Methamphetamine

**Systematic (IUPAC) name**

*N*-methyl-1-phenylpropan-2-amine

**Identifiers**

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Methamphetamine (pronounced /ˈmɛθəˌmɛθəmiːn/ [13]), also known as metamfetamine (INN for the (+) form), methylamphetamine, N-methylamphetamine, desoxyephedrine, and colloquially as "meth" or "crystal meth", is a psychostimulant of the phenethylamine and amphetamine class of drugs. It increases alertness, concentration, energy, and in high doses, can induce euphoria, enhance self-esteem, and increase libido.[14] [15] Methamphetamine has high potential for abuse and addiction by activating the psychological reward system via triggering a cascading release of dopamine, norepinephrine and serotonin in the brain. Methamphetamine is FDA approved for the treatment of ADHD and exogenous obesity, marketed in the USA under the trademark name Desoxyn.[16]

Methamphetamine is illicitly synthesized and then sold in a crystalline form resembling small shards of odorless, bitter-tasting crystals; leading to the colloquial nickname "crystal meth". Following a period of heavy use, also known as "binge", which typically lasts days or even weeks, a severe withdrawal syndrome lasting up to ten days can occur, primarily consisting of depression, fatigue, excessive sleeping and an increased appetite. Chronic methamphetamine abuse may result in prolonged psychiatric disorders, cognitive impairment, as well as an increased risk of developing Parkinson's disease.

As a result of methamphetamine-induced neurotoxicity to dopaminergic neurons, chronic abuse may also lead to symptoms which persist beyond the withdrawal period for months, and even up to a year.[17] Research has found that 20% of methamphetamine addicts experience a psychosis resembling schizophrenia which persists for longer than six months post-methamphetamine use; this amphetamine psychosis can be resistant to traditional treatment.[18] In addition to psychological harm, physical harm, primarily consisting of cardiovascular damage, may occur with
chronic abuse or acute overdose.\cite{19}

**History**

Methamphetamine was first synthesized from ephedrine in Japan in 1893 by chemist Nagai Nagayoshi.\cite{20} The term "methamphetamine" was derived from elements of the chemical structure of this new compound: methyl alpha-methylphenylethylamine. In 1919, crystallized methamphetamine was synthesized by Akira Ogata via reduction of ephedrine using red phosphorus and iodine. In 1943, Abbott Laboratories requested for its approval from the U.S. Food and Drug Administration (FDA) for the treatment of narcolepsy, mild depression, postencephalitic parkinsonism, chronic alcoholism, cerebral arteriosclerosis, and hay fever. Methamphetamine was approved for all of these indications in December, 1944. All of these indication approvals were eventually removed. The only two approved marketing indications remaining for methamphetamine are for attention-deficit hyperactivity disorder (ADHD) and the short-term management of exogenous obesity, although the drug is clinically established as effective in the treatment of narcolepsy.\cite{21}

**World War II**

One of the earliest uses of methamphetamine was during World War II, when it was used by Axis and Allied forces.\cite{22} The German military dispensed it under the trademark name Pervitin. It was widely distributed across rank and division, from elite forces to tank crews and aircraft personnel, with many millions of tablets being distributed throughout the war.\cite{23} From 1942 until his death in 1945, Adolf Hitler may have been given intravenous injections of methamphetamine by his personal physician Theodor Morell. It is possible that it was used to treat Hitler's speculated Parkinson's disease, or that his Parkinson-like symptoms that developed from 1940 onwards resulted from using methamphetamine.\cite{24} In Japan, methamphetamine was sold under the registered trademark of Philopon (ヒロポン hiropon) by Dainippon Sumitomo Pharma for civilian and military use. As with the rest of the world at the time, the side effects of methamphetamine were not well studied, and regulation was not seen as necessary.

**Post-war usage**

After World War II, a large Japanese military stockpile of methamphetamine, known by its trademark Philopon, flooded the market.\cite{25} The Japanese Ministry of Health banned it in 1951; since then, it has been increasingly produced by the Yakuza criminal organization.\cite{26} On the streets, it is also known as S, Shabu, and Speed, in addition to its old trademarked name. In the 1950s, there was a rise in the legal prescription of methamphetamine to the American public. In the 1954 edition of *Pharmacology and Therapeutics*, indications for methamphetamine included "narcolepsy, postencephalitic parkinsonism, alcoholism, certain depressive states, and in the treatment of obesity."\cite{27} The 1960s saw the start of significant use of clandestinely manufactured methamphetamine, as well as methamphetamine created in users' own homes for personal and recreational use which continues to this day.
Legal restrictions

