

Pharmacognosy

ALKALOIDS

Unit 4th (1)

- Naturally occurring chemical compounds containing basic nitrogen atoms
- Physiologically active
- Insoluble or sparingly soluble in water
- Crystalline solids; a few are amorphous
- Usually classified according to the nature of the basic chemical structures from which they are derived
- Form double-salts with compounds of Hg, Au, Pt, and other heavy metals.

Reagents: Wagner's (Iodine in Potassium iodide), Mayer's (Potassium mercuric iodide), Dragendorff's (Potassium bismuth iodide)

□ Named from:

1. the generic name of the plant yielding them
2. the specific name of the plant yielding them
3. the common name of the drug yielding them
4. their physiologic activity
5. the discoverer

□ Possible functions:

1. Poisonous agents protecting the plant against insects and herbivores
2. End products of detoxification reactions representing a metabolic locking up of compounds otherwise harmful to the plant
3. Regulatory growth factors
4. Reserve substances capable of supplying nitrogen or other elements necessary to the plants economy.

□ Common amino acid precursors:

□ Phenylalanine

□ Tyrosine

□ Tryptophan

□ Histidine

□ Anthranilic acid

□ Lysine

□ Ornithine

□ Important general reactions involved:

□ Decarboxylation

The process of removing a carboxyl group from a chemical compound

□ Transamination

The process of transposing an amino group within a chemical compound

□ Classification based on the ring structure or nucleus of the chief alkaloid group in the plant drug:

□ Pyridine-

Piperidine

□ Tropane

□ Quinoline

□ Isoquinoline

□ Indole

□ Imidazole

□ Steroid

□ Alkaloidal amines

□ Purine

PYRIDINE - PIPERIDINE ALKALOIDS

TROPANE ALKALOIDS

QUINOLINE ALKALOIDS

ISOQUINOLINE ALKALOIDS

- ✓ Contain the isoquinoline ring structure

Sources:	Alkaloid(s)
Ipecac	emetine
hydrastis	berberine, hydrastine
sanguinaria	sanguinarine
curare	tubocurarine
opium	morphine, codeine, thebaine

BIOSYNTHESIS OF OPIUM ALKALOIDS:

Tyrosine ----- L Dopa ----- Dopamine
+
3,4 - dihydroxyphenylpyruvic acid

PAPAVERINE ----- norlaudanosoline

(ket intermediate)



Reticuline



Salutaridine



Salutaridinol



THEBALNE



Codeinone



CODEINE



MORPHINE

IPECAC

- Rhizomes and roots of *Cephaelis ipecacuanha*
- Contains 5 alkaloids
 - 3 principal alkaloids
 - 1.emetine
 - 2. elphaeline
 - 3.psychotrine



Ipecac syrup

- treatment of drug overdose and some poisonings
- procedure emesis
- central medullary effect by stimulation of chemoreceptor

Ipecac fluidextract

- 14x stronger than the syrup

Dover's powder

- ipecac + opium
- Diaphoretic

Emetine/ methylcephaeline

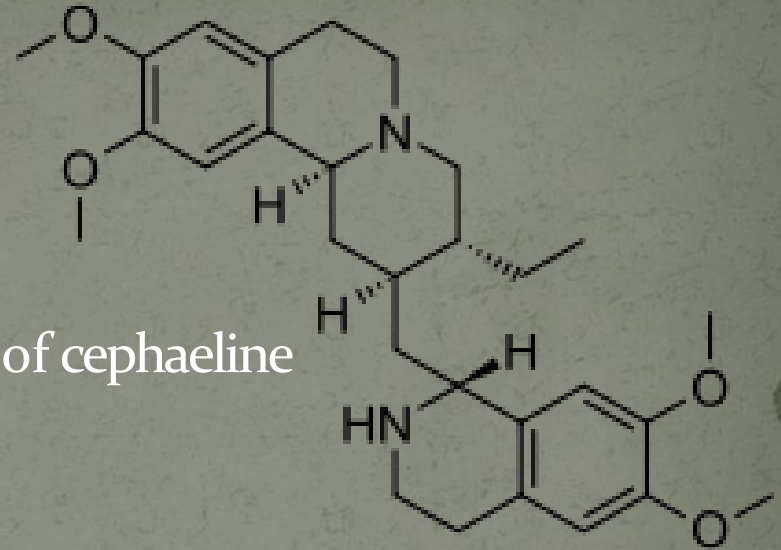
- synthetic methylation product of cephaeline

Emetine hydrochloride

- hydrated hydrochloride of emetine
- turns yellow when exposed to light

Uses:

