Psychoactive Plants: Opium Poppy, Marijuana, and Cocaine

Psychoactive Drugs

Psychoactive drugs affect the central nervous system mainly by influencing the release of neurotransmitters or mimicking their actions

On the basis of their effects, they can be classified as stimulants, hallucinogens, or depressants

Stimulants excite and enhance mental alertness and physical activity; they reduce fatigue and suppress hunger

Hallucinogens produce changes in perception, thought, and mood, often inducing a dreamlike state

Depressants dull mental awareness, reduce physical performance, and often induce sleep or a trancelike state

By strict definition, a narcotic drug is one that induces central nervous system depression resulting in numbness, lethargy, and sleep

In contemporary use, the term narcotic is applies to any psychoactive compound that is dangerously addictive (under this definition, cocaine, a stimulant, would be a narcotic drug)

Addictive compounds generally elicit one or more of the following: psychological dependence, physiological dependence, and tolerance

The Opium Poppy

The ancient curse

The opium poppy, *Papaver somniferum*, belongs to the poppy family, Papaveraceae

The ovary matures into a capsule, and if the capsule is sliced when it is still green, it exudes a milky latex rich in potent alkaloids (see fig. 20.1)

The dried latex turns brown and can be peeled from the capsule; this is crude opium

Opium has been eaten, drunk, and smoked for centuries; the usual method of preparation was to dissolve the crude opium in wine

Later, Hippocrates and other early physicians advocated poppy wine as a medicine for many complaints

During the Middle Ages, a common method of preparing opium was to dissolve it in alcohol; this tincture, later known as laudanum, became a popular medication for centuries

The Opium Wars

The Chinese used opium for centuries mainly for medicinal purposes

After the introduction of tobacco smoking to China (ca 1600 A.D.), tobacco was mixed with opium; gradually the amount of tobacco decreased until opium was smoked alone leading to addition among many Chinese

The British were trading with the Chinese for silk, tea, and porcelain, but the Chinese demanded payment in silver

To alleviate the drain of silver from Great Britain, the British decided to exploit the Chinese addiction to opium

The British (via the British East India Company) had access to large amounts of opium, mainly from India, and a large illegal trade with opium rather than silver used as payment for Chinese goods developed through the port of Canton (the U.S. and other countries were also involved)

In 1839, in an attempt to stop the opium trade, the Chinese government confiscated and destroyed all the opium in Canton harbor

The British retaliated by sending warships, and the first Opium War lasted from 1839 to 1842

The British won and received major concessions including the right to trade in opium, the opening of more ports in China for foreign trade, and establishment of Hong Kong as a British colony

The second Opium War was fought 10 years later; Britain, other European countries, and the U.S. were granted additional concessions

The opium trade ended in 1913, but by this time opium was being cultivated in China and some 25% of the population was addicted

Opium alkaloids

More than 20 alkaloids have been identified in opium, with morphine and codeine probably the most significant

Morphine was isolated in 1806 and was soon recognized for its analgesic value

Endorphins are chemicals produced naturally in the brain that modify mood by reducing sensations of pain and enhancing pleasurable feelings; endorphins bind to receptors in the brain, spinal cord, and intestines

Morphine depresses areas of the brain involved in the perception of pain and reduces anxiety that accompanies pain, apparently by binding to endorphin receptor sites

Morphine is a general central nervous system depressant and, like opium, is strongly addictive

The use of morphine declined dramatically after it was realized just how addictive the drug could be, but it is still the drug of choice today for intense pain (e.g., from severe burns, visceral pain during recovery from surgery, pain associate with some cancers, pain from kidney stones)

Medically, codeine is one of the most commonly used opiates; it has value as an oral analgesic but is only one-fifth as strong as morphine; it is usually used in combination with nonopiate analgesics such as aspirin and acetaminophen

Codeine is superior to morphine in suppressing the cough reflex in the central nervous system; therefore, it is often used in prescription cough syrups

Heroin

Heroin, a semisynthetic derivative of morphine, was introduced as a nonaddictive opiate with analgesic properties superior to morphine and cough-suppressant properties superior to codeine; it was used in many over-the-counter medicines for about two decades (see fig. 20.2)

We now know that heroin is six times more addictive than morphine; it is not used medicinally in the U.S. nor is it manufactured here legally

Withdrawal

Addictive substances, including opium and opium derivatives, trigger a withdrawal response when the drug is no longer taken

Common symptoms include increased respiration, perspiration, runny nose, goose bumps, muscle twitches, insomnia, vomiting, and diarrhea

Marijuana

The marijuana plant is *Cannabis sativa*, but some taxonomists recognize two additional species and several varieties

Marijuana plants are dioecious, meaning that staminate (male) flowers and pistillate (female) flowers are on different plants (see fig. 20.3)

The plants are known for their resin production by glandular trichomes, with the maximum amount of resin coating the unfertilized pistillate flowers and adjacent leaves

Potency of the resin, which contains the hallucinogenically active compounds, varies greatly depending on genetic strains and growing conditions

It is believed to have originated in central Asia; it is widely cultivated today and many names have been given to the plants and to products made from the plants or resin (e.g., marijuana, hemp, grass, pot, hash, hashish, bhang, charas, ganja, ma, kif, dagga)

Early history in China and India

Use of *Cannabis* can be traced back about 5000 years to ancient China where the hemp plant was valued for its fibers (for cloth, paper, and rope) and medicinal properties

Earliest documented records of marijuana's use as a hallucinogen can be traced to the Scythians, ancient nomadic Slav horsemen from central Asia, about 500 B.C.

