicals present in cannabis flower which may also contribute to or mitigate the effects of THC. For example, CBD is not intoxicating by itself, but large amounts of CBD have been observed to increase intoxication from THC when consumed orally (Klein, et al., 2011). This is a subject that needs further study, but consumer perception has had a powerful effect on the cannabis industry in terms of price setting and marketing.

The consumer research company CBD Oracle has authored several reports highlighting ongoing issues with inaccurate and misleading cannabis product labeling. In 2021, CBD Oracle purchased 51 "hemp" products advertised as containing delta-8-THC and had these products tested by an independent cannabis testing laboratory. They discovered 76% of these items contained greater than the federal limit of 0.3% delta-9-THC for a hemp item (Johnson, 2021). In 2022, CBD Oracle tested 53 "hemp" products which advertised that they contained delta-9-THC and found that only 49% of the products were within 15% of the labeled potency (Johnson, 2022).

Colorado researchers in 2023 tested 23 samples of cannabis flower and found that approximately 70% of the samples had a total THC concentration more than 15% lower than the concentration advertised on the label (Schwabe, Johnson, Harrelson, & McGlaughlin, 2023).

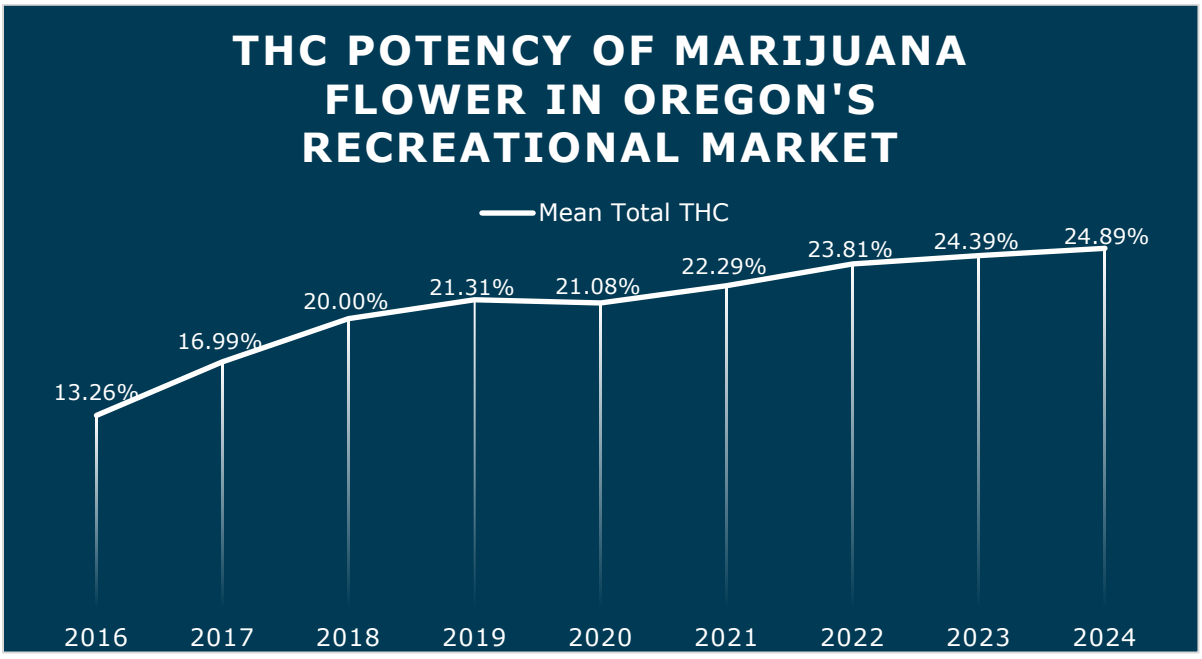


Figure 2. Mean total THC in flower categorized as "Buds" within CTS

In Oregon, CTS data shows there has been a steady increase in the average total THC concentration in marijuana flower categorized as "Bud" [20] over the past eight years.

This could be an indication of THC inflation[21] by licensees. This is an issue which has been widely reported to OLCC by marijuana licensees. Licensees face market pressure to report higher THC results in flower due to consumer preferences and financial incentives. Flower with higher reported THC potency tends to command premium prices (see The Power of Price on Potency, page 23). This can create pressure to intentionally manipulate the test results, including by manipulating the samples before they are tested. Over time, this trend can artificially elevate the reported average THC potency across the state, creating a feedback loop where licensees race to meet the new higher baseline THC potency to remain competitive. Another explanation for this increase would be that growers actively selected for marijuana strains which provide higher results. Both forces are likely at play.

CANNABINOID CONCENTRATION TESTING METHODOLOGY

Cured cannabis flowers were frozen with liquid nitrogen and processed to a fine powder using a mortar and pestle. Residual moisture was determined by measuring the weight of water lost upon drying at 80 °C until a constant weight was obtained. Total cannabinoids were solvent extracted from the ground flowers using methanol. Individual cannabinoids were detected using reverse-phase HPLC with diode-array detection. Quantification was performed by comparing responses against the responses of reference standards. See Appendix F for further details regarding cannabinoid concentration testing methodology.

HEMP FLOWER

LABEL AND THIRD-PARTY LABORATORY CLAIMS

All flower in this category purported to be "hemp" when purchased, typically referencing the federal definition: 0.3% delta-9-THC or less.[22] Four samples (7.8%) actually exceeded 0.3% delta-9-THC based on label claims or third-party laboratory test results and appear unambiguously to be marijuana under federal law. Another 36 samples (70.6%) did not exceed 0.3% delta-9-THC based on label claims or third-party laboratory test results. The remaining 11 samples (21.6%) were not accompanied by any specific claims about the concentration of delta-9-THC.[23]

Oregon regulations on the sale of hemp flower to Oregon consumers in the general market limit the allowable concentration of total THC, not only delta-9-THC. Specifically, usable

[20] This is the category name used in CTS to describe the most valuable part of harvested cannabis. "Bud" is trimmed cannabis flower which is sold to consumers and is usually intended for use by inhalation.
[21] A practice where the total THC concentration reported by laboratories overstates actual concentration of total THC in the batch. This can be a result of actions by the laboratory or their staff, the licensee who requested testing or their staff, or some combination of actions by multiple parties.
[22] The hemp industry typically takes the position that cannabis and products derived from cannabis are hemp as long as they do not exceed 0.3% delta-9-THC on a dry weight basis, regardless of the total THC concentration (citing to the definition in 7 USC 1639o). In contrast, the DEA has expressed their opinion that THCA "is equivalent to delta-9-THC" in this context: "Thus, for the purposes of enforcing the hemp definition, the delta-9-THC level must account for any delta-9-THCA in a substance" (Boos, Letter to Shane Pennington, 2024).
[23] For the purposes of this report, a statement on the label that the flower contains "less than 0.3% delta-9-THC" or similar language was not considered a specific claim in the absence of a COA or a specific concentration of delta-9-THC detected in the flower.

hemp and hemp cannabinoid product are limited to 0.3% total THC and are not permitted to contain ADCs.[24] Based on the label claims or third-party test results, the vast majority of the hemp flower samples we purchased, 78.4% (40 of 51), were prohibited for sale to an Oregon consumer: 7.8% (4 of 51) contained ADCs, and 70.6% (36 of 51) exceeded 0.3% total THC.[25] Only 21.6% of samples (11 of 51) appeared likely to be legal for sale to Oregon consumers based on the label claims and COAs.

In addition to the 11 samples (21.6%) that appear to be below Oregon's total THC threshold, four samples (7.8%) only slightly exceeded Oregon's total THC threshold for sale to consumers, purportedly containing more than 0.3% but less than 1% total THC. These products were likely not sold with the intention of producing significant intoxication. The remaining 36 samples (70.6%) are likely to be significantly intoxicating based on the concentration of total THC or the presence of ADCs.

Of the "THCA hemp" flower samples, 28 had associated label claims or test results indicating the total THC concentration.[26] These samples ranged from 17.9% to 38.6% total THC, with a mean of 24.7% total THC (standard deviation ±4.9%) and a median of 23.2% total THC.[27]

CRL RESULTS

All 51 samples of hemp flower tested by the CRL exceeded 0.3% total THC. Based on these results, all of this flower is prohibited for sale to Oregon consumers, ranging from 0.4% to 30.5% total THC.

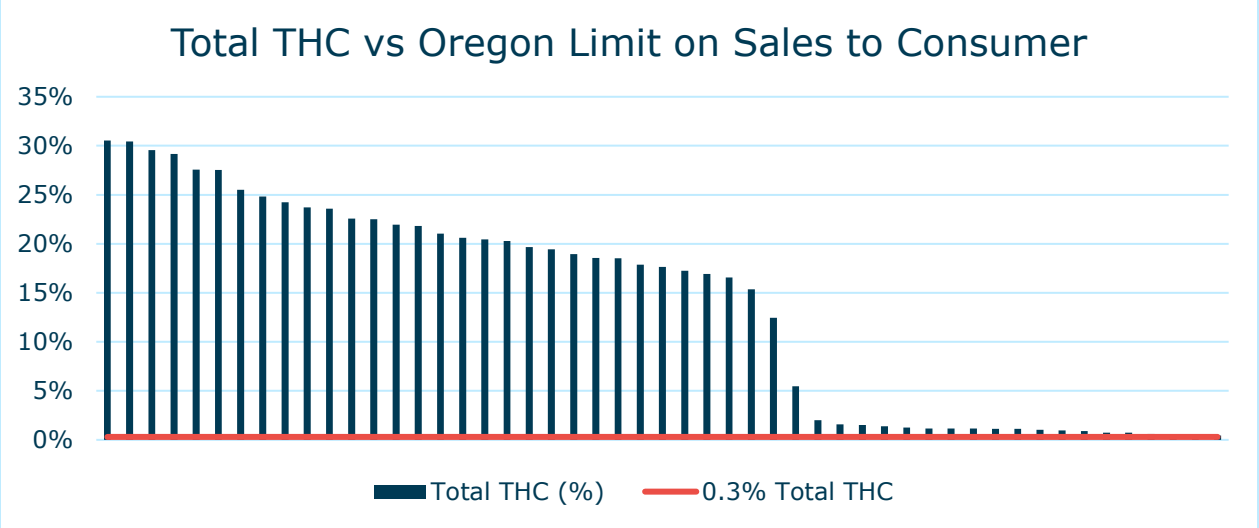


Figure 3. Total THC in "hemp" flower samples

[24] OAR 845-026-0400 and 845-026-0410 limit the concentration to 0.3%, but allow a 10% buffer for hemp flower to exceed this limit.
[25] For the purposes of this evaluation, products sold or marketed as "THCA hemp" or "THCA flower" were presumed to exceed 0.3% total THC even if the exact concentration of THCA or total THC was not specified.
[26] One sample purporting to contain 5.75% total THC and 12.74% CBD was excluded from this figure. While it contains substantially more THC than genuine CBD hemp flower, it represents a cannabis phenotype that is distinct from high-THC/low-CBD cannabis.
[27] Excluding three samples that were advertised as THCA flower but did not contain specific label claims about delta-9-THC or THCA concentration and did not have associated COAs.

Additionally, the majority of hemp flower tested by the CRL, 74.5% (38 of 51), contained more than 0.3% delta-9-THC. Cannabis flower that exceeds 0.3% delta-9-THC is unambiguously considered marijuana under federal law.

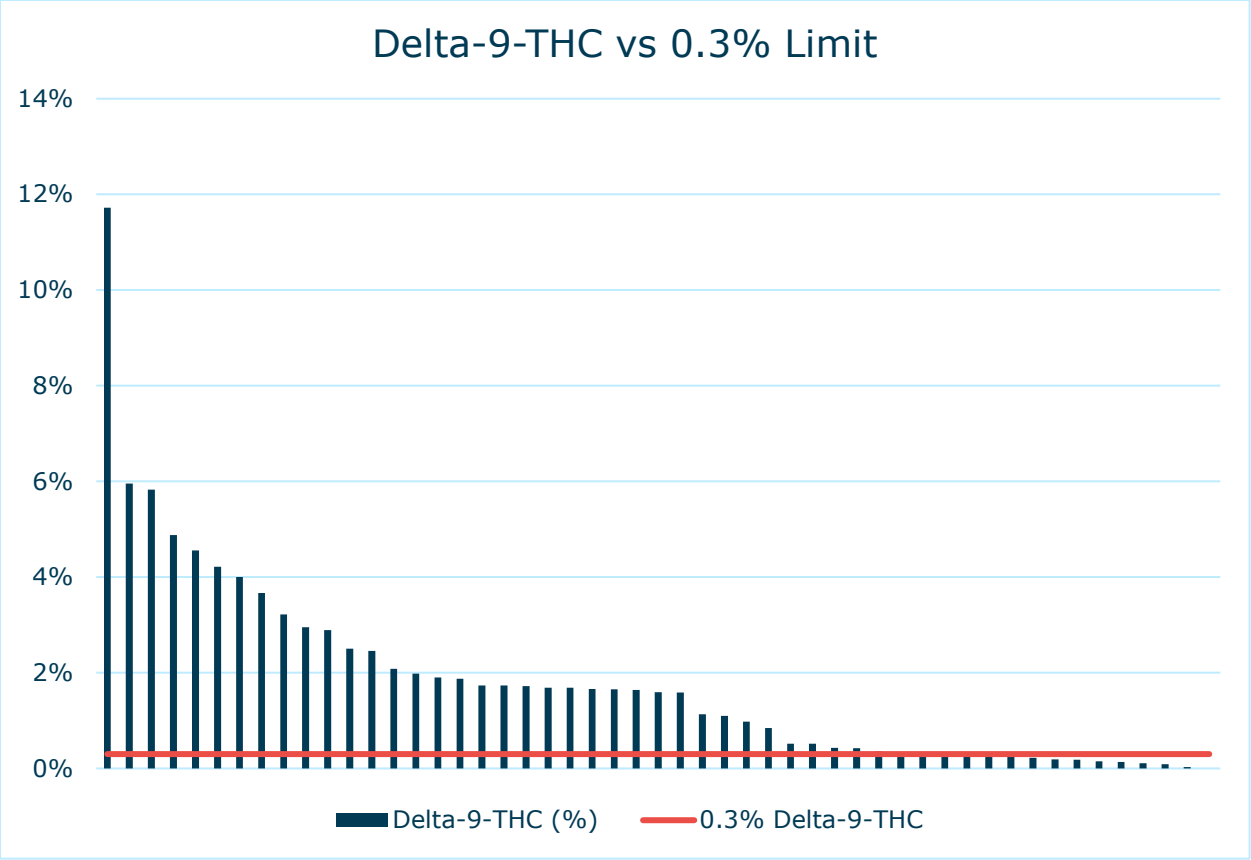


Figure 4. Delta-9-THC in "hemp" flower samples

It is worthwhile to note that cannabis flower is inherently heterogeneous. Different individual flowers ("buds") from the same harvest batch can have significantly different concentrations of delta-9-THC or total THC. It is possible that some of the hemp flower that exceeded 0.3% delta-9-THC came from a batch that legitimately tested below 0.3% as a batch-wide average based on representative sampling. If this was the case for any of the tested samples, it is not immediately clear what the implications would be for the legal category of the material. The DEA has suggested that the analysis of whether a cannabis material is hemp or marijuana based on the 0.3% threshold for delta-9-THC "is conducted separately for each substance, without regard to the delta-9-tetrahydrocannabinol concentration of the substances from which it is derived" (Boos, 2022). This could result in a curious situation where a batch of cannabis flower as a whole may be hemp because it does not exceed 0.3% delta-9-THC; but when divided into smaller increments for sale, some of those smaller increments may become marijuana under federal law if the individual increment exceeds 0.3% delta-9-THC, despite being derived from a batch that did not exceed 0.3% delta-9-THC.

It is also possible that some of the delta-9-THCA that was originally present in the samples decarboxylated into delta-9-THC after the manufacturer or distributor tested the flower. This can happen over time (see Time and Potency, page 26), likely depending on the conditions under which the flower was stored, especially if it was stored in an environment with significant fluctuations in temperature. In this case, the batch as a whole could have been hemp at the time it was tested, but it could have become marijuana under federal law in the interval between the time that the manufacturer or distributor tested the flower and the time that it was sold.[28]

While these factors may be relevant when considering specific samples of hemp flower individually, the data in aggregate paints a clear picture: The majority of flower that OLCC purchased as "hemp" was in fact marijuana under federal law. There may be additional factors that account for the discrepancy between the alleged delta-9-THC concentration and the concentration reported by the CRL. For example:

- Some of the flower may have been sold as less than 0.3% delta-9-THC on the basis of pre-harvest testing, without testing the delta-9-THC concentration of the finished flower. Pre-harvest testing typically happens a few weeks prior to harvest. Cannabinoid concentrations increase dramatically in these last few weeks (Oregon State University Southern Oregon Research and Extension Center, 2021).
- Some testing laboratories may be underreporting the delta-9-THC concentration when testing hemp flower. This could be intentional by the laboratory because it is likely to attract and retain clients who want test results showing their flower is hemp under federal law. It could also be unintentional, where the laboratory is unaware of the bias in their test results, but clients have identified the laboratory as a reliable source of test results showing low concentrations of delta-9-THC.
- When testing the flower, the manufacturer or distributor may be intentionally selecting samples that are likely to have lower concentrations of delta-9-THC than the batch as a whole. For example, they may send samples of less developed flowers with larger stems and with lower-potency fan leaves still intact.

The results from the CRL can be divided into four general categories:

Low THCA and low CBDA: This typically represents cannabis that is grown primarily for its total CBG[29] content. Based on CRL results, 5.9% of the hemp samples (3 of 51) fit in this category. Within this category, none (0 of 3) exceeded 0.3% delta-9-THC but all (3 of 3) exceeded 0.3% total THC.

Low THCA and high CBDA: This typically represents cannabis that is grown primarily for its total CBD[30] content. Based on CRL results, 21.6% of the hemp samples (11 of 51) fit in this category. Within this category, 55.5% of samples (5 of 11) exceeded 0.3% delta-9-THC and all (11 of 11) exceeded 0.3% total THC.

[28] Based on the theory that "hemp" is defined based exclusively on delta-9-THC concentration, without regard to THCA; see footnote 22, page 20.
[29] Cannabigerol (CBG), CAS # 25654-31-3 and cannabigerolic acid (CBGA), CAS # 25555-57-1 (see Appendix E)
[30] CBD (see footnote 13) and cannabidiolic acid (CBDA), CAS # 1244-58-2 (see Appendix E)

High THCA and low CBDA: This typically represents cannabis grown for its total THC content. While any consumer would perceive this type of flower as ordinary marijuana, some businesses sell it as "THCA hemp." Sellers purport that the flower is hemp under federal law as long as it does not exceed 0.3% delta-9-THC, regardless of the total THC concentration. Based on CRL results, 60.8% of the hemp samples (31 of 51) fit in this category. Within this category, all samples (31 of 31) exceeded both 0.3% delta-9-THC and 0.3% total THC.

Atypical: A few hemp samples, 11.8% (6 of 51) did not fit any of the ordinary categories. These atypical results divide into three distinct subcategories:

- **Artificially derived cannabinoids:** All of the hemp flower samples that were advertised to contain ADCs, including flower advertised as containing HHC, THCO,[31] or THCP,[32] contained significant levels of delta-8-THC. Based on CRL results, 7.8% of the hemp samples (4 of 51) fit in this category. Within this category, 25% of samples (1 of 4) exceeded 0.3% delta-9-THC and all (4 of 4) exceeded 0.3% total THC. All samples in this category also contained detectable amounts of delta-4(8)-*iso*-THC. Delta-4(8)-*iso*-THC is a cannabinoid derivative that does not occur in the cannabis plant but has been reported to occur when delta-8-THC is manufactured from CBD by acid-catalyzed isomerization (Geci, Scialdone, & Tishler, 2023).
- **High CBD and low CBDA:** One sample contained very high levels of decarboxylated CBD. This sample had a relatively low level of total THC, mostly in the form of THCA. This most likely represents CBG hemp flower to which decarboxylated CBD isolate has been added. This sample did not exceed 0.3% delta-9-THC but did exceed 0.3% total THC.
- **Intermediate CBD/THC:** One sample contained moderate amounts of THCA and CBDA, with approximately a 2:1 ratio of total CBD to total THC. Cannabis flower of this type is relatively uncommon within both the hemp market and the adult use marijuana market. This sample exceeded both 0.3% delta-9-THC and 0.3% total THC.

This breakdown is consistent with the different types of "hemp" flower that OLCC is familiar with being available in the market.

As shown in Figure 5 and Figure 6, there was significant deviation between the CRL results and the alleged total THC in the samples of "THCA hemp" (high THCA and low CBDA) that were accompanied by total THC claims suitable for comparison. On average, the alleged total THC concentrations were 17% higher (median 5% higher) than the CRL results. Interestingly, the majority of the discrepancies were in samples that the CRL found to contain less than 20% total THC. In samples with CRL results below 20% total THC, the alleged concentrations of total THC were on average 48% higher than the CRL results. In samples with CRL results above 20% total THC, the alleged concentrations of total THC were on average 0.6% lower than the CRL results.

[31] Delta-9-THC-O-acetate (delta-9-THCO), CAS # 23132-17-4 or delta-8-THC-O-acetate (delta-8-THCO), CAS # 23050-54-6 (see Appendix E)
[32] Tetrahydrocannabiphorol, CAS # 54763-99-4 (see Appendix E)

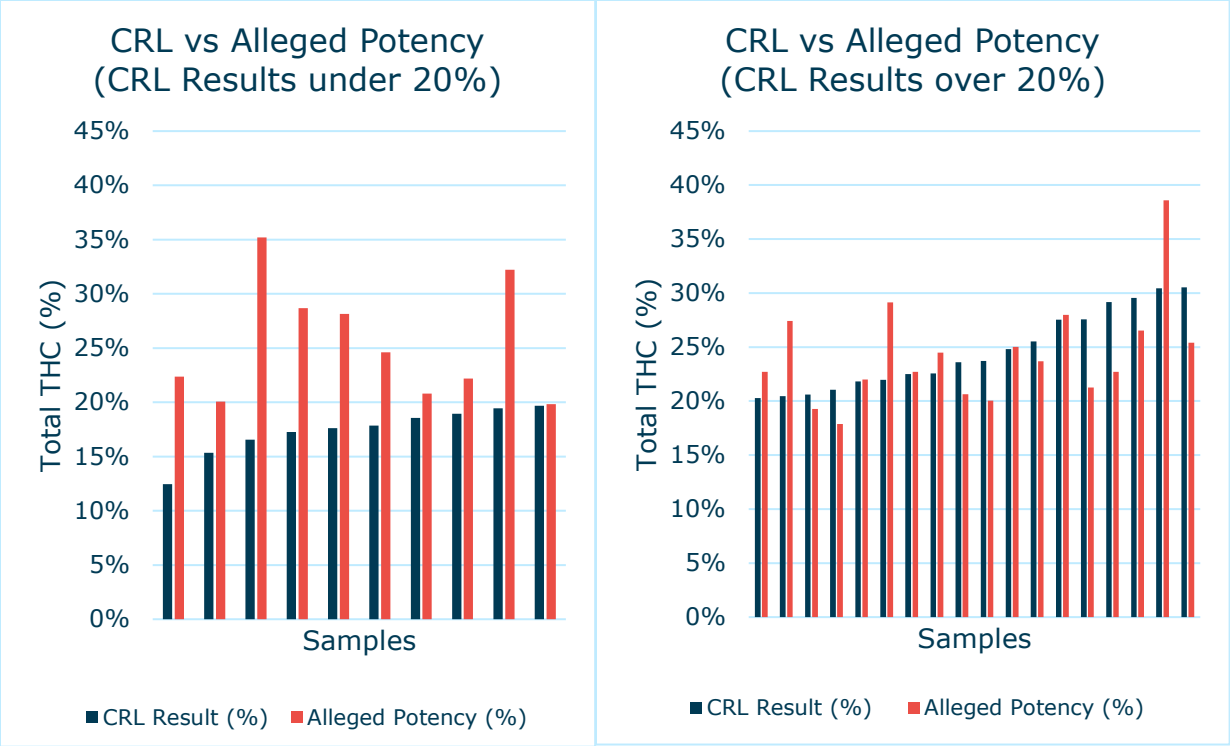


Figure 5. Total THC reported by CRL compared with alleged total THC concentration in "THCA hemp" flower samples

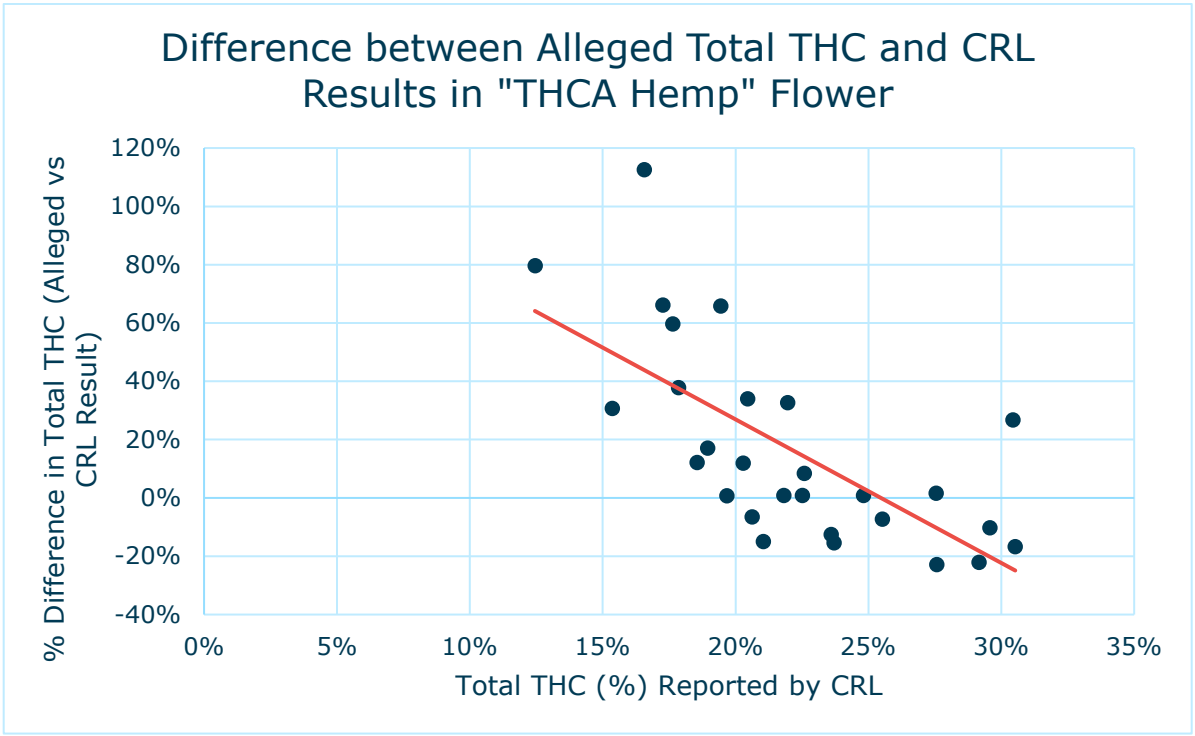


Figure 6. Difference between total THC reported by CRL compared with alleged total THC concentration in "THCA hemp" flower samples

These trends may indicate that the hemp market has a similar pressure to report at least 20% total THC as a threshold to enter the market, but that above this threshold there is less price pressure correlated to the concentration of THC. Additional data on the market dynamics of "THCA hemp" would be useful in testing this hypothesis.

