

Metabolites

Metabolites are compounds synthesized by plants for both essential functions, such as **growth and development (primary metabolites)**

and specific functions (secondary metabolites).

- **Primary metabolites**: Molecules that are essential for growth and development of an organism.

Examples:

1. Carbohydrates

2. Proteins

3. Lipids

5. Hormones

4. Nucleic acids

Secondary metabolites: molecules that are not essential for growth and development of an organism. Secondary metabolites are derived from primary metabolites. Alkaloids, glycosides, terpenoids.

Alkaloids

- Most are derived from a few common amino acids (i.e., tyrosine, tryptophan, ornithine or arginine, and lysine)

- Compounds have a ring structure and a nitrogen residue.
- These are commonly applied to basic nitrogenous compounds of plant origin that are physiologically active.
- Organic nitrogenous compounds with a limited distribution in nature.

Characteristics:

- They are bitter in taste.
- Insoluble or sparingly soluble in water, but the salts formed on reaction with acids are usually freely soluble.
- Most are crystalline solids although a few are amorphous.
- Free alkaloids are usually soluble in polar solvents like ether, chloroform.
- Some alkaloids are liquid because of lacking of oxygen in their molecules. (e.g coniine, nicotine, spartenine)
- Contains nitrogen -usually derived from an amino acid.
- They give a precipitate with heavy metal iodide

TESTS FOR ALKALOIDS

• Most alkaloids are precipitated from neutral or slightly acidic solution by

• **D**ragendorff's reagent (solution of potassium bismuth iodide) orange coloured precipitate.

• **M**ayer's reagent (potassium mercuric iodide solution) Cream coloured precipitate.

• **W**agner's reagent (iodine in potassium iodide) red-brown precipitate

• **H**ager's reagent (picric acid) yellow precipitate

Naming for alkaloids

- From the **generic name** or the **genus** of the plant yielding them (e.g. vinblastine and vincristine. atropine)

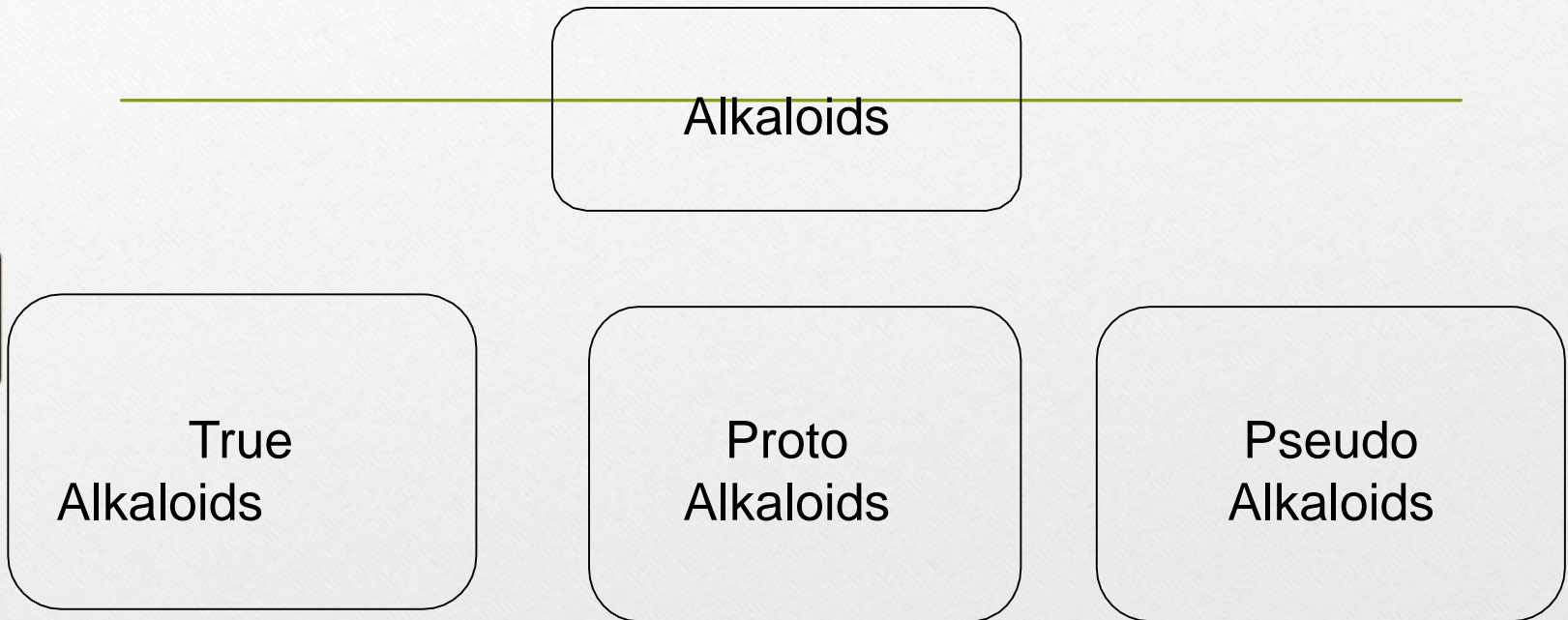
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- The **specific name** or **species** of the plant yielding alkaloids (e.g. belladonnine).

