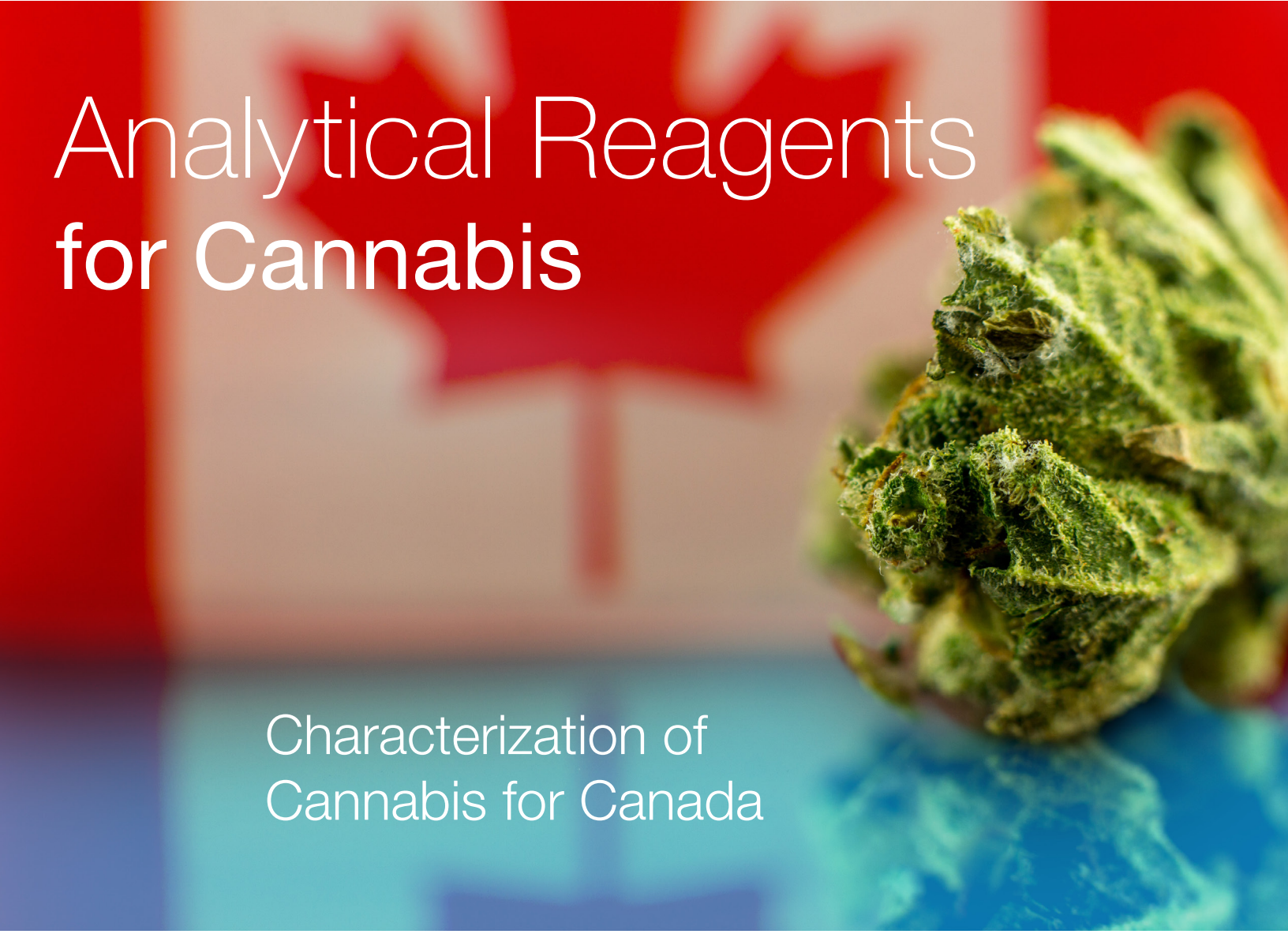
Analytical Reagents for Cannabis



Characterization of Cannabis for Canada

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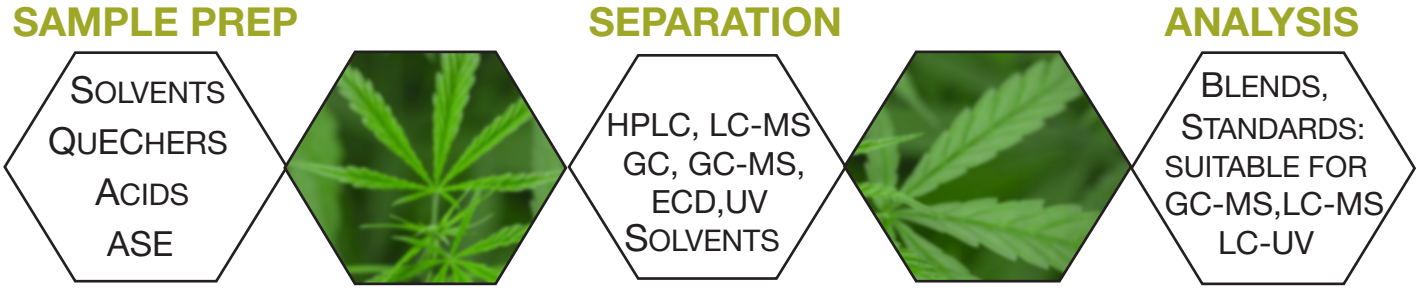
Analytical Cannabis Testing

From cultivating, extracting or processing, to researching cannabinoids for their therapeutic properties – **Canada's legalization of cannabis creates ample opportunities within agricultural, botanical, and analytical laboratories.**

Every step of the way, testing in the laboratory is crucial to determine the **safety for consumers, legitimacy of each crop and potency for distribution.** Consumption of cannabis necessitates the need to ensure safety from pesticides or other carcinogens, similar to any other agricultural harvest. However, the complexity of cannabis in its varying forms, along with a matrix of potential contaminants provides a number of analytical challenges. Toxicity via heavy metals or potential health hazards through a wide range of contaminates from mycotoxins/aflatoxins, microorganisms, residual solvents, and pesticides means that quality control screening using proper method validation is imperative.

The preliminary stages of method standardization have begun. The development of practices for efficiency in the lab are evolving as more information about testing cannabis is learned to close the gaps and support targeted confirmations and quantitations. Cannabis testing requires multiple analytical techniques to analyze the components. Sample preparation by QuEChERS (Quick, Easy, Cheap, Effective, Rugged, Safe) method is an effective extraction method to prepare the sample for characterization. Analytical testing labs use high performance liquid chromatography (HPLC) to analyze and separate