MARIJUANA FLOWER

The average potency reported by third-party laboratory compliance testing for the 50 marijuana samples was 24.9% total THC according to CTS data. The CRL test results showed the average potency for these samples was 22.5% total THC.

CRL RESULTS

The majority (72%; 36 of 50) of results reported by OLCC-licensed third-party testing laboratories were higher than the CRL test results. On average, the third-party laboratory results were 13.0% higher relative to the CRL results with a standard deviation of ±19.4%. In absolute percentage points, the average difference between the third-party results and the CRL results was +2.4% (standard deviation ±4.1%) total THC.

The difference between potency reported by the CRL and potency reported by third-party laboratories has substantial financial implications for the cannabis industry (see The Power of Price on Potency, page 23). Producers and wholesalers have a strong incentive to obtain the highest possible result for each batch of flower and laboratories have a strong incentive to provide higher results in order to attract and retain clients.

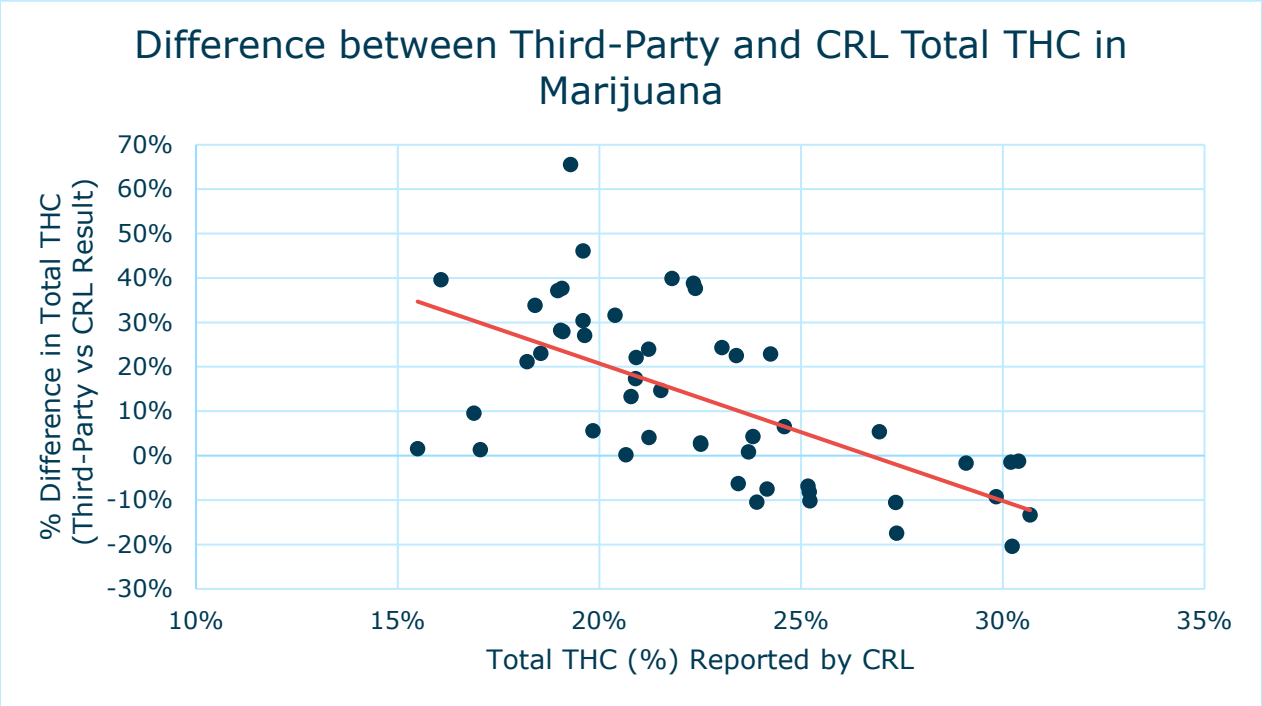


Figure 7. Difference between total THC reported by CRL compared with third-party laboratory results in marijuana flower samples

In 2024, OLCC issued administrative notices to several licensees and employees of licensees, including laboratory licensees, alleging improper sampling or adulterating samples prior to testing. This alleged violative sampling is only one of many possible methods by which a testing laboratory could produce results that skew higher than the actual average potency of the batch. Other forms of THC manipulation may also be occurring and are generally difficult to detect.

THE POWER OF PRICE ON POTENCY

Regulators have received many complaints from the industry regarding the strong influence of potency test results on cannabis flower prices set by wholesalers and retailers. As a result, producers reportedly feel significant pressure to have their cannabis be tested and labeled with the highest possible THC results to ensure a marketable crop at a competitive price point.

SALES VOLUME BY TOTAL THC

In order to investigate this claim, we reviewed CTS sales and THC potency data for all sales of marijuana categorized as "Bud" to consumers at retail locations in 2024. We restricted the query to sales of cannabis in quantities of less than an ounce to avoid introducing the variable "bulk" discounting practices on the data.

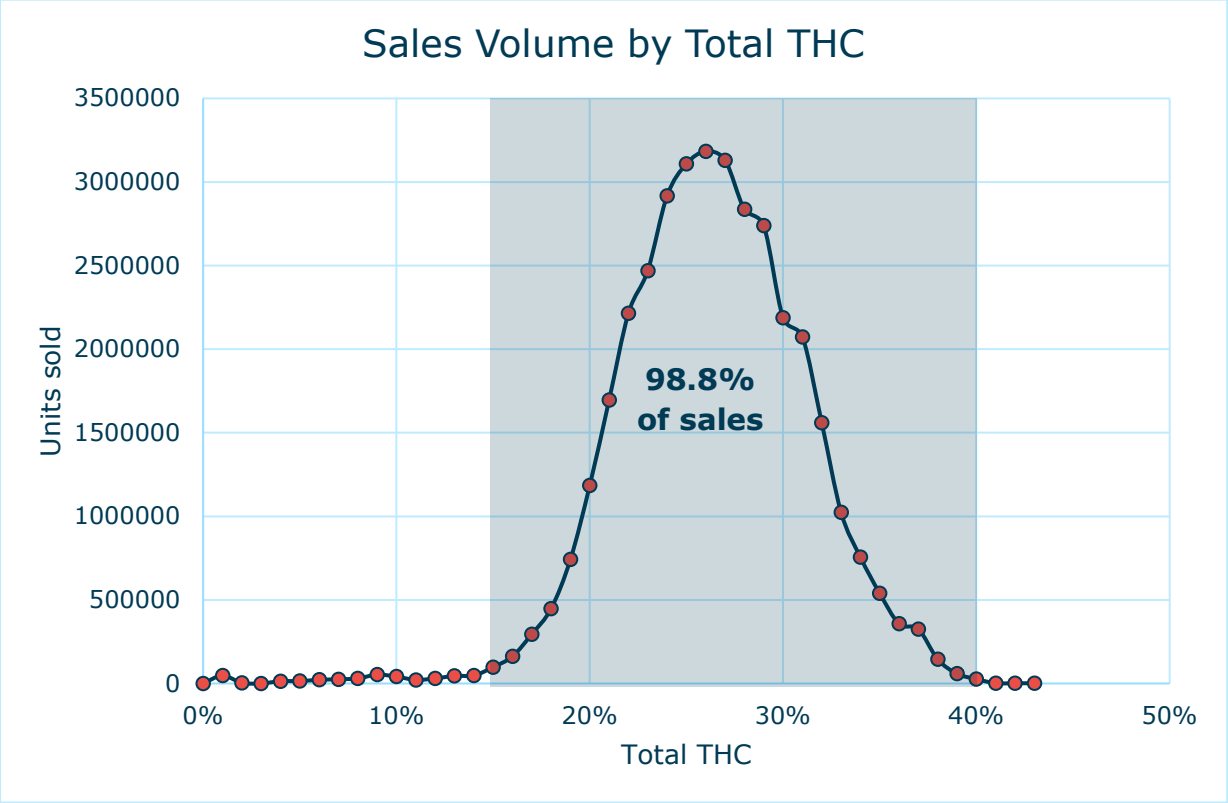


Figure 8. Sales volume of "Buds" by total THC concentration

We found that 98.8% of all units sold had total THC potency between 15–40% and that 92.9% of all units sold had total THC potency of 20% or greater. This seems to broadly corroborate the claim that lower THC flower has far more limited sales potential.

AVERAGE PRICE PER GRAM OF FLOWER BY TOTAL THC

We then reviewed the average price of each unit sold within each reported increment of 0.1% total THC. For example, among the 1,258,421 sales from packages of marijuana flower that had 25.9% total THC, the average price per gram was $4.75. When viewed in aggregate, this data tells a compelling story (Figure 9).

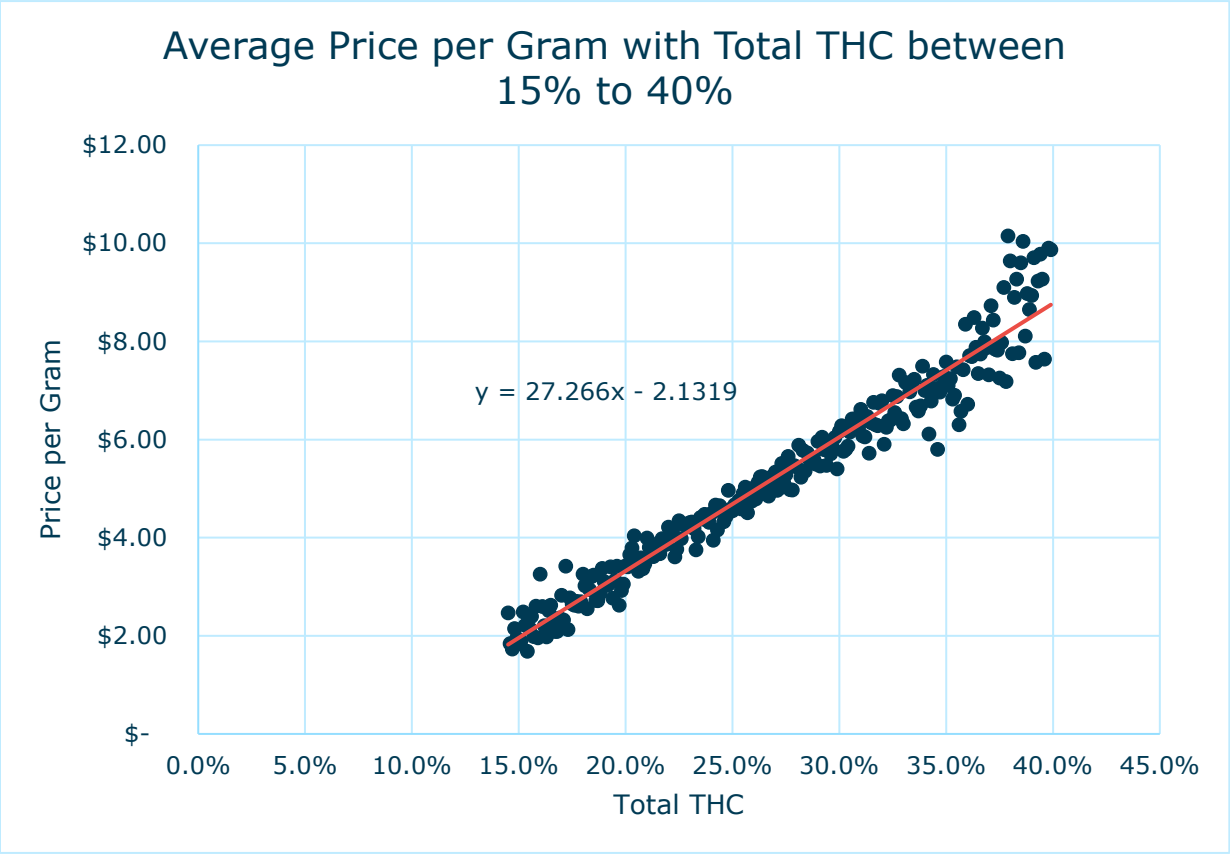


Figure 9. Average price per gram by total THC concentration from 15% to 40%

The correlation between reported total THC concentration and sale price is stark. While marijuana licensees differentiate their flower harvests through many different means (brand, strain, terpene profile, harvest date, etc.), it seems that total THC content has an extremely strong effect on retail pricing. On average, based on the fit line on Figure 9, each additional percentage point of total THC could translate to an additional $270 of retail sales per kilogram of flower. This finding is consistent with what licensees have reported to OLCC.

COMPARISON WITH CRL RESULTS

In collecting and testing packages for Operation Clean Leaf, we sought to evaluate the reported potency advertised on the label (based on compliance testing with OLCC-licensed third-part testing laboratories) compared with the potency observed when testing the

products at the CRL. This also allows for comparison of the relative accuracy of marijuana products within the OLCC market to hemp products sold in the general market.

Comparing the results of CRL testing for total THC with the third-party laboratory results for marijuana flower shows discrepancies that are consistent with the observed pricing and sales trends. Among relatively lower-potency marijuana samples – samples that the CRL found to contain less than 20% total THC – the discrepancy between the results from the third-party laboratory and the CRL was much larger (mean and standard deviation +27.3% ±17.1%). Among higher-potency marijuana samples – samples that the CRL found to contain more than 20% total THC – the average discrepancy between the results from the third-party laboratory and the CRL was smaller (mean and standard deviation +6.2% ±16.7%).

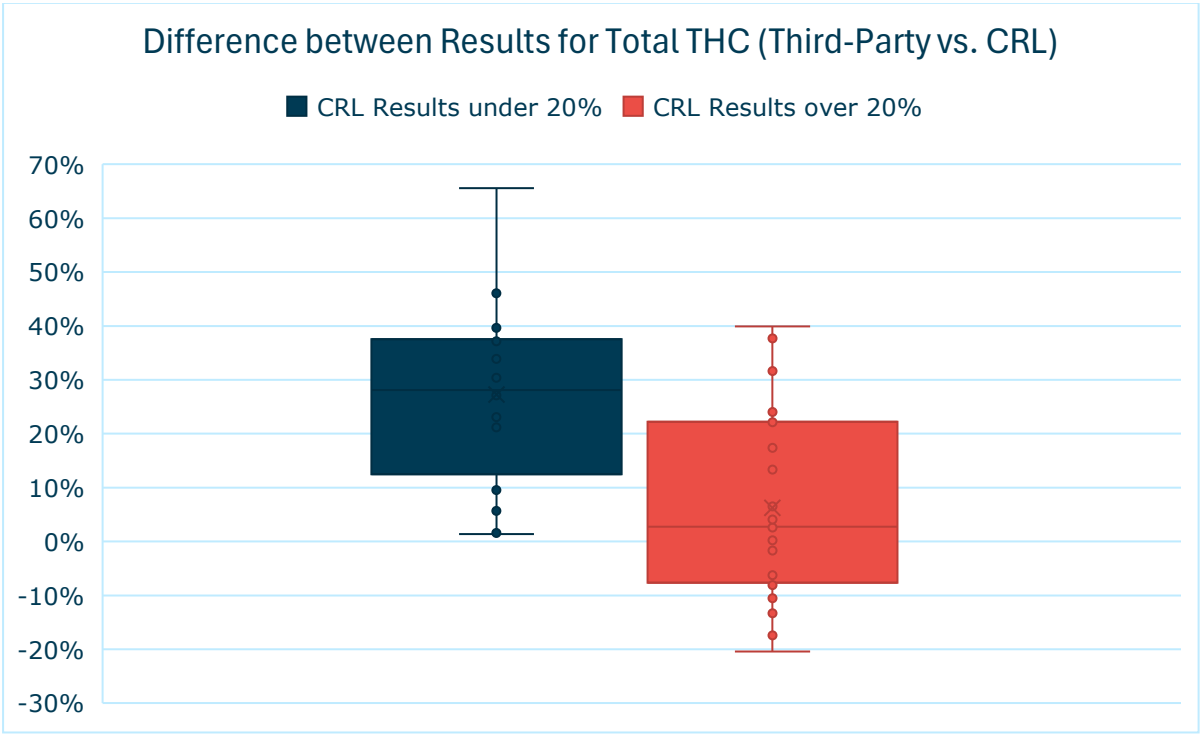


Figure 10. Difference between total THC reported by third-party laboratory compared with CRL results in marijuana flower samples

When reviewing this data, we wanted to compare it to the hemp flower samples that are sold as "THCA hemp" flower (page 20). Of the 31 hemp flower samples in this category, 28 had alleged concentrations of total THC on their labels, on the websites the samples were purchased from, or on COAs associated with the sample. This alleged potency information was compared with results from the CRL.

There is a substantial difference in the discrepancies between alleged potency and CRL results for lower-potency samples compared with higher potency samples. Among the relatively lower-potency "THCA hemp" – samples that the CRL found to contain less than 20% total THC – the discrepancy between the alleged potency and the results from the CRL was much larger (mean and standard deviation +48.2% ±34.7%). Among higher-potency

"THCA hemp" – samples that the CRL found to contain more than 20% total THC – the discrepancy between alleged potency and the results from the CRL was smaller (mean and standard deviation −0.6% ±17.6%).

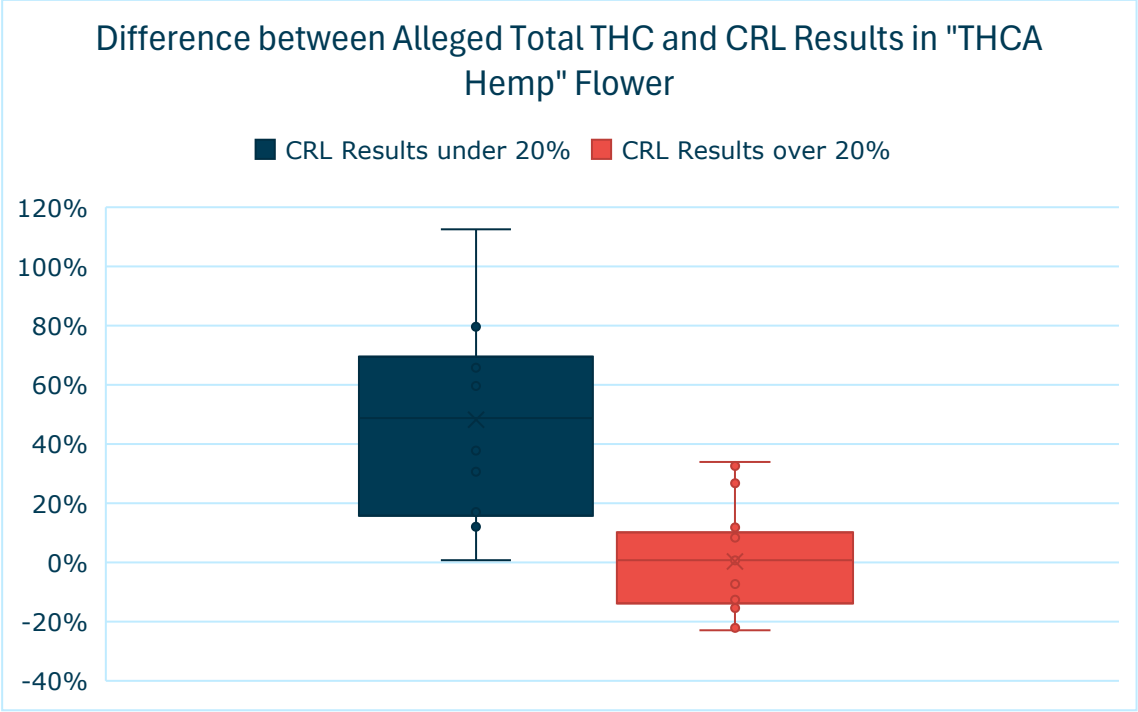


Figure 11. Difference between total THC reported by CRL compared with alleged total THC concentration in "THCA hemp" flower samples

TIME AND POTENCY

There are potentially innocuous reasons why the CRL results may be lower than the results of third-party laboratories. The total THC concentration in cannabis flower may degrade over time during storage, depending on storage conditions. This phenomenon has not been well studied, and it is not possible at present to estimate the effect of time and storage on cannabinoid concentration over time. Zamengo, et al. (2019) found that THC degraded significantly over time in flower and concentrates, while Davkova, et al. (2023) reported that storing flower at 104 °F and 75% relative humidity for three months actually increased the total THC concentration in the samples while resulting in significant decarboxylation of THCA to delta-9-THC.

To evaluate the influence of decarboxylation and degradation of THC over time in this data, we noted the amount of time that elapsed between the initial third-party testing reported in CTS and the testing performed by the CRL. First, we compared the change in the proportion of decarboxylated THC[33] between the third-party laboratory results and CRL results, plotted as a function of the time elapsed between the tests, to evaluate decarboxylation of THCA to delta-9-THC over time.

[33] The proportion of decarboxylation was calculated as [delta-9-THC]÷[total THC]. The change in decarboxylation was calculated as the difference of the proportion of decarboxylation in the CRL results and in the third-party laboratory results.

