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# Chemistry

## SUB. CODE- BSCC2402

*For B.Sc. 4<sup>th</sup> Semester*

**(Alkaloids)**  
**Module-VI**

***Alkaloids***

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# Alkaloids

Alkaloids are found primarily in **plants** and are especially common in certain families of flowering plants. More than 3,000 different types of alkaloids have been identified in a total of more than 4,000 **plant** species. In general, a given species contains only a few kinds of alkaloids.

Though it has been suggested that they are simply waste products of plants' metabolic processes, but there are evidences of their role in specific biological functions. In some plants, the concentration of alkaloids increases just prior to **seed** formation and then drops off when the seed is ripe, suggesting that alkaloids may play a role in this process. Alkaloids may also protect some plants from destruction by certain **insect** species.



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# Alkaloids: Classification

Alkaloids are often classified on the basis of their chemical structure. For example, those alkaloids that contain a ring system called indole are known as indole alkaloids. On this basis, the principal classes of alkaloids are the pyrrolidines, pyridines, tropanes, pyrrolizidines, isoquinolines, indoles, quinolines, and the terpenoids and steroids.

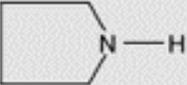
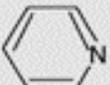
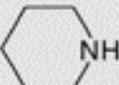
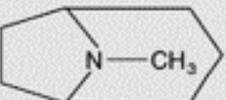
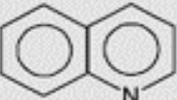
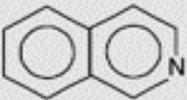
- **True (Typical) alkaloids** that are derived from amino acids and have nitrogen in a heterocyclic ring. e.g Atropine
- **Protoalkaloids** that are derived from amino acids and do not have nitrogen in a heterocyclic ring. e.g Ephedrine
- **Pseudo alkaloids** that are not derived from amino acids but have nitrogen in a heterocyclic ring. e.g Caffeine
- **False alkaloids** are non alkaloids give false positive reaction with alkaloidal reagents.



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# Alkaloids: Classification

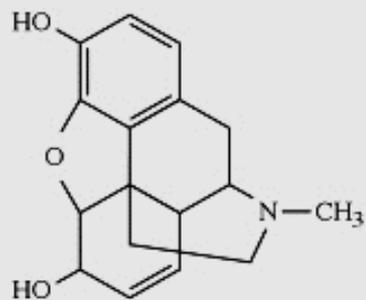
S.No.	Basic Ring Structure	Alkaloid	Botanical Origin	Family
1	<b>Pyrrolidine</b> 	Hygrine Stachydrine	<i>Erythroxylon coca</i> <i>Stachys tubrifera</i>	<i>Erythroxylaceae</i> <i>Labiatae</i>
2	<b>Pyridine</b> 	Arecoline Ricinine Trigenelline	<i>Areca catchu</i> <i>Ricinus communis</i> <i>Trigonella foenumgraecum</i>	<i>Palmaceae</i> <i>Euphorbiaceae</i> <i>Leguminosae</i>
3	<b>Piperidine</b> 	Connine Lobeline Pelletierine	<i>Conium maculatum</i> <i>Lobelia inflata</i> <i>Punica granatum</i>	<i>Umbelliferae</i> <i>Lobeliaceae</i> <i>Punicaceae</i>
4	<b>Tropane</b> <b>[Piperidine- Pyrrolidine (N-Methyl)]</b> 	Atropine  Cocaine Hyoscyamine	<i>Atropa belladone</i> <i>Datura stramonium</i> <i>Erythroxylon coca</i> <i>Atropa belladona</i>	<i>Solanaceae</i> <i>Solanaceae</i> <i>Erythroxylaceae</i> <i>Solanaceae</i>
5	<b>Quinoline</b> 	Quinine, Quinidine Cuspareine	<i>Cinchona officinalis</i> <i>Cusparia trifoliata</i>	<i>Rubiaceae</i> <i>Rutaceae</i>
6	<b>Isoquinoline</b> 	Papaverine Berberine Emetine Corydaline  Tubocurarine	<i>Papaver somniferum</i> <i>Hydrastis canadensis</i> <i>Uragoga ipecacuanha</i> <i>Corydalis aurea</i> <i>Corydalis solida</i> <i>Chondodendron tomentosum</i>	<i>Papaveraceae</i> <i>Berberidaceae</i> <i>Rubiaceae</i> <i>Fumariaceae</i> <i>Fumariaceae</i> <i>Menispermaceae</i>