cannabinoids. Gas chromatography tandem mass spectrometry (GC-MS/MS) and liquid chromatography tandem mass spectrometry (LC-MS/MS) are used for pesticide testing depending on the targeted molecule. Inductively coupled plasma-mass spectrometry (ICP-MS) and ICP-optical emission spectrometry (OES) with its multi-element capability, are used to quantify metals. GC headspace analysis is used to determine residual solvents, while GC-MS or GC-flame ionization detector (FID) is used for terpenes profiling.

Fisher Chemical™, Acros Organics™, and Alfa Aesar™ brands undergo rigorous quality assurance and testing processes that ensure excellent lot-to-lot consistency. The following grades listed in this brochure such as Optima™, GC Headspace, GC *Reslov*™, Specpure™, and TraceMetal™ are tested for the specific applications noted. **Using chemicals developed specifically for the technique or method outlined in this guide is recommended for analyzing cannabis per the latest industry guidelines.**



Analyte Type		Analytical Method
Sample Preparation or Extraction		QuEChERS
Contaminant	**Pesticides/Plant Growth Regulators**	LC-MS/MS and GC-MS/MS
	Residual Solvents: Volatile Organics Compounds (VOCs)	GC-MS, GC-FID
	Heavy Metals	ICP-MS and ICP-OES
	Mycotoxins/Aflatoxin Analysis	LC-MS
Phytochemical	**Potency of Cannabinoids**	HPLC-MS, HPLC-UV
	Terpene Profiling	GC-MS, GC-FID

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Sample Preparation or Extraction

Preparation of cannabis samples can be challenging given the various commercially available forms such as plants, concentrated oils, and edible products.

Regardless of the form or type of sample, the **QuEChERS method**, derived from the food industry, is a well-established technique used for extraction.

