Pharmacognosy

CHAPTERWISE NOTES

Drugs Containing Alkaloids

PHARMA

PHARMACOGNOSY

Drugs Containing Alkaloids

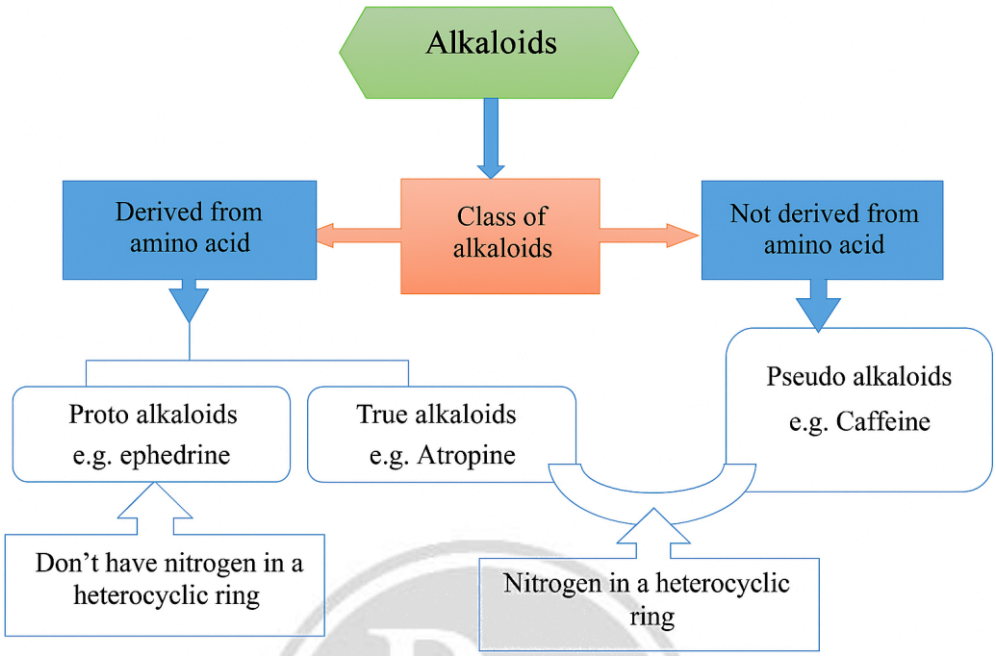
1. **Introduction**
   - **Occurrence**: Found in plant parts such as berries, bark, roots, and leaves, and also in animals and fungi.
   - **Structure**: Alkaloids usually contain complex ring structures with nitrogen atoms (often in heterocycles). They are typically derived from amino acids.
   - **Properties**: They have pharmacological effects, ranging from pain relief to being poisonous (e.g., strychnine).
   - **Applications**: Used for treating pain, malaria, hypertension, and mental disorders.
2. **Definition of Alkaloids**
   - **Alkaloids**: Nitrogen-containing organic compounds with complex ring structures, often having physiological effects. They are typically bases (alkaline in nature), and they are classified as secondary metabolites in plants, animals, and fungi.
3. **History of Alkaloids**
   - **Ancient Use**: Alkaloids have been used by ancient civilizations, including the Egyptians and Sumerians.
   - **First Isolation**: Alkaloids were first reproducibly isolated in the early 19th century with **morphine being one of the first alkaloids to be isolated (1803–1806).**
   - **Significant Discoveries**:

Year Isolated	Alkaloid
1803	Narcotine
1806	Morphine
1817	Strychnine
1819	Caffeine
1820	Quinine
1820	Colchicine
1826	Coniine

     - **20th Century Discoveries**: Alkaloids like **paclitaxel** (anticancer) and **catharanthus alkaloids** became important.

Classification of Alkaloids

- Alkaloids are classified based on their molecular precursors and structure. The classification includes three main types: **True Alkaloids**, **Protoalkaloids**, and **Pseudoalkaloids**.



1. True Alkaloids

- **Origin**: **Derived from amino acids.**
- **Structure**: Contain a heterocyclic ring with nitrogen.
- **Properties**: Bitter taste, **crystalline**, form water-soluble salts.
- **Examples**: Cocaine, Quinine, Dopamine, Morphine.
- **Precursors**: Amino acids like L-ornithine, L-lysine, L-phenylalanine, L-tyrosine, L-tryptophan, and L-histidine.

TRUE ALKALOIDS		
Precursor/ Parent Compound	**Chemical Group**	**Examples**
l-Ornithine	Pyrrolidine Alkaloids	Cuscohygrine, Hygrine
l-Ornithine	Tropane Alkaloids	Atropine, Cocaine, Hyoscyamine, Scopolamine (Hyoscine)
l-Ornithine	Pyrrolizidine Alkaloids	Ilamine, Indicine-N-oxide, Meteloidine, Retronecine
l-Lysine	Piperidine Alkaloids	Anaferine, Lobelanine, Lobeline, Pelletierine, Piperine, Pseudopelletierine, Sedamine
l-Lysine	Quinolizidine Alkaloids	Cytisine, Lupanine, Sparteine
l-Lysine	Indolizidine Alkaloids	Castanospermine, Swansonine
l-Tyrosine	Phenylethylamine Alkaloids	Adrenaline, Anhalamine, Dopamine, Noradrenaline, Tyramine

l-Tyrosine	Simple Tetrahydroisoquinoline Alkaloids	Codeine, Morphine, Norcoclaurine, Papaverine, Tetrandrine, Thebaine, Tubocurarine
l-Tyrosine / l-Phenylalanine	Phenethylisoquinoline Alkaloids (Amaryllidaceae)	Autumnaline, Crinine, Galanthamine, Haemanthamine, Lycorine, etc.
l-Tryptophan	Simple Indole Alkaloids	Psilocin, Serotonin, Tryptamine, Zolmitriptan
l-Tryptophan	Simple β-Carboline Alkaloids	Elaeagnine, Harmine
l-Tryptophan	Terpenoid Indole Alkaloids	Ajmalicine, Catharanthine, Secologanin, Tabersonine
l-Tryptophan	Quinoline Alkaloids	Quinine, Quinidine, Chloroquinine, Cinchonidine
l-Tryptophan	Pyrroloindole Alkaloids	Yohimbine, Chimonantheine, Corynanthine, Corynantheidine
l-Tryptophan	Ergot Alkaloids	Ergotamine, Ergocryptine
l-Histidine	Imidazole Alkaloids	Histamine, Pilocarpine, Pilosine
Marine Origin	Manzamine Alkaloids	Xestomanzamine-A, -B
l-Arginine	Marine β-Carboline Alkaloids	Saxitoxin, Tetrodotoxin
Anthranilic Acid	Quinazoline Alkaloids	Peganine
Anthranilic Acid	Quinoline Alkaloids	Dictamnine, Skimmianine, Bucharine, etc.
Acridone Pathway	Acridone Alkaloids	Acronycine, Rutacridone
Nicotinic Acid	Pyridine Alkaloids	Nicotine, Anabasine, Cassinine, Regelidine, Wilforine

2. **Protoalkaloids**
   - **Origin**: **Derive from amino acids but the nitrogen atom is not part of the heterocyclic ring.**
   - **Structure**: Simple alkaloids with a closed ring.
   - **Examples**: Hordenine, Mescaline, Yohimbine.
   - **Features**: Less common than true alkaloids.

