



Cannabis Testing Services

June 2021

Keystone Labs is a GMP testing facility established in 2005, serving the cannabis industry since 2015 by providing analytical testing services with the highest data integrity. Our pharmaceutical level requirements for validation, data integrity, instrument calibration, and documentation ensure we meet and exceed expectations of Health Canada. Keystone offers the Health Canada full suite of required compliant testing and additional services such as Environmental Monitoring, Stability Studies, additional microbiology testing, and terpene analysis. We follow our validated methods and the US and European Pharmacopoeia, and deliver a fully reviewed Certificate of Analysis to all our customers. Keystone is your lab partner and an extension of your cannabis production team.

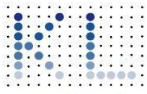
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ANALYTICAL TESTING

*(Health Canada required for regulated facilities)

*Cannabinoid Profile and Potency Testing

Health Canada requires the potency of THC and CBD for labelling purposes. Keystone's testing provides data on the potency level of the ten cannabinoids listed below, or total THC and total CBD.

Keystone Labs offers accurate quantification of cannabinoids using High Performance Liquid Chromatography (HPLC). The HPLC does not heat up the sample, therefore, any acid cannabinoid compounds, such as THC-A will remain in their natural form. This allows accurate quantification of all the acid (THC-A) and neutral (THC) forms of the client's cannabinoid profile and potency.

Instrumentation:

Agilent HPLC with Ultraviolet Detection (UVD)

Δ 9 –Tetrahydrocannabinol (Δ 9-THC)
Tetrahydrocannabinolic acid (THCA)
Cannabidiol (CBD)
Cannabidiolic acid (CBDA)
Cannabichromene (CBC)

Cannabigerol (CBG)
Cannabigerolic acid (CBGA)
Cannabidivarin (CBDV)
Cannabinol (CBN)
Tetrahydrocannabivarin (THCV)

*Visual Examination

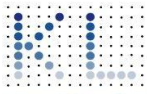
The visual inspection of raw cannabis material will document the size and shape of the bud and leaves, colour of the leaves, and the presence or absence of trichomes and stigma. An examination is performed to determine the presence or absence of foreign material (evidence of vermin or extraneous substances).

*Loss on Drying (Moisture Content)

The weight of volatile impurities relative to the total weight of the sample assessed by drying the sample in an oven.

*Microbial Analysis

Testing is performed according to current USP <2021> and <2022>, and/or EP 2.6.12 and EP 2.6.31 procedures as per client requirements. Microbial testing includes enumeration of Total Yeast and Mold, Bile Tolerant Organisms and Total Aerobic Organisms as well as the Absence of Escherichia coli, and Salmonella species.



Terpenes

Terpenes are fragrant oils that give cannabis its aromatic and flavour characteristics. Trichomes secrete these compounds and like cannabinoids, they bind to receptors in the brain that create numerous effects. Science and technology give us a better understanding of the beneficial interactions between terpenes and cannabinoids.

Instrumentation:

Agilent Gas Chromatography – Mass Spectrometer (GC-MS) with Headspace

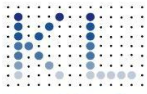
Borneol	Fenchol	trans-Nerolidol
Camphor	Fenchone	beta-Ocimene
Camphene	Guaiol	alpha-Phellandrene
(1S)-(+)-3-Carene	alpha-Humulene	alpha-Pinene
Geranyl Acetate	Isoborneol	beta-Pinene
beta-Caryophyllene	(R)-(+)-Limonene	Sabinene
alpha-Cedrene	Linalool	alpha-Terpinene
(+)-Cedrol	DL-Menthol	gamma-Terpinene
Eucalyptol	beta-Myrcene	Terpinolene
Farnesene	cis-Nerolidol	Valencene

*Aflatoxins

Aflatoxins are a family of naturally occurring toxins produced by *Aspergillus flavus* and *Aspergillus parasiticus*, which are abundant in warm and humid environments. These mycotoxins are poisonous and cancer-causing chemicals. Keystone Labs uses our in-house developed and validated LC-MS protocol to detect aflatoxins in parts per billion (ppb).

Instrumentation:

Agilent Liquid Chromatography – Mass Spectrometer (LC-MS)



***Pesticides**

Health Canada has listed 96 unauthorized pesticides that must be confirmed to be below the specified limit in cannabis products.

Instrumentation:

Agilent Liquid Chromatography – Mass Spectrometer (LC-MS) Agilent Gas Chromatography – Mass Spectrometer (GC-MS)

A list of the 96 pesticides detected by LC-MS/MS – GC-MS/MS.