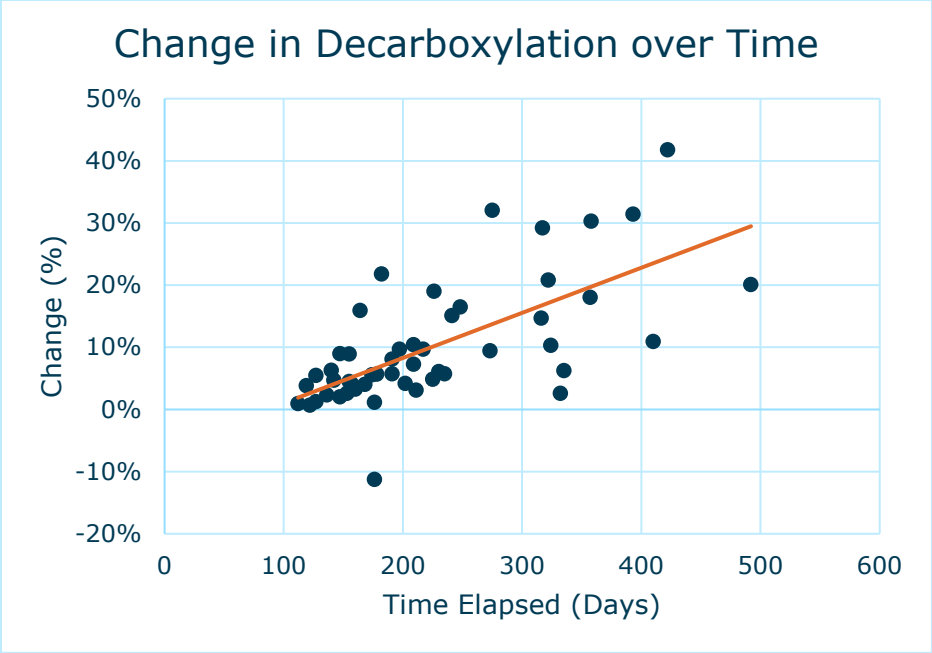


Figure 12. Change in proportion of decarboxylated THC over time

Predictably, there appeared to be a relationship between time elapsed between tests and the conversion of THCA to delta-9-THC, represented in Figure 12 as the change in the ratio of delta-9-THC to total THC between the third-party laboratory test and the CRL test. However, when we compared the time elapsed between tests against the change in total THC, there was no significant relationship (Figure 13).

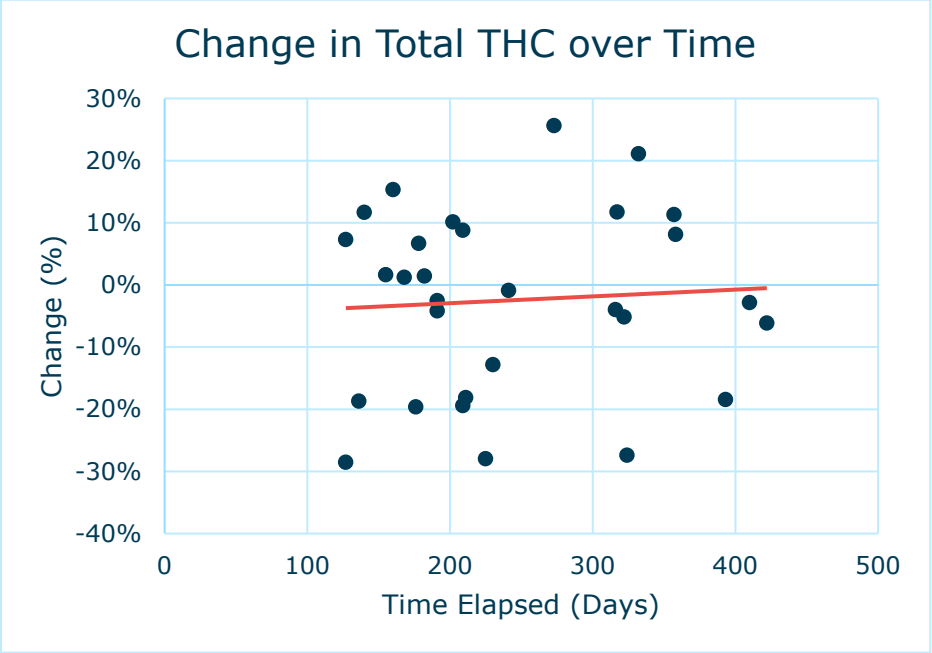


Figure 13. Change in total THC over time

If total THC degrades significantly as a function of time, this effect appears to be entirely drowned out by other factors in this data set. Differences in testing methodology and representativeness of samples between the CRL and third-party laboratories may be significant confounding factors. If so, it is very interesting that this effect is strong enough to obscure any correlation in the change in total THC over time but not in the decarboxylation of THC over time.

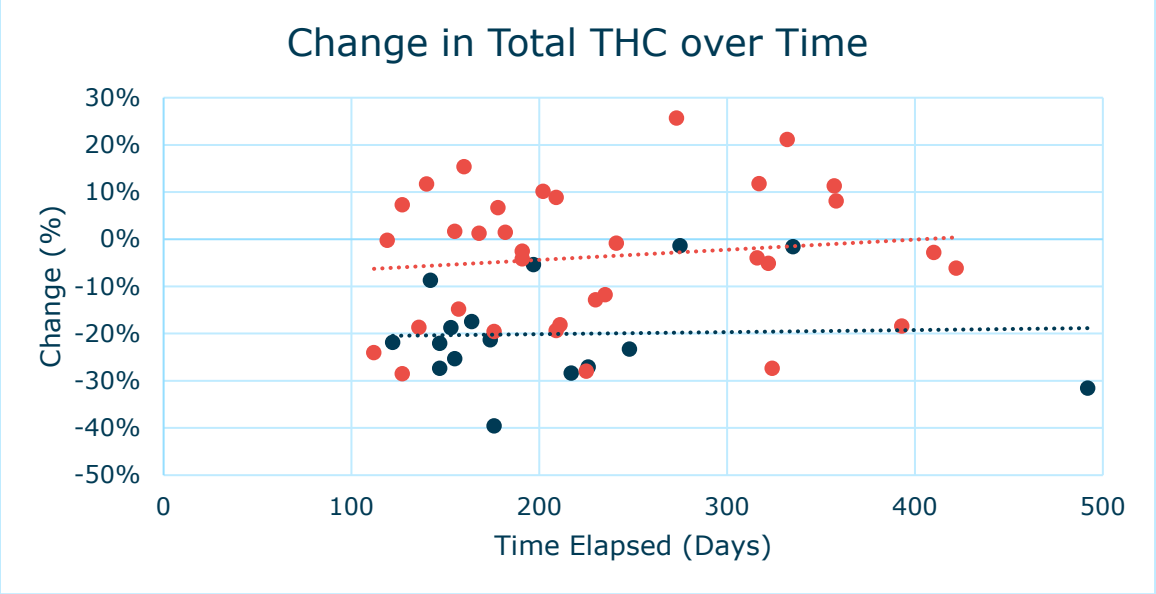


Figure 14. Change in Total THC over Time separating the greater than and less than 20% populations

The average age of samples in the two populations are similar, with the higher-potency samples skewing slightly older based on elapsed time between the original compliance test and the CRL test:

- **Under 20% total THC:** Median time elapsed 175 days; mean time elapsed 211 days with standard deviation of ±94 days. Very little correlation between percent change in total THC and elapsed time (r^2 = 0.0014 for the best fit line).
- **Over 20% total THC:** Median time elapsed 209 days; mean time elapsed 233 days with standard deviation of ±90 days. Very little correlation between percent change in total THC and elapsed time (r^2 = 0.0179 for the best fit line).

WHAT DOES THIS MEAN?

Initially, when viewing the marijuana data in a vacuum, one hypothesis was that Oregon's oversupply of marijuana created intense competition for market share, exerting increased pressure to inflate potency results on marijuana flower (Oregon Liquor and Cannabis Commission, 2023). That pressure would be especially high on lower the potency flower batches which would have difficulty securing space on retail shelves. However, in light of the hemp data, it seems there are similar forces at play in both the Oregon marijuana market and the national hemp flower market. This could be an indication that the pressure for flower to test above 20% total THC is reflective of broader cannabis consumer preferences at the national level.

HEMP EDIBLES

Fifty samples of cannabinoid edible products sold as "hemp" were purchased for analysis. OLCC reviewed these products based on their packaging and labeling and submitted them to the CRL for potency testing. With the exception of three products that appeared to be Skittles candies infused with cannabinoids, all products were in the form of "gummies."

EDIBLE PACKAGING AND LABELING

Generally speaking, hemp products for sale to consumers in Oregon outside of the OLCC market are not required to be packaged or labeled in a specific manner.[34] Within the OLCC market, all cannabis products that are sold to consumers, including hemp products, must meet certain packaging, labeling, and testing requirements. OLCC staff reviewed the packaging and labeling of each hemp edible sample in comparison with the established standards for regulated marijuana products and hemp products sold in the OLCC market. This was done via physical inspection of each product's packaging and labeling and submitting all samples for potency testing[35] conducted by the CRL. A standardized rubric was created to evaluate the hemp products across specific criteria. Three samples were unavailable during the review process and were not evaluated on some criteria.

Edible Package Review Methodology

OLCC staff consisting of the Hemp & Cannabinoid Compliance Coordinator, Packaging and Labeling Specialist, Laboratory Compliance Coordinator, and Hemp and Laboratory Regulatory Specialist – with over thirty years of combined experience in cannabis product regulation – evaluated the samples using a pre-built rubric to gather information across the following categories:

- **Child Resistance:** Cannabis products in the OLCC market are required to submit documentation that the package has been certified as child resistant as defined by 16 CFR Part 1700[36] by a qualified third-party child-resistant package testing firm. If the package does not meet these standards, the label must have the warning "This package is not child resistant." OLCC staff have familiarity with products that are sold in child resistant packaging, however, it should be noted that OLCC staff are not experts in this area and relied on physical inspection and experience.
- **Appealing to Minors:** We evaluated the label and product separately for their attractiveness to minors as defined in OLCC's administrative rules.[37] Examples include cartoons (as defined in OLCC rules), images of minors, and designs or brands of non-cannabis products that are marketed to minors. Products were also evaluated under OLCC rules as to whether they would be attractive to minors, primarily as to whether they resembled a non-cannabis consumer product primarily consumed by and marketed to children.[38]

[34] "Industrial hemp-derived vapor items" are an exception (ORS 475C.600 to 475C.684; OAR 845-026-7000 to -7070), but no industrial hemp-derived vapor items were examined in this study.
[35] Testing for delta-9-THC, delta-9-THCA, delta-8-THC, CBD, and CBDA
[36] 16 CFR Part 1700 -- Poison Prevention Packaging
[37] OAR 845-025-1015(5) and (17)
[38] OAR 845-025-3220

Figure 15. An observed example of gummy rings

- **Clear Potency:** We evaluated whether the label made a claim about its cannabinoid concentration such that layperson could reasonably understand what they were consuming. Products that used the Greek letter delta (δ or Δ) to identify the active ingredient were not considered to be sufficiently clear for us to mark the item as having a clear potency for the scoring matrix. Separately, Appendix D includes photos of the labels and our interpretation of the label claim so that we could evaluate the claim against the CRL results in "Label Claims vs CRL Results."

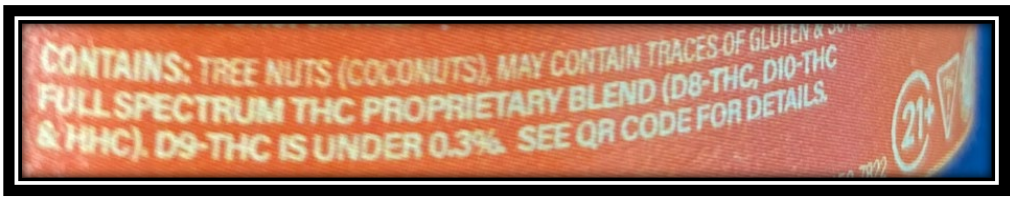


Figure 16. An example of a product with an unclear potency claim.

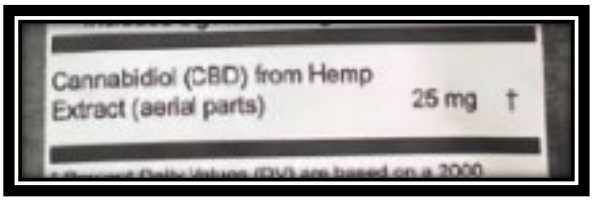


Figure 17. An example of a clear potency claim

- **Identified Serving Size:** This category was used to indicate whether the label contained language that clearly described what quantity or portion of the product was intended to be consumed as a single serving.

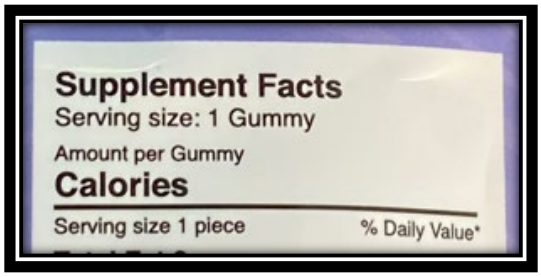


Figure 18. An example of a clearly identified serving size

- **ID Verification at Sale:** This category was used to indicate whether ID verification was required to purchase the sample.[39] Online websites requiring you to push a button claiming you are over 18 or 21 were not considered age verification. If the online retailer required sending a photo of a valid ID or used a third-party service to verify a valid ID, this was considered an age verification process.
- **Health Claims:** This category was used to note the presence of any claim made on the label that expressly states or implies a relationship between a substance and a disease or health-related condition.
- **Ingredient Listing Type (Food vs Dietary Supplement):** We noted which labels appeared to list ingredients with a traditional food label or a dietary supplement label. This paper does not weigh in on any legal issues surrounding these templates, but added this information because it may provide more information to consumers and potentially impacts disclosure of major allergens.

Figure 19. Examples of observed supplement (left) and food (right) labels

- **Prohibited Ingredients:** When ingredients were listed, we evaluated if any of the listed ingredients would be prohibited in cannabis products sold in the OLCC market. Examples of prohibited ingredients in the OLCC market include nicotine and melatonin.[40] While ADCs are prohibited for sale to Oregonians, we did not consider the presence of those in this category. Instead, we listed products found to contain ADCs under "Prohibited Potency.
- **Prohibited Potency:** This category was used to identify products that either appear to contain ADCs or that exceed the THC limits established by OLCC for hemp products based on the label claims.[41]

[39] OAR 845-025-2820 - Retailer Operational Requirements (contains list of valid ID for purchase of marijuana in Oregon)
[40] OAR 845-025-1015(1) and 845-025-3220(3)
[41] OAR 845-026-0400 and OAR 845-026-0410 for sales to adults in the general market

- **Warning Statements:** For this category, we did not evaluate the labels to see if their warning statements matched OLCC requirements, but instead looked for any warnings that may reasonably alert a consumer to the potential intoxicating nature of these products. For example, "For use only by adults 21 and older" and "Do not operate heavy machinery."
- **Warning Symbol:** Whether the label included any generally recognized warning symbol that appears to warn the consumer the product contained cannabis or THC. We did not consider "21+" in and of itself to be a warning symbol.

Figure 20. Examples of observed warning symbols

CHILD RESISTANCE

56% of products (27 of 48) had some form of child-resistant packaging. Of products with potency levels that are prohibited for sale in Oregon (based on label claims), 35% (12 of 34) lacked child-resistant packaging. There was a correlation between child-resistant packaging and products prohibited for sale to Oregon consumers (65% of prohibited potency products vs 33% of non-prohibited products).

Oregon researchers revealed that rates of child poisonings substantially increased after the allowable potency limits for marijuana edibles doubled in 2022 (Dilley, Hendrickson, Everson, & Jeanne, 2024). This underscores the need for safe packaging of intoxicating products as a means of promoting public health and safety.

APPEALING TO MINORS

36% of products (18 of 50) were found to have a label or product shape (or both) that was attractive to minors. For example, the packaging and label of sample 24B-568 is clearly meant to be an imitation of "Trolli" gummy candy which is a candy marketed to minors.

Figure 21. A photo of sample 24B-568 (left) next to an image of Trolli Strawberry Puffs (right) packaging (Ferrara Candy Company, 2025)

OLCC believes these products pose a threat to minors due to their "lookalike" nature. It is reasonable to assume that consumers, especially children, could misunderstand the intoxicating nature of the product, which increases the likelihood of child poisonings.

PRODUCT CATEGORIES

Conventional foods and dietary supplements are subject to different labeling requirements when regulated by the U.S. Food and Drug Administration (FDA) in interstate commerce. While the ODA Food Safety program is prohibited from considering hemp to be an adulterant in foods,[42] the FDA has clearly stated that CBD and THC are prohibited in both conventional foods and dietary supplements in interstate commerce.

Of the products reviewed, 56% (27 of 48) were labeled as conventional foods and 21% (10 of 48) were labeled as dietary supplements. The remaining 23% (11of 48) were not clearly labeled as either conventional foods or dietary supplements.

DOSAGE AND SERVING SIZE

It is important for consumers to be able to readily identify what substances are present in a product and in what quantity. Labels on the hemp edibles we evaluated frequently obscure this information. Common issues include:

- Advertising the dose without specifying whether this is the dose per serving or the total amount present in the entire container.
- Only specifying the amount of "full spectrum hemp extract," "broad spectrum hemp extract," or some other ingredient or mixture of ingredients, without specifying how much of any particular cannabinoid is present.
- Multiple different serving sizes listed on the same product. For example, the nutrition panel says the serving size is "1 gummy" but elsewhere the directions say to "start with half."
- Use of the Greek letter delta (δ or Δ). While the product manufacturers are familiar with this symbol, it may not be recognizable to the average consumer.

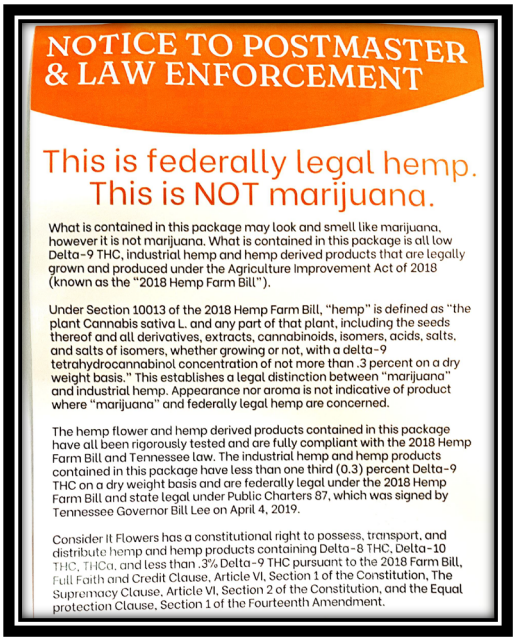
POTENCY TESTING INFORMATION

Most websites and many labels claim the product is tested by a third-party laboratory, but finding the results of these alleged tests often proved difficult to impossible. While many products include a quick-response (QR) code on the label that purports to link to test results, very few of these QR codes actually function as a consumer would expect. Many are broken links. When a link works, it typically takes the consumer to a website with dozens of test results for a wide variety of products, or to the manufacturer's home page, rather than to the specific certificate of analysis (COA)[43] for the product in hand. Many web sites have a long list of COAs available, but the product name on the website often does not match the product description on the COA, making it difficult to determine whether the product in question is listed on the test results page at all.

[42] In this context, "food" encompasses both conventional foods and dietary supplements.
[43] In this report, the term "COA" is used specifically to refer to a report containing laboratory results from third-party laboratory testing; we do not use it to refer to test results reported by the CRL.

Additionally, 60% of products (29 of 48) do not provide a lot number or batch number on the label. Without a lot or batch number, a consumer cannot be certain whether the test results they are looking at – if they are able to locate any results – correspond to the lot or batch of the product they purchased. Even when a lot or batch number is present on the product, the test results do not necessarily contain the lot or batch number. Some manufacturers only have one set of test results for a product, which could indicate that they only tested a single lot or batch and do not routinely test subsequent lots or batches.

Occasionally an online retailer would include a COA with the product they shipped. On several occasions this COA was for hemp flower (presumably the flower used to manufacture the product) rather than for the product itself. Most products were shipped with some kind of statement to the shipper (USPS, FedEx, UPS) that the item was compliant with the 2018 Farm Bill and was legal to ship to all states.


NOTICE TO POSTMASTER & LAW ENFORCEMENT

This is federally legal hemp.
This is NOT marijuana.

What is contained in this package may look and smell like marijuana, however it is not marijuana. What is contained in this package is all low Delta-9 THC, industrial hemp and hemp derived products that are legally grown and produced under the Agriculture Improvement Act of 2018 (known as the "2018 Hemp Farm Bill").

Under Section 10013 of the 2018 Hemp Farm Bill, "hemp" is defined as "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 .3 percent on a dry weight basis." This establishes a legal distinction between "marijuana" and industrial hemp. Appearance nor aroma is not indicative of product where "marijuana" and federally legal hemp are concerned.

The hemp flower and hemp derived products contained in this package have all been rigorously tested and are fully compliant with the 2018 Hemp Farm Bill and Tennessee law. The industrial hemp and hemp products contained in this package have less than one third (0.3) percent Delta-9 THC on a dry weight basis and are federally legal under the 2018 Hemp Farm Bill and state legal under Public Charters 87, which was signed by Tennessee Governor Bill Lee on April 4, 2019.

Consider It Flowers has a constitutional right to possess, transport, and distribute hemp and hemp products containing Delta-8 THC, Delta-10 THC, THCa, and less than .3% Delta-9 THC pursuant to the 2018 Farm Bill, Full Faith and Credit Clause, Article VI, Section 1 of the Constitution, The Supremacy Clause, Article VI, Section 2 of the Constitution, and the Equal protection Clause, Section 1 of the Fourteenth Amendment.

Figure 22. An example of a notice to mail carriers regarding the legality of the product

HEMP EDIBLE POTENCY

LABEL CLAIMS

Edibles with Prohibited Potency

Of the samples purchased, 70% (35 of 50) were prohibited for sale to Oregon consumers based on the labeled potency or information linked to the samples on the websites from which the products were ordered.

Only one edible product appeared to exceed 0.3% delta-9-THC based on its label claims: Sample 24B-605 claims to contain 3600 mg delta-9-THC in a product weighing 75 grams, which translates to a concentration of 4.8% delta-9-THC, despite the claim on the back of the package that the product "contains a total tetrahydrocannabinol concentration that does not exceed 0.3%."

Discrepancy between Label Claims and Product COAs

Only 10% (5 of 48) of the edible packages had clear potency listed on the label and an actual clear link to the product's COA. Among products where a corresponding COA was able to be located, the results on the COA often differed from the label claim by a significant amount. For example:

- **Sample 24B-581:** The label claims the product contains 10 mg delta-9-THC each and 15 mg CBD each. The label shows each serving is 4 grams. The COA sent with the product shows each serving is 4.5 grams and contains 8.735 mg/serving of delta-9-THC and 0.405 mg/serving of CBD.
- **Sample 24B-656:** The label claims the product contains 10 mg delta-9-THC per serving. The label also shows each serving is 4 grams. The COA provided with the product states the items contain 2.98 mg/g of delta-9-THC. In a 4 gram serving, this is nearly 20% more than the label claim (11.92 mg/serving delta-9-THC).

Having a THC potency higher than the consumer expects could result in greater levels of intoxication especially in novice users and users with lower tolerance to THC.

CANNABIS REFERENCE LABORATORY RESULTS

Edibles with Prohibited Potency

Results from the CRL substantiated that many of these products are prohibited for sale in Oregon. Hemp products sold to Oregon consumers age 21 and over are limited to no more than 2 mg delta-9-THC per serving and no more than 20 mg delta-9-THC per container. Of the 50 edibles tested:

- 21 samples (42%) exceeded the 20 mg per container limit, often by a significant margin. Among the products with a quantifiable concentration of delta-9-THC, the amount per package ranged from 2 mg on the low end to 331 mg on the high end (mean 86 mg, median 56 mg).
- 25 samples (50%) exceeded the 2 mg per serving limit, often by a significant margin. Among the products with a quantifiable concentration of delta-9-THC, the amount per package ranged from 0.2 mg on the low end to 25.5 mg on the high end (mean 7.6 mg, median 7.8 mg)
- Overall, 26 samples (52%) exceeded one of these two limits on delta-9-THC.

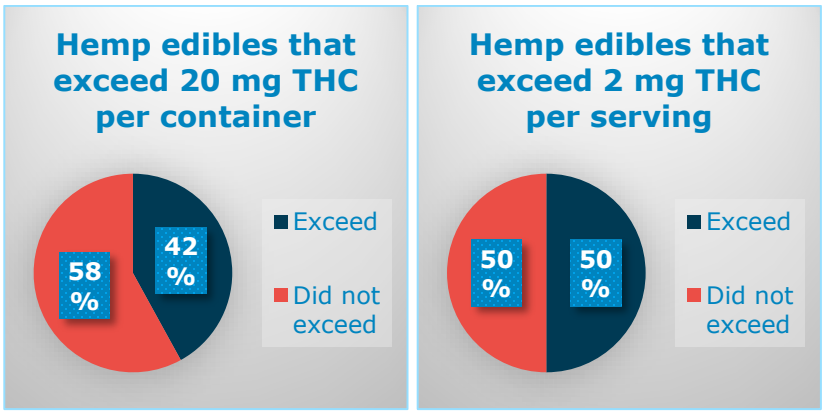


Figure 23. Hemp edibles prohibited for sale to Oregon consumers based on THC content.