- From the **discoverer** (e.g. pelletierine)

~ All names of alkaloids should end in “-ine”.

~ A prefix or suffix is added to the name of a principal alkaloid from the same source. (quinine, quinidine, hydroquinine)

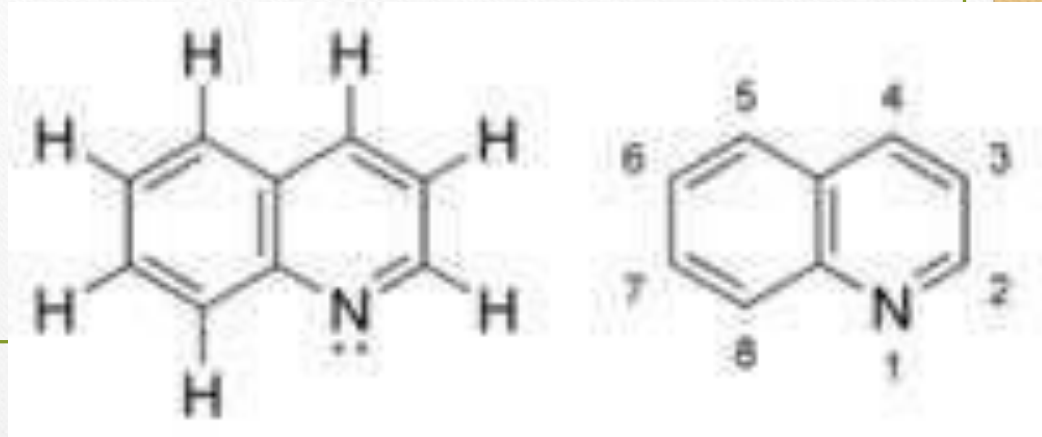
TYPES OF ALKALOIDS



True or hetero cyclic alkaloids

- Pyridine- Piperidine alkaloids e.g. Hygrine, Cocca species
- pyrrole & pyrrolidine alkaloids
- Tropane alkaloids
- Quinoline alkaloids
- Isoquinoline alkaloids
- Indole alkaloids
- Imidazole alkaloids
- Norlupinane alkaloids
- Steroid alkaloids
- Purine alkaloids

QUINOLINE DERIVATIVES



e.g. Quinine,
quinidine,
cinchonine



Quinine

- Dia-stereo-isomer of quinidine
- It occurs as white, odourless, bulky crystals or as a crystalline powder.
- It darkens when exposed to light and effloresces in dry air.
- It is freely soluble in alcohol, ether and chloroform but slightly soluble in water.

Uses

- Antimalarial
- For treating of chloroquine resistant falciparum malaria combination with pyrimethamine and sulfadoxine or tetracycline or clindamycin.
- It has a skeletal muscle relaxant effect.
- It is widely used for the prevention and treatment of nocturnal recumbency leg cramps.

INDOLE DERIVATIVES

e.g. ergometrine,
ergotamine,
reserpine, vincristine,
vinblastine

ISOQUINOLINE DERIVATIVES

e.g. Morphine,
codeine,
berberine, emetine

IMIDAZOLE DERIVATIVES

e.g. Pilocarpine, iso pilocarpine

PSEUDO ALKALOIDS

DITERPINES

e.g. Aconitine, aconine, hypoaconitine

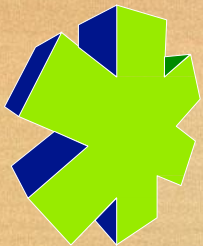
PROTO OR NON HETERO CYCLIC ALKALOIDS

ALKYLAMINES

e.g. Ephedrine, pseudoephedrine, colchicine

Uses of Alkaloids in Plants:

- Poisonous agents which protect plants against insects and herbivores.
- For regulatory growth factors
- Reserve substance capable of supplying nitrogen or other elements necessary to the plant's economy



