

## **Brief outline of occurrence, distribution, isolation, identification tests, therapeutic activity and pharmaceutical application of alkaloid**

### **ALKALOIDS**

Alkaloids occur in plant both in free form and as salts of organic acids. Sertuerner in 1806, laid the foundation of alkaloid chemistry, when he reported isolation of morphine from opium. Discovery of other important alkaloid, particularly by Pelletier and Caventon, rapidly followed: emetine (1817), strychnin (1817), caffeine (1819), quinine (1820), etc.

The term Alkaloid or Alkali was first suggested by Meissner in 1829, which he applied to the basic compounds.

The alkaloids are the basic nitrogenous organic products of plant origin, having marked physiological actions when administered internally. Alkaloids have complex molecular natures, wherein generally nitrogen is in heterocycle rings. Alkaloids are secondary, tertiary or quaternary amines. Being amines, they have basic properties.

Alkaloids occur in plant both in free form and as salts of organic acids such as muconic, quinic, maleic, citric or oxalic acid. They are reported to be present in different parts of the plant and can be isolated from seeds (nut-vomica, areca), fruits (black pepper), leaves (belladonna, vasaka, datura), rhizomes and roots (ipecac, aconite, rauwolfia), bark (kurchi, cinchona) and fungi (ergot).

#### **Identification of Alkaloids by Precipitation Method**

1. *Mayer's reagent* (potassium mercuric iodide solution) : Cream or pale yellow precipitate.
2. *Dragendorff's reagent* (potassium bismuth iodide solution): Brown or reddish brown color or precipitate.
3. *Wagner's reagent* (Iodine and potassium iodide solution): Brown or reddish-brown colour or precipitate.
4. *Hager's reagent* (saturated solution of picric acid): Yellow precipitate.

Phospho tungstic acid and tannic acid are also used for detection of certain alkaloids by precipitation.

#### **(b) Identification of Alkaloids by Colour Reagents**

Purine and xanthine group of alkaloids (eg, caffeine) do not respond to these tests. Colour reagents like potassium chloride with caffeine, mineral acids for colchicine or P-dimethyl aminobenzaldehyde with indole alkaloids produce distinct colours.

### **Distribution**

Amongst the angiosperms, Leguminosae, Papaveraceae, Ranunculaceae, Solanaceae, Rubiaceae, Berberidaceae, Liliaceae and Amaryllidaceae are outstanding plant families for yielding alkaloids.

Alkaloids are colourless, crystalline, non-volatile and bitter solids. Most of them are optically active and are laevo-rotatory. They are insoluble or sparingly soluble in water and fully soluble in organic solvents like alcohols, ether, chloroform. There are exceptions to these general rules. Coniine, nicotine and hygrine are liquids. Berberine salts are coloured. Ephedrine, colchicine and mesocaine are non-heterocyclic alkaloids. Coniine is dextro-rotatory, while papaverine is optically inactive and ricinine is neutral. Erythromycin and chloramphenicol are antibiotic alkaloids. Alkaloids are also obtained from synthetic sources, e.g., heroin; homotropine etc.

Alkaloids are highly potent medicaments and possess curative properties, eg. morphine (opium) has a narcotic action, reserpine (rauwolfia) is a tranquiliser, strychnine (nux-vomica) is a nervine stimulant, cocaine (coca leaf) is a local anaesthetic, and hyoscine (belladonna) is an antispasmodic. Alkaloids in higher doses are poisonous.

Alkaloids are biosynthesised due to participation of several amino acids and enzymatic systems. Tobacco alkaloids are derived from ornithine. In the biogenesis of solanaceous alkaloids, phenylalanine, ornithine and methionine are involved. The indole alkaloids of rauwolfia, vinca, nux-vomica etc. are derived from tryptophan. Phenylalanine is also the precursor for biogenesis of ephedra, opium and colchicum alkaloids.