PROTO ALKALOIDS		
Precursor	**Chemical Group**	**Examples**
l-Tyrosine	Phenylethylamine Alkaloids	Hordenine, Mescaline
l-Tryptophan	Terpenoid Indole Alkaloids	Yohimbine
l-Ornithine	Pyrrolizidine Alkaloids	Stachydrine, 4-Hydroxy Stachydrine

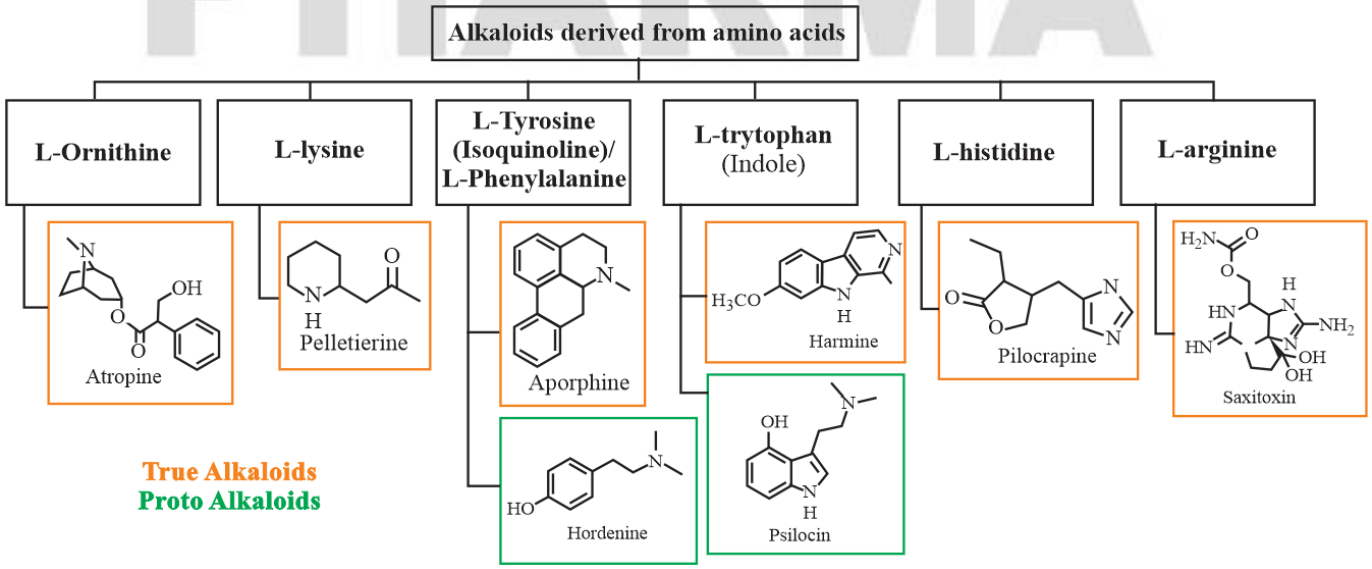
3. Pseudoalkaloids

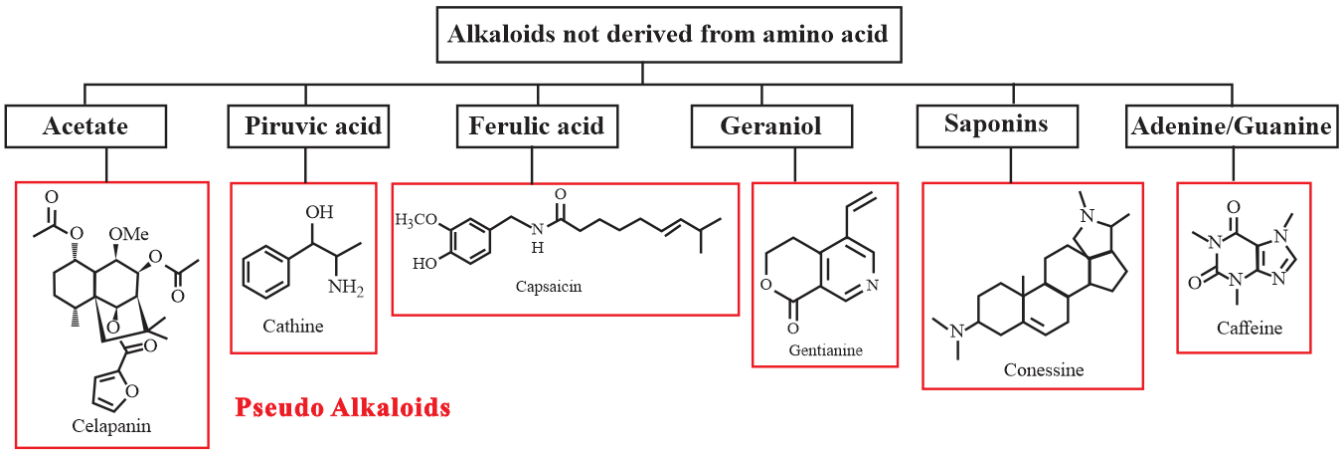
- **Origin**: **Not directly derived from amino acids; derived from non-amino acid precursors.**
- **Structure**: Nitrogen atom inserted into the molecule at a later stage, often involving trans-amination reactions.
- **Examples**: Conine, Capsaicin, Ephedrine, Solanidine, Caffeine, Theobromine.
- **Features**: Can result from steroidal or terpenoid skeletons.

PSEUDO ALKALOIDS		
Precursor/Source	**Chemical Group**	**Examples**
Acetate	Piperidine Alkaloids	Coniine, Coniceine, Pinidine
Sesquiterpene	Sesquiterpene Alkaloids	Cassinine, Evonoline, Wilforine, Celapanin
Pyruvic Acid	Ephedra Alkaloids	Ephedrine, Cathine, Cathinone, Norephedrine
Ferulic Acid	Aromatic Alkaloids	Capsaicin
Geraniol	Terpenoid Alkaloids	Aconitine, Atisine, Gentianine, β-Skytanthine
Saponins (Cholestane-based)	Steroid Alkaloids	Conessine, Jervine, Solanidine, Solasodine, Protoveratrine A/B
Adenine/Guanine	Purine Alkaloids	Caffeine, Theobromine, Theophylline

4. Additional Classifications

- **Atypical Alkaloids**: Also known as non-heterocyclic alkaloids, contain nitrogen in aliphatic chains.
- **Typical Alkaloids**: Known as heterocyclic alkaloids, contain nitrogen in a heterocyclic ring system.





Group	Example & Source
1. Nonheterocyclic Alkaloids	
Phenylethylamine alkaloid	Ephedrine, Mescaline, Hordenine — *Ephedra* sp.
Tropolone alkaloids	Colchicine — *Colchicum* sp.
Modified diterpene	Taxol — *Taxus* sp.
2. Heterocyclic Alkaloids	
a. Mono-nuclear Heterocyclic Alkaloids	
Pyridine	Lobeline — *Lobelia* sp.
Piperidine	Piperine — *Piper* sp.
Pyrrole	Hygrine — *Coca* sp.
Pyrrolidine	Nicotine — *Tobacco* sp.
Imidazole	Pilocarpine — *Pilocarpus* sp.
b. Poly-nuclear Heterocyclic Alkaloids	
Isoquinoline	Morphine, Papaverine — Opium
Quinoline	Quinine — *Cinchona* sp.
Indole	Ergotamine, Reserpine, Vincristine, Strychnine — *Ergot*, *Rauwolfia*, *Vinca*, *Nux vomica*
Quinazoline	Vasicine — *Vasaka*
Tropane	Atropine, Hyoscine — *Datura*, *Belladonna*
Purine	Caffeine — Coffee, Tea
Steroid	Solasodine — *Solanum* sp.
Terpenoid	Aconitine — *Aconite* sp.

Properties of Alkaloids:

- **General Properties**:
  - Typically **colourless, crystalline solids**.
  - **Basic** with a **ring structure**.
  - **Bitter** taste.
  - Some are **chiral** and exist as **isomers**.
  - **Solubility**:
- Free alkaloid bases are soluble in **organic solvents** but insoluble in water.
- Alkaloidal salts are **soluble in water** and **partially soluble in organic solvents**.
- **Exceptions:**
  - **Some alkaloids are not basic or are colored (e.g., betanidine, berberine, sanguinarine).**
  - **Some alkaloids are liquid (e.g., nicotine).**

Extraction of Alkaloids:

1. **Method A**:
   - Use alkaline substances (e.g., sodium bicarbonate, ammonia) to release alkaloid bases.
   - Extract with **organic solvents** (e.g., ether or petroleum spirit).
   - Separate alkaloid salts in the aqueous phase after shaking with an acid.
2. **Method B**:
   - Use aqueous alcohol with **dilute acid** to extract.
   - Add **alkali** (e.g., sodium bicarbonate) to precipitate free alkaloids.
   - Use **organic solvents** to separate alkaloids.

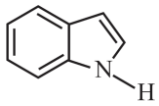
- **Volatile liquid alkaloids** (e.g., nicotine) are isolated by **distillation**.