Additionally, products sold to Oregon consumers are not permitted to contain ADCs. Because this category is defined by the manufacturing method information that is not typically disclosed by manufacturers, determining whether a product contains ADCs requires making inferences. This is discussed in greater detail below (see Edibles with Artificially Derived Cannabinoids). Based on the CRL results, it appears that 28 samples (56%) contained ADCs.

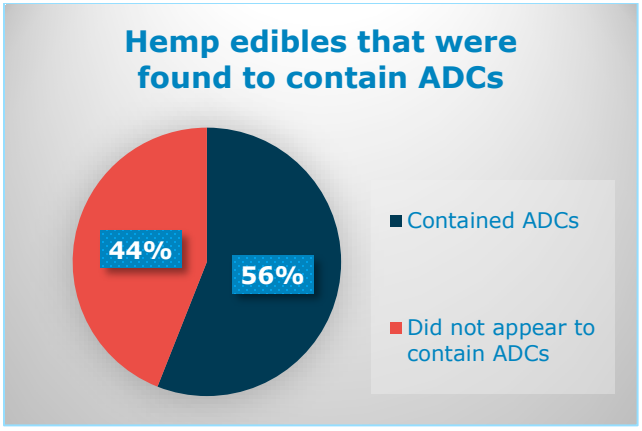


Figure 24. Hemp edibles prohibited for sale to Oregon consumers based on ADC content.

There was some overlap between products prohibited based on the amount of delta-9-THC they contained and products prohibited based on containing ADCs. Overall, 37 samples (74%) were prohibited for sale under at least one of these criteria. Only 13 samples (26%) appeared to be in compliance with Oregon's regulations on cannabinoids in hemp products.

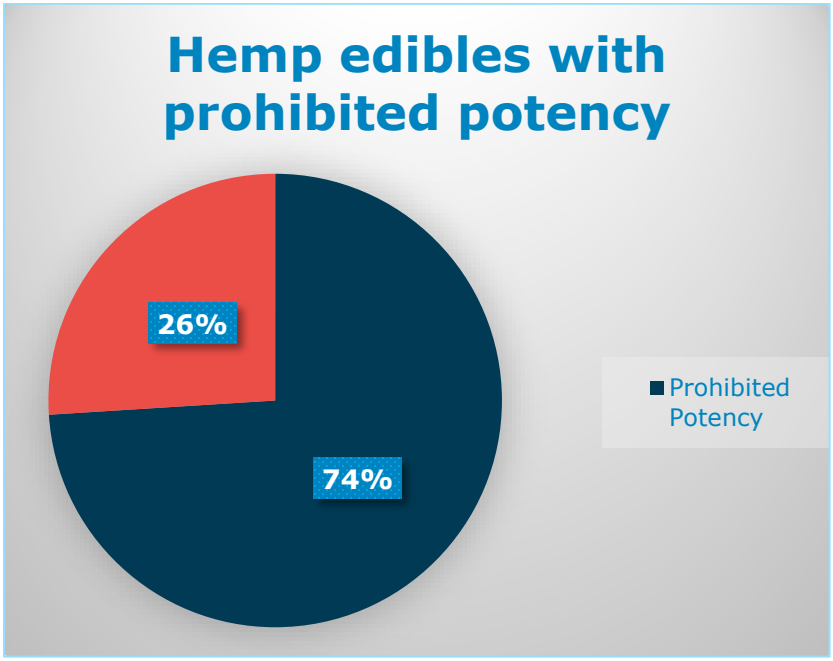


Figure 25. Hemp edibles prohibited for sale to Oregon consumer based on THC or ADC content.

Additionally, two of the products (4%) exceeded 0.3% delta-9-THC and do not appear to be hemp under any interpretation of the federal definition.

Edibles with Artificially Derived Cannabinoids

Products containing ADCs present a unique potential for risks to public health, beyond the ordinary risks associated with the unregulated or non-compliant sale of intoxicants.

In addition to naturally occurring cannabinoids that have been the subject of some degree of research, ADCs can include substances that have never been seen before, that have not been studied in any capacity, and to which humans have never previously been exposed. Bringing pharmacologically active substances to market without any data whatsoever on their potential toxicity poses unquantifiable risks to consumers.

But even when a substance has a robust history of use and relatively well-characterized pharmacological and toxicological profile, as is the case for delta-9-THC, the process of manufacturing it synthetically has the potential to introduce risk of harm to consumers. As OLCC has previously described: (Oregon Liquor and Cannabis Commission, 2021)

- Manufacturers synthesizing ADCs may employ a wide range of solvents and reagents. If they do not take adequate steps to remove residual solvents or reagents from the reaction product, a consumer could be exposed to those residues. Cannabis product testing does not typically encompass testing for all solvents or reagents that may be used in the production of an ADC. It would be impractical to do so because of the wide variety of synthetic routes that may be used to generate any number of ADCs from a cannabis-derived starting material.
- As a rule, chemical reactions are not 100% efficient. In nearly every reaction, some amount of side-reaction products will also be created. These byproducts will differ depending on the specific reaction conditions, including the reagents, solvents, temperature, pressure, and atmosphere. If a manufacturer is not carefully purifying the reaction product, characterizing the byproducts that remain in the purified material, and establishing toxicological profiles for these byproducts, it is impossible to accurately quantify the risk that these byproducts may pose to consumers.

The concern about uncharacterized byproducts appears to be supported by data from the CRL. Some of the chromatograms on the gummies included regions with significant uncharacterized peaks.[44] Further analytical work would be required to begin establishing the structures associated with these peaks and establish whether they are cannabinoid related. The fact that these concerning clusters of peaks were present in chromatograms for products that also contained cannabinoids that are typically manufactured synthetically suggests that Oregon's cautious approach to these compounds is well-founded.

[44] Uncharacterized peaks in a chromatogram represent substances that are present in the sample but are not able to be identified.

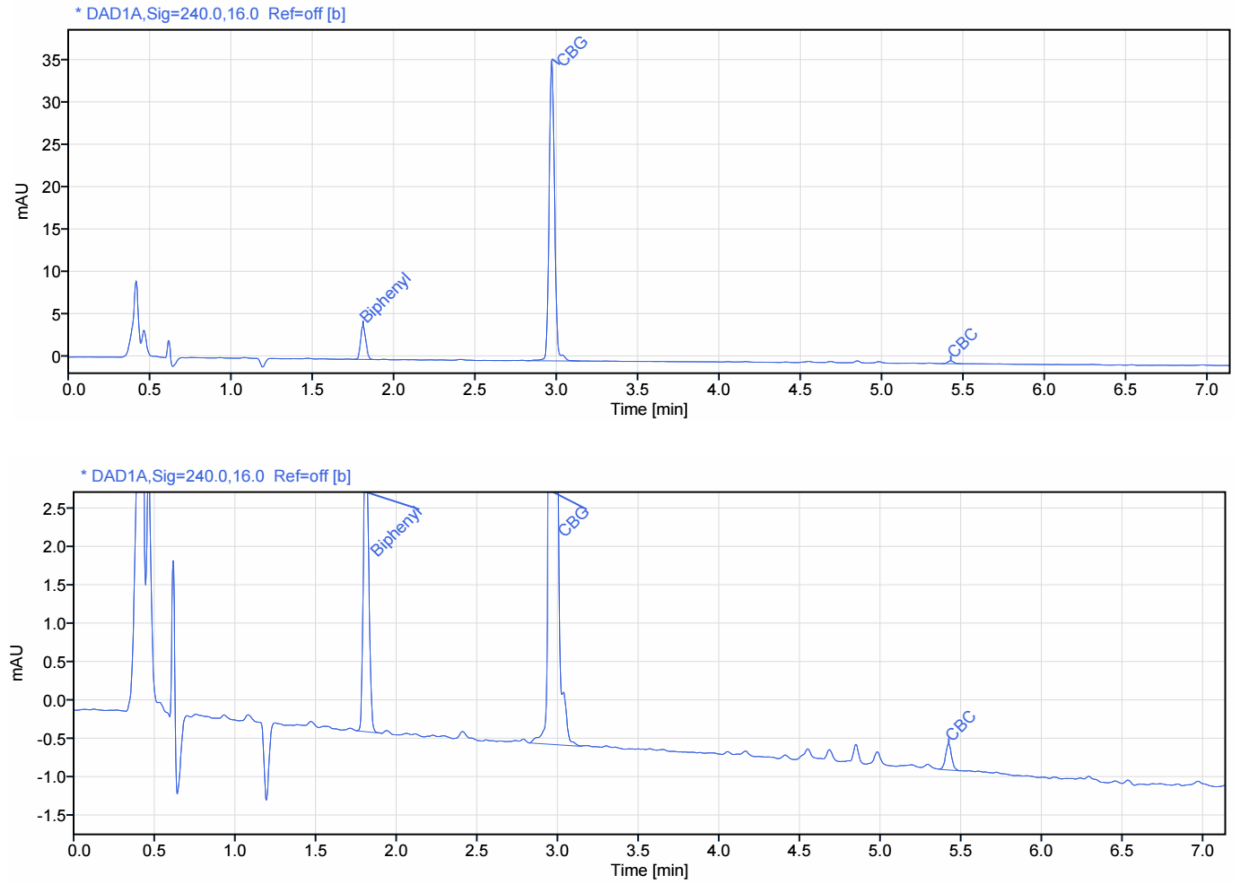


Figure 26. Chromatogram of sample 24B-660 (including zoomed in view)

Label Photo: 24B-660	Label Claim	CRL Results
	Weight: NA Piece Count: 10 **Potency Claim:** CBG: 10 mg/piece 100 mg/package	Weight: 56.6 Piece Count: 10 **Potency:** CBG: 8.69 mg/piece 86.9 mg/package Delta-9-THC: 0.242 mg/piece 2.42 mg/package CBD: 0.262 mg/piece 2.62 mg/package

Figure 27. Image of label and quantified results of sample 24B-660

Figure 26 is an example of what is observed during chemical analysis of a product with a relatively simple cannabinoid profile. This is the data observed from sample 24B-660.[45]

[45] The biphenyl peak in the chromatogram image is an internal standard and not actually present in the samples.

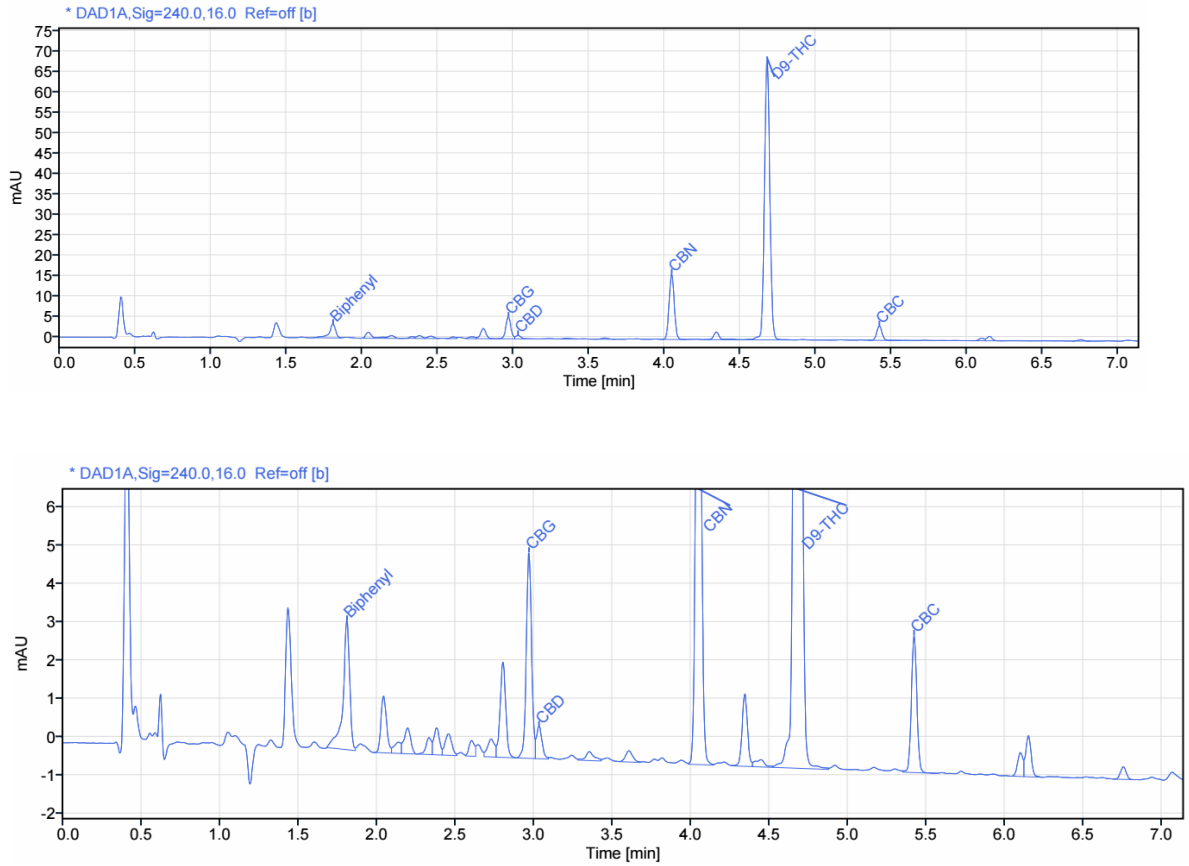


Figure 28. Chromatogram of sample 24B-708 (including zoomed in view)

Label Photo: 24B-708	Label Claim	CRL Results
	Weight: NA Piece Count: NA **Potency Claim:** "Total": 600 mg Delta-9-THC: 0.29%	Weight: 63.7 g Piece Count: 13 **Potency:** Delta-9-THC: 25.5 mg/piece 331 mg/package CBD: 0.392 mg/piece 5.10 mg/package CBN: 2.34 mg/piece 30.4 mg/package CBG: 2.15 mg/piece 28.0 mg/package

Figure 29. Image of label and quantified results of sample 24B-708

Figure 28 is an example of what is observed during chemical analysis of a product with a much more complex mixture of cannabinoids and other unidentified peaks. This is the data observed from sample 24B-708.[46]

[46] The biphenyl peak in the chromatogram image is an internal standard and not actually present in the samples.

Because manufacturers do not disclose the specific manufacturing processes used to obtain the cannabinoids in their products, interpreting which products contain ADCs requires us to make some assumptions:

- **Cannabinoids presumptively considered artificially derived:** For the purposes of this analysis, we considered cannabinoids that are not known to occur naturally in cannabis to be presumptively artificially derived.[47] If the CRL reported any quantifiable amount of these cannabinoids, we regard the product as containing ADCs for this analysis. The cannabinoids in this category are: HHC,[48] delta-9-THCO, delta-8-THCO, and THCP.[49]
- **Delta-8-THC:** Delta-8-THC occurs as a natural constituent of cannabis, apparently as a degradation product from delta-9-THC (Hazekamp, Tejkalová, & Papadimitriou, 2016). However, it occurs in such trace amounts that it is generally impractical to isolate naturally occurring delta-8-THC at scale for use in consumer products, especially from hemp. While a trace amount of delta-8-THC is not necessarily indicative of artificial origin, for the purposes of this analysis we are treating delta-8-THC that is present at 1 mg per serving or greater as an ADC.
- **Delta-9-THC:** Both naturally occurring and artificially derived delta-9-THC are available to hemp product manufacturers,[50] so the origin of the delta-9-THC cannot be inferred from its concentration or quantity in a product. Instead, we looked at the overall cannabinoid profile of the product to reach a conclusion. The most straightforward approach was to differentiate the source of delta-9-THC based on the relative concentration of delta-8-THC in the product. The natural prevalence of delta-8-THC in cannabis edibles can be estimated based on results reported to OLCC in CTS: Among 3,917 marijuana edibles tested for cannabinoid concentration in 2024, 3,867 (98.7%) contained no quantifiable amount of delta-8-THC; among the 50 samples with quantifiable amounts of delta-8-THC, the median ratio of delta-9-THC to delta-8-THC was 102:1. For the purposes of this analysis, we regard delta-9-THC as an ADC if the ratio of delta-9-THC to delta-8-THC in the product is 50:1 or lower.

[47] It is also possible that these cannabinoids might be synthesized from non-cannabis starting materials, in which case they would not be included in the definition of "artificially derived cannabinoids." This is a meaningful distinction: If the substance was not derived from cannabis, it is not "hemp" and falls outside of Oregon's regulatory framework for cannabis. However, this doesn't mean that such a product would be legal for sale to Oregon consumers; it just changes the basis under which it is prohibited. Fully synthetic cannabinoids in foods would most likely be considered be considered adulterants (Oregon law generally excludes hemp or marijuana from being considered adulterants in food, but no such exclusion applies to synthetic cannabinoids) and most cannabinoid receptor agonists that are not derived from cannabis are Schedule 1 controlled substances in Oregon under OAR 855-080-0021(3). However, to simplify the analysis for the purposes of this report, we are taking at face value the claims that these are "hemp" and simply treating any cannabinoid that does not appear to be a naturally occurring cannabinoid extracted from the plant as being an ADC.

[48] We are aware of one report of HHC detected in cannabis seeds (Basas-Jaumandreu & de las Heras, 2020), but only at a trace level without quantification and without any description of how it was identified or characterized. Until or unless more evidence accrues, we do not regard this as cannabinoid that is recognized as a naturally occurring constituent of cannabis. The CRL looked for both the 9*S* and 9*R* isomers.

[49] The CRL specifically looked for delta-9-THCP. While THCP occurs in cannabis, it is orders of magnitude lower in concentration than delta-9-THC. Note that THCP in "hemp" products may not actually be derived from hemp; we are not currently aware of a plausible precursor substance in hemp that would be used to synthesize THCP at scale.

[50] Delta-9-THC occurs in non-trivial amounts in most cannabis, including in hemp plants grown for their CBD content. In the process of extracting and isolating CBD from hemp, purified delta-9-THC may also be collected as an output of that process. On the other hand, it is also possible to use high-CBD hemp extract as a starting material to synthesize delta-9-THC through acid-catalyzed isomerization (i.e. as an artificially derived cannabinoid).

As noted in Figure 24, it appeared that 28 of the samples (56%) contained at least one ADC. Based on the criteria described above:

- 18 samples (36%) appear to contain artificially derived delta-9-THC. In seven of these, the concentration of delta-9-THC was lower than the concentration of delta-8-THC, indicating that this delta-9-THC may have been an incidental byproduct of the delta-8-THC manufacturing process.
- 18 samples (40%) appear to contain artificially derived delta-8-THC.
- Seven samples (14%) contain HHC. This includes one sample that contained only trace amounts of HHC (less than 1 mg per package); in the other six, HHC was a major constituent of the product.
- One sample (2%) contained delta-9-THCO, but only at very low concentration.
- One sample (2%) contained delta-8-THCO. In this sample, delta-8-THCO was a major constituent of the product.
- No samples contained any quantifiable amount of THCP.

LABEL CLAIMS VS CRL RESULTS

Substantial discrepancies were noted between the results reported by the CRL and the claims made on product labels. Overall, of the 56 potency claims[51] that were evaluated, only 14 (25%) were within ±10% of the target potency.

CBD

A total of 21 samples made claims about CBD content on their label. On average, the actual amount of CBD per serving measured by the CRL was 10.5% lower than the label claim,[52] with a standard deviation of ±54.8%. The median result was 14.8% lower than the label claim.

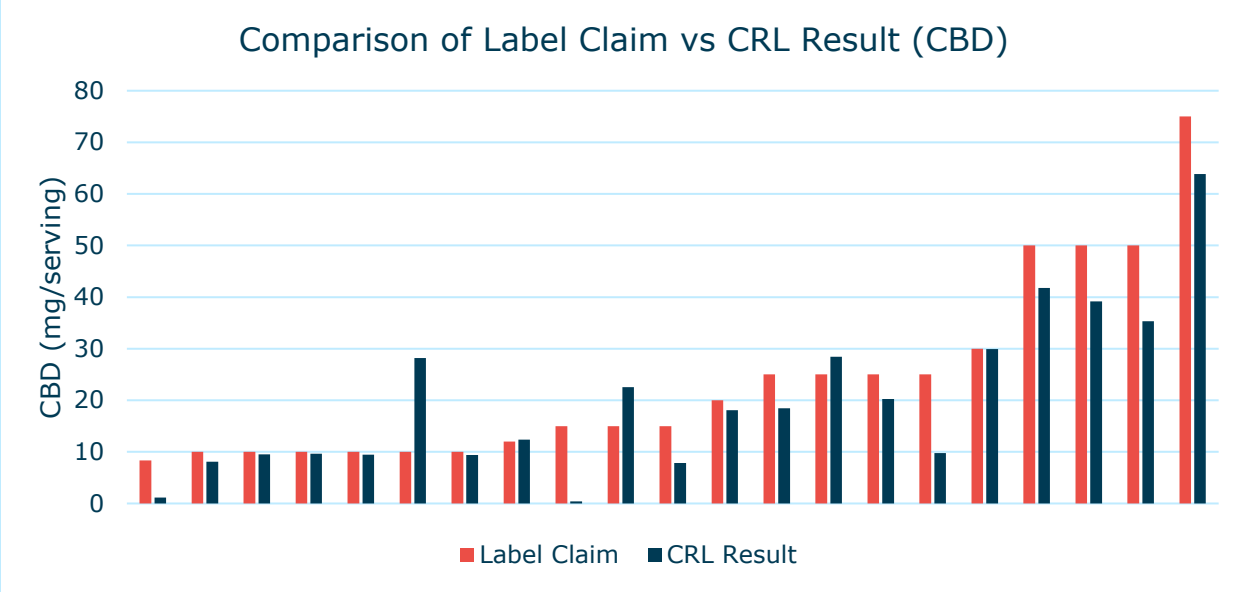


Figure 30. Comparison of CBD label claims vs CRL results.

[51] Some labels contained potency claims for more than one cannabinoid; each claim was analyzed independently.
[52] Percent difference was quantified as: ([CRL result]/[label claim])−1.

Samples ranged from being 97.4% lower than claimed (label claimed 15 mg/serving, CRL detected 0.39 mg/serving) to being 182% higher than claimed (label claimed 10 mg/serving, CRL detected 28.2 mg/serving). Only seven of the 21 samples (33.3%) were within ±10% of the target potency.

Additionally, four samples were found to contain at least 10 mg CBD per serving but did not disclose the amount of CBD on the product label.

Delta-9-THC

A total of 23 samples made claims on their label about containing a specific non-zero quantity of delta-9-THC.[53] On average, the actual amount of delta-9-THC per serving measured by the CRL was 17.7% lower than the label claim, with a standard deviation of ±39.3%. The median result was 19.9% lower than the label claim.

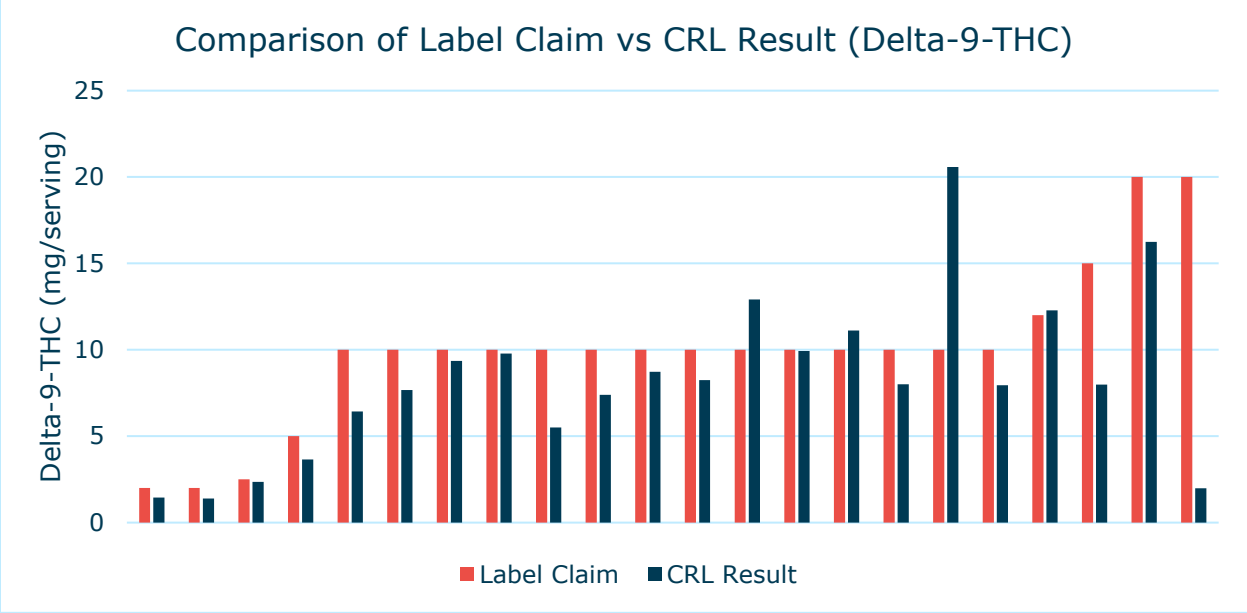


Figure 31. Comparison of delta-9-THC label claims vs CRL results. [54]

Samples ranged from being 100% lower than claimed (label claimed 360 mg/serving, CRL did not detect any quantifiable amount of delta-9-THC) to being 106% higher than claimed (label claimed 10 mg/serving, CRL detected 20.6 mg/serving). Only five of the 23 samples (22%) were within ±10% of the target potency.

