Common Compounds in FTIR Drug Checking in B.C.

April, 2025

About the BCCSU Drug Checking Program

The BC Centre on Substance Use (BCCSU) is an academic centre housed within Providence Health Care (PHC) and Providence Research, and is a University of British Columbia (UBC) Faculty of Medicine-affiliated centre focused on substance use and addiction medicine. The BCCSU is supported by the Province of BC with a mission to "provide provincial leadership in substance use and addiction research, education and clinical care guidance and to seamlessly integrate these pillars to help shape a comprehensive, connected system of treatment and care that reaches all British Columbians.

The BCCSU Drug Checking Program supports a network of drug checking services across BC through research, education, training, and practical guidance. In partnership with people who use drugs, service users and providers, health authorities, Indigenous communities, researchers, clinicians and harm reduction experts, we collaborate to share evidence generated from drug checking services across the province, build capacity among technicians and service providers, and develop resources to support service set up and delivery.

Our growing collection of drug checking guidance and standard operating procedures is available on our website.

Acknowledgements

This document is an updated and expanded version of a previous work, *FTIR Signals of Common Compounds* (2019), by Sam Tobias, Sara Guzman, Hadley Pierce, Nicole Esligar.

Author

Mia Pohl
Program Engagement Coordinator, BCCSU

Reviewers and Contributors

The author gratefully acknowledges the following individuals for offering their unique input to enrich this document:

Jen Angelucci
Research Data Coordinator, BCCSU

Jana Baller
Drug Checking Lead, Fraser Health Authority

David Byres
Training Coordinator, BCCSU

Lea Gozdzialski, PhD
Research Associate, Substance Drug Checking / University of Victoria

Becca Johnson
Drug Checking Technician, Get Your Drugs Tested

Chris Kling
Drug Checking Program Coordinator, ANKORS Nelson

Bryce Koch, RN BN NP-F
Day Health Nurse Practitioner, Dr. Peter Center / Primary Care Provider, Island Sexual Health

Brittany Maclachlan
Drug Checking Technician, ASK Kelowna

Jennifer Matthews, MSc
Drug Checking Implementation Lead

Antoine Marcheterre
Drug Checking Lead, Interior Health Authority

Will McLellan
Co-Founder, Mountainside Harm Reduction Society

Julie-Soleil Meeson
Manager of Content and Practice Promotion, Association des intervenants en dépendance du Québec

Claire McDonald
Drug Checking Technician, Get Your Drugs Tested

Warren O'Briain
Senior Policy Advisor, BCCSU

Douglas Rusk
Manager of Harm Reduction and Program Development, Queer & Trans Health Collective

Mick Sandy
Drug Checking Technician / Street Outreach, ASK Kamloops

Michelle Thomas
Site Manager, Get Your Drugs Tested

Emilee Wells
Drug Checking Manager, POUNDS Project

Taylor Yonkman
Drug Checking Technician/HIV & Hep C Outreach Coordinator, ANKORS East Kootenay

Special Thanks

This document would not be possible without the collaborative spirit and shared wisdom of Interior Health, Get Your Drugs Tested, POUNDS, Substance Drug Checking, AIDQ, QTHC, ANKORS, ASK Wellness Society, Fraser Health Authority, and Mountainside Harm Reduction. These organizations generously shared their knowledge and perspectives on the substances included in this guide. Thank you for your time and efforts in creating resources for new and experienced technicians alike.

The BCCSU drug checking program also expresses sincere appreciation to the individuals and organizational partners within the drug checking community who continue to enhance the ever-evolving landscape of drug checking practices. This includes people with lived and living experience of substance use, drug checking service providers, and members of the provincial drug checking working group. The insights and observations shared are immensely valuable, and serve as a catalyst to improve drug checking and harm reduction initiatives across British Columbia.

Land Acknowledgement

The British Columbia Centre on Substance Use would like to respectfully acknowledge that the land on which we work is the unceded territory of the Coast Salish Peoples, including the territories of the xʷməθkwəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), and səlílp lwətaɬ (Tsleil-Waututh) Nations.

We recognize that the ongoing criminalization, institutionalization, and discrimination experienced by people who use drugs disproportionately harms Indigenous peoples and that continuous efforts are needed to dismantle colonial systems of oppression. We are committed to the process of reconciliation with Indigenous peoples and recognize that it requires significant and ongoing changes to the health care system.

Feedback

We love to hear from you! If you have comments, suggestions, or to request drug checking training, please contact: drugchecking@bccsu.ubc.ca.

Suggested Citation

British Columbia Centre on Substance Use (BCCSU). Common Compounds in FTIR Drug Checking in BC. 2025. https://drugcheckingbc.ca/wp-content/uploads/sites/4/2025/05/Common-Compounds-for-FTIR-BC.pdf

Publisher

British Columbia Centre on Substance Use (BCCSU)
400-1045 Howe Street, Vancouver, BC, V6Z 2A9
inquiries@bccsu.ubc.ca

Publication Date

Apr 30, 2025

Table of Contents

Purpose and Scope

This guide is designed to provide drug checking technicians in B.C. with a resource for understanding and identifying substances using Fourier Transform Infrared (FTIR) spectroscopy. It aims to enhance their ability to interpret spectral data accurately and differentiate between similar compounds. By offering clear instructions and practical tips, the guide empowers technicians to improve the reliability and effectiveness of drug-checking services. While references are made to the Bruker software, OPUS, this document is a general guide to identifying patterns seen in FTIR drug checking and not necessarily specific to OPUS.

This guide was created using data from the B.C. provincial drug checking database, "DCBC", comprised of samples brought to community drug checking services in B.C. This guide focuses on substances that are easily tested via FTIR and are commonly seen at drug checking sites, and therefore excludes substances that cannot be easily checked using FTIR drug checking (such as inhalants) or are rarely seen in drug checking despite common use (such as cannabis).

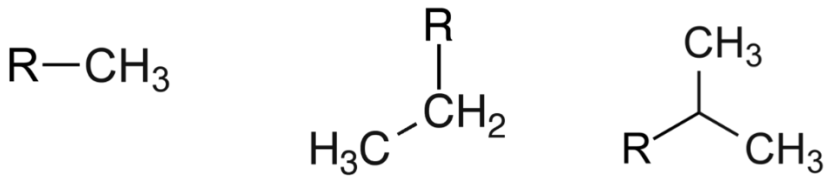
This document should not be used to suggest or imply any guarantee of effects or safety of substances. Effects can be different depending on the person and situation. This document should not be used for any medical purposes. All medical discussions should happen between a client and their medical practitioner.

This is not to be considered a comprehensive guide. Subjective experiences using substances are not to be considered universal, nor is the reason why people use these substances to be assumed. Each person's experience with a substance is unique to their physiology and only broad generalizations can be made about how a drug will interact with a person. Overdose (OD) information is given as general information for the drug checker and should not be used as medical information.

Dosage and duration of substances are outside the scope of this document. Please view the Additional Resources section for more information on these topics.

Definitions

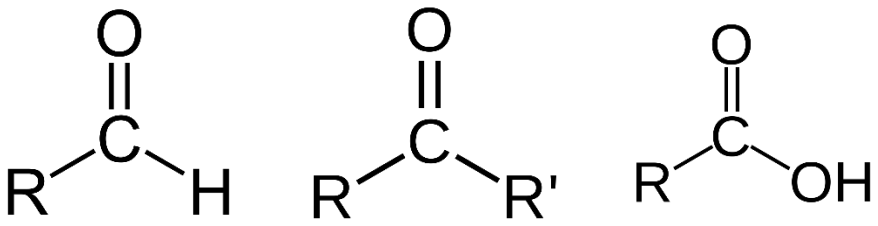
Word	Definition
Adrenergic	A substance that affects the adrenergic system in the body via adrenaline (epinephrine) or noradrenaline (norepinephrine).
Adulterant	Other substances in drugs besides the expected active ingredient, whether intentional (cuts, buffs, substitutions, etc.) or not (contaminants).
Agonist/ Antagonist	In the context of neurotransmitters, an agonist is a substance that will activate (turn on) a binding site. An antagonist will block a binding site, preventing it from activating.
Alkyl Group	A functional group consisting of single-bonded carbon and hydrogen. (R is short for "the rest of the molecule")



Methyl Group | *Ethyl* Group | *Isopropyl* Group

Amnesia	Temporary or permanent loss of memory.
Anaesthetic	A drug that causes a temporary loss of sensation or awareness of sensation.
Analgesic	Pain-reducing drug.
Analogue	A compound with a similar structure to another (structural analogue), but differing in a key component, usually a functional group. Sometimes used to describe two drugs that have very similar functions but do not share the same structure (functional analogue).
Anhydrate/ Anhydrous	A crystal form of a substance that is free of any water in its crystal structure.
Antipyretic	Fever-reducing drug.

Anxiolytic	Anxiety-reducing drug.
Aspiration	In the context of an overdose: inhaling one's own vomit
Bioavailability	The proportion of a substance that has an active effect on a body versus the proportion that is metabolized or excreted without an effect.
Biphasic	In reference to dosage: a dose response that appears one way below a threshold dose, and a different way above the threshold dose.
Bruxism	Involuntary teeth grinding and jaw clenching.
Buff (Diluent)	Pharmacologically inactive substance used to add weight or bulk to the final product. AKA bulking agent
Carbonyl Group	A functional group consisting of carbon double-bonded to oxygen. (R and R' both stand for "the rest of the molecule")

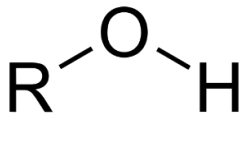


Aldehyde Group | *Ketone* Group | *Carboxyl* Group

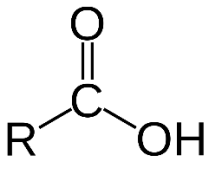
Carcinogenic	A substance that can cause cancer.
Co-crystallize	Two or more substances that form into a uniform crystal solid.
Confirmation Bias	The tendency to search for, interpret, or favour information that supports one's beliefs.
Contaminant	Unintended substance inclusions in drugs. These can include microplastics, metals, microorganisms, and precursors or byproducts of incomplete chemical synthesis in the production of a substance. May have a pharmacological effect or not.
Contraindicated Mixture	A combination of substances that can cause harm when used together.

Crystal Structure	The repeating arrangement of atoms or molecules that make up a solid.
Cut	Pharmacologically active substance added to a mixture. Used to enhance or mimic the effect of a substance or to facilitate the administration of a substance.
Delirium	Disturbances to awareness, attention, and higher-order cognition. May involve hyper/hypoactivity, disrupted sleep, emotional disturbances, altered states of consciousness, and perceptual disturbances. Not to be confused with *delusion,* which is a false belief that cannot be shifted despite ready evidence to the contrary.
Derealization	An altered perception of the external world. Things may not seem real, feel detached from the external world, or other distortions in perceptions may occur.
Dermal	In the context of substances, a substance applied to the skin.
Dermatitis	Skin inflammation: itchiness, swelling, sores, rash, etc. Contact dermatitis is a rash or sore that is caused by contact with an allergen or other irritant.
Dissociative	A substance that distorts perceptions of sight, sound, and *proprioception* (body-position/movement-sense) to produce feelings of detachment from the environment or self.
Diuretic	A substance that increases the production of urine.
Down	A mixture of substances formed into small balls that generally include an opioid, caffeine, and a carbohydrate such as a sugar. Sometimes includes a sedative or tranquilizer, but can include any number of compounds.
Electrolyte	Minerals that carry an electric charge when dissolved in body fluids. Essential to fluid balance, regulating nerve and muscle function, and supporting other bodily processes. (e.g. sodium, potassium, chloride, calcium, magnesium, phosphate.)
Empathogen (Entactogen)	A class of psychoactive drugs that increase self-awareness, empathy, oneness, relatedness, and/or emotional openness.

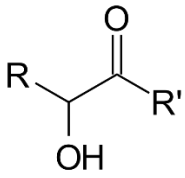
Enantiomer	Two chemically identical molecules that are mirror images of each other, often thought of as right and left-hand molecules. Usually denoted with terms like R (Ratio), S (Sinister), D (Dextro), L (Levo), and others. R and S enantiomers are sometimes spelled as 'Ar' and 'Es'.
Entourage Effect	Compounds other than the main psychoactive compound in a mixture contributing or changing the overall psychoactive effects of the drug. Usually refers to drugs derived from plants.
Flatulence	Passing gas from the digestive system, i.e. farts.
Functional Group	A group of atoms in a molecule with distinctive chemical properties, regardless of the other atoms in the molecule.
Hepatoxic	A substance that causes damage to the liver at certain doses.
Hydrate/ Hydrous	A crystallized form of a substance that has co-crystallized with water bonded into the crystal structure. Substance is not necessarily wet to the touch.
Hydrophilic	A substance that readily attracts and absorbs water, whether liquid or vapour in the ambient air. *Hydrophobic* substances resist mixing with water.
Hydroxy Group	A functional group consisting of oxygen and hydrogen. Also called a *hydroxyl* group. Alcohols have at least one of these. (R and R' both stand for "the rest of the molecule")



Hydroxy Group



Carboxyl Group



Hydroxy Ketone

Hyperglycemia/ Hypoglycemia	High blood sugar/low blood sugar.
Hypertension/ Hypotension	High blood pressure/low blood pressure.

Hyperthermia/ Hypothermia	High body temperature/low body temperature.
Hyponatremia/ Hypernatremia	Low blood sodium / high blood sodium.
Hypoxia	Low blood oxygen
Incontinence	Loss of bladder control.
Ionized	An atom or molecule that has an electron added or removed from it.
Laxative	A substance that encourages the movement of the bowels.
Lipid	A broad group of hydrophobic organic compounds which include fats, waxes, sterols, fat-soluble vitamins, monoglycerides, diglycerides, phospholipids, and others.
Mania	A condition defined by an abnormally elevated state of hyperactivity, intense moods, and energy. Someone experiencing a *manic episode* may not sleep or eat, have disinhibited behaviours, irritability, and aggressive impulses amongst other symptoms.
Metabolite	A substance produced by the body when it breaks down other substances. (e.g. Drug Y is a metabolite of drug X because the body breaks down drug X into drug Y.)
Methyl Group	An alkyl functional group consisting of a carbon atom with three hydrogen atoms attached to it.
Mindfulness	The cognitive skill of observing one's own thought patterns in the present moment.
Monohydrate	A crystal solid that contains one molecule of water per every molecule of a substance.
Neuroplasticity	The ability of the brain and nervous system to adapt its structure, functions, or connections.
Neurotoxic	A substance that is damaging to the brain at sufficient doses.

Neurotransmitter A chemical that allows signalling between neurons in the body. Neurotransmitters are released, travel across the *synaptic cleft*, bind to a *receptor* site, and then are absorbed in a process called *re-uptake*.

Nystagmus Rapid, uncontrolled eye movement. Sometimes called eye-jiggling or vibrating vision.

OD Overdose. An amount of drugs taken that overwhelms the body, often in a life-threatening way.

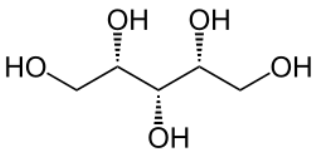
Opioid-naïve Technically, a person who has never had opiates in any form. Colloquially, an person that does not have a tolerance to opioids.

Palpitations A pounding in the chest; becoming aware of one's own heartbeat. In the context of drugs, an obvious pounding heartbeat that might be fast or uneven.

Pill Binder A substance that improves the cohesiveness of a powder mixture that is then pressed into a tablet or pill. Helps to keep the pill from breaking.

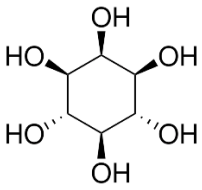
Polymorphism The ability for a substance to form different arrangements of molecules to make up a crystal structure. A *polymorph* is one of these possible configurations.

Polyol A substance with two or more hydroxy groups. All sugar alcohols are polyols.



Xylitol

Ethylene Glycol



Inositol

Polysubstance The use of a mixture of several drugs at the same time. (e.g. Cocaine and Ketamine)

Positional Isomer A molecule that differs only by the position of a functional group, or some other feature on the same parent structure.

Potentiation	The effect of increasing the potency or effectiveness of a drug or other treatment.
Precursor	Chemicals that are ingredients for the production of a drug. Can be pharmacologically active in the body or not.
Prodrug	An inactive drug that converts into an active form after it is metabolised.
Psychedelics	A subclass of drugs whose primary effect is to trigger non-ordinary mental states (known as psychedelic experiences or "trips") and a perceived "expansion of consciousness". The term means mind-manifesting (from Greek: *psyche deloun*, “to manifest mind”).
Psychoactive	A substance that causes changes in brain function and may result in alterations to mood, perception, consciousness, cognition, or behaviour.
Psychosis	Difficulty determining what is real and not real. May include delusions and/or visual/auditory distortions, disorganized thinking, incoherent speech, sleep problems, social withdrawal and other symptoms.
PTSD	Post-Traumatic Stress Disorder. Typically caused by extremely stressful events such as abuse, assault, war, injury, or disaster, but can occur through any means that causes intense activation of the nervous system. Symptoms may include flashbacks, nightmares, severe anxiety and uncontrollable thoughts.
Racemic	A mixture of two enantiomers of the same drug in equal proportions. Also called *racemate*.
Reuptake Inhibitor	A substance that prevents neurotransmitters from being reabsorbed and causes more neurotransmitter to remain in the *synaptic cleft* and activate more receptors.
Salt/Freebase Form	How a drug is formulated and distributed. Drugs are often basic (rather than acidic) in their native form, we call these base forms, or “freebase”. If a drug is neutralized before distribution, it forms a salt, or salt form. Which acid is used to neutralize the drug determines the resultant salt. (e.g. hydrochloric acid used to neutralize will form a hydrochloride salt.)

Serotonin Syndrome	A group of symptoms that can occur from the use of serotonergic (serotonin-releasing) drugs. May appears as hypertension, tachycardia, hyperthermia, tremor, diarrhea, and seizure. Can be life threatening.
Spectral Feature	A recognizable shape or pattern visible in a substance's FTIR signal. E.g. double peaks, triangular peaks, "Bunny ears".
Tableting Agent	A substance that allows for the creation of pressed pills, such as a lubricant.
Tachycardia	Increased heart rate.
Taper	In the context of withdrawal management, the gradual reduction of dosage, rather than sudden stoppage.
Topical	A substance that is applied directly onto a part of the body, such as a cream on the skin.
Tryptamine	A drug that is based off of the parent compound, tryptamine. Also sometimes referred to as an *indole*, which is a functional group or *moiety* of tryptamine.
Vasoconstriction	The constriction of blood vessels, which increases blood pressure. The opposite is *vasodilation*, which lowers blood pressure.

Prior Knowledge Required

This guide assumes that the technician has completed (or is enrolled in) the basic training offered by the BCCSU, including the supervised practicum. Further, it is assumed that the technician is broadly familiar with drug classes and effects, has a background in harm reduction and can navigate the OPUS drug checking software (or similar). There are some references to analytical chemistry in this document, but no prior background in chemistry is expected. This information is presented to the reader as an invitation to learn more about chemistry to deepen their understanding of the substances being checked and advised on.

Reviewing the fundamentals of FTIR spectrometry can be of aid in understanding this document and how to apply it to community drug checking. This video from Bruker, "FT-IR explained in 5 minutes" provides a good overview of some of the core concepts of vibrational spectroscopy that underpins the work with an FTIR instrument. See also the Additional Resources section.

Accessibility

This document is intended to be accessible to a trainee technician, however, the tiny details of spectra and the language used may be difficult to read for some people.

Colour and minute details are used throughout this document. For accessibility and ease of use, it is recommended that this document is read on a computer screen and zoomed in to a level where the spectra presented would fill a comparable proportion of the screen as would be present when performing a drug check using OPUS. A zoom level of 200% is recommended to allow for sufficient detail to be seen.

While efforts have been made to define much of the technical jargon in this document, some words are only defined in context and are *italicized*. Drugs that do not have a profile in this document are **bolded**, while drugs that do appear are hyperlinked (or in plain text where repeated). An exception to this rule is the adverse combination tables, which have all substances in bold font to improve readability.

Spectra are generally shown in full from 3900^{-1} – 600^{-1}, but where they are zoomed in or truncated, look for the zoom symbol:

Substances Included

Drugs in this guide are grouped into six categories that parallel how they are categorized within the provincial drug checking database, DCBC. While there are many ways to group substances, and there may not be a consensus on this categorical system, these categories are used to match what technicians will see when recording results in DCBC.

A dataset of substances checked in B.C. between December 1, 2023 and December 1, 2024 was used to inform which substances to include in this guide and where cuts and buffs appear in mixes. Samples with unknown origin (such as mail-in) were excluded from the dataset. Some substances were included for their historical relevance (i.e. were much more common in the past and may become common again) or because the substance is difficult to find via FTIR but is known to be prevalent due to confirmatory testing. Some substances are included to represent a group of drugs (such as synthetic cathinones) despite no individual member being particularly common.

Some substances have not yet been included in this document and will be added at a later date. This document will be periodically updated to include new substances of note. This is intended to be a living document that follows changes in the substances seen in community drug checking.

Substance Information

Drugs are presented in this guide with basic facts and subjective user experiences based on published evidence. Not every drug has relevant information in each category; only information that is considered useful to the technician is presented here.

Category	Description
Molecule	The drug molecule.
AKA	Different names for the substance. Sources can be pharmaceutical names, street names, shortened forms, or long forms.
Pronounced	How to pronounce the substance. Different regions may pronounce the drug differently.
Description	A short description of the substance and any relevant comparisons
Possible effects	The way that the substance impacts the way a person thinks, acts, or feels. The physical effects of drugs on the body. In this document, these effects are usually considered desirable by the person using the drug.
Possible side effects	Effects that may happen to the service user when using the substance that are not desired or intended. Information included is to help the drug checker give harm reduction advice and recognize undesirable effects when adverse reactions occur.
Caution!	Potentially dangerous aspects of the substance. For the service user, may indicate risk of overdose (OD), permanent health harms, or death.
Found in	Where the substance is typically seen in drug checking in B.C., such as a buff that is specific to a particular drug, such as levamisole in cocaine. This is sourced from data from the provincial drug checking database DCBC and shouldn't be considered universal to all regions (even within B.C.!).
Contraindicated mixtures	Mixtures known to have adverse effects, either from clinical trials or trip reports.
FTIR library entries	The libraries where the substance appears, along with the names used in the libraries.
Notes	Information on the drug, the molecule, or tips on identification.

Adverse effects from Contraindicated drug mixtures

Polysubstance use is common, and it is useful for the drug checker to be aware of mixtures that have been found to be particularly hazardous. The section on adverse mixture effects includes some drugs that do not have a full profile in this document (such as **dextromethorphan**) and have been included due to their relative prevalence and use. Other contraindicated mixtures exist and this guide should not be considered comprehensive. These warnings have been included to help technicians understand some of the risks associated with these specific mixtures and identify possible harms but **should not be used as a medical guide or thought of as guaranteed effects if the mixture is to be used**.

Where possible, these adverse effects have been derived from medical sources. However, these data do not exist for most unregulated drugs. These tables of adverse effects from mixtures are based on the following sources:

1. UpToDate Drug Interactions[18]
2. Drugs.com Drug Interaction Report[19]
3. Tripsit Drug Combinations[20]
4. Psychonaut Wiki Dangerous Combinations[21]
5. Psychcombo Psychoactive Combination Matrix[22]
6. Professional experience of Bryce Koch, Nurse Practitioner[a]
7. Peer reviewed publications and other published sources as referenced.
8. Bluelight Forum[123,124,125]
9. Anecdotal information gathered at drug checking services in the course of service use.

FTIR Libraries

This guide references spectra from the BCCSU FTIR library (including the BCCSU Tryptamine library). Some substances are not included in the BCCSU library and therefore references from SWGDRUG, TICTAC and the Bruker PHARMA libraries are used. Two supplementary open-access libraries (Kykeon, ENFSI) may be of help after using the primary and pharmaceutical libraries if there still appear to be unidentified components. However, both libraries have only recently begun to be used by drug checking services in B.C. Refer to the BCCSU standard operating procedure on FTIR Libraries for more information on libraries and which ones to use in drug checking.

[a] Bryce Koch is the Day Health Nurse Practitioner at the Dr. Peter Center in Vancouver and a primary care provider at Island Sexual Health in Victoria. He has extensive experience in safe supply, substance use management, and mass gathering (festival) harm reduction and medical support.

The spectra presented here have all been truncated to the region of 3900^{-1} – 600^{-1}, as they would be acquired from a Bruker FTIR with ZnSe optics (high humidity option). This is for uniformity of the document as all listed spectra have data in this region, and technicians will generally work within this range.

Chemical Form Comparisons

Where relevant, the freebase and salt forms of drugs are presented and compared to give the drug checker an understanding of how the form of the drug can affect the spectra, and to consider the form when considering the mode of consumption (e.g. smoking vs. injection).

Form	Description
Freebase / Base	Substances that are basic in their native form (i.e. pH higher than 7) are considered a base or freebase. Often oily substances. Usually more suited to smoking versus injecting. (e.g. cocaine base / Crack Cocaine)
Salt	Substances that have been neutralized with an acid to form a crystalline salt. The salt form is noted with the substance where relevant. Substances in salt are usually not suited for smoking. Salts are generally more stable than freebases. Hydrochloride (HCl) salts are the most common, hydrobromide (HBr) salts and fumarates are sometimes seen.
Citrate	A specific salt made from neutralizing a base substance with citric acid. Generally seen in pharmaceuticals (e.g. Fentanyl citrate patches)

Analogue Comparisons

Analogues of fentanyl and various benzodiazepines have become more prevalent in community drug checking in B.C.; for these two drug groups comparisons between analogues and parent compounds are provided in a manner that is practical for the working technician. Comparisons of analogues will help the technician to understand where the differences in peaks lie and therefore how to tell the analogues apart. This is an attempt to alleviate the selection bias seen in drug checking where the first option shown in OPUS is often used without back-checking against other analogues.

Alternate Reference Spectra Comparisons

Most substances in drug checking have entries in multiple FTIR libraries, and sometimes multiple entries within the same library. These spectra for the same substance can look very similar or very different. There are a wide variety of reasons why different entries for the same substance do not look the same. To fully understand why two spectra appear different requires full knowledge of the condition of the substance and the manner in which it is scanned:

1. Different physical forms: Many drugs can be present as a crystalline salt or an oily freebase, and the spectra will be different from one form to the other.
2. Different drug form: salt forms as well as base forms will have an effect on the IR spectrum.
3. Hydration states: Substances can have water molecules incorporated right into their crystal structure (e.g. **Epsom salts**). It is still a dry substance, but the effect on the IR spectrum can be significant.
4. Impurities: No reference substance is chemically pure. Impurities can add peaks, wash out peaks, change peak amplitude, or wavenumber position.
5. Sample preparation: A spectrum will look different depending on if it is an undiluted powder, diluted in a solvent, or spread as a thin film.
6. Instrument conditions: Damage to the FTIR can change how the spectrum looks.
7. Reference was incorrectly or simply not labelled: incorrect form (e.g. salt instead of base), incorrect salt, incorrect hydration (e.g. anhydrate instead of hydrate), and so on.

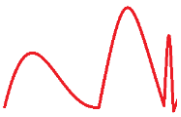
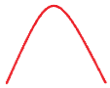
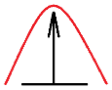
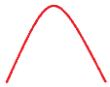
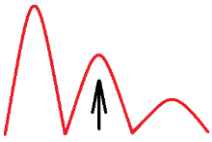
Hydration states cause the most confusion around alternate spectra (See Xylazine, MDMA, 2C-B, and Creatine). The differences between anhydrous (without Water) and hydrous (with water) spectra are large. Both forms are seen in drugs submitted to drug checking and can be confusing to the drug checker.

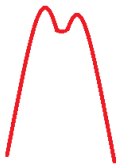
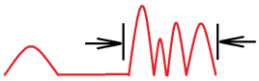
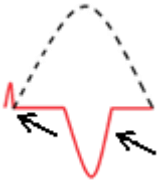
Errors in library entries (See Crack Cocaine) must be memorized by the technician as the BCCSU can only revise FTIR libraries that originate from the BCCSU.

Because of the wide range of possibilities for spectra to look different from one library to another, it is not always possible to be sure why one spectrum appears different from another. Some variation in FTIR library references allows the drug checking technician to pick the best match for their individual sample. A certain amount of error is to be always expected when working in imperfect conditions, but the BCCSU strives to provide references that will closely reflect what drug checking technicians will see in community in B.C.

Spectral Shapes

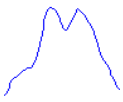
This document refers to patterns in spectra files by shapes. This is a compendium of words used and corresponding shapes they refer to.

Verbiage	Meaning	Pictogram
Spectrum	A visual representation of a substance in a pattern of peaks and valleys produced by an FTIR	
Peak	A prominence in the spectrum	
Valley	A depression in the spectrum	
Amplitude	The height of a peak in AU (Absorbance Units)	
Wavenumber position	The location of the top of a peak from left to right on the spectrum, in cm^{-1} units	
Noise	Random peaks and valleys along the baseline of a spectrum	
Sharp peak	A peak with a pointy top and a narrow base	
Broad peak	A peak with a rounded top and a wide base	
Triangular peak	A peak with a base that flares out in a triangular manner	
Strong/Major peak	A peak that has an amplitude closer to the top of the spectrum	
Moderate peak	A peak that has an amplitude closer to the middle of the spectrum	

Weak/Minor peak	A peak that has an amplitude closer to the baseline of the spectrum	
Double/triple peak	A set of peaks that have distinct tops but have merged bodies	
Peak shoulder	A set of two or more peaks that do not have distinct tops and instead appear as one peak with a side that juts out or has a lump on it.	
Fingerprint region	The right-hand side of the spectrum, usually containing a complex collection of peaks.	
Residual	The remainder of the spectrum left over after subtractions are performed.	
Subtraction artefact	An artificial feature of a spectrum created when a subtraction is done with a reference that does not match with the sample. Peaks may appear that do not correspond to further substances (false peaks) or deep depressions in the spectrum can result from over-subtractions.	

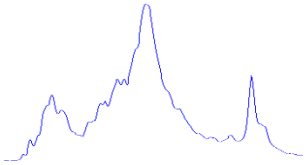
Visual Mnemonics

Visual mnemonics (e.g. “bunny ears”) are used throughout this document and are intended to be an informal and convenient way for technicians to remember important features of spectra of commonly occurring substances. Many of these mnemonics were made by technicians in B.C. to aid in the memorization and communication of important parts of the spectra, for example referring to the “Mountain” in methamphetamine as a shorthand way of referring to the spectral feature located between 3100^{-1} and 2300^{-1}. Technicians are encouraged to develop their own visual mnemonics appropriate to their context to improve their pattern recognition skill and enjoyment of their work.



Fentanyl “M”

Caffeine “Cat ears”



Meth “Mountain”

Spectral Feature Comparisons

Along with visual mnemonics (Meth “Mountain”, etc.), sometimes there are peaks or spectral features that “stick out” for technicians and become visual landmarks that are relied upon when making identifications. These landmarks are sometimes shared between substances, however, leading to the possibility of a technician wasting time attempting to prove the presence of a substance when a lookalike may be a better match, should it be searched for. (See Carfentanil).

Understanding shared spectral features allows the technician to improve uncertain matches to be within a group of substances, such as carbohydrates (See Mannitol). In situations where specificity is not possible, giving a group can be a useful way to show what information is known.

Finally, comparisons between hydrated (crystal) substances and water will help the technician to understand the spectral similarities and differences between water bound within a crystal structure and water that has been absorbed into a substance’s mass. (See MDMA).

Subtractive Analysis

The heart of FTIR analysis in drug checking lies in subtractions. By comparing peaks of reference spectra to that of a measured spectrum, a technician can identify substances in a mixture. When doing subtractive analysis, it is important that the highest peaks in a reference spectrum should always be searched for in a measured spectrum before making use of lesser peaks.

The primary indicator of the presence of a substance is the presence of at least some of the tallest peaks in a spectrum. While any peak in a spectrum may appear in the same location and amplitude as other substances, it is rare for multiple major peaks to be shared in this way. Use of moderate and minor peaks should generally be reserved as a means to confirm a matching major peak rather than primary evidence of the presence of a substance. This helps to avoid confirmation bias and misidentifications when doing subtractive analysis.

Opioids

Opioids are drugs derived from the opium poppy (opiates) or synthetically manufactured to activate opioid receptors in the body. There are many opioids presenting to drug checking with varying potencies.

The most common illicitly produced opioid in B.C. is Fentanyl**,** along with its analogues. While there are many analogues of fentanyl, not all are found in community drug checking. The two most detected via FTIR are para-Fluorofentanyl and ortho-Methylfentanyl**,** while the highly-potent Carfentanil is harder to detect but is seen in confirmatory testing.

Hydromorphone**,** Oxycodone**,** and Heroin are less potent opioids than fentanyl but are still commonly seen in drug checking.

A variety of precursors are used to make fentanyl or fentanyl analogues and can be found in final products. Precursors change in prevalence due to a variety of factors, but these are currently the most common found via FTIR:

- **4-anilino-1-boc-piperidine**
- **1-Boc-4-(4-fluoro-phenylamino)-piperidine**
- **Piperidone**
- **4-ANPP**
- **N-Boc-Norfentanyl base**
- **Propionanilide**
- **4-Anilinopiperidine**
- **despropionyl para-Fluorofentanyl**
- **Para-Fluoro-4-Anilinopiperidine**
- **N-Propionyl Para-Fluoro Norfentanyl base**

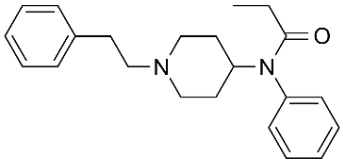
Heroin has three associated compounds that show up on occasion when testing, **Morphine**, **6-Monoacetylmorphine** (6-MAM), and **3-Monoacetylmorphine** (3-MAM).

There are many more opioids to learn about, such as **Codeine**, **Tramadol** and **Opium.** Of special note is the potent and hard-to-detect group of opioids known as **Nitazenes**. **Kratom** is an herbal substance with opioid and stimulant effects.

Awareness of **Opioid Agonist Therapy** (OAT) medications such as **Methadone, Suboxone** (**Buprenorphine** with **Naloxone**)**,** or long-acting morphine (**Kadian, M-Eslon**) may help in discussions with service users or when discussing referrals.

1. Fentanyl

Molecule



AKA Fent, down, pants, skittles, Fentora (lozenge), China white

Pronounced Fen-tah-nil

Description High-potency synthetic opioid analgesic (pain reliever), 50-100 times more potent than **Morphine**.[1,2] Can be temporarily reversed by **Naloxone**.

Possible effects Pain killer (analgesic), sedation, euphoria[3]

Possible side effects Constipation, pupil constriction, confusion, drowsiness, nausea, low blood pressure, respiratory depression, involuntary muscle movements, loss of consciousness, coma[3]

Caution!

1. High potency makes accurate dosing difficult, increasing risk of OD.
2. Withdrawal symptoms can occur after discontinuation.[4]
3. Death can occur due to depression of respiration leading to hypoxia (low blood oxygen).[4]

Some potentially contra-indicated mixtures

Mixing opioids with:	Possible effects
GHB/GBL[20,22] **Ketamine**[19,20,22] **Kratom**[22] **Nitrous Oxide**[18,20,22] **Opioids**[19]	Sedation, loss of consciousness, vomiting, amplify effects (increased OD risk)
Alcohol[19,20,22] **Benzodiazepines**[19,20,21,22]	**All above and:** blackouts, memory loss
Amphetamines[18,19,20,21,22] **Cathinones**[22] **MD-x**[21]	OD risk: stimulants mask the effects of sedatives and vice versa
Cocaine[18,20,22]	**All above and:** hypertension
Dextromethorphan[18,20,22]	Sedation, heart & breathing problems, hepatoxicity, OD risk, serotonin syndrome
MAOIs[20,22]	Serotonin syndrome
Tramadol[20]	**All above and:** Seizure risk, incr. OD risk

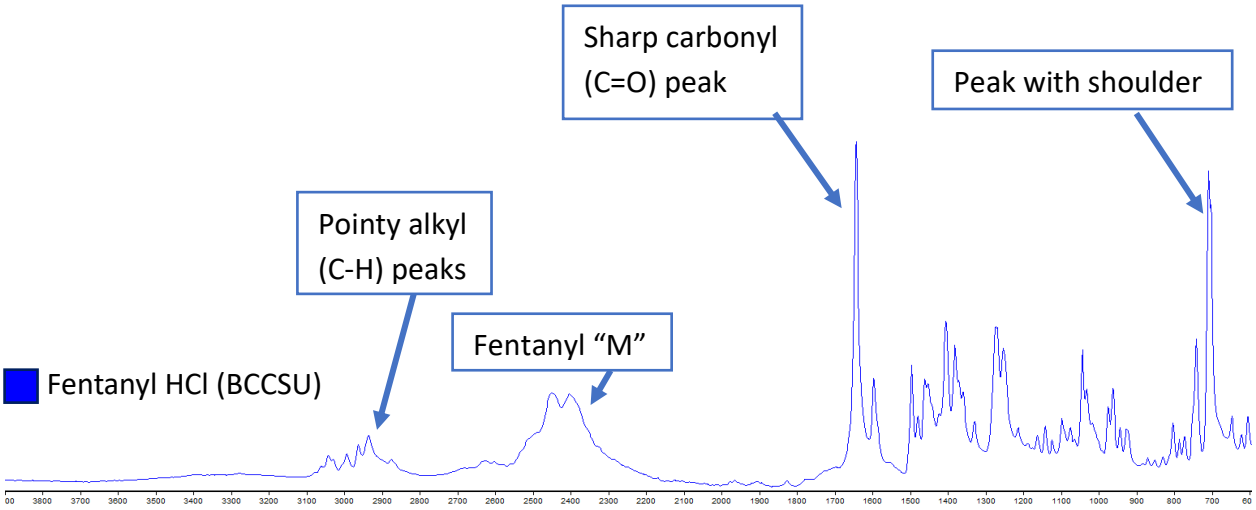
FTIR library entries

Library	Salt Form	Base Form	Citrate Form
BCCSU	Fentanyl HCl		Fentanyl Citrate
SWGDRUG	Fentanyl HCl		
TICTAC	Fentanyl HCl	Fentanyl freebase	Fentanyl Citrate
PHARMA-2			FENTANYL CITRATE

Notes

1. Fentanyl citrate is primarily found in dermal (skin-applied) patches.
2. Fentanyl (and its analogues) primarily works as a mu-opioid receptor agonist.[23]

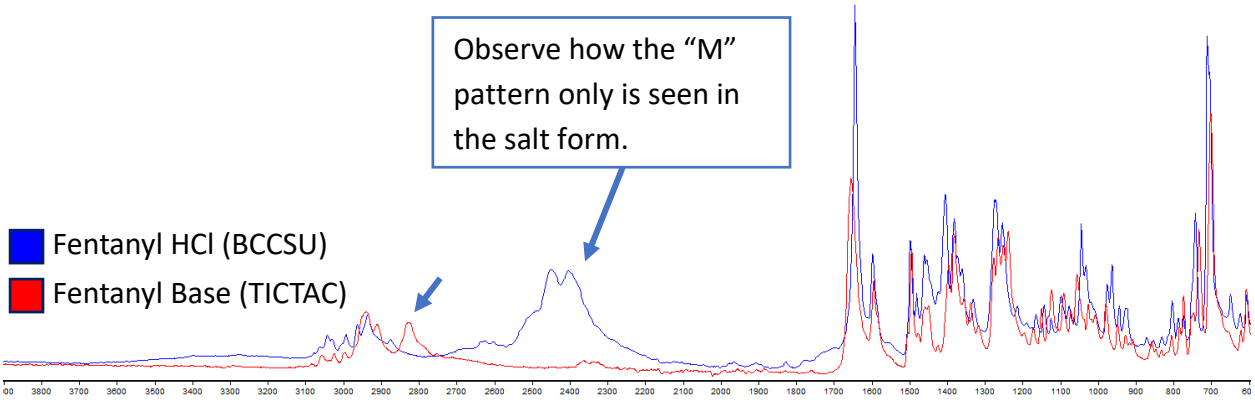
Primary FTIR Spectrum for Fentanyl



Fentanyl HCl is the most common form of fentanyl that is seen in drug checking and has good landmarks to find when investigating mixtures:

- The prominent "M" feature around $2500^{-1} – 2300^{-1}$.
- The major carbonyl peak at ~1650^{-1}.
- The major peak with a shoulder at ~700^{-1}. The shoulder can be difficult to spot, but using the zoom function should help show whether or not it is present.
- The pointy alkyl peaks in the $3100^{-1} – 2800^{-1}$ range. These can coincide with peaks of other substances, especially Erythritol.

