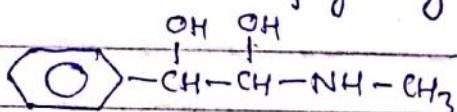


Alkaloids :- An alkaloid is a compound of plant which has a structure containing one or more basic nitrogen heterocyclic rings and cause marked physiological activity in human and animals.

The above definition of the alkaloids is by no means perfect and does not cover all compounds classed as alkaloids.

- (1) Piperine, the alkaloid of pepper, is not basic and has practically no physiological activity.
- (2) Purines such as caffeine (in coffee and tea) and theobromine (in cocoa bean), which stimulate the nervous system, and are heterocycles containing nitrogens, conform to the definition of alkaloids.
- (3) Opium (containing the alkaloid morphine) and hashish or bhang are both habit forming drugs, yet the active principle of the latter does not contain nitrogen.
- (4) Ephedrine is a straight chain alkaloid that is produced by animal glands, and has marked physiological activity.



A

Ephedrine.

Alkaloids having the general common properties ! -

- (a) They are found in plants, although a few are of animal origin.
- (b) They are basic in character and show marked physiological activity.
- (c) They have heterocyclic rings containing nitrogen as a part of their structure.

Most of the alkaloids induce physiological responses when administered to man and animals. Thus the active principles of some of the oldest drugs drugs and medicines known to man were alkaloids. By now over 2500 alkaloids have been isolated and their structure elucidated.

occurrence and isolation :- Alkaloids occur chiefly in plants of the dicotyledons families and are localised in seeds, leaves, bark, or root of the plant. Each site may contain several closely related alkaloids. They occur largely as salts of common plant acids such as acetic acid, oxalic acid, lactic acid, malic acid, tartaric acid, citric acid or certain special organic acids.

For extraction of alkaloids the plant material is macerated. If the material is rich in fat (seeds) it is first extracted with ligroin or petroleum ether for their removal. The plant residue is then extracted with methanol and cellulosic material separated by filtration. The filtrate is evaporated to give the crude plant extract. This is then dissolved in dilute acid and extracted with ether. The acid solution of the alkaloids salts is then basified and extracted with ether. Evaporation of ether solution gives a solid mixture of crude alkaloids. It is then subjected to fractional crystallisation for separation into individual pure alkaloids.

The general scheme for the extraction of alkaloids is illustrated

macerated plant

Step I

I. Extract with Ligroin

II. Filter

Filtrate $\xrightarrow{\text{Evaporate}}$ Fats

Plant Residue

Step II

I. Extract with CH_3OH

II. Filter out cellulosic material

III. Evaporate filtrate

Crude plant extract

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Step III

i. Dissolve in dilute organic acid

ii. Extract with ether.

Ether solution $\xrightarrow{\text{Evaporate}}$ Non-basic material

Acid solution of alkaloid salts

i. NaOH solution

Step IV

ii. Extract with ether.

Aqueous residue

Ether solution

Step V. Evaporate.

Alkaloids

The ion exchange method - Recently an entirely new technique based on the ion exchange principle for the isolation of alkaloids has been developed. The alkaloids react with H⁺ ion to form a covalent bond by exchange with a positive ion and are adsorbed smoothly on a hydrogen ion exchanger. They are then removed from the exchanger by regeneration with alkali together with a suitable solvent as ethanol or acetone.



General properties of Alkaloids :-

1. Alkaloids are usually colourless, crystalline, Non-volatile solids while a few of them (cocaine, nicotine) are liquids .
2. Except liquid alkaloids which are soluble in water , the rest are insoluble in water but dissolve in ethanol, ether, chloroform and benzene .
3. They are optically active, the majority being levorotatory .
4. They are basic with a bitter taste, and dissolve in mineral acids to form salts .
5. Physiological activity - Most of them possess marked physiological activity when orally administered , cocaine is a violet poison , quinine is an antimalarial , cocaine acts as local anaesthetic , morphine relieve pain , atropine dilates pupil of the eye and so on .
6. Basic character - The molecule of an alkaloid contains one or more basic nitrogen atoms , most alkaloids are tertiary monoacid bases , while a few are secondary bases . Thus they form well defined crystalline salts with mineral acids , the hydrochloride and nitrate being generally readily soluble in water .