- Antiamebic
- Expectorant
- Emetic



SANGUINARIA

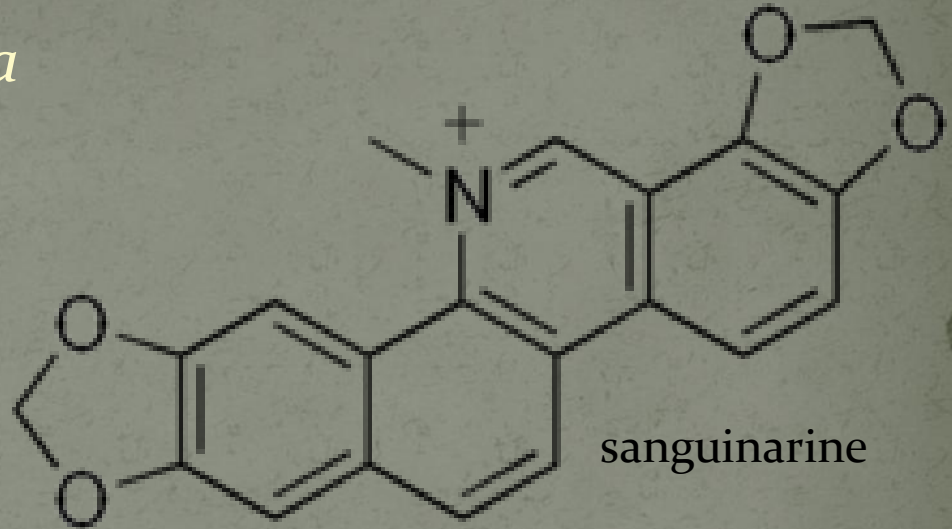
- Bloodroot
- Rhizome of *Sanguinaria canadensis*

Other sources:

- Ranunculaceae
- Berberidaceae
- Menispermaceae
- Papaveraceae

Alkaloids (protopine series):

- sanguinarine
- chelerythrine
- protopine
- allocryptopine



Alkaloids (protopine series):

are colorless but tend to form colored salts:



sanguinarine-----◇ reddish salts



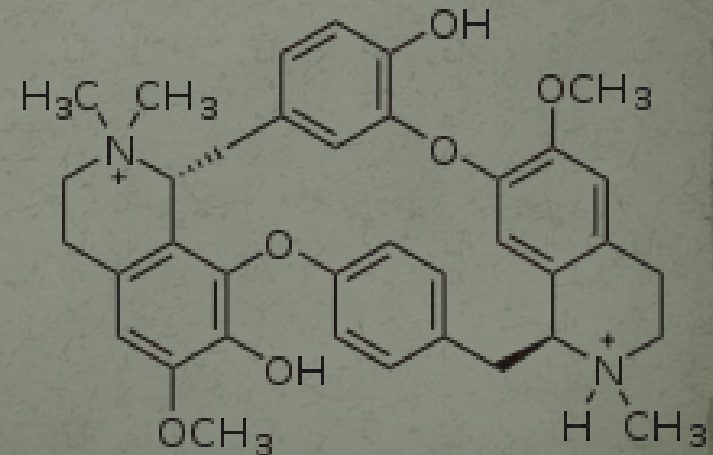
chelerythrine-----◇ yellowish salts

Uses:

- stimulating expectorant
- emetic

CURARE

- First drug
- South American arrow poison from bark and stem of *Strychnos castelnaei*
 - Early preparations:
 - Calabash (gourd)
 - tube (bamboo)
 - pot curare (clay pot)
 - brownish or black, shiny, resinoid mass with a bitter taste
 - Alkaloids:
 - Tubocurarine most important quaternary compound contains
- bis-benzylisoquinoline structure



□ *Curariform effect*

- Paralyzing effect on voluntary muscle exhibit by the crude extract
- Toxic action blood vessels
- Histamine like effect

□ Tubocurarine Cl

- Salt; white, yellowish white to grayish white, odorless crystalline powder

Uses:

- Skeletal muscle relaxant
- Control convulsions of strychnine poisoning and of tetanus
- Adjunct to shock therapy in neuropsychiatry
- Diagnostic aid in myasthenia gravis

OPIUM

- Gum opium
- Milky exudate (air-dried) obtained by incising the riped capsule of *Papaver somniferum*
- Opium poppy – plantsource

Alkaloids:

1. morphine – 4-12%
2. codeine – 0.8 – 2.5%
3. noscapine (formerly narcotine) – 4- 8%
4. papaverine – 0.5 – 2.5%
5. thebaine – 0.5- 2%
6. meconic acid – 3-5%



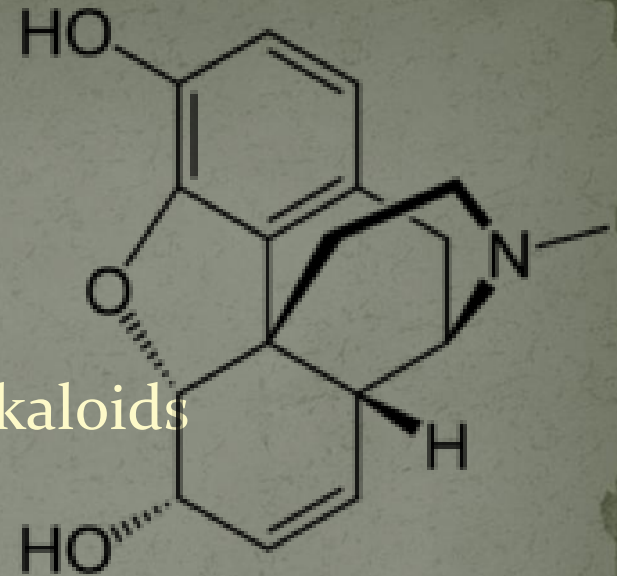
Uses:

