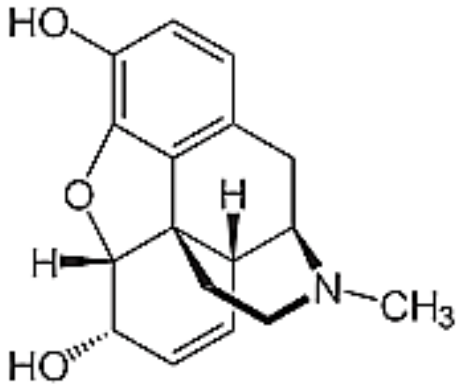
Alkaloids

The first individual alkaloid, morphine, was isolated in 1804 from poppy (*Papaver somniferum*).



Definition and properties

Alkaloids are a group of naturally occurring chemical compounds (natural products) that contain mostly basic nitrogen atoms. This group also includes some related compounds with neutral and even weakly acidic properties.

Some synthetic compounds of similar structure are also termed alkaloids.

In addition to carbon, hydrogen and nitrogen, alkaloids may also contain oxygen, sulfur and more rarely other elements such as chlorine, bromine, and phosphorus.

Alkaloids are produced by a large variety of organisms including bacteria, fungi, plants, and animals. They can be purified from crude extracts of these organisms by acid-base extraction.

Alkaloids

Definition and properties

Alkaloids can be purified from crude extracts of these organisms by acid-base extraction.

Many alkaloids are toxic to other organisms.

They often have pharmacological effects and are used as medications, as recreational منعش drugs, or in entheogenic الطقوس rituals. Examples are the local anesthetic مخدر and stimulant cocaine, the psychedelic منشط psilocin, the stimulant منبه caffeine, nicotine, the analgesic مسكن morphine, the antibacterial berberine, the anticancer compound vincristine, the anti-hypertension agent reserpine, the anti-cholinergic agent atropine, the vasodilator vincamine, the anti-arrhythmia compound quinidine, the anti-asthma therapeutic ephedrine, and the antimalarial drug quinine.

Although alkaloids act on a diversity of metabolic systems in humans and other animals, they almost uniformly invoke a bitter taste.

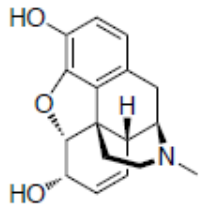
Naming

The concept of "alkaloid".

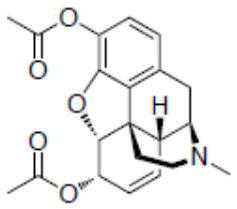
The name "alkaloid was introduced in 1819 by the German chemist Carl Friedrich Wilhelm Meißner, and is derived from late Latin root *Latin:* alkali.

There is no unique method of naming alkaloids. Many individual names are formed by adding the suffix "ine" to the species or genus name. For example, atropine is isolated from the plant *Atropa belladonna*, strychnine is obtained from the seed of Strychnine tree (*Strychnos nux-vomica* L.). If several alkaloids are extracted from one plant then their names often contain suffixes "idine", "anine", "aline", "inine" etc. There are also at least 86 alkaloids containing the root "vin" (extracted from the Vinca plant).

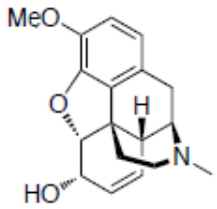
Alkaloids



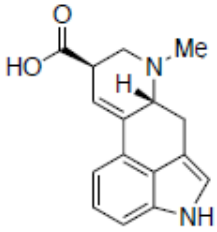
Morphine
Papaver somniferum
(Plant)



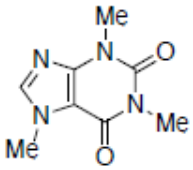
Heroin
(diacetyl morphine or diamorphine)
a semisynthetic derivative of morphine



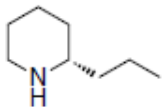
Codeine
(methylmorphine)



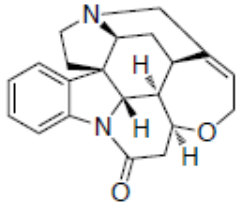
lysergic acid
ergot fungi



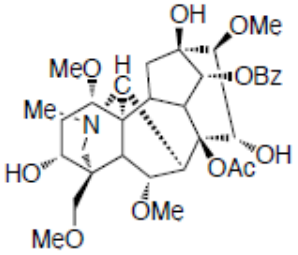
Caffeine
Isolated from plants - first 1819
Stimulant
Alkaloid