Chemical Tests for Alkaloids:

Test Name	Reagent Used	Observation/Result
Dragendorff's Test	**Potassium Bismuth Iodide (Dragendorff's reagent)**	**Orange-red precipitate**
Mayer's Test	**Potassium Mercuric Iodide (Mayer's reagent)**	**Creamy-white precipitate**
Hager's Test	**Saturated Picric Acid solution (Hager's reagent)**	**Yellow crystalline precipitate**
Wagner's Test	**Dilute Iodine solution (Wagner's reagent)**	**Reddish-brown precipitate**
Tannic Acid Test	**Tannic acid solution**	**Buff-colored precipitate**
Ammonia Reineckate Test	**Ammonia Reineckate solution**	**Pink flocculent precipitate**

1.1 Indole Alkaloids

Indole



Structure and Properties:

- **Indole is a benzopyrrole, where the benzene and pyrrole rings are fused at the 2,3-positions of the pyrrole.**
- **Physical Properties:** Colorless crystalline solid, mp 52-54°C, bp 254°C.
- The molecule is planar with moderate polarity.
- **Solubility:** Soluble in petroleum ether, benzene, chloroform, and hot water, but 1:540 soluble in cold water at 25°C. Forms salts with strong acids and bases.

Commercial and Biological Importance:

- Used in perfumes for its aromatic properties.
- Found in biologically active compounds like serotonin, psilocin, psilocybin, reserpine, and melanin pigments.

Occurrence and Significance:

- Present in **tryptophan (essential amino acid), heteroauxin (plant growth hormone),** and important alkaloids.
- Produced during pancreatic digestion and protein decomposition (e.g., skatole).
- Studied for its role in brain chemistry and psychotomimetic effects.

Isoindole:

- Isoindole is an isomer of indole, fused at the 3,4-positions. It is unstable, with derivatives like N-methylisoindole known.

History:

- **First obtained in 1866 by Adolf von Baeyer.**

Plants Containing Indole Alkaloids: Vinca, Ergot, Rauwolfia, Nux vomica, Physostigma.

1.1.1 Ergot

Synonyms:

- Ergot, Rye Ergot, Secale cornutum, Spurred rye, Ergota

Biological Source:

- Ergot is the dried sclerotium of the fungus ***Claviceps purpurea***, belonging to the **Clavicipitaceae family.** It develops in the ovary of rye (Secale cereale, Poaceae family).

Geographical Source:

- Found mainly in Czechoslovakia, Hungary, Switzerland, Germany, France, Yugoslavia, Spain, Russia, and India (cultivated in Kodaikanal, Tamil Nadu).

Cultivation and Collection:

- The fungus life cycle includes:

1. **Sphacelia (asexual stage):** Fungal spores infect rye flowers, producing a sweet, viscous honeydew.
2. **Sclerotium (sexual stage):** Hyphae penetrate the ovary, forming a dark, hard sclerotium (ergot), which is collected after 6 weeks.
3. **Ascospore stage:** If not collected, the sclerotia produce ascospores in the next season, which infect new plants.

Chemical Constituents:

- **Water-soluble group:** **Ergometrine (ergonovine), Ergometrinine.**
- **Water-insoluble groups:**
  - **Ergotamine group:** Ergotamine, Ergotaminine, Ergosine.
  - **Ergotoxine group:** Ergocristine, Ergocryptine, Ergocornine.

Pharmacological Effects:

- **Ergometrine:** Oxytocic effect, used for postpartum hemorrhage.
- **Ergotamine:** Used as a migraine-specific analgesic (dihydroergotamine).
- **Lysergic acid diethylamide (LSD):** Psychotomimetic effects, prepared from lysergic acid.

Active Alkaloids:

- **Ergotamine, Ergometrine (ergonovine) are the major pharmacologically active alkaloids,** while other derivatives have varying effects on uterine tone and migraine relief.

Uses:

- **Ergometrine:** Stimulates uterine contractions, prevents postpartum hemorrhage
- **Ergotamine & Dihydroergotamine:** Analgesics for migraine treatment

1.1.2 Nux Vomica (*Strychnos Nux Vomica*)

Synonyms:

- Semen strychni, Nux vomica seed, Poison nut, Quaker buttons, Bachelor's buttons, Vomit nut, Crow fig.

Biological Source:

- Dried ripe seeds of ***Strychnos nux vomica* (*family: Loganiaceae*)**, containing not less than 1.2% strychnine.

Geographical Source:

- Found in South India (Malabar Coast, Kerala, Bengal, Eastern Ghats), North Australia, and Ceylon.

Chemical Constituents:

- **Strychnine (1.25%):** Toxic alkaloid, responsible for central nervous system effects.
- **Brucine (1.5%):** Less toxic, used for determining bitter value.
- **Loganin:** A glucoside present in the pulp.
- **Other Alkaloids:** Strychnicine, Vomicine, Pseudostrychnine, and traces of fatty matter and copper.

Chemical Tests:

1. **Strychnine Test:** Ammonium vanadate + H_2SO_4 → **purple stain**
2. **Potassium Dichromate Test:** Potassium dichromate + H_2SO_4 → **violet color**
3. **Brucine Test:** Concentrated HNO_3 → **yellow to orange stain**
4. **Hemicellulose Test:** Iodine + H_2SO_4 → **blue stain**

Uses:

- **Strychnine:** Bitter tonic, appetite stimulant, improves digestion, nervine tonic, circulatory stimulant (cardiac failure)
- **Brucine:** Less toxic; local anodyne for itching and ear inflammation

Note:

- **Despite being called the "vomit nut," Nux vomica does not have emetic properties.** However, ***Strychnos potatorum*** is known for its emetic action.

1.1.3 Physostigma (Calabar Bean)

Synonyms:

- Calabar bean, Ordeal bean, Chop nut.

Biological Source:

- Dried ripe seeds of ***Physostigma venenosum (family: Leguminosae),*** containing not less than 0.15% alkaloids.

Geographical Source:

- Found in West Africa, Old Calabar, India, and Brazil.

Chemical Constituents:

- **Alkaloids (0.1-0.2%):**
  - **Physostigmine (Eserine): The major alkaloid (0.04–0.3%), a crystalline solid, soluble in alcohol, sparingly in water.**
  - **Other alkaloids:** Eseramine, Geneserine, Physovenine.
  - Also contains Stigmasterol.

Chemical Structure:

- **Physostigmine is a methyl carbamide ester of eroline.**

Uses:

- **Ophthalmic:** Pupil contraction, glaucoma treatment
- **Intestinal:** Stimulates smooth muscles, relieves chronic constipation
- **Circulatory:** Slows pulse, raises blood pressure
- **CNS:** Depressant causing muscle weakness

1.1.4 Rauwolfia (Sarpagandha)

Synonyms:

- Sarpagandha, Chandrika, Chootachand, Indian Snake Root

Biological Source:

- Dried roots of ***Rauwolfia serpentina*** **(family: Apocynaceae).**

Geographical Source:

- Native to the Orient, found in India, Pakistan, Burma, Thailand, Vietnam, Indonesia, Malaysia, Sumatra, and Java.

Chemical Constituents:

- **Alkaloids (0.7–2.4% total alkaloidal bases):**
  - **Reserpine (antihypertensive, tranquilizer), Ajmaline (for cardiac arrhythmias), Ajmalicine (8-yohimbine),** Rescinnamine, Raubescine, Deserpidine, ψ-Reserpine, Rescinnamine, Raubasine, Serpentine, Serpentinine, Tetrahydroreserpine, Isoajamaline, Yohimbine.
- **Other Compounds:** Phytosterols, Fatty acids, Unsaturated alcohols, Sugars.

Uses:

- Hypnotic, Sedative, Antihypertensive; Treats Insanity, Lowers Blood Pressure, Relieves Bowel Pain; Enhances Labor Contractions; **Ajmaline** (Arrhythmias); **Reserpine & Deserpidine** (Tranquilizers, Antihypertensives)

Marketed Products:

- Confido, Lukol, Serpina (Himalaya Drug Company), Sarpagandhan Bati (Baidyanath).

1.1.5 Vinca (*Catharanthus roseus*)

Synonyms:

- Vinca rosea, Madagascar Periwinkle, Barmasi, Catharanthus

Biological Source: Dried the entire plant of ***Catharanthus roseus*** **(family: Apocynaceae).**

Geographical Source:

- Native to Madagascar, found in tropical and subtropical regions, including India, Australia, South Africa, and the Americas.
- Cultivated as a garden plant in Europe and India.

