القلويدات

Alkaloids

هي مركبات عضوية تحوي في بنيتها على ذرة آزوت واحدة او اكثر و في اغلب الاحيان ضمن حلقات غير متجانسة و يمكن لذرة الآزوت ان تتواجد بشكل :

* امين ثا نوي
* امين ثالثي
* املاح امونيوم رباعية
* بشكل اوكسيد الامين
* مجموعة اميدية

سبب تسميتها قلويدات لان معظمها يتمتع بخواص قلوية .

تصنيف القلويدات :

عرف حتى الآن حوالي 12000 مركب قلويدي و لكن القلويدات الهامة طبيا عددها محدود

و تصنف القلويدات :

* حسب الفصائل النباتية التي تحويها
* حسب الاصطناع الحيوي
* حسب البنية الكيميائية
* حسب التاثير الفارماكولوجي

تصنيف القلويدات العام : 

التصنيف حسب الاصطناع الحيوي :

تصنف القلويدات على اساس المركب الاساسي الذي تصطنع منه القلويدات حيويا و التي تتضمن القلويدات المشتقة من :

* الاورنيتين Ornithine : قلويدات التروبان و البيروليدين
* التريبتوفان Tryptophan : قلويدات الاندول و الكينولين
* الليزين Lysine :
* فينيل الانين Phenyl alanine
* تيروزين Tyrosine
* هيستيدين Histidine
* انترانيليك اسيد Anthranillic acid
* مواد اخرى

التصنيف حسب البنية الكيميائية :

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| **Class** | **Major groups** | **Main synthesis steps** | **Examples** |
| *Alkaloids with nitrogen heterocycles (true alkaloids)* |
| [Pyrrolidine](https://en.wikipedia.org/wiki/Pyrrolidine)  Pyrrolidine structure.svg |  | [Ornithine](https://en.wikipedia.org/wiki/Ornithine) or [arginine](https://en.wikipedia.org/wiki/Arginine%22%20%5Co%20%22Arginine) → [putrescine](https://en.wikipedia.org/wiki/Putrescine%22%20%5Co%20%22Putrescine) → N-methylputrescine → N-methyl-Δ1-pyrroline | [Cuscohygrine](https://en.wikipedia.org/wiki/Cuscohygrine), [hygrine](https://en.wikipedia.org/wiki/Hygrine%22%20%5Co%20%22Hygrine), hygroline, stachydrine |
| [Tropane](https://en.wikipedia.org/wiki/Tropane)  Tropane numbered.svg | Atropine groupSubstitution in positions 3, 6 or 7 | [Ornithine](https://en.wikipedia.org/wiki/Ornithine) or [arginine](https://en.wikipedia.org/wiki/Arginine%22%20%5Co%20%22Arginine) → [putrescine](https://en.wikipedia.org/wiki/Putrescine%22%20%5Co%20%22Putrescine) → N-methylputrescine → N-methyl-Δ1-pyrroline  | [Atropine](https://en.wikipedia.org/wiki/Atropine), [scopolamine](https://en.wikipedia.org/wiki/Scopolamine), [hyoscyamine](https://en.wikipedia.org/wiki/Hyoscyamine%22%20%5Co%20%22Hyoscyamine)[[](https://en.wikipedia.org/wiki/Alkaloid#cite_note-ref34-49) |
| Cocaine groupSubstitution in positions 2 and 3 | [Cocaine](https://en.wikipedia.org/wiki/Cocaine), [ecgonine](https://en.wikipedia.org/wiki/Ecgonine%22%20%5Co%20%22Ecgonine)  |