In 1983, laws were passed in the United States prohibiting possession of precursors and equipment for methamphetamine production. This was followed a month later by a bill passed in Canada enacting similar laws. In 1986, the U.S. government passed the Federal Controlled Substance Analogue Enforcement Act in an attempt to curb the growing use of designer drugs. Despite this, use of methamphetamine expanded throughout rural United States, especially through the Midwest and South.\(^{[28]}\)

Since 1989, five U.S. federal laws and dozens of state laws have been imposed in an attempt to curb the production of methamphetamine. Methamphetamine can be produced in home laboratories using pseudoephedrine or ephedrine, which, at the time, were the active ingredients in over-the-counter drugs such as Sudafed and Contac. Preventive legal strategies of the past 17 years have steadily increased restrictions to the distribution of pseudoephedrine/ephedrine-containing products.\(^{[29]}\)

As a result of the U.S. Combat Methamphetamine Epidemic Act of 2005, a subsection of the USA PATRIOT Act, there are restrictions on the amount of pseudoephedrine and ephedrine one may purchase in a specified time period and further requirements that these products must be stored in order to prevent theft.\(^{[29]}\) Increasingly strict restrictions have resulted in the reformulation of many over-the-counter drugs, and some, such as Actifed, have been discontinued entirely in the United States.

Meth lab waste is extremely hazardous and toxic. Waste cleanup is a major issue for authorities and property owners. Common wastes include brake cleaner, ammonia, soda bottles, kitty litter, lithium batteries, engine starter, matches, and pseudoephedrine blister packs.\(^{[30]}\)

Pharmacology

A member of the family of phenethylamines, methamphetamine is chiral, with two isomers, levorotary and dextrorototary.\(^{[11]}\) The levorotary form, called levomethamphetamine, is an over-the-counter drug used in inhalers for nasal decongestion. Levomethamphetamine does not possess any significant central nervous system activity or addictive properties. This article deals only with the dextrorotatory form, called dextromethamphetamine, and the racemic form.

Methamphetamine is a potent central nervous system stimulant that affects neurochemical mechanisms responsible for regulating heart rate, body temperature, blood pressure, appetite, attention, mood and emotional responses associated with alertness or alarming conditions.\(^{[11]}\) The acute physical effects of the drug closely resemble the physiological and psychological effects of an epinephrine-provoked fight-or-flight response, including increased heart rate and blood pressure, vasoconstriction (constriction of the arterial walls), bronchodilation, and hyperglycemia (increased blood sugar). Users experience an increase in focus, increased mental alertness, and the elimination of fatigue, as well as a decrease in appetite.

The methyl group is responsible for the potentiation of effects as compared to the related compound amphetamine, rendering the substance on the one hand more lipid-soluble, enhancing transport across the blood-brain barrier, and on the other hand more stable against enzymatic degradation by monoamine oxidase (MAO). Methamphetamine causes the norepinephrine, dopamine, and serotonin (5HT) transporters to reverse their direction of flow. This inversion leads to a release of these transmitters from the vesicles to the cytoplasm and from the cytoplasm to the
Methamphetamine (releasing monoamines in rats with ratios of about NE:DA = 1:2, NE:5HT = 1:60), causing increased stimulation of post-synaptic receptors. Methamphetamine also indirectly prevents the reuptake of these neurotransmitters, causing them to remain in the synaptic cleft for a prolonged period (inhibiting monoamine reuptake in rats with ratios of about NE:DA = 1:2.35, NE:5HT = 1:44.5).\[31\]

Methamphetamine is a potent neurotoxin, shown to cause dopaminergic degeneration,\[32\]\[33\] High doses of methamphetamine produce losses in several markers of brain dopamine and serotonin neurons. Dopamine and serotonin concentrations, dopamine and 5HT uptake sites, and tyrosine and tryptophan hydroxylase activities are reduced after the administration of methamphetamine. It has been proposed that dopamine plays a role in methamphetamine-induced neurotoxicity, because experiments that reduce dopamine production or block the release of dopamine decrease the toxic effects of methamphetamine administration. When dopamine breaks down, it produces reactive oxygen species such as hydrogen peroxide.