Microscopy:

- **Calcium Oxalate Crystals: Absent.**

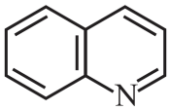
Chemical Constituents:

- **Alkaloids** (present in the entire plant, especially the leaves and roots): **Vinblastine (anticancer), Vincristine (cytotoxic, treats leukemia),** Vindoline, **Catharanthine, Ajmalicine, Serpentine**, Tetrahydroalstonine.
- Other Compounds: Monoterpenes, Sesquiterpenes, Indole and indoline glycosides.

Uses:

- **Vinblastine:** Antitumor (Hodgkin's disease)
- **Vincristine:** Treats childhood leukemia
- **Astringent & Tonic:** Menorrhagia, hemorrhages, sore throats, tonsillitis
- **Bleeding Piles:** Internal and external use
- **Diabetes Treatment**
- **Purgative:** Gentle laxative, especially in syrup for chronic constipation

1.2 Quinoline Alkaloids



1. **Quinoline Structure**:
   - Heterocyclic compound with a double carbon ring and one nitrogen atom.
2. **Source of Quinine**:
   - Derived from the bark of *Cinchona ledgeriana* (a tree in the Rubiaceae family).
3. **Antimalarial Properties**:
   - Quinine is toxic to *Plasmodium* species, including *Plasmodium vivax* (causes malaria).
   - Targets protozoans invading and multiplying within red blood cells, causing cell rupture and symptoms like fever and chills.
4. **Malaria Transmission**:
   - Spread through the bite of female *Anopheles* mosquitoes.

1.2.1 Cinchona (Cinchona spp.)

Synonyms:

- Cortex Cinchonae, Countess, Peruvian or Jesuit's Bark

Biological Source:

- Dried bark of the stem or root of ***Cinchona calisaya, Cinchona ledgeriana, Cinchona officinalis, and Cinchona succirubra* (family: Rubiaceae).**

Geographical Source:

- Native to the tropical valleys of the Andes in Bolivia and Southern Peru.
- Cultivated in Indonesia (Java), Zaire, India, Guatemala, Bolivia, Ceylon, etc.

Characteristics:

- **Microscopic Features:** Cork with thin-walled cells, red-brown parenchyma containing starch grains, **prismatic calcium oxalate** microcrystals, and lignified phloem fibres.

Chemical Constituents:

- **Alkaloids:** More than 30 alkaloids, with key ones being: **Quinine, Quinidine, Cinchonine, Cinchonidine.**
- Other constituents include quiniarnine, cinchotine, hydroquinine, hydrocinchonidine, cinchotannic acid, and quinic acid. Glycosides, starch grains, and calcium oxalate crystals are also present.

Chemical Tests:

1. **Thalleioquin Test:** Dilute H_2SO_4 + bromine water + sample → **emerald green color forms.**

2. **Red Fumes Test:** Heating with glacial acetic acid → evolution of **red fumes.**
3. **Ultraviolet Fluorescence:** Cinchona bark + H_2SO_4 → **blue fluorescence under UV light** → due to methoxy group in quinine and quinidine.

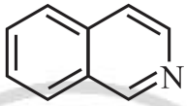
Uses:

- **Antimalarial, Analgesic, Antipyretic, Stomachic, Cardiac Depressant (Quinidine), Treats Rheumatism & Neuralgia (Cinchonidine)**

Substitutes:

- **Cuprea Bark (*Remijia pedupiculato*):** Contains similar alkaloids (quinine, quinidine, cinchonine), but differs in morphology.

1.3 Isoquinoline Alkaloids



- **Structure:** **Isoquinoline consists of a double carbon ring with one nitrogen atom.**
- **Sources:**
  - Argemone species (Prickly Poppy), Chelidonium species (Celandine Poppy), Corydalis species (Fitweed), Dicentra species (Dutchman's Breeches), Papaver species (Poppy), Sanguinera species (Bloodroot).
- **Alkaloids Present:**
  - Papaverine, Sangumarine, Protoverine, Chelidonine
- **Pharmacological Effects:**
  - GI Tract Irritants, CNS Stimulants (from relaxation to seizures), Vasodilation (relaxation of blood vessels).
- **Uses:**
  - **Herbal Uses: Scotch Broom** (Sedative-Hypnotic), **Prickly Poppy** (Euphoriant, Glaucoma), **Mescal Bean** (Hallucinogen), **Sanguinaria** (Dental Plaque), **Papaverine** (Muscle Relaxant), **Celandine** (Gastric/Biliary Disorders)
  - **Medical: Celandine** (Gastric Issues), **Prickly Poppy** (Capillary Dilation in Glaucoma)

1.3.1 Ipecac

Synonyms:

- Ipecacuanha, Brazilian or Johore Ipecac, Hippo, Ipecacuanha root, Radix ipecacuanhae.

Biological Source:

- Dried root or rhizome of ***Cephaelis ipecacuanha (Brot.) A. Rich. (Brazilian Ipecac) or Cephaelis acuminata Karst. (Cartagena Ipecac),*** **family Rubiaceae.**

Geographical Source:

- Native to Brazil; also found in Colombia, Cartagena, Nicaragua, Panama, Malaya, Burma, and cultivated in India (Darjeeling, Nilgiris, Sikkim).

Microscopy:

- The transverse section shows a brown cork, starch grains (muller-shaped), and **calcium oxalate raphides in the cortex.**

Chemical Constituents:

- **Alkaloids: 2-3%, including emetine**, cephaeline, psychotrine, and psychotrine methyl ether.
  - **Emetine: Active, nonphenolic alkaloid.**

Chemical Test for Emetine:

- Powdered drug + HCl + water → filter → add KCl to filtrate → **yellow color** → **turns red on standing** → indicates emetine.

Uses:

- **Emetic, Expectorant, Treats Amoebic Dysentery, HIV Inhibitory (Psychotrine, Methyl Ether)**

Adulterants:

- Substituted by roots of ***Richardsonia scabra, Cryptocoryne spiralis, Psychotria emetica, Calotropis gigantea*.**
- Powdered form may be adulterated with almond meal.

1.3.2 Opium (Papaver somniferum)

Synonyms

- Crude Opium, Raw Opium, Gum Opium, Afim, Post.

Biological Source

- Dried latex from unripe capsules of ***Papaver somniferum* (Family: Papaveraceae).**
- Must contain:
  - Morphine: ≥ 10%
  - Codeine: ≥ 2%
  - Thebaine: ≤ 3%

Geographical Source

- Found in Turkey, Russia, Yugoslavia, India, Pakistan, Afghanistan, China, Iran, Myanmar, Laos.
- Cultivated in India (M.P. and U.P.) for alkaloidal extraction.

Chemical Constituents

- **Alkaloids (35 types):**
  - **Morphine (10–16%): The primary alkaloid, Codeine (0.8–2.5%), Narcotine, Noscapine (4–8%), Thebaine (0.5–2%), Papaverine (0.5–2.5%)**
  - Other alkaloids: Neopine, Pseudo/oxymorphine, Protopine, Hydrocotamine, etc.
- **Meconic acid: Combined with alkaloids.**

Chemical Tests

1. **Meconic acid:** Aqueous extract + $FeCl_3$ → **Deep reddish purple**, persists with HCl.
2. **Morphine:** Morphine + concentrated H_2SO_4 + formaldehyde → **dark violet color forms**.

Uses

- Narcotic, Analgesic, Sedative; **Morphine** (Pain, Cough, Diarrhea), **Codeine** (Cough Sedative), **Noscapine** (Non-Narcotic Cough Suppressant), **Papaverine** (Muscle Relaxant), **Opium/Morphine** (Addiction & Treatment), **Heroin** (Highly Addictive)

1.3.3 Curare

Synonyms

- South American arrow poison, Ourari, Urari, Woorari, Wourara, Woorali.

Biological Source

- **Source:** Dried extract from the stems of:
  - ***Strychnos castelnaei, S. toxifiera, S. crevauxii, S. gubleri* (Family: Loganiaceae).**
  - ***Chondodendron tomentosum, C. microphylla* (Family: Menispermaceae).**

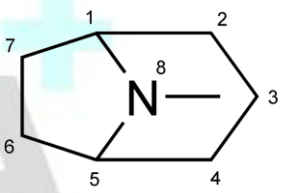
Chemical Constituents

- Contains several alkaloids and quaternary compounds.
  - **Primary Alkaloid: Curarine.**
  - **Quaternary Bases:** Calabashcurarine I and Calabashcurarine II.
  - **Strychnine:** Absent in curare, though the drug comes from the Strychnos genus.