Marijuana use spread from central Asia to Asia Minor, northern Africa, India, and elsewhere

The first written mention in India is found in the Sanskrit *Zend-Avesta* around 600 B.C.

Marijuana use in India was associated largely with religious ceremonies and achieving a contemplative state

Three grades of *Cannabis* have been recognized in India:

Bhang, the least potent, consists of dried, cut tops that are ground with spices to prepare a drink or candy

Ganja is prepared from resin-rich pistillate flowers and tops of specially bred high-yielding strains; it is usually smoked

Charas, the most potent, consists of pure resin (also known as hashish) from these special strains and is also smoked

The use of *Cannabis* spread throughout the Muslim world, into the Middle East and Africa where hookahs (water pipes – see fig. 20.4) were commonly used for smoking hashish

Legend has it that Hashishins, 12th-century religious fanatics who swore to kill all of their enemies, were worked into a murderous frenzy by smoking *Cannabis*; the words "assassin" and "hashish" both derive from the name Hashishin

Spread to the West

Marijuana was probably introduced into the U.S. around the turn of the 20th century, possibly from Mexico or the Caribbean Islands

Its use became popularized in the U.S. in the 1920s, but in the 1930s concerns about marijuana led to the establishment of laws prohibiting its use

A dramatic increase in marijuana use came about during the social revolution of the 1960s; marijuana became the recreational drug of choice among members of the so-called counterculture of this time

Today, marijuana use is still popular, but it competes with a host of other readily available drugs

THC and its psychoactive effects

Cannabis contains a large number of phenolic compounds known as cannabinoids, but the main psychoactive component is delta-9-tetrahydrocannabinol (THC)

The concentration of THC in the plant varies considerably, depending on genetic strain, sex of the plant, climate, and growing conditions

The effects of *Cannabis* include a sense of euphoria and calmness

According to studies, even moderate use of marijuana impairs learning, short-term memory, and reaction time

Because THC is fat soluble, it accumulates in body tissues, and measurable amounts may remain in the body for days after inhalation

Effects of marijuana on males include a decrease in sperm production and decreased testosterone levels; in pregnant women, THC can cross the placenta and possibly damage the fetus

Marijuana and hashish are usually inhaled in smoke, which can damage lung tissue

The effects of marijuana relate to the interaction of THC with cannabinoid cell surface receptors in many regions of the brain

Medical use

Over the centuries in various cultures, marijuana has been used to treat numerous ailments

In contemporary medicine, marijuana is used mainly to treat glaucoma and as an aid to chemotherapy

Glaucoma is a group of eye diseases characterized by increased pressure within the eye that can damage the optic nerve and cause blindness

Smoking marijuana and ingesting preparation with THC significantly decrease ocular pressure in patients with glaucoma

Patients undergoing chemotherapy for cancer often experience side effects of nausea, vomiting, and loss of appetite; these side effects can be reduced by using marijuana or marinol, a synthetic form of THC

Marijuana has also been used to counteract weight loss associated with the AIDS wasting syndrome, and to reduce spasmodic movements in patients with multiple sclerosis and Parkinson's disease

Since 1996, eight states (Alaska, California, Colorado, Hawaii, Maine, Nevada, Oregon, and Washington) have enacted laws or passed referenda that effectively allow patients to use medical marijuana

Several studies are underway to determine the medical efficacy of marijuana, and some physicians have called for a reclassification of marijuana from a Schedule I drug (defined as a drug with no accepted medical use and a high potential for abuse) to a Schedule II drug (a drug that can be prescribed for appropriate medical applications)

Cocaine

Cocaine is the major alkaloid of the coca plant; it occurs in the leaves, which can be harvested two or three times a year

Cocaine belongs to a group of compounds known as tropane alkaloids, many of which occur in the nightshade family

South American origins

The coca plant is native to the Andes where the leaves have been chewed for centuries; figurines depicting coca chewing date back 3500 years (see fig. 20.5)

When chewed, coca leaves reduce appetite and thirst, and increase energy levels and endurance

According to myth, a god created the coca plant to alleviate hunger and thirst among the people

By the end of the 15th century, use of coca was widespread among the Incas, but casual chewing was considered a sacrilege

After the Spanish conquest, enslaved natives working in mines were given coca leaves to chew

Freud, Holmes, and Coca-Cola

Cocaine was isolated from coca leaves in the late 1850s; its anesthetic qualities were quickly recognized, but it was the stimulating qualities that popularized it

Sigmund Freud was an enthusiastic advocate of the drug as a stimulant and as a means of combating morphine addiction