It is likely that the approximate twelvefold increase in dopamine levels and subsequent oxidative stress that occurs after taking methamphetamine mediates its neurotoxicity.\[34\]

Recent research published in the Journal of Pharmacology And Experimental Therapeutics (2007)\[35\] indicates that methamphetamine binds to and activates a G protein-coupled receptor called TAAR1.\[36\] TAARs are a newly discovered receptor family\[37\]\[38\] whose members are activated by a number of amphetamine-like molecules called trace amines, thyronamines,\[39\] and certain volatile odorants.\[40\]

It has been demonstrated that a high ambient temperature increases the neurotoxic effects of methamphetamine.\[41\]

**Effects**

**Physical effects**

Physical effects can include anorexia, hyperactivity, dilated pupils, flushing, restlessness, dry mouth, headache, tachycardia, bradycardia, tachypnea, hypertension, hypotension, hyperthermia, diaphoresis, diarrhea, constipation, blurred vision, dizziness, insomnia, numbness, palpitations, arrhythmias,\[42\] tremors, dry and/or itchy skin, acne, pallor, and with chronic and/or high doses, convulsions,\[43\] heart attack,\[44\] stroke,\[45\] and death.\[45\]\[46\][47]\[48]\[49]\[50]

**Psychological effects**

Psychological effects can include euphoria, anxiety, increased libido, alertness, concentration, energy, self-esteem, self-confidence, sociability, irritability, aggression, psychosomatic disorders, psychomotor agitation, grandiosity, hallucinations, excessive feelings of power and invincibility, repetitive and obsessive behaviors, paranoia, and with chronic and/or high doses, amphetamine psychosis can occur.\[45\]\[51\]

**Withdrawal effects**

Withdrawal symptoms of methamphetamine primarily consist of fatigue, depression and an increased appetite. Symptoms may last for days with occasional use and weeks or months with chronic use, with severity dependent on the length of time and the amount of methamphetamine used. Withdrawal symptoms may also include anxiety, agitation, akathisia, excessive sleeping, vivid or lucid dreams, deep REM sleep and suicidal ideation.\[52\]
**Long-term effects**

Methamphetamine use has a high association with depression and suicide as well as serious heart disease, amphetamine psychosis, anxiety and violent behaviours. Methamphetamine also has a very high addiction risk.[19] Methamphetamine is neurotoxic and is associated with an increased risk of Parkinson's disease.[17] Methamphetamine abuse can cause neurotoxicity which is believed to be responsible for causing persisting cognitive deficits, such as memory, impaired attention and executive function. Over 20 percent of people addicted to methamphetamine develop a long-lasting psychosis resembling schizophrenia after stopping methamphetamine which persists for longer than 6 months and is often treatment resistant.[18]

**Pharmacokinetics**

Following oral administration, methamphetamine is readily absorbed with peak methamphetamine concentrations occurring in 3.13 to 6.3 hours post ingestion. The amphetamine metabolite peaks at 10 to 24 hours.[11] Methamphetamine is also well absorbed following inhalation and following intranasal administration.[11] It is distributed to most parts of the body. Because methamphetamine has a high lipophilicity it is distributed across the blood brain barrier and crosses the placenta.[11]

Methamphetamine is metabolized in the liver with the main metabolites being amphetamine (active) and 4-hydroxymethamphetamine; other minor metabolites include 4-hydroxyamphetamine, norephedrine, and 4-hydroxynorephedrine.[11] Other drugs metabolized to amphetamine and methamphetamine include benzphetamine, furfenorex, and famprofazone.[56] Selegiline (marketed as Deprenyl, EMSAM, and others) is metabolized into the less active L-isomer of amphetamine and the inactive L-isomer of methamphetamine.[11] Although only the D-Isomer of selegiline will metabolize into active metabolites, both isomers may cause a positive result for methamphetamine and amphetamine on a drug test, in certain cases.[58]

It is excreted by the kidneys, with the rate of excretion into the urine heavily influenced by urinary pH. Between 30-54% of an oral dose is excreted in urine as unchanged methamphetamine and 10-23% as unchanged amphetamine. Following an intravenous dose, 45% is excreted as unchanged parent drug and 7% amphetamine.[59] The half-life of methamphetamine is variable with a mean value of between 9 and 12 hours.[11]

**Detection in biological fluids**

Methamphetamine and amphetamine are often measured in urine, sweat or saliva as part of a drug-abuse testing program, in plasma or serum to confirm a diagnosis of poisoning in hospitalized victims, or in whole blood to assist in a forensic investigation of a traffic or other criminal violation or a case of sudden death. Chiral techniques may be employed to help distinguish the source of the drug, whether obtained legally (via prescription) or illicitly, or possibly as a result of formation from a prodrug such as famprofazone or selegiline. Chiral separation is needed to assess the possible contribution of l-methamphetamine (Vicks Inhaler) toward a positive test result.[60] [61] [62]

**Tolerance**

As with other amphetamines, tolerance to methamphetamine is not completely understood but known to be sufficiently complex that it cannot be explained by any single mechanism. The extent of tolerance and the rate at which it develops vary widely between individuals, and, even within one person, it is highly dependent on dosage, duration of use, and frequency of administration. Tolerance to the awakening effect of amphetamines does not readily develop, making them suitable for the treatment of narcolepsy.[63]