Alkaloidal reagents - The solution of alkaloids in dilute mineral acids when treated with certain reagents form insoluble precipitates , often having characteristic colours and melting points ! Such reagents as are used for identification of alkaloids are frequently spoken of as alkaloidal reagents . The common ones are -

chloroplatine acid H_3PtCl_6 , phosphomolybdate acid , phosphotungstate acid , Picric acid , Tannic acid , potassium mercuric iodide ($HgCl_2 - KI$) - (may also reagent) potassium bismuth tartrate (KBi_5O_4) - Dragendorff's

reagent), potassium cadmium iodide ($KCdI_3$) in arsenic reagent), Potassium Iodide solution in iodine (KI_3).

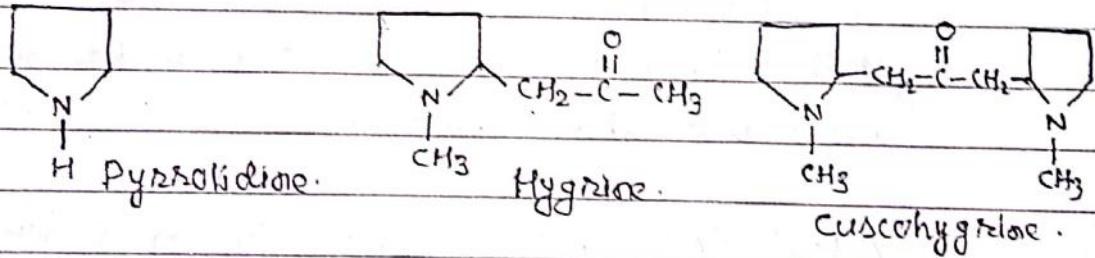
The some alkaloidal reagents may be used for the precipitation of proteins and other complex substances of basic nature.

Classification of alkaloids -

The various classes of alkaloids according to the tetracyclic ring system they contain are listed below -

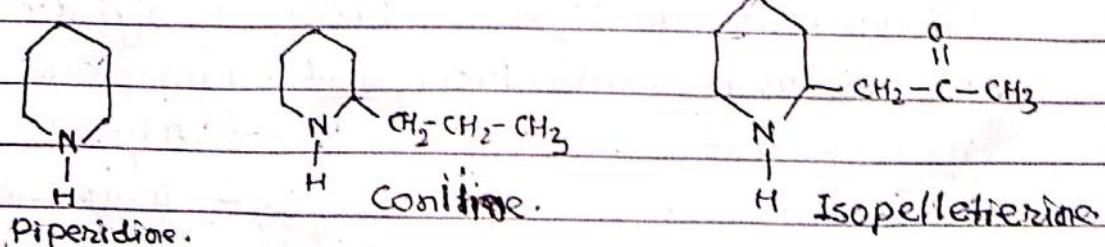
- i. Pyrrolidine alkaloids
- ii. Piperidine alkaloids
- iii. Pyridine-Pyrrolidine alkaloids
- iv. Pyridine-Piperidine alkaloids
- v. Quinoline alkaloids
- vi. Isoquinoline alkaloids
- vii. Indole alkaloids.

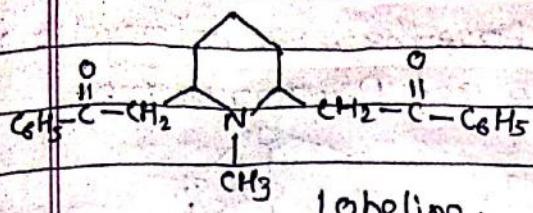
(i) Pyrrolidine Alkaloids :- They contain the pyrrolidine (Tetrahydropyrrrole) ring system e.g., Hygrine and Cuscohygrine.



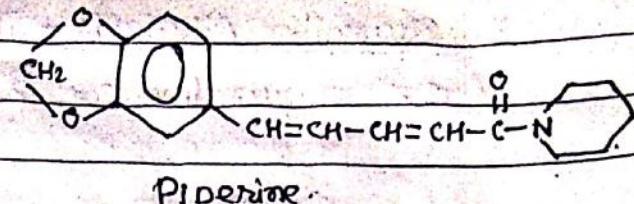
Hygrine is isolated from the leaves of the Peruvian coca shrub. Cuscohygrine is found in cusco leaves.

2. Piperidine Alkaloids :- They have piperidine (Hexahydropyridine) as the hexacyclic structure unit e.g. conitine, Isopelletierine, lobeline and Pipерине.





Lobeline.