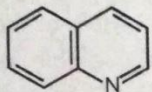
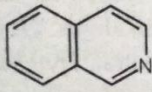
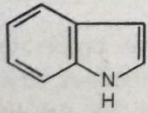
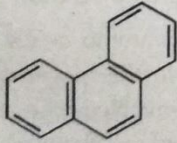
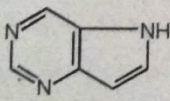
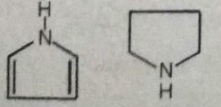
### **(c) Functions of Alkaloids**

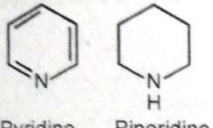
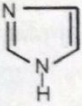
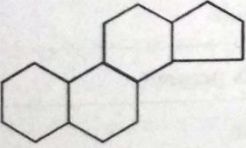
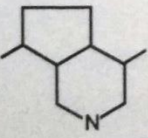
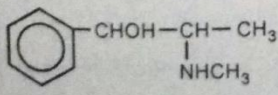
1. Protective agents and discourage animal or insect attacks.
2. Plant stimulants or regulators in physiological activities, such as growth, reproduction and metabolism.
3. Detoxicating agents.
4. Reservoirs of protein synthesis.

### **(d) Classification of Alkaloids**

Alkaloids are classified according to the basic chemical structure, from which they are derived. The broad classification of alkaloid containing drugs is given in the following Table 8.1.

Table 8.1 : Classification of Alkaloids Containing Crude Drugs

Basic structure	Type of alkaloid	Examples	Sources
$  \begin{array}{c}  \text{H}_2\text{C} - \text{CH} - \text{CH}_2 \\    \quad   \quad   \\    \quad \text{N} - \text{CH}_3 \quad \text{CH}_2 \\    \quad   \quad   \\  \text{H}_2\text{C} - \text{CH} - \text{CH}_2  \end{array}  $	1. Tropane alkaloids	Atropine, cocaine, hyoscine, hyoscyamine	Datura, coca, belladonna, hyoscyamus, withania
	2. Quinoline alkaloids	Quinine, quinidine, cinchonine, cinchonidine	Cinchona species
	3. Isoquinoline alkaloids	Papaverine, narcotine, emetine, berberine	Opium, ipecacuanha, berberis
	4. Indole alkaloids	Strychnine, brucine, serpentine, ergometrine, reserpine	Nux-vomica, rauwolfia, ergot, vinca
	5. Phenanthrene alkaloids	Morphine, codeine, thebaine	Opium
	6. Purine alkaloids	Caffeine, theobromine	Tea, coffee
 <p>Pyrrole      Pyrrolidine</p>	7. Pyrrole and pyrrolidine alkaloids	Nicotine, hydrine, trigonelline	Tobacco, fenugreek, coca

Basic structure	Type of alkaloid	Examples *	Sources
 Pyridine      Piperidine	8. Pyridine and piperidine alkaloids	Coniine, lobeline, ricinine	Hemlock, lobelia, tobacco, castor
	9. Imidazole alkaloids	Pilocarpine	Pilocarpus
 Cyclopentanoperhydrophenanthrene	10. Steroidal	Conessine, solanidine, solanine, veratramine, veratridine	Kurchi, veratrum, potato
	11. Diterpene	Aconitine, aconine	Aconite
	12. Alkaloidal amines	Ephedrine, pseudophedrine, colchicin	Ephedra, colchicum

### Extraction of Alkaloids:

The specificity of the method of extraction depends upon the chemical nature of alkaloid to be extracted. The general method of extraction is as follows:

The drug is powdered and extracted with ethanol. The solvent is removed and residue is treated with dilute inorganic acid, whereupon the bases are extracted as their soluble salts. The free bases are liberated by addition of sodium carbonate and extracted with organic solvents like ether or chloroform. The solvent is removed under vacuum and the crude alkaloidal extract is separated by physical means such as chromatography.

Alternatively, the powdered drug is moistened with water and mixed with lime, which combines with acids, tannins and other phenolic substances. The extraction is then carried out with benzene or petroleum ether. The organic layer is shaken with aqueous alkali. Alkaloidal salts which remain in aqueous liquid are separated, basified, and extracted with chloroform for further purification.