- Stimulant-depressant (first stimulates and then depresses nerve response)
- analgesic
- narcotic
- checks excessive peristalsis
- miotic
 - *Powdered opium*
 - used in making Dover's powder and camphorated opium tincture
 - combined with antidiarrheal preparations
 - *Paregoric or camphorated opium tincture*
 - antiperistaltic
 - *Laudanum, opium tincture, deodorized opium tincture*
 - antiperistaltic
 - *Maw or poppyseed*
 - bluish black or yellowish white
 - contains no significant quantity of alkaloids

□ Morphine

□ *DIDEHYDROXYEPOXY
METHYLMORPHINANDIOL*

- most important of the opiumalkaloids
- narcotic analgesic
- strongly hypnotic and narcotic
- induces vomiting, constipation and ~~lb~~ formation



structural features CNS acting analgesic:

- quaternary- central carbon atom with no H substitution
- a phenyl group or isostere attached to central C atom
- tertiary nitrogen atom
- 2 - carbon bridge separating (3) and (1)

□ Codeine

- most widely used opium alkaloid
- a methylmorphine in which the methyl group replaces the hydrogen of the phenolic hydroxyl group
- occurs as fine needles or white crystalline powder

Uses:

- Narcotic analgesic
- Antitussive
- Sedatives in allaying coughs
- Less toxic and involves lesser danger of habit formation compared to codeine

Diacetylmorphine or heroin

- formed by acetylation of morphine
- action is similar, yet more pronounced than that of morphine

Apomorphine HCl

- morphine treated with HCl
- one water molecule is lost
- emetic; used subcutaneously in cases of poisoning

□ Paparavine HCl

- muscle relaxant

- antitussive in combination with codeine sulfate

Hydromorphone HCl or dihydroxymorphine HCl

- one of the hydroxyl groups of morphine is replaced by a ketone group; adjacent double bond is removed

- prepared by reducing morphine in HCl solution with H₂ in the presence of a catalyst

- powerful narcotic analgesic

- strongly depresses respiratory mechanism

Hydrocodone bitartrate or dihydrocodeine bitartrate

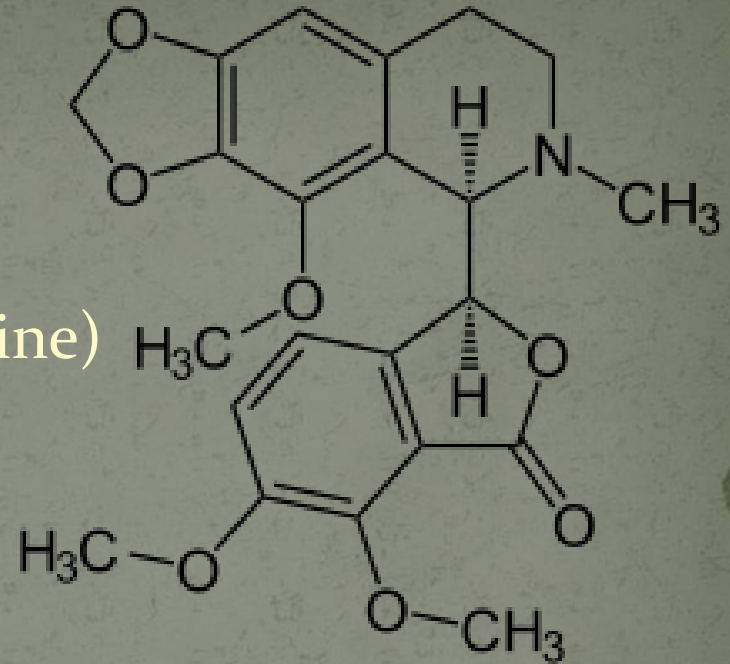
- antitussive

□ Noscapine

- commonly called narcotine
- exists as free base in opium
- no narcotic properties (anarcotine)
- antitussive

Opioid

- synthetic morphinelike compounds
- nonhabit forming
- others are antitussive



INDOLE ALKALOIDS

1. Rauwolfia

- reserpine
- rescinamine
- deserpidine

2. Catharanthus (vinca)

- vinblastine
- vincristine

3. Nux vomica

- strychnine
- brucine

4. physostigma

- physostigmine

5. Ergot

- ergotamine
- ergonovine

Biosynthesis

Tryptamine \diamond ajmaline \diamond

+

Corynanthe-type
(monoterpenoid precursor)

Serpentine

reserpine

RAUWOLFIA SERPENTINA

- -dried roots of rauwolfia serpentine

ALKALOID SERIES:

- 1. weakly basic indole alkaloids
 - reserpine }
 - rescinamine } PRINCIPAL alkaloids
 - desperidine }
 - 8-yohimbine
- reserpiline
- 2. indoline alkaloids of intermediate basicity
 - ajmaline }
 - isoajmaline } NO TRANQUILIZING EFFECT
 - rauwolfinine }
- 3. strong anhydronium bases
 - serpentine
 - serpentinine
 - alstonine

USES

-hypotensive

PACKAGING & STORING

must be packaged and stored in a well-closed container in a cool, dry place that is secure against insect attack.