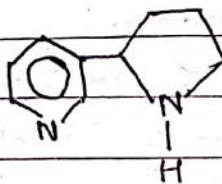
Piperine.

Coniine occurs in the oil of hemlock and is poison to humans.

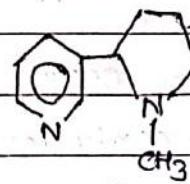
Isopelletierine is isolated from bark of pomegranate tree.

Lobeline obtained from the seeds of Indian tobacco is used in medicine as a respiratory stimulant and as a tobacco substitute.

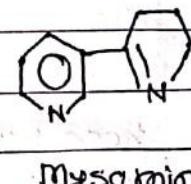
3. Pyridine Alkaloids - Pyridine Alkaloids - The tetrcyclic ring system present in these alkaloids is pyrrolidine-pyridine. Example are nicotine or myosmine.



Pyrrolidine-Pyridine.



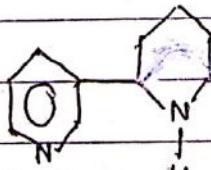
Nicotine.



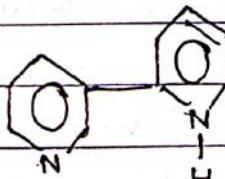
Myosmine.

Nicotine is isolated from tobacco leaf. It is highly toxic which is very small does does causes respiratory stimulation, and in large does causes respiratory failure and death. Myosmine also occurs in tobacco and aroma of tobacco smoke is due to it.

4. Pyridine-Piperidine Alkaloids - This family of alkaloids contain a pyridine ring system joined to a piperidine ring system. The simplest member is Anabasine, the chief alkaloid isolated from the poisonous Asiatic plant, *Anabasis aphyllon*. Another alkaloid of this class is Anatabine.

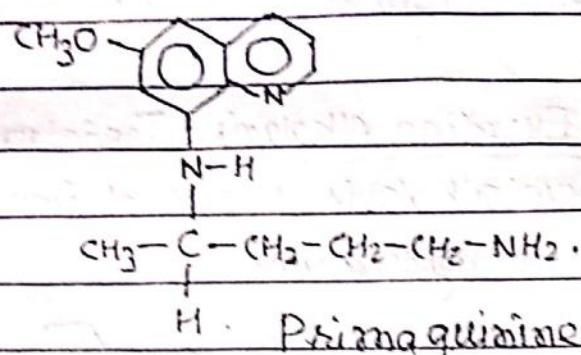
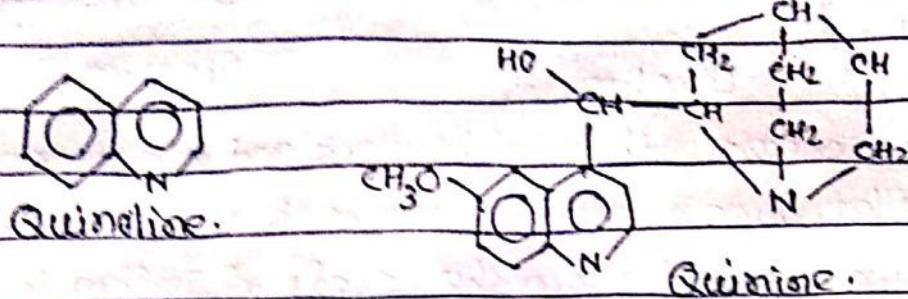


Anabasine.



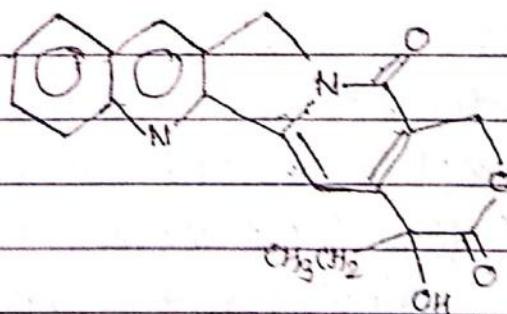
Anatabine.

5. Quinoline Alkaloids - These have the basic heterocyclic ring system quinoline e.g. Quinine and Primaquine.



Quinine occurs in the bark of cinchona tree. It has been used for centuries for treatment of malaria. Synthetic drugs such as primaquine have largely replaced quinine as an antimalarial.

A recently isolated alkaloid of this group is camptothecin found in Chinese tree camptotheca acuminata Nyssaceae. This is known as antileukemic and antitumor activity in animals.



Camptothecin.