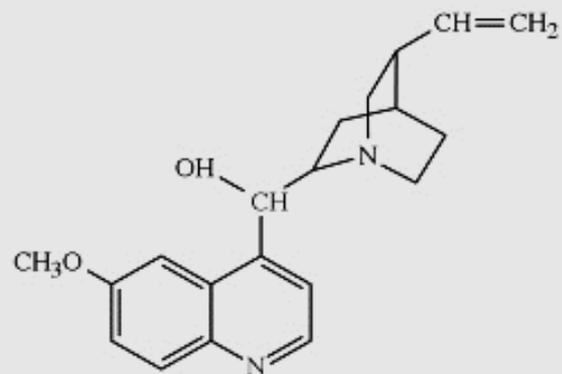
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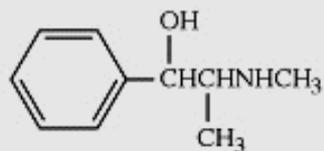
## Alkaloids



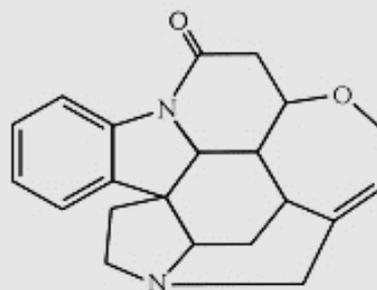
morphine



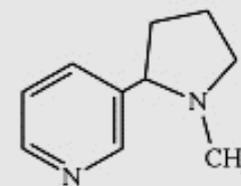
quinine



ephedrine



strychnine



nicotine



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## Extraction and isolation of alkaloids

1. The dried and powdered plant material is extracted with pet ether (or hexane, colemans etc.) first. This removes fats, oils, terpenes, waxes etc. This extract is discarded.
2. The material is now subjected to an alcohol extraction, eg with methanol or ethanol. The extract is evaporated to give crude alkaloids mixture.
3. This extract is partitioned between an diluted aq. tartaric acid solution and ethyl acetate.
4. The ethyl acetate layer contains neutral and weakly basic alkaloids.
5. The aq. layer is neutralised with  $\text{NH}_3$  or  $\text{Na}_2\text{CO}_3$  and again extracted with ethyl acetate. The organic layer now contains basic alkaloids, while the aq. layer contains quarternary ammonium ions.



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## Extraction and isolation of alkaloids

Many alkaloids can be isolated directly from the alcoholic extract by chromatographic methods. This separation method works well for tropane alkaloids (atropine, cocaine, scopolamine).

The alcohol extract is fractionated by column chromatography on  $\text{SiO}_2$ , solvent chloroform followed by chloroform with rising methanol content. This separates lipids and terpenes from the crude alkaloid fraction. The alkaloid fraction is again chromatographed ( $\text{SiO}_2$ ;  $\text{CHCl}_3$  :  $\text{MeOH} = 10:1$ ) to isolate the pure alkaloids.



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# Physiological action

Alkaloids have a wide range of pharmacological-activities. Many have found use as starting points for drug discovery.

Alkaloids	Effects on humans	Alkaloids	Effects on humans
quinine	antimalarial	quinidine	antiarrhythmic
ephedrine	antiasthma	morphine	analgesic
homoharringtonine	anticancer	piperine	antihyperglycemic
galantamine	cholinomimetic	psilocin	psychotropic
vincamine	vasodilatory	cocaine, caffeine, nicotine, theobromine	stimulant

Alkaloids can be toxic too (e.g. atropine, tubocurarine). Although alkaloids act on a diversity of metabolic systems in humans and other animals, they almost uniformly evoke a bitter taste.



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# References

1. K.D Sharma and Y. R. Sharma, Kalyani Publishers, Unit-III page-310;
2. University Chemistry, Vol-IV, Dr. U. N. Dash, Dr. KK. Ojha, Himalaya Publishing house, Unit V, page-390