Terpenoids



Terpenoids

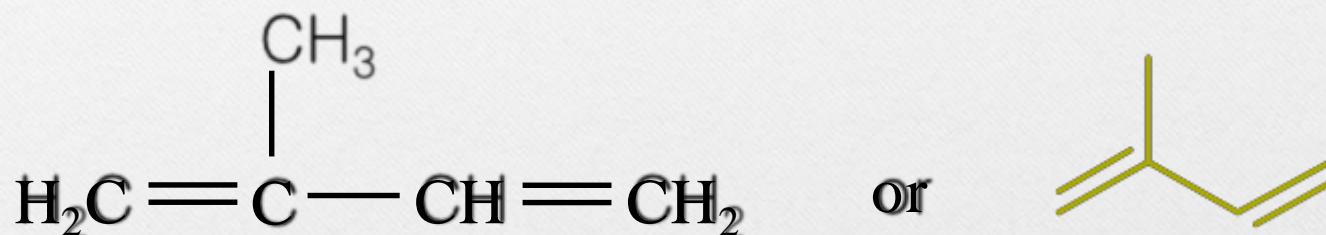
- Terpenes are generally polymers of 5-carbon unit called isoprene
- Give scent, flavors, colors, medicine...

The Biological Isoprene Unit

- The isoprene units in terpenes do not come from isoprene.
- They come from isopentenyl pyrophosphate.
- Isopentenyl pyrophosphate (5 carbons) comes from acetate (2 carbons) via mevalonate (6 carbons).

Terpenes

- Terpenes are natural products that are structurally related to isoprene.



Isoprene
(2-methyl-1,3-butadiene)

CLASSIFICATION OF TERPENES

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TYPE OF TERPENE	NUMBER OF CARBON ATOMS	ISOPRENE UNITS
hemiterpene	C ₅	one
terpene	C ₁₀	two
sesquiterpene	C ₁₅ C ₂₀	three
diterpene	C ₃₀ C ₄₀	four
triterpene		Six
tetraterpene		eight

CLASSIFICATION OF TERPENES

- **Hemiterpenes** consist of *a single isoprene* unit. Isoprene itself is considered the only hemiterpene, but oxygen-containing derivatives such as prenol and iso valeric acid are hemiterpenoids.
- **Monoterpenes** consist of *two isoprene* units and have the molecular formula $C_{10}H_{16}$. Examples of monoterpenes are: geraniol, limonene and terpineol.
- **Sesquiterpenes** consist of *three isoprene* units and have the molecular formula $C_{15}H_{24}$. Examples of sesquiterpenes are: humulene, farnesenes, farnesol.
- **Diterpenes** are composed of *four isoprene* units and have the molecular formula $C_{20}H_{32}$. They derive from geranylgeranyl pyrophosphate. Examples of diterpenes are cafestol, kahweol, cembrene and taxadiene (precursor of taxol).

CLASSIFICATION OF TERPENES

- **Sesterterpenes**, terpenes having 25 carbons and *five isoprene* units, are rare relative to the other sizes, example: geranylarnesol.

- **Triterpenes** consist of *six isoprene* units and have the molecular formula $C_{30}H_{48}$. The linear triterpene squalene, the major constituent of shark liver oil, is derived from the reductive coupling of two molecules of farnesyl pyrophosphate. Squalene is then processed biosynthetically to generate either lanosterol or cycloartenol, the structural precursors to all the steroids.
- **Sesquiterpenes** are composed of *seven isoprene* units and have the molecular formula $C_{15}H_{24}$. Sesquiterpenes are typically microbial in their origin. Examples of sesquiterpenes are ferrugicadiol and tetraprenylcurcumene.

CLASSIFICATION OF TERPENES

- **Tetraterpenes** contain *eight isoprene* units and have the molecular formula $C_{40}H_{64}$. Biologically important tetraterpenes include the acyclic lycopene, the monocyclic gamma-carotene, and the bicyclic

alpha- and beta-carotenes.
- **Polyterpenes** consist of long chains of *many isoprene* units, eg, Natural rubber .
- **Nor-isoprenoids** e.g.: C_{13} -norisoprenoids 3-oxo- α -ionol present in Muscat of Alexandria leaves and 7,8-dihydroiononederivatives, such as megastigmane-3,9-diol and 3-oxo-7,8-dihydro- α -ionol found in Shiraz leaves (both grapes in the species *Vitis vinifera*)

THANK YOU.....
