



Clinical Toxicology: Hallucinogens

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Introduction



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What Can I Derive from this Course?



- Beginning of identification
 - Physical appearance of the drug
 - Street names
 - Associated paraphernalia
- Probable cause for warrants, arrests
- Understanding the impairment signs specific to the hallucinogen
- Safety risks to subject, medical professionals and law enforcement

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Clinical Toxicology – Definition

- Clinical toxicology involves the research, prevention and treatment of diseases caused by chemicals, drugs and toxins.
- Special attention is paid to levels of chemical exposure and to the effects that exposure can have on people.
- Clinical toxicology is especially useful when dealing with people who are poisoned or who have overdosed



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Clinical Toxicology – Pharmacology and Pharmacokinetics

- Pharmacology – what the drug does to the body
- Pharmacokinetics – what the body does to the drug



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Pharmacokinetics

- L – Liberation
- A – Absorption
- D – Distribution
- M – Metabolism
- E - Excretion



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Resources



Medical / Legal Sources

- DEA.gov
- UNODC (United Nations Office of Drug Control)
- EMCDDA (European Monitoring Center for Drugs and Drug Abuse)
- State Law Enforcement Agencies (e.g. FDLE)
- National Institute on Drug Abuse (NIDA)



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Resources



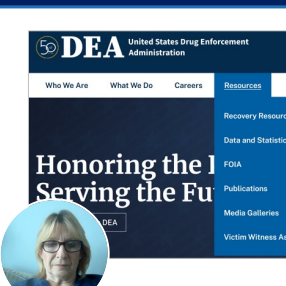
Non Medical / Legal Sources

- Erowid.com
- Bluelight.com
- Reddit.com
- Opiophile.com



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Drug Enforcement Agency (DEA)



50th
1973 - 2023

DEA United States Drug Enforcement Administration

Get Updates | Scan Alert | English | Español

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Recovery Resources
Data and Statistics
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Source - UNODC

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Source - EMCDDA

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Florida Department of Law Enforcement

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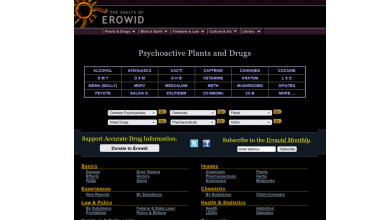
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Erowid



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The screenshot shows the Erowid website's 'Psychoactive Plants and Drugs' section. At the top, there's a navigation bar with links like 'Home', 'About Erowid', 'Privacy Policy', 'Terms of Use', 'Contact Us', and 'Help'. Below this is a title 'Psychoactive Plants and Drugs'. A table lists various substances with columns for Name, Plant/Animal, Class, Category, Subcategory, and Date. Below the table are several filters and search options, including 'Filter by', 'Sort by', and 'Search'. There are also links for 'Support Accurate Drug Information' and 'Subscribe to the Erowid Monthly'. The page is divided into sections for 'Herbs', 'Mushrooms', 'Chemicals', 'Liquors & Beverages', 'Fruits', 'Seeds & Spores', 'Synthetic & Cultured', 'Nutrition & Food', 'Cannabis', 'Herbs', 'Mushrooms', 'Chemicals', 'Liquors & Beverages', 'Fruits', 'Seeds & Spores', 'Synthetic & Cultured', 'Nutrition & Food', 'Cannabis', 'Herbs', 'Mushrooms', 'Chemicals', 'Liquors & Beverages', 'Fruits', 'Seeds & Spores', 'Synthetic & Cultured', 'Nutrition & Food', 'Cannabis'.

