Bioactive alkaloid markers - An overview

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ABSTRACT: *Alkaloids are the organic products of natural or synthetic origin. Alkaloids are colourless, crystalline, non volatile, solids; a few such as coniine and nicotine are liquids and a few even coloured, viz. berberine is yellow. True alkaloids – Atropine, Protoalkaloids – Ephidrine, Pseudoalkoloids – Caffeine. This review is focused the types of alkaloids and isolated compound of alkaloids for biological activity based.*

Key Words: *Alkaloids, Atropine, Ephedrine, Caffeine, Isolated, biological*

Introduction:
Alkaloids are the organic products of natural or synthetic origin which are basic in nature and contain one or more nitrogen atoms (usually in a heterocyclic ring) and posses specific physiological actions, due to the presence of lone pair of electron on nitrogen atom, alkaloids are basic.

Properties of alkaloids:
Alkaloids are colourless, crystalline, non volatile, solids; a few such as coniine and nicotine are liquids and a few even coloured, viz. berberine is yellow. The free bases (i.e. alkaloids themselves) are insoluble in water but soluble in most of the organic solvents.

Types of alkaloids:

A. True alkaloids:
These are derived from amino acids and have nitrogen in a heterocyclic ring. Eg: Atropine

B.Protoalkaloids:
These are derived from amino acids and do not have nitrogen in a heterocyclic ring. Eg: Ephidrine

C.Pseudoalkoloids:
These are not derived from amino acids but have nitrogen in a heterocyclic ring. Eg: Caffeine

D.False alkoloids:
These are non alkaloids gives false positive reactions for alkaloidal reagents.

Classification:
Alkaloids can be classified in any of the following ways.

- Biosynthetic classification
- Pharmacological classification
- Taxonomic classification
- Chemical classification

1. Biosynthetic classification:
This method of classification gives the significance to the precursor from which the alkaloids are biosynthesized in the plants.
For example:

- Indole alkoids are derived from tryptophan.
- Piperidine alkaloids are derived from lycine.
- Imidazole alkaloids are derived from histidine.

2. Pharmacological classification:
The alkaloids exhibit a broad spectrum of pharmacological actions on the basis of which they are classified in to different class, such as analgesics ,cns stimulants and depressents, purgatives, anticholinergics, anti malarial etc.

3. Taxonomic classification:

This classification essentially deals with the taxon i.e, Taxonomic category. for example:

- Cannanabinaceous alkaloids. eg: cannabis sativa.
- Rubiaceous alkaloids. eg:cinchona species

4. Chemical classification:

The criteria for chemical classification are the presence of a basic chemical structure. This is probably the most widely accepted and common mode of classification of alkaloids.

Examples are;

- Pyridine and piperidine alkaloids e.g arecoline, lobeline and nicotine.
- Tropane alkaloids e.g atropine, hyoscyamine and hyoscine.
- Quinolones alkaloids e.g quinine, quinidine, cinchonine, cinchonidine.
- Isoquinoline alkaloids e.g hydrastine, tubocurarine, emetine and opium alkaloids.
- Indole alkaloids e.g ergonovine, reserpine and strychnine.
- Imidazole alkaloids e.g pilocarpine.
- Purine bases e.g caffeine and theobromine.
- Steroidal alkaloids e.g protoveratrine.