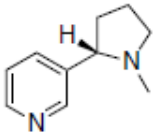
Coniine
Neurotoxin from
Conium maculatum
(Plant)



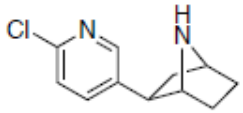
Strychnine
Toxin from *Strychnos nux-vomica*
(tree)



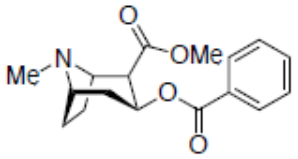
Aconitine
Toxin from aconite species
(plant)



Nicotine
Stimulant from the *Nicotiana* (Nightshade) genus
(Plants)



Epibatidine
Pain killer (200 x more potent than morphine)
Epipedobates tricolor
(Frog)



Cocaine
Erythroxylum coca (Plant)
Alkaloid

Nomenclature

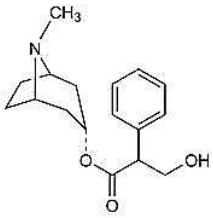
Trivial names should end by "ine". These names may refer to:

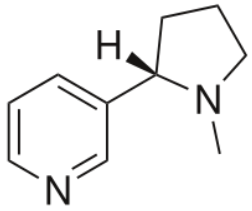
- **The genus of the plant, such as Atropine from *Atropa belladona*.**
- **The plant species, such as Cocaine from *Erythroxylon coca*.**
- **The common name of the drug, such as Ergotamine from ergot.**
- **The name of the discoverer, such as Pelletierine that was discovered by Pelletier.**
- **The physiological action, such as Emetine that acts as emetic, Morphine acts as narcotic.**
- **A prominent physical character, such as Hygrine that is hygroscopic.**

Alkaloids Classifications

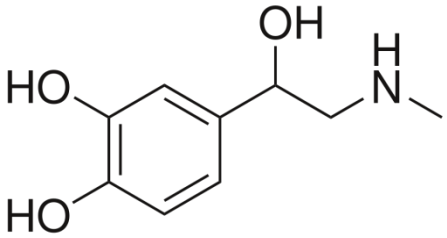
Alkaloids are often divided into the following major groups:

1) **"True alkaloids", which contain nitrogen in the heterocycle and originate from amino acids. Their characteristic examples are atropine, nicotine, and morphine.**

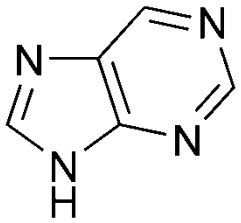


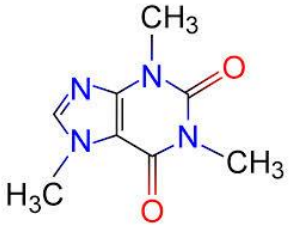


1) **"Protoalkaloids", which contain nitrogen and also originate from amino acids. Examples include mescaline, adrenaline and ephedrine.**

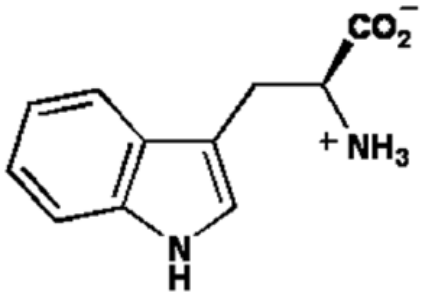


1) **"Pseudalkaloids" – alkaloid-like compounds that do not originate from amino acids. This group includes, terpene-like and steroid-like alkaloids, as well as purine-like alkaloids such as caffeine, theobromine, theacrine and theophylline.**