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Hallucinogens – Goals and Objectives

- Identify nine commonly abused hallucinogens
- Review the physical appearance and street names of the drugs for identification, probable cause purposes
- Review the chemistry associated with each drug
- Define the naturally versus synthetic entities and the means of preparation which may be of value in search warrants, physical safety of law enforcement/healthcare
- Identify modes of administration including dosage and duration
- Discuss physical and psychological manifestations that may present to law enforcement and/or healthcare



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Hallucinogens – General Characteristics

- Mood and perception are elevated
- Minimal impairment to intellect and memory
- Minimal side effects to autonomic nervous system
- Rarely results in fatalities
- Not physically addictive
- May be difficult to identify in drug screens



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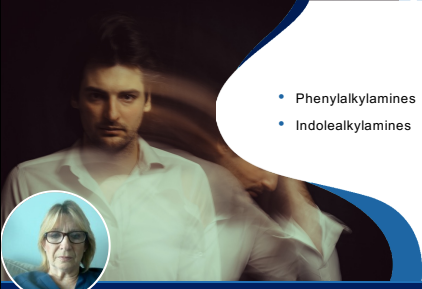

Hallucinogens – General Chemistry

- Binds to 5-HT2 receptors - (5-hydroxytryptamine / serotonin)
- Located in the central and peripheral nervous systems
- Activated by the serotonin neurotransmitter
- Serotonin receptors modulate other neurotransmitters:
 - GABA
 - Dopamine
 - Epinephrine / Norepinephrine
 - Acetylcholine
 - Glutamate



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Classifications – Serotonin Hallucinogens



• Phenylalkylamines
• Indolealkylamines

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Classifications - Phenylalkylamines



• Psychoactive and stimulant effects (e.g. amphetamine, methamphetamine, MDMA)
• Include ring substitutions (e.g. 2C series, D series)
• Seizures reported in the US and Europe since 2009
• Additional phenethylamines have been reported to the UNODC since 2011 (e.g. 4-FMA, 5-APB, 6-APB, 2C-C-NBOMe)

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Classifications - Phenylalkylamines



• Slight modification to mescaline led to a very powerful hallucinogenic – 4-bromo-2,5-dimethoxyphenethylamine (2C-B)
• Synthesized by Shulgin in 1974
• Psychoactive manifestations are reportedly dose dependent with greater stimulant effects at lower doses, greater hallucinogenic / entactogenic effects at higher doses
• Not all phenethylamines are listed as Schedules I and II in the 1971 United Nations Convention on Psychotropic Substances
• Some are under individual country control

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Classifications – Indolealkylamines (IAAs)

- 5-hydroxytryptamine (5-HT or serotonin) analogs
- Greatest affinity for the 5-HT_{2A} receptor
- Specific IAA's –
 - d-lysergic acid diethylamide (LSD)
 - d-lysergic acid amide/ergine (LSA)
 - psilocybin
 - bufotenine
 - 5-methoxy-N,N-dimethyltryptamine (5-MeO-DMT)
 - β-carbolines (e.g. harman, harmaline and harmine)
 - N,N-dimethyltryptamine (DMT)

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Classifications – Indolealkylamines (IAAs)

- Easily synthesized in clandestine labs
- Available via the internet
- Population at risk: teenagers, young adults
- 5-MeO-DMT touted as the successor to "ecstasy"
- Abuse well documented in the United States
- Overdose, poly-pharmacy with multiple IAAs may result in fatal hyperserotonergic toxicity - "serotonin syndrome"
- Serotonin toxicity significantly increased due to psychotropic agents

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Pharmacologic Effects

- Anxiety
- Appetite changes
- Aggression
- Memory
- Mood
- Thermoregulation
- Sleep cycles
- GI

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Pharmacologic Effects



Serotonin receptors are the target of both licit and illicit pharmacologic agents:

- Antidepressants/antipsychotics
- Antiemetics
- Hallucinogens
- Entactogens



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Hallucinogenics – Natural and Synthetic



- Ayahuasca
- Mescaline
- Nutmeg
- Psilocybin
- Salvia
- Angel's Trumpet
- 4-Bromo-2,5-Dimethoxyphenethylamine (2C-B)
- Lysergic acid diethylamide (LSD)
- 3,4-Methylenedioxymethamphetamine (MDMA - Ecstasy)



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Ayahuasca - General



- Psychotropic plant – native to South America
- Naturally occurring or synthesized
- Schedule I
- Intense effects
- Short duration desires as opposed to longer effect desirability like LSD