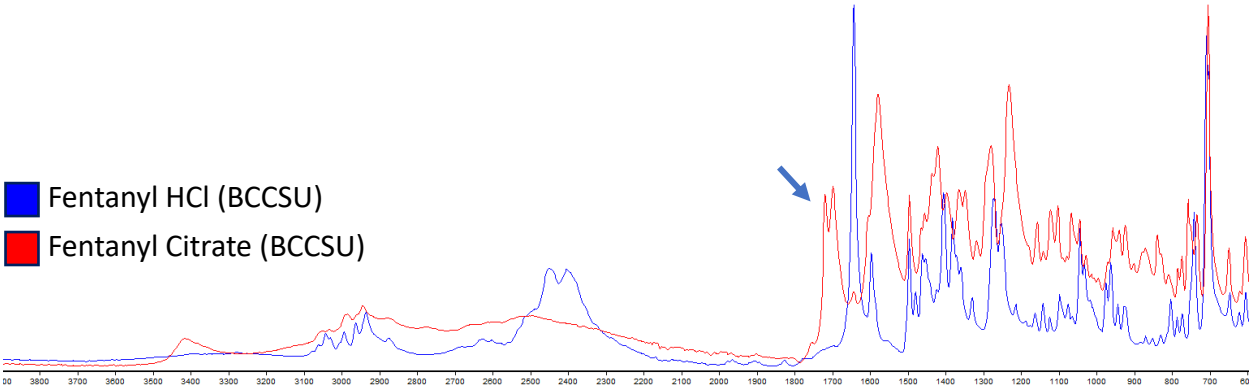
Spectral Comparison of Fentanyl Salt vs. Base



When fentanyl is changed from salt back to its freebase version, the "M" shape is completely removed from the spectrum. It is important not to rely on a single feature when identifying a substance as an alternate form may have totally different spectral characteristics. In other words, the lack of an "M" shape is no guarantee that fentanyl is not present in another form.

To note as well, fentanyl base has a peak near 2700^{-1} that may be useful to differentiate the two spectra, as most peaks in the fingerprint are fairly similar between the two forms.

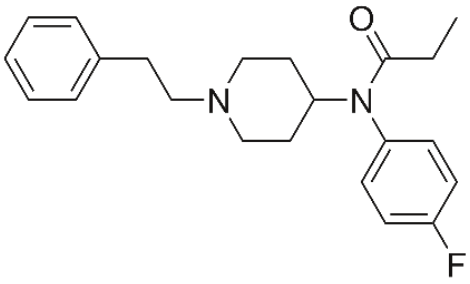
Spectral Comparison of Fentanyl HCl and Fentanyl Citrate



Fentanyl citrate is sometimes seen in fentanyl patches which can be scraped and used like fentanyl HCl would. Here we can see that aside from one peak near 700^{-1} that there is little in common between these spectra. This shows how much of an impact the type of salt has on the spectrum, despite the actual drug molecule remaining the same. The twin peaks near 1700^{-1} occur in an odd spot, sometimes these peaks can be mistaken for that of Crack Cocaine or even Carfentanil.

2. para-Fluorofentanyl

Molecule



AKA pFF, gas

Pronounced Pair-ah floor-oh-fen-ta-nil

Description A chemical and functional analogue of fentanyl. Academic reports conflict on potency compared to fentanyl[5], but it is possibly of similar potency to fentanyl by weight[6]. Anecdotal reports indicate a shorter duration than fentanyl. Can be temporarily reversed by **Naloxone**. Confirmatory evidence from samples checked in B.C. suggests that OPUS matches for ortho-fluorofentanyl are likely to be para-fluorofentanyl since they are so similar.

Effects See Fentanyl. Note that perceived "feel", duration, dose, and risk of overdose are not equivalent to that of fentanyl.

Mixtures See Fentanyl.

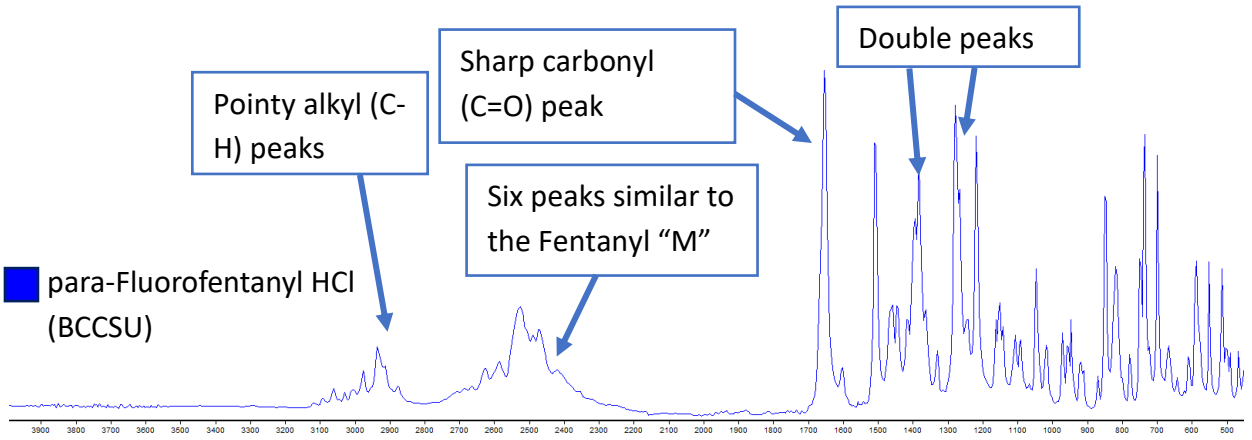
FTIR library entries

Library	Salt Form	Base Form
BCCSU	Para-Fluorofentanyl HCl	Para-fluorofentanyl base
SWGDRUG	Para-Fluoro fentanyl HCl	
TICTAC	Para-Fluoro fentanyl	

Notes

1. The TICTAC reference for para-fluorofentanyl shows a rather noisy signal that might be interpreted as additional peaks in the 3900^{-1} – 3100^{-1} and 2300^{-1} – 1700^{-1} ranges.
2. It is named after the fluorine atom added to fentanyl. "Para" is a positional term referring to the spot on the ring where the fluorine is attached to.
3. The street name "gas" refers to the strong odour that "raw" samples of this substance sometimes has. The smell is probably a byproduct of synthesis (i.e. leftover solvents, precursors) rather than the drug itself.

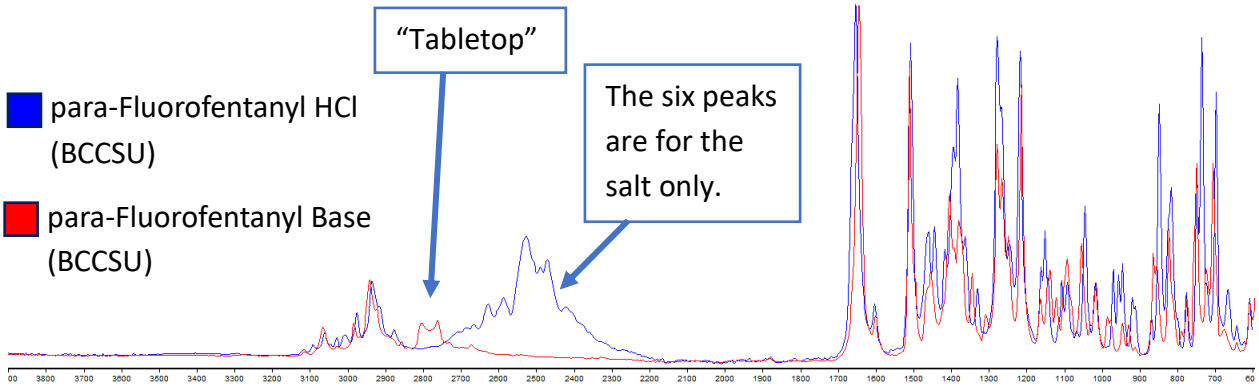
Primary FTIR Spectrum for para-Fluorofentanyl



The hydrochloride salt form is most commonly seen for para-Fluorofentanyl, and follows a similar pattern of identification to that of fentanyl HCl:

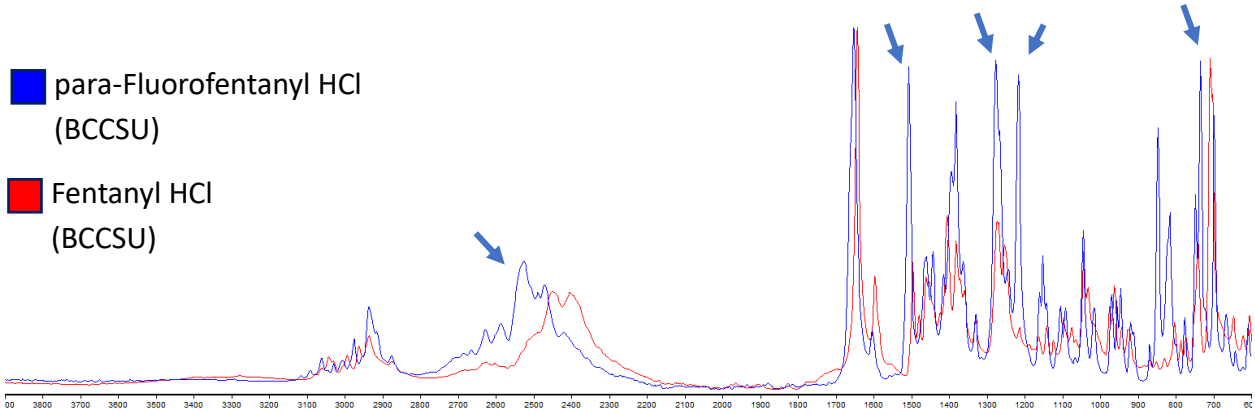
- The distinctive collection of six peaks around 2700^{-1} – 2400^{-1}.
- The carbonyl peak at ~1650^{-1}.
- The two double peaks at ~1400^{-1} and ~1250^{-1}.
- The one alkyl peak at ~2930^{-1}.

Spectral Comparison of para-Fluorofentanyl Salt vs. Base



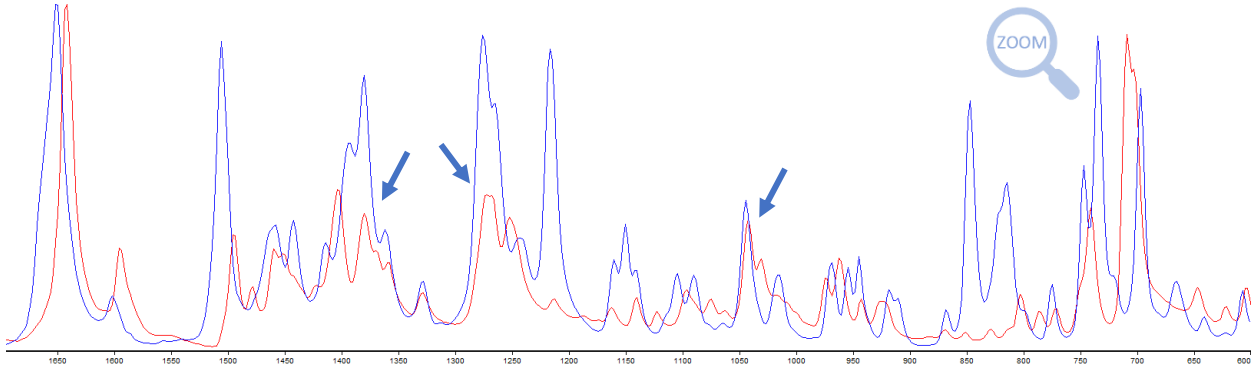
Like fentanyl base, para-fluorofentanyl base has a lot of differences when compared to the salt form. The alkyl peaks look similar, but the six-peaked feature disappears completely. A small "tabletop" feature appears and will be the primary way to identify this substance outside of the fingerprint.

Analogue Comparison of para-Fluorofentanyl HCl and Fentanyl HCl



There are several peaks that distinguish para-fluorofentanyl HCl from fentanyl HCl:

- The six peak feature in para-fluorofentanyl is significantly offset from the fentanyl HCl "M", allowing both to be visible simultaneously.
- The fingerprint has a lot of major peaks to work with, as indicated.
- More peaks can be seen in the fingerprint, below:

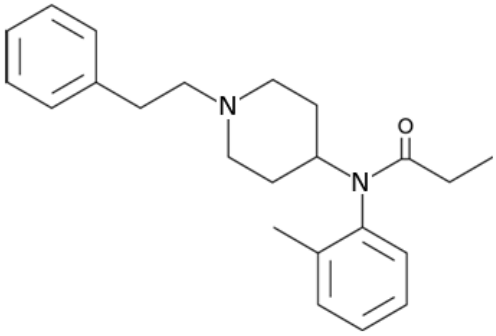


We can see that while there are many peaks that are in similar places, only a few may be difficult to tell apart (indicated). Remember to look for the tallest peaks of para-fluorofentanyl first, minor peaks are irrelevant if the major or moderate peaks cannot be found at all.

It is important to note that the two substances may be present in the same sample. Because they share similar but slightly shifted peaks, this may result in a messy and unconvincing match, especially after the first is subtracted. Looking at both spectral matches individually against their respective references can be helpful.

3. ortho-Methylfentanyl

Molecule



AKA omF

Pronounced Or-thoh meh-thul-fen-tah-nil

Description A chemical and functional analogue of fentanyl. Possibly of a similar potency to fentanyl by weight[7]. Anecdotal reports indicate a lower potency than fentanyl. Can be temporarily reversed by **Naloxone**.

Effects See Fentanyl. Note that perceived "feel", duration, dose, and risk of overdose are not equivalent to that of fentanyl.

Mixtures See Fentanyl.

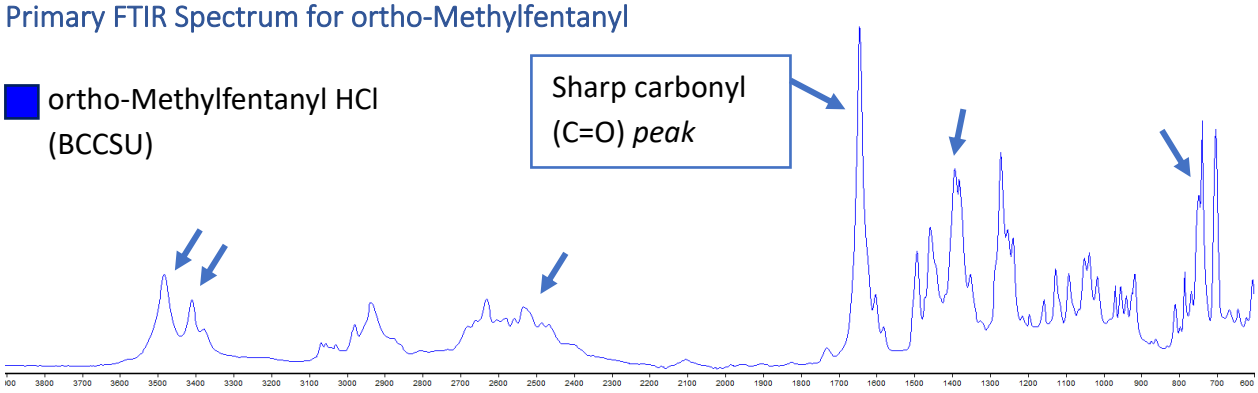
FTIR library entries

Library	Salt Form
BCCSU	Ortho-methylfentanyl HCl

Notes

1. It is named after the methyl group added to fentanyl. "Ortho" is a positional term that refers to where the methyl group is attached.

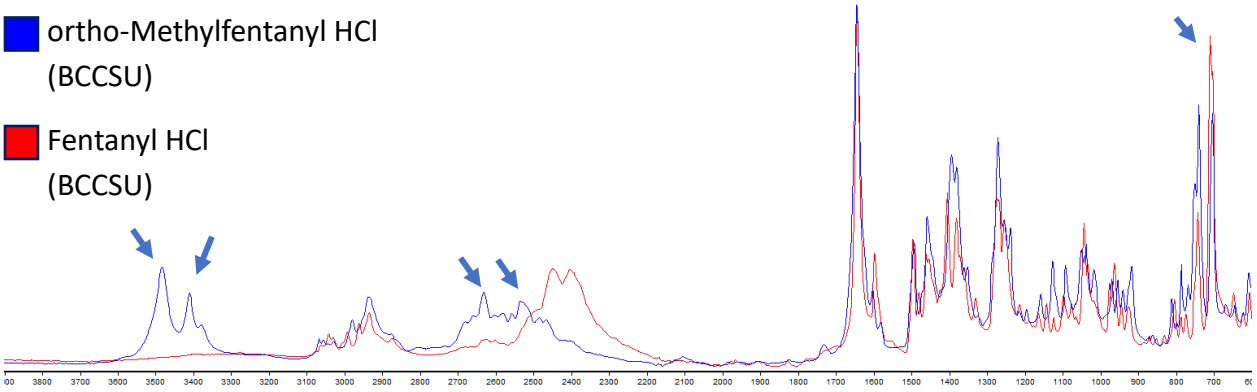
Primary FTIR Spectrum for ortho-Methylfentanyl



ortho-Methylfentanyl HCl is harder than both fentanyl HCl and para-fluorofentanyl HCl to identify; its features are not as distinct. There are concrete landmarks, however:

- Two peaks at ~3500^{-1} and ~3400^{-1}.
- The carbonyl peak at ~1640^{-1}.
- The tallest peaks in the 3100^{-1} – 2400^{-1}. These are difficult to use because they are relatively weak peaks, and share locations with para-fluorofentanyl.
- The double peaks at ~1400^{-1} and ~750^{-1}.

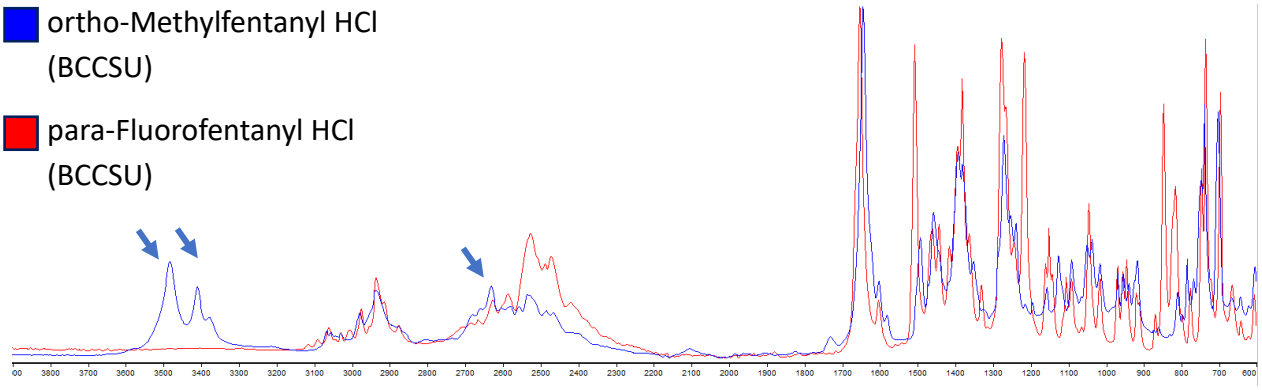
Analogue Comparison of ortho-Methylfentanyl HCl and Fentanyl HCl



When comparing ortho-methylfentanyl HCl to fentanyl HCl, the indicated peaks are useful for telling them apart:

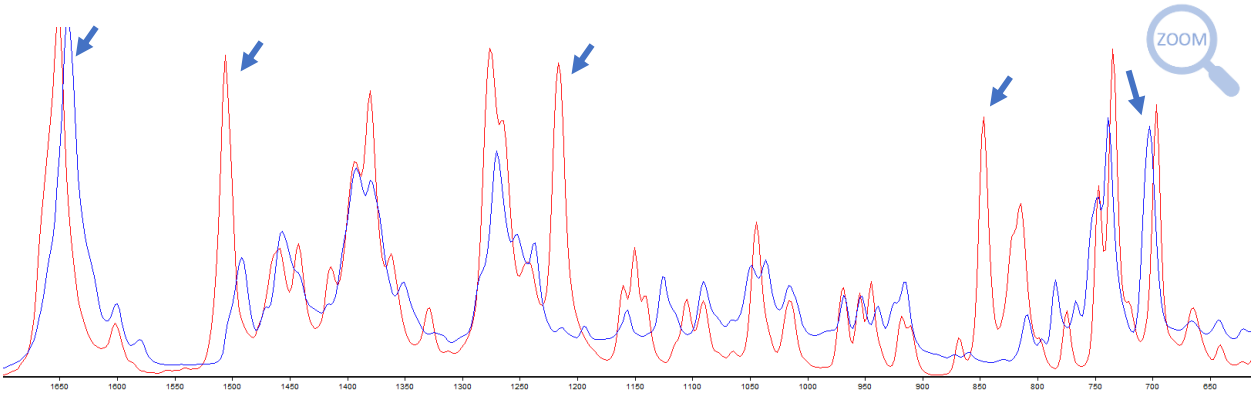
- The two peaks at ~3500^{-1} and ~3400^{-1}.
- The two peaks at ~2650^{-1} and ~2550^{-1}.
- The double peak which is present in the fentanyl HCl spectra at ~700^{-1} but not ortho-methylfentanyl.

Analogue Comparison of ortho-Methylfentanyl HCl and para-Fluorofentanyl HCl



ortho-methylfentanyl HCl is not as common as para-fluorofentanyl HCl, you should compare these two analogues as well. There also happens to be a lot of overlap between the two, but a few landmarks are available to you:

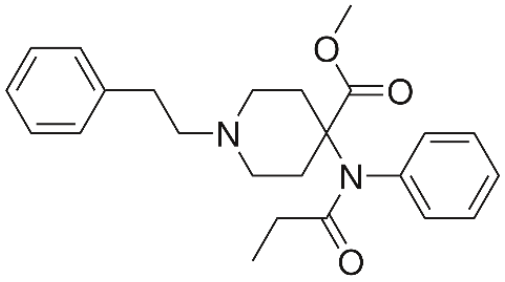
- The two peaks at ~3500^{-1} and ~3400^{-1}.
- The peak at ~2650^{-1} doesn't appear to be very different but is useful in the field for differentiating ortho-methylfentanyl.
- More distinctions in the fingerprint below:



The fingerprint has a lot of overlap as well, with para-fluorofentanyl having more unique peaks than ortho-methylfentanyl. When trying to show evidence of ortho-methylfentanyl, look to the position of the carbonyl peak at ~1630^{-1}. The peak at ~700^{-1} might be useful, but this peak is shared with fentanyl HCl as well.

4. Carfentanil

Molecule



Pronounced Kar-fen-tah-nil

Description A chemical and functional analogue of fentanyl originally used in veterinary care. Considered to be up to 100 times as potent as fentanyl by weight[8]. Can be temporarily reversed by **Naloxone**.

Effects See Fentanyl. Note that perceived "feel", duration, dose, and risk of overdose are not equivalent to that of fentanyl.

Caution!

1. Hot spots are more likely (and dangerous) with potent substances.
2. Extremely high potency makes accurate dosing without very expensive equipment nearly impossible. As a result, OD risk is increased when this substance is present.

Mixtures See Fentanyl.

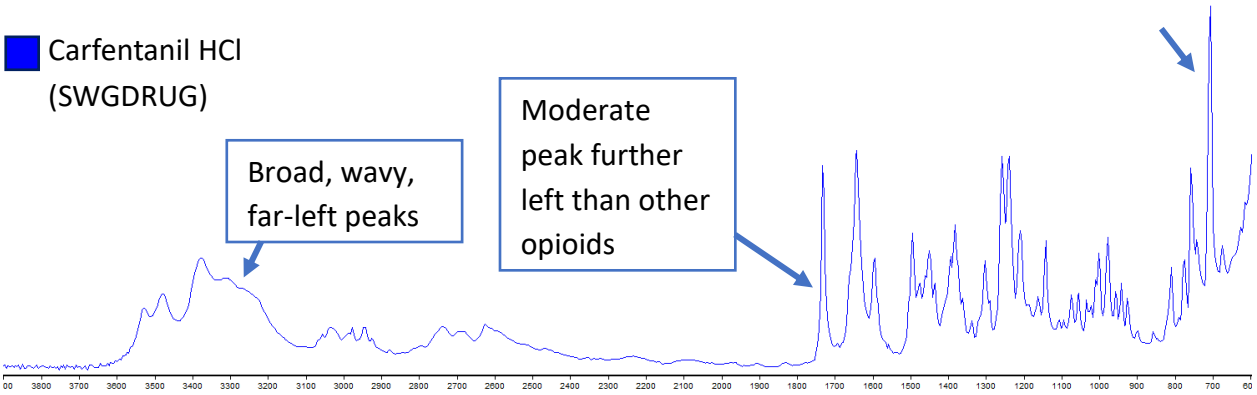
FTIR library entries

Library	Salt Form	Citrate Form
SWGDRUG	Carfentanil HCl	Carfentanil Citrate

Notes

1. Carfentanil is the most potent analogues of fentanyl found in unregulated opioids in B.C.
2. Due to its high potency, carfentanil can be difficult to detect via FTIR as it is often a small proportion of the overall mixture
3. It is named after the additional carbonyl group added to the molecule.
4. Some sources call it carfenta**nyl.**

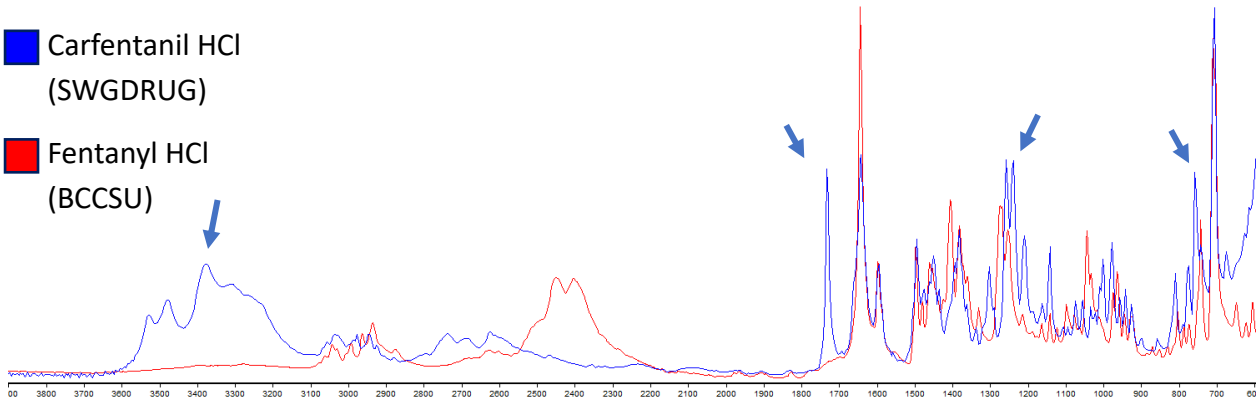
Primary FTIR Spectrum for Carfentanil



Carfentanil hydrochloride is the most common form seen, but the citrate salt may also appear. It is a difficult substance to identify because its spectrum has few strong features, but these landmarks will help:

- The wavy peaks to the far left, and in particular the left-most peaks at ~3520^{-1} and ~3480^{-1}.
- The peak at ~1730^{-1}. This peak sometimes overlaps with other substances (see below).
- The major peak at ~700^{-1}. This peak is shared precisely with fentanyl HCl, as seen below.

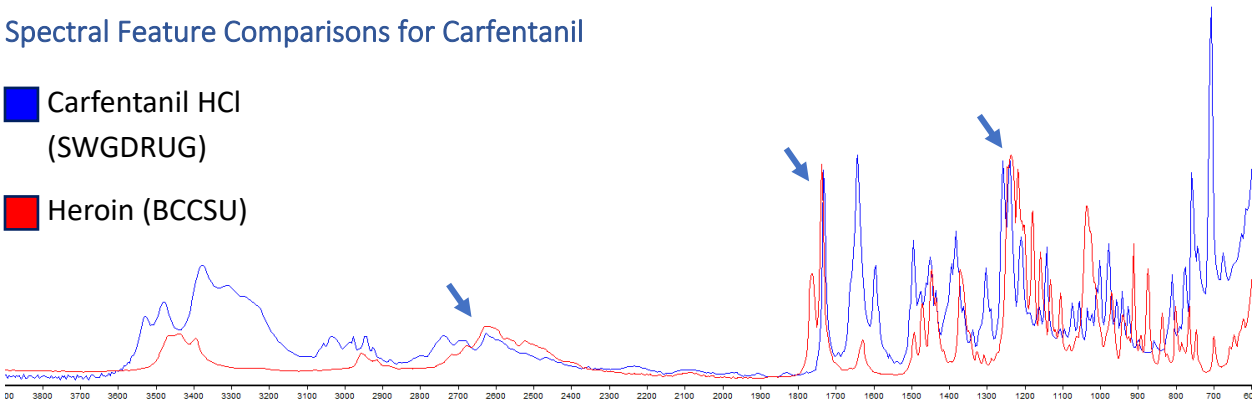
Analogue Comparison of Carfentanil HCl and Fentanyl HCl



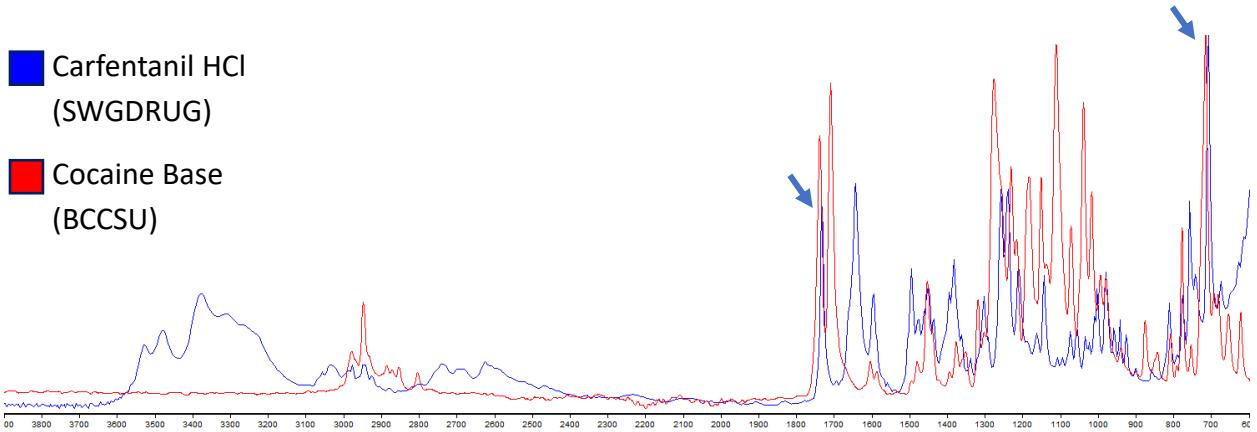
Due to the potency of carfentanil HCl, care must be taken not to "hunt" for the substance and possibly fall victim to confirmation bias. The carbonyl peak at ~1650^{-1} and the peak at ~700^{-1} are nearly perfectly aligned between the two. Despite the lack of any major peaks to work with, there are a few landmarks to look for:

- The collection of peaks to the left and the moderate peak at ~1730^{-1}
- The moderate peaks at ~1730^{-1}, ~1240^{-1}, and ~750^{-1}.

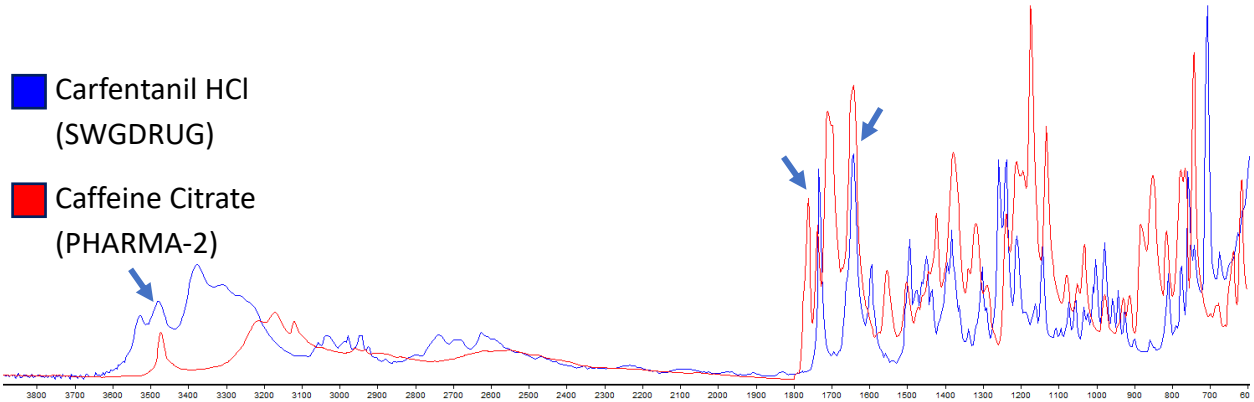
Spectral Feature Comparisons for Carfentanil



Carfentanil can sometimes be mistaken for Heroin because of one very important peak at ~1750^{-1}. Elsewhere, there are some similarities, such as 2600^{-1} and in the ~1250^{-1} region.



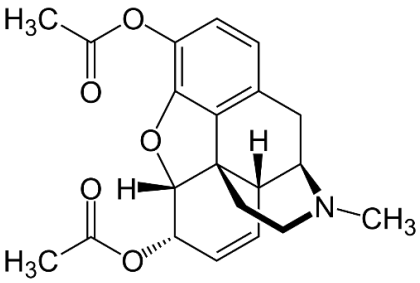
Similar to heroin, Crack Cocaine also has a peak at ~1750^{-1} that overlaps with carfentanil. It also nearly overlaps with the major peak of carfentanil at ~700^{-1}.



Consider the similarities between Caffeine citrate and carfentanil. The peak at ~3470^{-1} and the two peaks that line up at ~1750^{-1} and ~1650^{-1} cause confusion. Because caffeine citrate can only be found in the Pharma library, false matches for carfentanil can occur, especially if these two peaks are included in a limit search.

5. Heroin

Molecule



AKA Diacetylmorphine (DAM), diamorphine, dope, down, smack, black tar, junk

Pronounced Heh-row-in

Description Opioid made from opium poppies. About 2-4 times as potent as **Morphine**[9] (Fentanyl is 30-50 times as potent as Heroin by weight[10]). Prescribed as Diacetylmorphine (DAM) in severe opiate use disorder treatment[11]. Can be temporarily reversed by **Naloxone**.

Possible effects Pain killer, sedative, euphoria[12]

Possible side effects Skin rash, itching, drowsiness, constipation, nausea, vomiting, agitation, anxiety, confusion, fatigue, involuntary muscle movements, nightmares, blurred vision[12] neurotoxicity[13], dry mouth[119]

Caution!

1. Withdrawal symptoms can occur after discontinuation.
2. Death via OD occurs due to depression of respiration leading to hypoxia (low blood oxygen).

Mixtures See Fentanyl.

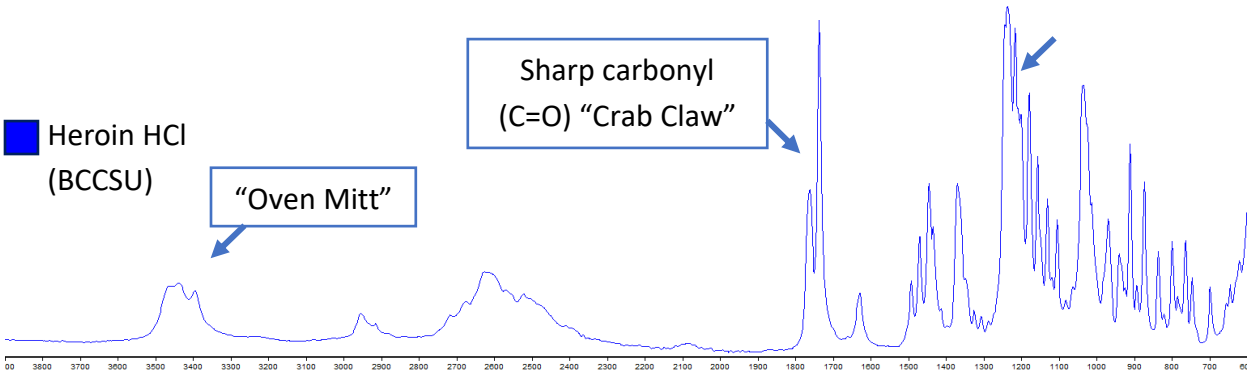
FTIR library entries

Library	Salt Form	Base Form
BCCSU	Heroin HCl	
SWGDRUG	Heroin Hydrochloride Monohydrate	Heroin Base
TICTAC		Heroin Base
PHARMA-2	HEROIN, HEROIN HCL, DIACETYLMORPHINE, DIACETYLMORPHINE HCL	

Notes

1. Heroin is derived from a plant, and often is composed of several psychoactive components (and contaminants) depending on the crop and quality of refinement. Many of these are unlikely to be found via FTIR due to being minor components.
2. Diacetylmorphine (DAM) is the principle psychoactive constituent of heroin and pharmaceutically refined DAM may be used by prescription in opiate use disorder treatment.[11, 135]
3. Due to the entourage effect of the other compounds present in heroin, there may be significant subjective differences to the service user between heroin and pharmaceutical-grade DAM.
4. Heroin breaks down into **Morphine** in the brain, which then primarily works as a mu-opioid receptor agonist.[24]

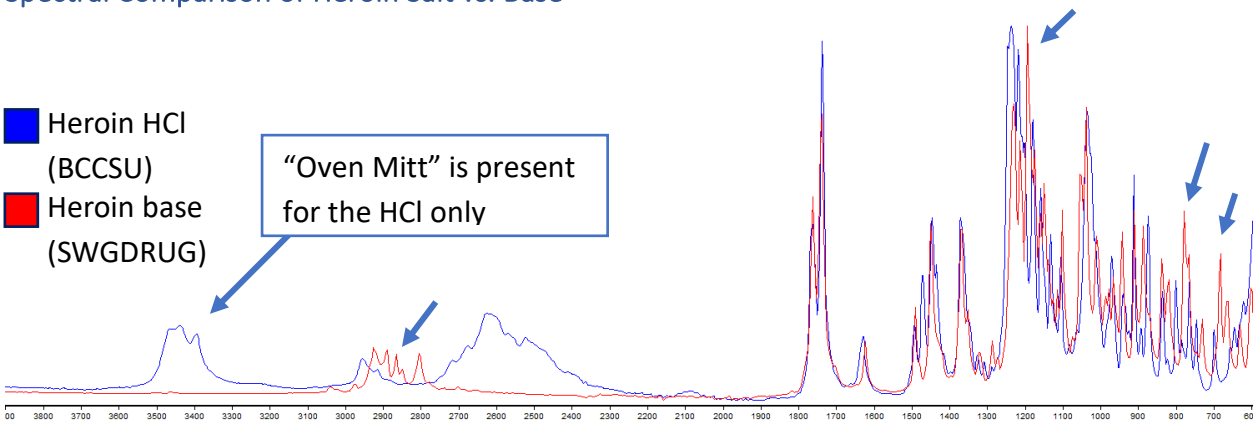
Primary FTIR Spectrum for Heroin



Heroin HCl is the most common form of heroin, and has some useful features that aid in identification:

- The "Crab Claw" carbonyl feature is heroin HCl's most recognizable feature, when combined with Caffeine, the "Crab Claw" feature forms a characteristic set of stepped peaks known as the "Stairway to Heroin".
- The "Oven Mitt" at ~3420^{-1}
- The major double peak with two shoulders at ~1250^{-1} that has a series of falling peaks to the right.