Additionally, six samples were found to contain at least 2 mg delta-9-THC per serving but did not disclose the amount of delta-9-THC on the product label.

[53] Claims that a product "does not exceed 0.3%" were not considered to be a specific claim.
[54] Excludes outlier sample 24B-605 which claimed to contain 360 mg delta-9-THC per serving; the CRL did not detect any quantifiable amount of delta-9-THC in this sample; see Sample 24B-605, page 44.

Delta-8-THC

A total of six samples made claims about delta-8-THC content on their label. On average, the actual amount of delta-8-THC per serving measured by the CRL was 38.7% lower than the label claim, with a standard deviation of ±27.5%. The median result was 32.5% lower than the label claim.

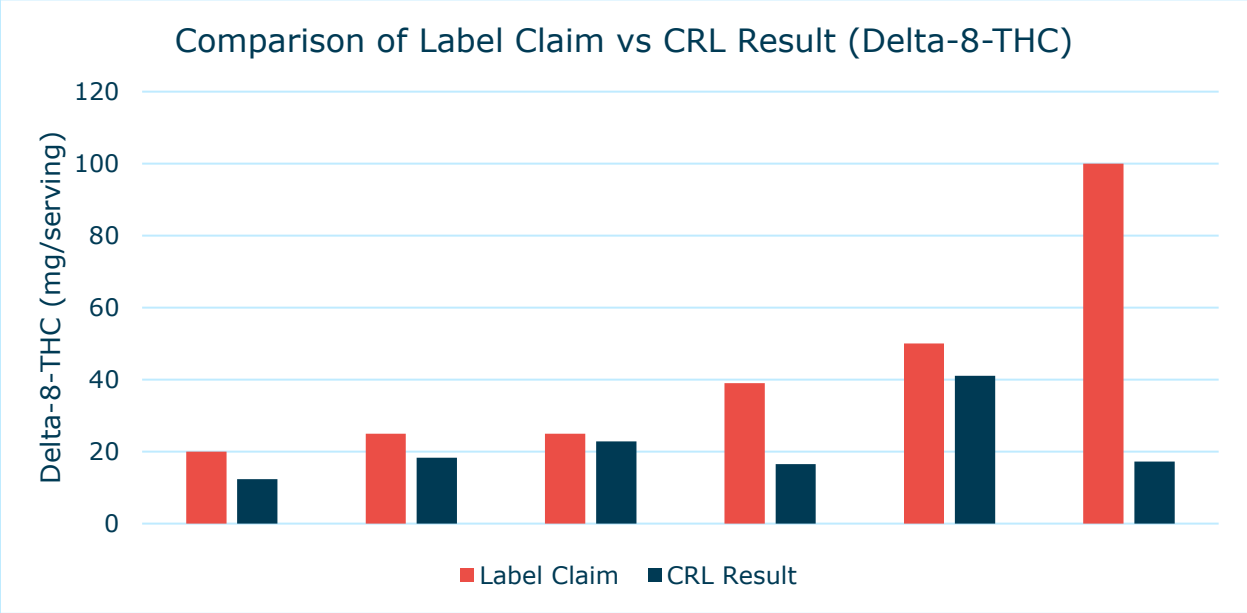


Figure 32. Comparison of delta-8-THC label claims vs CRL results.

Samples ranged from being 82.8% lower than claimed (label claimed 100 mg/serving, CRL detected 17.2 mg/serving) to being 8.7% lower than claimed (label claimed 25 mg/serving, CRL detected 22.8 mg/serving); no sample was found to contain more delta-8-THC than claimed on the label. Only one of the six samples (17%) were within ±10% of the target potency.

Additionally, nine samples were found to contain at least 2 mg delta-8-THC per serving but did not disclose the amount of delta-8-THC on the product label.

HHC

A total of four samples made claims about HHC content on their label.[55] On average, the actual amount of total HHC per serving measured by the CRL was 38.6% lower than the label claim, with a standard deviation of ±45%. The median result was 29.4% lower than the label claim.

Samples ranged from being 100% lower than claimed (label claimed 100 mg/serving, CRL detected no quantifiable amount) to being 4.2% higher than claimed (label claimed 80 mg/serving, CRL detected 83.3 mg/serving). Only one of the four samples (25%) were within ±10% of the target potency.

[55] The labels did not specify which isomer of HHC; for the purpose of this analysis, we have treated HHC as the sum of 9*S*-HHC and 9*R*-HHC.

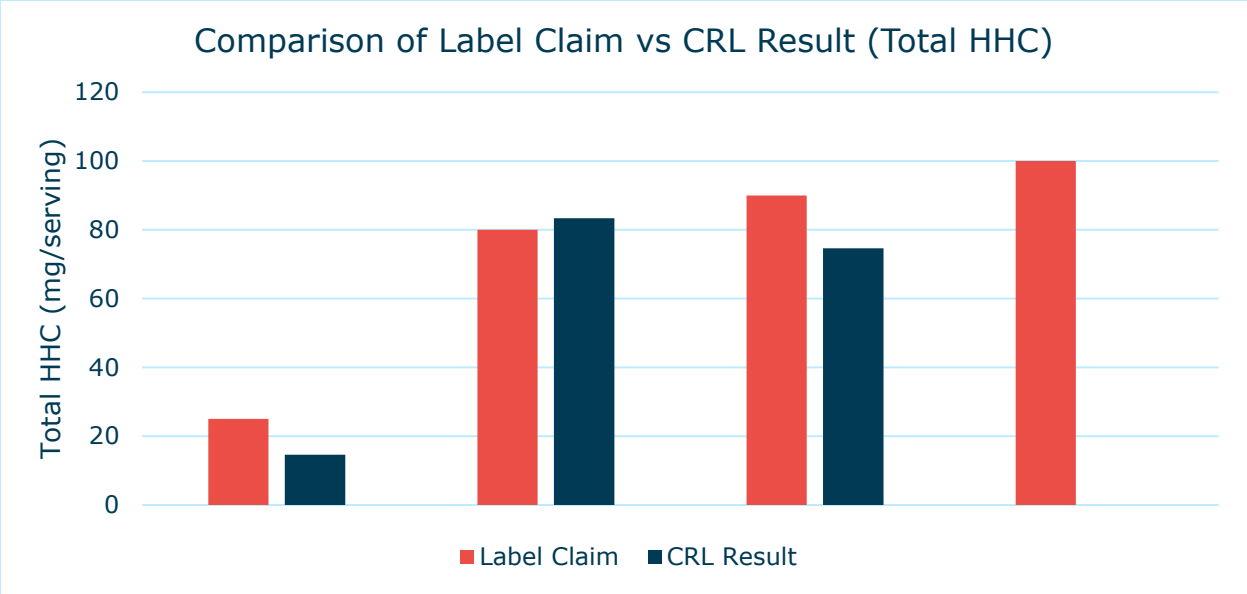


Figure 33. Comparison of total HHC label claims vs CRL results.

Additionally, three samples were found to contain at least 5 mg HHC per serving but did not disclose the amount of HHC on the product label.

THCO

Only one sample made claims about THCO content on their label.[56] The actual amount of THCO per serving measured by the CRL was 100% lower than the label claim (label claimed 100 mg/serving, CRL did not detect any quantifiable about THCO). Additionally, one sample was found to contain 34.6 mg THCO per serving but did not disclose the amount of THCO on the product label; another contained a very small quantifiable amount (0.64 mg/serving).

THCP

Only one sample made claims about THCP content on their label. The CRL did not detect any quantifiable amount of THCP in this sample. No other samples were found to contain any quantifiable amount of THCP.

Egregious Misrepresentations

During our review of products there were a couple of particularly concerning examples we wanted to highlight as concerning:

SAMPLE 24B-605: PACKWOODS PASSION FRUIT PUNCH

The "Packwoods Passion Fruit Punch" was labeled as having 3600 mg of hemp derived delta-9-THC. This package seems to primarily contain semisynthetic cannabinoids HHC and THCO rather than the delta-9-THC it advertised. The package weight and piece count were 10% higher than reported on the label. This product had an expiration date listed as 5/1/2024, however the product was sold and delivered to us in September of 2024, well after its reported expiration.

[56] The label did not specify whether it was intended to contain delta-8-THCO or delta-9-THCO; for the purpose of this analysis, we have treated THCO as the sum of delta-8-THCO and delta-9-THCO.

Label Photo: 24B-605	Label Claim	CRL Results
 	Weight: 75 g Piece Count: 10 **Potency Claim:** Delta-9-THC: 360 mg/piece 3600 mg/package	Weight: 82.5 g Piece Count: 11 **Potency:** HHC: 46.67 mg/piece 513.4 mg/package THCO: 34.62 mg/piece 380.8 mg/package

Figure 34. Image of label and quantified results of sample 24B-605.

The QR code captioned "scan for lab results" on the back of the package links to the primary website of the product rather than to any lab results. After navigating to the "lab reports" section of the website there was no listing for delta-9-THC edibles or any other category that appears to match this product.

SAMPLES 24B-586, -587, AND -588: SKITTLEZZZ

The "Skittlezzz" jars we ordered came in three different variants of different advertised cannabinoids (THCO, delta-8-THC, and HHC).

Label Photo: 24B-588	Label Claim	CRL Results
	Weight: 13.3 g Piece Count: 20 **Potency Claim:** HHC: 100 mg/piece 2000 mg/package	Weight: 28.98 g Piece Count: 23 **Potency:** Delta-8-THC: 16.04 mg/piece 368.9 mg/package CBN: 0.364 mg/piece 8.37 mg/package

Figure 35. Image of label and quantified results of sample 24B-588.

All informational side labels were only marginally legible by magnifying photos of the text. The weights and cannabinoid contents of the packages all appeared to be significantly different than how they were represented on the labels. The piece counts were incorrect on two of the three variants (see Appendix D for details). The packaging did not appear to be child-resistant. Each jar contained candy similar in appearance to Skittles sold by Mars Inc. The totality of these issues increases our concern regarding products like these which were sold without appropriate age verification.

Figure 36. Note their similarity to products traditionally marketed and sold to children.

WEIGHT & SERVINGS: LABEL VS REALITY

Conventional foods are generally required to list the weight of the item on the label. We reviewed the hemp edible products to compare the weight and piece count reported on the label with the weight and piece count reported by the CRL.

While 47 of 50 of the products (94%) made a claim about how many pieces or servings were being provided in the package, only 37 of 50 of the products (74%) had an identified weight claim on the label. We found 21% of the packages (10 of 47) had a different number of pieces in the package than the label claimed. Most packages with discrepancies contained more pieces than the label claimed; only one package had fewer pieces than claimed.

The weight discrepancies were far more concerning. The weight of the products measured by the CRL frequently differed substantially from the claims made by the seller. We found there was, on average, an absolute difference of 20% between the measured weight and the label weight, with a standard deviation of ±28%. For example, sample 24B-594 contained nearly 40% less weight than it claimed on the label (the label stated 148 grams vs 89.71 grams when weighed). By contrast, sample 24B-588 contained over double the weight stated on the label (13.3 grams on the label vs 29.09 grams when weighed).

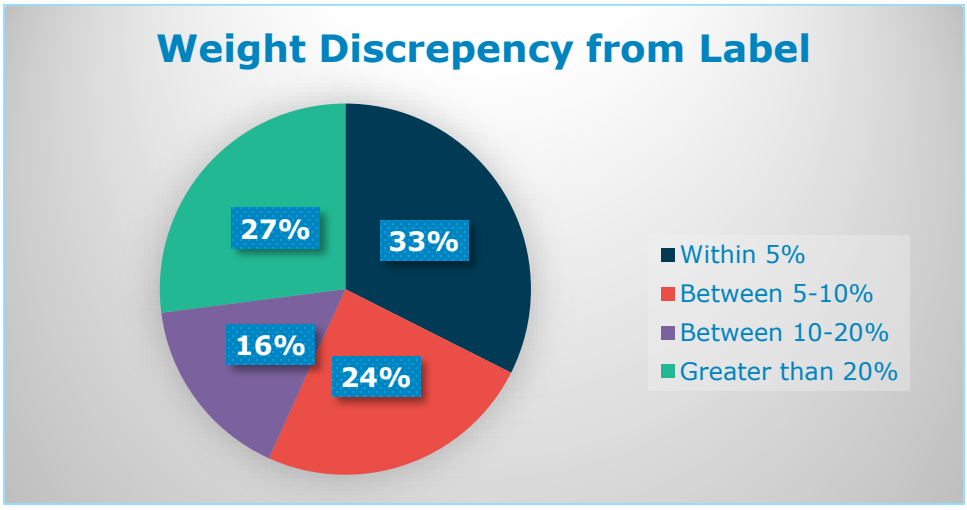


Figure 37. Discrepancy between weights listed on label and the actual weights of products.

Weight and serving count on the label are important information for consumers to have so that they can understand how to accurately assess the amount of a psychoactive substances they may consume.

AGE VERIFICATION

The vast majority of the hemp products purchased for Operation Clean Leaf were sold without appropriate age verification. A web site simply asking for the customer to enter a date of birth or click a button stating the customer was at least 21 (or in some cases, 18) years of age was not considered appropriate age verification. Online age verification was considered appropriately completed if an online retailer requested further proof of age, such as a photo of a valid ID, a photo of the ID and a "selfie," or a photo of an ID and a "selfie" holding the ID and credit card with matching name. In-person retailers were considered to have appropriately verified age if they required a valid form of ID as defined in ORS 475C.217, such as a driver's license, state-issued identification card, or passport.

Fifty useable marijuana flower samples were purchased from 19 OLCC-licensed retailers. Of the 19 purchases, 18 were done in an undercover capacity. All OLCC-licensed marijuana retailers required a valid form of ID to complete the sale.

Oregon laws and rules prohibit the sale of adult use cannabis items,[57] including hemp items that meet certain criteria, to a person under 21 years of age in Oregon's general market.

Five in-person purchases of "hemp" flower (all of which were adult use cannabis items) from the general market were completed. None of these retailers required valid ID. The purchaser did not disclose that he worked for OLCC except in one case. Seventeen "hemp" edibles were obtained by in-person purchases. Based on label claims, 9 of these clearly fit the definition of an adult use cannabis item; none of the retailers who sold these 9 products required valid ID as proof of age. However, all in-person purchases were completed by an adult male, 59 years of age.

In addition, 46 samples of "hemp" flower or "THCA" flower (all of which were adult use cannabis items) were purchased from 38 online retail websites. Only five (13%) of these retailers required the purchaser to provide proof of age beyond clicking a button claiming to be over 21 or entering a date of birth.

Of the "hemp" edibles, 33 were purchased from 25 online retail websites. Based on label claims and COAs, 32 of the edibles fit the definition of adult use cannabis items. Only three (12%) of these retailers required the purchaser to provide proof of age beyond clicking a button claiming to be over 21 or entering a date of birth.

[57] OAR 845-026-0300; OAR 603-048-1500(4); ORS 571.339(4). A hemp item is an "adult use cannabis item" if the item contains 0.5 mg or more delta-9-THC, THCA, or delta-8-THC in the entire container; if the testing was insufficiently sensitive to show that the product does not exceed 0.5 mg; if the product contains any ADCs; or if the product contains 0.5 mg or more of any other cannabinoid advertised by the manufacturer or seller as having an intoxicating effect.

CONCLUSION

Through Operation Clean Leaf, OLCC staff were able to successfully purchase a large amount of high THC cannabis flower and edible products that are prohibited for sale to Oregon consumers from online retailers and conventional ("brick and mortar") retail stores. This demonstrates the need for a robust collaborative regulatory approach to address this ongoing national issue.

Testing cannabis samples with the CRL has provided valuable data to understand and interpret trends within the cannabis industry.

Potency testing on marijuana flower corroborated anecdotal reports that OLCC has received about the prevalence of third-party laboratory test results overstating the concentration of total THC in marijuana flower bought off the shelf at retailers. Comparing these results with pricing trends observed in OLCC CTS data paints a picture of the competing incentives at play in cannabis potency testing. The extent to which discrepancies between total THC results from the CRL results and from third-party laboratories can be explained by actions taken by the licensee requesting the testing, or by laboratory methods and practices, requires further investigation.

Due to the significant differences between CRL results and third-party laboratory results, we were unable to gain insight into the natural changes in potency over time between harvest, initial testing, and ultimate sale to a consumer. OLCC staff will continue to monitor research regarding the shelf stability of THC and evaluate whether further research with the CRL is warranted.

The discovery of cannabis flower that contained a prohibited amount of pesticide being sold to consumers demonstrates the need for continued collaboration with the CRL in off-the-shelf audit testing. It is clear that the state has further need to explore the prevalence of pesticides through non-targeted pesticide testing. The overwhelming presence of DEET within both marijuana and hemp samples will require further study. The presence of spirodiclofen in one sample provides evidence that pesticides not currently being screened for are being found on cannabis and that should continue to be investigated.

The hemp edible label review and CRL testing of hemp edible products that were able to be purchased in Oregon indicate widespread non-compliance with Oregon's regulations on the sale of hemp products to consumers. Oregon was the first state to adopt regulations addressing and mitigating potential harms of intoxicating hemp products, and Oregon's regulatory scheme for cannabinoid hemp products is one of the most robust in the nation. However, it appears that retailers within Oregon and in other states continue to sell prohibited products to Oregon consumers, often without adequate age verification to ensure that potentially intoxicating products stay out of the hands of minors.

The CRL testing of hemp edibles and a comparison of these results with hemp edible labeling showed widespread issues with the accuracy of potency claims. The label review provided OLCC staff with quantifiable data regarding compliance issues as OLCC works to implement legislation creating a registry of cannabinoid hemp products sold in Oregon.

The test results for "THCA hemp" flower were especially noteworthy. Many businesses nationwide are selling high-THC cannabis flower to consumers with minimal regulation. These sales are premised on the claim that the flower is hemp under federal law because it contains no more than 0.3% delta-9-THC, regardless of the high levels of total THC. The test results from the CRL show that this is a false premise.

Every sample of "THCA hemp" tested by the CRL contained well over 0.3% delta-9-THC. This is cannabis that clearly appears to be "marijuana" and is being imported into Oregon and sold to Oregon consumers, often without adequate age verification. Oregon collects a tax on the retail sale of marijuana, and this tax revenue benefits Oregonians through distributions to cities, counties, schools, Oregon State Police, and the Oregon Health Authority. In addition to the public health and safety hazards presented by the unregulated sale of marijuana, businesses selling marijuana labeled as "hemp" outside of Oregon's regulated system also deprive the state of revenue for those sales.

The data presented in this report has provided actionable results to protect against threats to public health and provided insights to better inform data-driven cannabis policy. We look forward to continuing collaboration with the CRL to further investigate areas of regulatory concern and interest.

REFERENCES

Basas-Jaumandreu, J., & de las Heras, F. (2020). GC-MS Metabolite Profile and Identification of Unusual Homologous Cannabinoids in High Potency Cannabis sativa. *Planta Medica, 86*(5), 338-347. doi:10.1055/a-1110-1045

Boos, T. L. (2022, September 13). Letter to Alex Jensen.

Boos, T. L. (2024, May 13). Letter to Shane Pennington.

Brightfield Group. (2023). *The State of Delta-8.* Brightfield Group. Retrieved from https://www.brightfieldgroup.com/

Crombie, N. (2015). *Marijuana and Pesticides.* Retrieved from OregonLive.com.: https://www.oregonlive.com/projects/marijuana-legalization/pesticides/

Davkova, I., Cvetkovikj, K., Trajkovska, A., Stoilkovska Gjorgievska, V., Kulevanova, S., Stefkov, G., & Karapandzova, M. (2023). Effects of temperature on THC and THCA content during storage. *Macedonian Pharmaceutical Bulletin, 69*(Supplement 1), 249-250. doi:10.33320/maced.pharm.bull.2023.69.03.122

Dilley, J. A., Hendrickson, R. G., Everson, E. M., & Jeanne, T. L. (2024). Monitoring Cannabis Adverse Events: Lessons From Edible Packaging Policies and Child Poisonings. *American Journal of Public Health*. doi:10.2105/AJPH.2024.307789

Farrer, D. G. (2015). *TECHNICAL REPORT: Oregon Health Authority's process to determine which types of contaminats to test for in cannabis products, and levels for action.* Oregon Health Authority.

Ferrara Candy Company. (2025, 5 2). *Trolli Strawberry Puffs*. Retrieved from www.trolli.com: https://www.trolli.com/products/unique-shapes/strawberry-puffs

Fonseca, R. (2024, June 17). How dirty is your weed? A joint investigation finds high levels of pesticides in products. *Los Angeles Times*. Retrieved from https://www.latimes.com/california/story/2024-06-14/the-dirty-secret-of-californias-legal-weed

Gagnon, M., McRitchie, T., Montsion, K., Tully, J., Blais, M., Snider, N., & Blais, D. R. (2023). High levels of pesticides found in illicit cannabis inflorescence compared to licensed samples in Canadian study using expanded 327 pesticides multiresidue method. *Journal of Cannabis Research, 5*. doi:https://doi.org/10.1186/s42238-023-00200-0

Geci, M., Scialdone, M., & Tishler, J. (2023). The dark side of cannabidiol: The unanticipated social and clinical implications of synthetic Δ8-THC. *Cannabis and Cannabinoid Research, 8*(2), 270-282. doi: 10.1089/can.2022.0126

Hanuš, L. O., Meyer, S. M., Muñoz, E., Taglialatela-Scafati, O., & Appendino, G. (2016, October 10). Phytocannabinoids: a unified critical inventory. *Natural Product Reports, 33*, 1357-1392. doi: 10.1039/c6np00074f

Hazekamp, A., Tejkalová, K., & Papadimitriou, S. (2016, September 1). Cannabis: From Cultivar to Chemovar II—A Metabolomics Approach to Cannabis Classification. *Cannabis and Cannabinoid Research, 1*(1), 202-215. doi:https://doi.org/10.1089/can.2016.0017

Johnson, L. (2021, October 21). *CBD Oracle Lab Study Shows Some Delta-8 Products Are 7700% Over the Legal Delta-9 THC Limit*. Retrieved from CBD Oracle: https://cbdoracle.com/news/delta-8-thc-products-market-study-consumer-safety-and-legality/#primary-author-popup

Johnson, L. (2022, April 25). *Lab Study: Over 50% of Hemp Delta-9 Products Are Mislabeled, and Get You Higher Than Cannabis*. Retrieved from CBD Oracle: https://cbdoracle.com/news/hemp-delta-9-thc-products-lab-study-consumer-safety-and-legality/

Klein, C., Karanges, E., Spiro, A., Wong, A., Spencer, J., Huynh, T., . . . McGregor, I. s. (2011). Cannabidiol potentiates Δ⁹-tetrahydrocannabinol (THC) behavioural effects and alters THC pharmacokinetics during acute and chronic treatment in adolescent rats. *Psychopharmacology* .