RESERPINE – is the chief alkaloid and has a strong hypotensive and sedative activity

- white or pale buff to slightly yellow crystalline powder; darkens slowly when exposed to light

USES: antihypertensive and tranquilizer

RESCINNAMINE

Methyl reserpate ester of 3,4,5-trimethoxy cinnamic acid

Uses: antihypertensive

DESERPIDINE:

-is an alkaloid from roots of *Rauwolfia canescens*
-11-desmethoxyreserpine

USES:

-antihypertensive
-tranquilizer

CATHARANTHUS

- vinca and periwinkle
- dried whole plant of *catharanthus rosea*
- have anticancer potential

ALKALOIDS:

- ajmalicine, tetrahydroalstonine, serpentine, lochnerine

U.S ADOPTED

DRUG NAMES

Scientific name

- | | |
|---------------|----------------------------|
| -Vinblastine | Vincal leukoblastine (VLB) |
| -Vinleurosine | leurosine |
| -Vinrosidine | leurosidine |
| -vincristine | leucristine (LC) |

= possess demonstrable antiproliferative activity

VINBLASTINE SULFATE

-antineoplastic

-recommended for generalized Hodgkin's disease, lymphocytic lymphoma, histiocytic lymphoma, mycosis fungoides, advanced testicular carcinoma, kaposi's sarcoma, and choriocarcinoma and breast cancer unresponsive to other therapies.

VINCRISTINE SULFATE

treatment for acute leukemia

combination therapy in Hodgkin's disease, lymphosarcoma, reticulum sarcoma, rhabdomyosarcoma, neuroblastoma, and Wilms's tumor.

VINDESINE

-semisynthetic derivative of vinblastine

NUX VOMICA

dried ripe seed of *strychnos nux vomica*

ALKALOIDS;

- strychnine

- brucine

USES:

Serve as a commercial source of strychnine and brucine

STRYCHNINE:

- extremely toxic

- CNS stimulant

- blocks inhibitory spinal impulses at the postsynaptic level.

- results in tonic convulsion

USES:

vermine killer

BRUCINE

- less toxic
- alcohol denaturant

PHYSOSTIGMINE

- physostigma or calabar bean or ordeal bean
- dried ripe seed of *physostigma venenosum*

Alkaloids:

- physostigmine(eserine)
- eseramine
- geneserine
- physovenine

Physostigmine or eserine

- acquires red tint when exposed to heat, light, air or metal

Uses:

- reversible inhibitor of cholinesterase
- enhances effects of acetylcholine
- used in open-angle glaucoma, decreases intraocular pressure

PHYSOSTIGMINE SALICYLATE OR ESERPINE SALICYLATE

-it is a white powdered that also acquires a red tint when exposed to the conditions described under physostigmine.

- cholinergic (ophthalmic)
- IV antidote for poisoning caused by anticholinergic

PHYSOSTIGMINE SULFATE

- cholinergic
- applied topically to conjunctiva
- white microcrystalline powder is deliquescent in moist air and acquires the red tint previously described.

ERGOT

-rye ergot or *secale cornutum*

Dried sclerotium of *claviceps purpurea* developed on plants of rye

-not less than 0.15% alkaloids (ergotoxine)

-0.01% water soluble (ergonovine)

Spurred eye- common name of the drug

Mycellium-mass of tissue formed with the hyphae

1.sphacelial stage- asexual stage of the ergot fungi where the spores are being transferred from one plant to the other by insects in honeydew

Sclerotium-resting body, hardened ovary

2.ascigerous stage-sexual stage

-production of sexual spores or ascospores

Ergotism-outbreak in old times before moderns agriculture practices

a. in France- gangrene

-restricted blood flow due to vasoconstricting action of alkaloids

-previously called ST.ANTHONY's FIRE

b. in Rhine and Germany- convulsion

constituents of ergot:

1.ergonovine-most important

2.ergotoxine-

3.ergoloxine-ergoristine + ergokryptine + ergocornine

Lysergic acid-precursor of medicinal useful alkaloids from ergot

Derivatives of isolysergic acid-physiologically inert

Histamine and tyramine- contribute to physiologic activity of crude drug

USES:

□ oxytocic properties

ERGONOVINE MALEATE OR ERGOMETRINE MALEATE

-white or faintly yellow,colorless ,microcrystalline powder

Ergobasine- Switzerland

-first isolation

Uses:

oxytocic

vasoconstrictor

Ergometrine-isolysergic acid isomer of ergonovine

METHYLERGONOVINE MALEATE

-semisynthetic homolog of ergonovine

-lysergic acid + 2-aminobutanol

-white to pinkish tan,microcrystalline powder

Uses;

oxytocic

slightly more active and longer than ergonovine

ERGOTAMINE TARTRATE

- specific analgesic in treatment of migrain by reducing extracranial blood flow and decreases the amplitude of pulsations
- enhanced by caffeine

HYDROERGOTAMINE MESYLATE

- semisynthetic alkaloid ergotamine by hydrogenation
- migraine treatment, more effective and tolerated compared to ergotamine

ERGOTOXINE

- mixture of alkaloid ergocristine ergokryptine ergocornine
- formely employed as ergotoxine extranisulfunrate