Abamectin	Acephate	Acetamiprid	Acequinocyl
Aldicarb	Allethrin	Azadirachtin	Azoxystrobin
Benzovindiflupyr	Bifenazate	Bifenthrin	Boscalid
Buprofezin	Carbaryl	Carbofuran	Chlorantraniliprole
Chlorphenapyr	Chlorpyrifos	Clofentezine	Clothianidin
Coumaphos	Cyantranilipole	Cyfluthrin	Cypermethrin
Cyprodinil	Daminozide	Deltamethrin	Diazinon
Dichlorvos	Dimethoate	Dimethomorph	Dinotefuran
Dodemorph	Endosulfan-alpha	Endosulfan-beta	Endosulfan sulfate
Ethoprophos	Etofenprox	Etoxazole	Etridiazol
Fenoxycarb	Fenpyroximate	Fensulfothion	Fenthion
Fenvalerate	Fipronil	Flonicamid	Fludioxonil
Fluopyram	Hexythiazox	Imazalil	Imidacloprid
Iprodione	Kinoprene	Kresoxim-methyl	Malathion
Metalaxyl	Methiocarb	Methomyl	Methoprene
Methyl parathion	Mevinphos	MGK-264	Myclobutanil
Naled	Novaluron	Oxamyl	Paclobutrazol
Permethrin	Phenothrin	Phosmet	Piperonyl butoxide
Pirimicarb	Prallethrin	Propiconazole	Propoxur
Pyraclostrobin	Pyrethrins	Pyridaben	Quintozene
Resmethrin	Spinetoram	Spinosad	Spirodiclofen
Spiromesifen	Spirotetramat	Spiroxamine	Tebuconazole
Tebufenozide	Teflubenzuron	Tetrachlorvinphos	Tetramethrin
Thiacloprid	Thiamethoxam	Thiophanate-methyl	Trifloxystrobin

Price and Service List

Health Canada Required Testing	Description	Cost per sample
Visual Examination	<ul style="list-style-type: none"> Physical Identity Absence of Foreign Objects 	Contact Keystone for Pricing
Loss on Drying (Moisture Content)	<ul style="list-style-type: none"> Loss on Drying 	
Cannabinoid Potency	<ul style="list-style-type: none"> THC, THCA, CBD, CBDA <ul style="list-style-type: none"> *minimum required* 	
Microbial Enumeration	<ul style="list-style-type: none"> Total Aerobic Count Total Yeast and Mold Count Bile Tolerant Enumeration 	
Absence of Microbial Contaminants	<ul style="list-style-type: none"> <i>Escherichia coli</i> <i>Salmonella species</i> 	
Aflatoxins	<ul style="list-style-type: none"> Aflatoxin B1 Total Aflatoxins 	
Heavy Metal	<ul style="list-style-type: none"> Arsenic Mercury Lead Cadmium 	
Pesticides	<ul style="list-style-type: none"> 96 Pesticides specified by Health Canada 	
¹Residual Solvents	<ul style="list-style-type: none"> 28 Residual Solvents specified by Health Canada 	
Total:		

¹ Testing conducted for cannabis oil extraction using hydrocarbons only

Optional Testing	Description	Cost per sample
Cannabinoid Profile	<ul style="list-style-type: none"> Full 10 cannabinoids 	Contact Keystone for Pricing
Terpenes	<ul style="list-style-type: none"> 30 Terpenes 	
Absence of Microbial Contaminants	<ul style="list-style-type: none"> <i>Pseudomonas aeruginosa</i> <i>Staphylococcus aureus</i> 	
Environmental Monitoring (active air, passive air and surface contact sampling)	<i>Contact us for more information</i>	
Stability Studies	<i>Contact us for more information</i>	

Ask about Service Agreement discounts.

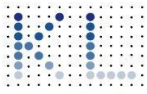
Sample Amounts Required for each Cannabis Test using USP or EP Methods

Test	Sample Amount USP Methods (grams for dry cannabis, mL for oil or capsules)	Sample Amount EP Methods (grams for dry cannabis, mL for oil or capsules)
Visual Examination	1	1
Loss on Drying (Moisture Content) ⁵	5	5
Cannabinoid Potency & Profile	1	1
Microbial Enumeration	10	10
Absence of Microbial Contaminants / BTGN	10	26
Aflatoxins	5	5
Heavy Metals	3	3
Pesticides	5	5
Terpenes	1	1
Total sample volume	41 grams or mL	57 gram or mL

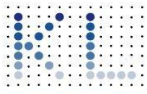
NOTE: The amounts of required sample sizes are specified in the Current United States Pharmacopeia (USP) and Current European Pharmacopeia (EP)

Methods and Specifications for Cannabis Testing

Test	Method (validated, USP or EP)	Specifications
Visual Examination	Visual Exam SOP-4002	Report Result
Loss on Drying (Moisture Content)	Loss on Drying USP <731>	Report Result
	Loss on Drying EP 2.2.32	Report Result
Potency	Validated method SOP-4033	Report <u>Total THC</u> in mg/g Report <u>Total CBD</u> in mg/g
Cannabinoid Profile	Validated method SOP-4033	Positive for cannabinoids, report profile (THC, THCA, CBD, CBDA, CBG, CBGA, CBC, CBN, THC, V, CBDV)
Microbial Enumeration	Microbial Enumeration Tests – Nutritional and Dietary Supplements Current USP <2021>	As per USP <2023> Microbial Attributes of Nonsterile Nutritional and Dietary Supplements; Specifications for Dried or Powdered Botanicals: <u>Total Aerobic Count</u> ≤100,000 CFU/g <u>Total Yeast and Mold</u> ≤1,000 CFU/g <u>Bile Tolerant Gram-Negative Bacteria</u> ≤1,000 MPN/g
	Microbiological Examination of Non-Sterile Products: Microbial Enumeration tests Current EP 2.6.12	As per EP 5.1.8 Specifications Table C: <u>Total Aerobic Count</u> ≤500,000 CFU/g <u>Total Yeast and Mold</u> ≤50,000 CFU/g <u>Bile Tolerant Gram-Negative Bacteria</u> ≤10,000 CFU/g