Mackowsky, D. (2016, 6 1). *Pesticide & Potency Analysis of Street-Grade versus Medicinal Cannabis*. Retrieved from Cannabis Industry Journal: https://cannabisindustryjournal.com/feature_article/pesticide-potency-analysis-of-street-grade-versus-medicinal-cannabis/#:~:text=Using%20the%20QuEChERS%20approach%2C%20which%20is%20the%20industry,cannabinoid%20content%20in%20street-grade%20cannabis%20ver

OLCC. (2021). *Operation Table Rock - Enforcement Outcomes.* Retrieved from https://www.oregon.gov/olcc/Docs/commission_minutes/2021/Operation-Table-Rock.pdf

Oregon Department of Agriculture . (2025, 5 6). *Cannabis and Pesticides*. Retrieved from Oregon Department of Agriculture - Pesticide, Fertilizer, and PARC Programs: https://www.oregon.gov/oda/pesticides/Pages/cannabis-and-pesticides.aspx

Oregon Liquor and Cannabis Commission. (2021). *Considerations in Establishing Cannabinoid Limits for Hemp Products.*

Oregon Liquor and Cannabis Commission. (2023). *2023 Recreational Marijuana Supply and Demand Legislative Report.* Retrieved from https://www.oregon.gov/olcc/Docs/reports/2023-Supply-and-Demand-Report.pdf

Oregon Liquor and Cannabis Commission. (2024, 12 23). *OLCC Recalls Cannabis Flower*. Retrieved from OLCC product recall page: https://content.govdelivery.com/accounts/OLCC/bulletins/3c9046e

Oregon State University Southern Oregon Research and Extension Center. (2021, September 15). *Hemp Newsletter.* Retrieved from

https://extension.oregonstate.edu/sites/extd8/files/documents/50336/09152021-hemp-newsletter.pdf

Rheay, H. T., Omondi, E. C., & Brewer, C. E. (2021, April). Potential of hemp (Cannabis sativa L.) for pairedphytoremediation and bioenergy production. *GCB Bioenergy, 13*(4), 525-536.

Schwabe, L. A., Johnson, V., Harrelson, J., & McGlaughlin, M. E. (2023, April 12). Uncomfortably high: Testing reveals inflated THC potency on retail Cannabis labels. *PLOS ONE*. doi:https://doi.org/10.1371/journal.pone.0282396

St. John, P. (2024, June 14). A New Threat to Cannabis Users: Smuggled Chinese Pesticides. *LA Times*. Retrieved from https://www.latimes.com/california/story/2024-06-14/a-new-threat-to-cannabis-safety-smuggled-pesticides

Voelker R, H. M. (2014). *Pesticide use on cannabis.* Cannabis Safety Instiute. Retrieved from https://cdn.technologynetworks.com/tn/Resources/pdf/pesticide-use-on-cannabis.pdf

Zamengo, L., Bettin, C., Badocco, D., Di Marco, V., Miolo, G., & Frison, G. (2019, May). The role of time and storage conditions on the composition of hashish and marijuana samples: A four-year study. *Forensic Science International, 298*, 131-137. doi:10.1016/j.forsciint.2019.02.058

APPENDIX A: PESTICIDE TESTING INFORMATION

EXTRACTION AND PREPARATION OF SAMPLES FOR ANALYSIS OF PESTICIDES

For this study we chose to focus on detection of a diverse array of pesticides, rather than quantification or low-level detection; therefore, we performed minimal sample cleanup to avoid unintentional losses of pesticides.

Cannabis flowers were frozen in liquid nitrogen and then were ground to a fine powder using a pre-chilled mortar and pestle. A 0.5 g portion of the ground sample was transferred to a 15 mL poly-propylene tube followed by addition of 10 mL of extraction solution (acetonitrile fortified with 10 ppb of triphenyl phosphate as an internal standard). The contents were mixed for 30 – 45 minutes using a horizontal shaker followed by centrifugation to pellet the solids. 5 mL of the supernatant was passed through a C18 solid-phase extraction cartridge (Agilent PN# 5982-1365) using gravity. After the supernatant had passed through a small amount of pressure was applied to recover extract remaining in the cartridge. The extract was then analyzed by HPLC-MS/MS and GC-MS/MS. Quality control samples included reagent blanks, method blanks, calibrants, continuing calibration verifications, and sample spikes.

TABLE A1: TARGETED ANALYTE LIST

The list of targeted pesticides that were the subject of this study. The "Source" indicates the location of detection. The "Method" indicates the preferred chromatographic and detection method.

Pesticide	Source	Method	Pesticide	Source	Method
Acephate	Oregon	LC	Malathion	Oregon	LC/GC
Acequinocyl	Oregon	LC/GC	Metalaxyl	Oregon	LC/GC
Avermectin B1a	Oregon	LC	Metazachlor	Canada	LC/GC
Azoxystrobin	Oregon	LC/GC	Methamidophos	California	LC
Bifenazate	Oregon	LC/GC	MGK-264	Oregon	LC
Bifenthrin	Oregon	LC/GC	Myclobutanil	Oregon	LC/GC
Boscalid	Oregon	LC/GC	Naled	Oregon	LC/GC
Buprofezin	Canada	LC/GC	Paclobutrazol	Oregon	LC/GC
Carbaryl	Oregon	LC	Parathion Methyl	Oregon	LC/GC
Chlorantraniliprole	Oregon	LC	Permethrin	Oregon	LC/GC

Chlorfenapyr	Oregon	GC	Phosmet	Oregon	LC/GC
Chlorothalonil	California	GC	Piperonyl butoxide	Oregon	LC/GC
Chlorpyrifos	Oregon	LC/GC	Praclostrobin	Canada	LC/GC
Chlorthiophos	California	LC/GC	Prallethrin	Oregon	LC/GC
Cyfluthrin	Oregon	LC/GC	Procymidon	California	GC
Cypermethrin	Oregon	LC/GC	Profenofos	California	LC/GC
Diazinon	Oregon	LC/GC	Propamocarb	Canada	LC
Dichlorvos	Oregon	LC/GC	Propiconazole	Oregon	LC/GC
Esenvalerate	California	GC	Pymetrozine	California	LC/GC
Ethoprophos	Oregon	LC/GC	Pyrethrins	Oregon	LC
Etofenprox	Oregon	LC/GC	Pyridaben	Oregon	LC/GC
Etoxazole	Oregon	LC/GC	Pyrimethanil	California	LC/GC
Fenobucarb	California	LC/GC	Spinosyns	Oregon	LC
Fenpropathrin	California	LC/GC	Spirodiclofen	Canada	LC/GC
Fenpyroximate	Oregon	LC	Spiromesifen	Oregon	LC/GC
Fipronil	Oregon	LC/GC	Spirotetramat	Oregon	LC/GC
Fludioxinil	Oregon	LC/GC	Tebuconazole	Oregon	LC/GC
Fluopyram	Canada	LC/GC	Teflubenzuron	Canada	LC
Imazalil	Oregon	LC	Tetramethrin	Canada	LC/GC
Imidacloprid	Oregon	LC	Thiophanate-methyl	California	LC
Isoprocarb	California	LC/GC	Trichlorfon	California	LC
Kresoxim Methyl	Oregon	LC/GC	Tridemorph	California	LC/GC
Malaoxon	Canada	LC	Trifloxystrobin	Oregon	LC/GC

TABLE A2: LIST OF MARIJUANA FLOWER SAMPLE IDS AND SCREEN STATUS

List of marijuana sample IDs and screening status. (Y) indicates that the sample was screened using the corresponding method or not (N).

Sample ID	LC screen	GC screen
24B-662	Y	Y
24B-663	Y	Y
24B-664	Y	Y
24B-665	Y	Y
24B-666	Y	Y
24B-667	Y	Y
24B-668	Y	Y
24B-669	Y	Y
24B-670	Y	Y
24B-671	Y	Y
24B-672	Y	N
24B-673	Y	N
24B-674	Y	N
24B-675	Y	N
24B-676	Y	N
24B-677	Y	N
24B-678	Y	N
24B-679	Y	N
24B-680	Y	N
24B-681	Y	N
24B-682	Y	N
24B-683	Y	N
24B-684	Y	N
24B-685	Y	N
24B-686	Y	N

Sample ID	LC screen	GC screen
24B-687	Y	N
24B-688	Y	N
24B-689	Y	N
24B-690	Y	N
24B-691	Y	N
24B-692	Y	N
24B-693	Y	N
24B-694	Y	N
24B-695	Y	N
24B-696	Y	N
24B-697	Y	N
24B-698	Y	N
24B-699	Y	N
24B-700	Y	N
24B-701	Y	N
24B-702	Y	N
24B-703	Y	N
24B-704	Y	N
24B-705	Y	N
24B-706	Y	N
24B-707	Y	N
24B-714	Y	N
24B-715	Y	N
24B-716	Y	N
24B-717	Y	N

TABLE A3: LIST OF HEMP FLOWER SAMPLE IDS AND SCREEN STATUS

List of hemp sample IDs and screening status. (Y) indicates that the sample was screened using the corresponding method or not (N).

Sample ID	LC screen	GC screen
24B-623	Y	Y
24B-624	Y	Y
24B-625	Y	Y
24B-626	Y	Y
24B-627	Y	Y
24B-628	Y	Y
24B-629	Y	Y
24B-630	Y	Y
24B-631	Y	Y
24B-632	Y	Y
24B-633	Y	Y
24B-634	Y	Y
24B-635	Y	Y
24B-636	Y	Y
24B-637	Y	Y
24B-638	Y	Y
24B-639	Y	Y
24B-640	Y	Y
24B-641	Y	Y
24B-642	Y	Y
24B-643	Y	N
24B-644	Y	N
24B-645	Y	N
24B-646	Y	N

Sample ID	LC screen	GC screen
24B-647	Y	N
24B-648	Y	N
24B-649	Y	N
24B-650	Y	N
24B-651	Y	N
24B-652	Y	N
24B-653	Y	N
24B-654	Y	N
24B-657	Y	N
24B-658	Y	N
24B-659	Y	N
24B-709	Y	N
24B-710	Y	N
24B-711	Y	N
24B-712	Y	N
24B-713	Y	N
24B-728	Y	N
24B-730	Y	N
24B-731	Y	N
24B-732	Y	N
24B-734	Y	N
24B-735	Y	N
24B-739	Y	N
24B-71	Y	N

APPENDIX B: PACKAGING AND LABELING SCORING MATRIX

Sample ID	Product	Adult Use	Purchased	Label Type	Clear Potency	Prohibited Potency	Link to Lab Results	Identified Serving Size	Prohibited Active Ingredients	Prohibited Ingredient Notes
24B-568	TRRLLI STRAWBERRY PUFFS MEDICATED 600MG THC	Yes	Online	Unclear	No	Yes	No	No	Unknown	
24B-580	MR HEMP FLOWER D9 GUMMIES	Yes	Online	Food	No	Yes	Yes	Yes	No	
24B-581	GOLD SPECTRUM 100MG 40CT WATERMELON	Yes	Online	Food	No	Yes	Yes	Yes	No	
24B-582	GUMMY GIRL WEEKEND VIBES	Yes	Online	Unclear	No	Yes	No	Yes	No	
24B-584	HULKAMANIA BODYSLAM THC GUMMIES - WATERMELON CRUSH	Yes	Online	Supplement	Yes	Yes	No	Yes	No	
24B-585	DAY DRIFT HYBRID GUMMIES 100MG	Yes	Online	Food	Yes	Yes	Yes	Yes	No	
24B-586	DELTA 8 2000MGS SKITTLEZZZ	Yes	Online	Food	No	Yes	No	Yes	No	
24B-587	THCO 2000MGS SKITTLEZZZ	Yes	Online	Food	No	Yes	No	Yes	No	
24B-588	HHC 2000MGS SKITTLEZZZ	Yes	Online	Food	No	Yes	No	Yes	No	
24B-589	CANNABUDDY DELTA 8 + DELTA 9 TRIPLE LAYER BEARS 40MG D8 + 40MG D9	Yes	Online	Food	Yes	Yes	No	Yes	No	
24B-590	GALAXY TREATS DELTA 8 + DELTA 9 THCP GUMMIES - BERRY MELON LIFTER	Yes	Online	Food	No	Yes	Yes	Yes	No	
24B-591	BOLT CBD PEACH GUMMY RINGS	Unknown	In Person	Unclear	No	No	No	No	Unknown	No ingredients
24B-592	CYCLING FROG PASSIONFRUIT GUMMIES, 10MG THC + 10MG CBD	Yes	Online	Supplement	Yes	Yes	Yes	Yes	No	
24B-593	NULEAF NATURALS FULL SPECTRUM D9 THC GUMMIES	Yes	In Person	Supplement	No	Yes	Yes	Yes	No	
24B-594	HEMP LIVING PURE DELTA 8 GUMMIES HIGH POTENCY PACK 500MG 20CT - RAINBOW	Yes	Online	Food	No	Yes	No*	Yes	No	
24B-595	HEMP LIVING SOUR SERIES DELTA 9 GUMMIES - 100MG D9 THC 10CT - BLUEBERRY LEMONADE	Yes	Online	Food	Yes	Yes	No*	Yes	No	
24B-596	HEMP LIVING HEAVYWEIGHT GUMMIES THC-P + D8 + D9 200MG - 2CT - RAINBOW CANDY	Yes	Online	Food	Yes	Yes	No*	Yes	No	
24B-597	HEMP LIVING NITE-TIME GUMMIES 300MG D8 + 180MG CBN - WATERMELON	Yes	Online	Food	Yes	Yes	No*	Yes	No	
24B-598	INFUSED CANNABIDIOL CBD MAGIC LEAF GUMMY CANDIES	Unknown	In Person	Food	No	Other	No	Yes	No	
24B-599	PLATINUM CBD+ SWEET BEARS	Unknown	In Person	Food	No	No	No	Yes	No	
24B-600	CANVAST FOCUS D9+THCV GUMMIES	Yes	Online	Food	Yes	Yes	No	Yes	No	Magnesium L-threonate
24B-601	DADS GRASS DELUXE THC + CBD GUMMIES	Yes	Online	Food	Yes	Yes	No	Yes	No	
24B-602	DADS GRASS DELUXE THC + CBD GUMMIES (2PC)	Yes	Online	*Unavailable*	Yes	No	*Unavailable*	*Unavailable*	*Unavailable*	
24B-603	HEMP BOMB HIGH POTENCY HEMP GUMMIES	Yes	Online	Food	Yes	No	No	Yes	No	
24B-605	PACKWOOD D9 GUMMIES 3600MG PASSION FRUIT PUNCH	Yes	Online	Food	Yes	Yes	No	Yes	No	

Sample ID	Allergens Disclosed	Child Resistance	Attractive to Minors (Label)	Attractive to Minors (Product Shape)	Health Claims or Misleading Claims	Warning Statements	Warning Symbol	ID Verification	Lot/Batch ID	General Notes
24B-568	Unknown	Yes	Yes	No	No	Yes	Yes	No	No	Says this product contains cannabis, a Schedule I controlled substance
24B-580	NA	Yes	Yes	No	No	Yes	Yes	No	No	<0.3% d9-THC
24B-581	NA	Yes	No	No	No	Yes	No	No	Yes	<0.3% d9-THC
24B-582	NA	Yes	No	No	No	Yes	Yes	No	No	
24B-584	NA	Yes	No	Unknown	No	Yes	Yes	No	Yes	Contains MCT oil; may be derived from an allergen
24B-585	Yes	Yes	Yes	No	No	Yes	No	No	Yes	
24B-586	NA	No	No	Yes	No	Yes	No	No*	No	Largely illegible text
24B-587	NA	No	No	Yes	No	Yes	No	No*	No	Largely illegible text
24B-588	NA	No	No	Yes	No	Yes	No	No*	No	Largely illegible text
24B-589	NA	Yes	Yes	Yes	No	Yes	No	No*	No	
24B-590	NA	Yes	Yes	No	No	Yes	Yes	No	Yes	
24B-591	Unknown	No	No	Yes	Yes	Yes	No	No*	No	Says it reduces anxiety (health claim); "THC free"; no test results available to verify if product is "adult use"
24B-592	NA	Yes	Yes	Unknown	No	Yes	No	No*	Yes	Says <0.3% THC; included ingredient list despite using supplement template
24B-593	NA	Yes	No	No	No	Yes	No	No*	Yes	Says <0.3% THC
24B-594	NA	Yes	No	No	No	Yes	No	Yes	No	Says <0.3% THC
24B-595	NA	Yes	No	Unknown	No	Yes	No	Yes	No	Says <0.3% THC
24B-596	NA	No	No	Unknown	No	Yes	No	Yes	Yes	Says <0.3% THC
24B-597	NA	Yes	No	Unknown	No	Yes	No	Yes	Yes	Says <0.3% THC
24B-598	NA	No	No	Yes	No	Yes	No	No	No	Says <0.3% THC; no test results available to verify if product is "adult use"
24B-599	NA	Yes	Yes	Yes	No	Yes	No	No	No	Says <0.03% THC; no test results available to verify if product is "adult use"
24B-600	NA	Yes	No	Unknown	Yes*	Yes	Yes	No	Yes	Says "Organic" on front of label, but no organic symbol; illegible text (right side of package)
24B-601	NA	No	Yes	No	No	Yes	No	No	Yes	Smiley faces on back of label
24B-602	*Unavailable*	*Unavailable*	No	No	*Unavailable*	*Unavailable*	No	No	*Unavailable*	Not available during packaging and labeling review; available data based on product photos
24B-603	NA	No	Yes	Unknown	Yes	Yes	No	No	No	CBD concentration on label is much lower than COA indicates
24B-605	NA	Yes	No	Unknown	Yes	Yes	No	No*	Yes	Label says <0.3% THC but potency (3600 mg ÷ 75 g) is >4% THC; product is expired

Sample ID	Product	Adult Use	Purchased	Label Type	Clear Potency	Prohibited Potency	Link to Lab Results	Identified Serving Size	Prohibited Active Ingredients	Prohibited Ingredient Notes
24B-606	SUNMED NEURO GUMMIES	Yes	In Person	Supplement	No	Other	No	Yes	No	
24B-607	PEACHES & DREAM INFUSED GUMMIES D9 EDIBLE 10CT HYBRID	Yes	Online	Food	No	Yes	No	Yes	No	
24B-608	BUDD CBD DREAM DROPS	No	In Person	Food	Yes	No	No	Yes	Yes	Melatonin
24B-609	WATERMELON HEMP GUMMIES 1:1 CBD:D9 20MG EA 10CT	Yes	Online	Unclear	No	Yes	No	No	Unknown	No ingredients
24B-610	HASH HOUSE GEM LIVE ROSIN HHC GUMMIES 500MG WATERMELON 10CT	Yes	Online	Unclear	No	Yes	No	Yes	No	
24B-611	SOLUTION PREMIUM CBD GUMMIES 30CT	Unknown	In Person	Supplement	Yes	No	No	Yes	No	
24B-612	12MG D9 THC EDIBLES	Yes	Online	Unclear	Yes	Yes	No	Yes	Unknown	No ingredients
24B-615	URB D9 THC GUMMIES DRAGONBERRY LEMONADE 10MG EA 35CT	Yes	In Person	Food	Yes	Yes	Yes	Yes	No	
24B-616	DELTA BOSS D8 WATERMELON WEDGE 500MG	Yes	In Person	Food	No	Yes	No	Yes	No	
24B-617	KINGDOM CANNABINOIDS THE DAY TRIPPER HHC 25MG 5CT	Yes	In Person	Supplement	Yes	Yes	No	Yes	No	
24B-618	WORKMANS RELIEF PUNCH IN 25MG CBD	Yes	In Person	Supplement	Yes	No	No	Yes	No	
24B-619	BLUEBERRY CBD GUMMIES GREENGENE	Yes	In Person	Food	Yes	No	Yes	Yes	No	
24B-620	MAXTON HEALTH HEMP GUMMY BEARS	Unknown	In Person	Supplement	Yes	No	No	Yes	Yes	Melatonin
24B-621	PROCANA CBD BALANCE CHEWS	Unknown	In Person	Supplement	Yes	No	No	Yes	No	
24B-622	JUST CBD CBD+THC ORANGE SLICES	Yes	In Person	Supplement	No	Yes	No	Yes	No	
24B-656	CALIGREENGOLD GUMMIES 250MG THC 25CT	Yes	Online	Food	Yes	Yes	Yes	Yes	No	
24B-660	SEVENTH HILL CBG GUMIES 10CT WHITE PEACH	Yes	In Person	Food	No	No	Yes	No	No	
24B-661	NA ("25 MG BROAD SPEC")	Unknown	In Person	Unclear	No	No	No	No	Unknown	
24B-708	JOLLY RANCHER GUMMIES 600MG	Yes	Online	Unclear	No	Yes	No	No	Unknown	No ingredients
24B-729	BEARLY LEGAL D9 GUMMIES	Yes	Online	Unclear	Yes	Yes	No	Yes	Unknown	No ingredients
24B-733	HIXOTIC DELTA-9 THC GUMMIES 2CT - PEACH PEAR PUNCH	Yes	Online	Unclear	Yes	Yes	No	Yes	No	
24B-736	VENERA GUMMY THCA+D9+THCP - BLUE RASPBERRY	Yes	Online	Food	No	No	No	Yes	No	
24B-737	NICK'S NUGS OG D9 GUMMIES 10MG D9 + 75MG CBD EA 10CT	Yes	Online	Food	Yes	Yes	No	Yes	No	
24B-738	CONSIDERITFLOWER ARTISAN GUMMY INDICA REAL STRAIN FIX 1CT CHERRY	Yes	Online	Unclear	Yes	Yes	No	Yes	Unknown	No ingredients
24B-740	NORTHERN LIGHTS D9 THC STRAWBERRY PINEAPPLE GUMMIES 20PK	Yes	Online	*Unavailable*	Yes	Yes	*Unavailable*	No	*Unavailable*	

Sample ID	Allergens Disclosed	Child Resistance	Attractive to Minors (Label)	Attractive to Minors (Product Shape)	Health Claims or Misleading Claims	Warning Statements	Warning Symbol	ID Verification	Lot/Batch ID	General Notes
24B-606	NA	Yes	No	No	No	Yes	No	No*	Yes	CoA says 39mg of cannabinoids not 30. Label says "Less than 0.3% delta 9"
24B-607	NA	Yes	No	No	Yes	Yes	Yes	No	No	Serving size is 1 but label says "Take 1/2"
24B-608	NA	No	No	No	No	Yes	No	No*	Yes	Expired July 2024; "Zero-THC"
24B-609	Unknown	No	No	No	No	Yes	Yes	No	No	No ingredients listed
24B-610	NA	Yes	No	No	No	Yes	No	No	Yes	
24B-611	NA	No	No	Yes	No	Yes	No	No	No	Claims "THC-free"; no test results available to verify if product is "adult use"
24B-612	No ingredients	Yes	No	No	No	Yes	Yes	No	No	No ingredients listed; no manufacturer information
24B-615	NA	Yes	No	No	No	Yes	No	No	Yes	
24B-616	NA	No	No	Yes	No	Yes	No	No	No	Font illegible; image of smoking
24B-617	NA	Yes	No	Unknown	No	No	No	No	No	
24B-618	NA	Yes	No	Unknown	No	Yes	No	No*	No	Claims "Non-detect THC at <0.1%"; testing not sensitive enough to show <0.5 mg THC per package
24B-619	NA	No	No	Unknown	No	Yes	No	No*	No	Lab results do not match product (different lot/color)
24B-620	NA	No	Yes	Yes	Yes*	Yes	No	No*	No	"Organically grown"; gummy bear shape; "18+"; no test results available to verify if product is "adult use"
24B-621	NA	Yes	No	No	Yes	Yes	No	No*	Yes	Expired 3/12/23; no test results available to verify if product is "adult use"
24B-622	NA	Yes	No	No	No	Yes	Yes	No	Yes	Font size and color are nearly illegible
24B-656	Yes	No	No	No	No	Yes	No	No*	No	
24B-660	NA	Yes	No	Unknown	No	Yes	Yes	No	Yes	Testing not sensitive enough to show <0.5 mg THC per package
24B-661	Unknown	No	No	No	No	No	No	No	No	Not available during packaging and labeling review; available data based on product photos
24B-708	Unknown	No	No	No	No	No	No	No	No	Website claims 50mg per piece 600mg per gummy.
24B-729	Unknown	Yes	Yes	No	No	Yes	No	Yes	No	Smiley face on label; serving size is 1/4 of a gummy; no ingredients listed
24B-733	No	No	No	Unknown	No	Yes	No	No	No	Has ingredient list (like a food label) but no nutritional information panel
24B-736	No	No	No	Unknown	No	Yes	No	No	No	
24B-737	No	No	No	No	No	Yes	Yes	Yes	No	
24B-738	Unknown	No	No	No	No	No	No	Yes	Yes	
24B-740	*Unavailable*	*Unavailable*	No	No	*Unavailable*	Yes	No	No	*Unavailable*	Not available during packaging and labeling review; available data based on product photos