Ergoloid-methanisulfonate

- for elderly patients
- vasorelaxant, increased cerebral blood flow lower BP and causes bradycardia

METHYsergide maleate

- semisynthesized from lysergic acid
- serotonin antagonist
- for prophylaxis of vascular headache

LYSERGIC ACID DIETHYLAMIDE (LSD)

produces a predominant central sympathetic stimulation to parallel slight depression

most active and specific psychotomemetic agent

drugs related to ergot:

Ololiuqui -ancient ajtec hallucinogec drug

-from seed of rovea corymbosa ipomomea

spp and arygyreia

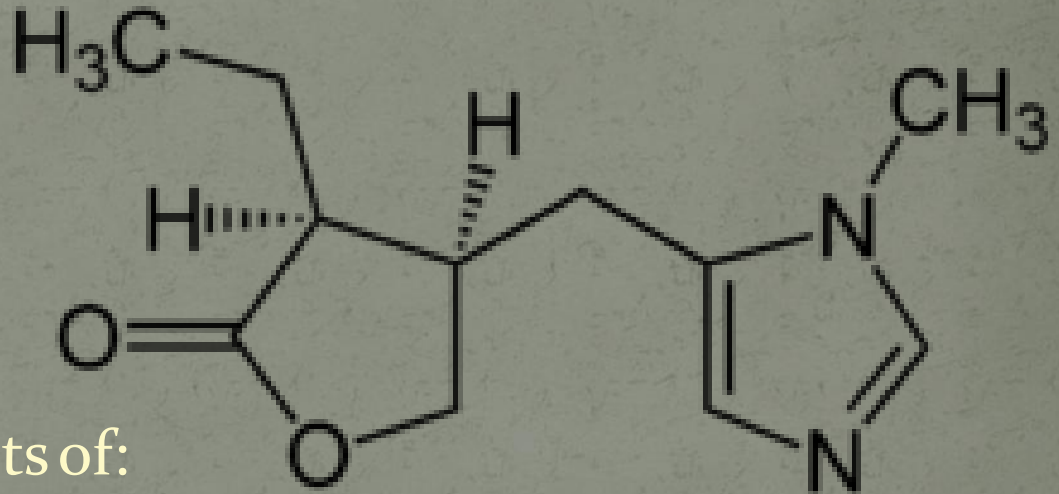
IMIDAZOLE ALKALOIDS

Contain imidazole (glyoxaline) rings

PILOCARPINE

PILOCARPUS

- AKA jaborandi
- Consists of leaflets of:
 - *Pilocarpus jaborandi* Holmes
 - *Pilocarpus microphyllus* Stapf
 - *Pilocarpus pinatifolius* Lamaire
- Indigenous to Brazil



PILOCARPINE

- the lactone of pilocarpic acid, an acid with glyoxaline nucleus
- Oily, syrupy liquid, though its salts crystallize easily
- May be obtained by
 1. treating the powdered leaves with sodium carbonate
 2. Extracting with benzene
 3. Shaking the benzene extract with dilute hydrochloric or nitric acid
 4. Aqueous solution is made alkaline and shaken with chloroform
 5. The chloroform is shaken with acid
 6. The alkaloidal salt is allowed to crystallize.

PILOCARPINE

□ MOA:

It directly stimulates the muscarinic receptors in the eye, causing constriction of the pupil and contraction of the ciliary muscle.

□ **In narrow-angle glaucoma**

Miosis opens the anterior chamber angle to improve the outflow of aqueous humor.

□ **In chronic open-angle glaucoma**

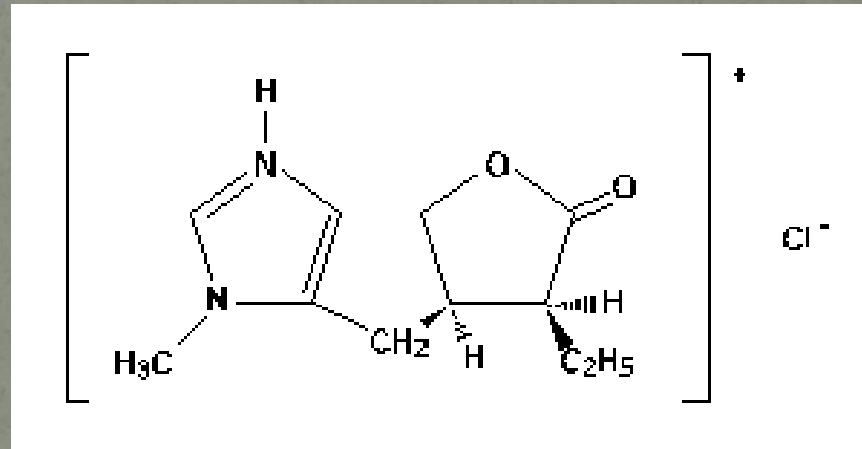
The increase in outflow is independent of the miotic effect. Contraction of the ciliary muscle enhances the outflow of aqueous humor via indirect effects on the trabecular system.