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Ayahuasca - Chemistry



- Primary psychoactive agent - N,N-Dimethyltryptamine (DMT)
- Oral bioavailability is very low unless combined with another agent that inhibits DMT metabolism.
- Plants contain harmala alkaloids (harmine, harmaline, tetrahydroharmaline) that inhibit MAO which metabolizes DMT

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Ayahuasca - Pharmacology



- Fully hallucinogenic - between 0.2 and 0.4 mg/kg.
- Onset – rapid
- Resolution – 30 to 45 minutes
- DMT is sustained long after the oral administration allowing absorption and the psychoactive effects

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Ayahuasca – Modes of Administration



- Oral
- Insufflated
- Inhaled
- Injected

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Ayahuasca – Physical Effects






- Hypertension
- Tachycardia
- Agitation
- Seizures
- Midriasis
- Nystagmus
- Dizziness
- Ataxia
- Coma
- Respiratory arrest

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Off-label indications/Uses






- Intense visual hallucinations
- Depersonalization
- Altered sense of time
- Distortion of body image
- Auditory distortion

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Mescaline – Physical Appearance






- One of the oldest known hallucinogens (5,700 yrs)
- Derived from the Peyote cactus plant (*Lophophora williamsii* or *Anhalonium lewinii*)
- Native to Southwest North America
- Dry, arid conditions
- Dried tops are known as Peyote buttons
- Schedule 1 drug

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Mescaline – Chemistry



- 3,4,5-trimethoxyphenethylamine
- Tryptamine derivative
- Indolealkylamine
- Affects the serotonergic 5-HT2A-C receptors



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Mescaline – Street Names



- Buttons
- Cactus
- Mesc
- Peyoto



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Mescaline - Preparation



- Mescaline is extracted from grinding the dried tops, the "crowns" of the cactus
- Soaked in methanol for 24 hours then filtered at which time solution is acidified
- Methanol evaporates and remaining solution is neutralized.
- Mescaline extracted with chloroform



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Mescaline – Methods of Administration




- Buttons are ingested either fresh or as dried buttons
- Can be chewed or rehydrated to make a hallucinogenic drink
- Dried buttons can be ground into a powder and placed into capsules for oral ingestion
- Powder can also be combined with other smokable products such as tobacco or cannabis

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Mescaline – Physical Effects (Sympathomimetic)




As a phenethylamine derivative, signs and symptoms are consistent with a sympathomimetic effect:

- Tachycardia
- Hypertension
- Hyperthermia
- Diaphoresis
- Midriasis

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Mescaline – Additional Physical & Psychological Effects




- Euphoria
- Hallucinations
- Psychosis
- Extreme nausea/vomiting
- Headache
- Muscle weakness
- Impaired motor coordination
- Agitation
- Anxiety
- Altered perception of time, spatial awareness, body

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Nutmeg - General

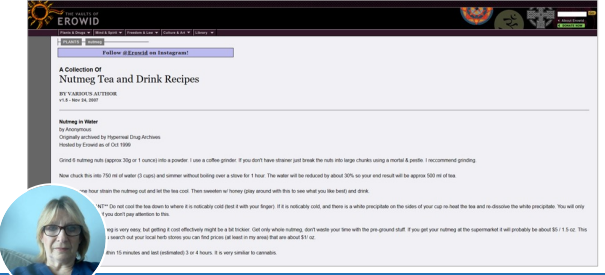


- Nutmeg (Myristica fragrans)
- Overdoses reported for 400 years
- Myristicin component (4-12%)
- Oral ingestion



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Nutmeg





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Nutmeg - Chemistry



- Metabolized into 3-methoxy-4,5 methylenedioxymphetamine (MMDA)
- Similar structure to 3,4 methylenedioxymphetamine (MDMA)
- Serotonin agonist
- Not an amphetamine but produces similar effects
- Anticholinergic syndrome



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Nutmeg – Physical Characteristics