APPENDIX C: OPERATION CLEAN LEAF SAMPLE ORIGIN MAP

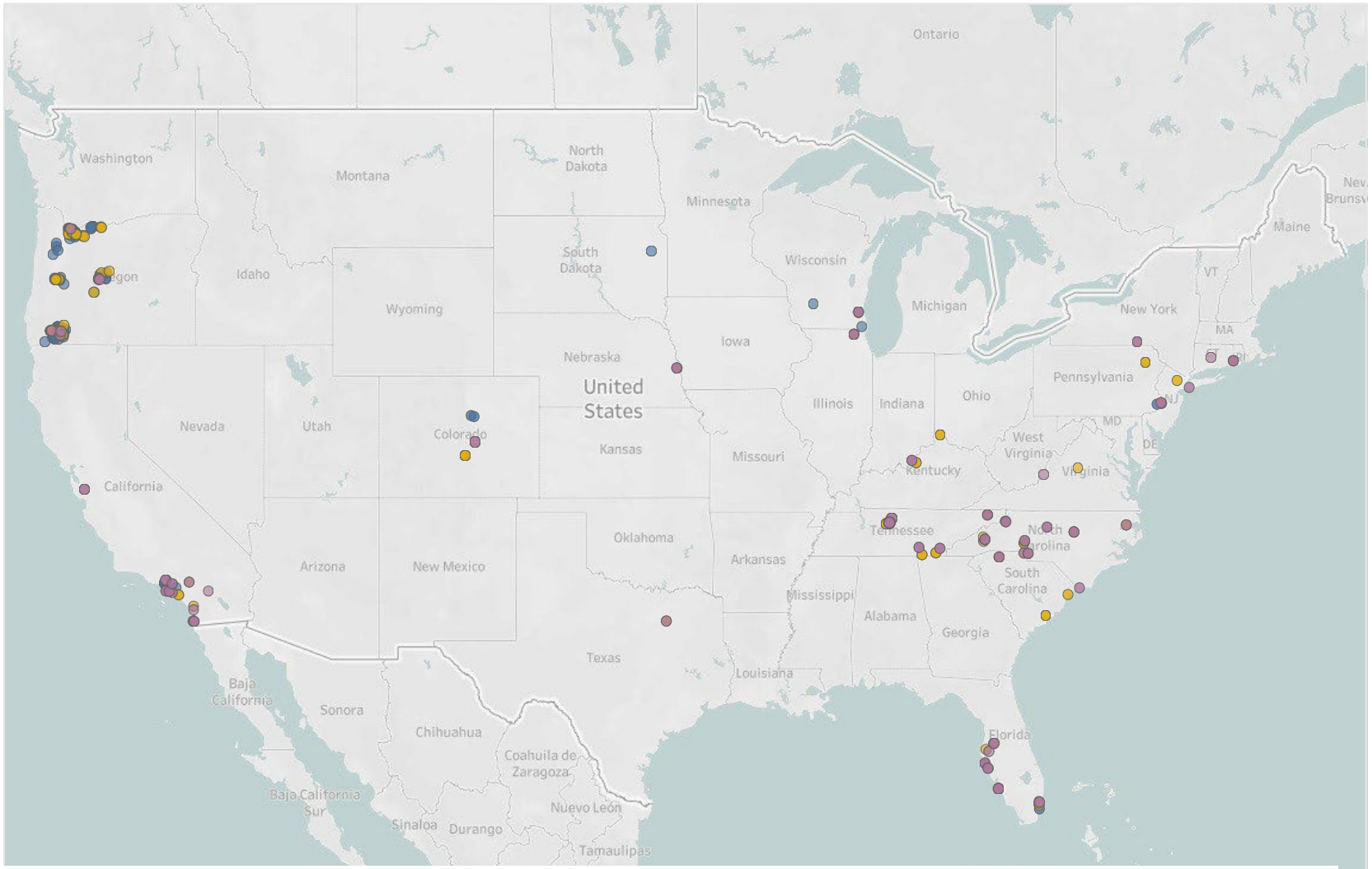


Figure 38. Map of latitude and longitude for the reported **shipping**, **ordering**, and **manufacturing** locations of cannabis samples collected for Operation Clean Leaf

APPENDIX D: HEMP LABEL CLAIM VS CRL TESTING RESULT COMPARISON

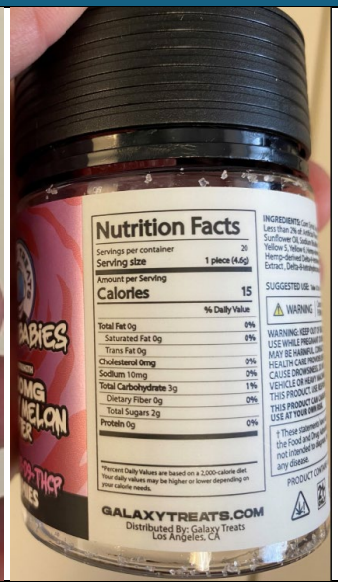
Label Photo: 24B-568	Label Claim	CRL Results
	Weight: 28.3 g Piece Count: NA **Potency Claim:** "THC": 600 mg/package	Weight: 41 g Piece Count: 5 **Potency:** Delta-8-THC: 75.25 mg/package 15.05 mg/piece
Label Photo: 24B-580	**Label Claim**	**CRL Results**
	Weight: 20.7 g Piece Count: 5 **Potency Claim:** Delta-9-THC: 10 mg/piece	Weight: 22.5 g Piece Count: 5 **Potency** Delta-9-THC: 11.12 mg/piece 55.62 mg/package Delta-8-THC: 1.80 mg/piece 9.01 mg/package CBD: 0.11 mg/piece 0.56 mg/package CBN: 0.3 mg/piece 1.5 mg/package

Label Photo: 24B-581	Label Claim	CRL Results
	Weight: 158 g Piece Count: 40 **Potency Claim:** Delta-9-THC: 10 mg/piece 400 mg/package CBD: 15 mg/piece 600 mg/package	Weight: 156 g Piece Count: 40 **Potency:** Delta-9-THC: 6.44 mg/piece 257.4 mg/package CBD: 0.39 mg/piece 15.7 mg/package
Label Photo: 24B-582 (Day)	**Label Claim**	**CRL Results**
	Weight: NA Piece Count: 3 **Potency Claim:** Delta-9-THC: 10 mg/piece 30 mg/package CBD: 10 mg/piece 30 mg/package Delta-10-THC: 10 mg/piece 30 mg/package	Weight: 15.6 g Piece Count: 3 **Potency:** Delta-9-THC: 7.77 mg/piece 23.3 mg/package CBD: 7.75 mg/piece 23.2 mg/package Delta-8-THC: 2.34 mg/piece 7.0 mg/package HHC: 0.18 mg/piece 0.53 mg/package CBN: 0.63 mg/piece 1.9 mg/package CBG: 0.19 mg/piece 0.57 mg/package

Label Photo: 24B-583 (Night)	Label Claim	CRL Results
	Weight: NA Piece Count: 3 **Potency Claim:** Delta-9-THC: 10 mg/piece 30 mg/package CBD: 10 mg/piece 30 mg/package	Weight: 15.9 g Piece Count: 3 **Potency:** Delta-9-THC: 8.25 mg/piece 24.8 mg/package CBD: 8.48 mg/piece 25.4 mg/package Delta-8-THC: 0.21 mg/piece 0.62 mg/package
Label Photo: 24B-584	**Label Claim**	**CRL Results**
	Weight: 42.7 g Piece Count: 10 **Potency Claim:** Delta-9-THC: 10 mg/piece (“Approx.”) HHC: 90 mg/piece (“Approx.”)	Weight: 42.85 g Piece Count: 10 **Potency:** Delta-9-THC: 7.404 mg/piece 74.04 mg/package HHC: 74.59 mg/piece 745.9 mg/package Delta-8-THC: 1.307 mg/piece 13.07 mg/package CBD: 0.915 mg/piece 9.15 mg/package

Label Photo: 24B-585	Label Claim	CRL Results
	Weight: 75 g Piece Count: 10 **Potency Claim:** Delta-9-THC: 20 mg/piece 200 mg/package HHC: 80 mg/piece 800 mg/package CBD: 50 mg/piece 500 mg/package	Weight: 70.2 g Piece Count: 10 **Potency:** Delta-9-THC: 16.25 mg/piece 162.5 mg/package HHC: 83.34 mg/piece 833.4 mg/package CBD: 41.77 mg/piece 417.7 mg/package
Label Photo: 24B-586	**Label Claim**	**CRL Results**
	Weight: 13.3 g Piece Count: 20 **Potency Claim:** Delta-8-THC: 100 mg/piece 2000 mg/package	Weight: 25.78 g Piece Count: 20 **Potency:** Delta-8-THC: 17.21 mg/piece 344.2 mg/package

Label Photo: 24B-587	Label Claim:	CRL Results
	Weight: 13.3 g Piece Count: 20 **Potency Claim:** THCO: 100 mg/piece 2000 mg/package	Weight: 26.18 g Piece Count: 22 **Potency:** Delta-8-THC: 13.28 mg/piece 292.1 mg/package CBN: 0.399 mg/piece 7.46 mg/package
Label Photo: 24B-588	**Label Claim**	**CRL Results**
	Weight: 13.3 g Piece Count: 20 **Potency Claim:** HHC: 100 mg/piece 2000 mg/package	Weight: 28.98 g Piece Count: 23 **Potency:** Delta-8-THC: 16.04 mg/piece 368.9 mg/package CBN: 0.364 mg/piece 8.37 mg/package

Label Photo: 24B-589	Label Claim	CRL Results
 	Weight: 22 g Piece Count: 2 **Potency Claim:** Delta-9-THC: 20 mg/piece 40 mg/package Delta-8-THC: 20 mg/piece 40 mg/package	Weight:11.71 g Piece Count: 2 **Potency:** Delta-9-THC: 1.98 mg/piece 3.97 mg/package Delta-8-THC: 12.37 mg/piece 24.74 mg/package CBD: 10.88 mg/piece 21.75 mg/package CBN: 0.663 mg/piece 1.33 mg/package
Label Photo: 24B-590	**Label Claim**	**CRL Results**
 	Weight: 92 g Piece Count: 20 **Potency Claim:** “D8 + D9 + THCP” 125 mg/piece 2500 mg/package	Weight: 90.2 g Piece Count: 20 **Potency:** Delta-9-THC: 8.38 mg/piece 167.6 mg/package Delta-8-THC: 87.13 mg/piece 1743 mg/package

Label Photo: 24B-591	Label Claim	CRL Results
 	Weight: 371 g Piece Count: 50 **Potency Claim:** CBD: 20 mg/piece 1000 mg/package	Weight: 358.5 g Piece Count: 50 **Potency:** CBD: 18.1 mg/piece 905 mg/package
Label Photo: 24B-592	**Label Claim**	**CRL Results**
 	Weight: 50 g Piece Count: 10 **Potency Claim:** Delta-9-THC: 10 mg/piece 100 mg/package CBD: 10 mg piece 100 mg/package	Weight: 48.9 g Piece Count: 10 **Potency:** Delta-9-THC: 8.72 mg/piece 87.2 mg/package CBD: 9.49 mg/piece 94.9 mg/package Delta-8-THC: 0.335 mg/piece 3.35 mg/package

Label Photo: 24B-593	Label Claim	CRL Results
	Weight: 20 g Piece Count: 4 **Potency Claim:** Delta-9-THC: 5 mg/piece 20 mg/package	Weight: 21 g Piece Count: 4 **Potency:** Delta-9-THC: 3.66 mg/piece 14.7 mg/package Delta-8-THC: 0.214 mg/piece 0.856 mg/package CBD: 1.96 mg/piece 7.84 mg/package CBN: 2.21 mg/piece 8.83 mg/package CBG: 4.01 mg/piece 16.0 mg/package
Label Photo: 24B-594	**Label Claim**	**CRL Results**
	Weight: 148 g Piece Count: 20 **Potency Claim:** Delta-8-THC: 25 mg/piece 500 mg/package	Weight: 89.7 g Piece Count: 20 **Potency:** Delta-8-THC: 18.28 mg/piece 365.6 mg/package Delta-9-THC: 3.61 mg/piece 72.2 mg/package CBD: 0.47 mg/piece 9.3 mg/package

Label Photo: 24B-595	Label Claim	CRL Results
	Weight: 48.6 g Piece Count: 10 **Potency Claim:** Delta-9-THC: 10 mg/piece 100 mg/package CBD: 50 mg/piece 500 mg/package	Weight: 46 g Piece Count: 10 **Potency:** Delta-9-THC: 8.24 mg/piece 82.4 mg/package CBD: 39.17 mg/piece 391.7 mg/package
Label Photo: 24B-596	**Label Claim**	**CRL Results**
	Weight: 9.7 g Piece Count: 2 **Potency Claim:** Delta-9-THC 10 mg/piece 20 mg/package Delta-8-THC 39 mg/piece 78 mg/package THCP: 1 mg/piece 2 mg/package	Weight: 8.94 g Piece Count: 2 **Potency:** Delta-9-THC: 20.6 mg/piece 41.2 mg/package Delta-8-THC: 16.5 mg/piece 33.1 mg/package CBD: 1.69 mg/piece 3.38 mg/package

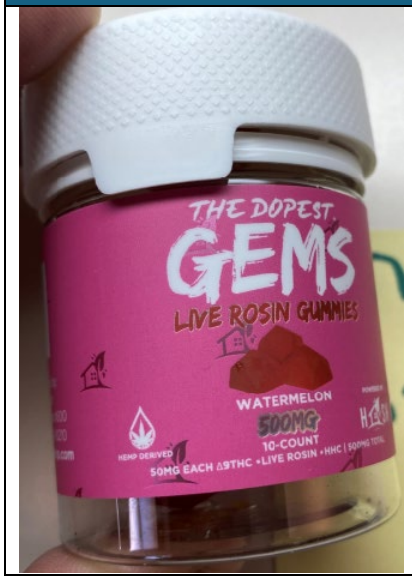
Label Photo: 24B-597	Label Claim	CRL Results
 	Weight: 93.6 g Piece Count: 12 **Potency Claim:** Delta-8-THC: 25 mg/piece 300 mg/package CBN: 15 mg/piece 180 mg/package	Weight: 58.8 g Piece Count: 12 **Potency:** Delta-8-THC: 22.83 mg/piece 273.9 mg/package CBN: 14.43 mg/piece 173.1 mg/package Delta-9-THC: 1.09 mg/piece 13.1 mg/package
Label Photo: 24B-598	**Label Claim**	**CRL Results**
 	Weight: 223 g Piece Count: "Approx" 60 **Potency Claim:** CBD: 500 mg/package	Weight: 242.8 g Piece Count: 71 **Potency:** CBD: 73.8 mg/package 1.04 mg/piece

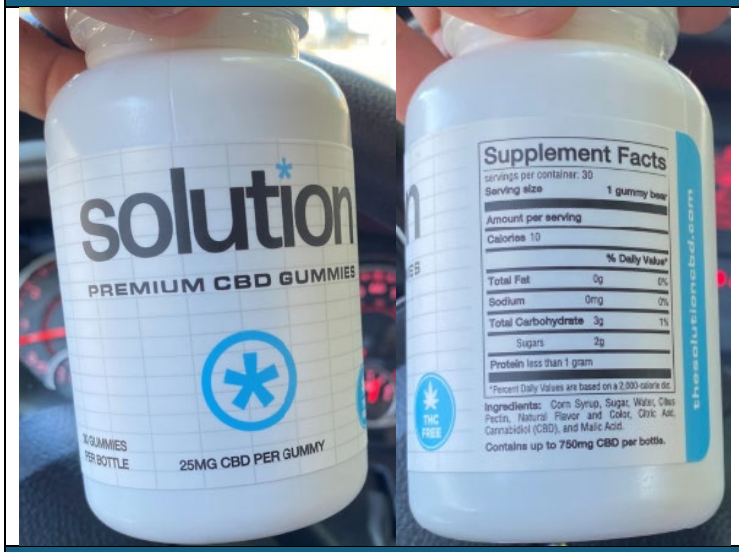
Label Photo: 24B-599	Label Claim	CRL Results
	Weight: 72 g Piece Count: 20 **Potency Claim:** CBD: 50 mg/piece 1000 mg/package	Weight: 89 g Piece Count: 20 **Potency:** CBD: 35.33 mg/piece 706.6 mg/package
Label Photo: 24B-600	**Label Claim**	**CRL Results**
	Weight: 15 g Piece Count: 3 **Potency Claim:** Delta-9-THC: 2.5 mg/piece 7.5 mg/package THCV: 2.5 mg/piece 7.5 mg/package CBG: 25 mg/piece 75 mg/package	Weight: 15.4 g Piece Count: 3 **Potency:** Delta-9-THC: 2.37 mg/piece 7.10 mg/package THCV: 3.71 mg/piece 11.1 mg/package CBG: 29.2 mg/piece 87.7 mg/package THCO: 0.64 mg/piece 1.9 mg/package

Label Photo: 24B-601	Label Claim	CRL Results
	Weight: 120 g Piece Count: 30 **Potency Claim:** Delta-9-THC: 2 mg/piece 60 mg/package CBD: 10 mg/piece 300 mg/package	Weight: 120 g Piece Count: 30 **Potency:** Delta-9-THC: 1.45 mg/piece 43.5 mg/package CBD: 9.64 mg/piece 289 mg/package
Label Photo: 24B-603	**Label Claim**	**CRL Results**
	Weight: 20 g Piece Count: 8 **Potency Claim:** CBD: 30 mg/piece 240 mg/package	Weight: 21.3 g Piece Count: 8 **Potency:** CBD: 29.93 mg/piece 239.4 mg/package

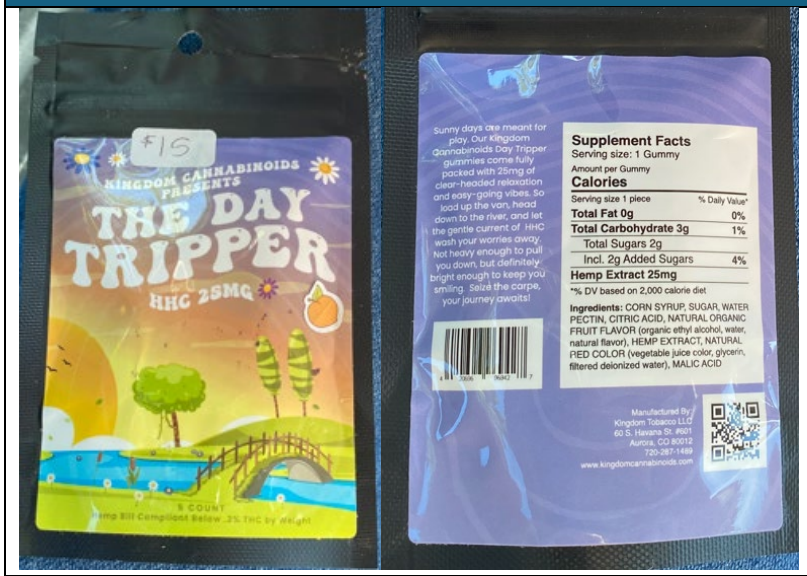
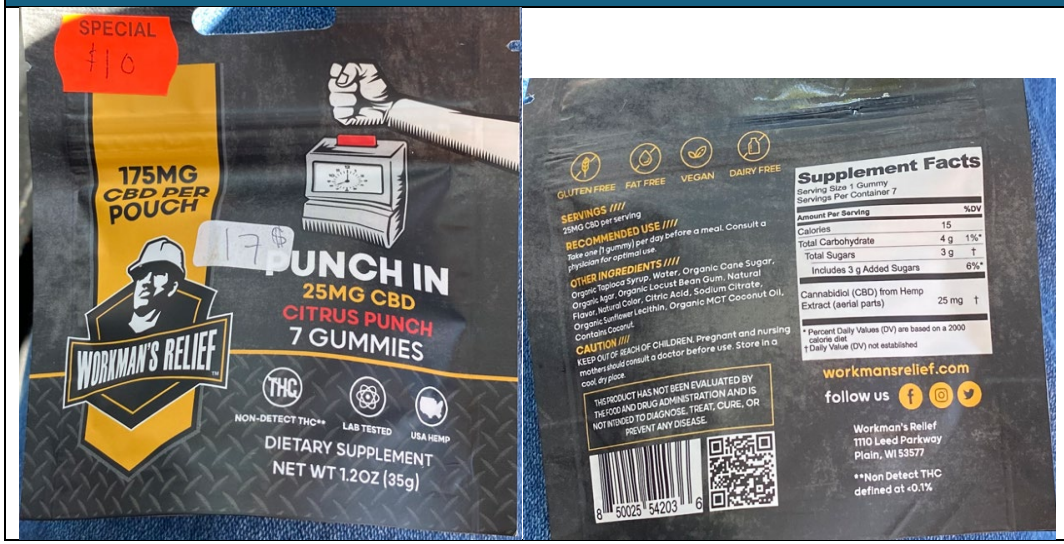
Label Photo: 24B-605	Label Claim	CRL Results
 	Weight: 75 g Piece Count: 10 **Potency Claim:** Delta-9-THC: 360 mg/piece 3600 mg/package	Weight: 82.5 g Piece Count: 11 **Potency:** HHC: 46.67 mg/piece 513.4 mg/package THCO: 34.62 mg/piece 380.8 mg/package
Label Photo: 24B-606	**Label Claim**	**CRL Results**
 	Weight: 30 g Piece Count: 5 **Potency Claim:** “Full Spectrum Hemp”: 30 mg/piece 150 mg/package	Weight: 25.8 g Piece Count: 5 **Potency:** Delta-9-THC: 0.429 mg/piece 2.15 mg/package CBD: 16.93 mg/piece 84.65 mg/package

Label Photo: 24B-607	Label Claim	CRL Results
 	Weight: 50 g Piece Count: 10 **Potency Claim:** Delta-8-THC: 50 mg/piece 500 mg/package	Weight: 44 g Piece Count: 10 **Potency:** Delta-8-THC: 41.06 mg/piece 410.6 mg/package Delta-9-THC: 3.02 mg/piece 30.2 mg/package
Label Photo: 24B-608	**Label Claim**	**CRL Results**
 	Weight: 49.6 g Piece Count: 20 **Potency Claim:** CBD: 25 mg/piece 500 mg/package	Weight: 40 g Piece Count: 20 **Potency:** CBD: 18.46 mg/piece 369.2 mg/package

Label Photo: 24B-609	Label Claim	CRL Results
 	Weight: NA Piece Count: 10 **Potency Claim:** "1:1 CBD / Delta-9-THC" 20 mg/piece 200 mg/package	Weight: 59.4 g Piece Count: 11 **Potency:** Delta-9-THC: 12.92 mg/piece 142.1 mg/package Delta-8-THC: 7.24 mg/piece 79.7 mg/package CBD: 28.17 mg/piece 309.9 mg/package
Label Photo: 24B-610	**Label Claim**	**CRL Results**
 	Weight: NA Piece Count: 10 **Potency Claim:** Delta-9-THC + HHC 50 mg/piece 500 mg/package	Weight: 37.6 g Piece Count: 10 **Potency:** HHC: 46.2 mg/piece 462 mg/package CBD: 0.867 mg/piece 8.67 mg/package CBG: 0.749 mg/piece 7.49 mg/package CBN: 1.43 mg/piece 14.3 mg/package

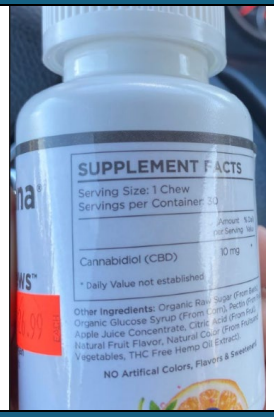
Label Photo: 24B-611	Label Claim	CRL Results
	Weight: NA Piece Count: 30 **Potency Claim:** CBD: 25 mg/piece 750 mg/package	Weight: 102 g Piece Count: 30 **Potency:** CBD: 28.45 mg/piece 853.62 mg/package
Label Photo: 24B-612, -613, and -614	**Label Claim**	**CRL Results**
	Weight: NA Piece Count: 25 **Potency Claim:** CBD: 12 mg/piece 300 mg/package Delta-9-THC: 12 mg/piece 300 mg/package	Weight: 130 g Piece Count: 25 **Potency:** CBD: 12.39 mg/piece 309.3 mg/package Delta-9-THC: 12.29 mg/piece 306.3 mg/package Delta-8-THC: 3.81 mg/piece 9.49 mg/package *Each color tested separately; results above are the mean average among the samples.*

