

D.PHARM 1ST YEAR
PHARMACOGNOSY
ALKALOIDS

CHAPTER-4 **2026-27**

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PHARMACOGNOSY



Class 4

Chapter 4

SYLLABUS

Brief outline of **occurrence**, **distribution**, **isolation**, **identification tests**, **therapeutic activity** and **pharmaceutical applications** of **alkaloids**, **terpenoids**, **glycosides**, **volatile oils**, **tannins** and **resins**.

Alkaloids

Terpenoids

Glycosides

Volatile Oils

Tannins

Resins

Introduction to Alkaloids

NATURAL COMPOUNDS • EXTRAORDINARY EFFECTS

Plants
Inspire
Better
Tomorrows

Alkaloids

Alkaloids are **naturally occurring organic compounds**, mostly of **plant origin**, which contain one or more **nitrogen atoms** and generally possess **basic (alkaline) properties**. Most alkaloids produce marked **physiological or pharmacological effects** in humans and animals.

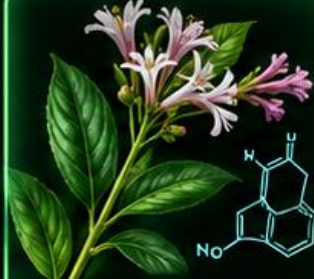
The term 'alkaloid' was introduced by **W. Meissner** in **1819**.

NATURE
CHEMISTRY
HEALTHIER
LIVES

Examples include:



Morphine
— Opium



Quinine
— Cinchona



Atropine
— Belladonna



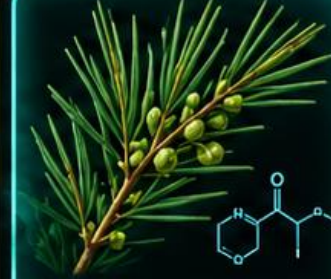
Reserpine
— Rauwolfia



Vincristine
— Vinca



Caffeine
— Tea/Coffee



Ephedrine
— Ephedra

FROM PLANTS TO POSSIBILITIES

KNOWLEDGE
GROWS
WELLNESS

General Characteristics of Alkaloids

"Small Molecules
Big Impacts"

Plants
Produce
Possibilities

Most alkaloids are:

1



Nitrogen-containing
organic compounds.

2



Basic in nature because of
the presence of nitrogen.

3



Bitter in taste.

4



Physiologically active.

5



Usually present in plants
as **salts of organic acids**.

6



Mostly **crystalline solids**,
although a few are liquids.

7



Usually **colourless**, although
some alkaloids are coloured.

8



Sparingly soluble in water
in their free-base form.

9



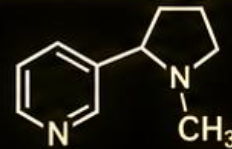
Soluble in organic solvents such
as **chloroform and ether** in their
free-base state.

10



More water-soluble when
converted into salts with acids.

Examples of liquid alkaloids include
nicotine and **coniine**.



Nicotine



Coniine

ALKALOIDS
FROM
PLANTS
FOR A
HEALTHIER
TOMORROW

NATURAL
COMPOUNDS
BRIGHTER
FUTURES

N
NATURE
CHEMISTRY
BETTER
LIVES

DISCOVER
EXTRACT
ISOLATE
UNDERSTAND
APPLY

PLANTS
CHEMISTRY
PEOPLE
A BRIGHTER
WORLD

2. Occurrence of Alkaloids

Alkaloids occur mainly in the **plant kingdom**, although some have also been reported from **microorganisms** and **animals**.



In **plants**, alkaloids may occur in different **organs** including:

Plant part	Example
 Roots	Rauwolfia
 Rhizomes	Ipecac
 Bark	Cinchona
 Leaves	Belladonna, Datura, Coca
 Seeds	Nux vomica
 Fruits	Black pepper
 Latex	Opium
 Entire plant	Ephedra, Vinca

DISCOVER
EXTRACT
ISOLATE
IDENTIFY
VALUE

ALKALOIDS

NATURE'S
BIOACTIVE GIFTS

FROM
PLANTS
TO
POSSIBILITIES

Within plant cells, alkaloids are commonly stored in **cell vacuoles**, usually as **salts of organic acids**.