Uses

- **Muscle Relaxant (Surgery), Controls Convulsions (Strychnine Poisoning, Tetanus), Treats Hydrophobia, Cholera, Tetanus; Alkaloid Source**

1.4 Tropane Alkaloids



- **Structure:** Contain the **8-azabicyclo octane nucleus, made of pyrrolidine and piperidine rings. Tropane is a 3-hydroxy tropene derivative,** with two stereoisomers: tropine and pseudotropine.
- **Sources:** Found in plants of the Solanaceae, Erythroxylaceae, and Convolvulaceae families.
- **Key Components:**
  - **Tropic acid** in atropine and atrophic acid (formed by water loss from tropic acid in apoatropine).
  - **Other organic acids:** tiglic acid, acetic acid, isobutyric acid, and isovaleric acid.

1.4 Tropane Alkaloid

1.4.1 Belladonna

Synonyms

- Belladonna herb, Belladonna leaf, **Deadly nightshade leaves**, Banewort, Death's herb, Dwale, **Poison black cherry**, Folia belladonnae.

Biological Source

- **Source:** Dried leaves and flowering tops of ***Atropa belladonna Linn.*** (European Belladonna), **Family: Solanaceae.**
- **Alkaloids: Contains 0.35% of total alkaloids, primarily hyoscyamine.**

Geographical Source

- Cultivated in the United States, Canada, UK, Germany, and India.

Microscopy:

- **Anisocytic and anomocytic stomata.**
- **Block-shaped 'crystal sand' calcium oxalate crystals in mesophyll.**

Chemical Constituents

- **Alkaloids: 0.3–1.0%, primary being hyoscyamine.**
- **Other alkaloids: Atropine,** apoatropine, belladonnine, cuscohygrine, **scopolamine**, homatropine, atroscine, and leucatropic acid.
- Contains rutin, kaempferol, quercetin, scopoletin (fluorescent under ammonia, test for poisoning).
- Acid-soluble ash (14%), acid-insoluble ash (4%).

Uses

- **Therapeutic Uses:** Treats peptic ulcer, colitis, diarrhea, diverticulitis, pancreatitis; anticholinergic for GI and urinary spasms; mydriatic, sedative, anodyne; controls excessive sweating in tuberculosis; parasympathetic depressant.
- **Other Uses:** Narcotic, diuretic, anticholinergic; in Belladonna plaster for backache, muscle stiffness, joint pain.

1.4.2 Coca Leaves

Synonyms

- Coca, Cuca, Cocaine, Folium cocae, Peruvian coca, Truxillo coca, Java coca, Bolivian coca.

Biological Source

- **Source:** Dried leaves of various species of ***Erythroxylon.***
  - **Species: *Erythroxylon coca Lam (Bolivian coca), Erythroxylon coca var. Spruceanum* (Peruvian, Truxillo, or Java coca), *Erythroxylon truxillense Rusby.***
- **Family:** Erythroxylaceae.

Geographical Source

- Found mainly in Bolivia, Peru, Indonesia, Ceylon, Java, and India.

Microscopy

- **Epidermis:** Straight anticlinal walls with **rubiaceous type stomata** (lower surface).
- **Calcium Oxalate: Prism crystals in spongy parenchyma.**

Chemical Constituents

- **Alkaloids: Cocaine** (main active compound), Annamyl Cocaine, Truxilline/Cocamine, Tropacocaine in Java coca, Yellow crystalline glucosides in Java coca.
- **Peruvian/Truxillo leaves: Higher alkaloid content than Bolivian leaves (preferred for medicinal use).**

Uses

- **Cocaine:** CNS stimulant; muscle stimulant; relieves fatigue, hunger, nausea, vomiting, and stomach pain; hallucinogenic; local anesthetic for skin and mucous membranes; basis for synthetic anesthetics (novocain, stovain).

Adulterants

- Jaborandi leaves are used as an adulterant in coca leaves.

1.4.3 Datura Herb

Biological Source

- **Source:** Dried leaves and flowering tops of ***Datura metel Linn*** **and** ***Datura metel var. fastuosa (Black Datura),*** belonging to the family **Solanaceae.**

Geographical Source

- Found in India, England, and other tropical and subtropical countries.

Microscopy

- **Lamina:** Upper epidermis with rectangular cells covered by cuticles. Presence of covering and **glandular trichomes** (uni-seriate, multicellular, warty).
- **Midrib**: Collenchyma strips, **Crystal sand calcium oxalate** in parenchyma cells. The lower epidermis has more trichomes and stomata.

Chemical Constituents

- **Alkaloids:** Up to 0.5% total alkaloids.
  - **Main Alkaloid: Hyoscine (scopolamine).**
  - **Other Alkaloids:** L-hyoscyamine (scopoline), atropine (in smaller quantities).

Chemical Tests

- **Silver Nitrate Test:** Hyoscine hydrobromide solution + Datura herb → **yellowish-white precipitate forms** → soluble in dilute ammonia.

Uses

- **Black Datura: More potent/toxic; source of hyoscine (scopolamine); parasympatholytic, anticholinergic, CNS depressant; treats cerebral excitement, asthma, cough.**

Other Species

- ***D. arborea (Tree Datura):*** Contains 0.44% alkaloids, mainly hyoscine. Used in clairvoyance induction.
- ***D. quercifolia:*** Found in Mexico. Contains both hyoscyamine and hyoscine.
- ***D. innoxia:*** Found in India. Contains hyoscine and hyoscyamine, used for spasmodic asthma.
- ***D. tatula (Purple Stramonium):*** Similar alkaloids to D. stramonium, used in asthma treatment.
- ***D. ferox (Chinese Datura):*** Used in homeopathy.

Marketed Products

- Jatifaladi Bati, Jatyadi tail (Baidyanath).

1.4.4 Duboisia

Synonyms

- Corkwood, Cork tree.

Biological Source

- Dried leaves of ***Duboisia myoporoides, Duboisia hopwoodii, and Duboisia leichhardtii, all belonging to the family Solanaceae.***

Geographical Source

- Found mainly in Australia and Ecuador.

Microscopy (*D. myoporoides*)

- **Mesophyll:** Cylindrical palisade cells, sub-rectangular collecting cells, spongy parenchyma with **micro-sphenoidal calcium oxalate crystals.**
- **Lower Epidermis:** Numerous **cruciferous stomata, scattered glandular trichomes** (75–95 µ long, 15–25 µ wide).

Chemical Constituents

- ***D. myoporoides:***
  - **Chief Alkaloids:** Scopolamine, Atropine, Hyoscyamine (converted to atropine), Norhyoscyamine, Tigloidine, Valtropine, Tiglyoxytropine.
- ***D. hopwoodii:***
  - **Alkaloids:** Nicotine and non-nicotine compounds, up to 25% of the dried weight.

Chemical Tests

1. **Atropine Test:** Atropine + gold chloride solution (in water + HCl) → **lemon-yellow precipitate forms.**
2. **Vitali-Morin Test:** **Atropine + fuming HNO_3 → evaporate on water-bath → yellow polynitrocompound forms.** Positive reaction for tropane alkaloids.

Uses

- **Atropine:** Parasympatholytic; antidote for pilocarpine; treats bronchial spasms, peptic ulcers, pupil dilation, Parkinsonism.
- **Scopolamine:** Used for motion sickness, ulcers, sedative/hypnotic; mydriatic; enhances respiration.
- **Duboisia Sulphate:** Atropine substitute.
- **Homeopathic:** Used for paralysis, eye infections; antidoted by coffee and lemon juice.

1.4.5 Hyoscyamus

Synonyms

- Common Henbane, Hog's-bean, Jupiter's-bean, Symphonica, Cassilata, Cassilago, Deus Caballinus.

Biological Source

- Dried leaves and flowering tops of ***Hyoscyamus niger Linn.,*** belonging to the family **Solanaceae.**

Geographical Source

- Found throughout Central and Southern Europe, Western Asia, extending to India and Siberia. Also found in North America and Brazil.