Spectral Comparison of Heroin Salt vs. Base

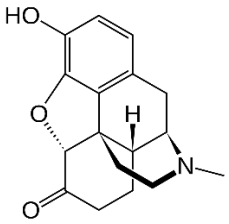


Heroin base is seen in drug checking less often than heroin HCl, but does appear on occasion. The base form has some spiky alkyl peaks in the 2950^{-1} – 2750^{-1} region that help to distinguish the two, but lacks the "Oven Mitt" and the rise in the center of the spectrum. Aside from the alkyl peaks, there are a few peaks in the fingerprint (indicated) that can be used when looking for heroin base, but the fingerprint of the base heavily resembles that of the HCl salt and the two can sometimes co-occur in match lists in OPUS. Context clues such as which cuts and buffs are present as well as the method of consumption can be used to help point towards which form is more likely if OPUS cannot.

Remember that the base form of drugs is usually more suited for smoking and sometimes will be seen alongside an acidifier such as Ascorbic Acid (Vitamin C).

6. Hydromorphone

Molecule



AKA Dihydromorphinone, Dilaudid, dillies, dilly-8, hydros

Pronounced Hye-droh-morr-fone

Description Opioid derived from morphine. About 4-5 times the potency of **Morphine**[14]. Is prescribed as a pharmaceutical alternative to fentanyl in B.C[15]. Can be temporarily reversed by **Naloxone**.

Possible effects Pain killer, sedative, euphoria[16]

Possible side effects Itching, drowsiness, constipation, nausea, vomiting, agitation, anxiety, confusion, fatigue, gastric problems, nightmares, blurred vision, neurotoxicity[16]

Caution!

1. Withdrawal symptoms can occur after discontinuation.
2. Death via OD occurs due to depression of respiration leading to Hypoxia (low blood oxygen).

Mixtures See Fentanyl.

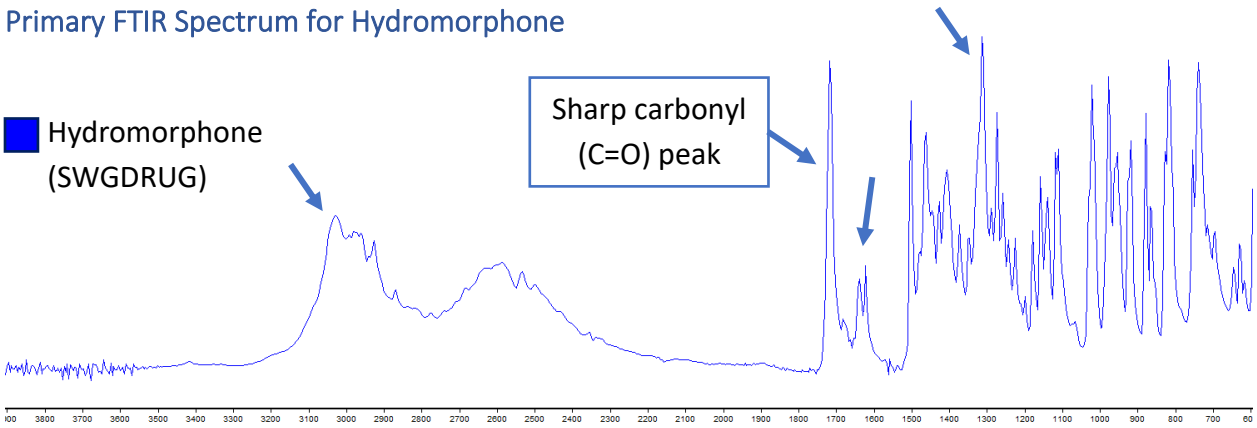
FTIR library entries

Library	Salt Form
SWGDRUG	Hydromorphone HCl
PHARMA-2	HYDROMORPHONE, HYDROMORPHONE HCL, DILAUDID

Notes

1. Hydromorphone may be difficult to find in pills due to its high potency, resulting in low concentration relative to the pill filler.
2. The typical pill filler for pharmaceutical hydromorphone (Dilaudid) is Lactose, but may also contain Microcrystalline Cellulose (MCC)[130,136]
3. Hydromorphone (like fentanyl) primarily works as a mu-opioid receptor agonist.[24]

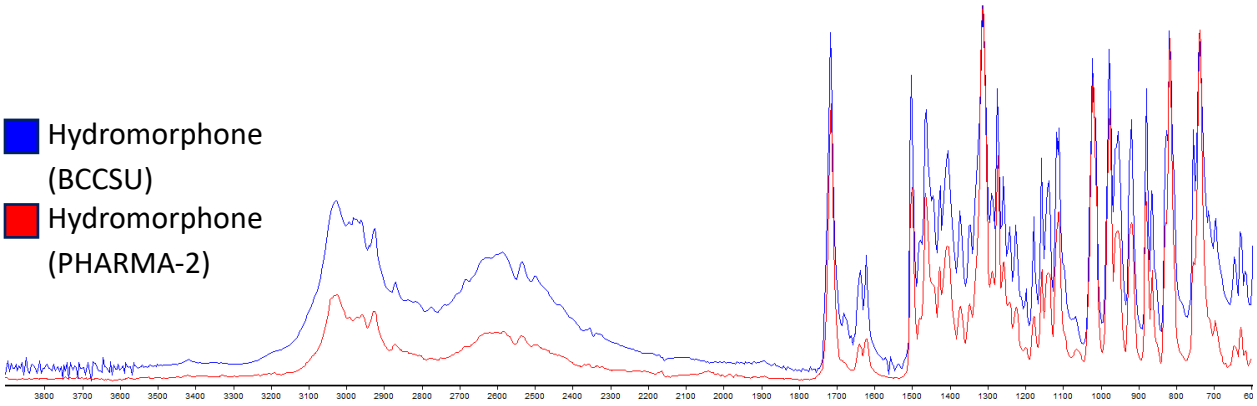
Primary FTIR Spectrum for Hydromorphone



Hydromorphone is usually a challenge to find as it is often a minor proportion of a pressed pill, but some aspects of the spectra may be helpful for identification:

- Moderate peaks in the ~3100^{-1} – 2900^{-1} region may poke out of other spectra, or
- The entire region of ~3100^{-1} – 2400^{-1} may appear "lifted" when viewed as a mixture, even if individual peaks of hydromorphone are hard to discern.
- The carbonyl peak at ~1720^{-1}.
- The major peak ~1300^{-1}.
- The double peak at ~1640^{-1}.

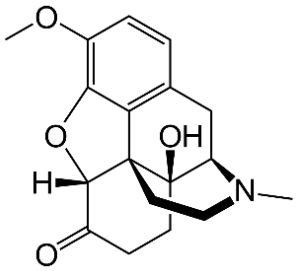
Alternate Reference Spectrum for Hydromorphone



Observe the difference in amplitude between the BCCSU reference and the PHARMA-2 reference. The peak wavenumber position appears to be similar between the two spectra and the overall shape and behaviour of the spectra seem similar, however. Presumably the BCCSU reference is the hydrated form of hydromorphone, though this is uncertain.

7. Oxycodone

Molecule



AKA Oxycontin, Oxy, Percocet, Perc

Pronounced Awks-ee-koh-dohn

Description Opioid about 1.5 times as potent as **Morphine**.[14] Can be temporarily reversed by **Naloxone**.

Possible effects Pain killer, sedative, euphoria

Possible side effects Itching, drowsiness, constipation, nausea, vomiting, confusion, fatigue, gastric problems, hypotension[17]

Caution!

1. Withdrawal symptoms can occur after discontinuation.
2. Death via OD occurs due to depression of respiration leading to hypoxia (low blood oxygen).

Mixtures See Fentanyl.

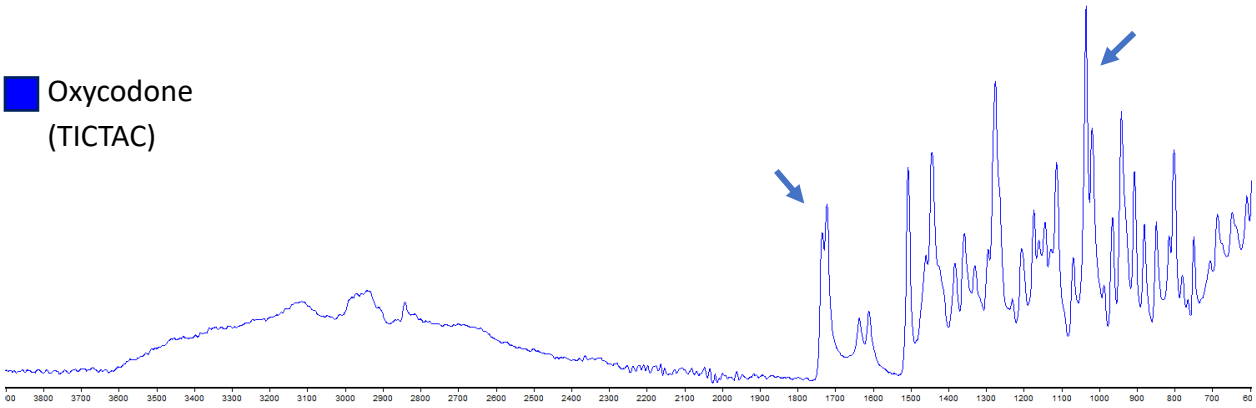
FTIR library entries

Library	Salt Form
SWGDRUG	Oxycodone HCl Monohydrate
TICTAC	Oxycodone
PHARMA-2	OXYCODONE, OXYCODONE HCL

Notes

1. **Percocet** is a mixture of oxycodone and acetaminophen. If no acetaminophen is found via FTIR, It is a counterfeit tablet!
2. Oxycodone works as a mu-, kappa-, and delta-opioid receptor agonist.[26]

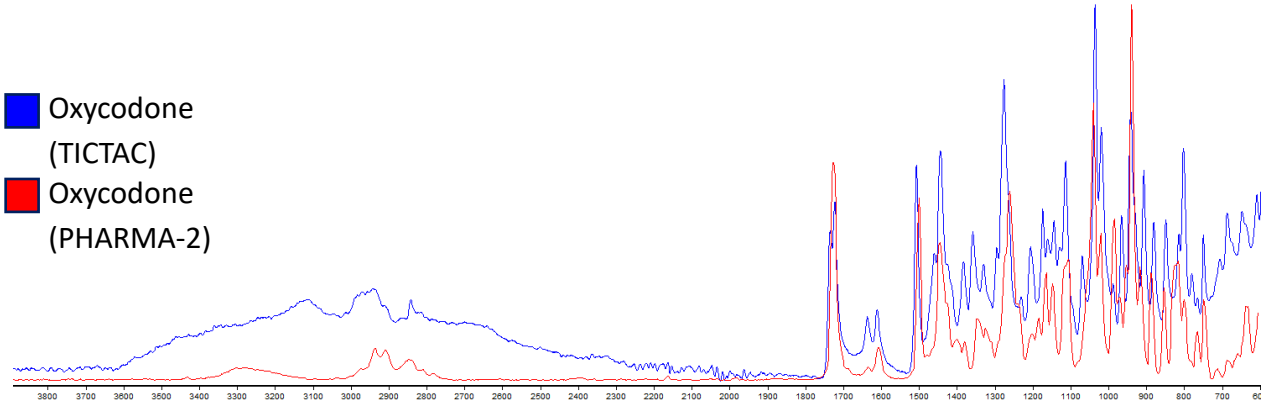
Primary FTIR Spectrum for Oxycodone



Oxycodone has fewer landmarks than hydromorphone, but there are still some features that can aid in identification:

- A single strong peak at ~1040^{-1}.
- The moderate double peak at ~1730^{-1}, in contrast to the usual strong carbonyl peak that other opioids have here.
- The gentle rise of the ~3500^{-1} – 2300^{-1} region may be seen as a “lift” that can be observed in mixtures.

Alternate Reference Spectrum for Oxycodone



Observe the amplitude difference between the TICTAC and PHARMA-2 spectra. Like the differences in spectra for Hydromorphone, perhaps the TICTAC reference is the hydrated form of oxycodone.

Depressants

Depressants slow down activity in the central nervous system, leading to feelings of relaxation, sedation, and reduced anxiety. They can impair motor coordination and cognitive function, and overdose can result in respiratory depression and death.

The depressant category includes several different subgroups of drugs, but is heavily represented by benzodiazepines, as well as drugs closely related to benzodiazepines. Bromazolam**,** Desalkylgidazepam**,** and Flualprazolam are true benzodiazepines, while Etizolam is a closely-related and functionally similar drug.

To learn more about relevant benzodiazepines, learn more about **Alprazolam** (Xanax), **Lorazepam** (Ativan), **Diclazepam**, **Diazepam** (Valium), **Clonazepam** (Klonopin), and **Flubromazepam**. Lorazepam, followed by clonazepam and diazepam are the most prescribed benzodiazepines in BC.[137] There are a wide variety of benzodiazepines available, but not all are seen at drug checking sites in B.C.

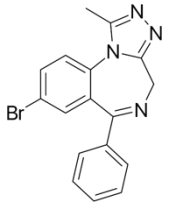
Xylazine is a tranquilizer used as a depressant in a similar fashion to benzodiazepines, but chemically is very distinct and has different effects. A drug closely related to Xylazine that is important to learn is **Medetomidine**. This drug is more potent and harder to detect via FTIR.

GHB and the similar compound GBL are seen more in party and festival settings, but both are depressants and are included in this section. **Bromo-GBL** and **1,4-Butanediol** are psychoactive precursors of GHB that are relevant to learn when checking GHB.

Alcohol is a common depressant that sometimes is forgotten in the drug conversation due to its ubiquity. **Dextromethorphan** (DXM/Robitussin) is sold as a cough and cold medicine but also is used recreationally as a dissociative (colloquially: robotripping). Both are central nervous system depressants that can cause harm on their own and especially when mixed with other substances.

8. Bromazolam

Molecule



AKA Bromo, benzo-down/dope (when in down)

Pronounced Broh-mah-zoh-lahm

Description A chemical and functional analogue of alprazolam (Xanax). Synthesized in the 70's but never marketed.[27] Considered to be of similar potency to **Alprazolam**.[29]

Possible effects Muscle relaxation, sedation, anxiolytic (anxiety-reducing)[30]

Possible side effects Loss of coordination & balance, confusion, weakness, dizziness, fatigue, amnesia (memory loss), delirium, long periods of unconsciousness[30], low blood pressure[120]

Caution!

1. High potency makes accurate dosing difficult, increasing risk of OD.
2. Withdrawal is possible when discontinuing use and can be fatal if not tapered correctly (medical supervision).
3. Causes prolonged CNS depression when combined with opioids and can lead to hypoxia (low blood oxygen).
4. Complicates ODs when used with opioids due to prolonged sedation and lack of effect of **Naloxone** on benzodiazepines.

Some potentially contra-indicated mixtures

Mixing benzodiazepines with:	Possible effects
Dextromethorphan[20,22] **Ketamine**[19,20,22]	Sedation, vomiting, loss of consciousness
Tramadol[20,21,22]	**All above and:** Amplify effects (increased OD risk)
Alcohol[19,20,21,22] **GHB/GBL**[20,21,22] **Kratom**[22] **Opioids**[19,20,21,22]	**All above and:** blackouts, memory loss
Amphetamines[21] **Cocaine**[21]	OD risk; stimulants mask the effects of sedatives and vice versa

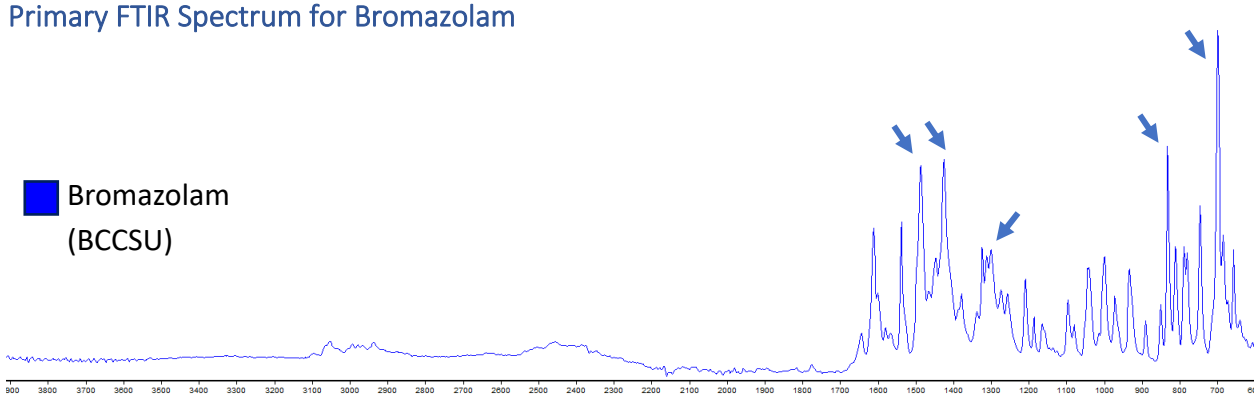
FTIR library entries

Library	Entry
BCCSU	Bromazolam
SWGDRUG	Bromazolam
TICTAC	Bromazolam

Notes

1. Due to its high potency, bromazolam can be difficult to detect via FTIR as it is often a small proportion of the overall mixture.
2. The name comes from the bromine atom that replaces the chlorine atom in **Alprazolam** (chloarazolam is another name).
3. Bromazolam primarily works as a $GABA_A$ agonist.[28]

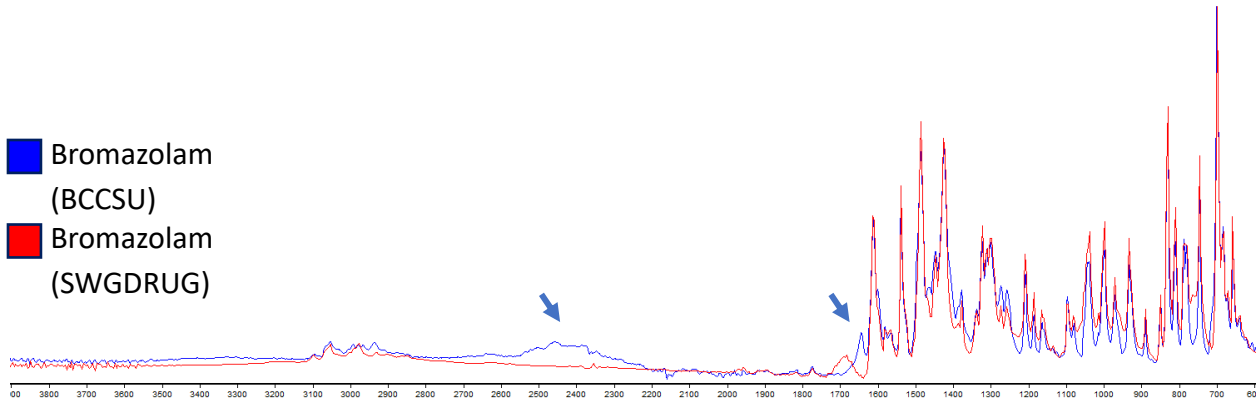
Primary FTIR Spectrum for Bromazolam



Bromazolam is not an easy substance to identify via FTIR. Within the fingerprint, look for:

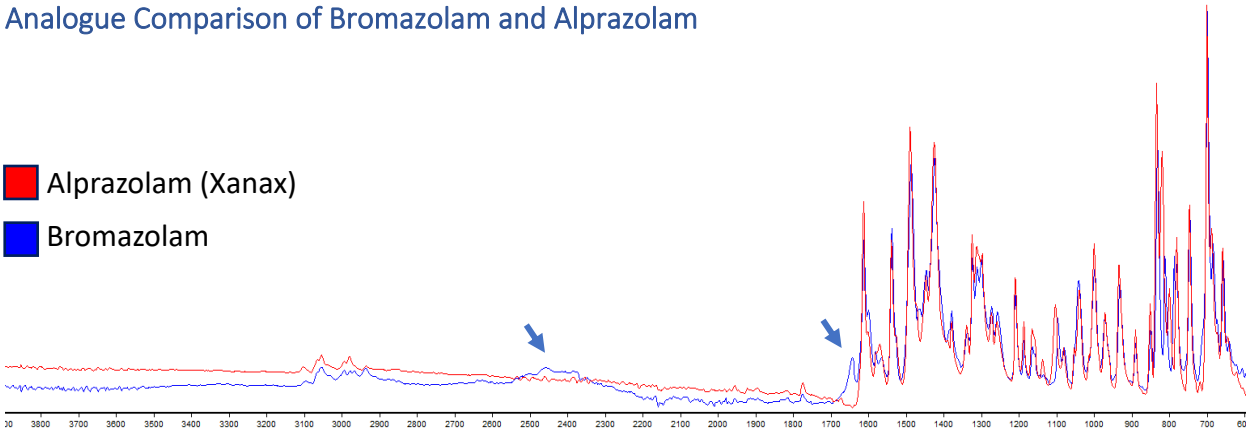
- The major peak at ~690^{-1}. This peak is shared with other substances (especially opioids).
- The three moderate peaks indicated.
- The triple peak at ~1300^{-1}.

Alternate Reference Spectra for Bromazolam



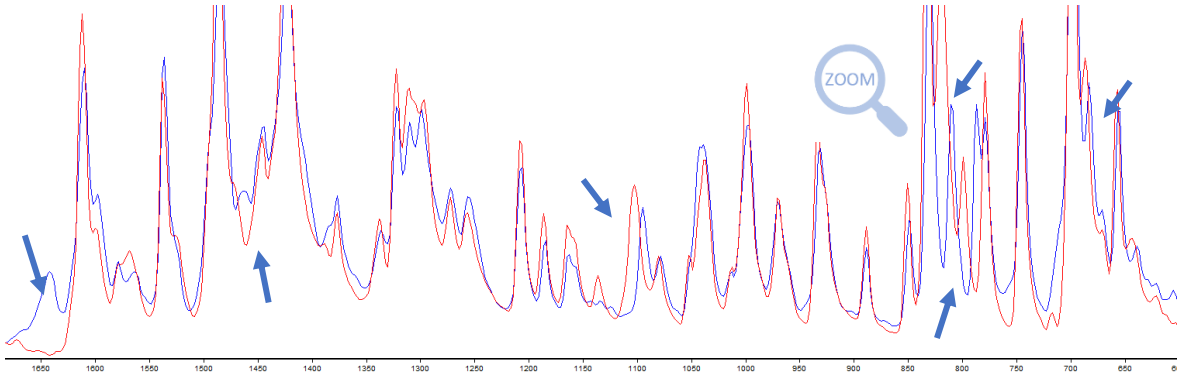
Observe the differences here between the BCCSU and SWGDRUG references. It is not clear why they differ in these regions.

Analogue Comparison of Bromazolam and Alprazolam



Bromazolam and alprazolam, are similar substances and their spectra are also very similar. At first glance, one could be forgiven for not seeing any difference at all! The only peak that really can be seen to be different is the one at ~1640^{-1}, but it is not a particularly strong peak to work with. The rise from 2500^{-1} – 2300^{-1} doesn't necessarily appear for bromazolam (see above), so this area isn't always useful for telling the two substances apart.

The fingerprint looks identical at first, but a closer look reveals some differences.

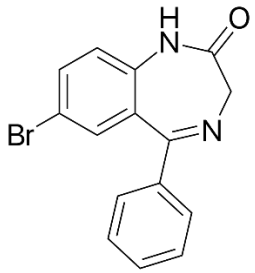


Looking very closely, the differences between the two substances are slight but visible. If several subtractions have occurred and artefacts have started to accumulate, these slight differences may be erased, making it nearly impossible to tell alprazolam from bromazolam. Thankfully, alprazolam is nowhere near as common as bromazolam in B.C. Contextual clues such as where the substance was purchased can help point to which is more likely to be present if the spectral comparison does not yield an answer.

It is important to note that alprazolam is not prescribed in the form of "bars" in B.C. The "Xanax" bars found in drug checking in BC are most often counterfeit, containing a non-pharmaceutically available benzodiazepine.

9. Desalkylgidazepam

Molecule



Pronounced Dehz-al-kl-**g**id-ah-zih-pam (g as in go)

Description A benzodiazepine related to gidazepam, which is a prescribed drug in some countries. Has a very long duration when compared to other benzodiazepines.[33]

Effects See Bromazolam. Note that perceived "feel", duration, dose, and risk of overdose are not equivalent to that of bromazolam.

Mixtures See Bromazolam.

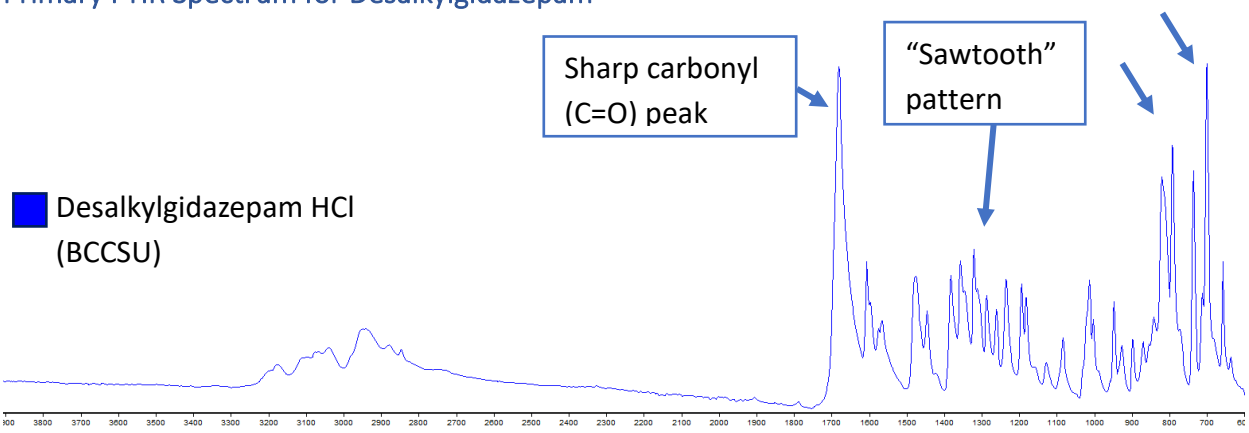
FTIR library entries

Library	Salt Form	Base Form
BCCSU	Desalkylgidazepam	Desalkylgidazepam Base

Notes

1. Due to its high potency, desalkylgidazepam can be difficult to detect via FTIR as it is often a small proportion of the overall mixture
2. Desalkylgidazepam is a metabolite of gidazepam.[33]
3. The name means "Gidazepam minus an alkyl functional group" (des).
4. Because desalkylgidazepam has a long duration, repeated doses may accumulate in the body, risking overdose.

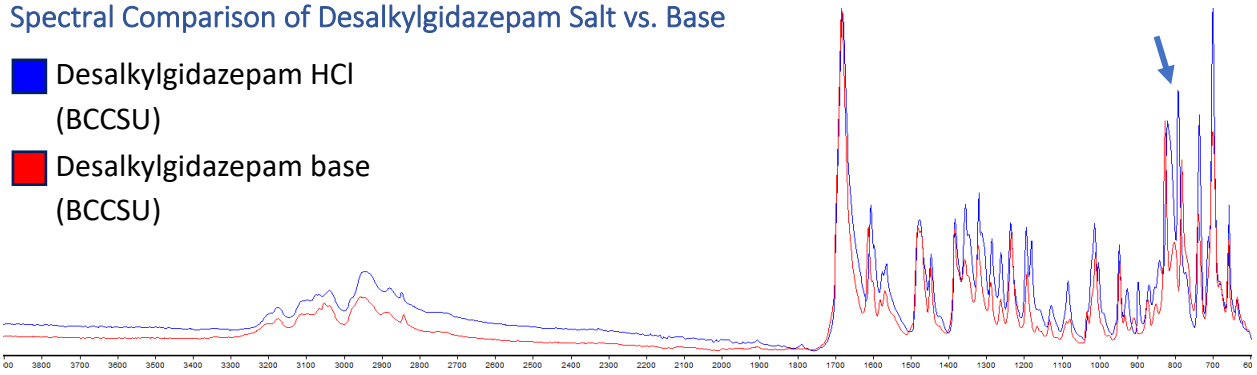
Primary FTIR Spectrum for Desalkylgidazepam



Desalkylgidazepam HCl is the most common form of this drug, and has a fingerprint with several strong features:

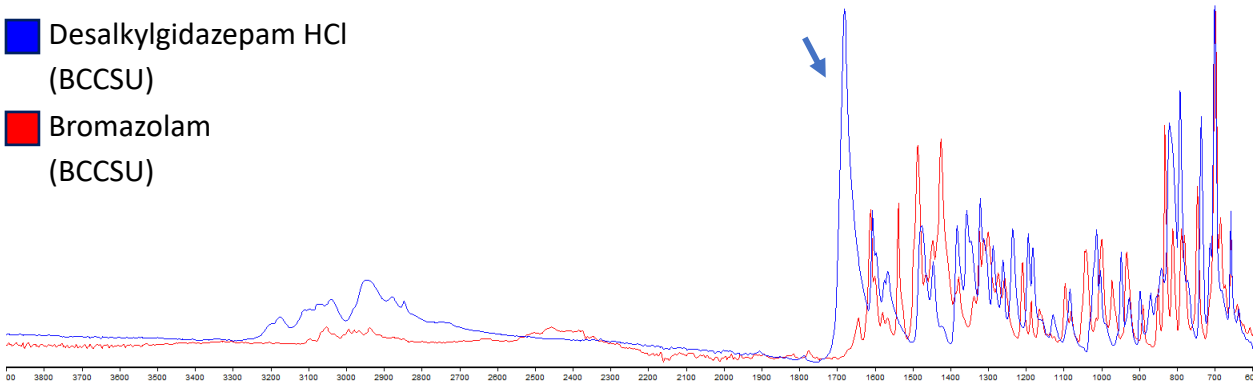
- The carbonyl peak at ~1670^{-1}.
- The mid-fingerprint "Sawtooth" pattern. This may be mistaken for the "Crown" of Xylazine.
- The major peak at ~700^{-1}. This peak is shared with opioids.
- The double peak at ~800^{-1}.

Spectral Comparison of Desalkylgidazepam Salt vs. Base



The HCl salt and base forms of desalkylgidazepam closely resemble each other, which can make differentiating them difficult. Context clues as to the mode of consumption may help identify which is more likely (base forms are more suited to smoking) otherwise there is one peak that is especially useful for telling them apart.

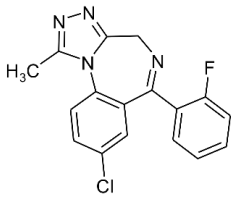
Analogue Comparison of Desalkylgidazepam HCl and Bromazolam



Desalkylgidazepam HCl and bromazolam have commonalities in their spectra, but the most obvious difference is the desalkylgidazepam carbonyl peak at ~1670^{-1}. Note that the major peak at ~700^{-1} is shared between the two and also with opioids.

10. Flualprazolam

Molecule



Pronounced Floo-ahl-prah-zoh-lahm

Description A chemical and functional analogue of alprazolam (Xanax). Synthesized in the 70's but never marketed.[34]

Effects See Bromazolam. Note that perceived "feel", duration, dose, and risk of overdose are not equivalent to that of bromazolam.

Mixtures See Bromazolam.

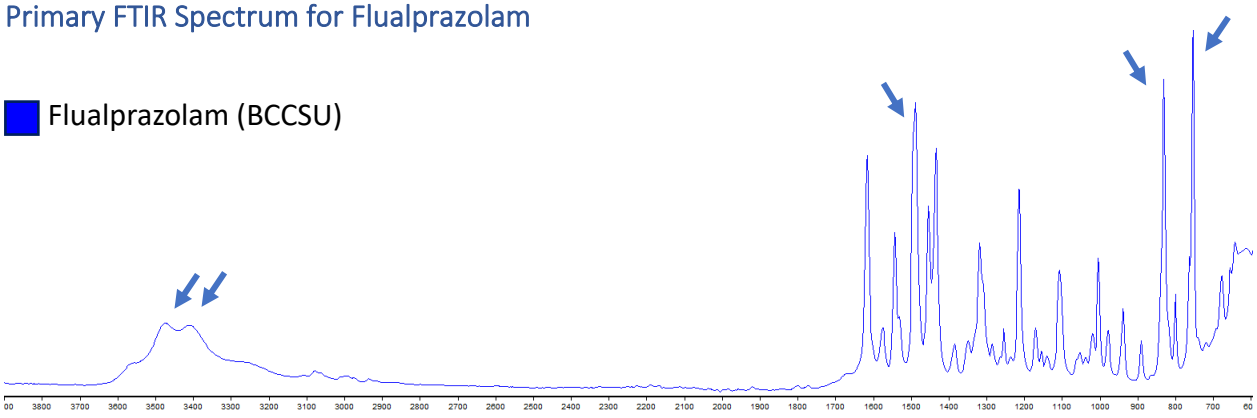
FTIR library entries

Library	Entry
BCCSU	Flualprazolam
SWGDRUG	Flualprazolam
TICTAC	Flualprazolam

Notes

1. Due to its high potency, flualprazolam can be difficult to detect via FTIR as it is often a small proportion of the overall mixture.
2. The name comes from the fluorine atom that is added to alprazolam.

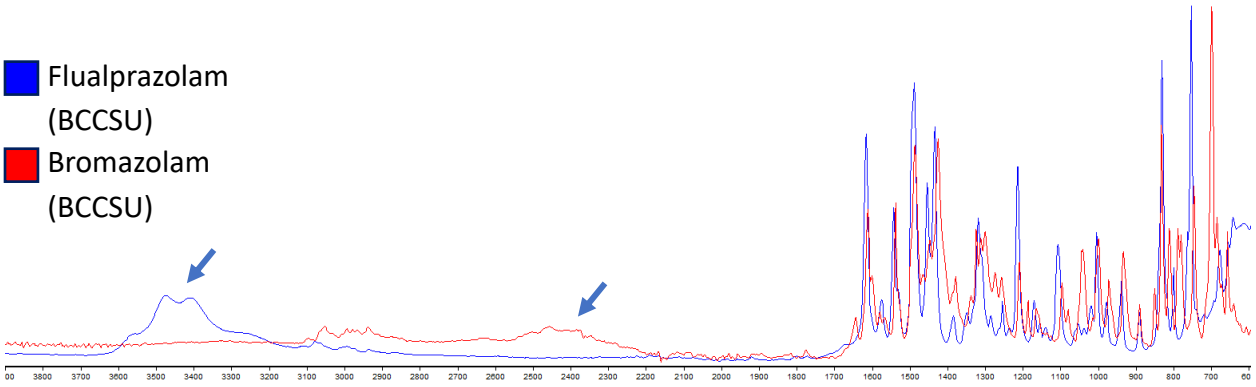
Primary FTIR Spectrum for Flualprazolam



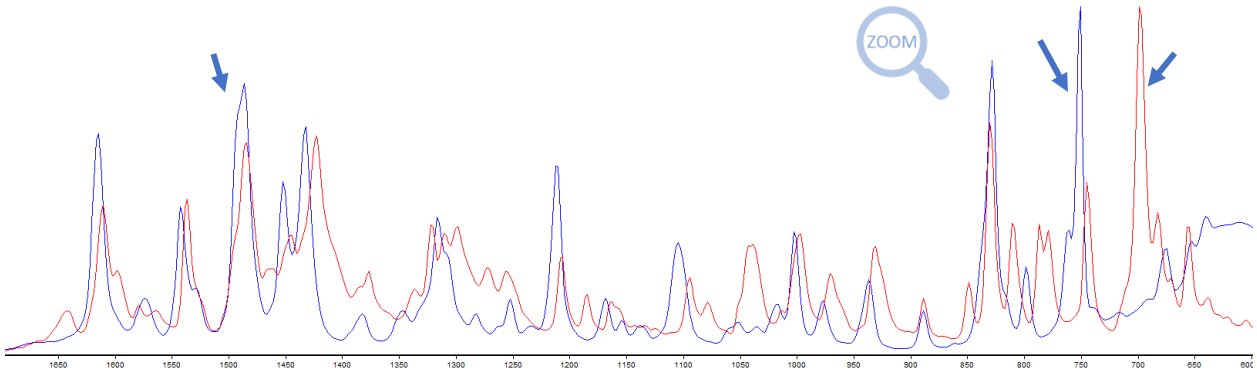
Fluaprazolam is easier to identify via FTIR than bromazolam, but still is not easy work. Look for:

- The pair of humps at ~3500^{-1} and ~3400^{-1}.
- The two peaks at ~820^{-1} and ~750^{-1}.
- The peak with a shoulder at ~1450^{-1}.

Analogue Comparison of Flualprazolam and Bromazolam



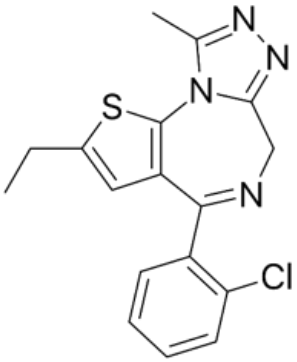
Comparing fluaprazolam to bromazolam, the double-humped prominence of flualprazolam and the mid-spectrum rise of bromazolam are useful areas to look for to start, but the fingerprint is a bit trickier:



Here we can see that differentiating flualprazolam from bromazolam via the fingerprint can be quite difficult. The fluaprazolam peak at ~750^{-1} and the bromazolam peak at ~700^{-1} are the best candidates to accomplish this goal, though the flualproazolam double peak at ~1480^{-1} may also be useful.

11. Etizolam

Molecule



AKA Tiz

Pronounced Eh-tiz-oh-lam

Description A short-acting benzodiazepine-related drug, used in some countries to treat anxiety and insomnia.[35]

Effects See Bromazolam. Note that perceived "feel", duration, dose, and risk of overdose are not equivalent to that of bromazolam.

Mixtures See Bromazolam.

FTIR library entries

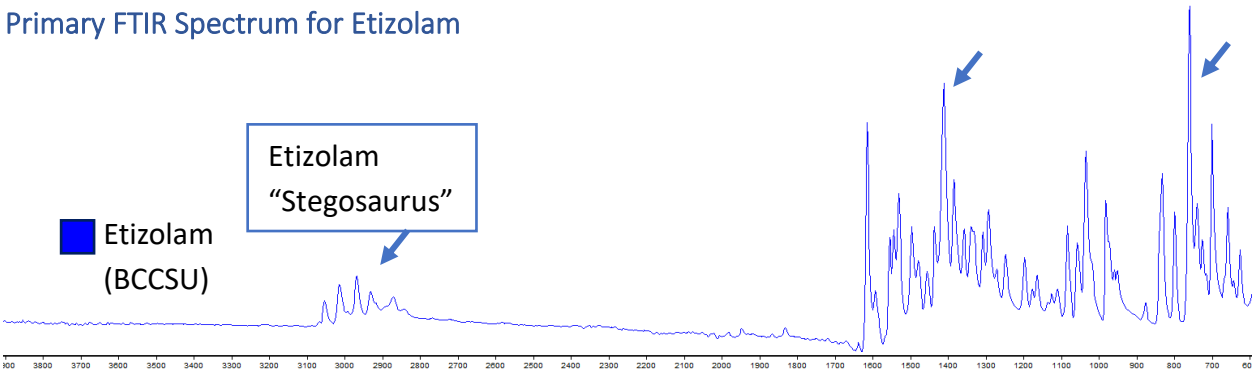
Library	Entry
BCCSU	Etizolam
SWGDRUG	Etizolam
TICTAC	Etizolam

Notes

1. Etizolam is a thienodiazepine derivative, which makes it an analogue of benzos. It is often regarded as a benzodiazepine because it acts in the same way in the body.[36]
2. Due to its high potency, etizolam can be difficult to detect via FTIR as it is often a small proportion of the overall mixture
3. Confirming the presence of etizolam with a test strip is difficult because etizolam reacts poorly with a benzodiazepine test strip.[b] A positive result could also mean a true benzodiazepine is present, alongside or in place of etizolam.[128]

[b] See the BCCSU standard operating procedure on benzodiazepine test strips to improve testing outcomes.