Short-term tolerance can be caused by depleted levels of neurotransmitters within the synaptic vesicles available for release into the synaptic cleft following subsequent reuse (tachyphylaxis). Short-term tolerance typically lasts until neurotransmitter levels are fully replenished; because of the toxic effects on dopaminergic neurons, this can be greater than 2–3 days. Prolonged overstimulation of dopamine receptors caused by methamphetamine may
eventually cause the receptors to downregulate in order to compensate for increased levels of dopamine within the synaptic cleft.\textsuperscript{[64]} To compensate, larger quantities of the drug are needed in order to achieve the same level of effects. Reverse tolerance or sensitization can also occur.\textsuperscript{[63]} The effect is well established, but the mechanism is not well understood.

**Addiction**

Methamphetamine is very addictive.\textsuperscript{[65]} While the withdrawal itself may not be dangerous, withdrawal symptoms are common with heavy use and relapse is common.

Methamphetamine-induced hyperstimulation of pleasure pathways leads to anhedonia. It is possible that daily administration of the amino acids L-tyrosine and L-5HTP/tryptophan can aid in the recovery process by making it easier for the body to reverse the depletion of dopamine, norepinephrine, and serotonin. Although studies involving the use of these amino acids have shown some success, this method of recovery has not been shown to be consistently effective.

It is shown that taking ascorbic acid prior to using methamphetamine may help reduce acute toxicity to the brain, as rats given the human equivalent of 5–10 grams of ascorbic acid 30 minutes prior to methamphetamine dosage had toxicity mediated,\textsuperscript{[66]} yet this will likely be of little avail in solving the other serious behavioral problems associated with methamphetamine use and addiction that many users experience. Large doses of ascorbic acid also lower urinary pH, reducing methamphetamine's elimination half-life and thus decreasing the duration of its actions.\textsuperscript{[68]}

To combat addiction, doctors are beginning to use other forms of stimulants such as dextroamphetamine, the dextrorotatory (right-handed) isomer of the amphetamine molecule, to break the addiction cycle in a method similar to the use of methadone in the treatment of heroin addicts. There are no publicly available drugs comparable to naloxone, which blocks opiate receptors and is therefore used in treating opiate dependence, for use with methamphetamine problems.\textsuperscript{[69]} However, experiments with some monoamine reuptake inhibitors such as indatraline have been successful in blocking the action of methamphetamine.\textsuperscript{[70]} There are studies indicating that fluoxetine, bupropion and imipramine may reduce craving and improve adherence to treatment.\textsuperscript{[71]} Research has also suggested that modafinil can help addicts quit methamphetamine use.\textsuperscript{[72]}\textsuperscript{[73]}

Methamphetamine addiction is one of the most difficult forms of addictions to treat. Bupropion, aripiprazole, and baclofen have been employed to treat post-withdrawal cravings, although the success rate is low. Modafinil is somewhat more successful, but this is a Class IV scheduled drug. Ibogaine has been used with success in Europe, where it is a Class I drug and available only for scientific research. Mirtazapine has been reported useful in some small-population studies.\textsuperscript{[74]}

As the phenethylamine phentermine is a constitutional isomer of methamphetamine, it has been suggested that it may be effective in treating methamphetamine addiction. Phentermine is a central nervous system stimulant that acts on dopamine and norepinephrine. When comparing (+)-Amphetamine, (+/-)-ephedrine, and phentermine, one key difference among the three drugs is their selectivity for norepinephrine (NE) release vs. dopamine (DA) release. The NE/DA selectivity ratios for these drugs as determined in vitro \[(\text{EC(50) NE(-1)}/\text{EC(50) DA(-1)})\] are \((+/-)-ephedrine (18.6) > \text{phentermine (6.7)} > (+)-amphetamine (3.5)).\textsuperscript{[75]}

Abrupt interruption of chronic methamphetamine use results in the withdrawal syndrome in almost 90\% of the cases. The mental depression associated with methamphetamine withdrawal lasts longer and is more severe than that of cocaine withdrawal.\textsuperscript{[71]}
Medical use

Methamphetamine has been FDA approved for use in children and adults under the trade name Desoxyn for the treatment of ADHD and exogenous obesity, as well as off-label for the treatment of narcolepsy and treatment-resistant depression.[21] Methamphetamine is known to produce central effects similar to the other stimulants, but at smaller doses, with fewer peripheral effects.[76] Methamphetamine's fat solubility also allows it to enter the brain faster than other stimulants, where it is more stable against degradation by monoamine oxidase (MAO).