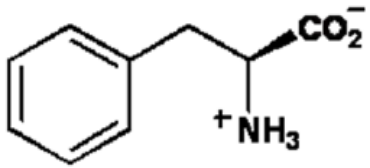




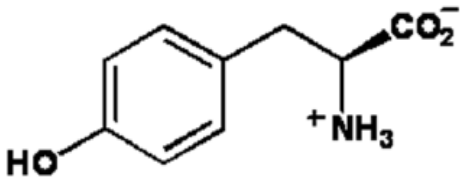
α-Amino Acids used to make Alkaloids



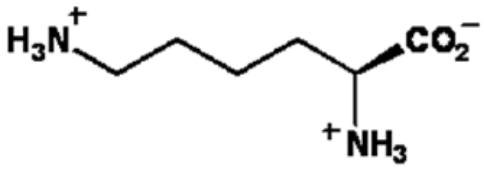
tryptophan



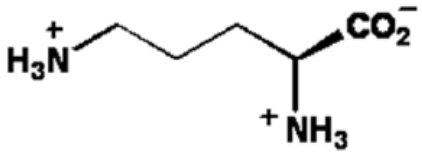
phenylalanine



tyrosine



lysine



ornithine

Chemical properties of alkaloids

- Present in the Plant as- Salt, ester, N-oxide, quaternary compound.)
- Generally very toxic compound.
- Have bitter taste.
- Unstable compound in (Heat, Light, pH changes ”some of”

Physicochemical properties

- Solid crystalline compound (exception are: coniine and Nicotine are liquid (It doesn't have Oxygen in their structure).

- Colorless compound (exception are berberine (yellow), Betaine (red).

- Sharp melting Point because it’s pure compound in crystal form.

- Can be either 1º, 2º, 3º or 4^0 alkaloid:
- Basicity depends on availability of lone pair of electrons:

1. Electron donating or electron withdrawing neighbors.
2. Type of hybridization.
3. Aromaticity.

Detection of alkaloid

Wagner's test: **(I_2/kI): Reddish brown precipitate .**

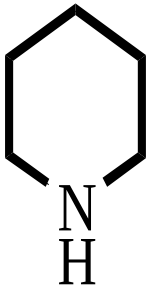
Mayer's: **($HgCl_2$ Creamy precipitate with True alkaloid.**

Hagger's test: **(Picric acid) Yellow precipitate with True alkaloid.**

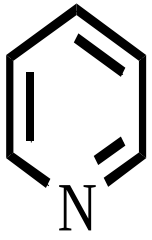
Dragendroff: **(Potassium Bismuth Iodide) Reddish Brown precipitate .**

Tannic acid solution: **Different alkaloid colored precipitate .**

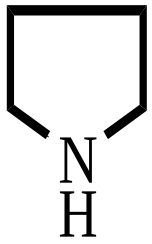
Classifications of Alkaloids according to their chemical structures (groups)