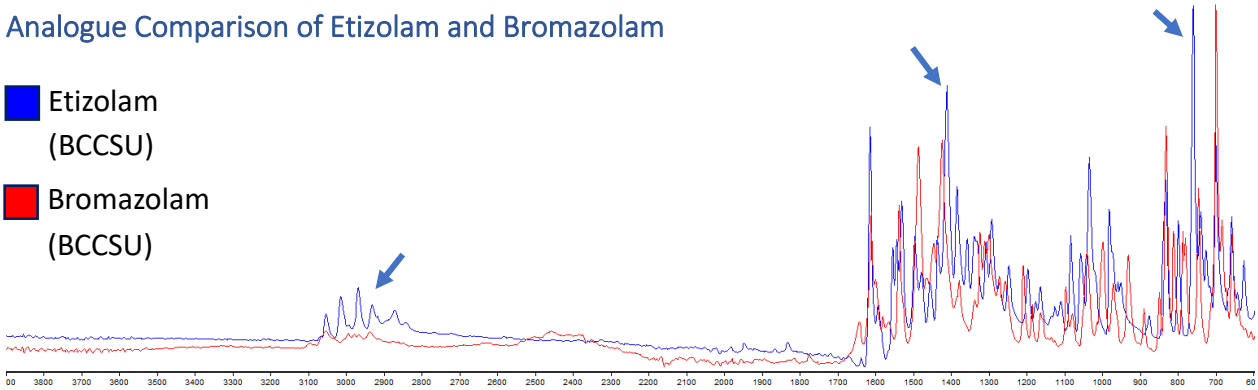
Primary FTIR Spectrum for Etizolam



Etizolam is not a true benzodiazepine, but its spectrum resembles that of other benzodiazepines. Some features to look for:

- The “Stegosaurus” feature is the most recognizable for etizolam.
- The major peak at ~740^{-1}.
- The collection of peaks surrounding the moderate peak at ~1400^{-1}.

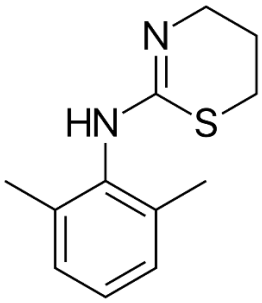
Analogue Comparison of Etizolam and Bromazolam



Comparing etizolam to bromazolam, it can be seen that the major identification patterns for etizolam are not shared with bromazolam.

12. Xylazine

Molecule



AKA Tranq; tranq-dope

Pronounced Zai-luh-zeen

Description A tranquilizer originally synthesized for veterinary care. Repeated use can lead to hard-to-heal sores and other tissue damage, both around and apart from injection sites.[31]

Possible effects Sedation, muscle relaxation, pain relief.[31]

Possible side effects Dry mouth, incontinence, low heart rate (bradycardia), respiratory depression, low blood pressure, fainting, long periods of unconsciousness, abscesses, skin ulceration.[31]

Caution!

1. May complicate and prolong withdrawal symptoms when present with opioids.
2. May complicate and prolong ODs when present with opioids due to prolonged sedation and lack of effect of **Naloxone** on xylazine.[134]
3. Death can occur due to depression of respiration leading to hypoxia (low blood oxygen). [31]

Some potentially contra-indicated mixtures

Mixing xylazine with:	Potential Effects:
Benzodiazepines[116] **Opioids**[116]	Potentiates and prolongs effects, complicates ODs, sedation, loss of consciousness, vomiting

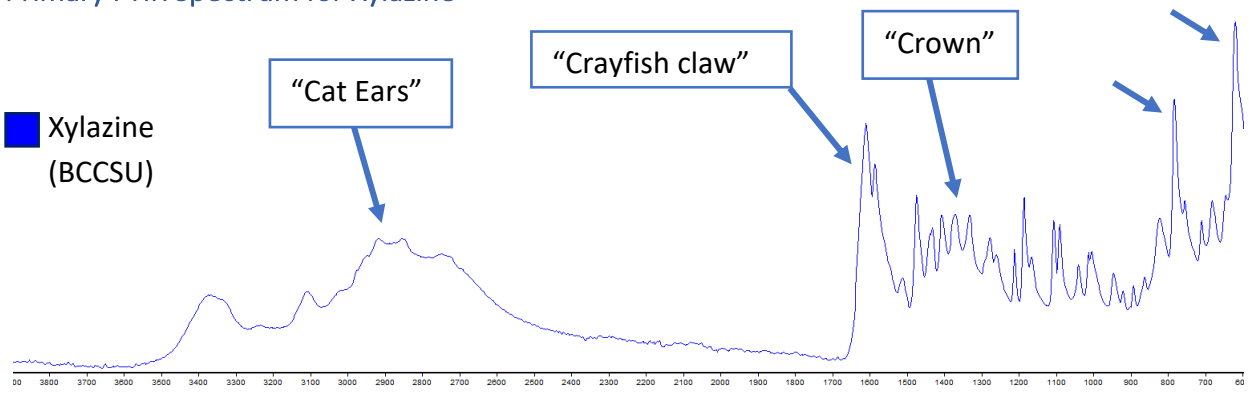
FTIR library entries

Library	Salt Form	Notes
BCCSU	Xylazine HCl	Entries for hydrate and anhydrate forms
SWGDRUG	Xylazine HCl	Hydrate form
TICTAC	Xylazine	Hydrate form
PHARMA-2	XYLAZINE	Anhydrate form

Notes

1. Due to its high potency, xylazine can be difficult to detect via FTIR as it is often a small proportion of the overall mixture
2. There are three hydration states for xylazine that are seen in drug checking: anhydrate, hemihydrate, and monohydrate.
3. Xylazine's interactions with many other drugs are poorly understood. It should be assumed that there are more contraindicated mixtures than those listed here.
4. Xylazine has the same route of action (alpha-2 adrenergic agonist) as **Medetomidine.**[32]

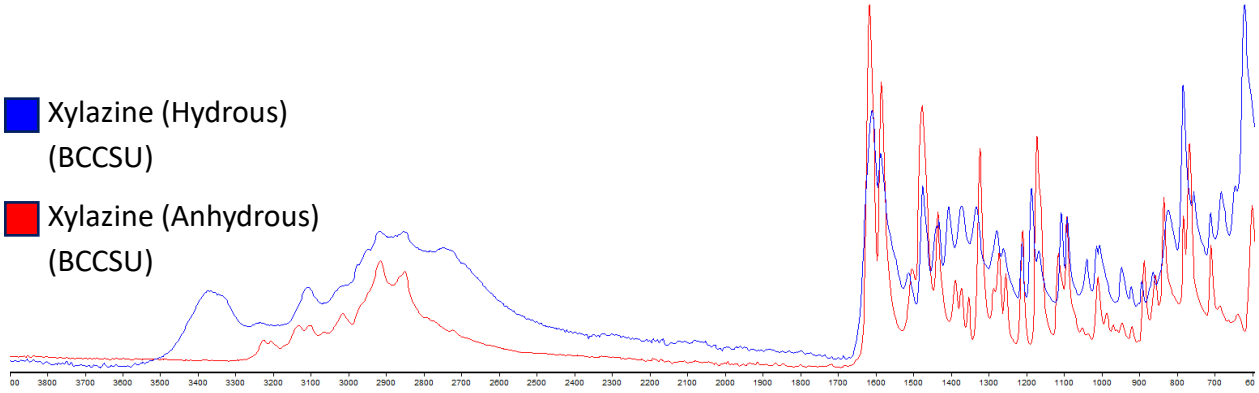
Primary FTIR Spectrum for Xylazine



Xylazine can be tricky to identify as in B.C. it often presents as small proportions of a mixture. Look for these features:

- The "Crayfish Claw" at ~1600^{-1}. The triangular-shaped base of the double peak will help to distinguish it from opioids and Caffeine.
- The major peaks at ~750^{-1} and ~620^{-1}.
- The "Cat Ears" atop the rise from 3500^{-1} to 2500^{-1}.
- The "Crown" feature in the fingerprint.

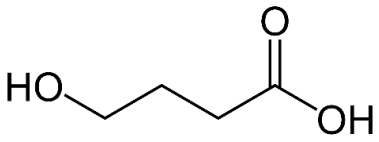
Alternate Spectrum for Xylazine



Here we can see the radical change in spectra brought about by the inclusion of water in the crystal structure. Observe which features are diminished and which are amplified; the “Crab Claw” at 1600^{-1} is greatly amplified by the removal of water from the crystal structure. The rounded double peak at ~3400^{-1} is completely eliminated in the anhydrous form, and the rise from 3500^{-1} to 2500^{-1} is trimmed to two moderate peaks that may make identification of the anhydrous form a bit easier than the hydrous form.

13. GHB

Molecule



AKA G, liquid ecstasy, juice, sodium oxybate, Xyrem

Full name Gamma-Hydroxybutyric acid / gamma-hydroxybutyrate (when in salt form)

Pronounced Gee-aych-bee/Gam-mah hye-drok-see-byoo-teer-ik ah-sid

Description Naturally occurring depressant substance. Used to treat narcolepsy.[37] Has biphasic effects; it is stimulating in low doses and sedating in high doses.[40]

Possible effects Stimulation (low dose), sedation (high dose), muscle relaxation, euphoria, disinhibition, libido increase[39], dream potentiation, entactogenic effects

Possible side effects Dizziness, nausea, excessive salivation, headaches, sedation, respiratory depression, motor control loss [38]

Caution!

1. The margin between a typical dose and an overdose is very thin. This is known as a "narrow therapeutic window".
2. GHB, GBL, and **1,4-BDO** all have different dosages but are often mixed together or misidentified when sold.
3. Because GHB, GBL, and **1,4-BDO** are often mixed in water, it is difficult to know the true concentration(s) and the appropriate dose.
4. Death can occur due to respiratory depression and/or vomiting.

Some potentially contra-indicated mixtures

Mixing GHB/GBL with:	Possible effects
Dextromethorphan[20,22] **Ketamine**[20,21,22] **Nitrous Oxide**[20,22]	Sedation, loss of consciousness, vomiting
Kratom[22] **Opioids**[20,21,22] **Tramadol**[20,21,22]	**All above and:** Amplify effects (increased OD risk)
Alcohol[20,21,22,121] **Benzodiazepines**[20,21,22]	**All above and:** blackouts, memory loss, breathing problems
Amphetamines[20,21,22] **Cathinones**[22] **Cocaine**[20,21,22] **MD-x**[20,21,22]	OD risk; stimulants mask the effects of sedatives and vice versa

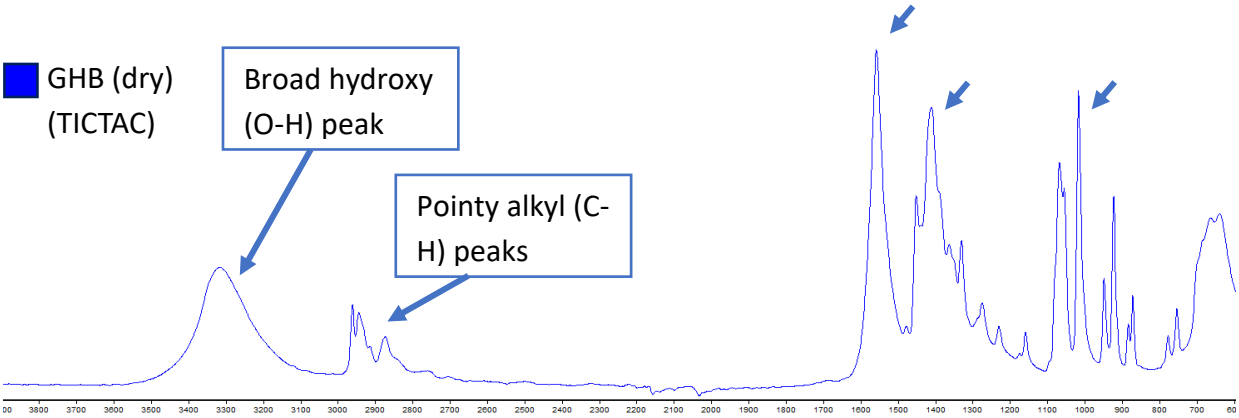
FTIR library entries

Library	Entry	Notes
TICTAC	GHB – dry, GHB - wet	"Wet" = in water
PHARMA-2	GAMMA HYDROXYBUTYRIC ACID	Dry GHB

Notes

1. GHB usually presents to drug checking diluted in water. If the concentration is not high enough, identification becomes difficult as the water washes out the signals of any other substances present.
2. In higher concentrations, GHB can settle at the bottom of a bottle (undissolved GHB salt crystals may appear). For checking, sample the solution from the bottom to maximize the concentration of GHB.[118]

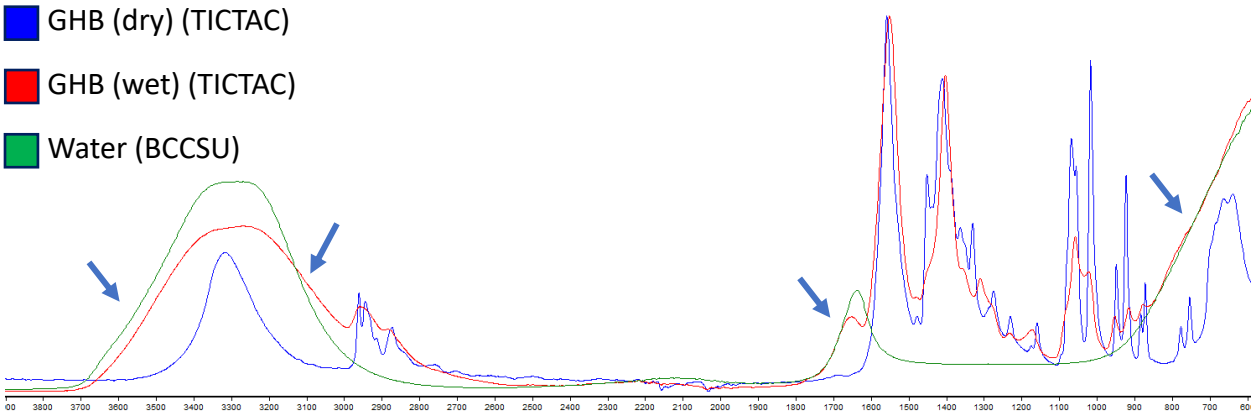
Primary FTIR Spectrum for GHB



GHB is a relatively simple molecule but has lots of features that are useful for identification:

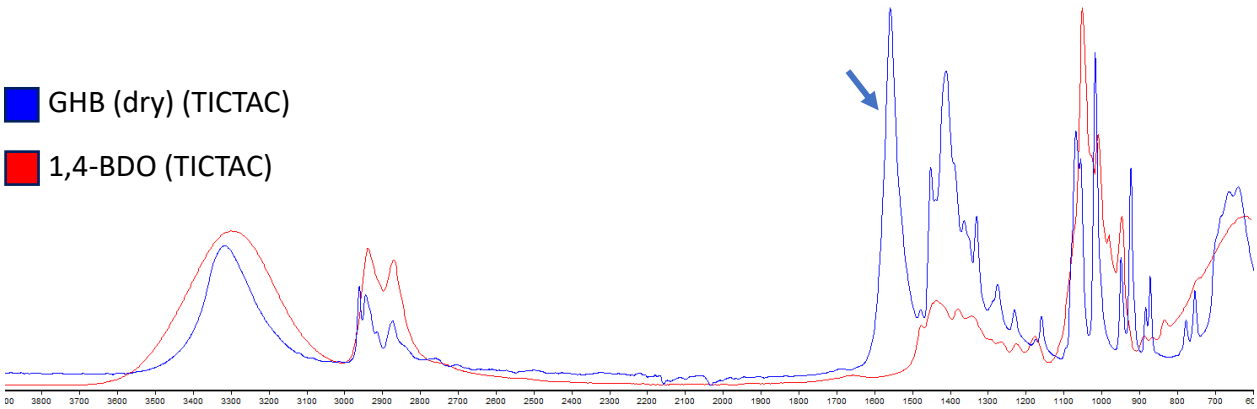
- The hydroxy and alkyl peaks often poke through a water spectrum.
- The two major triangular peaks at 1550^{-1} and 1400^{-1}.
- The collection of moderate peaks around the tall skinny peak at ~1020^{-1}.

Spectral Feature Comparisons for GHB



Observe the difference in spectra between dry and wet GHB. “Wet” GHB is GHB dissolved in water. GHB is hydrophilic and absorbs water from the air around it, it will eventually liquefy (it is a *deliquescent* substance). Some amount of water should be expected when checking GHB. Water has a “washing-out” effect where details of the underlying spectra are smoothed out. Much of the overall shape of the underlying GHB spectra is still present.

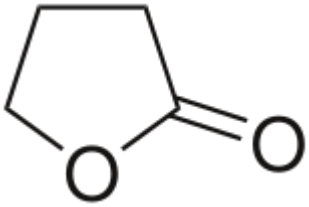
When looking at water specifically, we can see how the presence of it adds to the spectrum (e.g. the hump at ~1650^{-1}), but also erases information entirely. Some of the information isn’t heavily affected, such as the tall peaks at ~1500^{-1} and ~1400^{-1}, but also notice how the ramp to the right has almost no texture or features left at all. Subtracting water from the wet GHB spectrum will not yield the dry GHB spectrum.



1,4-BDO, like GBL, is a prodrug of GHB (i.e. turns into GHB in the body), but has a different dosage than either GHB or GBL. Unlike GBL, however, is how similar the spectrum for 1,4-BDO looks when compared to GHB. The major peak at ~1550^{-1} in GHB is the big difference between the two, but it can be seen that there is a lot of overlap. This could lead to a technician missing 1,4-BDO, which can have consequences for the service user.

14. GBL

Molecule



Full name Gamma-Butyrolactone / γ-butyrolactone

Pronounced Gee-bee-ell / Gah-mah Byoo-teer-oh-lahk-tohn

Description Prodrug of GHB. GBL and **1,4-BDO** are converted to GHB in the bloodstream.[38] Faster onset due to higher bioavailability.[41]

Effects See GHB. Note that perceived "feel", duration, dose, and risk of overdose are not equivalent to that of GHB.

Caution!

1. GBL is more often available undiluted compared to GHB, making it stronger by volume compared to most GHB solutions.
2. As GBL converts to GHB in the body, it has the same overdose presentation and dangers.

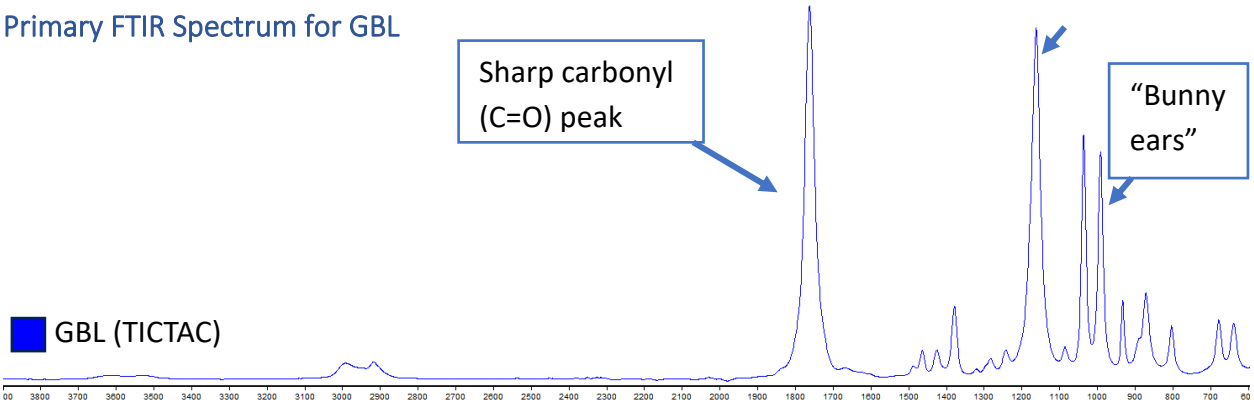
Mixtures See GHB.

FTIR library entries

Library	Entry
SWGDRUG	Gamma-Hydroxybutryric acid lactone
TICTAC	GBL
PHARMA-2	G-BUTYROLACTONE

Notes

1. Be careful when handling GBL and **1,4-BDO** as they will damage plastics and strip paints that they come into contact with. This also means that they may become contaminated with dissolved plastic if they are stored in plastic containers.[42]
2. GBL is *miscible* in water, meaning it has no upper limit of concentration when mixed with water. A solution might be 90% water and 10% GBL, or the other way around, without any change in appearance. GBL will never separate in high concentrations like GHB will!



The spectrum for GBL shares some of the same characteristics as GHB such as a prominent carbonyl peak, but it is otherwise distinct. Here, this spectrum of GBL is likely undiluted as the peaks are sharp and distinct, without the smoothing effect of water. Look for the two strong peaks and the moderate "bunny ears" formation when looking for GBL.

Stimulants

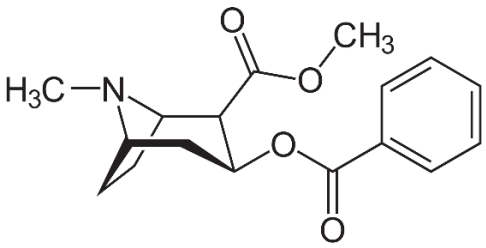
Stimulants are drugs that increase activity in the central nervous system, resulting in heightened alertness, energy, and euphoria. They also raise heart rate, blood pressure, and breathing rate.

Stimulant use is widespread, but there is less variety of drugs in the stimulant category that are seen in community drug checking sites. Cocaine, Crack Cocaine and Methamphetamine are the most common drugs of this category.

Further stimulants to learn about are **Amphetamine** and **Methylphenidate.** An important sub-group of stimulants are prescribed as ADHD and/or narcolepsy medications and are mostly known by their brand names, such as **Adderall** (Amphetamine/Dextroamphetamine), **Vyvanse** (lisdexfetamine; prodrug of dextroamphetamine), and **Concerta** and **Ritalin** (methylphenidate).

15. Cocaine

Molecule



AKA Coke, Up, Blow, Dust, Soft, Snow, Powder, Coca

Pronounced Koh-kayn

Description Naturally occurring stimulant from the coca plant. Leaf can be chewed or ingested directly, or the cocaine can be extracted and refined.[45]

Possible effects Euphoria, stimulation, local pain relief, cognitive enhancement, wakefulness, increased libido, anxiolytic[47]

Possible side effects Nosebleeds, nasal cavity irritation, dehydration, vasoconstriction, anxiety, irritability, abnormal and/or elevated heart rate (tachycardia), increased blood pressure (hypertension), heart attack, mania, loss of smell, psychosis[43]

Caution!

1. Chronic nasal use can cause necrotic nasal tissues.
2. Withdrawal symptoms possible when discontinuing use.
3. Delusions and psychosis possible with chronic lack of sleep.
4. Cocaine is cardiotoxic; chronic use and/or overdose can lead to permanent heart conditions and sudden cardiac death.

Some potentially contra-indicated mixtures

Mixing cocaine with:	Possible effects
Benzodiazepines[21] **GHB/GBL**[20,21,22]	OD risk; stimulants mask the effects of sedatives and vice versa
Kratom[22] **Opioids**[20,21]	
Alcohol[20,21,22,122]	**All above and:** potentiation through formation of **Cocaethylene** in the body, increased cardiotoxicity
Beta-blockers[125]	Tachycardia
Dextromethorphan[20,22]	**All above and:** Panic attacks
MD-x[20,21,22] **Cathinones**[22]	**All above and:** Increased heart strain, hypertension, mania
Amphetamines[18,19,20,21,22] **Caffeine**[18,20,22]	**All above and:** Risk of heart attack, irregular heart rhythm
2C-x[20,21,22] **5-MeO-xxT**[20,22,125] **Cannabis**[20,22] **DMT**[20,21,22] **LSD**[20,21,22] **Mescaline**[22] **Mushrooms**[20,21,22]	Anxiety, thought loops
Ketamine[19,20,21,22]	Hypertension, risk of fall
Tadalafil/Sildenafil[124]	Heart strain, risk of heart attack
MAOIs[20,22,125]	Hypertension, unpredictable increase in potency and duration
Tramadol[20,22]	Seizure risk

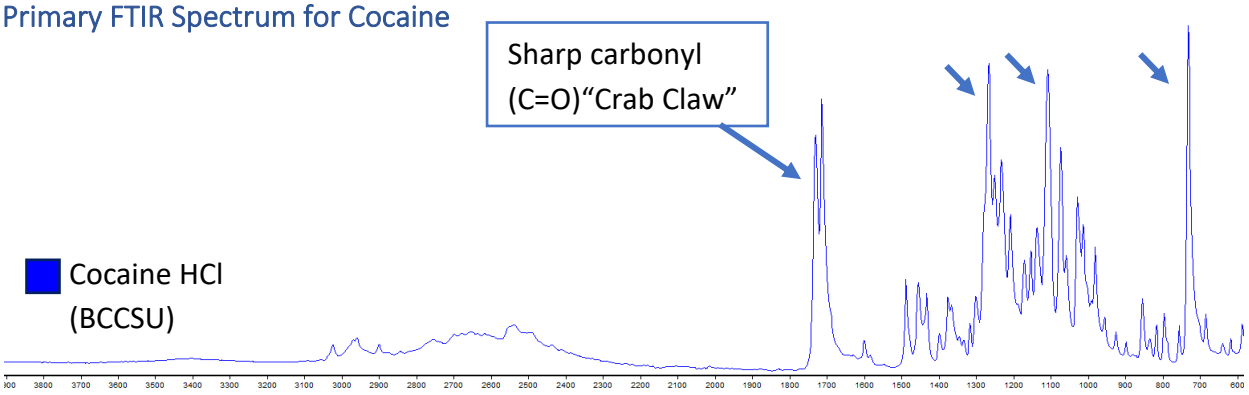
FTIR library entries

Library	Salt Form
BCCSU	Cocaine HCl
SWGDRUG	Cocaine HCl
TICTAC	Cocaine HCl
PHARMA-2	COCAINE, COCAINE HYDROCHLORIDE

Notes

1. Like Heroin, cocaine is refined from a plant and often contains many organic compounds (and/or contaminants) that vary in concentration depending on the crop and quality of refinement. These are unlikely to be seen on FTIR as they are often minor components.
2. Coca leaf has been chewed by the indigenous peoples of South America for thousands of years. The effects of coca leaf and refined cocaine should not be considered equivalent due to the entourage effect of the many organic compounds present in coca leaf as well as the differences in the absorbsion of the drug.[48]
3. Cocaine is a central nervous system stimulant via reuptake inhibiton of the neurotransmitters epinephrine, norepinephrine, serotonin, and dopamine.[44]

Primary FTIR Spectrum for Cocaine

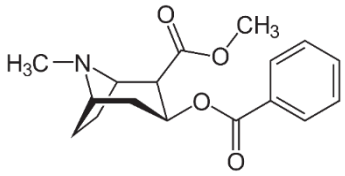


Cocaine HCl has strong features that make FTIR analysis relatively easy:

- The “Crab Claw” at 1700^{-1}.
- Major peaks at ~1250^{-1}, ~1100^{-1}, and ~720^{-1}.

16. Crack Cocaine

Molecule



AKA Crack, rock, hard (base)

Pronounce Koh-kayn

Description The freebase form of cocaine which can be more easily smoked. Forms waxy lumps.

Effects See Cocaine. Note that perceived "feel", duration, dose, and risk of overdose are not equivalent to that of cocaine. Notably different than cocaine HCl is the prevalence of respiratory problems from smoking crack cocaine.[49]

Mixtures See Cocaine.

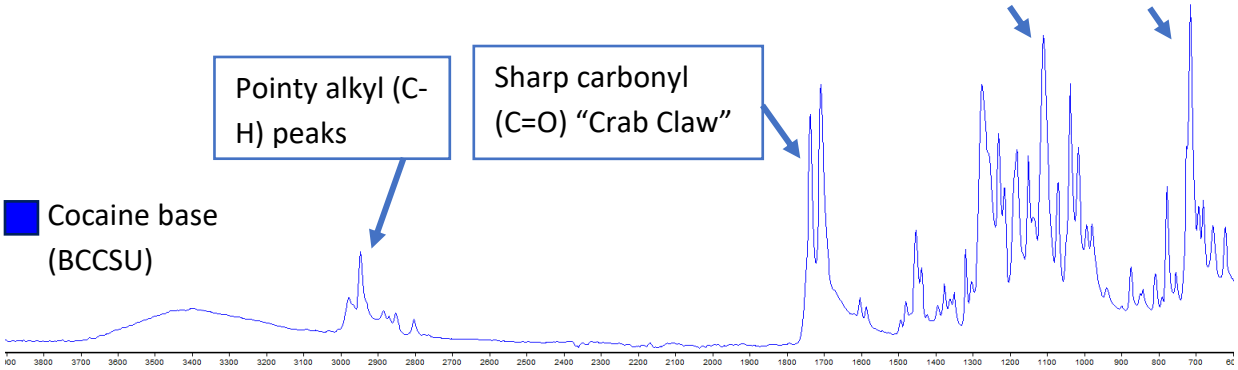
FTIR library entries

Library	Base Form
BCCSU	Cocaine Freebase
SWGDRUG	Cocaine Base
TICTAC	Cocaine base
PHARMA-2	COCAINE BASE, COCAINE.HCL*

Notes

1. *This library entry is also crack cocaine, it is labelled as cocaine hydrochloride incorrectly.
2. While crack cocaine is simply the freebase version of cocaine, there is a vast divide in cultural, political, racial, and punitive aspects.[50]
3. "Crack" is an *onomatopoea*; crack cocaine can make a crackling sound when heated.[46]

Primary FTIR Spectrum for Crack Cocaine

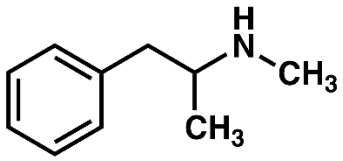


Crack cocaine, is simply the base form of cocaine HCl, and shares a lot of the same features. Look for:

- The "Crab Claw" carbonyl formation is somewhat wider in the base form than the HCl, almost appearing as "Bunny Ears".
- The peak at ~710^{-1}.
- The major peak at ~1110^{-1} that is surrounded by moderate peaks.
- The alkyl peak at ~2950^{-1}.

17. Methamphetamine

Molecule



AKA Side, jib, ish, meth, glass, ice, shard, tina, crystal

Full name N-meth(yl)amphetamine

Pronounced Meth-ahm-fet-ah-meen / meh-thul-ahm-fet-ah-meen

Description Stimulant derived from amphetamine. Rarely used to treat ADHD symptoms.[52]

Possible effects Stimulation, euphoria, stamina enhancement, increased libido, cognitive enhancement[52]

Possible side effects Body odour, dehydration, teeth grinding (bruxism), dry mouth, constipation, increased body temperature, muscle spasms, neurotoxicity, mania[52] tooth loss[53]

Caution!

1. High potency makes accurate dosing difficult.
2. Meth is considered neurotoxic at recreational doses.[54]
3. Withdrawal symptoms possible when discontinuing use.
4. Delusions and psychosis possible with chronic lack of sleep.

Some potentially contra-indicated mixtures

Mixing meth with:	Possible effects
Benzodiazepines[21] **GHB/GBL**[20,21,22] **Opioids**[19,20,21,22]	OD risk; stimulants mask the effects of sedatives and vice versa
Alcohol[19,20,21,22]	**All above and:** tachycardia, blood pressure changes
Cannabis[20,22] **Mushrooms**[20,21,22] **Mescaline**[22] **DMT**[20,21,22] **LSD**[20,21,22] **2C-x**[20,21,22] **5-MeO-xxT**[20,22,125]	Anxiety, thought loops, panic attacks
Caffeine[18,19,20,22] **Cathinones**[22] **Dextromethorphan**[20,22]	**All above and:** Increased heart strain, tachycardia, hypertension, mania
Cocaine[18,19,20,21,22]	**All above and:** risk of heart attack, irregular heart rhythm
Ketamine[19,20,22]	Hypertension, risk of fall
MD-x[20,21]	Increased neurotoxicity
Tadalafil/Sildenafil[124]	Heart strain, risk of heart attack
MAOIs[20,22,125]	Hypertension, unpredictable increase in potency and duration
Tramadol[20,22]	Seizure risk, serotonin syndrome
Beta-blockers[125]	Tachycardia

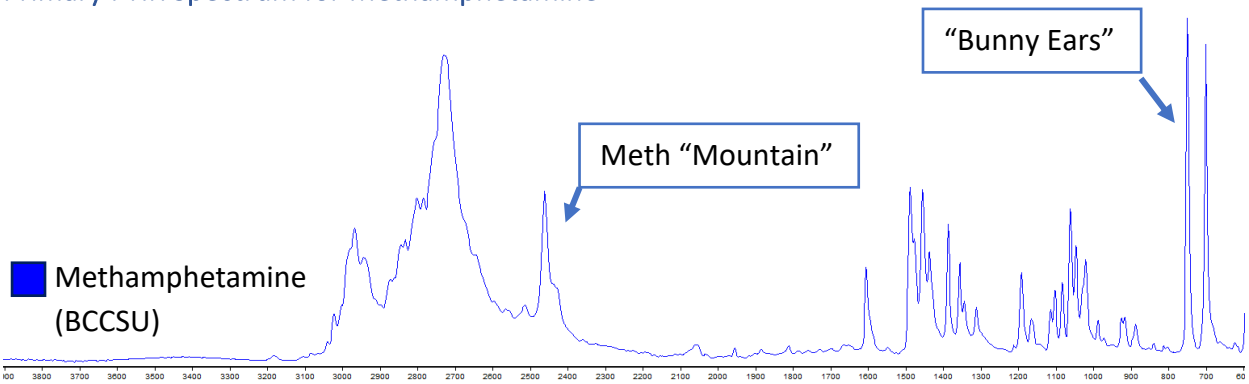
FTIR library entries

Library	Salt Form
BCCSU	Methamphetamine HCl
SWGDRUG	D,L-Methamphetamine HCl, D-Methamphetamine
TICTAC	Methylamphetamine HCl
PHARMA-2	METHAMPHETAMINE HCL, METHAMPHETAMINE.HCL

Notes

1. D-(dextro) and L-(levo) Methamphetamine are not interchangeable.
2. Dextro-methamphetamine is stronger than levo.[52]
3. There are a number of substances that can co-crystallize with methamphetamine. The presence of shards or large crystals is no guarantee of purity!
4. Methamphetamine is a central nervous system stimulant.[52]

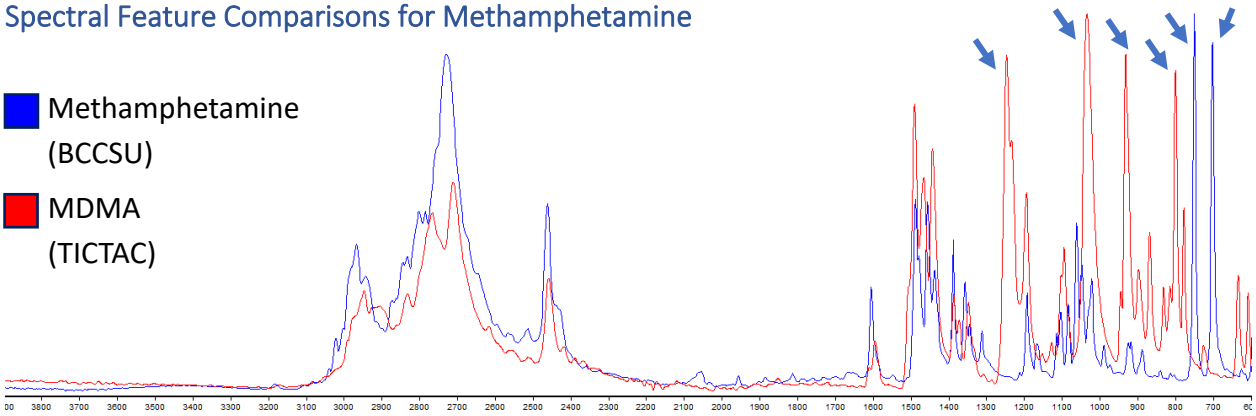
Primary FTIR Spectrum for Methamphetamine



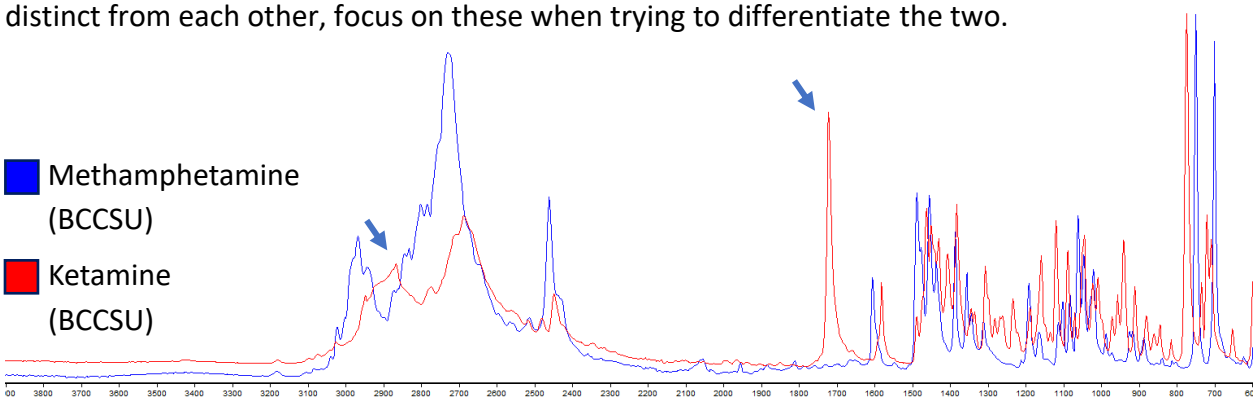
Methamphetamine has two major features that typically make this an easy substance to identify via FTIR:

- The three-peaked "Mountain" feature that dominates the spectrum outside of the fingerprint. The individual peaks of the mountain will help differentiate it from similarly shaped mountain features, especially the sharp spike on the right side of the mountain.
- The prototypical "Bunny Ears" at ~720^{-1}.

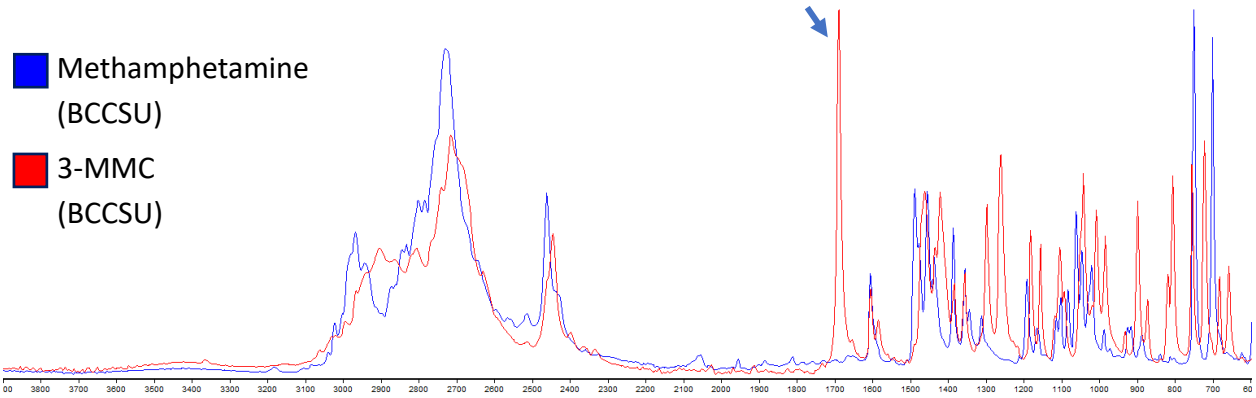
Spectral Feature Comparisons for Methamphetamine



MDMA is derived from amphetamines, but don't jump to conclusions about the "Mountain" feature that appears in both. MDMA and methamphetamine have major peaks that are fully distinct from each other, focus on these when trying to differentiate the two.



Notice the different shape of the left part of the Ketamine "Mountain" compared to methamphetamine, that sloped shape should help to distinguish the two. Also look for the lone peak at ~1700^{-1} in the ketamine spectrum.



Lastly, 3-MMC also has a "Mountain" feature. Like ketamine, note the misaligned left peak of the "Mountain" and the lone peak at ~1680^{-1}. 3-MMC does not have major peaks where the methamphetamine "Bunny Ears" are located, making this a useful area to tell them apart.