Investigational use

A 2006 study by a group of University of Montana scientists showed that methamphetamine appears to lessen damage to the brains of rats and gerbils that have suffered strokes. Their preliminary research has found that small amounts of methamphetamine created a protective effect, while higher doses increased damage. The findings have shown that methamphetamine could be used medically to lessen stroke damage.[77]

Health issues

Meth mouth

Methamphetamine users and addicts may lose their teeth abnormally quickly, a condition informally known as meth mouth. According to the American Dental Association, meth mouth "is probably caused by a combination of drug-induced psychological and physiological changes resulting in xerostomia (dry mouth), extended periods of poor oral hygiene, frequent consumption of high-calorie, carbonated beverages and bruxism (teeth grinding and clenching). Some reports have also speculated that the caustic nature of the drug is a contributing factor.[78] [79] Similar, though far less severe, symptoms have been reported in clinical use of regular amphetamine, where effects are not exacerbated by extended periods of poor oral hygiene.[80] [81]

Public health issues

Use in pregnancy and breastfeeding

Methamphetamine passes through the placenta and is secreted into breast milk. Infants born to methamphetamine-abusing mothers were found to have a significantly smaller gestational age-adjusted head circumference and birth weight measurements. Methamphetamine exposure was also associated with neonatal withdrawal symptoms of agitation, vomiting and tachypnea.[84] This withdrawal syndrome is relatively mild and only requires medical intervention in approximately 4% of cases.[71]
Increased risk of sexually transmitted disease

Men who use methamphetamine, cocaine, MDMA, and ketamine are twice as likely to have unprotected sex, according to British research.[85] American psychologist Perry N. Halkitis performed an analysis using data collected from community-based participants among gay and bisexual men to examine the associations between methamphetamine use and sexual risk taking behaviors. Methamphetamine use was found to be related to higher frequencies of unprotected sexual intercourse in both HIV-positive and unknown casual partners. The association between methamphetamine use and unprotected acts were also more pronounced in HIV-positive participants. These findings suggested that methamphetamine use and engagement in unprotected anal intercourse are co-occurring risk behaviors that potentially heighten the risk of HIV transmission among gay and bisexual men.[86] Methamphetamine allows users to engage in prolonged sexual activity, which may cause genital sores and abrasions. Methamphetamine can also cause sores and abrasions in the mouth via bruxism (teeth clenching and grinding), which can turn typically low-risk sex acts, such as oral sex, into high-risk sexual activity.[87] As with the injection of any drug, if a group of users share a common needle without sterilization procedures, blood-borne diseases, such as HIV or hepatitis, can be transmitted. The level of needle sharing among methamphetamine users is similar to that among other drug injection users.[88]

Routes of administration

Studies have shown that the subjective pleasure of drug use (the reinforcing component of addiction) is proportional to the rate at which the blood level of the drug increases. These findings suggest the route of administration affects the potential risk for psychological addiction independently of other risk factors, such as dosage and frequency of use.[89] Intravenous injection is the fastest route of drug administration, causing blood concentrations to rise the most quickly, followed by smoking, suppository (anal or vaginal insertion), insufflation (snorting), and ingestion (swallowing). Ingestion does not produce a rush, an acute transcendent state of euphoria, as forerunner to the high experienced with the use of methamphetamine, which is most pronounced with intravenous use. While the onset of the rush induced by injection can occur in as little as a few seconds, the oral route of administration requires approximately half an hour before the high sets in.[90]

Injection

Injection, also known as "slamming", "banging", "shooting up" or "mainlining", is a popular method used by addicts which carries relatively greater risks than other methods of administration. The hydrochloride salt of methamphetamine is soluble in water. Intravenous users may use any dose range, from less than 100 milligrams to over one gram, using a hypodermic needle, although it should be noted that typically street methamphetamine is "cut" with a water-soluble cutting material, which constitutes a significant portion of a given street methamphetamine dose.[91] Intravenous users risk developing pulmonary embolism (PE), a blockage of the main artery of the lung or one of its branches, and commonly develop skin rashes (also known as "speed bumps") or infections at the site of injection. As with the injection of any drug, if a group of users share a common needle without sterilization procedures, blood-borne diseases, such as HIV or hepatitis, can be transmitted.