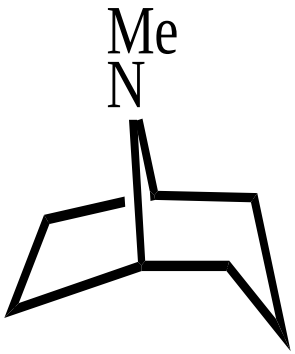
Piperidine



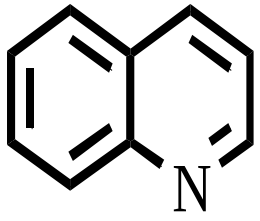
Pyridine



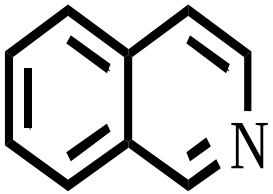
Pyrrolidine



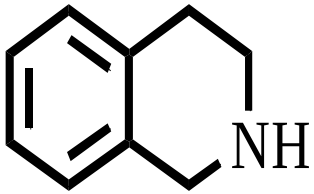
Tropane



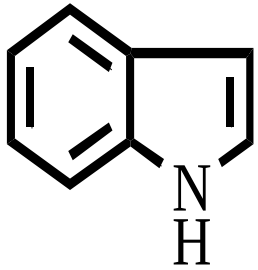
Quinoline



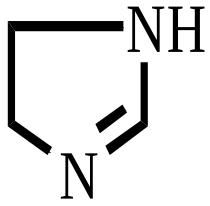
Isoquinoline



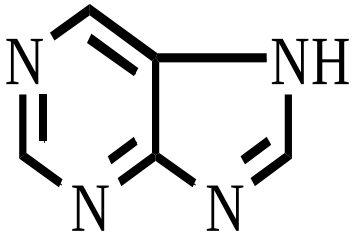
Tetrahydro-isoquinoline



Indole



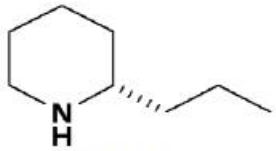
Imidazole



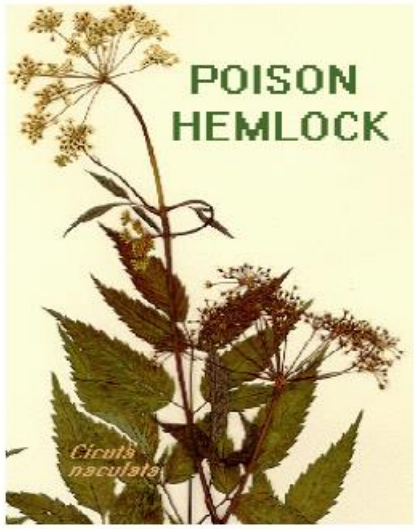
Purine

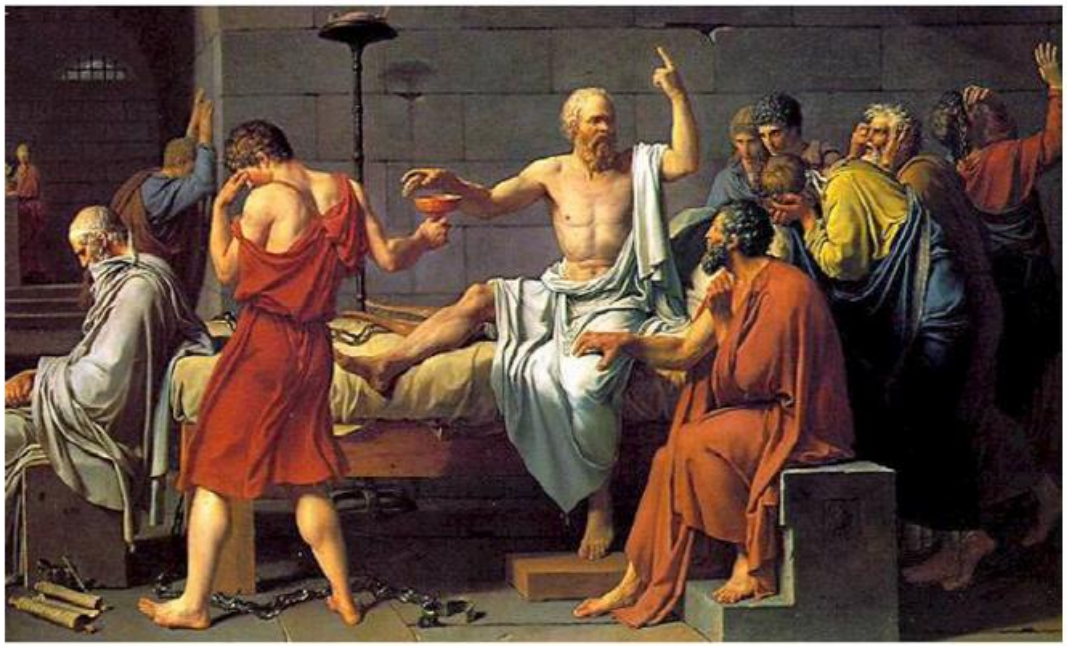
True Alkaloids Piperidine Group Coniine (Poisons)

Hemlock Alkaloids



Coniine





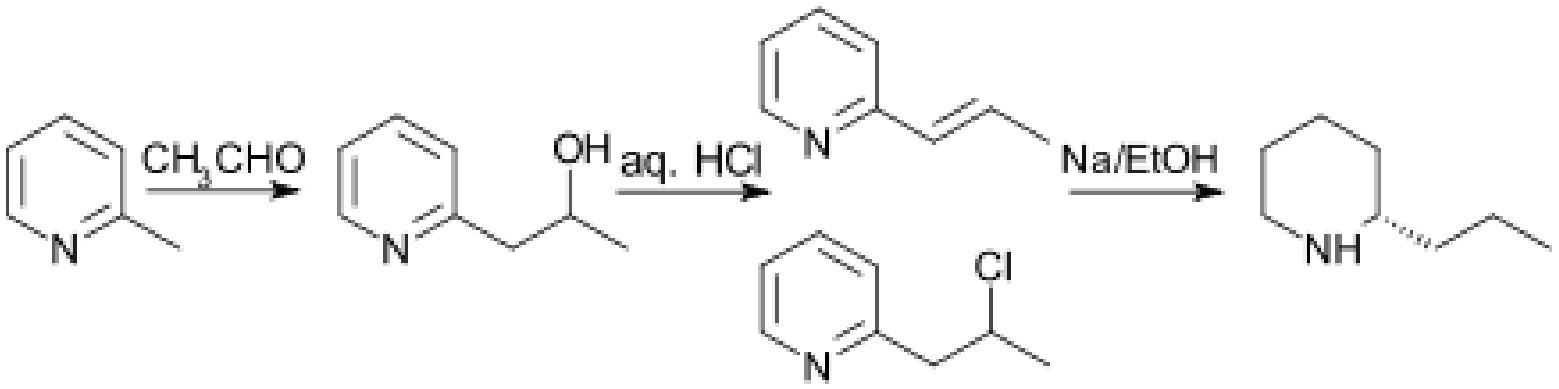
Socrates drinking poison hemlock, 399 B.C.