Psychedelics

Psychedelics are substances that alter perception, mood, and cognitive processes. This category is broad and includes drugs that have varying amounts of stimulant, entactogen/empathogen, dissociative, and hallucinogenic properties.

While many drugs in the psychedelic group exist, the following are the most commonly seen at community drug checking sites:

- MDMA and MDA (MD-x family) are closely related and often co-occur in mixtures
- Ketamine is an anesthetic dissociative that has psychedelic effects at higher doses
- DMT is a potent psychedelic that is used individually as a freebase or in a mixture such as **ayahuasca** (which contains an **MAOI**)
- 2C-B is another potent psychedelic
- 3-MMC (metaphedrone) is a cathinone that has stimulant and entactogenic effects

Cathinones are a group of **amphetamine**-like drugs. There are many drugs in this group, but **N-ethylpentylone** (ephylone) has been sold in place of MDMA and linked to overdose deaths.

MD-MAPA, and **PMK Ethyl Glycidate** are three notable precursors for MDMA to know about. The supplement **5-HTP** is sometimes used as a hangover remedy for drugs in the MD-x family but can be risky to use at the same time as serotonergic drugs.

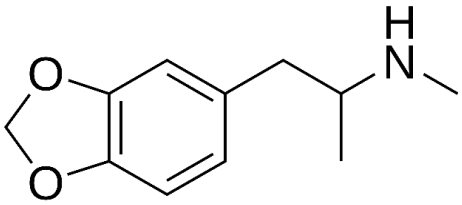
There are many other drugs to learn about in this group, some uncommon substances that may show up (especially at festivals) are as follows:

- **2-MMC, 4-MMC** (Mephedrone), and **4-CMC** are all part of the cathinone family
- Within the 2C-x family, learn about **2C-C** and **2C-I**
- **Mescaline**
- **4-HO-MET** (Colours)
- **4-AcO-DMT** (Closely related to psilocybin)
- The 5-MeO-xxT family: **5-MeO-DMT, 5-MeO-DiPT** (Foxy), and **5-MeO-MiPT** (Moxy)

LSD, **Mushrooms** (Psilocybin), and **Cannabis** (THC) are all difficult (or impossible) to test via FTIR, but are important drugs to know about in the psychedelic family. Lastly, anecdotal reports show that the psychiatric medication **Lithium** should not be used with psychedelics.

18. MDMA

Molecule



AKA Ecstasy, X, XTC, E, molly, clarity, moon rock

Full name 3,4-Methylenedioxymethamphetamine

Pronounced Meh-thul-een-dye-ohk-see-meh-thahm-fet-ah-meen

Description Synthetic empathogen of the amphetamine class.[55] Used in therapeutic treatments as well as recreational practices.[56]

Possible effects Euphoria, mood enhancement, empathy enhancement, spiritual experiences, stimulation, relaxation, anxiolytic, increased sociability, increased libido[57]

Possible side effects Vibrating vision (nystagmus), high body temperature, increased heart rate (tachycardia), dry mouth, teeth grinding (bruxism), dehydration, excessive thirst, difficulty urinating, sexual dysfunction, low blood electrolytes (hyponatremia).
Comedown: anxiety, "brain zaps", insomnia, depression, cognitive fatigue, dream disturbance, irritability[57]

Caution!

1. Serotonin syndrome is possible, especially when combined with other serotonin releasers.
2. Excessive thirst and inability to pee can lead to water toxicity.
3. Overheating and dehydration can lead to seizures and death.

Some potentially contra-indicated mixtures

Mixing MD-x with:	Possible effects
Benzodiazepines **GHB/GBL**[20,21,22] **Opioids**[21]	OD risk; stimulants mask the effects of sedatives and vice versa
Alcohol[20,21,22,124]	**All above and:** Cardiovascular strain, dehydration, nausea
Amphetamines[20,21,122] **Caffeine**[20,22]	Increased neurotoxicity, tachycardia, overheating
Cocaine[20,21,22,122]	**All above and:** Risk of heart attack
Tadalafil/Sildenafil[124]	Heart strain, risk of heart attack
5-HTP[125]	Serotonin syndrome
5-MeO-xxT[20,22,125]	**All above and:** Anxiety, thought loops, panic attacks
Beta-blockers[125]	Tachycardia
Dextromethorphan[20,22,124]	Serotonin syndrome, overheating, diarrhea, vomiting, hyponatremia
MAOIs[20,21,22,125]	Hypertension, unpredictable increase in potency and duration, serotonin syndrome
Tramadol[20,22]	Seizure risk, serotonin syndrome

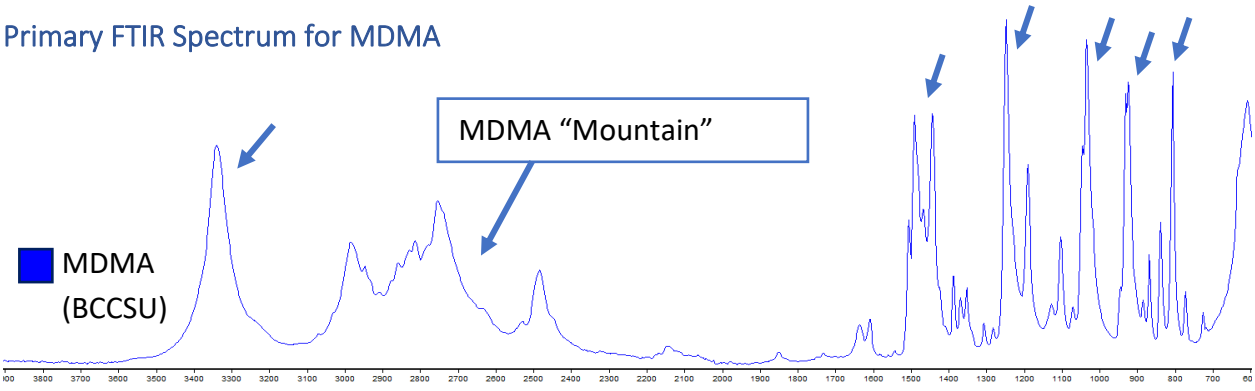
FTIR library entries

Library	Salt Form	Notes
BCCSU	MDMA HCl	Hydrate form
SWGDRUG	D,L-3,4-HDMA HCl	Anhydrate form
TICTAC	Crystal MDMA, MDMA	Hydrate & anhydrate forms, respectively
PHARMA-2	MDMA, 3,4-METHYLENEDIOXY METHAMPHETAMINE	Anhydrate form

Notes

1. MDMA acts primarily by increasing the release of the neurotransmitters serotonin, dopamine, and norepineprhine.[57]
2. MDMA is partially metabolized into MDA in the body, which has its own effects.[58]
3. 2,3-MDMA is a positional isomer of MDMA and should not be confused with the common 3,4-MDMA.
4. Do not mix up MDMA with MDA when selecting spectra:
    a. MDA: 3,4-methylene dioxy amphetamine
    b. MDMA: 3,4-methylene dioxy meth amphetamine
5. **Trifluoromethylphenylpiperazine** (TFMPP) and **Benzylpiperazine** (BZP) together can resemble the effects of MDMA. These used to be much more of a problem in the past.

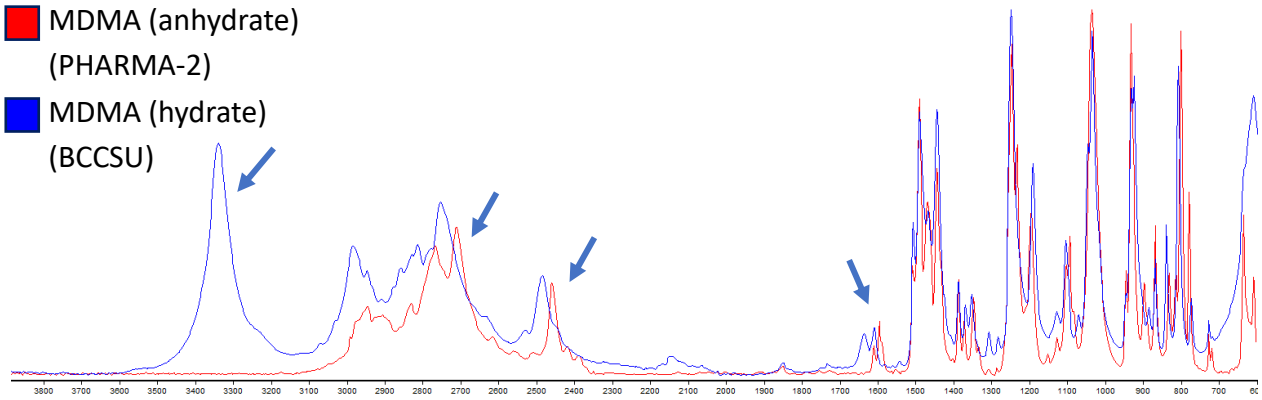
Primary FTIR Spectrum for MDMA



MDMA several prominent features that aid in identification:

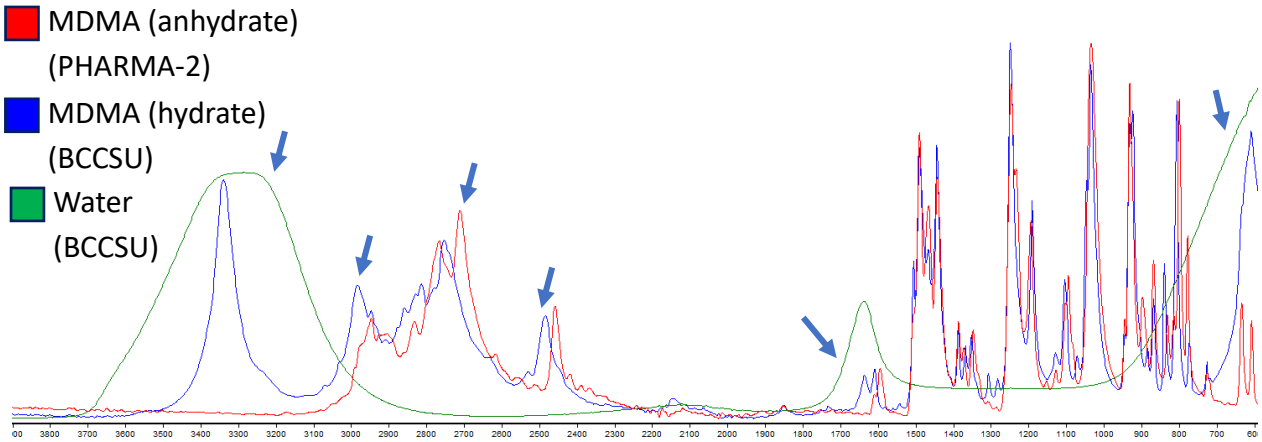
- Four major peaks in the fingerprint, two of which are double peaks.
- The "mountain" feature in the middle is reminiscent of meth but is less prominent overall.
- A wide peak at ~3350^{-1} that is present depending on the hydration state of the MDMA crystal. This spectrum is the hydrate version of MDMA.[138]
- A 4-peak group at 1500^{-1} – 1400^{-1}.

Alternate Spectrum for MDMA



When comparing the hydrate (co-crystallized with water) and anhydrous (crystal is free of water) forms, it can immediately be seen that the peak on the left has nothing to do with MDMA itself. Again, a hydrated crystal is not wet to the touch; this is not a solution of MDMA and water. While the effects of water incorporated into the molecular structure of the MDMA crystal can resemble the spectrum of water, the effects can be seen across more than just the three typical areas associated with water and are unpredictable. Observe the "shifting" effect the presence of water has throughout the mid-spectrum, changing the shape and position of the "Mountain" feature.

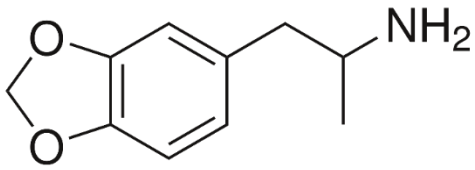
Spectral Feature Comparison for MDMA



A comparison between the hydrated polymorph of MDMA and Water can be made to reinforce the concept that a hydrated substance is not the same as a wet substance. Here we can see how some features of water are present in the peak at ~3350^{-1} and the ramp to the right, but the usual water hump at ~1650^{-1} does not appear to have an effect. Observe how the presence of water in the MDMA crystal has shifted the peaks between 3100^{-1} and 2400^{-1}. Clearly, subtracting water from the hydrated spectrum will not yield the anhydrous spectrum.

19. MDA

Molecule



AKA Sally, sass, sass-a-frass, white lightning,

Full name 3,4-Methylenedioxyamphetamine

Pronounced Meh-thul-een-dye-ohk-see-ahm-fet-ah-meen

Description Synthetic empathogen of the amphetamine class. More potent than MDMA by weight, tends to last longer, and is more "visual".[62]

Possible effects Euphoria, mood enhancement, empathy enhancement, spiritual experiences, stimulation, relaxation, anxiolytic, sociability, increased libido[61]

Possible side effects Vibrating vision (nystagmus), high body temperature, teeth grinding (bruxism), dehydration, difficulty urinating, increased heart rate, neurotoxicity

Comedown: anxiety, "brain zaps", insomnia, depression, cognitive fatigue, dream disturbance, irritability[59]

Caution!

1. Serotonin syndrome is possible, especially when combined with other serotonin releasers.
2. Overheating and dehydration can lead to seizures and death.

Mixtures See MDMA.

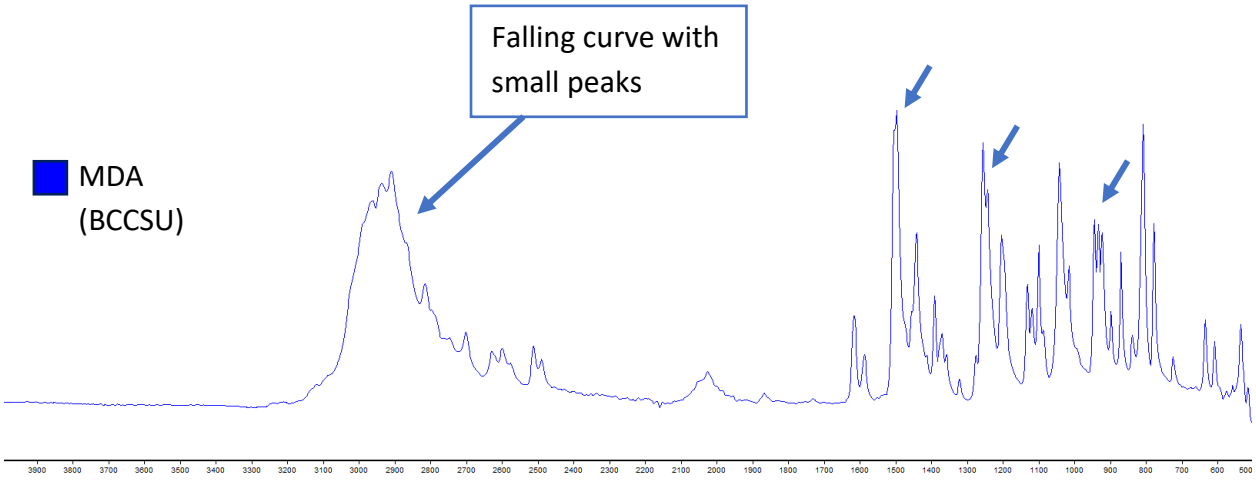
FTIR library entries

Library	Salt Form
BCCSU	MDA HCl
SWGDRUG	3,4-methylenedioxyamphetamine HCl
TICTAC	MDA Hydrochloride
PHARMA-2	3,4-METHYLENEDIOXYAMPHETAMINE

Notes

1. MDA acts primarily by increasing the release of the neurotransmitters serotonin, dopamine, and norepineprhine as well as acting as a reuptake inhibitor for the same.[60]
2. TICTAC has a reference called "MDA 19" that is not MDA.
3. Do not mix up MDA with MDMA when selecting a spectrum to view:
    a. MDA: 3,4-methylene dioxy amphetamine
    b. MDMA: 3,4-methylene dioxy meth amphetamine

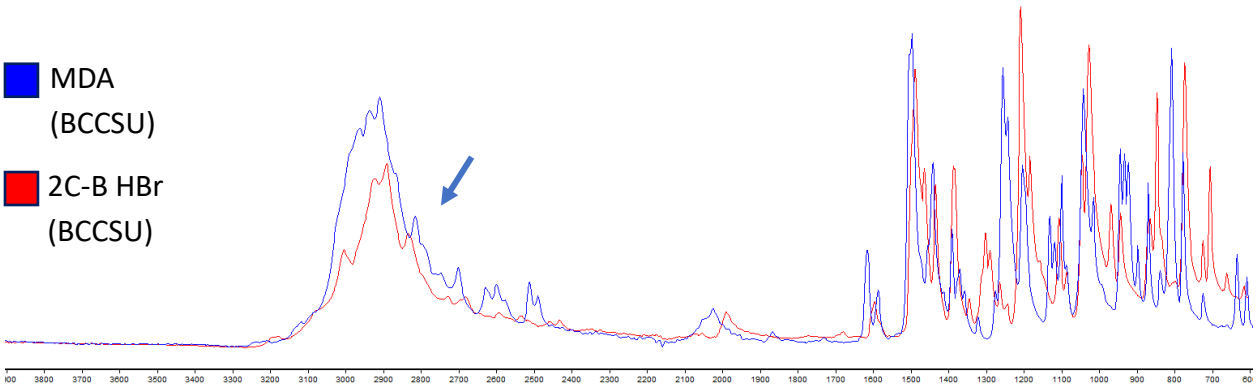
Primary FTIR Spectrum for MDA



MDA can be identified using its useful features:

- A distinctive falling curve with small peaks.
- A peak with a shoulder at ~1500^{-1}
- A double peak at ~1250^{-1}.
- A triple peak at ~920^{-1}.

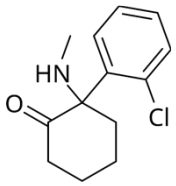
Spectral Feature Comparison for MDA



The falling slope pattern seen in MDA is shared with 2C-B , especially the hydrobromide salt. While it is currently rather uncommon to see MDA and 2C-B co-occurring, a mixture containing both is not inconceivable.

20. Ketamine

Molecule



AKA K, Special K, Calvin Klein (with cocaine), horse tranq

Pronounced Keh-tah-meen

Description Anesthetic, dissociative, and painkiller substance. Used therapeutically as an antidepressant and for pain management.[63] Biphasic effect: low doses produce a relaxing effect; high doses produce hallucinogenic/stimulating effects.[65]

Possible effects Pain relief, visual/auditory distortions, euphoria, dissociation, disinhibition, relaxation (low doses), trance state/temporary paralysis (higher doses), sedation, anti-anxiety (anxiolytic)[65,66]

Possible side effects Motor control loss, derealization, "K-hole" (temporary paralysis), decreased libido, memory loss (amnesia) delusions, psychosis, neurotoxicity, bladder dysfunction/injury (with chronic use), liver & kidney injury (with high dose chronic use)[66,68]

Caution!

1. Psychosis, delusions, and mania can be triggered if predisposed to these conditions.
2. Chronic high-dose use possibly causes organ damage and neurotoxicity.
3. Bladder toxicity can lead to permanent damage.

Some potentially contra-indicated mixtures

Mixing ketamine with:	Possible effects
Alcohol[19,20,21,22] **Benzodiazepines**[19,20,22] **GHB/GBL**[20,22] **Kratom**[22] **Opioids**[19,20,22] **Tramadol**[20,22]	Sedation, loss of consciousness, vomiting
Amphetamines[19,20,22] **Cocaine**[19,20,21,22] **Cathinones**[22]	Hypertension, risk of fall
MAOIs[20,22]	Unpredictable potentiation

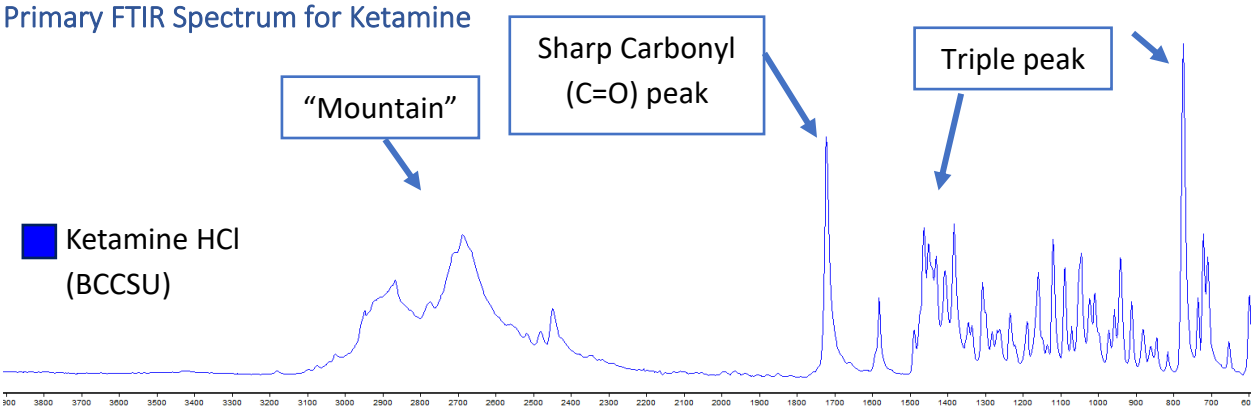
FTIR library entries

Library	Salt Form	Base Form
BCCSU	Ketamine HCl	Ketamine Freebase
SWGDRUG	Ketamine HCl	
TICTAC	Ketamine, Ketamine hydrochloride	
PHARMA-2	KETAMINE HCL	

Notes

1. Ketamine primarily works as a NMDA receptor antagonist.[64]
2. There are two enantiomers of ketamine that come up regularly in conversation: S-ketamine (Esketamine) and R-ketamine (Arketamine). FTIR is incapable of determining which enantiomer is present.
3. Common ketamine is a racemic (50:50) mixture of both enantiomers.[67]
4. S-ketamine is stronger than R-ketamine, along with having somewhat different subjective effects.[67]
5. The name comes from two of its functional groups, a ketone (C=O) and an amine (C-NH-C).

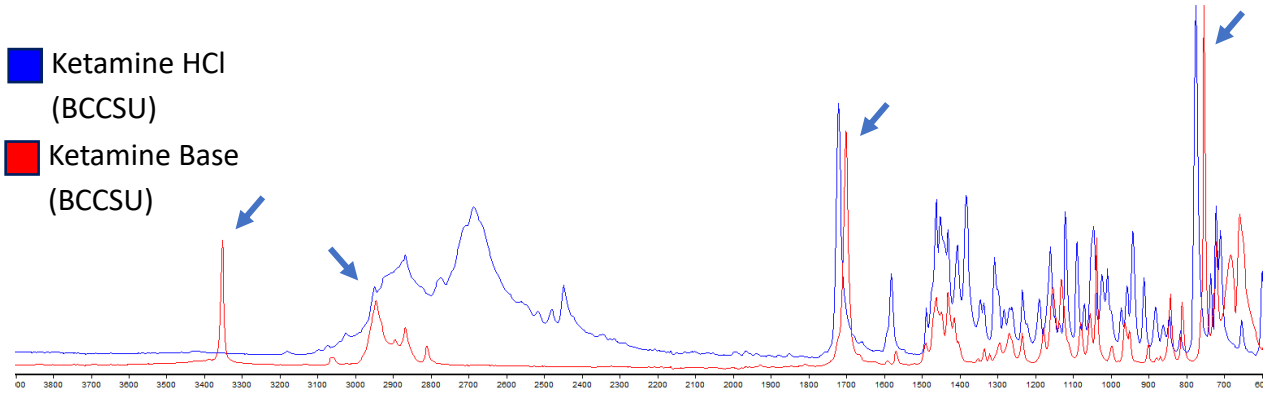
Primary FTIR Spectrum for Ketamine



Ketamine can be identified using:

- The moderate "Mountain" feature. Note the sloped peak on the left-hand side that distinguishes the ketamine "Mountain" from that of MDMA and Methamphetamine.
- The major peak at ~760^{-1}.
- The carbonyl peak at ~1700^{-1}
- A triple peak at ~1450^{-1}.

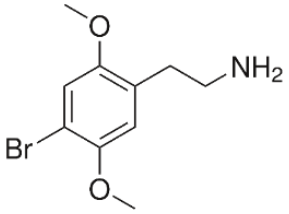
Spectral Comparison of Ketamine Salt vs. Ketamine Base



Ketamine base isn't very common, but sometimes appears alongside Crack Cocaine. When considering the base form, the two strong peaks of the ketamine spectrum have been preserved but have been shifted in wavenumber. The "mountain" feature has been reduced to a few alkyl peaks and a curious peak at ~3360^{-1} has appeared that should be a dead giveaway should you come across ketamine base.

21. 2C-B

Molecule



AKA Nexus, Erox

Pronounced too-cee-bee

Description Synthetic psychedelic phenethylamine with stimulant and empathogenic properties.[70] Dose sensitive: small increases in dose can create a much more intense effect.[117]

Possible effects Stimulation, visual/auditory distortions, increased libido, increased bodily sensations[72]

Possible side effects Nausea, anxiety, paranoia, increased heart rate, increased blood pressure, increased body temperature[71]

Caution!

1. High potency makes accurate dosing difficult.
2. Mixing with other substances can increase risk of panic attacks and psychosis.
3. Psychosis, delusions, and mania can be triggered if predisposed to these conditions.

Some potentially contra-indicated mixtures

Mixing 2C-x with:	Possible effects
Amphetamines[20,21,22,122] **Cocaine**[20,21,22,122] **Cathinones**[22,122]	Anxiety, thought loops, panic attacks, tachycardia
5-MeO-xxT[20,22] **Cannabis**[21,22] **MAOIs**[20,22,125]	Unpredictable potentiation
Tramadol[20,22]	Seizure risk
Lithium[126]	**All above and:** Increased psychosis risk

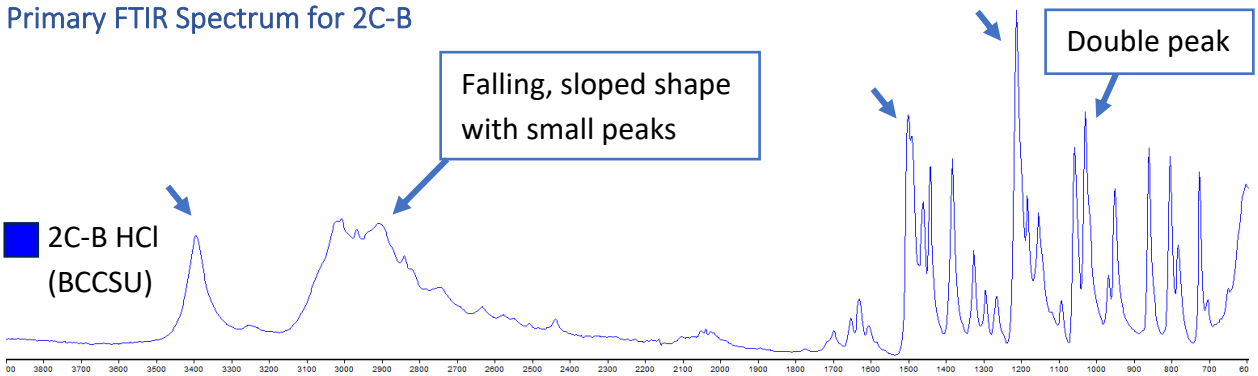
FTIR library entries

Library	HCl Salt Form	HBr Salt Form
BCCSU	2C-B HCl	2C-B HBr
SWGDRUG	2C-B HCl*	
TICTAC	2C-B HCl*	

Notes

1. *These do not match the BCCSU reference for 2C-B HCl. They could possibly be 2C-B HBr. Another possibility is that these are the anhydrous version of 2C-B HCl.
2. There are variants of 2C-B listed in the references that are not equivalent: 2C-B BZP diHCl, bk-2C-B HCl, 2C-B-fly HCl, and BOH-2C-B.
3. 2C-B works primarily as a serotonin (5-HT_{2A}) agonist but also has effects on other receptors as well.[77]
4. The 'B' in 2C-B refers to the bromine atom. Other members have different additions such as **2C-C** (Chlorine) and **2C-I** (Iodine).
5. The hydrochloride (HCl) form of 2C-B is slightly more potent by weight than the hydrobromide (HBr) form.
6. Be careful not to mix up 2C-B with the polysubstance mixture tucibi (tusi). The typically pink tucibi mixture rarely contains 2C-B in B.C.[74]
7. 2C-B is very painful to snort.[73]
8. 2C-B is structurally related to **Mescaline**.
9. There have been no reported deaths from 2C-B, but there have been from other members of the 2C-x family.[117]

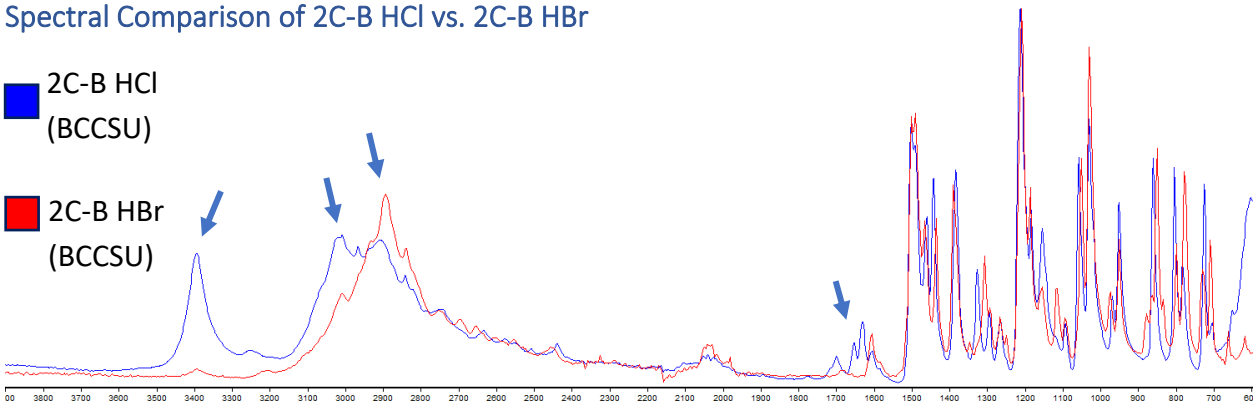
Primary FTIR Spectrum for 2C-B



2C-B has strong features that help in its identification:

- A falling slope pattern reminiscent of MDA in the mid-spectrum.
- The major peak at ~1200^{-1}.
- A peak at ~3400^{-1} that is likely a sign that this is the hydrated form of 2C-B HCl.
- The double peak at ~1500^{-1}.
- The double peak at ~1050^{-1}.

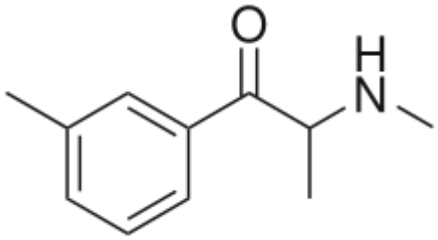
Spectral Comparison of 2C-B HCl vs. 2C-B HBr



Comparing the two salt forms, it can be seen that the tall peak on the left disappears, though this may be a result of different hydration states. The moderate peak at ~3020^{-1} is more evident in the HCl reference, while the peak at ~2880^{-1} is more prominent in the HBr reference. Further variations exist throughout the fingerprint as well.

22. 3-MMC

Molecule



AKA Metaphedrone

Full Name 3-Methylmethcathinone

Pronounced Three-em-em-cee / Three-meth-ul-meth-cath-ih-nohn

Description Stimulant-entactogen of the cathinone class. A structural analog of **4-MMC** (mephedrone) and **2-MMC**.[75]

Possible effects Stimulation, enhanced empathy & sociability, increased libido, anxiolytic, euphoria

Possible side effects Vibrating vision (nystagmus), teeth grinding (bruxism), nausea, anxiety, headaches, dehydration, body temperature dysregulation, vasoconstriction, increased blood pressure, abnormal heartbeat, increased heart rate, involuntary muscle contractions, seizure, delirium[76]

Caution! Overheating and dehydration can lead to seizures and death.

Some potentially contra-indicated mixtures

Mixing cathinones with:	Potential Effects
2C-x[22] **5-MeO-xxT**[22,125] **Cannabis**[22] **DMT**[22] **LSD**[22] **Mescaline**[22] **Mushrooms**[22]	Anxiety, thought loops, panic attacks
Amphetamines[22] **Caffeine**[22] **Dextromethorphan**[22]	**All above and:** increased heart strain, tachycardia, hypertension, mania
Cocaine[22]	**All above and:** risk of heart attack, irregular heart rhythm

Benzodiazepines[22] **GHB/GBL**[22] **Opioids**[22]	OD risk: stimulants mask the effects of sedatives and vice versa **All above and:** tachycardia, blood pressure changes
Alcohol[22]	
Ketamine[22]	Hypertension, risk of fall
Tadalafil/Sildenafil[124]	Heart strain, risk of heart attack
MAOI[22,125]	Unpredictable potentiation
Beta-blockers[125]	Tachycardia
Tramadol[22]	Seizure risk

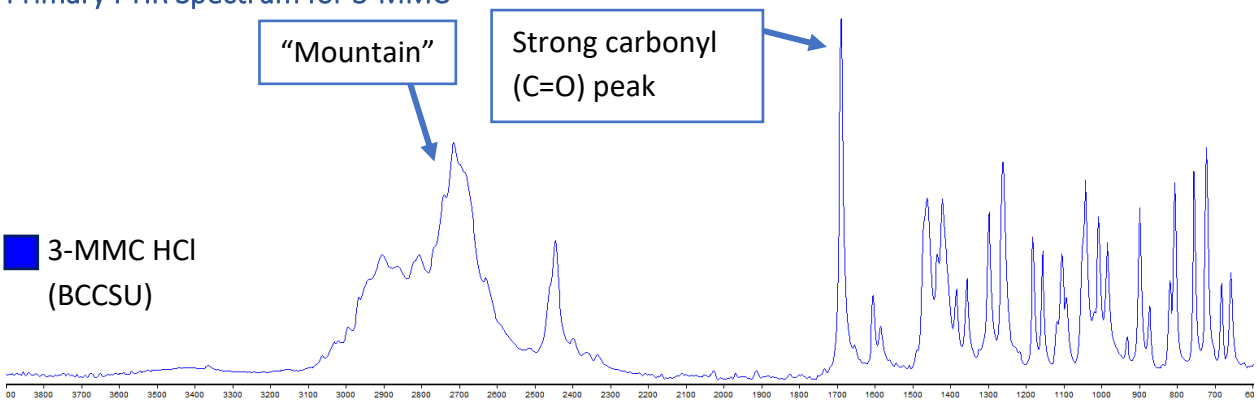
FTIR library entries

Library	HCl Salt Form
BCCSU	3-MMC HCL
SWGDRUG	3-Methylmethcathinone HCL
TICTAC	3-MMC HCL

Notes

1. Cathinones are structually similar from amphetamines.
2. 3-MMC is a reuptake inhibitor for the neurotransmitters norepinephrine and dopamine, as well as a releasing agent for dopamine, serotonin, and norepinephrine. It is most effective in releasing norepinephrine, which is why it may feel more like amphetamines.[78]

Primary FTIR Spectrum for 3-MMC

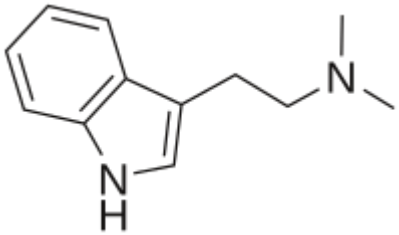


3-MMC has two strong features to work with:

- A "Mountain" feature. There is less distinction between the left and central lobes of its mountain, distinguishing it from that of Ketamine and others.
- A strong and skinny carbonyl peak at ~1680^{-1}.

23. DMT

Molecule



AKA Dmitri, “The Spirit Molecule”. Deemsters

Full Name N,N-DimethylTryptamine

Pronounced Dee-em-tee / Dye-meth-ul-trip-tah-meen

Description Naturally occurring psychedelic tryptamine. Short acting when ingested alone as a freebase, sometimes mixed with an MAOI-containing substance for longer effects (e.g. **Changa**, **Ayahuasca**)[79]

Possible effects Euphoria, increased libido, increased mindfulness, visual/auditory distortions, empathy & sociability enhancement[80]

Possible side effects Increased heart rate & pressure, body temperature dysregulation, nausea, anxiety, delusions[81]

Caution! Psychosis, delusions, and mania can be triggered if predisposed to these conditions.

Some potentially contra-indicated mixtures

Mixing DMT with:	Possible effects
Amphetamines[20,22] **Cocaine**[20,22] **Cathinones**[22]	Anxiety, thought loops
Cannabis[20,21,22]	Unpredictable potentiation
Tramadol[20,22]	Seizure risk
Lithium[126]	**All above and:** Increased psychosis risk

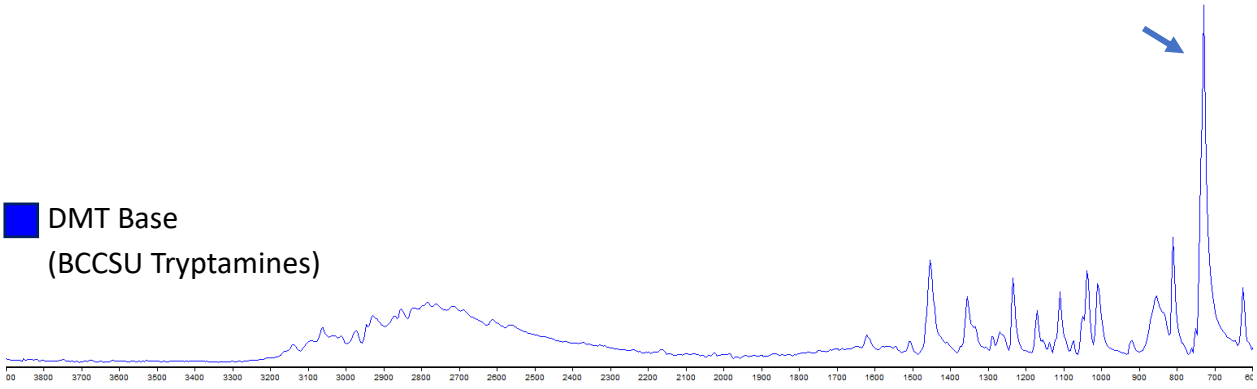
FTIR library entries

Library	Salt Form	Base Form
BCCSU*	DMT	DMT
SWGDRUG		DimethylTryptamine base
TICTAC	N,N-DMT	
PHARMA-2		N.N.-DIMETHYLTRYPTAMINE

Notes

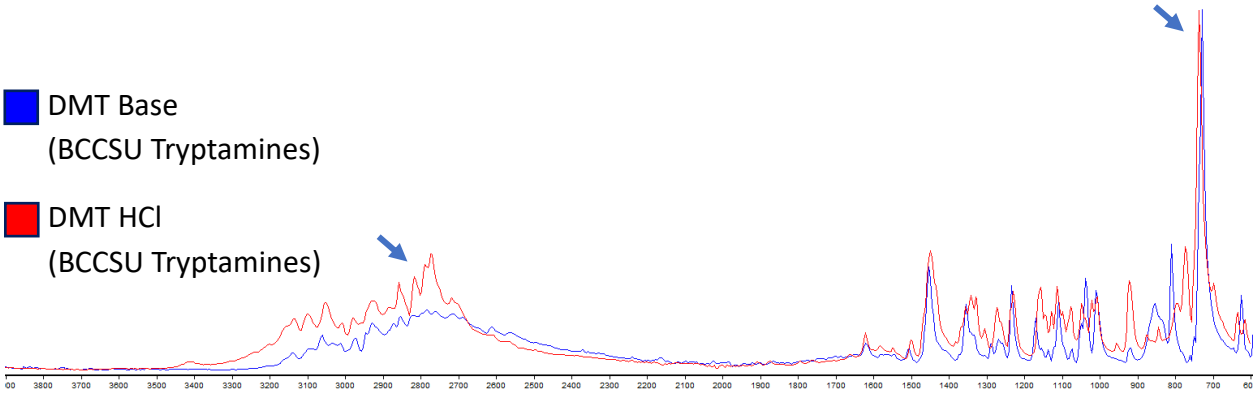
1. *This is the BCCSU Tryptamine library, not the main substance library.
2. **Changa, Ayahuasca**, and other MAOI-containing DMT mixes can be potentially hazardous when mixed with other substances.
3. DMT is often extracted from plant sources. It often contains impurities ranging from plant oils to other psychoactive compounds. This makes DMT samples less likely to be an easy match with the DMT references that are usually more refined.
4. The spectrum for DMT can look very similar to some synthetic tryptamines. However, it is very unlikely that DMT and synthetic tryptamines will appear in the same mixture.