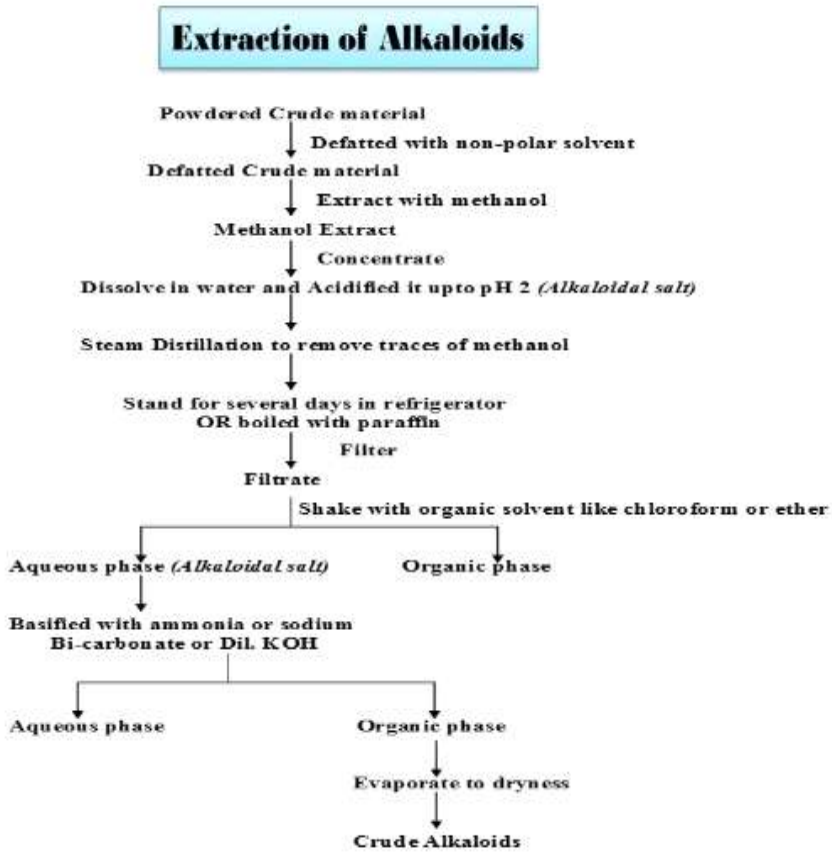
Bioactive alkaloid markers:

S. NO	TYPE OF ALKALOIDS	SOURCE	EXAMPLE	USES
A. NON HETEROCYCLIC ALKALOIS				
1.	Phenyl ethyl amine	ephedra	Ephedrine Pseudo ephedrine	Asthama
2.	Tropolone	Colchicum	Cochicines	Gout and Polypeptide
3.	Steroidal	Kurchi veratrum	Conessine veratramine	Dysentry, Hypertensive
B. HETEROCYCLIC ALKALOIDS				
1.	Pyridine and Piperidine	Lobelia Hemluck piper	Lobeline Coniine piperine	Spasmodic asthma Gonorrhoea
2.	Pyrrole and Pyrrolidine	Coca tobacco	Hygrine nicotine	CNS stimulant
3.	Imidazole	pilocarpus	pilocarpine	Atropine, antagonistic
4.	Isoquinoline	Opium cephaelis	Papaverine Narcotine Morphine emetine	Narcotic Analgesic Emetic
5.	Quinoline	Cinchona	Quininie Quinidine	Anti malariaanti
6.	Quinazoline	vasaka	vasicine	Anti tissue

Extraction of alkaloids:

The powdered crude material is defatted with non-polar solvent. This defatted crude material is extracted with methanol. The concentrated methanol extract is dissolved in water and acidified it up to pH 2 (Alkaloid salt).Then kept for steam distillation to remove traces of methanol and stand for several days in refrigerator or boiled with paraffin. The filter it and collect the filtrate and shake it with organic solvent like chloroform of ether.

Collect the aqueous phase and organic phase separately. To the aqueous phase (alkaloid salt) add ammonia or sodium bicarbonate or Dil.KOH to basify it. Then collect the organic phase from it and evaporate to dryness to get crude alkaloids.



Chemical tests:

General tests for alkaloids:

1. **Dragendroff's test:**
   Drug solution+ dragendroff's reagent (potassium bismuth iodide solution), formation of orangish red colour.
2. **Mayer's test:**
   Drug solution + few drops of Mayer's reagent (potassium mercuric iodide solution), formation of creamy white precipitant.
3. **Wagner's test:**
   Drug solution +few drops of Wagner's reagent (dilute iodide solution), formation of reddish brown precipitate.
4. **Hager's test:**
   Drug solution + few drops of Hager's reagent (saturated aq. solution of picric acid), formation of crystalline yellow precipitate.
5. **Tannic acid test:**
   Drug solution + few drops of tannic acid solution, formation of buff colored precipitate.
6. **Picrolonic acid test:**
   Drug solution + few drops of picrolonic acid, formation of yellow precipitate.