"The Death of Socrates" by Jacques-Louis David (1787)

Coniine:

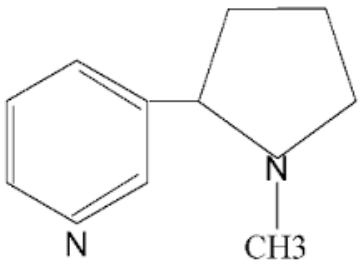
in 399 BC Socrates was sentenced to death for impiety and executed by being forced to drink a potion made from poison hemlock. The toxic component in hemlock is coniine.

Coniine Synthesis



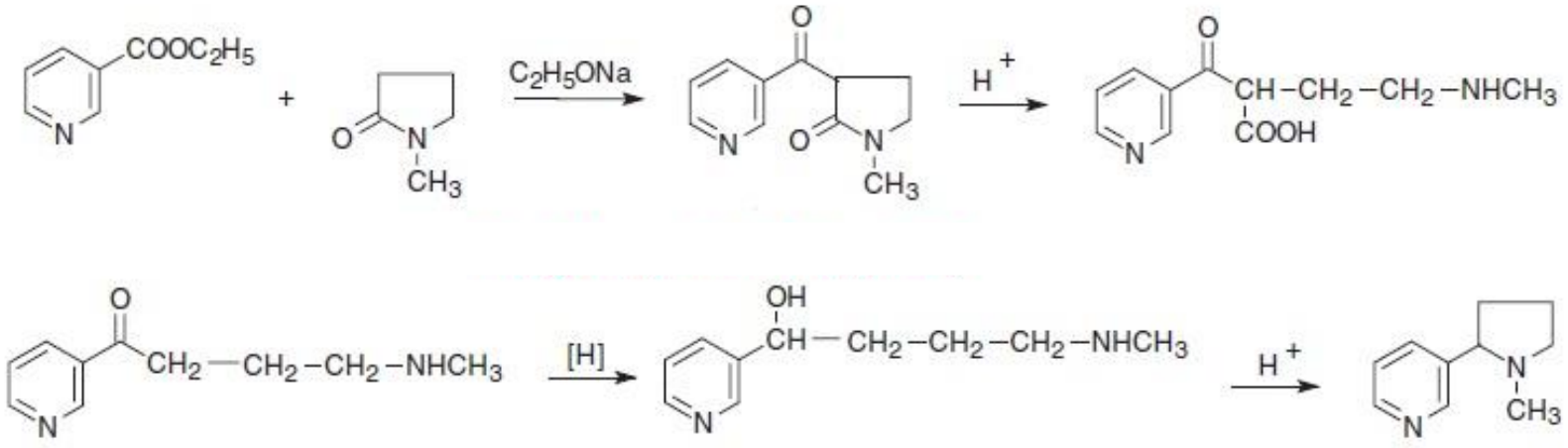
True Alkaloids Pyridine & Pyrrolidine Group
Nicotine from Tabacco