At the same time, cocaine was gaining in popularity in the U.S. and could be found in over-the-counter medicines, tonics, elixirs, and beverages

As a preparation for colds, asthma, and hay fever, its effectiveness was related to the shrinking of mucus membranes and draining of sinuses

It was promoted as a panacea for ailments from headaches to hysteria, and coca-wine became one of the most popular beverages of the late 19th century

Another cocaine-containing beverage was Coca-Cola, created in 1886 and marketed as a "brain tonic"; by the end of the century, negative effects of cocaine were recognized and it was eliminated from the Coca-Cola recipe in 1903

Widespread use of cocaine in the late 19th century is also evident from its appearance in literature of the day; the fictional detective Sherlock Holmes was a cocaine user

Cocaine was included under the Harrison Act of 1914, the first federal antinarcotic law that regulated the use of cocaine, opium, morphine, and heroin

Coke and crack

By the mid 1970s, cocaine use dramatically increased, and it was the favorite drug of the middle and upper class by 1980

It was believed that cocaine was not addictive and was relatively harmless (damage to the nose and mucus membranes was considered the major drawback)

Today, it is generally recognized that cocaine is a seriously dangerous drug

Cocaine makes its way into the U.S. from plantations in South America, mainly Colombia, Ecuador, Peru, and Bolivia; these plantations produce approximately 400 tons annually

The leaves are extracted to produce cocaine base, which is refined into cocaine hydrochloride, a white powder that is generally cut with various adulterants so that the percentage of cocaine hydrochloride in the street drug is reduced to about 12%

In this form, the powder can be snorted and the alkaloid absorbed through the mucus membranes of the nose

Freebasing involves boiling the powder in an ether solution to produce pure cocaine (the freebase), which is smoked to produce an intense high

Crack is a form of freebase prepared by heating a cocaine hydrochloride solution with baking soda to produce solid chunks that can be broken into tiny “rocks”, which are smoked to produce a quick, intense high

Crack is an especially addictive form of cocaine

Medical use

Cocaine acts as a local anesthetic, temporarily blocking the transmission of nerve impulses at the site of application

Novacain and Xylocaine, commonly used synthetic local anesthetics, are structurally similar to cocaine

Another valuable property of cocaine is its ability to constrict blood vessels when applied locally; this quality has made cocaine the anesthetic of choice for ear, nose, and throat surgery (it was formerly used for eye surgery as well)

A deadly drug

Cocaine is a powerful stimulant to the central nervous system that produces a short-lived euphoric high

The high is accompanied by a burst of energy and alertness similar to that produced by an intense adrenalin rush

Many users experience depression and lethargy following the high

Physiological effects of cocaine include increased heart rate, respiration, blood pressure, and body temperature, and dilation of the pupils

Cocaine abuse has resulted in death due to heart attack, cerebral hemorrhage, respiratory failure, and convulsions

Chronic cocaine use can cause a psychosis similar to schizophrenia with accompanying paranoia and hallucinations

Heavy users develop insomnia and appetite loss; if they are snorters, there is often considerable damage to mucus membranes and nasal cartilage

Cocaine is generally recognized as being both psychologically and physically addictive; withdrawal symptoms include depression, irritability, and drug craving

Main Points from A Closer Look 20.1 – The Tropane Alkaloids and Witchcraft

Tropane alkaloids occur mainly in the nightshade family; they include atropine, hyoscyamine, and scopolamine

These alkaloids have a variety of effects on the body: they relax smooth muscles, dilate the pupils of the eye, dilate blood vessels, increase heart rate and body temperature, induce sleep and lessen pain, stimulate and then depress the central nervous system, and some can cause hallucinations

All three of these tropane alkaloids occur in belladonna, henbane, mandrake, and jimsonweed

Belladonna has a long history of use as a medicinal, psychoactive, and poisonous plant

Mediterranean women would apply juice from the plant to their eyes, the result being dilation of the pupils and origin of the name "bella donna" or beautiful lady

Atropine is the alkaloid that causes dilation of the pupils; it is used medically today by ophthalmologists

Atropine also is used as an antispasmodic for treating Parkinson's disease, epilepsy, and stomach cramps; as a bronchodilator for treating asthma; as a heart stimulant following cardiac arrest, and as an antidote for various poisons and overdoses

Atropine itself is toxic and has a history of use as a poison

Belladonna, henbane, mandrake, and jimsonweed were also used by witches and sorcerers of the Middle Ages to prepare magic potions

Images of witches flying through the air on broomsticks and transforming themselves into animals originated from hallucinations induced by decoctions produced from these plants

Henbane was used medicinally in Europe as a sedative and pain reliever, especially for toothache

Mandrake, because of its root shaped somewhat like the human body, was used to treat male and female sexual complains

Datura (jimsonweed), because of its cosmopolitan distribution, has been used by many peoples for both medical and hallucinogenic purposes

The major active compound, scopolamine, can cause hallucinations of floating or flying; it is used today for motion sickness and for its sedative qualities

This lecture outline was prepared mainly from *Plants and Society*, by Levetin and McMahon, 2003 (3rd edition), and may contain phrases or entire sentences taken verbatim from that source.