Specific tests for alkaloids:

1. Tropane alkaloids:

1. **Vitali-Morin reaction:**
   Alkaloid/atropine+ drop of H_2SO_4,evaporate to dryness and add 0.3 ml of 3% solution of KOH in methyl alcohol, which produces bright purple colour indicates the presence of atropine.
2. On addition of $AgNO_3$ solution to solution of hyoscine hydrobromide, gives a yellowish white precipitate which is insoluble in HNO_3 and soluble in Dil.NH_3.

2. Purine alkaloids:

1. Murexide test :(caffeine, theobromine and theophylline).

Crystals of caffeine + drops of concentrted HCl and traces of $KClO_3$,evaporated on water bath,red colour is produced which turns to violet on exposure to ammonia vapour.

2. Tannic acid test :(caffeine and theophylline):

A concentrated solution of the alkaloid + tannic acid,white precipitate is obtained that dissolves in excess of the reagent.

3. Ferrous sulphate test:(theobromine):

To the solution of the alkaloids + drops of concentrated HCl +few drops of Br_2 water + adrp of $FeSO_4$+ few drops of ammonia, produces blue colour.

3. Quinoline alkaloids:

1. Fluorescence test:

Solution of the alkaloid in oxygenated acids (e,g H_2SO_4 ,HNO_3 or phosphoric acid), produces blue fluorescence.It is positive with quinine and quinidine.

2. Thalleoquine test:

Aqueous solution of the alkaloid salt + Br_2/ H_2O (few drops till the appearence of yellow colour) +NH_4OH, gives emerald green colour.

4. Steroidal alkaloids:

1. Salkowski Tests:

Chloroform solution of the extract when shaken with concentrated sulphuric acid and on standing yields red colour.

2. Lieberman Burchardt tests:

Chloroform solution of the extract with few drops of acetic anhydride and one ml of concentrated sulphuric acid from the sides gives reddish ring at the junction of 2 layers.

5. Isoquinoline alkaloids:

1. Helch's test:

Drug solution + H_2SO_4 + H_2O_2 +KCr_2O_7, gives violet colour.

2. Ekkert's test:

Drug solution + sodium nitroprusside + sodium hydroxide, leave for a period in HCL solution, it gives red colour.

Pharmacognostic screening of alkaloid containing drugs:

1. TROPANE ALKALOIDS:

Tropane alkaloids are a class of bicyclic alkaloids and secondary metabolites that contain a tropane ring in their chemical structure. Tropane alkaloids occur naturally in many members of the plant family Solanaceae. The various alkaloids obtained include atropine, cocaine, scopolamine etc. They have a wide variety of pharmacological actions on the central nervous system, respiratory system, gastrointestinal system and also as antidote against poisoning.

1. DATURA:

Fig 1: *Datura stomonium*

Datura stramonium is a foul-smelling, erect, annual, freely branching herb that forms a bush up to 60 to 150 cm tall.

synonym:Hell's bells, devil's trumpet, devil's weed.

B.S: It consists of dried leaf and seed of *Datura stramonium* Linn.

Family: Solanaceae

Constituents: scopolamine, atropine, hyoscyamine.

Uses:
Datura Stramonium is used to relieve the following ailments:
Asthma: Smoking burning leaves is known to be a very useful medicine for relieving asthma.
Malaria: The fruit of the plant is a remedy for phlegmatic type of malaria fever.
Heart disorders: It is known to relieve distress, palpitation, aortic ailment and cardiac pains

2.*Atropa belladona*:

Fig 2: *Atropa belladona*

Atropa belladonna, commonly known as belladonna or deadly nightshade, is a perennial herbaceous plant in the nightshade .
B.S: It consists of dried leaves of *Atropa belladonna*
family: Solanaceae.
Constituents: Atropine, L-hyoscyamine,
Uses: Atropa Belladonna (deadly nightshade) has following healing properties. 1. Antispasmodic 2. Pain reliever or anodyne 3. Muscle relaxant 4. Anti-inflammatory 5. Mydriatic (dilate pupil) 6. Sedative 7. Antidepressant.

2. PURINE ALKALOIDS:

Purine alkaloids are produced by plants, examples of which include caffeine, cocaine and nicotine. Degradation of purine alkaloids occurs in plants, fungi and bacteria.

A. Cocaine:

Fig 3: Cocoa plant

Cocaine is a naturally occurring substance found in the coca plant which is mostly grown in South America.