Stimulant, Nicotinic acetylcholine Receptor agonist



NICOTINE

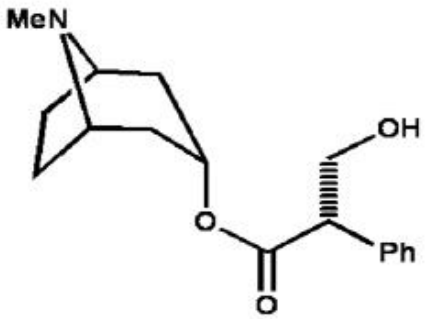
Nicotine Synthesis



True Alkaloids Tropane Group
Atropine

Tropane Alkaloids

Atropa belladonna
Deadly nightshade



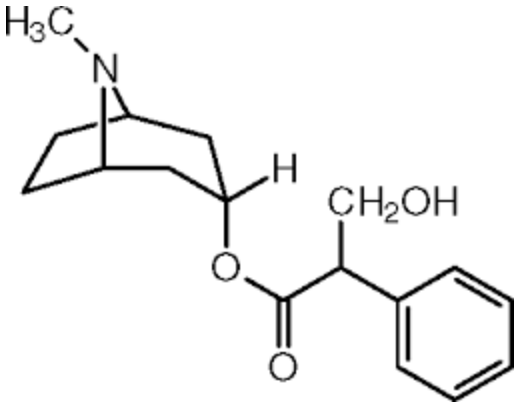
(±)-atropine
[(-)-hyoscyamine]