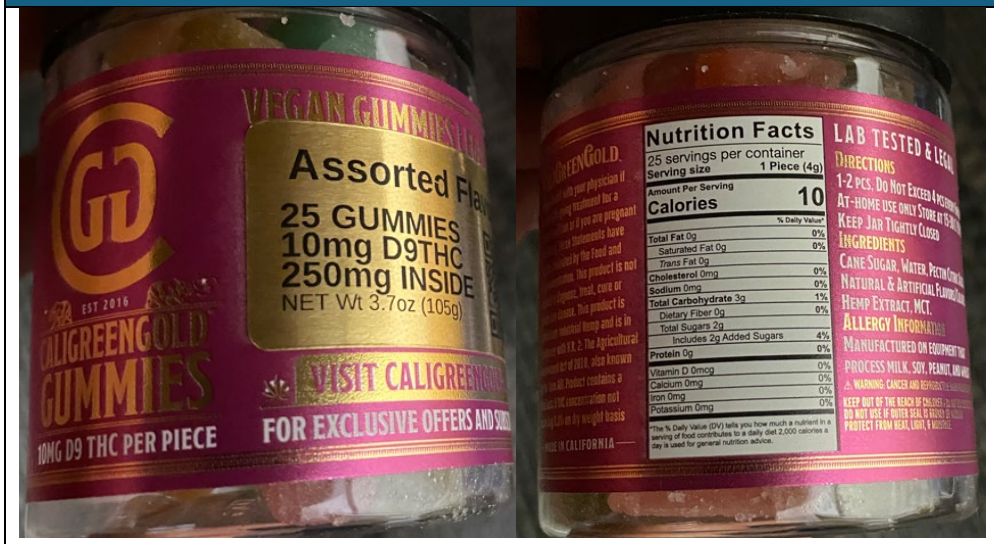
Label Photo: 24B-615	Label Claim	CRL Results
	Weight: 133 g Piece Count: 35 **Potency Claim:** Delta-9-THC: 10 mg/piece 350 mg/package	Weight: 142.5 g Piece Count: 37 **Potency:** Delta-9-THC: 7.67 mg/piece 284 mg/package Delta-8-THC: 0.243 mg/piece 8.99 mg/package CBD: 0.158 mg/piece 5.85 mg/package
Label Photo: 24B-616	**Label Claim**	**CRL Results**
	Weight: 170 g Piece Count: 20 **Potency Claim:** “Delta-8-THC, CBD, CBN, […] Delta-9-THC”: 25 mg/piece 500 mg/package	Weight: 126.4 g Piece Count: 20 **Potency:** Delta-8-THC: 33.78 mg/piece 675.6 mg/package CBN: 0.277 mg/piece 5.54 mg/package

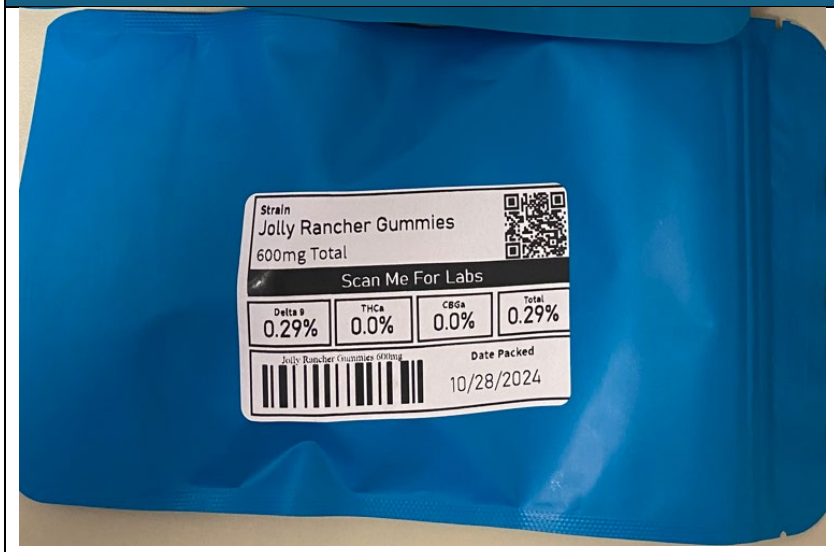
Label Photo: 24B-617	Label Claim	CRL Results
	Weight: NA Piece Count: 5 **Potency Claim:** HHC: 25 mg/piece	Weight: 29 g Piece Count: 10 **Potency:** HHC: 14.6 mg/piece 146 mg/package Delta-8-THC: 0.729 mg/piece 7.29 mg/package
Label Photo: 24B-618	**Label Claim**	**CRL Results**
	Weight: 35 g Piece Count: 7 **Potency Claim:** CBD: 25 mg/piece 175 mg/package	Weight: 30.8 g Piece Count:7 **Potency:** CBD: 20.28 mg/piece 141.92 mg/package

Label Photo: 24B-619	Label Claim	CRL Results
 	Weight: 6 oz (170 g) Piece Count: 20 **Potency Claim:** "Full Spectrum" CBD: 50 mg/piece 1000 mg/package	Weight: 107.1 g Piece Count: 21 **Potency:** Delta-9-THC: 2.15 mg/piece 45.2 mg/package CBD: 42.3 mg/piece 888 mg/package

Label Photo: 24B-620	Label Claim	CRL Results
 	Weight: NA Piece Count: 6 **Potency Claim:** CBD: 25 mg/piece 150 mg/package	Weight: 14.4 g Piece Count: 6 **Potency:** CBD: 9.79 mg/piece 58.7 mg/package

Label Photo: 24B-621	Label Claim	CRL Results
 	Weight: NA Piece Count: 30 **Potency Claim:** CBD: 10 mg/piece 300 mg/package	Weight: 126 g Piece Count: 30 **Potency:** CBD: 9.38 mg/piece 281 mg/package
Label Photo: 24B-622	**Label Claim**	**CRL Results**
 	Weight: 78 g Piece Count: "Approx." 11 **Potency Claim:** "CBD*" 15 mg/piece "THC*" 15 mg/piece *"...FULL SPECTRUM THC PROPRIETARY BLEND (D8-THC, D10-THC, & HHC)..."*	Weight: 75.9 g Piece Count: 11 **Potency:** CBD: 22.57 mg/piece 248.3 mg/package Delta-9-THC: 1.094 mg/piece 12.03 mg/package Delta-8-THC: 4.14 mg/piece 45.5 mg/package HHC: 7.97 mg/piece 87.7 mg/package CBN: 1.21 mg/piece 13.3 mg/package CBG: 0.457 mg/piece 5.03 mg/package

Label Photo: 24B-656	Label Claim	CRL Results
	Weight: 105 g Piece Count: 25 **Potency Claim:** Delta-9-THC: 10 mg/piece 250 mg/package	Weight: 103 g Piece Count: 25 **Potency:** Delta-9-THC: 9.37 mg/piece 234 mg/package Delta-8-THC: 0.34 mg/piece 8.6 mg/package CBN: 0.094 mg/piece 2.4 mg/package
Label Photo: 24B-660	**Label Claim**	**CRL Results**
	Weight: NA Piece Count: 10 **Potency Claim:** CBG: 10 mg/piece 100 mg/package	Weight: 56.6 Piece Count: 10 **Potency:** CBG: 8.69 mg/piece 86.9 mg/package Delta-9-THC: 0.242 mg/piece 2.42 mg/package CBD: 0.262 mg/piece 2.62 mg/package

Label Photo: 24B-708	Label Claim	CRL Results
	Weight: NA Piece Count: NA **Potency Claim:** "Total": 600 mg Delta-9-THC: 0.29%	Weight: 63.7 g Piece Count: 13 **Potency:** Delta-9-THC: 25.5 mg/piece 331 mg/package CBD: 0.392 mg/piece 5.10 mg/package CBN: 2.34 mg/piece 30.4 mg/package CBG: 2.15 mg/piece 28.0 mg/package
Label Photo: 24B-729	**Label Claim**	**CRL Results**
	Weight: NA Piece Count: 25 **Potency Claim:** Delta-9-THC: 10 mg/piece 250 mg/package	Weight: 133.3 g Piece Count: 25 **Potency:** Delta-9-THC: 9.781 mg/piece 244.5 mg/package Delta-8-THC: 1.54 mg/piece 38.5 mg/package

Label Photo: 24B-733	Label Claim	CRL Results
 	Weight: 10 g Piece Count: 2 **Potency Claim:** Delta-9-THC: 15 mg/piece 30 mg/package CBD: 15 mg/piece 30 mg/package	Weight: 9.64 g Piece Count: 2 **Potency:** Delta-9-THC: 7.98 mg/piece 15.96 mg/package CBD: 7.84 mg/piece 15.67 mg/package

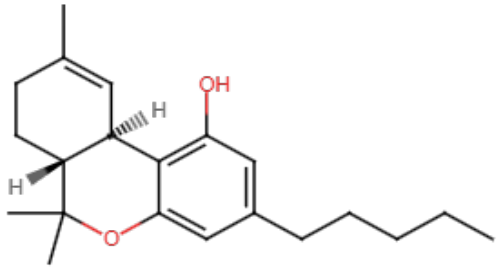
Label Photo: 24B-736	Label Claim	CRL Results
 	Weight: 9.4 g Piece Count: 2 **Potency Claim:** THCA+D9+THCP: 600 mg/piece 1200 mg/package	Weight: 9.12 g Piece Count: 2 **Potency:** Delta-8-THC: 111.9 mg/piece 223.9 mg/package Delta-9-THC: 7.25 mg/piece 14.5 mg/package

Label Photo: 24B-737	Label Claim	CRL Results
	Weight: 50 g Piece Count: 10 **Potency Claim:** Delta-9-THC: 10 mg/piece 100 mg/package CBD: 75 mg/piece 750 mg/package	Weight: 43.6 g Piece Count: 9 **Potency:** Delta-9-THC: 9.94 mg/piece 89.5 mg/package CBD: 63.9 mg/piece 575 mg/package CBN: 0.23 mg/piece 2.3 mg/package CBG: 0.53 mg/piece 5.3 mg/package
Label Photo: 24B-738	**Label Claim**	**CRL Results**
	Weight: NA Piece Count: 1 **Potency Claim:** Delta-9-THC: 10 mg/piece 10 mg/package	Weight: 3.61 g Piece Count: 1 **Potency:** Delta-9-THC: 7.9 mg/piece 7.9 mg/package CBD: 0.28 mg/piece 0.28 mg/package CBN: 0.20 mg/piece 0.20 mg/package

Label Photo: 24B-740	Label Claim	CRL Results
 	Weight: 70 g Piece Count: 20 **Potency Claim:** Delta-9-THC: 10 mg/piece 200 mg/package	Weight: 65.7 g Piece Count: 21 **Potency:** Delta-9-THC: 5.51 mg/piece 116 mg/package CBD: 0.151 mg/piece 3.17 mg/package CBN: 0.753 mg/piece 15.8 mg/package CBG: 0.29 mg/piece 6.1 mg/package

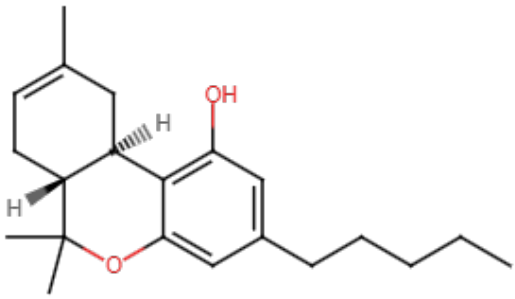
APPENDIX E: CANNABINOID INDEX

The following cannabinoids are referenced in this report:



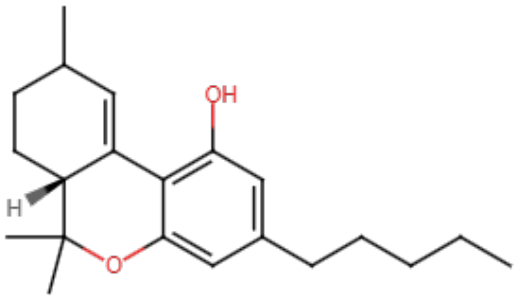
Delta-9-THC (Δ^9-THC)

CAS #: 1972-08-3
Other names: delta-9-tetrahydrocannabinol; (6a*R*,10a*R*)-delta-9-tetrahydrocannabinol; (−)-*trans*-Δ^9-tetrahydrocannabinol
IUPAC name: (6a*R*,10a*R*)-6,6,9-trimethyl-3-pentyl-6a,7,8,10a-tetrahydro-6*H*-benzo[*c*]chromen-1-ol



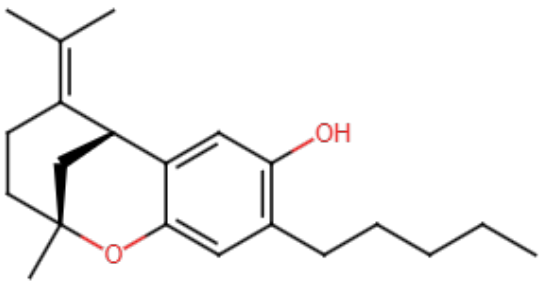
Delta-8-THC (Δ^8-THC)

CAS #: 5957-75-5
Other names: delta-8-tetrahydrocannabinol; (6a*R*,10a*R*)-delta-8-tetrahydrocannabinol; (−)-*trans*-Δ^8-tetrahydrocannabinol
IUPAC name: (6a*R*,10a*R*)-6,6,9-trimethyl-3-pentyl-6a,7,10,10a-tetrahydro-6*H*-benzo[c]chromen-1-ol



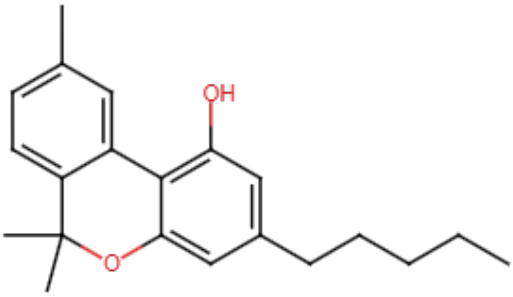
Delta-10-THC (Δ^{10}-THC)

CAS #: 95543-62-7
Other names: delta-10-tetrahydrocannabinol; (6a*R*,9*R*)-delta-10-tetrahydrocannabinol
IUPAC name: (6a*R*,9*R*)-6,6,9-trimethyl-3-pentyl-6a,7,10,10a-tetrahydro-6*H*-benzo[*c*]chromen-1-ol



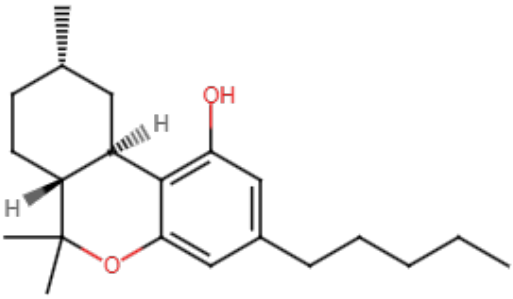
Delta-4(8)-*iso*-THC ($\Delta^{4(8)}$-*iso*-THC)

CAS #: 23050-59-1
Other names: delta-4(8)-isotetrahydrocannabinol
IUPAC name: (1*R*,9*R*)-9-methyl-5-pentyl-12-propan-2-ylidene-8-oxatricyclo[7.3.1.$0^{2,7}$]trideca-2,4,6-trien-3-ol



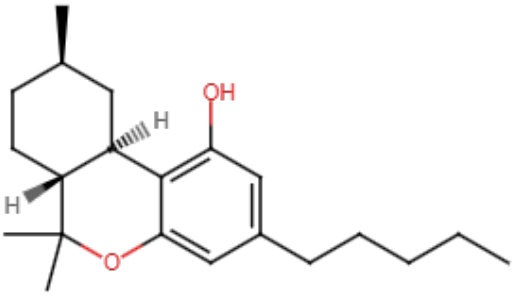
CBN

CAS #: 521-35-7
Other names: cannabinol
IUPAC name: 6,6,9-trimethyl-3-pentylbenzo[*c*]chromen-1-ol



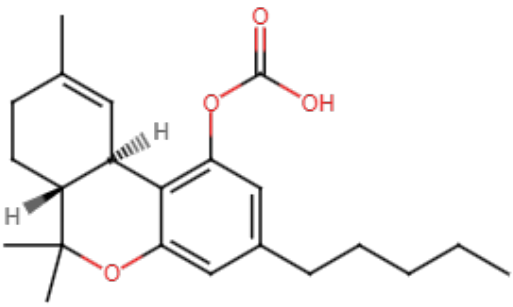
9*S*-HHC

CAS #: 946512-74-9[58]
Other names: 9*S*-hexahydrocannabinol
IUPAC name: (6*aR*,9*S*,10*aR*)-6,6,9-trimethyl-3-pentyl-6*a*,7,8,9,10,10*a*-hexahydrobenzo[*c*]chromen-1-ol



9*R*-HHC

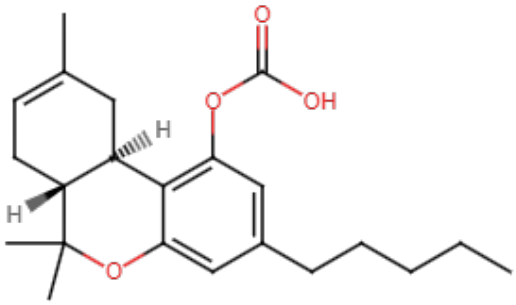
CAS #: 946512-74-9[59]
Other names: 9*R*-hexahydrocannabinol
IUPAC name: (6*aR*,9*R*,10a*R*)-6,6,9-trimethyl-3-pentyl-6*a*,7,8,9,10,10*a*-hexahydrobenzo[*c*]chromen-1-ol



Delta-9-THCO (Δ^9-THCO)

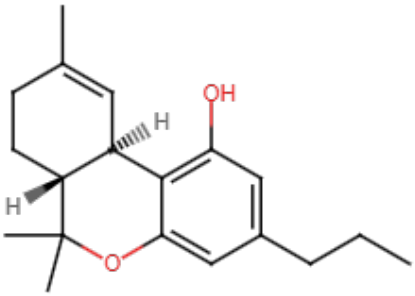
CAS #: 23132-17-4
Other names: delta-9-THC-O-acetate;
delta-9-THC acetate;
delta-9-tetrahydrocannabinol acetate
IUPAC name: [(6*aR*,10*aR*)-6,6,9-trimethyl-3-pentyl-6*a*,7,8,10*a*-tetrahydrobenzo[*c*]chromen-1-yl] acetate

[58] This CAS # refers to HHC generally, not specifically to either one of the isomers of interest
[59] This CAS # refers to HHC generally, not specifically to either one of the isomers of interest



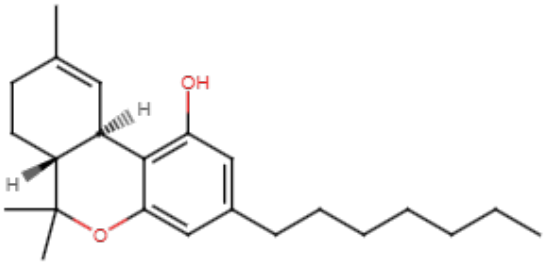
Delta-8-THCO (Δ^8-THCO)

CAS #: 23050-54-6
Other names: delta-8-THC-O-acetate;
delta-8-THC acetate;
delta-8-tetrahydrocannabinol acetate
IUPAC name: [(6*aR*,10*aR*)-6,6,9-trimethyl-3-pentyl-6*a*,7,10,10*a*-tetrahydrobenzo[*c*]chromen-1-yl] acetate



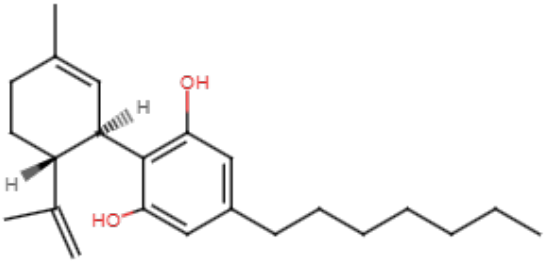
Delta-9-THCV (Δ^9-THCV)

CAS #: 31262-37-0
Other names: delta-9-tetrahydrocannabivarin;
Δ^9-THC-C3
IUPAC name: (6*aR*,10*aR*)-6,6,9-trimethyl-3-propyl-6*a*,7,8,10*a*-tetrahydrobenzo[*c*]chromen-1-ol



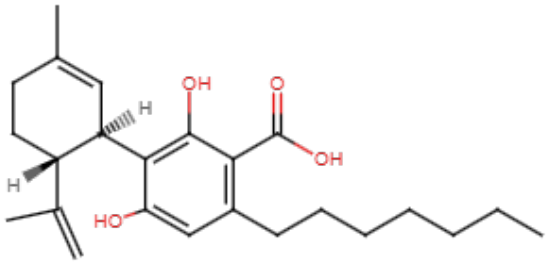
Delta-9-THCP (Δ^9-THCP)

CAS #: 54763-99-4
Other names: delta-9-tetrahydrocannabiphorol;
Δ^9-THC-C7
IUPAC name: (6*aR*,10*aR*)-3-heptyl-6,6,9-trimethyl-6*a*,7,8,10*a*-tetrahydrobenzo[*c*]chromen-1-ol



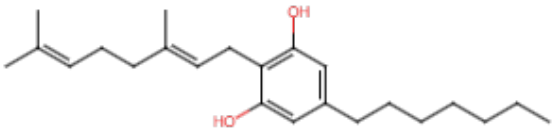
CBD

CAS #: 13956-29-1
Other names: cannabidiol;
(−)-trans-cannabidiol
IUPAC name: 2-[(1*R*,6*R*)-3-methyl-6-prop-1-en-2-ylcyclohex-2-en-1-yl]-5-pentylbenzene-1,3-diol



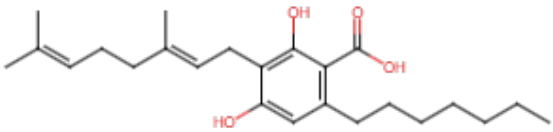
CBDA

CAS #: 1244-58-2
Other names: cannabidiolic acid
IUPAC name: 2,4-dihydroxy-3-[(1*R*,6*R*)-3-methyl-6-prop-1-en-2-ylcyclohex-2-en-1-yl]-6-pentylbenzoic acid



CBG

CAS #: 25654-31-3
Other names: cannabigerol
IUPAC name: 2-[(2*E*)-3,7-dimethylocta-2,6-dienyl]-5-pentylbenzene-1,3-diol



CBGA

CAS #: 25555-57-1
Other names: cannabigerolic acid
IUPAC name: 3-[(2*E*)-3,7-dimethylocta-2,6-dienyl]-2,4-dihydroxy-6-pentylbenzoic acid

APPENDIX F: EXTRACTION AND ANALYSIS OF CANNABINOIDS

FLOWERS

Flowers were frozen using liquid nitrogen and ground to a fine powder. 0.2 g was transferred to a 50 mL polypropylene tube. 20 mL of methanol (containing 200 µg/mL of biphenyl as an internal standard) was added. The tubes were shaken for 30 minutes and were then centrifuged. A 10 µL portion was diluted to 1 mL using methanol for a 100-fold final dilution. 5 µL was analyzed by HPLC using the conditions below.

GUMMIES

Gummy samples (3–5 pieces) were frozen using liquid nitrogen and ground to a fine powder. A 1 g portion was transferred to a 15 mL polypropylene tube followed by dissolution in 5 mL of water containing 1% (v/v) acetic acid. During development it was determined that acidification greatly improves the recovery of acidic cannabinoids. The tubes were heated at 65 °C and were intermittently vortexed until the candy was fully dissolved. 5 mL of 3:1 acetonitrile: methyl-tertbutyl ether was added followed by vigorous shaking. 3.25 g of QuEChERS salts (European Method EN 15662) was added followed by shaking and centrifugation. The top layer was fully removed to a clean tube. The liquid: liquid extraction step (minus addition of salts) was repeated two more times, and each time the upper layer was combined into the same tube from step 1 for a total of three repeated extractions of the aqueous layer. During development we observed that three extractions were necessary to quantitatively and repeatedly recover spiked cannabinoids. The final combined organic layers were diluted to 25 mL using acetonitrile. 5 µl was analyzed by HPLC using the conditions described below.

TABLE F1: HPLC CONDITIONS:

Column	Ascentis Express 90 Å C18, 150mm x 2.1 mm x 2 µm
Temperature	40 °C
Mobile phase	A: water with 0.1% phosphoric acid
	B: acetonitrile
Flow	0.75 mL/min
Gradient	60% B to 95% B over 10 minutes followed by a 1 minute hold at 95%.
Detection	240 nM (16 nM bandwidth), 4 nM slit
Injection	5 µL