Primary FTIR Spectrum for DMT



DMT is most commonly seen in its freebase form in drug checking in B.C. In this form, there are few strong features with the exception of one prominent peak at ~720^{-1}. This peak will serve as a required landmark. If this peak can be found, only then can the minor peaks throughout the fingerprint and the rise from 3200^{-1} – 2400^{-1} be used to confirm the likely presence of DMT.

Spectral Comparison of DMT Base vs. DMT HCl



DMT HCl is seen less often in drug checking in B.C., but it does occasionally appear. Here it can be seen that the rise in the left-center of the spectrum has more distinct peaks that make identification easier. The major peak at ~720^{-1} is present in both spectra, but note that the wavenumber position is offset. Given the spectra for the two forms are so similar, context clues may be needed to determine which form is more likely to be present.

DMT Fumarate is a salt form for DMT that is sometimes seen, but can only be found in the Kykeon FTIR library at the time of this writing.

Other Expected Drugs

The Other category includes drugs that do not clearly fit into the primary classifications above. This might include emerging substances, synthetic cannabinoids, or inhalants, each with diverse effects and risks.

There are a huge range of prescription medications and off-the-shelf drugs that can appear on occasion (such as when a pill is found on the street). Rather than attempting to learn all pharmaceutical drugs, when a decent match is found in OPUS it is more efficient to research a suspected match as plentiful information is available online. Only Tadalafil (Cialis) is presented here, though **Sildenafil** (Viagra) is also well known and the two drugs sometimes co-occur.

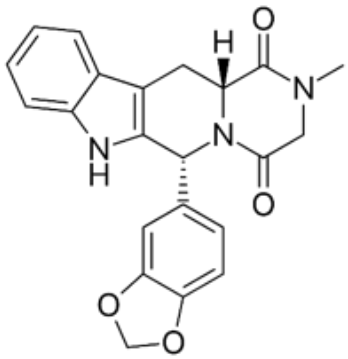
For steroids, read on the **Testosterone** family, **Trenbolone Enthanate,** as well as **Oxandrolone**. Individual drugs in the testosterone family (such as **Testosterone Enthanate**) are difficult to discern and the process can be likened in difficulty to differentiating fentanyl analogues.

Synthetic Cannabinoids (such as **ADB-BUTINACA**) rarely appear in B.C. drug checking but are used for their opioid-like effects. These are sometimes called “trippy dope” due to the somewhat psychedelic effects they can cause.

Nitrous Oxide (whippits/whippets) and **Poppers** (amyl nitrate) are both very common inhalants, but cannot easily be tested using an FTIR with the typical setup found at community drug checking sites.

24. Tadalafil (Cialis)

Molecule



AKA Gas station pills, herbal sex remedies

Description Drug used to treat erectile dysfunction and a few other conditions. Lasts longer than other drugs in the category such as sildenafil.[82]

Pronounced Tah-dah-lah-fil

Possible effects Enhanced sexual arousal

Possible side effects Headache, muscle pain, nausea, fatigue, constipation, diarrhea, dizziness, prolonged erection[82]

Caution!

1. Use with poppers (amyl nitrate) can dangerously lower blood pressure.[115]
2. Erections lasting longer than 4 hours is a medical emergency.

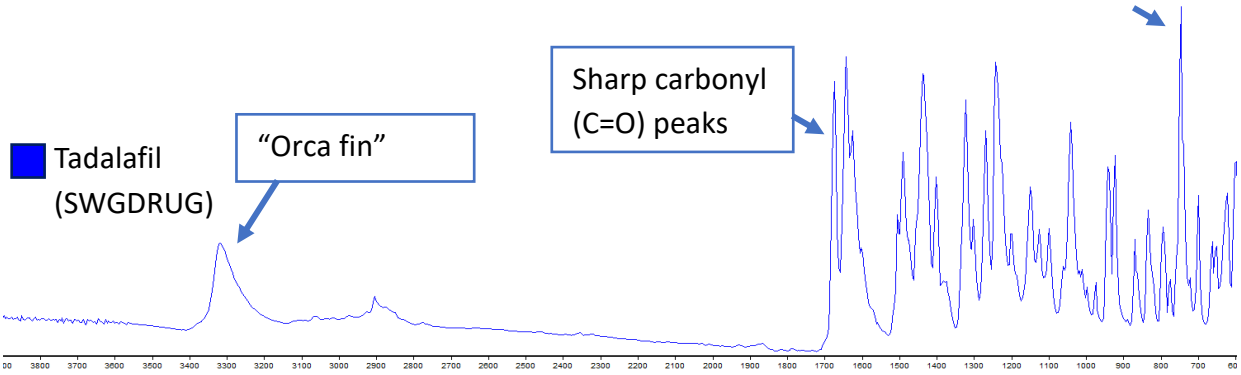
Some potentially contra-indicated mixtures

Mixing tadalafil with:	Potential Effects
Alcohol[19]	Hypotension, heart palpitations
Amphetamines **Cathinones** **Cocaine** **MD-x**[124]	Heart strain, risk of heart attack
Poppers (amyl nitrate)[115]	Severe hypotension

FTIR library entries

Library	Entry
SWGDRUG	Tadalafil
PHARMA-2	CIALIS

Primary FTIR Spectrum for Tadalafil



Tadalafil is a complex molecule; as such, the fingerprint has many peaks to work with, but these three are shortcuts to identification:

- The strong peak at ~730^{-1}.
- The double peak at ~1650^{-1}.
- The "Orca fin"-shaped peak at 3300^{-1}.

Cuts & Buffs

In contrast to expected substances, cuts and buffs are adulterants. Adulterants are substances added to expected substances with or without the knowledge of the buyer and can be broadly divided into two categories.

Cuts are substances that are pharmacologically active, meaning, they elicit an effect of some sort, either psychoactive or not. Cuts may be added for a variety of reasons, but the two main reasons are to enhance or mimic the desired effect, or to facilitate the administration of the substance. By enhancing the effect of the purported substance, cuts can either provide the illusion of a better-quality product, or attempt to compensate for poor quality.

These cuts are included in the guides here:

- Caffeine, the most common substance found in community drug checking
- Ascorbic Acid (Vitamin C), used to facilitate the administration of basic opioids
- Benzocaine, which mimics the numbing effect of cocaine

Buffs, also referred to as diluents or bulking agents, are usually inactive ingredients (or of negligible effect in the quantities used) that simply add weight or bulk out the final product. For this reason, buffs are often legal, readily available, and relatively inexpensive.

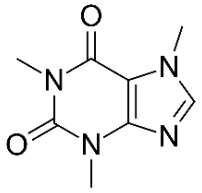
These buffs are included in the guides:

- Sugar alcohols and sugars: Erythritol, Xylitol, Mannitol, Inositol, Lactose, and Sucrose.
- Acetaminophen/Paracetamol (Tylenol)
- Phenacetin and Levamisole/Tetramisole, two medications used to bulk out cocaine
- Dimethyl Sulfone/MSM, a common meth buff
- Dicalcium Phosphate, Microcrystalline Cellulose (MCC) are common pill fillers.
- Creatine and Polyethylene Glycol (PEG), fillers
- Water, either as a diluent or unintentional dampening of a substance.
- Calcium Stearate, a common pill binder and lubricant used in pharmaceuticals.

Additional bulking agents to be aware of are **Glucose, Glutamine, Taurine, Calcium carbonate, Talc, Polyvinylpyrrolidone, Magnesium Sulfate** (Epsom salts) and **Propylene glycol.** Two numbing agents similar to benzocaine are **Procaine** and **Lidocaine. Sodium Bicarbonate** is used for making base forms of drugs. A rare and dangerous adulterant in cocaine is **Boric acid**. **Monosodium glutamate** (MSG) can resemble meth as well as ketamine. Finally, one more pill lubricant to know is **Stearic acid**, related to calcium stearate.

25. Caffeine

Molecule



Description Naturally occurring stimulant found in coffee, tea, and chocolate. Most commonly consumed psychoactive substance globally.[89]

Pronounced Kah-feen

Effects

Stimulant: wakefulness, physical and/or cognitive enhancement[89]

Buff: bulking agent in mixtures, facilitates smoking for opioids, enhances opioid anxiolytic (pain-relieving) properties[91]

Possible side effects High doses can cause nausea, headaches, restlessness, irritability, insomnia, anxiety, hyper/hypoglycemia, diuresis (increased urinating), increased electrolyte clearing in urine[88]

Found in Down, MDMA, Tucibi, Cocaine, others

Some potentially contra-indicated mixtures

Mixing caffeine with:	Potential effects:
Amphetamines[18,19,20,22] **Cathinones**[22]	Anxiety, tachycardia, hypertension, heart strain
Cocaine[18,20,22]	**All above and:** risk of heart attack, irregular heart rhythm
MD-x[20,22]	Increased neurotoxicity

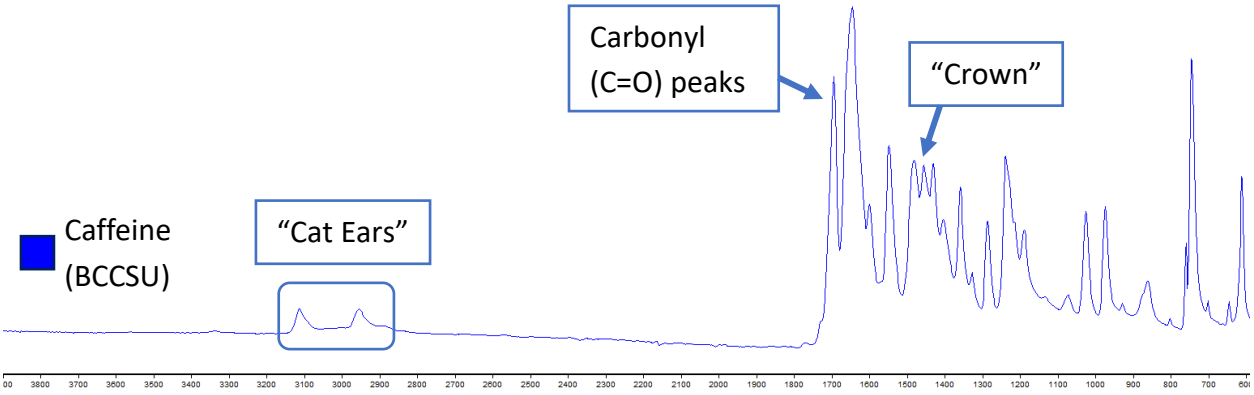
FTIR library entries

Library	Library Entry	Citrate Form
BCCSU	Caffeine	
SWGDRUG	Caffeine	
TICTAC	Caffeine	
PHARMA-2	CAFFEINE	CAFFEINE CITRATE
PHARMA-4	CAFFEINE PURE	

Notes

1. Caffeine is the most common substance detected by FTIR in B.C.
2. Caffeine primarily works by blocking the depressant effects of the metabolic compound adenosine and enhancing the release of the neurotransmitter acetylcholine.[90]

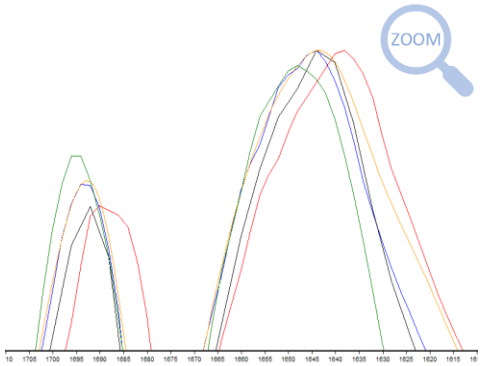
Primary FTIR Spectrum for Caffeine



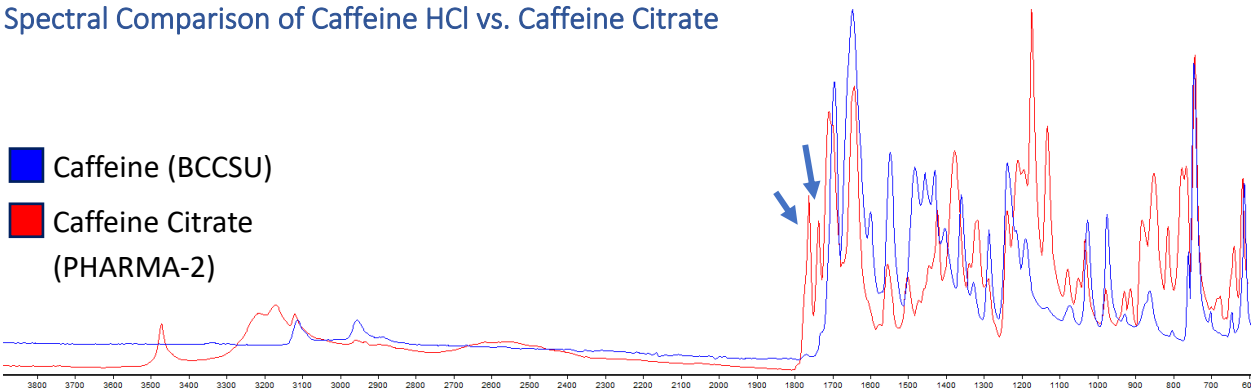
Caffeine is not typically difficult to identify. These patterns make for short work:

- The prototypical "Cat Ears" pattern.
- The strong carbonyl peaks at ~1650^{-1}. These are often shared with opioids.
- The "Crown" feature at ~1450^{-1}.

Caffeine seems to have quite a lot of variation in the wavenumber of the major peaks from reference to reference (observe the tips of the carbonyl peaks). This seems to match technician experience that caffeine often does not subtract "cleanly", often leaving artefacts. This may indicate that the spectrum of caffeine is rather sensitive to the conditions in which it was scanned. Making use of all available library entries might help situations where a caffeine subtraction is causing a lot of artefacts.



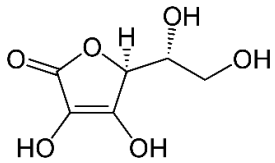
Spectral Comparison of Caffeine HCl vs. Caffeine Citrate



Caffeine citrate is seen relatively rarely in drug checking, however, when it does it can cause some confusion as it is located in the PHARMA-2 library. The two indicated peaks can sometimes cause unexpected hits for other substances in the relatively sparse 1800^{-1} – 1700^{-1} range if the PHARMA-2 library is not active.

26. Ascorbic Acid (Vitamin C)

Molecule



Pronounced Ah-skor-bik ah-sid

Description Naturally occurring vitamin found in fruits and vegetables. Prevents scurvy.

Effects Common cold remedy, dissolves basic (rather than acidic) substances for injection such as heroin.

Possible side effects Pain and/or swelling at injection site, burning sensation in veins[87]

Found in Down

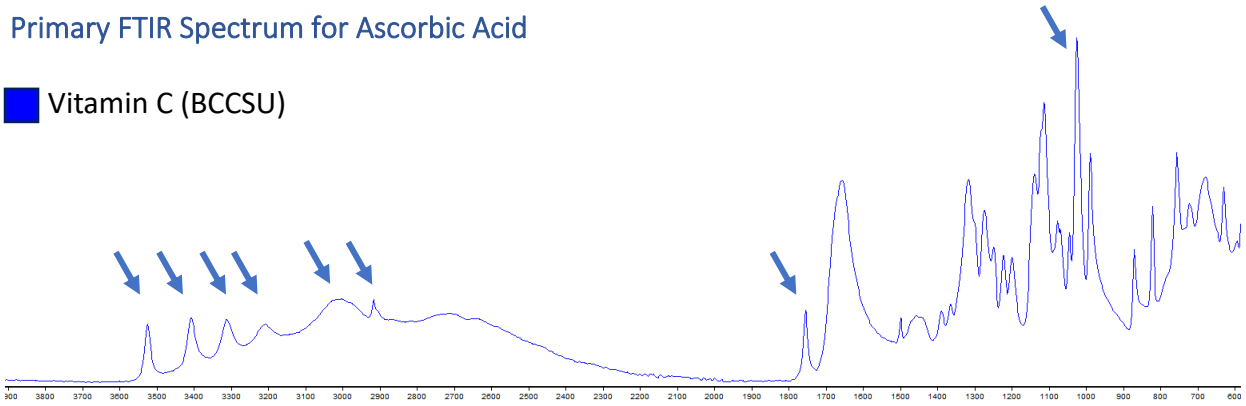
FTIR library entries

Library	Library Entry
BCCSU	Ascorbic Acid
TICTAC	Ascorbic Acid BP
PHARMA-1	L-ASCORBIC ACID*

Notes

1. *Do not use D-Ascorbic acid, this is not equivalent.
2. In high doses above 2g/day, can cause nausea, headaches, stomach cramps, and kidney stones.[82,87]

Primary FTIR Spectrum for Ascorbic Acid

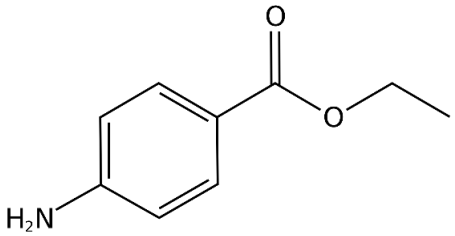


Vitamin C exhibits a satisfying pattern to spot at the left side of the spectrum, but also has other excellent features to work with:

- The wavy pattern of peaks from 3550^{-1} – 2900^{-1}.
- The major peak at ~1020^{-1}.
- Like caffeine citrate, the peak indicated at 1750^{-1} can sometimes lead the drug checker to think that Crack Cocaine, Heroin, or Carfentanil.
- are present as there are few substances with peaks in the 1800^{-1} – 1700^{-1} range.

27. Benzocaine

Molecule



AKA Orajel, Anaesthesin

Pronounced Ben-zuh-kayn

Description Topical painkiller/anesthetic

Effects Cut into cocaine to mimic the topical anesthetic quality and improve perception of purity.[85]

Possible side effects Allergic contact dermatitis (sores), hypersensitivity[86]

Caution! Chronic use (especially ingested) can cause a blood disorder called methemoglobinemia.[85,86]

Found in Cocaine, down

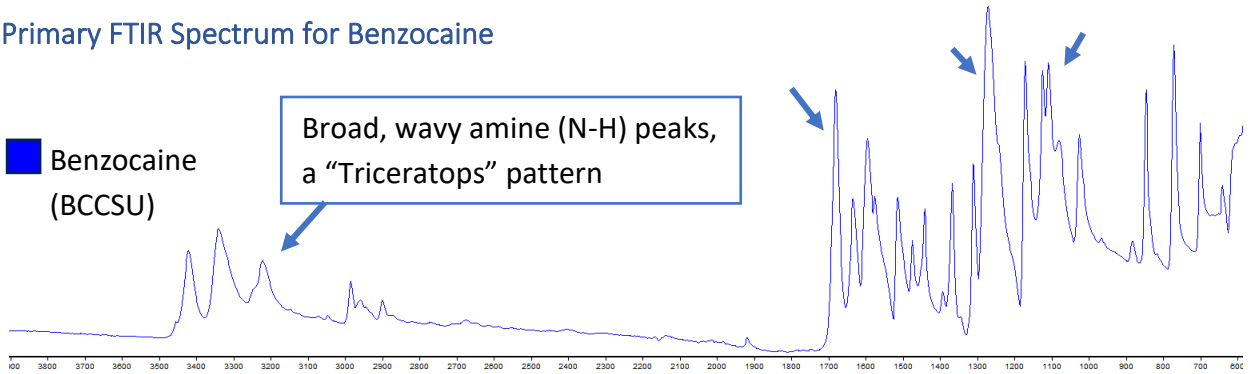
FTIR library entries

Library	Library Entry
BCCSU	Benzocaine
SWGDRUG	Benzocaine
TICTAC	Benzocaine
PHARMA-1	ANAESTHESIN
PHARMA-2	BENZOCAINE

Notes

1. Benzocaine belongs to a family of topical anaesthetics, this includes **Lidocaine** and **Procaine**.
2. Benzocaine works primarily to inhibit nerve endings from sending electrical impulses by blocking sodium channels.[93]

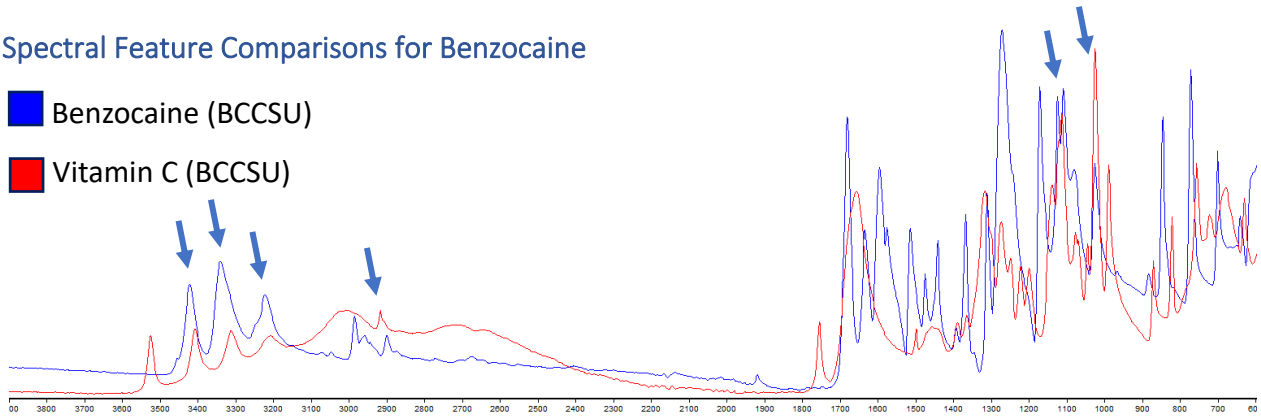
Primary FTIR Spectrum for Benzocaine



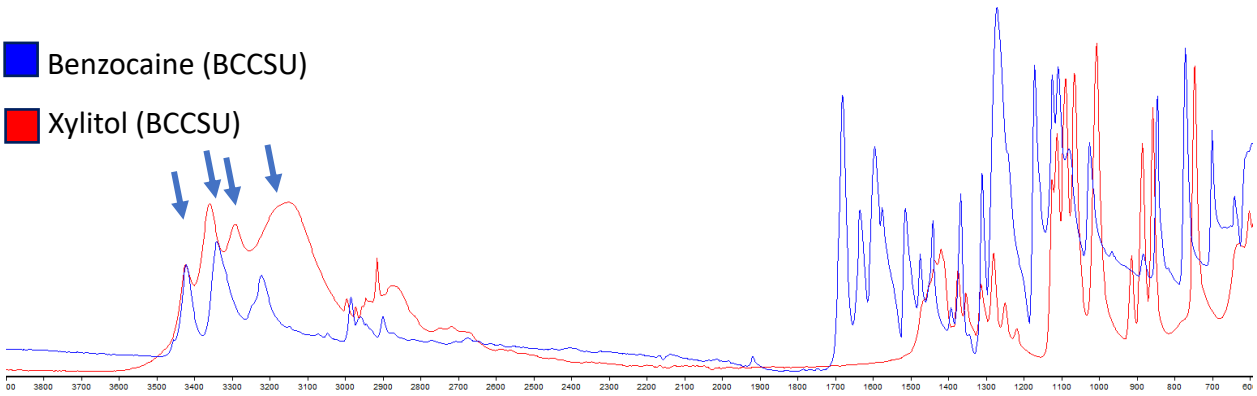
Benzocaine, like Ascorbic Acid (Vitamin C), has a fun feature at the left to work with, as well as strong peaks elsewhere:

- A three peaked “Triceratops” feature.
- The major triangular peak at ~1250^{-1}.
- The peak at ~1680^{-1}.
- The double peak at ~1100^{-1}.

Spectral Feature Comparisons for Benzocaine



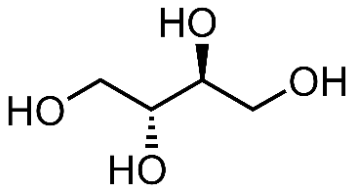
As mentioned, benzocaine and Ascorbic Acid (Vitamin C) both exhibit a three-peaked feature from 3450^{-1} – 3150^{-1}, though Vitamin C has an extra peak here. Benzocaine and vitamin C do not usually appear in the same mixtures.



Comparing benzocaine to Xylitol, the “Triceratops” feature does not match as well, but the four peaks of xylitol may nonetheless seem familiar for either benzocaine or vitamin C.

28. Erythritol

Molecule



AKA Splenda, Sweet n' Low, Swerve

Pronounce Ur-ih-thruh-taal

Description Naturally occurring sugar alcohol found in some fruits and vegetables. Is not metabolized and is excreted in urine.[94]

Effects Bulking agent, improves texture of down granules, masks bitter taste of down, does not burn like sucrose.

Possible side effects High oral doses: laxative effect, flatulence[94]

Found in Down

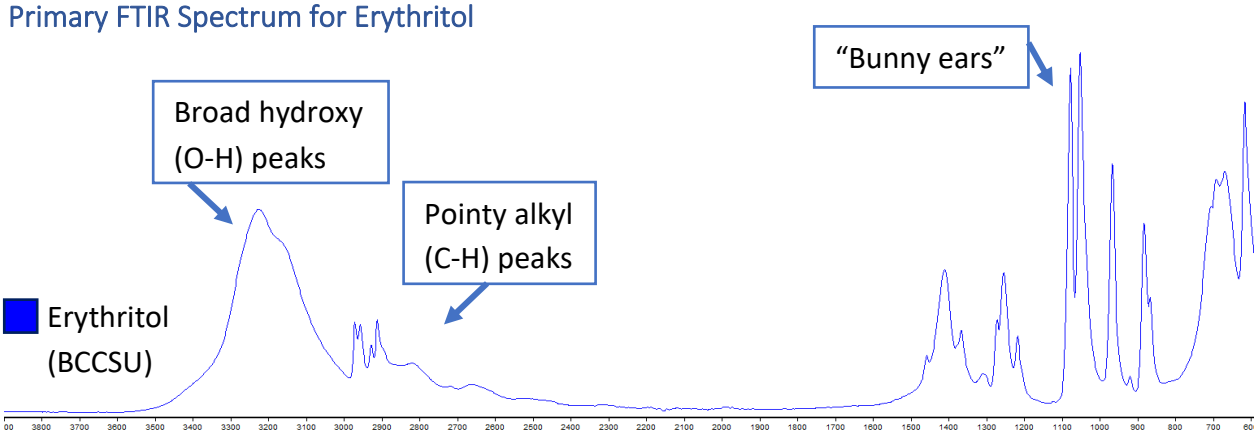
FTIR library entries

Library	Library Entry
BCCSU	Erythritol
TICTAC	Meso-erythritol*

Notes

1. **meso* is the common form of erythritol
2. Erythritol cannot be metabolized by humans or tooth bacteria, which is why it does not contribute to tooth decay.[95]
3. Erythritol is about 60-70% as sweet as sucrose.[95]
4. Sugar alcohols (the "-ol" substances here, known as polyols) sometimes get grouped in with "sugars", but they are different things.

Primary FTIR Spectrum for Erythritol

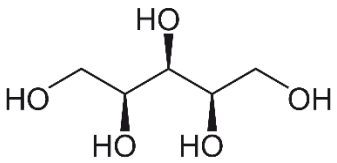


Erythritol is nearly as common as caffeine in B.C. drug checking, and has a few features that make it usually pretty easy to identify:

- The “Bunny ears” feature in the fingerprint region is by far the best way to find erythritol.
- The hydroxy peaks, though they are broad and sometimes do not appear consistently.
- The alkyl peaks are sometimes useful, but overlap with a lot of other substances.

29. Xylitol

Molecule



AKA Birch sugar

Pronounced Zai-luh-taal

Description Naturally occurring sugar alcohol

Effects Bulking agent, improves texture of down granules, masks bitter taste of down, does not burn like sugar

Possible side effects High oral doses: laxative effect, flatulence[97]

Found in Down

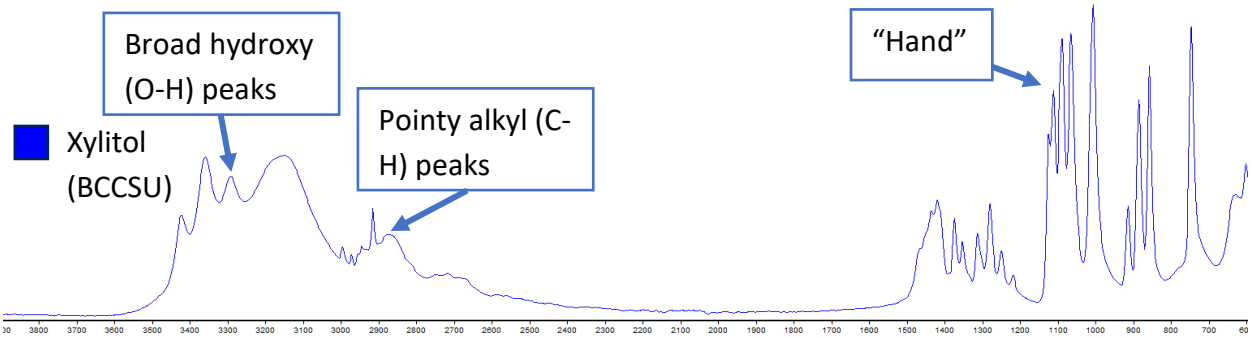
FTIR library entries

Library	Library Entry
BCCSU	Xylitol
TICTAC	Xylitol

Notes

1. Xylitol is about as sweet as sucrose and about 60% of the calories.[98]
2. Xylitol is toxic to dogs.[96]

Primary FTIR Spectrum for Xylitol

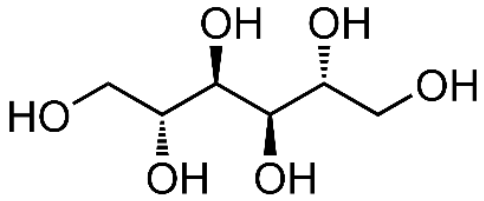


Xylitol is not as common as erythritol, but has better identification features:

- The collection of broad hydroxy peaks can show through other spectra even when xylitol is present in small quantities. These peaks can be mistaken for those of Ascorbic Acid (Vitamin C) or Benzocaine.
- A "hand" feature with four fingers and a thumb at 1250^{-1} – 1000^{-1}.
- The single sharp spike in the alkyl peaks may also be useful.

30. Mannitol

Molecule



AKA Baby lax

Pronounced Mah-nuh-taal

Description Sugar alcohol used in several medical procedures. Common sweetener in diabetic-friendly foods.[92]

Effects Bulking agent, improves texture of down granules, masks bitter taste of down, does not burn like sugar

Possible side effects Increased urination, bloating, dehydration (high doses), pain, blurred vision, hypotension[92]

Found in Down, MDMA, Tucibi

Potentially contra-indicated mixture

Mixing mannitol with:	Possible Effects
Polyethylene Glycol[19]	Dehydration, electrolyte imbalance

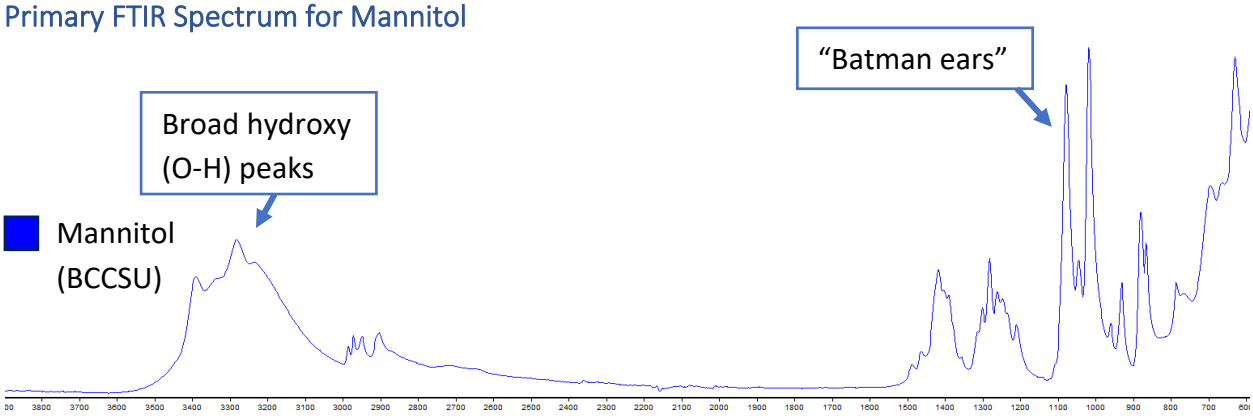
FTIR library entries

Library	Library Entry
BCCSU	Mannitol
SWGDRUG	Mannitol
TICTAC	D-Mannitol
PHARMA-2	D-MANNITOL, MANNITOL NS

Notes

1. D-Mannitol is the common form of mannitol, L-Mannitol is not interchangeable.
2. Mannitol is abundant in nature and about 50% as sweet as sugar.[101]

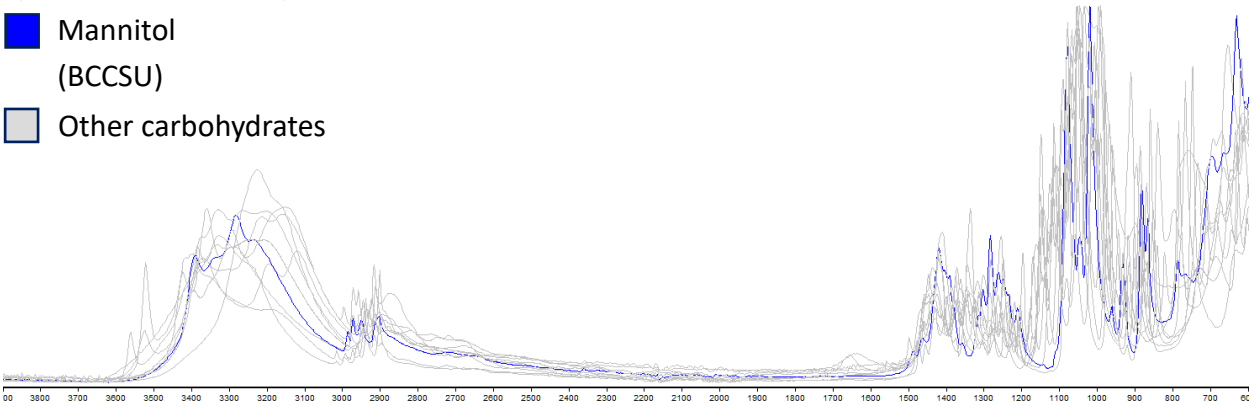
Primary FTIR Spectrum for Mannitol



Mannitol is molecularly very similar to Erythritol and Xylitol, and the interpretation of the spectrum can be done in a similar manner:

- A distinctive set of hydroxy peaks that may poke through the sample spectrum before other features are obvious.
- The "Batman ears" feature. The middle peak often gets obscured in mixtures.

Spectral Feature Comparison for Mannitol



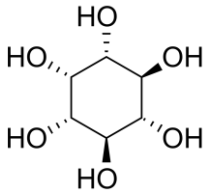
This comparison illustrates the similarities between carbohydrates. Here we can see all of the sugars and sugar alcohols (polyols) in this document, along with microcrystalline cellulose. Observe how every carbohydrate has

- a rise between 3600^{-1} – 3000^{-1}
- spiky alkyl peaks between 3000^{-1} – 2900^{-1}
- Almost nothing until ~1500^{-1}
- Some variation of peaks, humps and rises between 1500^{-1} – 1200^{-1}
- Major peaks and rises between 1100^{-1} – 950^{-1}
- A ramp up to the right

If these features are present but a specific carbohydrate cannot be identified, it can be said that an *uncertain carbohydrate* is likely present.

31. Inositol

Molecule



AKA *Myo*-inositol, Vitamin B8

Pronounced Ih-noh-sih-taal

Description Naturally occurring sugar alcohol.[99] May have health benefits when used as a supplement.[133]

Effects Bulking agent

Found in Cocaine, down, MDMA, ketamine

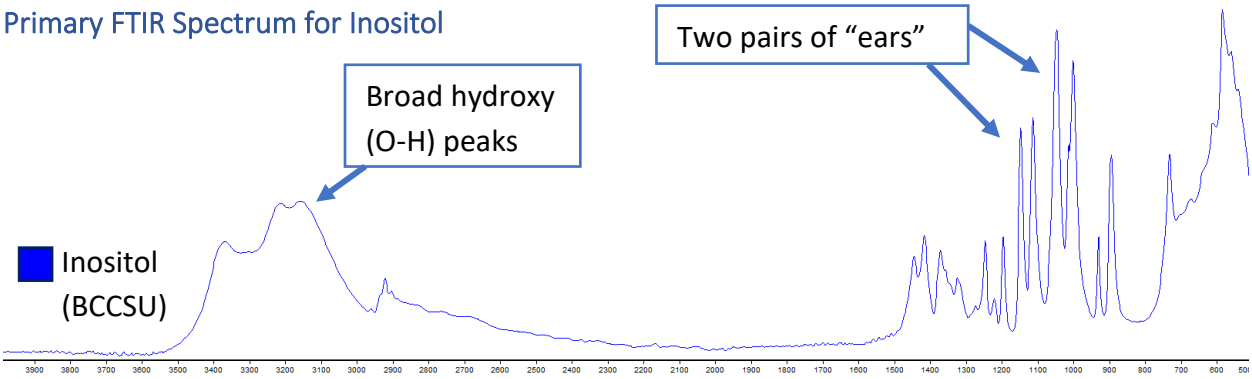
FTIR library entries

Library	Library Entry
BCCSU	Inositol
SWGDRUG	Inositol
PHARMA-1	MYO-INOSITOL
PHARMA-2	MYO-INOSITOL

Notes

1. *Myo*-inositol is the common form of inositol.
2. Inositol is not actually a vitamin, though it is sometimes called one.
3. Inositol is important in cellular biology; it is produced and used in many areas of the body.[99]
4. Inositol is about 50% as sweet as sugar.[102]

Primary FTIR Spectrum for Inositol

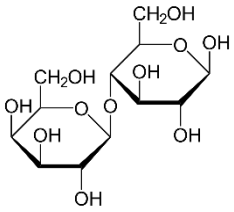


Like other sugar alcohols (polyols), inositol has:

- Spiky peaks in the fingerprint region, including two "bunny ears" features.
- Lumpy hydroxy peaks, but these are unique to inositol.