Smoking

Smoking amphetamines refers to vaporizing it to inhale the resulting fumes, not burning it to inhale the resulting smoke. It is commonly smoked in glass pipes made from glassblown Pyrex tubes and light bulbs. It can also be smoked off aluminium foil, which is heated underneath by a flame. This method is also known as "chasing the white dragon" (whereas smoking heroin is known as "chasing the dragon").[92] [93] There is little evidence that methamphetamine inhalation results in greater toxicity than any other route of administration.[94] [95] Lung damage has been reported with long-term use, but manifests in forms independent of route (pulmonary hypertension (PH)), or limited to injection users (pulmonary embolism (PE)).
**Insufflation**

Another popular route to intake methamphetamine is insufflation (snorting), where a user crushes the methamphetamine into a fine powder and then sharply inhales it (sometimes with a straw or a rolled up banknote, as with cocaine) into the nose where methamphetamine is absorbed through the soft tissue in the mucous membrane of the sinus cavity and straight into the bloodstream. Insufflation of methamphetamine can cause chemical damage to teeth, as it draws methamphetamine down the nasal passage, draining in the back of the throat and saturating the teeth with the caustic substances used in its illicit production.\(^{[79]}\)

**Suppository**

Suppository (anal or vaginal insertion) is a less popular method of administration used in the community with comparatively little research into its effects.\(^{[96]}\) Information on its use is largely anecdotal with reports of increased sexual pleasure and the effects of the drug lasting longer.\(^{[97]}\) As methamphetamine is centrally active in the brain, these effects are likely experienced through the higher bioavailability of the drug in the bloodstream (second to injection) and the faster onset of action (than insufflation).\(^{[98]}\) Nicknames for this method of use within methamphetamine communities include a "butt rocket", a "booty bump", "potato thumping", "turkey basting", "plugging", "boofing", "suitcasing", "keistering", "shafting", "bumming", and "shelving" (vaginal).\(^{[96]}\)\(^{[99]}\)

**Illicit production**

**Synthesis**

Synthesis is relatively simple, but entails risk with flammable and corrosive chemicals, particularly the solvents used in extraction and purification; therefore, illicit production is often discovered by fires and explosions caused by the improper handling of volatile or flammable solvents. Most of the necessary chemicals are readily available in household products or over-the-counter cold or allergy medicines. When illicitly produced, methamphetamine is commonly made by the reduction of ephedrine or pseudoephedrine. The maximum conversion rate for ephedrine and pseudoephedrine is 92%, although typically, illicit methamphetamine laboratories convert at a rate of 50% to 75%.\(^{[100]}\)

Most methods of illicit production involve protonation of the hydroxyl group on the ephedrine or pseudoephedrine molecule. Methamphetamine is most structurally similar to methcathinone and amphetamine. The most common method for small-scale methamphetamine labs in the United States is primarily called the "Red, White, and Blue Process", which involves red phosphorus, pseudoephedrine or ephedrine (white), and iodine (which is technically a purple color in elemental form), from which hydroiodic acid is formed. In Australia, criminal groups have been known to substitute "red" phosphorus with either hypophosphorous acid or phosphorous acid.\(^{[101]}\) This is a hazardous process for amateur chemists, because phosphine gas, a side-product from in situ hydroiodic acid production, is extremely toxic to inhale.

Another common method uses the Birch reduction (also called the "Nagai method"),\(^{[102]}\) in which metallic lithium, commonly extracted from non-rechargeable lithium batteries, is substituted for difficult-to-find metallic sodium. However, the Birch reduction is dangerous because the alkali metal and liquid anhydrous ammonia are both
Methamphetamine is extremely reactive, and the temperature of liquid ammonia makes it susceptible to explosive boiling when reactants are added.

A completely different procedure of synthesis uses the reductive amination of phenylacetone with methylamine,[104] both of which are currently DEA list I chemicals (as are pseudoephedrine and ephedrine). The reaction requires a catalyst that acts as a reducing agent, such as mercury-aluminum amalgam or platinum dioxide, also known as Adams' catalyst. This was once the preferred method of production by motorcycle gangs in California,[105] until DEA restrictions on the chemicals made the process difficult. Other less common methods use other means of hydrogenation, such as hydrogen gas in the presence of a catalyst.

Methamphetamine labs can give off noxious fumes, such as phosphine gas, methylamine gas, solvent vapors, acetone or chloroform, iodine vapors, white phosphorus, anhydrous ammonia, hydrogen chloride/muriatic acid, hydrogen iodide, lithium/sodium metal, ether, or methamphetamine vapors. If performed by amateurs, manufacturing methamphetamine can be extremely dangerous. If the red phosphorus overheats, because of a lack of ventilation, phosphine gas can be produced. This gas is highly toxic and, if present in large quantities, is likely to explode upon autoignition from diphosphine, which is formed by overheating phosphorus.