Microscopy

- **Epidermis:** Smooth cuticle, **glandular trichomes, and anisocytic stomata.**
- **Mesophyll:** Dorsiventral, palisade cells below the upper epidermis, **Prismatic or Cluster crystal of calcium oxalate crystals.**

Chemical Constituents

- **Alkaloids: Hyoscyamine (chief), Atropine, Hyoscine (Scopolamine).**
- **Other Constituents: Hyoscytricin (glucosidal bitter principle)**, choline, mucilage, calcium oxalate, potassium nitrate.
- **Seed Alkaloids: 0.5–0.6% hyoscyamine, small amount of hyoscine, 20% fixed oil.**
- **Alkaloid Content: 0.045% to 0.14% in dried leaves.**

Uses

- **Antispasmodic, Hypnotic, Mild Diuretic, Narcotic; Relieves Pain, Cystitis, Spasms; Used in Aperient Pills**

Marketed Products

- Brahmi Vati, Sarpagandhaghan Vati (Dabur)

1.4.6 Stramonium

Synonyms

- **Thorn apple leaves**, Jimson or Jamestown weed, Dhatura, Stinkweed, **Devil's apple**, Apple of Peru, Folia stramonii.

Biological Source

- Dried leaves and flowering tops of ***Datura stramonium Linn.*** **or its variety *D. tatula Linn*., from the family Solanaceae.**
- **Alkaloid content: 0.25% as hyoscyamine.** The prepared drug contains 0.23–0.27% alkaloids.

Geographical Source

- Found in Europe, Asia, America, and South Africa.
- Common in India (from Kashmir to Malabar), and cultivated in Germany, France, Hungary, and South America.

Microscopy

- **Leaf:** Bifacial structure with smooth cuticle, **stomata (anisocytic and anomocytic types), micro-sphenoidal and prismatic calcium oxalate crystals.**
- **Hair Types:** **Uni-seriate clothing hairs (3–5 cells), glandular hairs with oval heads (2–7 cells).**

Chemical Constituents

- **Main Alkaloids:** **Hyoscyamine, Hyoscine (Scopolamine).**
- **Additional Alkaloids:** Atropine (formed from hyoscyamine), Tropine, Pseudotropine, 6-hydroxyhyoscyamine.
- **Other Compounds:** Skimmianine, Meteloidine, Steroidal glycosides (Daturataturins A and B), Flavonoids (Chrysin, Quercetin, Kaempferol), β-sitosterol, Campesterol, Steroidal glycosides.

Uses

- **Narcotic, Antispasmodic, Anodyne; Treats Asthma, Parkinsonism, Boils, Earache; Hair Care; Hemorrhoids**

Marketed Products

- Maharasayan Vati (Mahaved Healthcare).

1.5 Amino Alkaloids (Proto-Alkaloids)

- **Structure**: Consist of one or more carbon rings with a nitrogen atom on a carbon side chain.
- **Notable Alkaloids**:
  - **Mescaline**: Psychedelic from peyote and San Pedro cacti, made from tyrosine, related to dopamine and epinephrine.
  - **Ephedrine**: Cardiac stimulant and bronchodilator, structurally like mescaline and epinephrine; can be risky for heart patients.
  - **Pseudoephedrine**: Ephedrine isomer with fewer heart effects, used as a safer bronchodilator.
  - **Colchicine**: Alkaloid from autumn crocus that stops cell division, used in cancer treatment and plant genetics.

1.5.1 Colchicum (*Autumn Crocus*)

Synonyms:

- Autumn Crocus, Cigdem, Colquico, **Meadow Saffron**, Naked Boys, European Colchicum Seed.

Biological Source:

- Dried ripe seeds and corms of ***Colchicum autumnale Linn.***, belonging to the family **Liliaceae.**

Geographical Source:

- Found mainly in Central and South Europe, including Germany, Greece, Spain, Turkey, and England.

Chemical Constituents:

- **Active Principle:** **Colchicine** (alkaloid), which is highly toxic.
- **Other alkaloids:** Demecolcine: Contains colchicoresin, fixed oil, glucose, and starch.

Chemical Tests:

- Colchicum corm + 70% H_2SO_4 or concentrated HCl → **yellow color (due to colchicine).**

Uses:

- Analgesic, Antirheumatic, Cathartic, Emetic; Treats Gout, Rheumatism, Leukemia, Behçet's Syndrome

1.5.2 Ephedra (Ma Huang)

Biological Source:

- Ephedra consists of the dried aerial parts of ***Ephedra gerardiana, Ephedra sinica, Ephedra equisetina, Ephedra nebrodensis,*** and other species in the family **Ephedraceae.**

Geographical Source:

- Found mainly in China, India, Nepal, Turkey, Pakistan, and Bhutan.

Chemical Constituents:

- **Alkaloids:**
  - **Ephedrine** (antiasthmatic, decongestant, vasoconstrictor),
  - **Pseudoephedrine** (decongestant),
  - Norpseudoephedrine (vasodilator for angina).

Chemical Test:

- Add HCl + copper sulfate + NaOH to 10 mg drug sample → **violet color forms** → add ether → **ethereal layer turns purple** + **aqueous layer turns blue.**

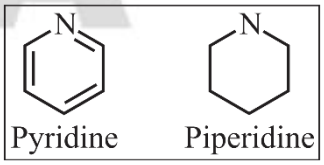
Uses:

- **Ephedrine:** Antiallergenic, Antiasthmatic, Decongestant, Stimulant, Vasoconstrictor, Cough Suppressant
- **Pseudoephedrine:** Decongestant, Cough Suppressant
- **Norpseudoephedrine:** Peripheral Vasodilator (Angina)
- **Overall:** Decongestant, Antiasthmatic, CNS Stimulant, Raises Blood Pressure, Relieves Rheumatism, Hay Fever, Colds, Aches

1.6 Pyridine-Piperidine Alkaloids

Pyridine:

- **Structure:** **Six-membered aromatic ring with five carbon atoms and one nitrogen (C5H5N).**
- **Physical Properties:** Colorless, flammable, toxic liquid; miscible with water and organic solvents; boils at 115°C.



- **Natural Occurrence:** **Found in nicotine (tobacco), ricinine (castor bean), and pyridoxine (vitamin B6).**

Piperidine:

- **Structure:** **Hydrogenated derivative of pyridine; one nitrogen atom in the cycle.**
- **Physical Properties:** Clear liquid with pepper-like aroma; boils at 106°C; soluble in water, alcohol, and ether.

1.6.1 Areca Nut

Synonyms:

- Betal nuts, Pinang, Semina Areacae, Supari (Hindi)

Biological Source:

- Areca nuts are the seeds of ***Areca catechu Linn.***, belonging to the **Palmaceae family.**

Geographical Source:

- Areca nut is cultivated in tropical regions, primarily in India, Sri Lanka, South China, Malay States, East Indies, Philippine Islands, and parts of East Africa (e.g., Zanzibar, Tanzania).
- In India, it is grown in the coastal regions of southern Maharashtra, Tamil Nadu, Karnataka, Bengal, and Assam.

Chemical Constituents:

- **Alkaloids (Piperidine series):**
  - **Arecoline (0.1–0.5%)**, Arecaine, Guvacine, Arecaidine, Guvacoline, Arecolidine.
- **Flavonoids: Catechins (e.g., (+)-catechin, (-)-epicatechin)**, Procyanidins (A1, B1, B2).
- **Tannin: Areca red (15%, phlobaphene nature).**

Uses:

- **Anthelmintic, Taenifuge, Vermifuge; Aphrodisiac; Nervine Tonic; Emmenagogue; Risk of Mouth Cancer**

Substitutes and Adulterants:

- **Substitutes:**
  - *Areca caliso, A. concinna, A. ipot, A. laxa, A. nagensis, A. triandra, Caryota cumingii, Heterospathe elata.*
- **Adulterants:**
  - Sago palm nuts *(Metroxylon species),* Dried tapioca (*Manihot esculenta*), Slices of sweet potato (*Ipomoea batatas*).
  - *Caryota urens* nuts (cut to resemble Areca nuts and coated with Areca nut extract).

Marketed Products:

- Areca nut is an ingredient in various herbal preparations, such as:
  - Himplasia (Himalaya Drug Company)
  - Khadiradi bati (Baidyanath)

1.6.2 Lobelia

Synonyms:

- Herba lobellae, Indian tobacco, Pukeweed, Asthma Weed

Biological Source:

- Lobelia consists of the dried aerial parts of ***Lobelia inflata Linn.***, belonging to the **Lobeliaceae family.**

Geographical Source:

- Indigenous to the Eastern and Central United States, Canada, and India.