PILOCARPINE

□ Salts

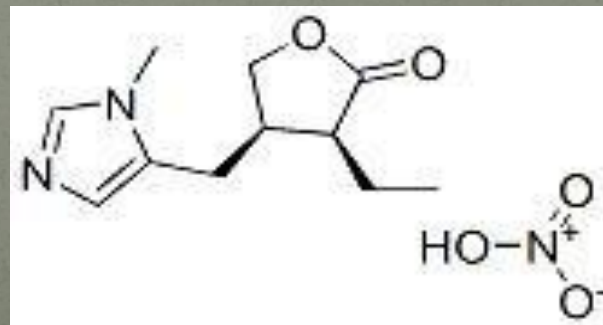
□ Pilocarpine hydrochloride - crystals of the hydrochloride of Pilocarpine

- Colorless
- Translucent
- Odorless
- faintly bitter
- Hygroscopic



□ Pilocarpine nitrate – crystals of the nitrate of Pilocarpine

- Shiny
- White
- Stable in air
- Light-sensitive



Uses:

Ophthalmic drugs for treatment of glaucoma

Applied topically

Dosage:

0.05-0.1mL of a 0.25 to 10% solution of Pilocarpine hydrochloride

OR

0.05-0.1mL of a 0.5 to 6% solution of Pilocarpine nitrate

Applied to the conjunctiva, 1-6x a day

Patients should be advised to wash hands immediately after application.



Pilocar[®]



Isopto-carpine[®]

STEROIDAL ALKALOIDS

Characterized by the cyclopentanophenanthrene nucleus either formed from cholesterol or have a common precursor with cholesterol

VERATRUM VIRIDE

- AKA American hellebore or green hellebore
- Veratum: “vere” = truly, “ater” = black
- Viride = green
- Consists of the dried rhizome and roots of *Veratum viride*
Alton

VERATRUM VIRIDE

- Grows in wet meadows in the mountainous section of New England and the Eastern United States, North Carolina, Tennessee, and northern Georgia
- Veratum: “vere” = truly, “ater” = black
- Obtained by:
 - digging the rhizomes
 - Cleaning
 - Cutting longitudinally
 - drying



VERATRUM VIRIDE

- Contains a large no. of alkaloids customarily classified in 3 groups, with their chemical constituents as basis.

Group 1	Group 2	Group 3
consists of esters of the steroidal bases (alkamines) with organic acids	consists of lucosides of of the alkamines	Consists of the alkamines
Includes: <ul style="list-style-type: none">•Cevadine•Germidine•Germitrine•Neogermitrine•Neoprotoveratrine•Protoveratrine•Veratridine	Includes: <ul style="list-style-type: none">•Pseudojervine•Veratrosine	Includes: <ul style="list-style-type: none">•Germine•Jervine•Rubijervine•veratramine

- The ester alkaloids, germidine and germitrine are probably the most important therapeutically.

VERATRUM VIRIDE

□ Uses:

□ Antihypertensive

- Small doses principally affect blood pressure without notably changing respiratory or cardiac rate

□ Cardiac-depressant

- In tincture form

□ Sedative

□ Insecticide

VERATRUM ALBUM

□ AKA European hellebore or white hellebore

□ Indigenous to central and southern Europe

□ Similar in appearance and structure with *V. viride*, though its external color is lighter

VERATRUM ALBUM

- Contains a complex mixture of ester alkaloids, glycoalkaloids, and alkamines similar to those occurring in *V. viride*.
- Ester alkaloids protoveratrine A and protoveratrine B are the most active
- Upon hydrolysis, both yield protoverine, acetic acid, methylbutyric acid, and methylhydroxybutyric acid (in protoveratrine A) or methyldihydroxybutyric acid (in protoveratrine B)
- Uses:
 - Antihypertensive
 - Insecticide



ALKALOIDAL AMINES

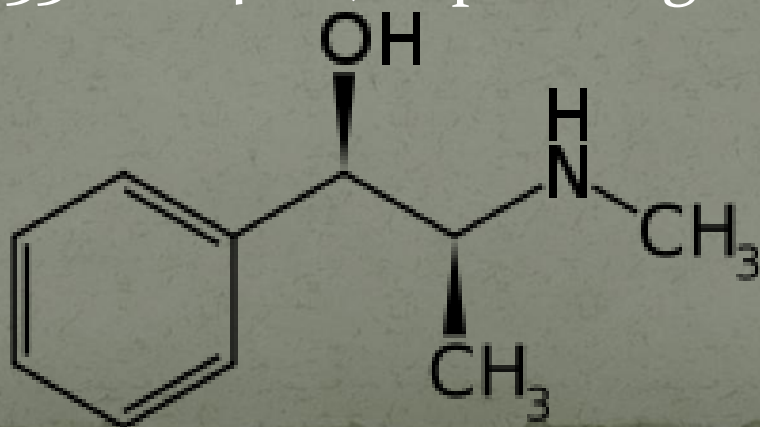
- Do not contain heterocyclic nitrogen atoms
- Mostly are simple derivatives of phenylethylamine

EPHEDRINE

- AKA (-)-erythro- α -[1(methyl-amino)ethyl]benzyl alcohol
- Obtained from Ephedra or ma huang (*Ephedra sinica* Stapf)
- “ma”=astringent, “huang”=yellow
- Used as a medicine in China for more than 5000 years