In recent years, reports of a simplified "Shake 'n Bake" synthesis have surfaced. The method is suitable for such small batches that pseudoephedrine restrictions are less effective, it uses chemicals that are easier to obtain (though no less dangerous than traditional methods), and it is so easy to carry out that some addicts have made the drug while driving.[106] Producing methamphetamine in this fashion can be extremely dangerous and has been linked to several fatalities.[107]
Production and distribution

Until the early 1990s, methamphetamine for the U.S. market was made mostly in labs run by drug traffickers in Mexico and California. Indiana state police found 1,260 labs in 2003, compared to just 6 in 1995, although this may be partly a result of increased police activity.\[108] As of 2007, drug and lab seizure data suggests that approximately 80 percent of the methamphetamine used in the United States originates from larger laboratories operated by Mexican-based syndicates on both sides of the border and that approximately 20 percent comes from small toxic labs (STLs) in the United States.\[109]

Mobile and motel-based methamphetamine labs have caught the attention of both the U.S. news media and the police. Such labs can cause explosions and fires and expose the public to hazardous chemicals. Those who manufacture methamphetamine are often harmed by toxic gases. Many police departments have specialized task forces with training to respond to cases of methamphetamine production. The National Drug Threat Assessment 2006, produced by the Department of Justice, found "decreased domestic methamphetamine production in both small and large-scale laboratories", but also that "decreases in domestic methamphetamine production have been offset by increased production in Mexico." The report concluded that "methamphetamine availability is not likely to decline in the near term."\[110]

In July 2007, Mexican officials at the port of Lázaro Cárdenas seized a ship carrying 19 tons of pseudoephedrine, a raw material needed for methamphetamine.\[111] The shipment originated in Hong Kong and passed through the United States at the port of Long Beach prior to its arrival in Mexico.

In the United States, illicit methamphetamine comes in a variety of forms with prices varying widely over time.\[112] Most commonly, it is found as a colorless crystalline solid. Impurities may result in a brownish or tan color. Colorful flavored pills containing methamphetamine and caffeine are known as yaa baa (Thai for "crazy medicine").

An impure form of methamphetamine is sold as a crumbly brown or off-white rock, commonly referred to as "peanut butter crank".\[113] Methamphetamine found on the street is rarely pure, but adulterated with chemicals that were used to synthesize it. It may be diluted or cut with non-psychoactive substances like inositol, isopropylbenzylamine or dimethylsulfone. Another popular method is to combine methamphetamine with other stimulant substances, such as caffeine or cathine, into a pill known as a "Kamikaze", which can be particularly dangerous due to the synergistic effects of multiple stimulants. It may also be flavored with high-sugar candies, drinks, or drink mixes to mask the bitter taste of the drug. Coloring may be added to the meth, as is the case with "Strawberry Quick".\[114] [115]
Natural occurrence

Methamphetamine has been reported to occur naturally in *Acacia berlandieri*, and possibly *Acacia rigidula*, trees that grow in West Texas.\[116\] Methamphetamine and regular amphetamine were long thought to be strictly human-synthesized\[117\] but *Acacia* trees contain these and numerous other psychoactive compounds (e.g., mescaline, nicotine, dimethyltryptamine), and the related compound β-phenethylamine is known to occur from numerous *Acacia* species.\[118\]

Terminology

Nicknames for methamphetamine are numerous and vary from region to region.

USA nicknames

Some common nicknames in the USA include "Snap, Crackle, Pop" "meth," "ice," "crystal," "crystal meth," "go," "go fast," "Okie coke," and "tweak." Other referenced nicknames in the U.S. are "poor man's cocaine"\[119\] and "Tina".\[120\]

Methamphetamine may also be referred to as "speed", a nickname that is commonly used for amphetamine (in racemic or dextrorotary form), which differs from methamphetamine by the absence of a methyl group in its chemical formula.\[121\]

It is also known as "batu" or "batunas" on Hawaii.\[122\] In the middle east it is known as "roni, ronin" or "bibo"

Nicknames in other countries

- "ice" (Australia)\[123\]
- "tik" (South Africa)\[124\]
- "bato" (Philippines)\[122\]
- "vint" (Russian for "a screw" (Russia))\[125\]
- "ya ice" (Thai for "Ice drug" (Thailand))
- "P" (from the "p" in "pure" (New Zealand))\[126\]
- "필로폰" (Korean for "Philopon" (South Korea))
- "shabu" (Japan, Hong Kong, Philippines, Malaysia)
- "batu kilat" (Malaysian for "shining rocks" (Malaysia))\[122\]
- "piko" (after the trade name "Pervitin" (Czech Republic))
- "peří" (in translation "Feathers" phonetically similar to "Pervitin" (Czech Republic))
- "perník" (in translation "gingerbread" phonetically similar to "Pervitin" (Czech Republic))

Legality

The production, distribution, sale, and possession of methamphetamine is restricted or illegal in many jurisdictions. Methamphetamine has been placed in Schedule II of the United Nations Convention on Psychotropic Substances treaty.\[127\]

References

Methamphetamine


References:


Methamphetamine


[65] Do You Know... Methamphetamine (http://www.camh.net/About_Addiction/Mental_Health/Drug_and_Addiction_Information/methamphetamine_dyk.html). Centre for Addiction and Mental Health.