Microscopy:

- **Leaf:** **Dorsiventral leaf** structure with elongated palisade parenchyma under the upper epidermis and abundant stomata on the lower epidermis.

Chemical Constituents:

- **Alkaloids:** About 0.4% crystalline alkaloids, with **lobeline as the primary active alkaloid.**
  - **Other alkaloids:** lobelidine, lobelanidine, lobelanine, and isolobinine (chemically related to lobeline).
- **Lobelacrine:** Previously considered the acrid principle, possibly lobelate of lobeline.
- **Seeds:** **Contain a higher concentration of lobeline than the rest of the plant.**

Uses:

- **Expectorant, Antiasthmatic, Convulsive Disorders** (epilepsy, tetanus, diphtheria, and tonsillitis)**, Respiratory Stimulant, Smoking Cessation; External Uses: Ophthalmia, Sprains, Skin Diseases, Tetanus Treatment**

1.6.3 Tobacco

Synonyms:

- Tobacco, Tabaci Folia

Biological Source:

- Dried leaves of ***Nicotiana tobaccum***, belonging to the **Solanaceae family.**

Geographical Source:

- Found mainly in India, United States, China, Brazil, Russia, Turkey, and Italy.

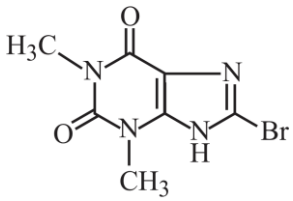
Chemical Constituents:

- The main alkaloid is **nicotine**, along with other alkaloids like nicotianin, nicotinine, nicoteine, and nicoteline.

Uses:

- **Pharmacological Action:** Nicotine has actions similar to coniine and lobeline.
- **Sedative, Diuretic, Expectorant, Discutient, Sialagogue, External Uses (Ulcers, Tremors, Piles), Antiseptic, Stimulant**

1.7 Purine Alkaloids



- **Structure**: **Purine alkaloids have a double carbon ring with four nitrogen atoms, similar to the purine base adenine found in DNA, RNA, and ATP.**
- **Precursor Compounds**: Important precursors include **inosine monophosphate (IMP) and xanthosine monophosphate (XMP), derived via the primary purine biosynthetic pathway.**
- **Effects**: **CNS Stimulant, Bronchial Muscle Relaxant, Diuretic**

- **Mode of Action**: They **inhibit phosphodiesterase → increase cAMP levels → trigger adrenaline release.**
- **Origin**: Purine alkaloids are derived from the nucleotides **adenosine (from IMP) and guanosine (from XMP).**
- **Notable Alkaloids**:
  - **Caffeine**: **Found in coffee (*Coffea arabica*), tea (*Thea sinensis*), yerba mate (*Ilex paraguariensis*), and cola (*Cola nitida*).**
  - **Theobromine**: Primarily derived from the seeds of **Cacao (*Theobroma cacao*)**.

1.7.1 Coffee

Synonyms:

- Coffee bean, Coffee seed, Arabica coffee, Arabian coffee, Abyssinian coffee, Brazilian coffee.

Biological Source:

- Dried ripe seeds of ***Coffea arabica***, belonging to the **Rubiaceae family.**

Geographical Source:

- Indigenous to Ethiopia, Brazil, India, Vietnam, Mexico, Guatemala, Indonesia, and Sri Lanka.

Chemical Constituents:

- **Caffeine: 2–3%,** Tannins: 3–5%, Proteins: 13%, Fixed Oils: 10–15%
- **Caffeine is present as a salt of chlorogenic acid.**

Uses:

- **Flavoring Agent, Stimulant (Nervine, Diuretic, CNS), Medicinal (Snake Bite, Vascular Soothing, Acts on Kidneys, Heart, Muscles)**

1.7.2 Tea *(Thea sinensis)*

Biological Source:

- Prepared leaves and leaf buds of ***Thea sinensis (Linn.)*** Kuntz., belonging to the **family Theaceae.**

Geographical Source:

- Mainly cultivated in India (Assam), Ceylon, Japan, and Java.

Characteristics:

- **Microscopy:**
  - Trichomes are thick-walled, **unicellular**, conical, found on the lower surface, especially in young leaves.
  - **Prisms, druses, styloids, raphides, and crystal sands calcium oxalate crystals** are present in the phloem and parenchyma.

Chemical Constituents:

- **Caffeine: 1–5%, Theobromine and Theophylline**
- **Tannins: 10–20% (mainly gallotannic acid),** contributing to the characteristic color of the leaves.
- Other Constituents: Yellow volatile oil, protein, wax, resin, and ash.

Chemical Tests:

1. **Murexide Reaction:** Caffeine + HCl + potassium chlorate → treated → exposed to ammonia vapors → **purple color appears.**
2. **Caffeine + tannic acid solution → white precipitate forms.**

Uses:

- **Stimulant, Astringent, Diuretic**

1.7.3 Kola *(Cola nitida)*

Biological Source:

- Dried seeds of ***Cola nitida***, belonging to the **family Malvaceae.**

Geographical Source:

- Indigenous to West Africa, primarily cultivated in countries like Nigeria, Ghana, and Ivory Coast.

Chemical Constituents:

- **Caffeine (2-3%), Theobromine, Colanine**, Tannins, Sugars, Starch

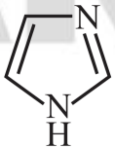
Chemical Tests:

- **Tannins Test:** Kola nuts + iron salts → **blue-black color** → confirms tannins presence.

Uses:

- **Stimulant, Astringent, Digestive Aid, Flavoring Agent, Traditional Ceremonial Use (offered as a sign of respect), Heart Health**

1.8 Imidazole Alkaloids



- **Structure**: Imidazole is a heterocyclic aromatic organic compound containing **a ring with two nitrogen atoms.**
- **Biological Importance**: Imidazole is found in key biological molecules like **histidine** and **histamine**.
- **Chemical Properties**:
  - Acts as a **base** (pKa = 7.0) and can also function as a **weak acid** (pKa = 14.5).
  - It exists in two tautomeric forms, with a hydrogen atom shifting between the two nitrogen atoms.
- **Notable Source: The primary plant source of imidazole alkaloids is *Pilocarpus jaborandi.***

1.8.1 Pilocarpus (Jaborandi)

Synonyms:

- Jaborandi, Arruda do Mato, Arruda brava, Jamguarandi, Juarandi.

Biological Source:

- The drug consists of the leaves of ***Pilocarpus jaborandi***, belonging to the **family Rutaceae.**

Geographical Source:

- Indigenous to South America, especially Brazil. Also found in Venezuela, Caribbean islands, and Central America.

Chemical Constituents:

- **Pilocarpine: The main imidazole alkaloid.**
- Other alkaloids include isopilocarpine, pilocarpidine, pilosine, pseudopilocarpine, and isopilosine.
- Alkaloid **content ranges from 0.5% to 1%** in different species.

Chemical Test:

- **To detect pilocarpine:** Add dilute sulfuric acid + hydrogen peroxide + benzene + potassium chromate → **organic layer turns bluish-violet** → **aqueous layer turns yellow.**

Uses:

- **Pilocarpine: Antagonist to Atropine, Contracts Pupil (Glaucoma), Diaphoretic, Stimulates Salivation and Glandular Secretions, Galactagogue**

1.9 Steroidal Alkaloids

- **Structure**: **Formed by the addition of nitrogen to a steroid molecule, typically C_{21} or C_{27} steroids, containing a steroidal backbone (tetracyclic 4-ring structure).**
- **Properties**: These alkaloids can be used as **medicines** or **precursors** for synthesizing other steroids.
- **Types**: Some steroidal alkaloids contain a **sugar molecule**, making them **alkaloidal glycosides** (sugar + steroidal alkaloid).
- **Examples**:
  - **Solanum species** (nightshade family, Solanaceae), including **solanine** and **chaconine**. These are **glycoalkaloids** present in various plant organs (leaves, tubers, etc.).

1.9.1 Ashwagandha

Synonyms:

- Withania root, Ashwagandha, Clustered Wintercherry.

Biological Source:

- Dried roots and stem bases of ***Withania somnifera*** Dunal, belonging to the **family Solanaceae.**

Geographical Source:

- Widely distributed from southern Europe to India and Africa.