Method	Chemical Used	For Certified, ACS, or for analysis	For LC or GC with ECD, FID or UV detectors	For Mass Spec. Detectors
Initial Extraction	Acetonitrile		A9994 - Pesticide Grade A9964 - Optima	A9554 - LC-MS
	Acetic Acid		A35500- HPLC	A113500 - LC-MS
Phase Separation	Anhydrous Magnesium Sulfate	A653 - Certified AA33337A3 - 99.5% Min		
	Sodium Chloride		AC446212500 - HPLC	
	Sodium Acetate	S2093 - ACS	AC446882500 - HPLC	
	Tribasic Sodium Citrate	S2793 - Certified		
	Dibasic Sodium Citrate	AC250242500-Pure		
Analysis by GC	Toluene		T2914 - Optima	
	Acetonitrile		A9964 - Optima	A9554 - LC-MS
	Formic Acid	AC270480025 - For analysis		A11750 - LC-MS
Analysis by LC	Formic Acid with Acetonitrile (0.1%)		HB98234 - HPLC	LS1204 - LC-MS
	Water		W74 - Optima	W64 - LC-MS
	Formic Acid	AC270480025 - For analysis		A11750 - LC-MS
	Triphenyl phosphate (TPP)	AC147672500 L08130.30		
Optional Reagents	Acetone		A404 - Pesticide A9294 - Optima	

HPLC and GC columns deliver high resolution separations required for subsequent analysis. Sample handling devices ensuring sample integrity and cleanliness of samples via hyphenated techniques.

Sample Preparation or Extraction

Cannabis absorbs lead, mercury, cadmium, arsenic, and other heavy metals in its cells from the soil, water, or low quality fertilizers. Trace elemental analysis is a well established method for working with plants. The following acids can be used to digest the sample prior to testing via ICP-MS and ICP-OES testing to determine if the crop or products are safe for consumers.

Grade	Description	Root Catalog #	Heavy Metal Content	Packaging	Sizes
Optima	Hydrochloric Acid	A466	ppt level	PFA bottle	250mL, 500mL, 1L, 2L
Optima	Nitric Acid	A467		PFA bottle	
Optima	Sulfuric Acid	A468		PFA bottle	
TraceMetal	Hydrochloric Acid	A508	low ppb level	HDPE bottle	
TraceMetal	Nitric Acid	A509		HDPE bottle	
TraceMetal	Sulfuric Acid	A510		HDPE bottle	
ICP-OES	Hydrochloric Acid	T00308	ppb level	PVC coated glass	500mL, 2.5L
ICP-OES	Nitric Acid	T00309		PVC coated glass	
ICP-OES	Sulfuric Acid	T00311		PVC coated glass	

Solvent Extraction

Solvent extraction is used to separate the plant matrix from the chemical components of cannabis. In particular, it is used to extract targeted compounds such as cannabinoids and terpenes.

Grade	Description	Catalog #	Packaging	Size
Certified ACS	Ethanol	A407-200	Steel drum	200L
HPLC	Heptane	H350-4	Amber glass	4L
Certified ACS	Hexanes	H292-200	Steel drum	200L
Certified ACS	2-Propanol (IPA)	A416-200	Steel drum	200L
Certified ACS	Methanol	A412-200	Steel drum	200L

*Other sizes available

Contaminant: Pesticides & Plant Growth Regulators

Knowing exactly how much pesticide is present in parts per million is crucial to ensure product safety. Depending on the pesticide of interest, LC-MS/MS with its sensitivity, and selectivity is a commonly used analytical technique. However, if the pesticide or analyte of interest is volatile in nature, then GC-MS/MS is the more suitable method.

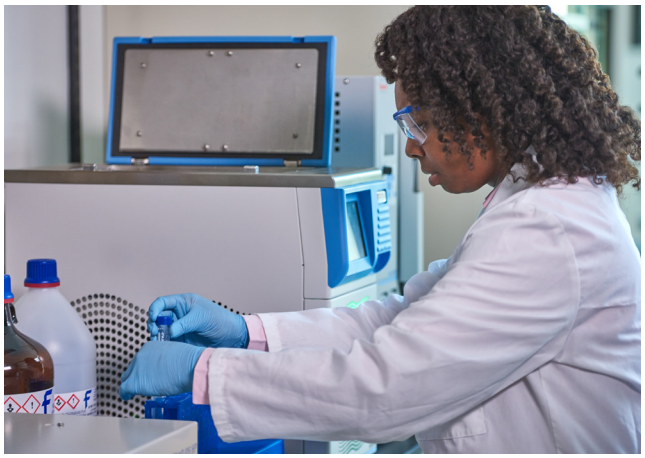
Application	Grade	Description	Root Catalog #	Size
Sample Preparation	Certified ACS, Suitable for Pesticide Residue Analysis	Sodium Sulfate (Granular, 10-60 mesh)	S415	Muliples sizes avilable based on need
LC-MS	Optima LC-MS	Acetic Acid	A113	
	Optima LC-MS	Acetonitrile	A955	
	Optima LC-MS	Ammonium Acetate	A114	
	Optima LC-MS	Formic Acid	A117	
	Optima LC-MS	Methanol	A456	
	Optima LC-MS	Water	W6	
GC-MS	Pesticide	Acetonitrile	A999	4L
	GC-MS	DCM	D150	4L
	Pesticide	Hexane	H300	4L
	Pesticide	Methanol	A450	4L