EPHEDRINE

- Produced commercially by:
 - Extraction of the plant material
 - Chemical procedure involving a reductive condensation between L-1-phenyl-1-acetylcarbinol and methylamine
- Occurs as white, rosette or needle crystals, or as an unctuous mass
- Soluble in water, alcohol, chloroform, ether, and liquid petrolatum
- Melts between 33 and 40°C, depending on its water content



EPHEDRINE

□ Uses:

- Sympathomimetic (stimulates α , β_1 , & β_2 adrenergic receptors)

□ Salts

□ Ephedrine Sulfate – crystals of the sulfate of Ephedrine

- Fine, white, odorless
- Darkens when exposed to light
- Used to combat hypotensive states, for allergic disorders, and for nasal decongestion
- Usual dose is:
25-50mg, 6-8x a day as necessary (oral & parenteral)
0.1-0.15mL of a 1-3% solution, 2-3x a day (intranasal)
- Readily soluble in water and in hot alcohol but not in ether

EPHEDRINE

- Ephedrine hydrochloride – crystals of the hydrochloride of Ephedrine
 - Fine, white, odorless
 - Affected by light
 - Used as a sympathomimetic
 - Usual dose is 25-50mg, every 3-4 hrs
 - Readily soluble in water and in hot alcohol but not in ether

□ Dainite KI, Quadrinal, Tedral, Bronkotabs, Bronkaid

COLCHICINE

- extracted from plants belonging to the *Colchicum* genus
- has one amino nitrogen atom
- lacks pronounced basicity and does not form a well-defined series of salts
- pale yellow, amorphous scales or powder that gradually turns darker when exposed to light
- soluble in water and ether; freely soluble in alcohol and chloroform
- inhibits leukocyte migration and reduces lactic acid production by leukocytes, resulting in a decreased deposition of uric acid
- causes reduction in phagocytosis which decreases inflammatory response

- *Colchicum* seed - dried, ripe seed of *C. autumnale*
- *Colchicum* corm – dried corm (stalk) of *C. autumnale*

Use:

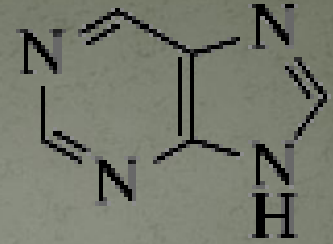
-suppressant for gout

Dosage:

-500-650 μ g, 1-3x a day (oral)

-500 μ g-1mg, 1-2x a day (intravenous)

PURINE BASES



- Derivatives of a heterocyclic nucleus consisting of the 6-membered pyrimidine ring fused to the 5-membered imidazole ring **purine**
- Does not occur in nature, but numerous derivatives are biologically significant

□ Xanthine – source of the most important purine bases
eg caffeine (1,3,7-trimethylxanthine), theophylline (1,3-dimethylxanthine), & theobromine (3,7-dimethylxanthine)

MOA: The methylxanthines competitively inhibit phosphodiesterase, which results in an increase of cyclic adenosine monophosphate with a subsequent release of endogenous epinephrine. This results in a direct relaxation of the smooth muscles of the bronchi and pulmonary vessels, a stimulation of the CNS, an induction of diuresis, an increase in gastric acid secretion, an inhibition of uterine contractions, and a weak positive inotropic effect on the heart.

Caffeine-containing drugs

□ Kola

- AKA cola or kolanuts
- Dried cotyledon of *Cola nitida* or other sp. of *Cola*
- Yields not less than 1% of anhydrous caffeine
- Impt. because of its caffeine content and flavor
- Contains up to 3.5% caffeine, and less than 1% theobromine
- Bound to the tannin kolacatechin in fresh nuts

Uses:

- Stimulant
- Ingredient in several carbonated beverages

- Coffee bean
 - AKA coffee seed
 - Dried, ripe seed of *Coffea arabica* or *C. liberica*
 - Contains about 1-2% caffeine, 0.25% trigonelline, 35% tannin, about 15% glucose and dextrin, 10-13% fatty oil (mainly olein and palmitin), and 10-13% proteins.

Roasted coffee – coffee roasted until it acquires a dark brown color and develops the characteristic aroma

Caffeol – oil that causes the aroma

- consists about 50% furfural with traces of valerianic acid, phenol, and pyridine

-produced during the roasting process

Decaffeinated coffee – prep. by extracting the most of the caffeine from the coffee bean, yet retaining the pleasant characteristic aroma

-contain up to 0.08% caffeine

Methods of freeing the seeds from the parchmentlike endocarp:

1. The fruits are allowed to dry and are then broken
2. The wet method in which the sarcocarp is removed by means of a machine, and the 2 seeds with the parchmentlike endocarp are allowed to dry in such a manner as to undergo a fermentation. After drying, the endocarp is removed.