[69] The Ice Age (See Below)


[79] Meth Mouth | Meth awareness and prevention project of South Dakota (http://www.mappeds.org/MethMouth.htm).


Methamphetamine


[90] Methamphetamine | Abstemious Outpatient Clinic, Inc. (http://www.abstemious.org/Meth.htm)

[91] Methamphetamine: One of America's Greatest Challenges Part I | University of Nebraska-Lincoln (http://elkhorn.unl.edu/public/live/g1748/build/g1748.pdf)

[92] Smoking Meth, the beginner and expert guide to chase the white dragon | Smokingsmeth.Net (http://www.smokingsmeth.net/)

[93] Heroin smoking by 'chasing the dragon': origins and history | BLTC RESEARCH (http://www.biopsychiatry.com/heroin.htm)

[94] Methamphetamine Toxicity Secondary to Intravaginal Body Stuffing | University of Hawaii System (http://www.hawaii.edu/hivand aids/Methamphetamine_Toxicity_Secondary_to_Intravaginal_Body_Stuffing.pdf)


[98] Ascorbic acid-deficient condition alters central effects of methamphetamine | ScienceDirect (http://www.sciencedirect.com/science?_ob=ArticleURL&ud=06SYR-48362JR-1HS&user=10&_coverDate=01/01/1987&_rdoc=1&_fmt=high&_orig=search&_origin=search&_sort=d&_docanchor=&_version=1&_acct=C000050221&_version=1&_udi=B6SYR-48362JR-1HS&md5=1424ff9a560445ada5fa52c2e96b4c36&searchtype=a)

[99] Urban Dictionary (http://www.urbandictionary.com/)


Further reading


External links

- NLM Hazardous Substances Data Bank (http://toxnet.nlm.nih.gov/cgi-bin/sis/search/r?dbs+hsdb:@term+@rn+@rel+537-46-2) - Entry for d-methamphetamine
- Erowid Methamphetamine Vault (http://www.erowid.org/chemicals/meth/meth.shtml)
- A Key to Methamphetamine-Related Literature (http://www.nyhealth.gov/diseases/aids/harm_reduction/crystalmeth/docs/meth_literature_index.pdf) - A comprehensive thematic index of methamphetamine research published in academic and scientific journals with links from citations to the PubMed abstracts.
- Meth FAQ (http://www.erowid.org/chemicals/meth/meth_faq.shtml#synthesis) - More detailed synthesis and synthesis from other sources.
- DEA’s Methamphetamine News Releases (http://www.usdoj.gov/dea/pubs/pressrel/meth_index.html)
- Chronic Amphetamine Use and Abuse (http://www.acnp.org/g4/GN401000166/Default.htm) - A thorough review on the effects of chronic use (American College of Neuropsychopharmacology)
- Self-help guide for family members and loved ones of methamphetamine addicts (http://methcoaster.yolasite.com/)
- ChemSub Online: Methamphetamine (http://chemsub.online.fr/name/methamphetamine.html)
- Mice On Meth (http://www.educatedearth.net/video.php?id=4326) - Video of mice suffering from methamphetamine addiction.
Documentaries

• The Ice Age (http://abc.net.au/4corners/special_eds/20060320/) - ABC Australia - 4 Corners — Australian methamphetamine use.


• The City Addicted to Crystal Meth - BBC (Louis Theroux) (http://www.bbc.co.uk/iplayer/episode/b00m572d/Louis_Theroux_The_City_Addicted_to_Crystal_Meth)

Academic Sources

• History and Epidemiology of Amphetamine Abuse in United States (http://books.google.com/books?hl=en&lr=&id=gVw_wzZU4x8C&oi=fnd&pg=PA113&dq=history+methamphetamine&ots=qAxtq4m1HZ&sig=najz_xcJJ782gsd41TEqXm40igo#v=onepage&q=history+methamphetamine&f=false)

• Methamphetamine, the Crystal Method, and the War on Drugs (http://law.bepress.com/expresso/eps/639/)

• The Methamphetamine Crisis in American Indian and Native Alaskan Communities (http://studentpulse.com/articles/77/the-methamphetamine-crisis-in-american-indian-and-native-alaskan-communities-toward-a-new-research-agenda)
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