- Hallucinations
- GI (nausea, vomiting, abdominal pain)
- Mydriasis versus miosis
- Dry mouth
- In severe cases:
 - Hemodynamic instability, tachycardia, seizures,
 - Flushing, anxiety



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Nutmeg – Duration

- Onset: 1-2 hours
- Duration: 1-7 hours after ingestion
- Resolution: 24-48 hours



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Nutmeg – Drug Testing

- Not detectable on routine drug screens



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Psilocybin – Appearance



- Long, slender stems topped by caps, dark gills on the underside
- Fresh - white or whitish-gray stems, caps dark brown around the edges, light brown / white in center
- Dried mushrooms - usually rusty brown with isolated areas of off-white

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Psilocybin



- Chemical obtained from certain types of fresh or dried mushrooms
- Psilocybin can be found in multiple species of mushrooms
- Endemic to Mexico, Central America, and the US
- Similar to mescaline in response
- Schedule I

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Psilocybin - Chemistry



- Upon ingestion, psilocybin is converted into psilocin - 4-hydroxy-dimethyltryptamine
- Psilocin is similar to serotonin structurally
- Binds to 5-HT2A receptors in the brain
- Attributed to psychotropic effects
- Amounts of psilocybin can vary
- Amount ingestion is not directly correlated to physical manifestations
- Effects may be affected by the setting in which the drug was used

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Psilocybin – Street Names




- Magic Mushrooms
- Mushrooms
- Shrooms



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Psilocybin – Methods of Administration



- Ingested orally – capsule or brewed as a tea
- Psilocybin-containing mushrooms can be eaten fresh, dried, or cooked (psilocybin is heat stable), brewed into a tea and drank, or dried, mixed with cannabis or tobacco, and then smoked.



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Psilocybin – Duration of Action




- Onset - 10 to 30 minutes
- Duration - 4 to 5 hours
- Resolution - 6 to 12 hours typically
- Possible persistence - hallucinations up to 4 days
- Flashbacks possible without additional ingestion from 2 weeks to 8 months post-exposure



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Psilocybin – Physical Effects






- Lethargy
- Loss of coordination
- Slurred speech
- Diaphoresis
- Hypertension
- Midriasis (> 90%)
- Tachycardias
- Euphoria
- Hallucinations
- Sensory distortion

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Psilocybin – Physical Effects






- "Bad trips"
- Panic attack
- Psychosis
- Paranoia
- Horizontal gaze nystagmus

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Psilocybin – Psychological Effects






- Confusion
- Inappropriate laughter
- Agitation
- Paranoia
- Hallucinations
- Euphoria
- Feeling of floating
- Changes in hearing and touch
- Psychological dependence

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Salvia Divinorum




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Salvia Divinorum – General Information




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- Perennial herb in the mint family abused for hallucinogenic effects
- Salvinorin A is the alleged psychoactive ingredient
- Endemic to Sierra Mazaleca region of Oaxaca, Mexico
- May be cultivated in multiple regions , outdoor and indoor. Prefer humid semitropical climates
- Salvia is not scheduled but may be controlled by states
- Spade-shaped variegated green leaves, hollow square stems, white flowers with purple calyces
- Grow to greater than 3 feet in height

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Salvia Divinorum - Street Names




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- Maria Pastora
- Sally-D
- Salvia

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Salvia Divinorum – Methods of Administration






- Inhaled – smoked or vaporized
- Oral (mastication)

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Salvia Divinorum – Physical Effects






- Loss of coordination
- Dizziness
- Slurred speech
- Perceptions of bright lights, vivid colors, shapes
- Heightened sense of body movement
- Body or object distortions

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Salvia Divinorum – Psychological Effects






- Anxiety
- Panic
- Uncontrollable laughter
- Sense of overlapping realities
- Hallucinations