Test	Method (validated, USP or EP)	Specifications
Absence of Microbial Contaminants	Microbial Procedures for Absence of Specified Microorganisms – Nutritional and Dietary Supplements Current USP <2022>	As per USP <2023> Microbial Attributes of Nonsterile Nutritional and Dietary Supplements; Dried or Powdered Botanicals <u>Escherichia coli</u> absent in 10g <u>Salmonella species</u> absent in 10g
	Microbiological Examination of Herbal Medicinal Products for Oral Use and Extracts Used in Their Preparation Current EP 2.6.31	As per EP 5.1.8 Specifications Table C: <u>Escherichia coli</u> absent in 1g <u>Salmonella species</u> absent in 25g
Aflatoxins	Validated method SOP-4036A	As per USP <561> Articles of Botanical Origin; Test for Aflatoxins: <u>Total Aflatoxins</u> (B1, B2, G1 plus G2) ≤20ppb <u>Aflatoxin B1</u> ≤5ppb
		As per EP 2.8.18: Determination of Aflatoxin B1 in Herbal Drugs: <u>Total Aflatoxins</u> (B1, B2, G1 and G2) ≤4ppb <u>Aflatoxin B1</u> ≤2ppb
Heavy Metal	Validated method SOP-4038	As per USP <561> Articles of Botanical Origin; Table 6 Limits of Elemental Impurities: <u>Arsenic</u> ≤2ppm <u>Cadmium</u> ≤0.5ppm <u>Lead</u> ≤5ppm <u>Total Mercury (including methylmercury)</u> ≤0.2ppm



Test	Method (validated, USP or EP)	Specifications
Heavy Metal (continued)		As per EP general monograph for Herbal Drugs, Heavy Metals: <u>Cadmium</u> ≤1.0ppm <u>Lead</u> ≤5.0ppm <u>Mercury (total)</u> ≤0.1ppm
Pesticides	Validated method SOP-4036A and SOP-4036B	Refer to Mandatory Cannabis Testing for Pesticide Active Ingredients List and Limitson pg. 10
¹Residual Solvents	*Validation method in progress	*Limits for Residual Solvents in Cannabis products as per Health Canada

¹ Testing conducted for cannabis oil extraction using hydrocarbons only

Health Canada Pesticide List and Limits

Residue	Health Canada Limit (ppm)
Abamectin	0.10
Acephate	0.02
Acequinocyl	0.03
Acetamiprid	0.10
Aldicarb	1.00
Allethrin	0.20
Azadirachtin	1.00
Azoxystrobin	0.02
Benzovindiflupyr	0.02
Bifenazate	0.02
Bifenthrin	1.00
Boscalid	0.02
Buprofezin	0.02
Carbaryl	0.05
Carbofuran	0.02
Chlorantraniliprole	0.02
Chlorphenapyr	0.05
Chlorpyrifos	0.04
Clofentezine	0.02
Clothianidin	0.05
Coumaphos	0.02
Cyantraniliprole	0.02
Cyfluthrin	0.20
Cypermethrin	0.30
Cyprodinil	0.25
Daminozide	0.10
Deltamethrin	0.50
Diazinon	0.02
Dichlorvos	0.10
Dimethoate	0.02
Dimethomorph	0.05
Dinotefuran	0.10
Dodemorph	0.05
Endosulfan sulfate	0.05
Endosulfan-alpha	0.20
Endosulfan-beta	0.05
Ethoprophos	0.02
Etofenprox	0.05

Residue	Health Canada Limit (ppm)
Etoazole	0.02
Etridiazole	0.03
Fenoxycarb	0.02
Fenpyroximate	0.02
Fensulfothion	0.02
Fenthion	0.02
Fenvalerate	0.10
Fipronil	0.06
Fonicamid	0.05
Fludioxonil	0.02
Fluopyram	0.02
Hexythiazox	0.01
Imazalil	0.05
Imidacloprid	0.02
Iprodione	1.00
Kinoprene	0.50
Kresoxim-methyl	0.02
Malathion	0.02
Metalaxyl	0.02
Methiocarb	0.02
Methomyl	0.05
Methoprene	2.00
Mevinphos	0.05
MGK-264	0.05
Myclobutanil	0.02
Naled	0.10
Novaluron	0.05
Oxamyl	3.00
Paclobutrazol	0.02
Parathion-methyl	0.05
Permethrin	0.50
Phenothrin	0.05
Phosmet	0.02
Piperonyl butoxide	0.20
Pirimicarb	0.02
Prallethrin	0.05
Propiconazole	0.10
Propoxur	0.02