32. Lactose

Molecule



Pronounced Lak-tows

Description Milk sugar

Effects Bulking agent, pill filler

Found in Pills (pharmaceutical and illicit), down, cocaine

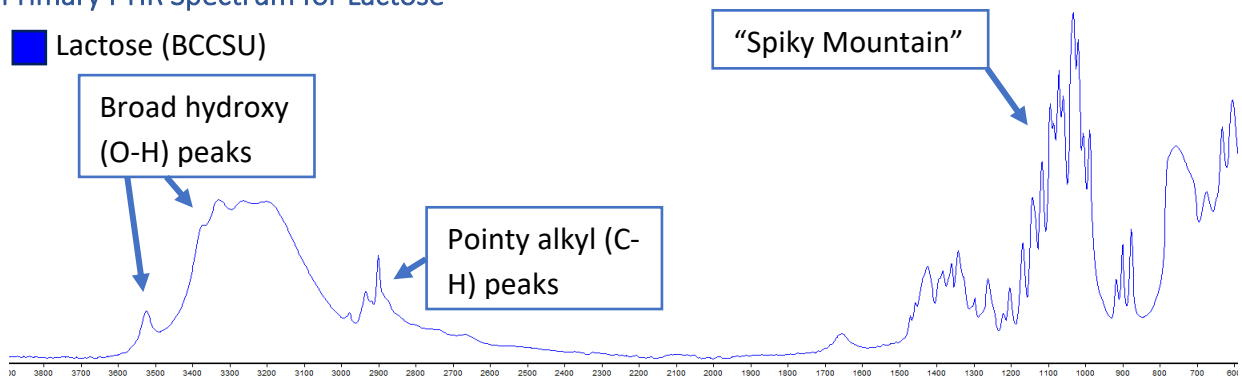
FTIR library entries

Library	Library Entry
BCCSU	Lactose
SWGDRUG	Alpha-Lactose
TICTAC	Lactose BP
PHARMA-2	D-(+)-LACTOSE POWDER

Notes

1. The spectrum for lactose can resemble microcrystalline cellulose (MCC) and sometimes is alongside MCC when used in pills.
2. Lactose is composed of **Galactose** and **Glucose**. Sharing glucose makes the lactose spectrum resemble that of Sucrose.
3. Lactose is about 20-40% as sweet as sucrose.[100]

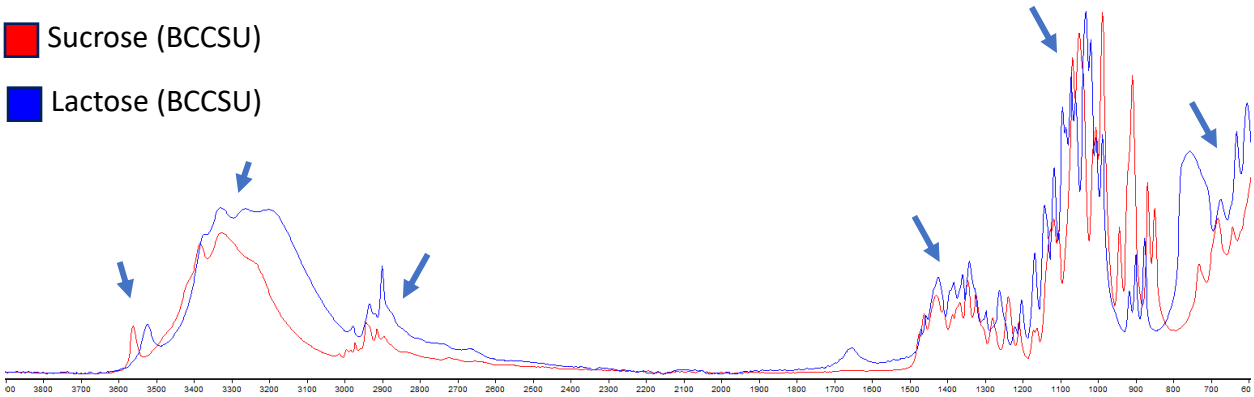
Primary FTIR Spectrum for Lactose



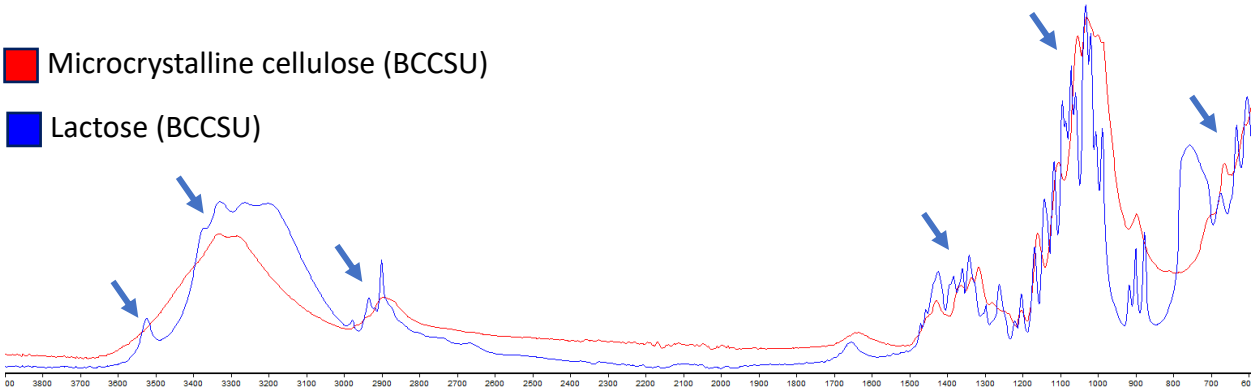
Lactose is a sugar, not a sugar alcohol, but the broad identification features are the same:

- The "Spiky Mountain" feature at $1200^{-1} - 950^{-1}$.
- The smaller but significant peak at ~3530^{-1}.
- The broad hydroxy peaks.
- The alkyl peak at ~2900^{-1}.

Spectral Feature Comparisons for Lactose



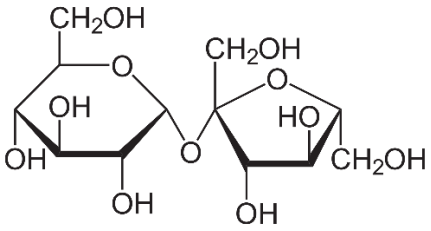
Given their shared constituent *saccharide* (sugar), **Glucose**, and a similar overall shape, it makes sense that lactose and Sucrose should have similarities beyond what can be expected of carbohydrates (See Mannitol). The peak between 3600^{-1} -3500^{-1} present in both compounds is a good example of this. Curiously, this peak is not present in glucose at all! Sucrose and lactose can sometimes co-occur within a mixture and given their similarities it can be difficult to make identifications for both.



Another substance that co-occurs with lactose is Microcrystalline Cellulose (MCC). These frequently show up together in pressed pills. Observe how MCC looks almost like a smoothed-out lactose, like a “wet” lactose. Differentiate the two by using the sharp peaks of lactose and the peak at ~3520^{-1}, which is not present at all in MCC.

33. Sucrose

Molecule



AKA Table sugar

Pronounced Soo-kross

Description Naturally occurring sugar.

Effect Bulking agent.

Found in Down, MDMA, meth, ketamine

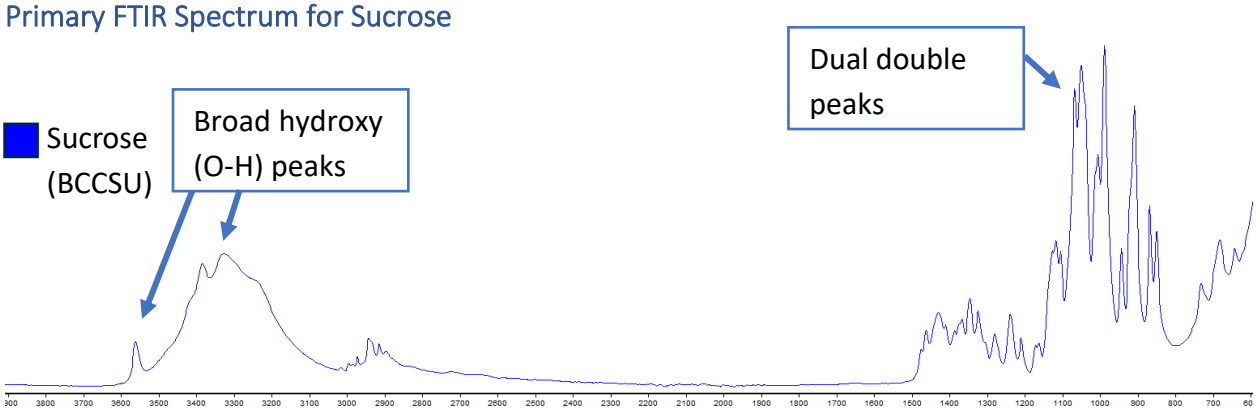
FTIR library entries

Library	Library Entry
BCCSU	Sucrose
SWGDRUG	Sucrose
TICTAC	Sucrose
PHARMA-1	D-(+)-SUCROSE
PHARMA-3	SHOP RITE ™ PURE CANE SUGAR

Notes

1. Sucrose is composed of **Fructose** and **Glucose**. Sharing glucose makes the sucrose spectrum resemble that of Lactose.

Primary FTIR Spectrum for Sucrose

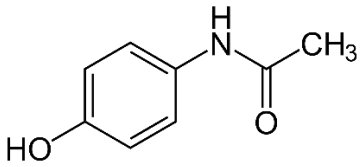


Sucrose has three features to look for in identification:

- The peak at ~3550^{-1}.
- The two sets of double peaks at ~1050^{-1} and ~980^{-1}.
- The broad hydroxy peaks.

34. Acetaminophen/Paracetamol (Tylenol)

Molecule



Full name 4'-Hydroxyacetanilide

Pronounced Ah-see-tah-mih-noh-fen / Pair-ah-see-tah-mohl

Description Medication for reducing pain (analgesic) and fever (antipyretic).[84]

Effects Bulking agent, pain relief

Caution! Large amounts can cause overdose and permanent liver damage or failure.[131]

Found in Opioids, down, cocaine

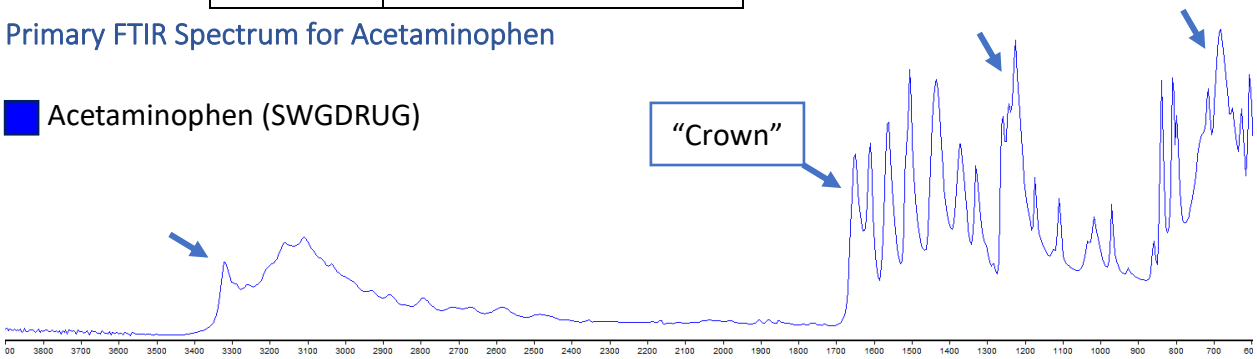
Potentially contra-indicated mixture

Mixing acetaminophen with:	Possible Effects
Alcohol[18,19]	Increased hepatoxicity

FTIR library entries

Library	Library Entry
SWGDRUG	Acetaminophen
TICTAC	Paracetamol
PHARMA-1	4'-HYDROXYACETANILIDE
PHARMA-2	ACETAMINOPHEN
PHARMA-4	PARACETAMOL PURE

Primary FTIR Spectrum for Acetaminophen

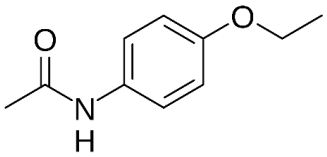


Acetaminophen (Paracetamol) has easy features to work with, look for:

- The peak at ~3220^{-1}.
- The "Crown" feature from 1700^{-1} – 1300^{-1}
- The major triangular peak at ~650^{-1}.
- The triple peak at ~1230^{-1}.

35. Phenacetin

Molecule



AKA Superbuff, magic

Pronounce Feh-nah-seh-tin

Description Withdrawn pharmaceutical drug. Reduces fever (antipyretic) and pain (analgesic). Turns into acetaminophen in the body. Rarely forms a carcinogenic compound in the body.[104]

Effects Buffing agent, pain relief.

Found in Down, crack cocaine, cocaine

Caution! Carcinogenic to the kidneys. [104]

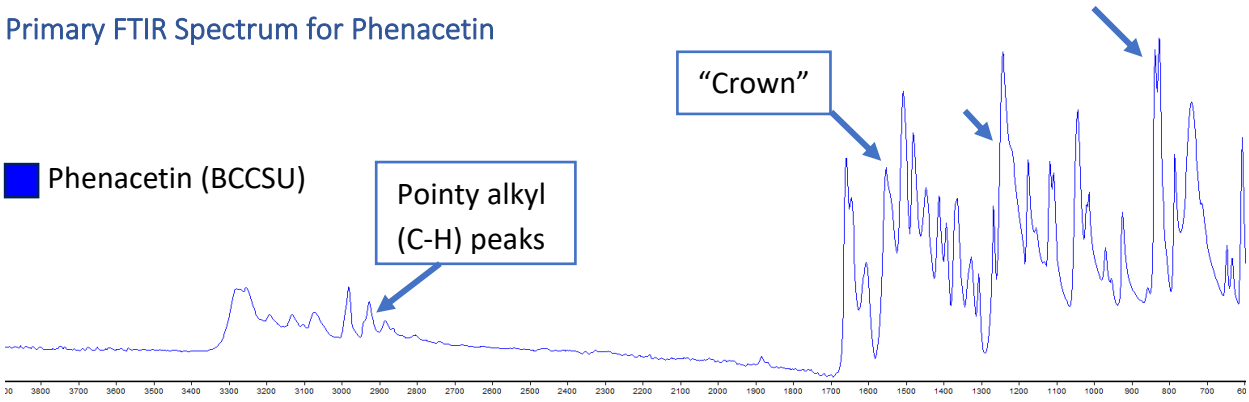
FTIR library entries

Library	Library Entry
BCCSU	Phenacetin
SWGDRUG	Phenacetin
TICTAC	Phenacetin
PHARMA-2	PHENACETIN

Notes

1. Phenacetin can not be "cooked out" of cocaine due to it behaving in a similar manner to cocaine when heated or dissolved. This is why it is called a "super" buff.[103]

Primary FTIR Spectrum for Phenacetin

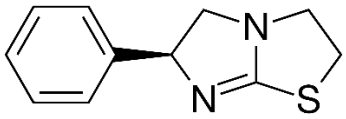


Phenacetin has easy features, like Acetaminophen/Paracetamol (Tylenol), to work with:

- A "Crown" feature from 1600^{-1} – 1300^{-1}.
- The double peak at ~820^{-1}.
- The peak with a shoulder at ~1230^{-1}.
- The alkyl peaks from 3000^{-1} – 2900^{-1}.

36. Levamisole/Tetramisole

Molecule



AKA Pig dewormer, Ergamisole

Pronounced Leh-vah-mih-soll

Description Withdrawn pharmaceutical drug to treat parasitic worm infections.[105]

Effects Possible synergistic effect with cocaine[132], bulking agent.

Possible side effects Nausea, headache, lowered white blood cell count, blotchy purple rash, necrotic tissues[129]

Caution! Chronic use depletes white blood cells, can cause bruising or lesions on the body and increased risk of infection.[106]

Found in Cocaine

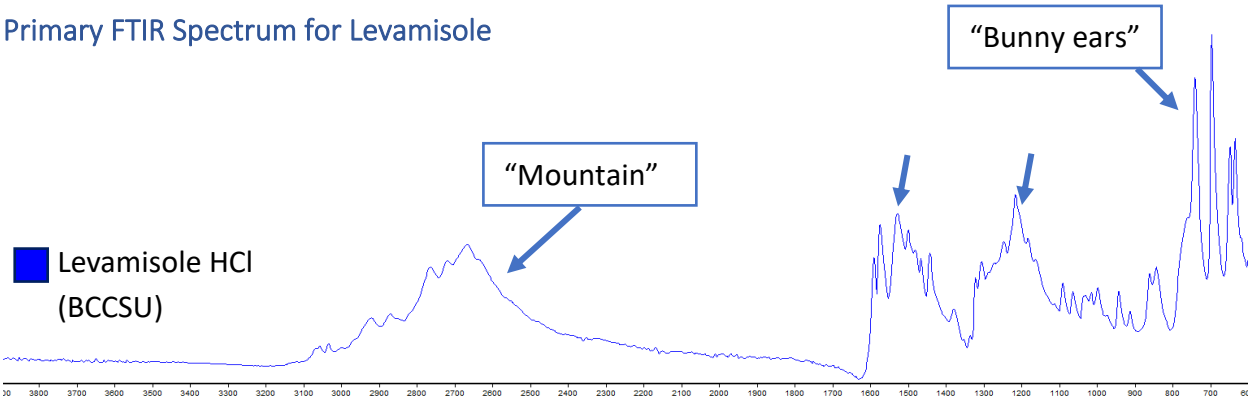
FTIR library entries

Library	Salt Form	Base Form
BCCSU	Levamisole HCl	
SWGDRUG	Levamisole HCl	
TICTAC	Levamisole HCl, (-)-tetramisole HCl	Levamisole base

Notes

1. Levamisole is colourless, tasteless, and has a lower melting point than cocaine. Like Phenacetin, this may help it pass street "purity" tests and be difficult to detect without equipment.[129]

Primary FTIR Spectrum for Levamisole

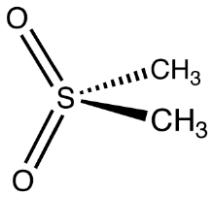


Levamisole can be a little tricky to identify via FTIR, but some landmarks to use are:

- A "Bunny ears" feature, with one "ear" being a double peak.
- The triangular "mountain" feature will "lift" up other spectra in a mixture.
- Two peaks at ~1530^{-1} and ~1220^{-1} that are particularly "bulky" and wide.

37. Dimethyl Sulfone/MSM

Molecule



AKA Methylsulfonylmethane (MSM), Methyl sulfone

Pronounced Dye-meh-thuhl suhl-fown / Meh-thuhl-suhl-faa-nuhl-meh-thayn

Description Naturally occurring organic compound. Relatively inert, but is claimed to have health benefits.[107]

Effect Bulking agent

Found in Methamphetamine, down, MDMA, ketamine

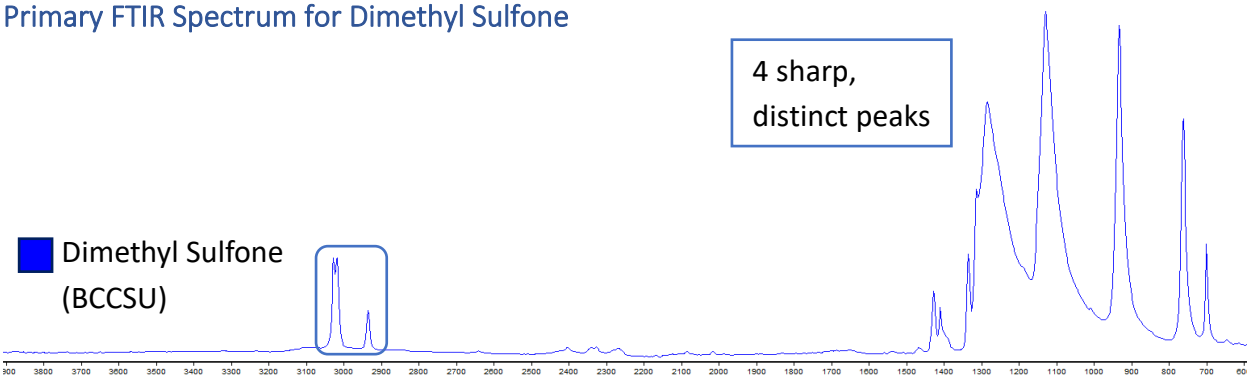
FTIR library entries

Library	Library Entry
BCCSU	Dimethyl Sulfone (MSM)
SWGDRUG	Dimethylsulfone
TICTAC	Dimethyl sulfone

Notes

1. MSM can co-crystallize with other substances, making it nearly impossible to tell by eye if the substance has been buffed.[108]

Primary FTIR Spectrum for Dimethyl Sulfone

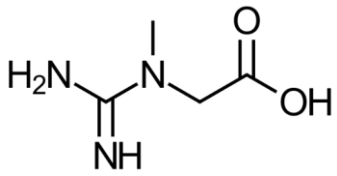


Most molecules seen in drug checking have chains of carbon as their backbone, dimethyl sulfone has instead a single atom of sulfur as a core. This leads to a spectrum that is visually distinctive from the rest, but luckily it is simple to identify:

- The double peak feature at ~3020^{-1} has nearly vertical sides making it poke out of other spectra in a distinct way.
- The triangular peaks of the fingerprint. Observe how the bases of the 4 peaks form a falling slope pattern.

38. Creatine

Molecule



Pronounced Kree-uh-teen

Description Naturally occurring compound in muscle and brain tissue.[110]

Effect Bulking agent

Found in Cocaine, MDMA

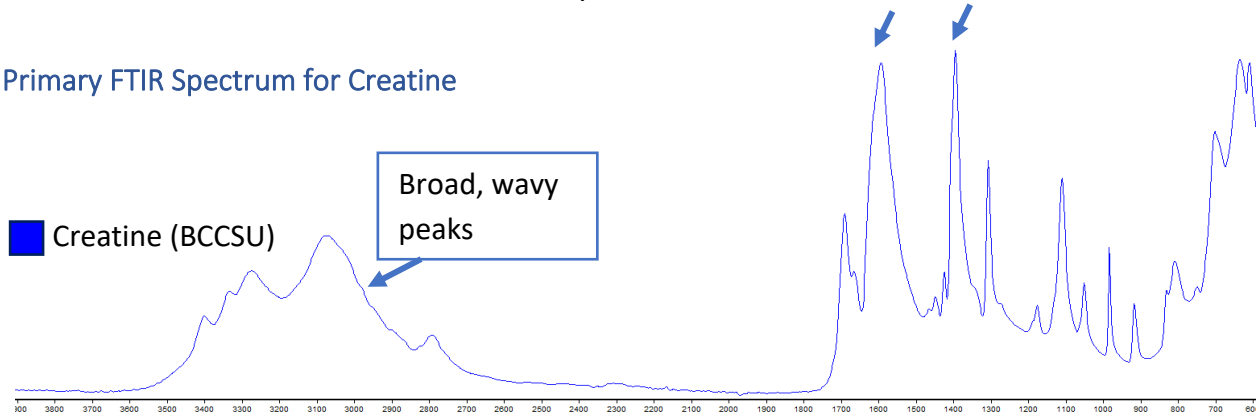
FTIR library entries

Library	Library Entry
BCCSU	Creatine Monohydrate
SWGDRUG	Creatine hydrate
TICTAC	Creatine
PHARMA-1	(1-METHYLGUANDINO)ACETIC ACID
PHARMA-2	CREATINE

Notes

1. Note that the metabolite creatinine is not the same as creatine, take care not to mix these up in OPUS.
2. Creatine monohydrate is the common form found in bodybuilding supplements.
3. In higher doses, creatine enhances physical activity, water retention in muscles, and recovery.[109]

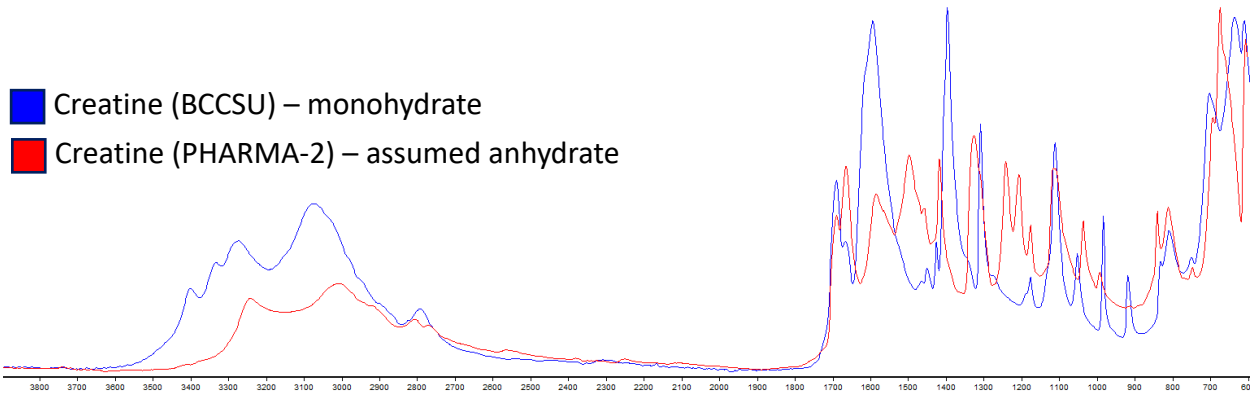
Primary FTIR Spectrum for Creatine



Creatine has a feature-filled molecule, with amine and carboxyl functional groups producing a spectrum that has lots of distinct shapes to match with:

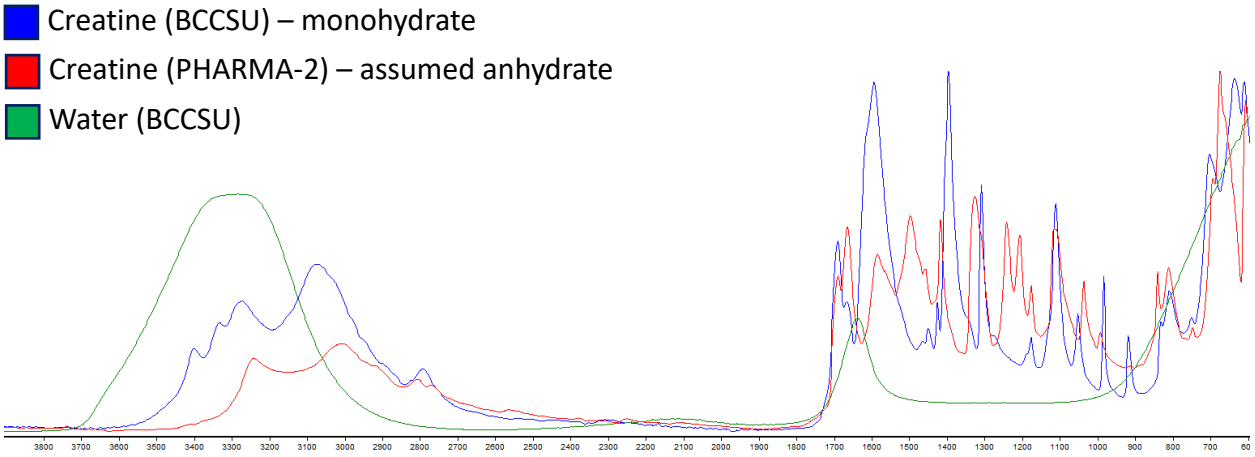
- A “mountain” feature with broad, wavy peaks.
- The major triangular peak at ~1600^{-1}.
- The major peak at ~1380^{-1}.

Alternate Spectrum for Creatine



Creatine looks vastly different depending on the library used, it is important to make use of each to determine which is the best match. In this case, the different references have different levels of hydration, it is safe to assume that the spectral differences are at least in part due to differing levels of water trapped in the structure of creatine.

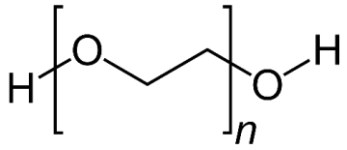
Spectral Feature Comparison for Creatine



Here we can see how unpredictable polymorphs can be; there is little resemblance of the hydrated creatine spectrum to that of Water. Perhaps an argument can be made that the water "lifts" the section of the creatine spectrum from 3900^{-1} – 2900^{-1}, but how this occurs does not follow a pattern. In the fingerprint, the presence of water in the crystal has rendered these two spectra distinct.

39. Polyethylene Glycol (PEG)

Molecule



Pronounced Paa-lee-eh-thuh-leen glai-kaal

Description Inert compound used widely in chemistry, industry, cosmetics, and medicine. Has a laxative effect at higher doses, but is otherwise nontoxic.[111]

Effect Bulking agent

Found in Opioids, pharmaceuticals

Potentially contra-indicated mixture

Mixing PEG with:	Possible Effects
Mannitol[19]	Dehydration, electrolyte imbalance

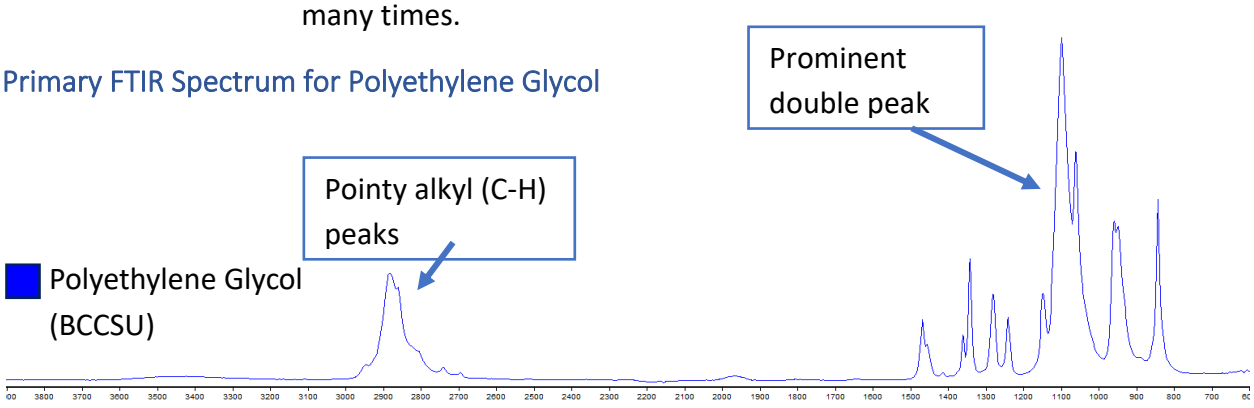
FTIR library entries

Library	Library Entry
BCCSU	Polyethylene Glycol (PEG)*
PHARMA-2	POLY(ETHYLENE GLYCOL) 2000, POLY(ETHYLENE GLYCOL) 300, POLY(ETHYLENE GLYCOL) 4000,

Notes

1. * The BCCSU library reference is PEG-4000.
2. The number after PEG refers to how heavy the average molecule chain is. The middle part of this molecule within the brackets is repeated many times.

Primary FTIR Spectrum for Polyethylene Glycol

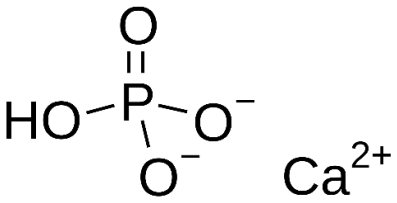


PEG is a simple molecule and therefore the spectrum looks a bit simpler than molecules with more features and branching. It has three distinct features to look out for:

- The major double peak at ~1100^{-1}.
- The moderate double peak at ~950^{-1}.
- The alkyl double peak at ~2880^{-1}.

40. Dicalcium Phosphate

Molecule



Pronounced Dye-kal-see-um faas-fate

Description Food additive, polishing agent in toothpaste, tableting agent.[112]

Effects Bulking agent, pill binder

Found in Pills (pharmaceutical and illicit)

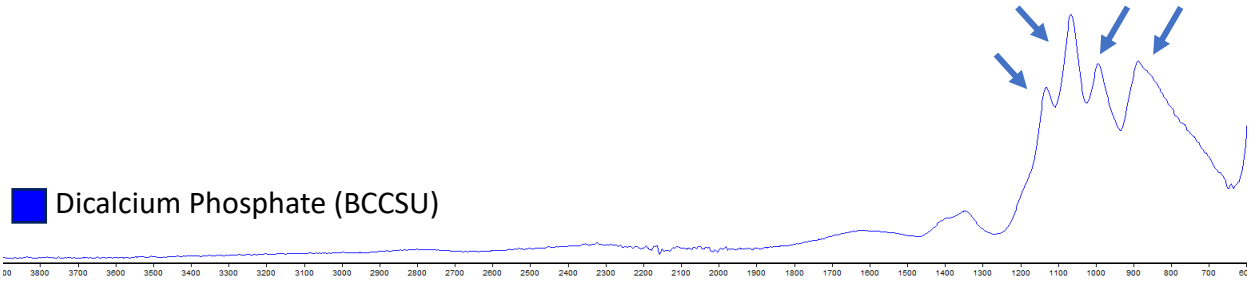
FTIR library entries

Library	Library Entry
BCCSU	Dicalcium Phosphate
PHARMA-2	PHOSPHATE CALCIUM DIBASIC

Notes

1. A primary component of PAREXYL, which is a toothpaste.
2. May come up as toothpaste, tooth powder or similar in OPUS

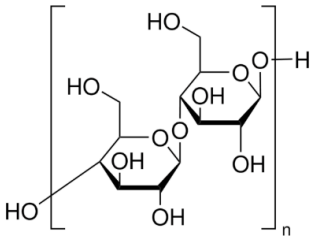
Primary FTIR Spectrum for Dicalcium Phosphate



Like Dimethyl Sulfone/MSM, dicalcium phosphate is a tetrahedral (3-sided pyramid) molecule, but has phosphorus as a core. This molecule has no carbon in it at all, which really makes the spectrum deviate from what is typically seen in drug checking. Here, four broad peaks with triangular bases in the fingerprint are all that can be used to make this identification.

41. Microcrystalline Cellulose (MCC)

Molecule



Pronounced Mai-krow-kri-stuh-luhn sehl-yoo-lows

Description Refined wood pulp (cellulose). Widely used in industry, cosmetics, food production, and pharmaceuticals. Cannot be digested, effectively inert to humans. Does not dissolve in water.[113]

Effects Bulking agent, pill filler

Found in Pills (pharmaceutical and illicit), down

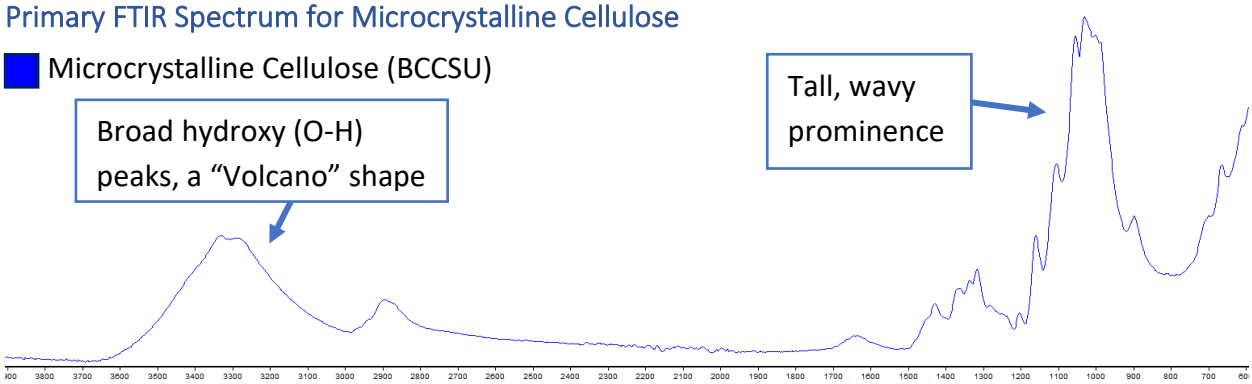
FTIR library entries

Library	Library Entry
BCCSU	Microcrystalline Cellulose
PHARMA-2	CELLULOSE MICROCRYSTALLINE (AVICEL)
PHARMA-4	VIVAPUR 105 – MICROCRYSTALLINE CELLULOSE

Notes

1. The spectrum for MCC can resemble lactose and sometimes is seen alongside lactose when used in pills.

Primary FTIR Spectrum for Microcrystalline Cellulose

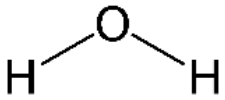


MCC is a very common substance in drug checking. This molecule is full of hydroxy groups and they produce two distinct features:

- A "Volcano" feature with broad slopes.
- A tall prominence reminiscent of Lactose, but MCC has wavy peaks that make identification a little bit harder.

42. Water

Molecule



Description Plain water.

Effect Diluent

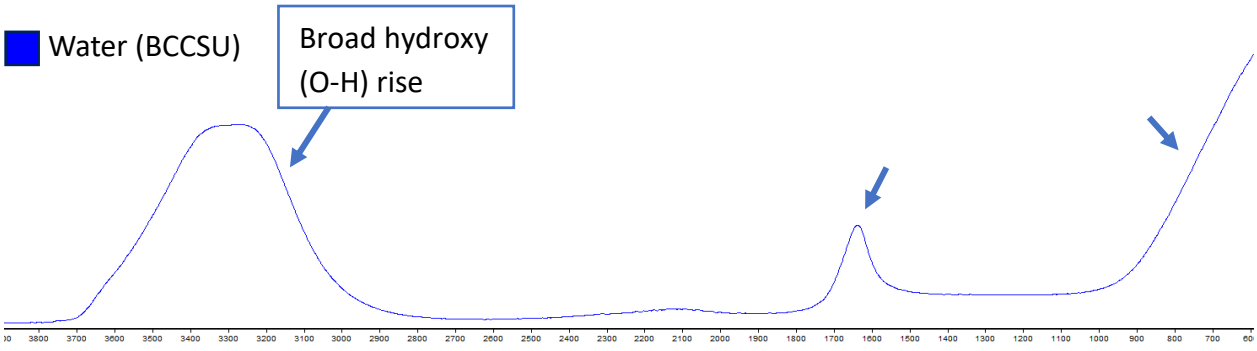
FTIR library entries

Library	Library Entry
BCCSU	Water
TICTAC	Water
PHARMA-2	WATER

Notes

1. Water most commonly appears intentionally as a diluent for liquid drugs such as GHB, but appears in wet powders as well.
2. Many substances are hydrophilic (water attracting) and can absorb enough water from air to appear on FTIR when left exposed for an extended period of time.
3. When included as a diluent, water has a “washing-out” effect where details of underlying spectra are smoothed out and the data is lost.
4. When included in a hydrated crystal, the resultant spectrum will have features that do not resemble the spectrum of water. The resultant spectrum may also have features that do resemble the spectrum of water.

Primary FTIR Spectrum for Water

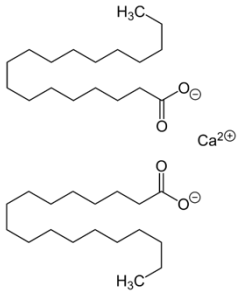


Water is a very simple molecule, and as such the spectrum only has three features for identification:

- A characteristic flat-topped hydroxy hump.
- A bump at ~1650^{-1} can often be spotted lifting other spectra.
- The ramp to the right.

43. Calcium Stearate

Molecule



Pronounced Kal-see-uhm stee-rate

Description A calcium soap, the main ingredient of soap scum. Used in industry and food processing.[114]

Effects Pill lubricant: keeps pills from sticking to presses, pill binder.

Found in Pills (pharmaceutical)

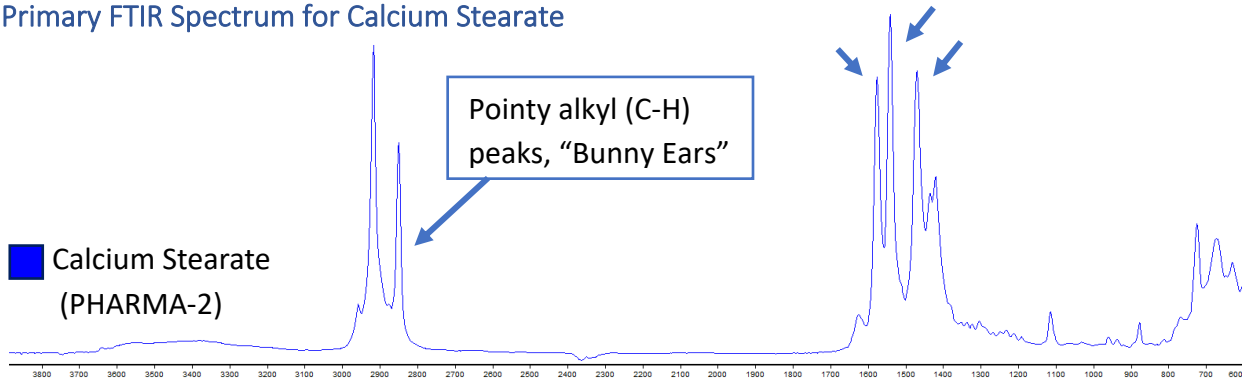
FTIR library entries

Library	Library Entry
PHARMA-2	CALCIUM STEARATE

Notes

1. Calcium stearate consists of two ionized molecules of **stearic acid**. The pharma libraries are required in order to get a match for this substance.
2. May be confused with nuts, oils, or other fatty substances when attempting to identify in OPUS.