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Angels Trumpets – General






- *Datura arborea*
- Anticholinergic
- Delirium
- Hallucinations

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Angel's Trumpet - Chemistry






- Tropane alkaloids (e.g. scopolamine, hyoscyamine, atropine)
- Post-synaptic competitive inhibition of cholinergic muscarinic receptors
- Symptoms noted 5–10 minutes after ingestion
- Mydriasis may last for days
- Higher doses - delirium, convulsions, flaccid paralysis
- Severe cases may be fatal
- Physostigmine, a cholinesterase inhibitor, may serve as antidote in conjunction with gastric lavage

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Angel's Trumpet – Anticholinergic Poisoning



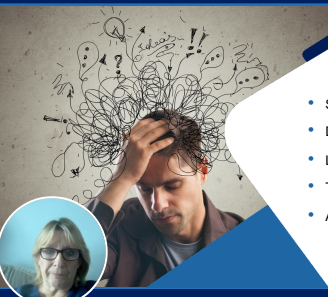



"Red as a beet, dry as a bone, blind as a bat, mad as a hatter, hot as a hare, full as a flask" ...

- Flushing
- Anhydrosis (inability to sweat), dry mucous membranes
- Mydriasis
- Altered mental status, hallucinations
- Hyperthermia
- Urinary retention

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Angel's Trumpet – Anticholinergic Poisoning






- Salivation / Dry mouth
- Diaphoresis
- Loss of accommodation
- Tachycardia
- Amnesia

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4-Bromo-2,5-Dimethoxyphenethylamine (2C-B) - General

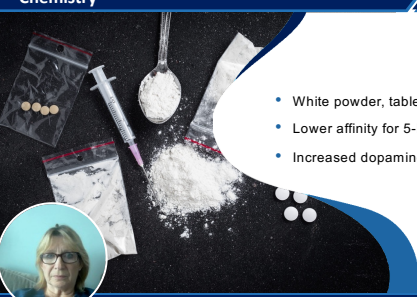





- First synthesized by [Alexander Shulgin](#) in 1974
- Originally sold as aphrodisiac – “Erox”, “Nexus”
- Substitute for MDMA when it became illegal

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4-Bromo-2,5-Dimethoxyphenethylamine (2C-B) - Chemistry






- White powder, tablets, gel caps
- Lower affinity for 5-HT2A
- Increased dopamine activity

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4-Bromo-2,5-Dimethoxyphenethylamine (2C-B) – Street Names



- 2C-B
- Nexus
- Bro
- Venus

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4-Bromo-2,5-Dimethoxyphenethylamine (2C-B) – Physical Effects



- Euphoria
- Seeing sounds
- Increase/decrease in overall sensorium
- Excessive laughter
- Hallucinations
 - Dose dependent
 - Wavelike
- Potential vasospasm
- Vasculitis
- Stroke

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Lysergic acid diethylamide (LSD) - General



- Produced in clandestine laboratories in the US
- First synthesized 1938, not until 1943 that the psychedelic properties were found
- Introduced as a commercial medication, Delysid, for various psychiatric uses in 1947
- Schedule I in 1966
- 2014 – research for treating anxiety

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LSD - Appearance





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LSD - Forms



- Tablets
- Capsules
- Liquid – odorless, colorless, slightly bitter taste
- Often added to absorbent paper, such as blotter paper, and divided into small decorated squares, with each square representing one dose.

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LSD – Street Names



- Acid
- Blotter Acid
- Dots
- Mellow Yellow
- Window Pane

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LSD – Physical Effects



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- Midriasis
- Hyperthermia
- Tachycardia
- Hypertension
- Diaphoresis
- Anorexia
- Insomnia
- Dry mouth
- Tremors

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LSD – Psychological Effects



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- Psychosis
- Hallucinogens - distorted perception of the shape and size of objects, movements, colors, sound, touch, and the user's own body image
- Acute anxiety
- Depression
- Flashbacks

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Synthetic LSD



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25I-NBOMe
4-iodo-2,5-dimethoxy-N-(2-methoxybenzyl)phenethylamine

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History of MDMA

- Developed in 1912 by Merck pharmaceuticals
- "Methylsafrylaminc" was originally intended as a parent compound for synthesis of anti-coagulants
- Used by psychiatrists in the late 1970s/80s for enhanced sessions though unapproved by the FDA
- Clandestine labs started development
- 1985 - classified it as Schedule I

