

Alkaloids

Introduction to Alkaloids

- Alkaloids are naturally occurring, nitrogen-containing compounds produced primarily by plants (though some are produced by fungi, bacteria, and animals).
- They often have a strong physiological effect on humans and animals.
- The nitrogen is typically part of a heterocyclic ring system, which greatly influences their chemical and pharmacological properties.

General Properties

1. Basicity:

- Alkaloids are usually basic due to the lone pair on the nitrogen. However, some alkaloids (e.g., colchicine) are neutral.

2. Physicochemical properties:

- Most are crystalline solids; a few (e.g., nicotine) are liquids.
- Many are bitter in taste.
- Soluble in organic solvents, but often sparingly soluble in water (in free-base form). However, their salts (formed with acids) are more water-soluble.

3. Pharmacological significance:

- Alkaloids frequently have potent biological activities. They can act on the central nervous system, cardiovascular system, or smooth muscles, among other targets.

Classification of Alkaloids

Alkaloids are classified based on:

1. **Biosynthetic pathway or precursor** (e.g., indole alkaloids, isoquinoline alkaloids).
2. **Chemical structure** (e.g., pyrrolidine, tropane, quinoline, isoquinoline, indole, steroidal, etc.).
3. **Taxonomical distribution** (e.g., family-specific alkaloids).

Various Alkaloids

Vinca

General Introduction:

- Vinca alkaloids are a group of dimeric indole alkaloids highly regarded for their anticancer properties.
- Initially extracted from the Madagascar periwinkle plant, they are used to treat various cancers by inhibiting mitotic cell division.

Synonyms:

- **Common Name:** Periwinkle alkaloids
- **Scientific Name:** Catharanthus roseus alkaloids
- **Other Names:** Vincristine, Vinblastine, Catharanthus alkaloids

Biological Source:

- **Plant:** Derived from the leaves of *Catharanthus roseus* (formerly *Vinca rosea*).
- **Family:** Apocynaceae

Composition:



- **Major Alkaloids:** Vincristine, Vinblastine, and semi-synthetic derivatives such as Vindesine and Vinorelbine.
- **Structural Units:** Consist of indole and dihydroindole units (specifically, Vindoline and Catharanthine linked by an indole-dihydroindole bridge).

Chemistry & Chemical Classes:

- **Chemical Class:** Indole alkaloids (Tryptophan derivatives)
- **Structure:** Complex dimeric molecules
- **Solubility:** Generally hydrophilic; modifications can improve pharmacokinetic properties.

Therapeutic Uses:

1. Vincristine:

- **Cancers Treated:** Acute lymphoblastic leukemia (ALL), Hodgkin's lymphoma, neuroblastomas.
- **Mechanism:** Inhibits microtubule assembly, causing metaphase arrest in mitosis.

2. Vinblastine:

- **Cancers Treated:** Hodgkin's lymphoma, testicular cancer, breast cancer, Kaposi's sarcoma.
- **Mechanism:** Binds to tubulin, preventing mitotic spindle formation.

Commercial Applications:

- Integral to many chemotherapy regimens.
- **Formulations:** Marketed as injectable formulations (e.g., vincristine sulfate, vinblastine sulfate).
- **Additional Derivatives:** Vindesine and Vinorelbine for specific cancer treatments.

Rauwolfia

General Introduction:

- Rauwolfia alkaloids are indole alkaloids known primarily for their sedative and antihypertensive effects.
- They have been used extensively in traditional medicine for treating hypertension and mental disorders.



Synonyms:

- **Common Name:** Indian snakeroot alkaloids
- **Scientific Name:** Rauwolfia serpentina alkaloids
- **Other Names:** Reserpine, Ajmaline, Serpentine alkaloids

Biological Source:

- **Plant:** Extracted from the dried roots of Rauwolfia serpentina.
- **Family:** Apocynaceae



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