PLANT CELLS • NATURAL STORAGE • BIOLOGICAL WISDOM

3. Distribution of Alkaloids



Alkaloids are not uniformly distributed throughout the plant kingdom. They are particularly common in certain families of **dicotyledonous plants**.



Important alkaloid-containing families include:

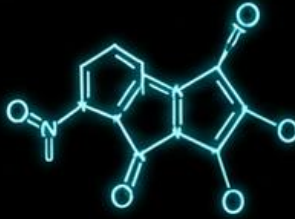


 Family	 Important alkaloids / drugs
 Solanaceae	Atropine, Hyoscyamine, Scopolamine
 Apocynaceae	Reserpine, Ajmaline, Vincristine
 Rubiaceae	Quinine, Quinidine, Caffeine
 Papaveraceae	Morphine, Codeine, Papaverine
 Loganiaceae	Strychnine, Brucine
 Ephedraceae	Ephedrine
 Erythroxylaceae	Cocaine



Thus, alkaloids show characteristic distribution in specific plant families and are especially abundant in several **dicot families**.

Plants
Produce
Powerful
Molecules



Nature
Synthesizes
Brilliance

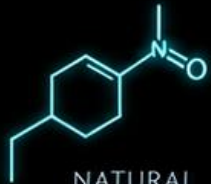
SAME ROOTS
DIFFERENT
MOLECULES
A BRIGHTER
WORLD



ALKALOIDS
NATURE'S
CHEMICAL DEFENSE
OUR THERAPEUTIC ALLIES



PLANTS
A TREASURY
OF BIOACTIVE
MOLECULES



NATURAL
PRODUCTS
BETTER
TOMORROWS



PHARMACOGNOSY
BRIDGES PLANTS
AND PEOPLE

4. Distribution Within the Plant

The same **alkaloid** may not be equally **distributed** in all parts of a **medicinal plant**.

For example:

Different Parts
Different Potency
Same Plant ...

1 Cinchona

Cinchona spp.



BARK

Alkaloids are mainly concentrated in the **bark**.

2

Rauwolfia

Rauwolfia serpentina



ROOTS

Reserpine and related alkaloids occur mainly in the **roots**.

3

Belladonna

Atropa belladonna



LEAVES



ROOTS

Tropane alkaloids occur mainly in the **leaves and roots**.

4

Opium

Papaver somniferum



DRIED LATEX
OBTAINED FROM
IMMATURE CAPSULES

Morphine and related alkaloids are present in the **dried latex** obtained from **immature capsules**.

5

Nux Vomica

Strychnos nux-vomica



SEEDS

Strychnine and brucine occur mainly in the **seeds**.

6

Vinca

Catharanthus roseus



LEAVES

Indole alkaloids occur in different aerial portions, especially the **leaves**.

General Method for Isolation of Alkaloids



ISOLATION → PURIFICATION → IDENTIFICATION

1 Step 1: Preparation of Drug

The crude drug is:

Dried

powdered

subjected to extraction

Fine or moderately coarse powder **increases contact** between the drug and extracting solvent.