Contaminant: Residual Solvents

Volatile Organic Compounds (VOCs)

Several potentially harmful compounds that are toxic or carcinogenic may be used when extracting or concentrating cannabis materials. Residual solvent testing determines if any components are found in the finished product, which ensures that consumers are not at risk.

The essential solvents below can be used with GC-MS and GC-FID testing methods.



Application	Grade	Description	Catalog #	Size
GC-MS	GC *Resolv*	Acetone	A928-4	4L
GC-MS	GC *Resolv*	n-Hexane	H307-4	4L
GC-MS	GC *Resolv*	Methanol	A457-4	4L
GC-MS	GC *Resolv*	Methylene Chloride	D154-4	4L
GC-FID	GC Headspace	Dimethylacetamide, DMAC	D160-1	1L
GC-FID	GC Headspace	Dimethyl Formamide, DMF	D133-1	1L
GC-FID	GC Headspace	Dimethyl Sulfoxide, DMSO	D139-1	1L
GC-FID	GC Headspace	N-methyl Pyrrolidone, NMP	N140-1	1L
GC-FID	GC Headspace	Water	W10-1	1L

Contaminant: Mycotoxins/Aflatoxin Analysis

Mycotoxins are secondary metabolites of mold that can contaminate a crop before and after harvest, or during transportation. The demand for LC-MS/MS is needed due to its sensitivity through robust analytical methodologies. The following reagents support this detection method to analyze the presence of fungi contamination on cannabis samples.

Application/Grade	Root Catalog #	Description	Packaging	Size
Cleaning, Molecular Biology	BP8203	Ethanol, 70% Solution, Denatured	HDPE bottle	1gal
LC-MS/MS	A113	Acetic Acid	Glass ampule	Multiple sizes available
LC-MS/MS	A955	Acetonitrile	Amber glass	
LC-MS/MS	A114	Ammonium Acetate	Amber glass	
LC-MS/MS	A456	Methanol	Amber glass	
LC-MS/MS	W6	Water	Amber glass	

Contaminant: Heavy Metals

Standards

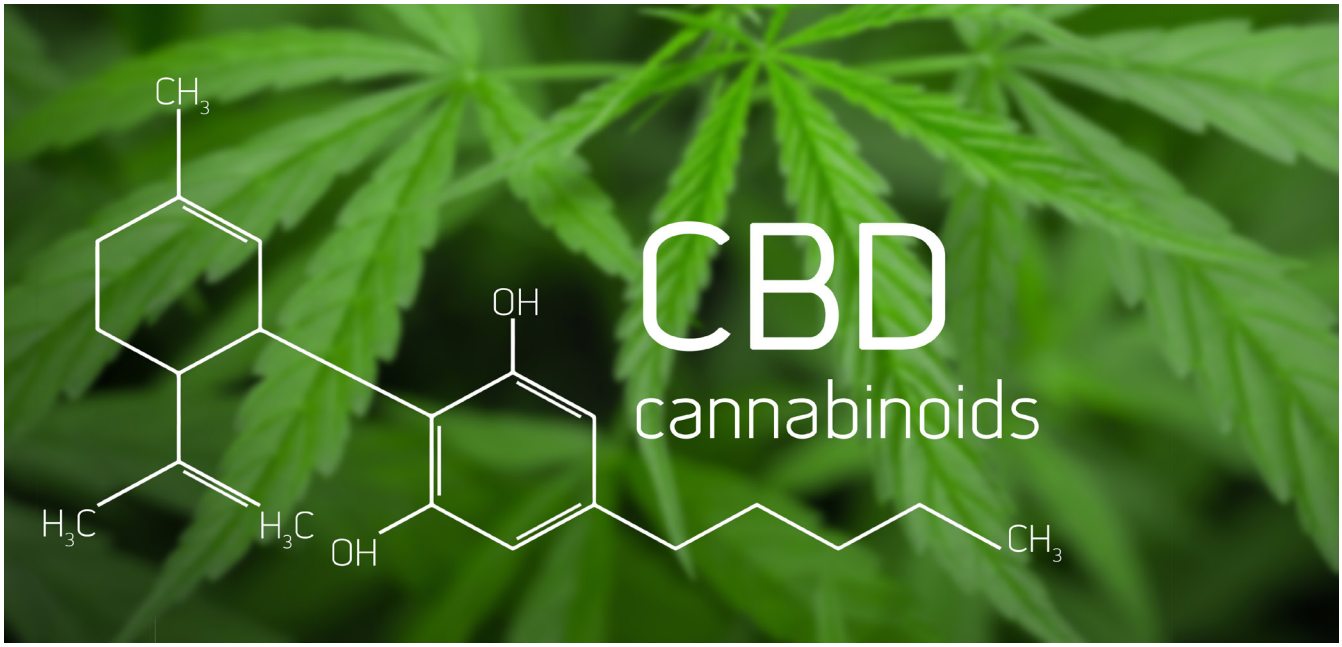
The following solutions are suitable for use as metal standards for trace elemental analysis via inductively coupled plasma-based techniques.