Uses:

Topical cocaine can be used as a local numbing agent to help with painful procedures in the mouth or nose. Cocaine is now predominantly used for nasal and lacrimal duct surgery.

3. Quinoline - Isoquinoline alkaloids:

1. Opium:

Fig: 4 Opium plant

Opium is a poisonous plant.

Plant Description-

Erect annual with milky juice; leaves alternate, simple, clasping, toothed; flowers terminal, with 5-more showy petals (white, pink, red, or purple); fruit a capsule with an expanded disc at the top and over small holes through which the minute seeds are dispersed.

B.S:Papaver somniferum

Family:Papaveraceae

Active constituents: morphine,codeine, narcotine, thebaine, noscapine, narceine, papaverine, etc.

Uses:relax smooth muscle tone,treatment of diarrhea and abdominal cramping.

2. Cinchona:

Fig: 5 Cinchona plant

Synonym: Jesuit"s bark

B.S: Cinchona Succirubra, C.calisaya, C.officinalis.

Family: Rubiaceae

Chemical constituents: Quinine, quinidine, cinchonine, cinchonidine.

Uses: Quinine is a classical anti malarial. Quinidine is used for cardiac arrhythmias and atrial fabrillation.

4. Quinazoline alkaloids:

1. Vasaka:

Fig: 6 Vasaka plant

Justicia adhatoda, commonly known in English as Malabar nut, adulsa, adhatoda, vasa, or vasaka, is a

medicinal plant native to Asia, widely used in Siddha Medicine, Ayurvedic, homeopathy and Unani systems of medicine.
B.S: *Adhatoda vasica*
Family: Acanthaceae
chemical constituents: vasicine, Luteolin, Tritriacontane, B- Sitosterol, Kaempferol, 3- Sophoroside, Adhatodic acid, q-Hydroxyvasicinine, Vit –C, vasicol. Vasicinol, Vaicinolone, Adhatodine, Adhavasinone, Anisotine, Carotene, Vasakin, Vasicinone, Vascicolone, Vasicolinone.
uses: Treatment of asthma, bronchitis, tuberculosis and other.It is also used as expectorant, antispasmodic, anthelmintic, antiseptic and bronchodilator.

5. Steroidal alkaloids:
1. Kurchi bark:

Fig: 7 Kurchi bark

Kurchi is a glabrous tree or large shrub found throughout the deciduous forest areas of India at low elevations.
B.S: It consists of seeds and barks of *Holarrhena antidysentrica*
Family: Apocyanaceae
Chemical constituents: Conessine, Isoconessine.
Uses: Treatment of amoebic dysentry, diarrhoea, irritable bowel syndrome, bleeding piles, and liver disorders.

2. Aswagandha:

Fig: 8 Aswagandha

Withania somnifera (WS), also known as ashwagandha, Indian ginseng, and winter cherry, it has been an important herb in the Ayurvedic and indigenous medical systems for over 3000 years.
B.S: *Withania somnifera* (L.) Dunal
Family: Solanaceae
Chemical constituents: Steroidal lactones, Withanine, amino acids, choline, beta-sitosterol, chlorogenic acid, scopoletin, withaferin etc. ...
Uses: Skin diseases, tumors, inflammation, arthritis and joint pains.

6. Indole alkaloids:

1. Rauwolfia:

Fig: 9 Rauwolfia

B.S: *Rauwolfia serpentina*, R. canescens, R. micrantha, and R. densiflora
Family: Apocynaceae.
Chemical constituents: Reserpine, Rescinnamine.
Uses: Ajmalicine, serpentine

7. Imidazole alkaloids:

Imidazole is an organic compound with the formula $C_3N_2H_4$. It is a white or colourless solid that is soluble in water, producing a mildly alkaline solution. In chemistry, it is an aromatic heterocycle, classified as a diazole, and has non-adjacent nitrogen atoms.

1. Pilocarpus:

Fig 10 : Pilocarpus

B.S: The dried leaflets of *Pilocarpus Jaborandi*, Holmes
Family: Rutaceae
Chemical constituents: Pilocarpine
Uses: Treat glaucoma

Conclusion:

Alkaloids are secondary metabolites. The biological herbal markers of alkaloids are useful in various ailments in the human life. In this review is very useful for further researcher. In this isolated compounds significant role in pharmacologically so its biologically active potential compound from alkaloids.

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