Chemical Constituents:

- **Main Alkaloid: Withanine.**

- **Other alkaloids:** Somniferine, Pseudowithanine, **Tropine,** Pseudotropine, Hygrine, Isopellederine, Anaferine, Anahygrine.
- **Steroid lactones (Withanolides)** found in leaves.

Uses:

- **Nervous Disorders, Intestinal Infections, Leprosy; Tranquillizer and Rejuvenator; Treats Insomnia, Wasting, Infertility; Poultice for Boils and Pain**

Marketed Products:

- Found in products like:
  - Balarishta (Baidyanath)

1.9.2 Kurchi Bark

Synonyms:

- Holarrhenna, Kurchi (Hindi).

Biological Source:

- Dried stem bark of ***Holarrhena antidysenterica*** Wall, belonging to the **family Apocynaceae.**

Geographical Source:

- Found throughout India, especially in wet forests of the Himalayas, up to 1,250 m altitude.

Characteristics:

- **Fracture: Brittle and splintery.**

Microscopy:

- **Cortex:** Broad zone with irregular polygonal parenchyma containing starch grains and **prismatic calcium oxalate crystals.**

Chemical Constituents:

- **Total alkaloids: 1.1% to 4.72%.**
- **Main steroidal alkaloid: Conessine (20–30%).**
- **Other alkaloids:** Conarrhimine, Conimine, Conamine, Conessimine, Isoconessimine, Dimethyl Conkurchine, **Holarrhimine.**
- **Also contains:** Gum, resin, tannin, lupeol, and **glycoside Holadysone.**

Uses:

- **Stomachic, Astringent, Tonic, Antidysenteric, Febrifuge, Anthelmintic; Treats Dysentery, Diarrhea, Dropsy**

Marketed Products:

- Diarex PFS, Diarex Vet (Himalaya Drug Company)
- Mahamanjishthadi kwath, Mahamanjisthadyarishta (Dabur)

1.9.3 Veratrum

Synonyms:

- American Hellebore, Green Hellebore, American Veratrum, Indian Poke.

Biological Source:

- Dried roots and rhizomes of the perennial herbs ***Veratrum viride Aiton and Veratrum album Linn.,*** belonging to the **family Liliaceae.**

Geographical Source:

- Mainly found in Canada, United States, and regions like Carolina, Tennessee, and Georgia.

Chemical Constituents:

- Contains alkaloids like:
  - Rubijervine, Cevadine, Germitrine, Germidine, Veratralbine, Veratroidine.
  - Neogermitrine, Neoprotoveratrine, Protoveratrine A & B, Veratridine.
  - Pseudojervine, Veratrosine (glycosides of alkamine).
  - **Alkamines:** Germine, Jervine, Rubijervine, Veratramine.

Uses:

- **Antihypertensive, Cardiac Depressant, Sedative, Insecticide, Relieves Irritation**

1.10 Diterpene Alkaloids

- **Occurrence:** Found in plants of the *Aconitum, Delphinium, Carrya, and Thalictrum genera.*
- **Classification:**
  - Diterpene alkaloids are divided into two categories based on their skeleton structure:
    - C_{19} skeleton
    - C_{20} skeleton
- **Significance:** These alkaloids are of growing interest due to their diverse applications.

1.10.1 Aconite

Synonyms:

- Monkshood, Friar's Cowl, Mouse-bane, Aconite root, Mithazahar (Hindi), Radix Aconiti.

Biological Source:

- Dried roots of ***Aconitum napellus Linn.***, belonging to the **family Ranunculaceae.**

Geographical Source:

- Native to the mountainous and temperate regions of Europe. Found in the Alps, Carpathian mountains, Germany, and the Himalayas. Commercial Aconite is mostly derived from wild plants grown in central and southern Europe, especially Spain.

Morphology:

- **Fracture:** Short, starchy, with a stellate cambium and central pith.

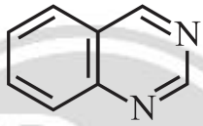
Chemical Constituents:

- **Aconitine (0.4–0.8%)**, hypaconitine, mesaconitine, aconine, napelline (isoaconitine), neoline, ephedrine, sparteine, picraconitine, acotinic acid, itaconic acid, succinic acid, malonic acid, fat, starch, aconosine, 14-acetyineoline, hokbusine A, senbusines A and C, mesaconitine.
- **Aconitines are diacyl esters of polyhydric amino alcohols and are extremely poisonous.**

Uses:

- **Local Analgesic, Antipyretic (Tincture Aconite), Toxic (Aconitine; 2-3 mg), Antineuralgic Liniments**

1.11 Quinazoline Alkaloids



1.11.1 Adusa (Vasaka)

Synonyms:

- Vasaka

Biological Source:

- Fresh or dried leaves of ***Adhatoda vasica*** Nees, belonging to the **family Acanthaceae.**

Geographical Distribution:

- Found throughout the plains of India and in the lower Himalayan ranges, up to an altitude of 1,500 meters.

Microscopy:

- **Dorsiventral structure** with two layers of palisade cells beneath the upper epidermis.
- **Epidermal cells:** Sinuous walls with **anomocytic stomata** on both surfaces.
- **Trichomes:** **Few uniseriate covering trichomes (1–3 cells), some glandular trichomes with unicellular stalk and 4-celled head.**
- **Calcium oxalate crystals:** **Acicular and prismatic** forms found in mesophyll.

Chemical Constituents:

- **Alkaloids:** Major alkaloid is **vasicine** (~1.3%), along with **vasicinol, vasicinone, and adhatonine.**
- **Aliphatic hydroketones:** 37-hydroxyhexateracont-1-en-5-one and 37-hydroxyhentetracontan-19-one.

Uses:

- **Respiratory Issues:** Bronchitis, Asthma, Cough Relief
- **Ayurvedic Uses:** Prescribed for **Bleeding Disorders, Tuberculosis, Oral Health.**

Marketed Formulations:

- Vasavaleha (Dabur)
- Kasamrit Herbal (Baidyanath)

1.12 Alkaloidal Drugs

1.12.1 *Eclipta alba*

Synonyms:

- False Daisy
- **Bhringaraj**
- Kesharaj (in Sanskrit)
- Yerba de Tajo (in Spanish)

Biological Source:

- ***Eclipta alba*** is the plant source, belonging to the **family Asteraceae.**

Geographical Distribution:

- Widely found in tropical regions of India, Sri Lanka, and Southeast Asia, and it also grows in South America and Africa.

Microscopy:

- **Leaf:** Dorsiventral structure with 2 layers of palisade cells.
- **Trichomes:** Glandular and non-glandular trichomes on the surface.
- **Calcium oxalate crystals:** Present in the mesophyll.

Chemical Constituents:

- **Alkaloids: Ecliptine, Ecliptamine.**
- **Flavonoids: Apigenin, Luteolin, Quercetin.**
- **Triterpenoids:** Ecliptogenin, β-amyrin.
- **Other Compounds:** Coumarins, Tannins, Steroids.

Uses:

- **Hair Growth, Liver Tonic, Anti-inflammatory, Antioxidant, Antimicrobial, Improves Circulation**

1.12.2 Shankhpushpi

Synonyms:

- Sankhapushpi

Biological Source:

- ***Convolvulus pluricaulis Choisy***, belonging to the **Convolvulaceae family.**

Habitat:

- Found growing wildly in the plains of India, especially in regions with tropical climates.

Microscopy:

- **Leaf: Dorsiventral structure** with palisade cells, vascular bundles bicolateral, and spongy parenchyma.

Chemical Constituents:

- **Shankhpushpine (alkaloid)**
- **Flavonoids:** Kaempferol, Kaempferol-3-glucosides
- **Coumarin derivatives:** 6-Methoxy-7-hydroxy coumarin
- **Long-chain fatty alcohols:** n-hexacosanol, n-octacosanol, n-triacontanol, dotriacontanol
- **Other compounds:** β-, ε-sitosterols, sugars (glucose, rhamnose, sucrose), 3,4-dihydroxycinnamic acid.

Uses:

- **Brain Tonic, Anti-hypertensive, Tranquillizer, Nervine Tonic**
- **Other benefits:** Reduces spontaneous motor activity and fighting response.

Substitute Plants:

- ***Canscora decussata*** (Gentianaceae) in Karnataka and Konkan.
- ***Chitoria ternate*** (Papilionaceae) used in Kerala as a substitute.

Marketed Formulations:

- Mentat (Himalaya Drug Company)