Type	Grade	Description	Root Catalog #	Formula	Size
Single Element	Specpure	Arsenic, plasma standard solution	AA13836	As in 5% HNO3	50mL, 100mL, 500mL
	Specpure	Calcium, plasma standard solution	AA13852	CaCO3 in 5% HNO3	50mL, 100mL, 500mL
	Specpure	Chromium, plasma standard solution	AA38728	Cr(NO3)3 in 5% HNO3	50mL, 100mL, 500mL
	Specpure	Chromium, plasma standard solution	AA13864	Cr in 5% HCl	50mL, 100mL, 500mL
	Specpure	Lead, plasma standard solution	AA13853	Pb in 5% HNO3	50mL, 100mL, 500mL
	Specpure	Mercury, plasma standard solution	AA13865	Hg in 5% HNO3	50mL, 100mL, 500mL
	Specpure	Nickel, plasma standard solution	AA13839	Ni in 5% HNO3	50mL, 100mL, 500mL
	Specpure	Thallium, plasma standard solution	AA13851	Tl in 5% HNO3	50mL, 100mL, 500mL
Element Mixtures	Specpure	Heavy Metals plasma standard solution	AA14657	Ag, As, Ba, Cd, Cr, Hg, Pb, Se	100mL, 500mL
	Specpure	Transition Metals plasma standard solution	AA44518	Cd, Co, Cr, Cu, Fe, Mn, Ni, V, Zn	100mL, 500mL

Phytochemical: Potency of Cannabinoids

Cannabis contains over 100 cannabinoids, of which tetrahydrocannabinol (THC), tetrahydrocannabinolic acid (THCA), cannabidiol (CBD), and cannabinol (CBN) are frequently the most important for potency determination. HPLC can be used to quantify the different ratios of these cannabinoids of interest to ensure the characteristics of the product in question. GC, due to the heating process, can convert some of the cannabinoids to their non-acidic forms. Thus, only the total amount can be quantified.

Application/Grade	Description	Catalog #	Packaging	Size
Optima LC-MS	Ammonium Acetate	A114-50	Amber glass	50g
Optima LC-MS	Formic Acid	A117-50	Nalgene	50mL
HPLC	IPA	A451-4	Amber glass	4L
HPLC	Methanol	A452-4	Amber glass	4L
HPLC	Water	W5-4	Amber glass	4L



Phytochemical: Terpene Profiling

Terpenes such as: myrcene, pinene, linalool, or limonene are essential building blocks that cause taste and smell, and can interact with cannabinoids to amplify effects. Since different levels can be used to treat personalized symptoms, properly differentiating between strains of cannabis by terpene profiling is crucial. Traditional testing methods involve a solvent-based extraction followed by GC analysis since most are non-polar volatile compounds.

Application	Grade	Description	Catalog #	Size
GC-MS	GC *Resolv*	Acetone	A928-4	4L
GC-MS	GC *Resolv*	n-Hexane	H307-4	4L
GC-MS	GC *Resolv*	Methanol	A457-4	4L
GC-MS	GC *Resolv*	Methylene Chloride	D154-4	4L
GC-FID	GC Headspace	Dimethylacetamide, DMAC	D160-1	1L
GC-FID	GC Headspace	Dimethyl Formamide, DMF	D133-1	1L
GC-FID	GC Headspace	Dimethyl Sulfoxide , DMSO	D139-1	1L
GC-FID	GC Headspace	N-methyl Pyrrolidone, NMP	N140-1	1L
GC-FID	GC Headspace	Water	W10-1	1L

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