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MDMA - Appearance

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MDMA – Forms

- Tablets
- Powder
- Liquid
- Pressed Capsules

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MDMA - Forms





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MDMA - Appearance





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MDMA - Disguised





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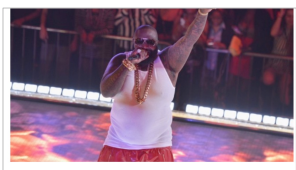
MDMA – Street Names




- Molly
- Adam / Eve
- Beans
- Clarity
- Disco
- Biscuit
- Go / STP
- Lover's Speed
- Peace
- X / XTC / MDMA / E
- Calvin Kleins / Euros
- Smurfs
- "The Hug Drug"

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MDMA – "Molly"




Rick Ross has raised considerable ire for a thoughtlessly offensive lyric he spit as a guest on *Rocky's Future* featuring "L.O.L.N.O." As noted by SPIN's Brandon Soderberg, the "horribly rape-y line" goes, "Put molly in her champagne, she ain't even know it / I took her home and I enjoyed that, she ain't even know it." Molly is the popular slang term for ecstasy, as outlined in SPIN's recent *Rolling in the Deep* timeline.

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MDMA - Pharmacology




- Increase net release of monoamine neurotransmitters (serotonin, norepinephrine, dopamine)
- Does not directly release serotonin, binds and blocks reuptake of the transporter involved
- Increased serotonin and dopamine responsible for the psychological effects of MDMA
- Increase in norepinephrine is responsible for physical effects (e.g. cardiovascular, mydriasis et al)

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Effect of Drugs on Neurotransmitters



Drug:	Serotonin	Dopamine	Norepinephrine	Acetylcholine
Ephedrine	-	-	++	-
Amphetamine	-	+	++	-
Methamphetamine	+	++	++	-
MDA	++	++	++	-
MDMA	++	+	++	-
MDEA	++	-	-	-
Ritalin	-	++	-	-
Prozac	++	-	-	-
Caffeine	-	-	++	-
Cocaine	+	++	++	-
Heroin	+	+	-	-
Diphenhydramine	-	-	-	++



(-) Little or no direct effect (+) Significantly affected (++) Strongly affected

<http://drugs.drugimpaired.com>

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MDMA - Pharmacokinetics





- Absorbed from the GI tract, peak concentration in plasma 2 hrs post oral administration
- Hepatic metabolism – much bound to tissue constituents
- As dose increases and higher-affinity enzymes are saturated, disproportionately large increases in blood/brain concentrations
- Elimination moderately slow - half-life is 8 hrs, 5 half-lives, 40 hrs to clear 95%.



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MDMA - Methods of Administration





- Oral (50-150 mg)
- Insufflated
- Inhaled
- Intravenous (rare)



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MDMA - Methods of Administration




- "Stacking" – taking 3 or more tablets simultaneously
- "Piggy-backing" – taking multiple tablets over a short period of time
- "Candy flipping" – taking MDMA and LSD together



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MDMA – Physical Effects




- Tachycardia
- Hypertension
- Hyperthermia
- Midriasis
- Rhabdomyolysis
- Bruxism
- Diaphoresis
- Dry mouth



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MDMA – Physical Effects

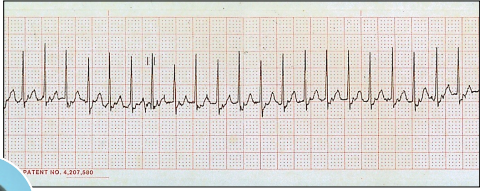



- Dehydration
- Electrolyte imbalance
- Hyperthermia
- Change in Mental Status
- Coughing
- Burns
- Pneumonitis



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MDMA - Tachycardia





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MDMA - Midriasis





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MDMA - Tactile Enhancement





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MDMA - Paraphernalia



- Vibrators
- Brushes
- Gripper gloves
- Topical analgesics





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MDMA – Entactogenesis







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MDMA – Heightened Visual Sense

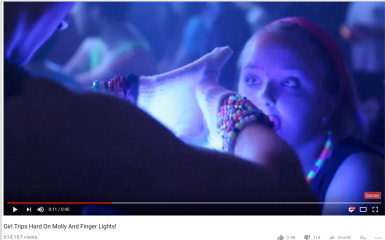






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MDMA – Heightened Visual Sense





Get Trips Ined On Mody And Finger Light!