Caffeine content comparison:

A cup of brewed coffee : 100-150mg

instant coffee : 85-100mg

tea: 60-75mg

cocoa: 5-40mg

12oz cola drink: 40-60mg

Est. max. daily dose: 1.5g

Uses:

- Dietetic
- Stimulant
- Diuretic

- Guarana

- Dried paste composed chiefly of the crushed seed of *Paullinia cupana*
- Contains 2.5-5% caffeine, and 25% catechutannic acid

Uses:

- Stimulant
- Astringent

- Maté

- AKA Paraguay tea
- Consists of the leaves of *Ilex paraguariensis*
- Contains 2% caffeine and tannin

Uses:

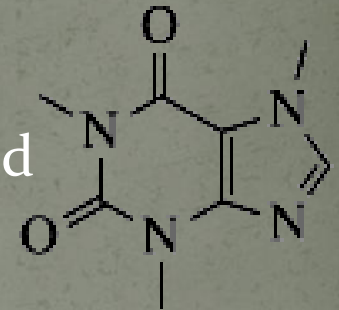
- Stimulant
- Laxative/purgative
- Diaphoretic
- Diuretic

Caffeine

- 1,3,7-trimethylxanthine
- Usually prep. from tea, tea dust, or tea sweeping, or recovered from coffee roasters
- Anhydrous or contains 1 molecule of water of hydration
- White powder or white glistening needles matted together in fleecy masses
- Bitter
- May be sublimed without decomposition when heated

Uses:

- CNS stimulant
- Caffeine and sodium benzoate
 - for IM inj. as an analeptic in the treatment of poisoning
 - Stimulant in acute circulatory failure
 - diuretic



caffeine

□ Tea

- AKA thea
- Consists of leaves and leaf buds of *Camellia sinensis*
- Occurs as more or less crumpled, bright green or blackish g masses
- Smells agreeable and aromatic
- Tastes pleasantly astringent and bitter
- Contains 1-4% caffeine (theine) and small amounts of adenine, theobromine, theophylline, and xanthine

Green tea – prep. by rapidly drying the freshly-picked leaves in copper pans over a mild artificial heat. The leaves are often rolled in the palm of the hand as they dry.

Black tea – prep. by heaping the fresh leaves until fermentation has begun. They are then rapidly dried artificially with heat.

Uses:

- Stimulant (due to caffeine)
- Astringent (due to the tannin)

Theophylline

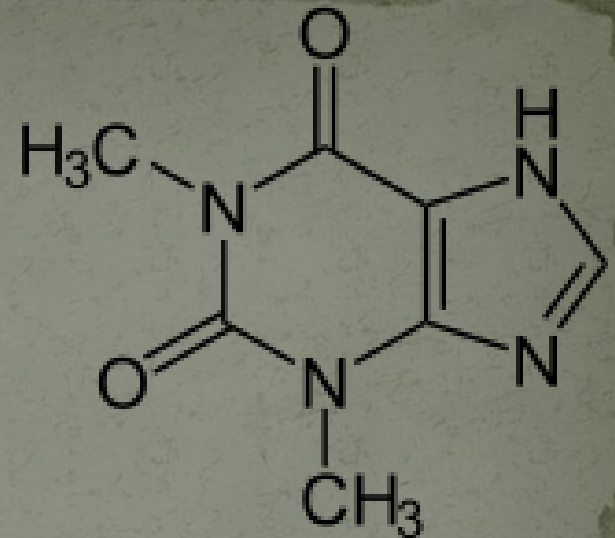
- Isomeric with theobromine
- White, odorless, bitter crystalline powder
- Soluble in about 120 parts of water, rendered more soluble in basic compounds

Uses:

- Smooth muscle relaxants for the symptomatic relief or prevention of bronchial asthma and treatment of reversible bronchospasm associated with chronic bronchitis and emphysema
- Diuretic

Aminophylline - valuable diuretic

- exhibits dilating action on the pulmonary vessels in relieving asthma and can lower venous pressure in certain cases of heart failure

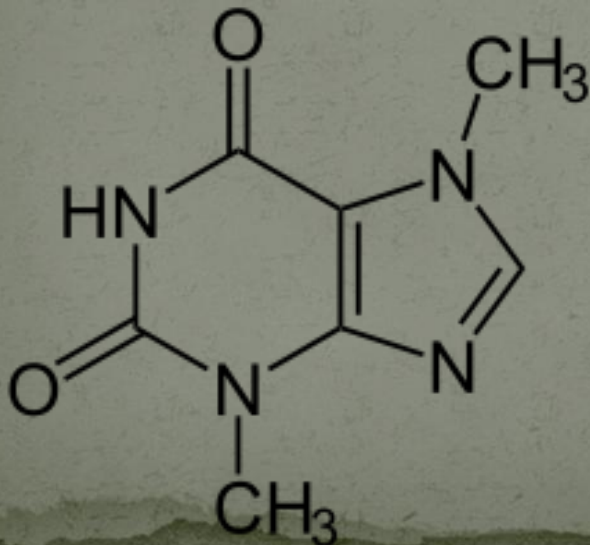


Theobromine

- 3,7-dimethylxanthine
- Prep from the dried, ripe seed of *Theobroma cacao*
- White, crystalline powder with bitter taste and sublimes at about 260°C.

Uses:

- Diuretic
- Smooth muscle relaxant
- Preferred over caffeine in the treatment of cardiac edema and angina pectoris, since it has little stimulant action



Thanking you