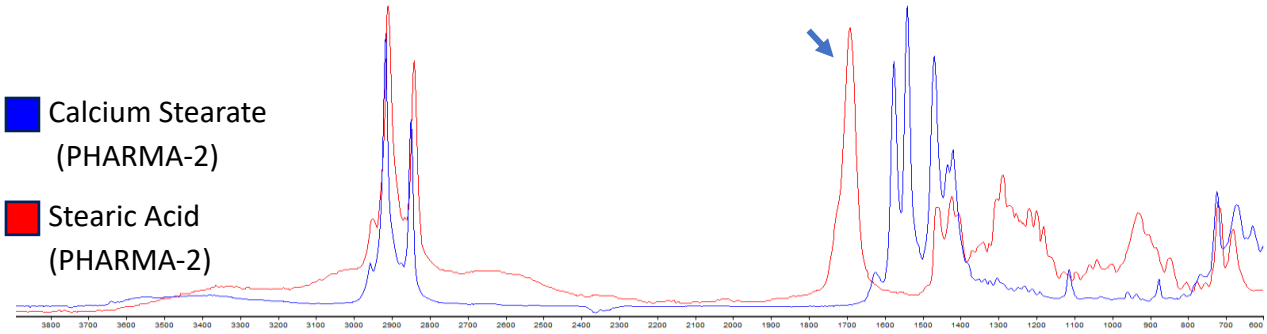
Primary FTIR Spectrum for Calcium Stearate



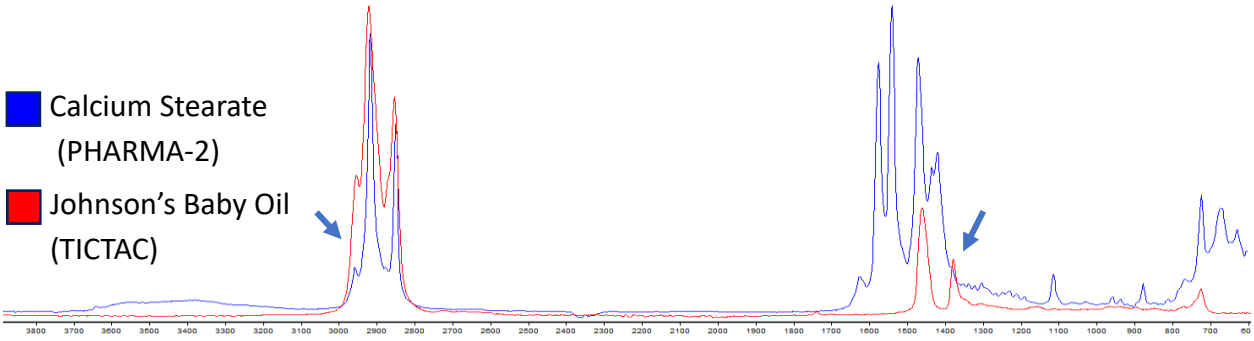
Calcium stearate consists of a pair of lipid molecules, which causes it to frequently be confused with oils (such as baby oil). Two groups make easy features to work with:

- Two major alkyl peaks project up in a region with few major peaks. If calcium stearate or **Stearic acid** are present, these two peaks will poke through other spectra.
- The three major peaks in the fingerprint also tend to make themselves known in the same way, though this area has much more competition from other substances.

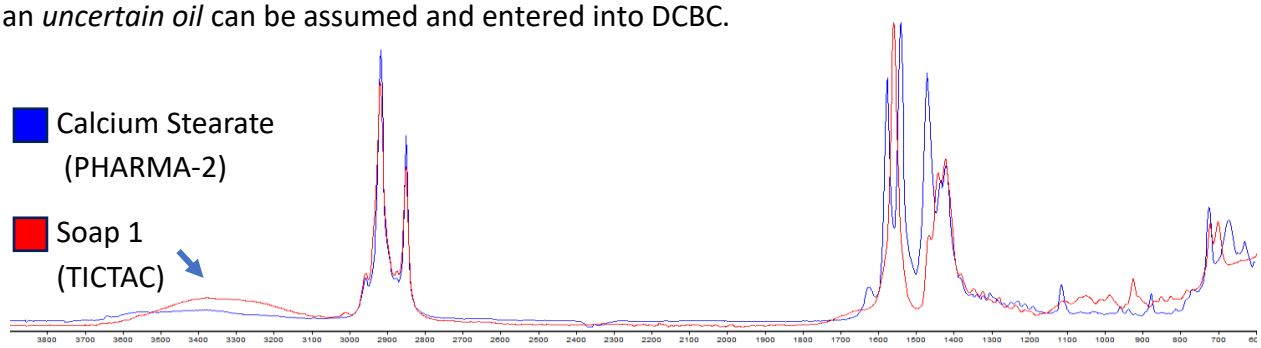
Spectral Feature Comparison for Calcium Stearate



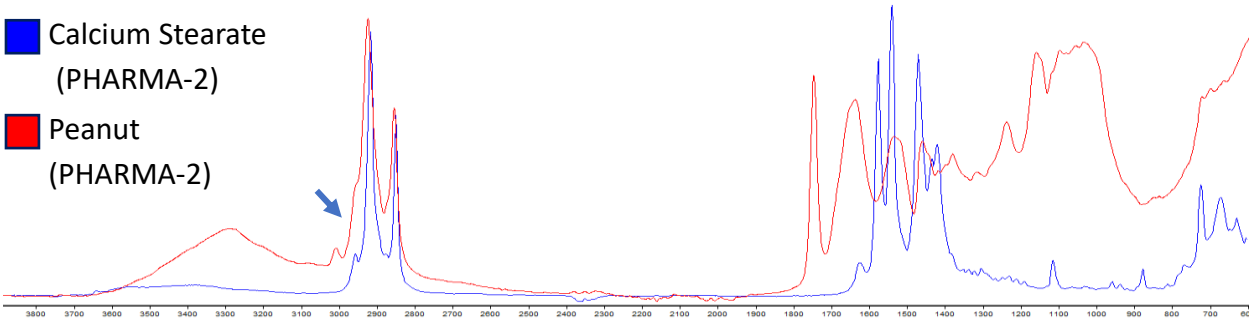
Stearic Acid should be searched for if a tall peak at ~1700^{-1} is visible alongside the "Bunny Ears"



Mineral oils have simpler spectra than soaps. When no clear peaks are visible in the fingerprint, an *uncertain oil* can be assumed and entered into DCBC.



Calcium stearate is a soap, therefore it matches well with generic soap entries.



Lastly, know that matches for peanuts or other nuts should not be taken at face value. A genuine nut on the FTIR is probably a prank being played on you by other drug checkers.

Additional Resources

Organization	Information	Link
BC Center on Substance Use	Drug checking information, data, and research	https://drugcheckingbc.ca/
Bluelight	Forums on drug use experiences and harm reduction	https://bluelight.org/
Canberra Alliance for Harm Minimization & Advocacy	Drug information	https://www.cahma.org.au/article/
Substance Drug Checking	Drug checking resources	https://substance.uvic.ca/#resources
Dancesafe	Drug information	https://dancesafe.org/drug-information
DRED Project	Drug resources, education, and harm reduction	https://dredproject.ca/
Erowid	Psychoactive substance information, experiences and research	https://www.erowid.org/
National Institute on Drug Abuse	Commonly used drugs	https://nida.nih.gov/research-topics/commonly-used-drugs-charts
PsychCombo	Combination chart for substances	https://psychcombo.com/combos/
Psychonautwiki	Psychoactive substance information, experiences	https://psychonautwiki.org/wiki/Main_Page
Toronto's Drug Checking Service	Drug information	https://drugchecking.community/drug-dictionary/
Tripsit	Psychoactive substance information, experiences	https://wiki.tripsit.me/wiki/Main_Page

References

1. Volpe DA, Tobin GAM, Mellon RD, et al. Uniform assessment and ranking of opioid Mu receptor binding constants for selected opioid drugs. *Regul Toxicol Pharmacol.* 2011;59(3):385-390. doi:10.1016/j.yrtph.2010.12.007
2. Higashikawa Y, Suzuki S. Studies on 1-(2-phenethyl)-4-(N-propionylanilino)piperidine (fentanyl) and its related compounds. VI. Structure-Analgesic activity relationship for fentanyl, methyl-substituted fentanyls and other Analogues. *Forensic Toxicol.* 2008;26(1):1-5. doi:10.1007/s11419-007-0039-1
3. National Institute on Drug Abuse. (2021, June). *Fentanyl Drug Facts*. *National Institutes of Health; U.S. Department of Health and Human Services. https://nida.nih.gov/publications/drugfacts/fentanyl#ref*
4. Fentanyl: Drug Information. In: UpToDate, Connor RF (Ed), Wolters Kluwer. (Accessed on March 10, 2025.)
5. Gundersen POM, Åstrand A, Gréen H, Josefsson M, Spigset O, Vikingsson S. Metabolite Profiling of Ortho-, Meta- and Para-Fluorofentanyl by Hepatocytes and High-Resolution Mass Spectrometry. J Anal Toxicol. 2020 Mar 7;44(2):140-148. doi: 10.1093/jat/bkz081. PMID: 31788682; PMCID: PMC7238673.
6. Toronto's Drug Checking Community. *Drug Dictionary*. (Accessed on March 10, 2025) https://drugchecking.community/drug-dictionary/
7. Hassanien et al. (2020) In vitro pharmacology of fentanyl analogs at the human mu opioid receptor and their spectroscopic analysis
8. Armenian P, Vo KT, Barr-Walker J, Lynch KL, 2018. Fentanyl, fentanyl analogs and novel synthetic opioids: A comprehensive review. Neuropharmacology 134, 121–132.
9. COMPARATIVE ANALGESIC POTENCY OF HEROIN AND MORPHINE IN POSTOPERATIVE PATIENTS Reichle, Claus W. et al. The Journal of Pharmacology and Experimental Therapeutics, Volume 136, Issue 1, 43 - 46
10. Ciccarone D, Ondocsin J, Mars SG. Heroin uncertainties: Exploring users' perceptions of fentanyl-adulterated and -substituted 'heroin'. Int J Drug Policy. 2017 Aug;46:146-155. doi: 10.1016/j.drugpo.2017.06.004. Epub 2017 Jul 18. PMID: 28735775; PMCID: PMC5577861.
11. Ministry of Health, Ministry of Mental Health Addictions. Health system response to the death review panel. Victoria (BC): BC Government; 2022, Sep 29 [cited 2025 Mar 10]. Available from: https://www2.gov. bc.ca/assets/gov/birth-adoption-deathmarriage-and-divorce/deaths/coronersservice/death-review-panel/moh_mmha_ response_2022drp.pdf.
12. Diacetylmorphine (diamorphine): Drug Information. In: UpToDate, Connor RF (Ed), Wolters Kluwer. (Accessed on March 10, 2025.)
13. Hans-Gert Bernstein, Kurt Trübner, Philipp Krebs, Henrik Dobrowolny, Hendrik Bielau, Johann Steiner, Bernhard Bogerts, Increased densities of nitric oxide synthase expressing neurons in the temporal cortex and the hypothalamic paraventricular nucleus of polytoxicomanic heroin overdose victims: Possible implications for heroin Neurotoxicity, Acta Histochemica, Volume 116, Issue 1, 2014, Pages 182-190, ISSN 0065-1281
14. WHO Guidelines for the Pharmacological and Radiotherapeutic Management of Cancer Pain in Adults and Adolescents. Geneva: World Health Organization; 2018. Table A6.2, Approximate potency of opioids relative to morphine; PO and immediate-release formulations unless stated otherwisea. Available from: https://www.ncbi.nlm.nih.gov/books/NBK537482/table/appannex6.tab2/
15. Nguyen, H. V., Mital, S., Bugden, S., & McGinty, E. E. (2024). British Columbia's Safer Opioid Supply Policy and Opioid Outcomes. JAMA internal medicine, 184(3), 256–264. https://doi.org/10.1001/jamainternmed.2023.7570
16. Hydromorphone: Drug Information. In: UpToDate, Connor RF (Ed), Wolters Kluwer. (Accessed on March 11, 2025.)
17. Oxycodone (Monograph): In: Drugs.com, American Society of Healthcare Professionals. (Accessed on March 11, 2025.)
18. UpToDate: Drug Interactions. In: UpToDate, Connor RF (Ed), Wolters Kluwer. (Accessed on March 14, 2025.)
19. Drug Interactions Report. In: Drugs.com American Society of Healthcare Professionals. (Accessed on March 14, 2025.)
20. Drug Combinations. In: Tripsit.me (Accessed March 14, 2025)
21. Dangerous Combinations. In: Psychonaut Wiki (Accessed March 14, 2025)
22. Psychoactive Combination Matrix. In: psychcombo.com (Accessed March 14, 2025)
23. Sandra D. Comer, Catherine M. Cahill, Fentanyl: Receptor pharmacology, abuse potential, and implications for treatment, Neuroscience & Biobehavioral Reviews, Volume 106, 2019, Pages 49-57, ISSN 0149-7634, https://doi.org/10.1016/j.neubiorev.2018.12.005.
24. Oelhaf RC, Azadfard M. Heroin Toxicity. [Updated 2023 May 8]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK430736/
25. Abi-Aad KR, Derian A. Hydromorphone. [Updated 2023 Aug 17]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470393/
26. Sadiq NM, Dice TJ, Mead T. Oxycodone. [Updated 2024 Feb 20]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK482226/
27. Manchester KR, Lomas EC, Waters L, Dempsey FC, Maskell PD (January 2018). "The emergence of new psychoactive substance (NPS) benzodiazepines: A review". *Drug Testing and Analysis*. **10** (1): 37–53. doi:10.1002/dta.2211. PMID 28471096.

28. Clayton T, Poe MM, Rallapalli S, Biawat P, Savić MM, Rowlett JK, et al. (2015). "A Review of the Updated Pharmacophore for the Alpha 5 GABA(A) Benzodiazepine Receptor Model". *International Journal of Medicinal Chemistry*. **2015**: 430248. doi:10.1155/2015/430248. PMC 4657098. PMID 26682068.
29. 2023. Critical Review Report: Bromazolam. World Health Organization Expert Committee on Drug Dependence. https://cdn.who.int/media/docs/default-source/46th-ecdd/bromazolam_46th-ecdd-critical-review_public-version.pdf?sfvrsn=4f1bccfa_1
30. Tan, K. R., Rudolph, U., & Lüscher, C. (2011). Hooked on benzodiazepines: GABAA receptor subtypes and addiction. *Trends in neurosciences*, *34*(4), 188–197. https://doi.org/10.1016/j.tins.2011.01.004
31. NIDA. 2024, September 18. Xylazine. Retrieved from https://nida.nih.gov/research-topics/xylazine on 2025, March 16
32. Greene SA, Thurmon JC (December 1988). "Xylazine—a review of its pharmacology and use in veterinary medicine". *Journal of Veterinary Pharmacology and Therapeutics*. **11** (4): 295–313. doi:10.1111/j.1365-2885.1988.tb00189.x. PMID 3062194.
33. Hargrove, Veronica PhD; Molina, D. Kimberley MD. DesAlkylgidazepam. The American Journal of Forensic Medicine and Pathology 45(4):p 362-363, December 2024. | DOI: 10.1097/PAF.0000000000000992
34. US 3987052, Hester Jr JB, "6-Phenyl-4H-s-triazolo[4,3-a][1,4]benzodiazepines.", issued 19 October 1976, assigned to Pharmacia and Upjohn Co.
35. *Mandrioli R, Mercolini L, Raggi MA (October 2008). "Benzodiazepine metabolism: an analytical perspective". Current Drug Metabolism. **9** (8): 827–844. doi:10.2174/138920008786049258. PMID 18855614.*
36. Sanna E, Pau D, Tuveri F, Massa F, Maciocco E, Acquas C, et al. (February 1999). "Molecular and neurochemical evaluation of the effects of etizolam on GABAA receptors under normal and stress conditions". *Arzneimittel-Forschung*. **49** (2): 88–95. doi:10.1055/s-0031-1300366. PMID 10083975. S2CID 19732765.
37. Mayer G (May 2012). "The use of sodium oxybate to treat narcolepsy". *Expert Review of Neurotherapeutics*. **12** (5): 519–29. doi:10.1586/ern.12.42. PMID 22550980. S2CID 43706704.
38. Schep LJ, Knudsen K, Slaughter RJ, Vale JA, Mégarbane B (July 2012). "The clinical toxicology of γ-Hydroxybutyrate, γ-butyrolactone and 1,4-butanediol". *Clinical Toxicology*. **50** (6): 458–70. doi:10.3109/15563650.2012.702218. PMID 22746383. S2CID 19697449.
39. Kapoor, P., Deshmukh, R., & Kukreja, I. (2013). GHB acid: A rage or reprive. *Journal of advanced pharmaceutical technology & research*, *4*(4), 173–178. https://doi.org/10.4103/2231-4040.121410
40. *van Nieuwenhuijzen PS, McGregor IS (August 2009). "Sedative and hypothermic effects of gamma-*Hydroxy*butyrate (GHB) in rats alone and in combination with other drugs: assessment using biotelemetry". Drug and Alcohol Dependence. **103** (3): 137–147. doi:10.1016/j.drugalcdep.2009.03.004. PMID 19446408.*
41. Busardò FP, Gottardi M, Tini A, Minutillo A, Sirignano A, Marinelli E, Zaami S. Replacing GHB with GBL in Recreational Settings: A New Trend in Chemsex. Curr Drug Metab. 2018;19(13):1080-1085. doi: 10.2174/1389200219666180925090834. PMID: 30251602.
42. Carl J. Sullivan, US Patent 5106525, Apr. 21, 1992 https://patentimages.storage.googleapis.com/a7/67/ee/11f4f7f3422844/US5106525.pdf
43. Cocaine Intoxication Zimmerman, Janice L. Critical Care Clinics, Volume 28, Issue 4, 517 – 526
44. Experimental Treatments for Cocaine Toxicity: A Difficult Transition to the Bedside, Connors, Nicholas J. et al., The Journal of Pharmacology and Experimental Therapeutics, Volume 347, Issue 2, 251 – 257
45. TIMOTHY PLOWMAN, The identification of coca (*Erythroxylum* species): 1860–1910, *Botanical Journal of the Linnean Society*, Volume 84, Issue 4, June 1982, Pages 329–353, https://doi.org/10.1111/j.1095-8339.1982.tb00368.x
46. *Nelson G (1998). Hip Hop America. Viking Penguin. p. 40.*
47. *Donroe JH, Tetrault JM (July 2017). "Substance Use, Intoxication, and Withdrawal in the Critical Care Setting". Critical Care Clinics (Review). **33** (3): 543–558. doi:10.1016/j.ccc.2017.03.003. PMID 28601134.*
48. *Rivera MA; Aufderheide AC; Cartmell LW; Torres CM; Langsjoen O (December 2005). "Antiquity of coca-leaf chewing in the south central Andes: a 3,000 year archaeological record of coca-leaf chewing from northern Chile". Journal of Psychoactive Drugs. **37** (4): 455–458. doi:10.1080/02791072.2005.10399820. PMID 16480174. S2CID 28661721.*
49. *Mégarbane, B; Chevillard, L (5 December 2013). "The large spectrum of pulmonary complications following illicit drug use: features and mechanisms". Chemico-Biological Interactions. **206** (3): 444–51. Bibcode:2013CBI...206..444M. doi:10.1016/j.cbi.2013.10.011. PMID 24144776.*
50. *Sterling, Eric. "Drug Laws and Snitching: A Primer". PBS. Retrieved 20 May 2013.*
51. Moszczynska A, Callan SP (September 2017). "Molecular, Behavioral, and Physiological Consequences of Methamphetamine Neurotoxicity: Implications for Treatment". *The Journal of Pharmacology and Experimental Therapeutics*. **362** (3): 474–488. doi:10.1124/jpet.116.238501. PMC 11047030. PMID 28630283
52. "Desoxyn- methamphetamine hydrochloride tablet". *DailyMed*. 8 September 2022.
53. Hussain F, Frare RW, Py Berrios KL (2012). "Drug abuse identification and pain management in dental patients: a case study and literature review". *Gen. Dent*. **60** (4): 334–345. PMID 22782046.
54. Yu S, Zhu L, Shen Q, Bai X, Di X (March 2015). "Recent advances in methamphetamine Neurotoxicity mechanisms and its molecular pathophysiology". *Behavioural Neurology*. **2015** (103969): 1–11. doi:10.1155/2015/103969. PMC 4377385. PMID 25861156.

55. Dunlap LE, Andrews AM, Olson DE (October 2018). "Dark Classics in Chemical Neuroscience: 3,4-Methylenedioxymethamphetamine" (PDF). *ACS Chem Neurosci*. **9** (10): 2408–2427. doi:10.1021/acschemneuro.8b00155. PMC 6197894. PMID 30001118.
56. Mitchell JM, Bogenschutz M, Lilienstein A, Harrison C, Kleiman S, Parker-Guilbert K, et al. (July 2023). "MDMA-Assisted Therapy for Severe PTSD: A Randomized, Double-Blind, Placebo-Controlled Phase 3 Study". *Focus*. **21** (3): 315–328. doi:10.1176/appi.focus.23021011. PMC 10316215. PMID 37404971.
57. *"DrugFacts: MDMA (Ecstasy/Molly)". National Institute on Drug Abuse. February 2016.*
58. *Crean RD, Davis SA, Von Huben SN, Lay CC, Katner SN, Taffe MA (October 2006). "Effects of (+/-)3,4-methylenedioxymethamphetamine, (+/-)3,4-methylenedioxyamphetamine and methamphetamine on temperature and activity in rhesus macaques". Neuroscience. **142** (2): 515–525. doi:10.1016/j.neuroscience.2006.06.033. PMC 1853374. PMID 16876329.*
59. Diaz J (1996). *How Drugs Influence Behavior*. Englewood Cliffs: Prentice Hall.
60. Rothman RB, Baumann MH (2006). "Therapeutic potential of monoamine transporter substrates". *Current Topics in Medicinal Chemistry*. **6** (17): 1845–1859. doi:10.2174/156802606778249766. PMID 17017961.
61. Monte AP, Marona-Lewicka D, Cozzi NV, Nichols DE (November 1993). "Synthesis and pharmacological examination of benzofuran, indan, and tetralin Analogues of 3,4-(methylenedioxy)amphetamine". *Journal of Medicinal Chemistry*. **36** (23): 3700–3706. doi:10.1021/jm00075a027. PMID 8246240.
62. Baggott MJ, Garrison KJ, Coyle JR, Galloway GP, Barnes AJ, Huestis MA, Mendelson JE (15 March 2019). "Effects of the Psychedelic Amphetamine MDA (3,4-Methylenedioxyamphetamine) in Healthy Volunteers". *Journal of Psychoactive Drugs*. **51** (2): 108–117. doi:10.1080/02791072.2019.1593560. PMID 30967099. S2CID 106410946.
63. Sachdeva B, Sachdeva P, Ghosh S, Ahmad F, Sinha JK (March 2023). "Ketamine as a therapeutic agent in major depressive disorder and posttraumatic stress disorder: Potential medicinal and deleterious effects". *Ibrain*. **9** (1): 90–101. doi:10.1002/ibra.12094. ISSN 2769-2795. PMC 10528797. PMID 37786516. S2CID 257117630.
64. Zanos P, Moaddel R, Morris PJ, Riggs LM, Highland JN, Georgiou P, et al. (July 2018). "Ketamine and Ketamine Metabolite Pharmacology: Insights into Therapeutic Mechanisms". *Pharmacol Rev*. **70** (3): 621–660. doi:10.1124/pr.117.015198. PMC 6020109. PMID 29945898.
65. Clinical Practice Guideline for Emergency Department Ketamine Dissociative Sedation: 2011 Update, Green, Steven M. et al. Annals of Emergency Medicine, Volume 57, Issue 5, 449 – 461
66. Acevedo-Diaz EE, Cavanaugh GW, Greenstein D, Kraus C, Kadriu B, Zarate CA, et al. (February 2020). "Comprehensive assessment of side effects associated with a single dose of ketamine in treatment-resistant depression". *J Affect Disord*. **263**: 568–575. doi:10.1016/j.jad.2019.11.028. PMC 8457026. PMID 31791675.
67. Hashimoto K (October 2019). "Rapid-acting antidepressant ketamine, its Metabolites and other candidates: A historical overview and future perspective". *Psychiatry and Clinical Neurosciences*. **73** (10): 613–627. doi:10.1111/pcn.12902. PMC 6851782. PMID 31215725.
68. *Smith HS (2010). "Ketamine-induced urologic insult (KIUI)". Pain Physician. **13** (6): E343–6. doi:10.36076/ppj.2010/13/E343. PMID 21102971.*
69. Joseph P, Binu R, Sebastian T, Fahmy H (11 December 2017). "Multiorgan Dysfunction Related to Chronic Ketamine Abuse". *Baylor University Medical Center Proceedings*. **27** (3): 223–225. doi:10.1080/08998280.2014.11929117. PMC 4059572. PMID 24982568.
70. González D, Torrens M, Farré M (2015-10-12). "Acute Effects of the Novel Psychoactive Drug 2C-B on Emotions". *BioMed Research International*. **2015**: 643878. doi:10.1155/2015/643878. PMC 4620274. PMID 26543863.
71. Carmo H, Hengstler JG, de Boer D, Ringel M, Remião F, Carvalho F, et al. (January 2005). "Metabolic pathways of 4-bromo-2,5-dimethoxyphenethylamine (2C-B): analysis of phase I metabolism with hepatocytes of six species including human". *Toxicology*. **206** (1): 75–89. Bibcode:2005Toxgy.206...75C. doi:10.1016/j.tox.2004.07.004. PMID 15590110.
72. Mallaroni P, Mason NL, Reckweg JT, Paci R, Ritscher S, Toennes SW, et al. (August 2023). "Assessment of the Acute Effects of 2C-B vs. Psilocybin on Subjective Experience, Mood, and Cognition". *Clin Pharmacol Ther*. **114** (2): 423–433. doi:10.1002/cpt.2958. PMID 37253161.
73. "Erowid 2C-B Vault : FAQ v1.0". *erowid.org*.
74. Antoine Marcheterre, "2024 BC Interior Festival Drug Checking" Interior Health/ANKORS/BCCSU. https://drugchecking.ca/wp-content/uploads/2025/01/2024-Festival-Drug-Checking-Infographic-26x98_WEB.pdf
75. Luethi D, Kolaczynska KE, Docci L, Krähenbühl S, Hoener MC, Liechti ME (May 2018). "Pharmacological profile of mephedrone analogs and related new psychoactive substances" (PDF). *Neuropharmacology*. **134** (Pt A): 4–12. doi:10.1016/j.neuropharm.2017.07.026. PMID 28755886. S2CID 28786127.
76. Ramaekers JG, Reckweg JT, Mason NL, Kuypers KP, Toennes SW, Theunissen EL (December 2024). "Safety and cognitive pharmacodynamics following dose escalations with 3-methylmethcathinone (3-MMC): a first in human, designer drug study". *Neuropsychopharmacology*. doi:10.1038/s41386-024-02042-7. PMID 39719487.

77. Moya PR, Berg KA, Gutiérrez-Hernandez MA, Sáez-Briones P, Reyes-Parada M, Cassels BK, et al. (June 2007). "Functional selectivity of hallucinogenic phenethylamine and phenylisopropylamine derivatives at human 5-HydroxyTryptamine (5-HT)2A and 5-HT2C receptors". *The Journal of Pharmacology and Experimental Therapeutics*. **321** (3): 1054–61. CiteSeerX 10.1.1.690.3752. doi:10.1124/jpet.106.117507. PMID 17337633. S2CID 11651502.
78. *Luethi D, Kolaczynska KE, Docci L, Krähenbühl S, Hoener MC, Liechti ME (May 2018). "Pharmacological profile of mephedrone analogs and related new psychoactive substances" (PDF). Neuropharmacology. **134** (Pt A): 4–12. doi:10.1016/j.neuropharm.2017.07.026. PMID 28755886. S2CID 28786127.*
79. McKenna DJ, Towers GH, Abbott F (April 1984). "Monoamine oxidase inhibitors in South American hallucinogenic plants: Tryptamine and beta-carboline constituents of ayahuasca". *Journal of Ethnopharmacology*. **10** (2): 195–223. doi:10.1016/0378-8741(84)90003-5. PMID 6587171.
80. *Strassman RJ (2001). DMT: The Spirit Molecule. A Doctor's Revolutionary Research into the Biology of Near-Death and Mystical Experiences. Rochester, VT: Park Street. ISBN 978-0-89281-927-0.*
81. Jonathan H, Jaime H, Serdar D, and Glen B (2019). "Ayahuasca: Psychological and Physiologic Effects, Pharmacology and Potential Uses in Addiction and Mental Illness". *Current Neuropharmacology*. **17** (2): 1–15. doi:10.2174/1570159X16666180125095902. ISSN 1875-6190. PMC 6343205. PMID 29366418. Archived from the original on 2023-05-05. Retrieved 2023-05-05.
82. *"Tadalafil Monograph for Professionals". Drugs.com. American Society of Health-System Pharmacists.*
83. Institute of Medicine (US) Panel on Dietary Antioxidants Related Compounds (2000). "Vitamin C". *Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium, and Carotenoids*. Washington, DC: The National Academies Press. pp. 95–185. doi:10.17226/9810. ISBN 978-0-309-06935-9. PMID 25077263.
84. Prescott LF (March 2000). "Paracetamol: past, present, and future". *American Journal of Therapeutics*. **7** (2): 143–147. doi:10.1097/00045391-200007020-00011. PMID 11319582. S2CID 7754908.
85. McKinney CD, Postiglione KF, Herold DA. Benzocaine-adultered street cocaine in association with methemoglobinemia. Clin Chem. 1992 Apr;38(4):596-7. PMID: 1568334.
86. Benzocaine: Drug Information. In: UpToDate, Connor RF (Ed), Wolters Kluwer. (Accessed on March 20, 2025.)
87. Vitamin C: Drug Information. In: UpToDate, Connor RF (Ed), Wolters Kluwer. (Accessed on March 20, 2025.)
88. Caffeine: Drug Information. In: UpToDate, Connor RF (Ed), Wolters Kluwer. (Accessed on March 20, 2025.)
89. Nehlig A, Daval JL, Debry G (1992). "Caffeine and the central nervous system: mechanisms of action, biochemical, metabolic and psychostimulant effects". *Brain Research. Brain Research Reviews*. **17** (2): 139–170. doi:10.1016/0165-0173(92)90012-B. PMID 1356551. S2CID 14277779.
90. Ribeiro JA, Sebastião AM (2010). "Caffeine and adenosine". *Journal of Alzheimer's Disease*. **20** (Suppl 1): S3-15. doi:10.3233/JAD-2010-1379. PMID 20164566.
91. Ialongo, D.; Tudino, V.; Arpacioglu, M.; Messore, A.; Patacchini, E.; Costi, R.; Di Santo, R.; Madia, V.N. Synergistic Effects of Caffeine in Combination with Conventional Drugs: Perspectives of a Drug That Never Ages. *Pharmaceuticals* **2023**, *16*, 730. https://doi.org/10.3390/ph16050730
92. Mannitol (systemic): Drug Information. In: UpToDate, Connor RF (Ed), Wolters Kluwer. (Accessed on March 20, 2025.)
93. Singh R, Patel P, Al Khalili Y. Benzocaine. 2024 Mar 20. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan–. PMID: 31082097.
94. *Scientific Panel on Food Additives and Nutrient Sources Added to Food, European Food Safety Authority (2015). "Scientific Opinion on the safety of the proposed extension of use of erythritol (E 968) as a food additive". EFSA Journal. **13** (3): 4033. doi:10.2903/j.efsa.2015.4033. ISSN 1831-4732. PMC 11883093.,*
95. Kawanabe J, Hirasawa M, Takeuchi T, Oda T, Ikeda T (1992). "Noncariogenicity of erythritol as a substrate". *Caries Research*. **26** (5): 358–362. doi:10.1159/000261468. PMID 1468100.
96. "Paws off xylitol; It's dangerous for dogs". US Food and Drug Administration. 7 July 2021. Retrieved 9 September 2021.
97. "Is xylitol good for your teeth?". Live well: Eat well. U.K. National Health Service. 13 April 2016. Retrieved 28 October 2018.
98. Xylitol: In: Drugs.com, American Society of Healthcare Professionals. (Accessed on March 20, 2025.)
99. Croze, M. L.; Soulage, C. O. (October 2013). "Potential role and therapeutic interests of *myo*-inositol in metabolic diseases". *Biochimie*. **95** (10): 1811–1827. doi:10.1016/j.biochi.2013.05.011. PMID 23764390.
100. Schaafsma, Gertjan (2008). "Lactose and lactose derivatives as bioactive ingredients in human nutrition" (PDF). *International Dairy Journal*. **18** (5): 458–465. doi:10.1016/j.idairyj.2007.11.013. ISSN 0958-6946. S2CID 10346203.

101. H.W Wisselink, R.A Weusthuis, G Eggink, J Hugenholtz, G.J Grobben, Mannitol production by lactic acid bacteria: a review, International Dairy Journal, Volume 12, Issues 2–3, 2002, Pages 151-161, ISSN 0958-6946, https://doi.org/10.1016/S0958-6946(01)00153-4.
102. Yunjie Li, Pingping Han, Juan Wang, Ting Shi, Chun You (2021): "Production of myo-inositol: Recent advance and prospective". *Biotechnology and Applied Biochemistry*, volume 69, issue 3, pages 1101-1111. doi:10.1002/bab.2181
103. "Cancer chemical in street cocaine". BBC News. 23 November 2006.
104. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Pharmaceuticals. Lyon (FR): International Agency for Research on Cancer; 2012. (IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, No. 100A.) PHENACETIN. Available from: https://www.ncbi.nlm.nih.gov/books/NBK304337/
105. Keiser J, Utzinger J (April 2008). "Efficacy of current drugs against soil-transmitted helminth infections: systematic review and meta-analysis". *JAMA*. **299** (16): 1937–48. doi:10.1001/jama.299.16.1937. PMID 18430913.
106. *Centers for Disease Control Prevention (CDC) (December 2009). "Agranulocytosis associated with cocaine use - four States, March 2008-November 2009". MMWR. Morbidity and Mortality Weekly Report. **58** (49): 1381–5. PMID 20019655.*
107. Lang KL (17 June 2001). "Methylsulfonylmethane (MSM)". *Quackwatch*.
108. *"Information Bulletin: Crystal Methamphetamine". www.justice.gov.*
109. *Engelhardt M, Neumann G, Berbalk A, Reuter I (July 1998). "Creatine supplementation in endurance sports". Medicine and Science in Sports and Exercise. **30** (7): 1123–9. doi:10.1097/00005768-199807000-00016. PMID 9662683.*
110. *Barcelos RP, Stefanello ST, Mauriz JL, Gonzalez-Gallego J, Soares FA (2016). "Creatine and the Liver: Metabolism and Possible Interactions". Mini Reviews in Medicinal Chemistry. **16** (1): 12–8. doi:10.2174/1389557515666150722102613. PMID 26202197.*
111. Sheftel VO (2000). *Indirect Food Additives and Polymers: Migration and Toxicology*. CRC. pp. 1114–1116
112. Corbridge, D. E. C. (1995). "Phosphates". *Phosphorus - an Outline of its Chemistry, Biochemistry and Uses*. Studies in Inorganic Chemistry. Vol. 20. pp. 169–305. doi:10.1016/B978-0-444-89307-9.50008-8. ISBN 9780444893079.
113. Hindi, S. S. Z. 2016. Microcrystalline cellulose: Its specifications and pharmaceutical processing. Biocrystals Journal. 1 (1): 26-38". *BioCrystals*.
114. Nora A, Szczepanek A, Koenen G (2001). "Metallic Soaps". *Ullmann's Encyclopedia of Industrial Chemistry*. doi:10.1002/14356007.a16_361. ISBN 3527306730.
115. Noviasky JA, Masood A, Lo V. Tadalafil (Cialis) for erectile dysfunction. Am Fam Physician. 2004 Jul 15;70(2):359-60. PMID: 15291094.
116. Friedman, J., Montero, F., Bourgois, P., Wahbi, R., Dye, D., Goodman-Meza, D., & Shover, C. (2022). Xylazine spreads across the US: A growing component of the increasingly synthetic and polysubstance overdose crisis. Drug and alcohol dependence, 233, 109380.
117. 2C-B In: Dancesafe.org (Accessed March 27, 2025)
118. GHB: In: Dancesafe.org (Accessed March 27, 2025)
119. Heroin: In: nida.nha.org (Accessed March 27, 2025) https://nida.nih.gov/research-topics/commonly-used-drugs-charts#Heroin
120. Benzos: In: nida.nha.org (Accessed March 27, 2025) https://nida.nih.gov/research-topics/commonly-used-drugs-charts#CentralNervousSystemDepressantsBenzos
121. GHB: In: nida.nha.org (Accessed March 27, 2025) https://nida.nih.gov/research-topics/commonly-used-drugs-charts#GammahydroxybutyrateGHB
122. Cocaine/Crack: In: nida.nha.org (Accessed March 27, 2025) https://nida.nih.gov/research-topics/commonly-used-drugs-charts#CocaineCokeCrack
123. Dangerous Drug Combos. In: Bluelight.org (Accessed March 27, 2025) https://www.bluelight.org/community/threads/%E2%AB%B8dangerous-drug-combos%E2%AB%B7.795784/
124. MDMA Essential Guide Drug Combinations. IN Bluelight.org (Accessed March 27, 2025) https://www.bluelight.org/community/threads/mdma-essential-guide-v1-00.79027/#post-912520
125. Psychedelic Safety Guidance. In: Bluelight.org (Accessed March 27, 2025)
126. 2C-B. In: psychonautwiki.org (Accessed March 27)
127. [Deleted]
128. Shapiro A, Sim D, Wu H, Mogg M, Tobias S, Patel P, Ti L. Detection of etizolam, flualprazolam, and flubromazolam by benzodiazepine-specific lateral flow immunoassay test strips. BC Centre on Substance Use Drug Checking Benzodiazepine test strip report. July 2020. 1-13.
129. BCCDC Harm Reduction Services (2021) *Levamisole*. BCCDC. https://towardtheheart.com/assets/uploads/1630094468KtSwWL7fFWUsjtJE8r0zwrdJUdBsKPupThpBUQh.pdf
130. DILAUDID® ORAL LIQUID and DILAUDID® TABLETS (hydromorphone hydrochloride). In: FDA.gov (accessed April 08, 2025) https://www.accessdata.fda.gov/drugsatfda_docs/label/2007/019892s015lbl.pdf
131. Don't Overuse Acetaminophen. In: FDA.gov (accessed April 08, 2025) https://www.fda.gov/consumers/consumer-updates/dont-overuse-acetaminophen

132. Solomon, N., & Hayes, J. (2017). Levamisole: A High Performance Cutting Agent. *Academic forensic pathology*, *7*(3), 469–476. https://doi.org/10.23907/2017.039
133. Inositol. In: healthline.com (accessed April 08, 2025) https://www.healthline.com/nutrition/inositol
134. An Update on Xylazine in the Unregulated Drug Supply: Harms and Public Health Responses in Canada and the United States In: ccsa.ca. July 2023. https://www.ccsa.ca/sites/default/files/2023-07/CCENDU-bulletin-update-on-Xylazine-in-the-unregulated-drug-supply-en.pdf
135. Heroin drug profile. In: European Union Drugs Agency. (Accessed April 28, 2025) https://www.euda.europa.eu/publications/drug-profiles/heroin_en
136. HYDROmorphone Hydrochloride Product Monograph. PHARMASCIENCE INC. May 2024. https://pdf.hres.ca/dpd_pm/00075571.PDF
137. Prescription Drug Atlas. BC Ministry of Health. June 2024. https://www2.gov.bc.ca/assets/gov/health/conducting-health-research/bc_prescription_drug_atlas_-_opioids_and_bzras_-_2024.pdf
138. Ruben F. Kranenburg, Henk-Jan Ramaker, Yannick Weesepoel, Peter W.F. Arisz, Peter H.J. Keizers, Annette van Esch, Cathelijne Zieltjens – van Uxem, Jorrit D.J. van den Berg, Janneke W. Hulshof, Sjors Bakels, Anouk M. Rijs, Arian C. van Asten, The influence of water of crystallization in NIR-based MDMA·HCl detection, Forensic Chemistry, Volume 32, 2023, 100464, ISSN 2468-1709, https://doi.org/10.1016/j.forc.2022.100464.