5:14:57 views



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MDMA – Bruxism and Trismus







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MDMA – Hyperthermia





Case Study - A 22-year-old white male was brought to the ED from a local night club.
The chief complaint was seizures and the patient unresponsive upon EMS arrival.
Enroute to the hospital, the patient went into cardiac arrest but was resuscitated. Upon arrival at the ED, the patient was noted to be extremely hot and diaphoretic. A rectal temperature was noted to be 109.8, HR: 130, BP 72/48.
Cooling measures were initiated and dopamine was started at 14 mcg/kg/min.
The patient progressed into cardiopulmonary arrest and resuscitation measures were Ineffective. Drug analysis was conducted as part of the post-mortem and the patient was positive for both MDMA and MDA.



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MDMA - Muscle Cramping




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MDMA –Hyponatremia




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Case Study –
A 17 year-old female was transported to the ED after having been found underneath a set of bleachers at a local outdoor “rave” concert. Friends who accompanied the patient reported that the patient had been taking “Molly” throughout the day with them but the patient had begun acting confused and was later found underneath the bleachers. EMS administered midazolam for noted seizure activity and transported the patient to the ED. The patient was unresponsive upon arrival to the ED and was intubated. Vital signs: HR 118, RR 24, BP 60/30, Temp 97.8F. Initial laboratory findings indicated hyponatremia and a CT Revealed significant cerebral edema. The patient failed to regain consciousness and progressed into cardiac arrest. Upon post-mortem, MDMA was identified as the only toxin present. Evidence of recent sexual intercourse was found to be present.

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MDMA – “Chat Room”

Mollies are MDMA. It's like ecstasy (aka e) but kinda different. It's incredibly fun and dangerous. Don't do it. All my friends do it and it's caused a lot of problems. It's not worth it, trust me. Plus people act really weird on it. I've seen my friends like roll around on the floor and rubbing themselves against walls when they're on this sh*t. And their pupils get huge and they're like “I love you, I love you, I love you” to everyone and they constantly want hugs and to hold people's hands and they breathe all weird and talk really funny and they're always scared of cats for some reason... ..and they think they're like on top of the world and can't believe how beautiful everything is and they clench their jaws really tightly when they're on it and bite the sides of their mouths and then they crash and don't eat or sleep for a day or two and feel like crap...then they do it again next weekend....



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MDMA – “Chat Room”



It's really quite hard to watch. My boyfriend does it all the time, at least 3 times a week and he's so skinny from doing it and he's like **tom chunks of flesh out of his mouth** before when he's on that sh*t and **his lips are always cut up from gnawing on them**. His buddy bit a huge chunk of his tongue off. Not to mention that he always does things like burn himself when he's on MDMA or e cuz he's like "I can't feel it, that's so cool" and then the next day has all these painful scars. Basically it makes you feel amazingly good and royally effs you up. Apparently it's not physically addicting but highly mentally addicting. All my friends were like "I'll just try it once" and now they all do it all the time and have great difficulty stopping. It usually comes in **caps or pill form** but you can snort it too. It's normally an off white colour.



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MDMA - Effects In Time





Short term

- Peak levels at 1-3 hours
- Serotonin Syndrome
- Electrolyte concerns

Long term

- Psychological dependence
- Dental damage
- Extreme depression for weeks or longer



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Psychological Effects





- Euphoria
- Confusion
- Acute psychosis
- Agitation
- Combativeness
- Aggressive, violent, and self-destructive behavior
- Paranoia
- Hallucinations
- Delusions



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Sources...



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THANK YOU

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