Anticholinergic

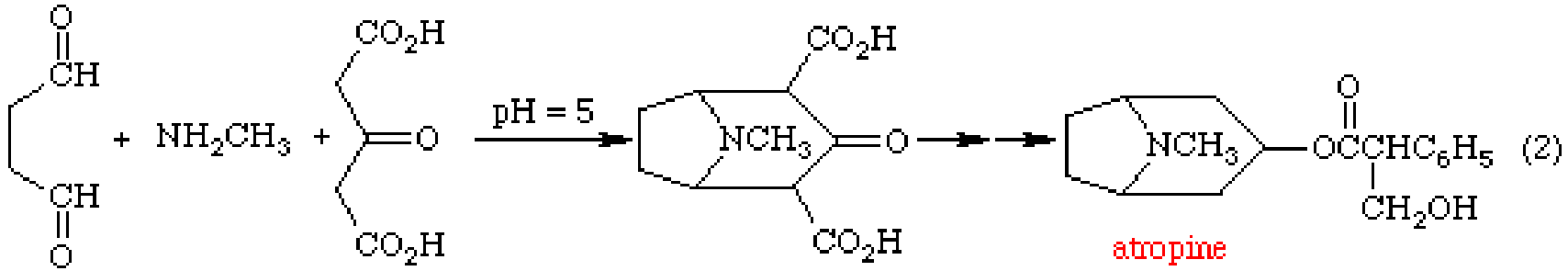
Hyoscyamus niger
Henbane

Atropine

Anticholinergic

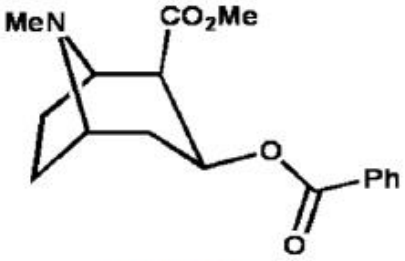


Atropine Synthesis



Tropane Alkaloids

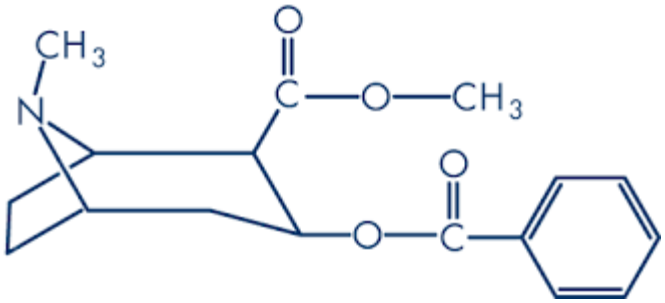
Erythroxylum coca



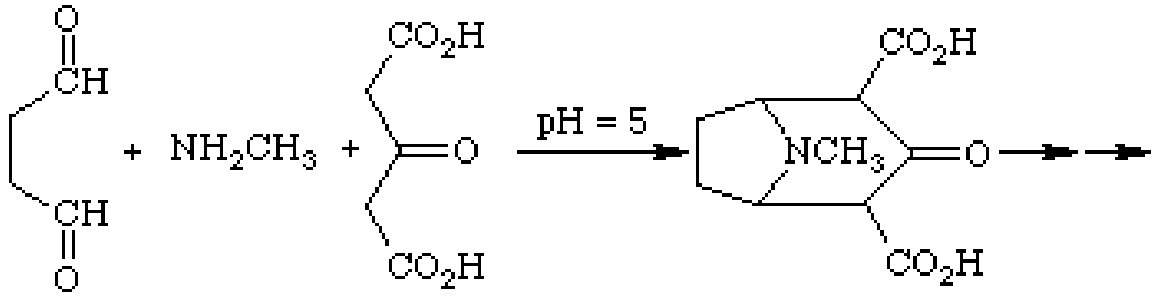
cocaine

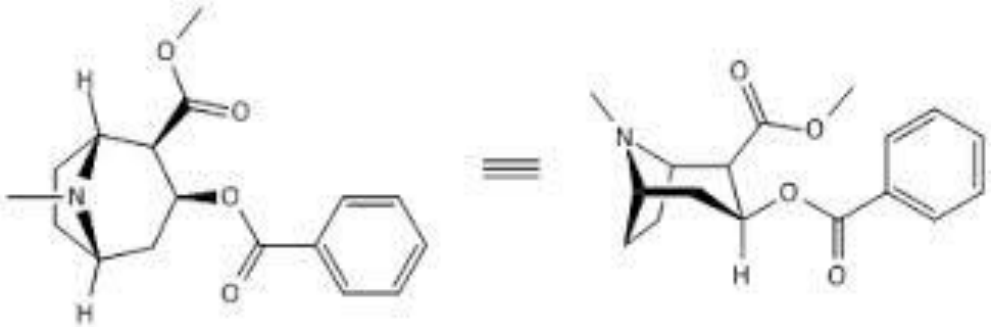
Cocaine

Anesthetic agent, at low doses



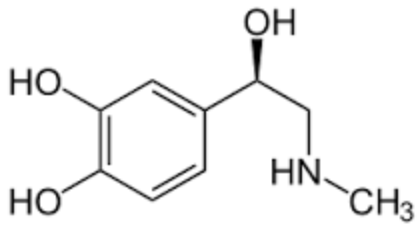
Cocaine Synthesis





Protoalkaloids

Adrenaline, Hormone



It increases activation of the sympathetic system associated with the energy and excitement of the fight-or-flight response, Increases also blood pressure

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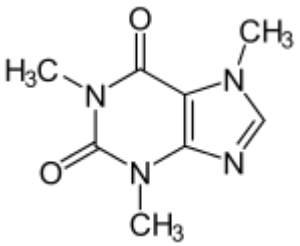
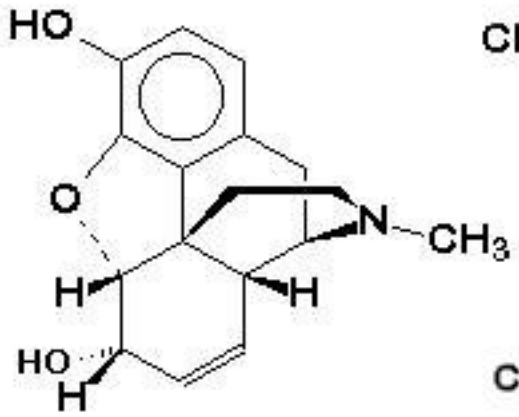
Pseudalkaloids

Purine Group
Caffeine

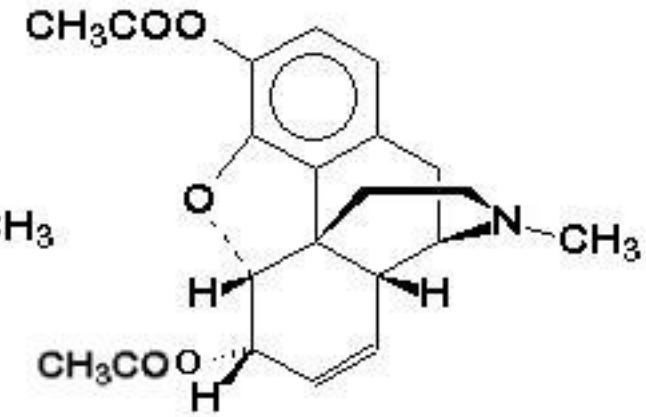
Stimulant, Adenosine receptor antagonist



Miscellaneous Group



Morphine



Heroin

Codeine

Narcotic Analgesic **from poppy (*Papaver somniferum*).**