2 Step 2: Defatting

The powdered drug may first be treated with a **non-polar solvent** to remove:

- Fats
- Waxes
- Chlorophyll
- Fixed oils
- Other lipophilic impurities

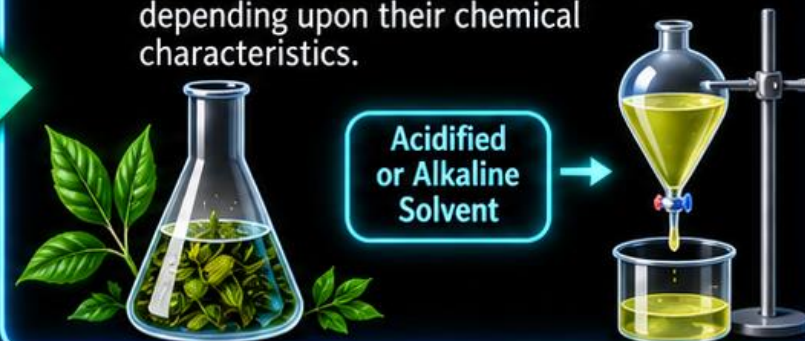
Non-polar solvent

This makes subsequent alkaloid extraction **easier**.

3 Step 3: Extraction

The alkaloids are extracted by an appropriate **acidified or alkaline extraction method** depending upon their chemical characteristics.

Acidified or Alkaline Solvent



4 Step 4: Conversion Into Free Base

If alkaloids have been extracted as salts, the solution is **made alkaline** so that the alkaloidal salts are converted into **free bases**.Add base
(make alkaline)Alkaloidal salts
(in solution)Free alkaloids
(free bases)

5 Step 5: Separation

The free alkaloids can then be transferred into a suitable **organic phase**.

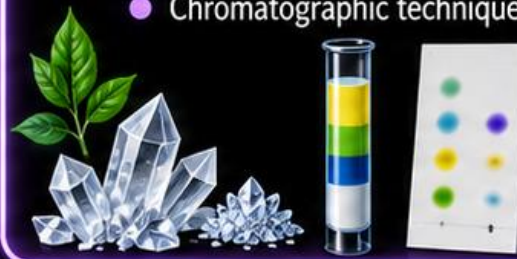
Aqueous phase

Organic phase
(with alkaloids)

6 Step 6: Purification

Purification may involve:

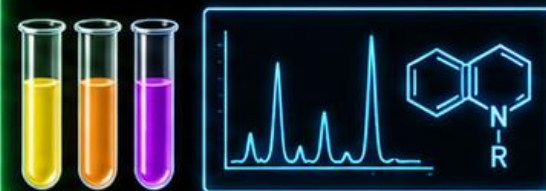
- Re-extraction
- Crystallization
- Fractionation
- Chromatographic techniques



7 Step 7: Identification

The isolated material is examined by:

- General alkaloid tests
- Specific chemical tests
- Chromatographic methods
- Spectroscopic techniques



Preparation

Defatting

Extraction

Free Base
Conversion

Separation

Purification

Identification

General Identification Tests for Alkaloids

- Most alkaloids react with certain reagents to produce **characteristic precipitates**.
- Before carrying out general tests, an **acidic extract** of the crude drug is commonly prepared.

Mayer's Test



✓ Indicates the presence of alkaloids.

Dragendorff's Test



✓ Indicates alkaloids.
★ One of the most commonly used tests for alkaloids.

Wagner's Test



✓ Indicates alkaloids.

Hager's Test



✓ Indicates alkaloids.

Quick Summary



Test	Positive result
Mayer's Test	Cream/white precipitate
Dragendorff's Test	Orange-red precipitate
Wagner's Test	Reddish-brown precipitate
Hager's Test	Yellow precipitate



Therapeutic Activities of Alkaloids

Alkaloids are among the most pharmacologically **active** constituents found in medicinal plants. Their actions cover several organ systems.

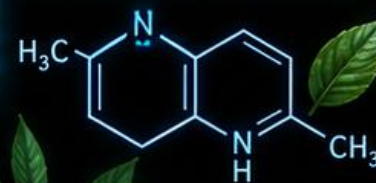
Plants
Produce
Possibilities

 Therapeutic Activity	Alkaloid Example 
 Analgesic	Morphine
 Antitussive	Codeine
 Antimalarial	Quinine
 Antiarrhythmic	Quinidine
 Antihypertensive	Reserpine
 Anticancer	Vincristine, Vinblastine
 Anticholinergic	Atropine
 Mydriatic	Atropine
 Bronchodilator	Ephedrine, Theophylline
 CNS stimulant	Caffeine
 Local anaesthetic	Cocaine
 Uterotonic	Ergometrine
 Antiglaucoma	Pilocarpine
 Antiasthmatic	Ephedrine
 Antispasmodic	Atropine, Papaverine

 **DIVERSE ACTIONS. REAL THERAPEUTIC VALUE.**

-  PLANT ORIGIN
-  POTENT PHARMACOLOGY
-  MULTIPLE TARGETS
-  BENEFIT HUMAN HEALTH

From Nature to New Horizons 



NATURE • SCIENCE • HEALTHIER LIVES



Alkaloids show diverse therapeutic actions across multiple body systems.



"Small Molecules Big Impacts"

MEDICINAL PLANTS
A RICH SOURCE
OF ALKALOIDS

PHARMACOGNOSY

MEDICINAL PLANTS

NATURAL PRODUCTS

BETTER THERAPIES

Pharmaceutical Applications of Alkaloids

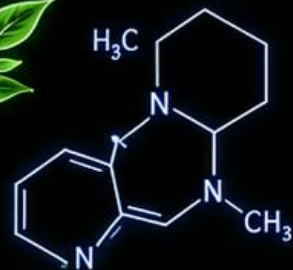
Alkaloids are important pharmacologically active natural compounds used directly as medicines or as lead compounds for drug development.

Their pharmaceutical applications include:

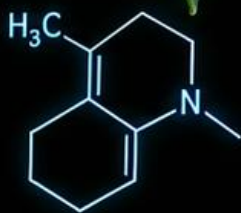
Pharmaceutical Application	Alkaloid Example	Main Use
 Analgesic	Morphine	Relief of severe pain
 Antitussive	Codeine	Suppression of cough
 Antimalarial	Quinine	Treatment of malaria
 Antiarrhythmic	Quinidine	Management of certain cardiac arrhythmias
 Antihypertensive	Reserpine	Reduction of blood pressure
 Anticancer	Vincristine, Vinblastine	Treatment of different cancers



Alkaloids serve as valuable therapeutic agents in modern medicine.



"SMALL
MOLECULES
BIG
IMPACT"



Nature
Provides
Healing
Molecules

PLANTS
PEOPLE
BETTER LIVES



Pharmaceutical Application	Alkaloid Example	Main Use
 Mydriatic	Atropine	Dilatation of pupil during ophthalmic examination
 Bronchodilator / Sympathomimetic	Ephedrine	Produces bronchodilation; historically used in asthma
 CNS stimulant	Caffeine	Increases alertness and reduces fatigue
 Local anaesthetic	Cocaine	Local anaesthesia in limited specialized procedures
 Uterotonic	Ergometrine	Produces uterine contraction; used in postpartum bleeding
 Antiglaucoma / Miotic	Pilocarpine	Reduces intraocular pressure and produces miosis

Summary Points of **Alkaloids**

- 1 Alkaloids are naturally occurring **nitrogen-containing organic compounds**.
- 2 They are mainly found in **medicinal plants**.
- 3 Most alkaloids are **basic** in nature and **bitter** in taste.
- 4 They are usually present in plants as **salts of organic acids**.
- 5 Alkaloids may occur in **roots, bark, leaves, seeds, fruits, latex, and whole plants**.
- 6 Common examples include **morphine, quinine, atropine, reserpine, caffeine, ephedrine, and vincristine**.
- 7 They are isolated mainly by **acid-base extraction** methods.
- 8 General identification tests include **Mayer's, Dragendorff's, Wagner's, and Hager's** tests.
- 9 Alkaloids possess strong **physiological and pharmacological activities**.
- 10 Major applications include **analgesic, antimalarial, anticancer, antihypertensive, antitussive, bronchodilator, CNS stimulant, and anticholinergic actions**.

THANK

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