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| [Pyrrolizidine](https://en.wikipedia.org/wiki/Pyrrolizidine)  Pyrrolizidine.svg | Non-esters | Inplants: [ornithine](https://en.wikipedia.org/wiki/Ornithine) or [arginine](https://en.wikipedia.org/wiki/Arginine) → [putrescine](https://en.wikipedia.org/wiki/Putrescine) → [homospermidine](https://en.wikipedia.org/w/index.php?title=Homospermidine&action=edit&redlink=1) → [retronecine](https://en.wikipedia.org/wiki/Retronecine)  | [Retronecine](https://en.wikipedia.org/wiki/Retronecine), heliotridine, laburnine  |
| Complex [esters](https://en.wikipedia.org/wiki/Esters) of monocarboxylic acids | Indicine, lindelophin, sarracine |
| Macrocyclic diesters | [Platyphylline](https://en.wikipedia.org/w/index.php?title=Platyphylline&action=edit&redlink=1), trichodesmine |
| 1-aminopyrrolizidines ([lolines](https://en.wikipedia.org/wiki/Loline_alkaloids%22%20%5Co%20%22Loline%20alkaloids)) | In [fungi](https://en.wikipedia.org/wiki/Neotyphodium): [L-proline](https://en.wikipedia.org/wiki/Proline) + [L-homoserine](https://en.wikipedia.org/wiki/Homoserine) → *N*-(3-amino-3-carboxypropyl)proline → norloline | Loline, *N*-formylloline, *N*-acetylloline[[](https://en.wikipedia.org/wiki/Alkaloid%22%20%5Cl%20%22cite_note-Schardl_et_al._2007-59)  |
| [Piperidine](https://en.wikipedia.org/wiki/Piperidine)  Piperidin.svg |  | [Lysine](https://en.wikipedia.org/wiki/Lysine) → [cadaverine](https://en.wikipedia.org/wiki/Cadaverine%22%20%5Co%20%22Cadaverine) → Δ1-piperideine | [Sedamine](https://en.wikipedia.org/w/index.php?title=Sedamine&action=edit&redlink=1), lobeline, anaferine, [piperine](https://en.wikipedia.org/wiki/Piperine%22%20%5Co%20%22Piperine)  |
|  | [Octanoic acid](https://en.wikipedia.org/wiki/Caprylic_acid) → coniceine → [coniine](https://en.wikipedia.org/wiki/Coniine) | [Coniine](https://en.wikipedia.org/wiki/Coniine), coniceine |
| [Quinolizidine](https://en.wikipedia.org/wiki/Quinolizidine)  Quinolizidine.svg | [Lupinine](https://en.wikipedia.org/wiki/Lupinine)   | [Lysine](https://en.wikipedia.org/wiki/Lysine) → [cadaverine](https://en.wikipedia.org/wiki/Cadaverine%22%20%5Co%20%22Cadaverine) → Δ1-piperideine  | [Lupinine](https://en.wikipedia.org/wiki/Lupinine), nupharidin |
| [Cytisine](https://en.wikipedia.org/wiki/Cytisine)   | [Cytisine](https://en.wikipedia.org/wiki/Cytisine) |
| [Sparteine](https://en.wikipedia.org/wiki/Sparteine)   | [Sparteine](https://en.wikipedia.org/wiki/Sparteine), [lupanine](https://en.wikipedia.org/w/index.php?title=Lupanine&action=edit&redlink=1" \o "Lupanine (page does not exist)) [anahygrine](https://en.wikipedia.org/w/index.php?title=Anahygrine&action=edit&redlink=1" \o "Anahygrine (page does not exist))[[](https://en.wikipedia.org/wiki/Alkaloid#cite_note-ref57-63) |
| [Matrine](https://en.wikipedia.org/wiki/Matrine)   | Matrine, oxymatrine, allomatridine |
| [Ormosanine](https://en.wikipedia.org/w/index.php?title=Ormosanine&action=edit&redlink=1)   | Ormosaninepiptantine,  |

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| [Indolizidine](https://en.wikipedia.org/wiki/Indolizidine) derivativesIndolizidine.svg |  | [Lysine](https://en.wikipedia.org/wiki/Lysine) → δ-semialdehyde of [α-aminoadipic acid](https://en.wikipedia.org/wiki/Alpha-Aminoadipic_acid) → [pipecolic acid](https://en.wikipedia.org/wiki/Pipecolic_acid%22%20%5Co%20%22Pipecolic%20acid) → 1 indolizidinone | [Swainsonine](https://en.wikipedia.org/wiki/Swainsonine),castanospermine  |

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| [Pyridine](https://en.wikipedia.org/wiki/Pyridine) derivativesPyridine.svg | Simple derivatives of pyridine | [Nicotinic acid](https://en.wikipedia.org/wiki/Nicotinic_acid) → dihydronicotinic acid → 1,2-dihydropyridine | [Trigonelline](https://en.wikipedia.org/wiki/Trigonelline), ricinine, [arecoline](https://en.wikipedia.org/wiki/Arecoline%22%20%5Co%20%22Arecoline)  |
| Polycyclic noncondensing pyridine derivatives | [Nicotine](https://en.wikipedia.org/wiki/Nicotine), [nornicotine](https://en.wikipedia.org/wiki/Nornicotine%22%20%5Co%20%22Nornicotine), [anabasine](https://en.wikipedia.org/wiki/Anabasine%22%20%5Co%20%22Anabasine), anatabine  |
| Polycyclic condensed pyridine derivatives | [Actinidine](https://en.wikipedia.org/wiki/Actinidine), gentianine, pediculinine |
| [Sesquiterpene](https://en.wikipedia.org/wiki/Sesquiterpene) pyridine derivatives | [Nicotinicacid](https://en.wikipedia.org/wiki/Nicotinic_acid), [isoleucine](https://en.wikipedia.org/wiki/Isoleucine%22%20%5Co%20%22Isoleucine)  | Evonine, hippocrateine,triptonine  |

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| [Isoquinoline](https://en.wikipedia.org/wiki/Isoquinoline) derivatives and related alkaloids Isoquinoline numbered.svg | Simple derivatives of isoquinoline  | [Tyrosine](https://en.wikipedia.org/wiki/Tyrosine) or [phenylalanine](https://en.wikipedia.org/wiki/Phenylalanine) → [dopamine](https://en.wikipedia.org/wiki/Dopamine) or [tyramine](https://en.wikipedia.org/wiki/Tyramine%22%20%5Co%20%22Tyramine) (for alkaloids Amarillis)  | Salsoline, lophocerine  |
| Derivatives of 1- and 3-isoquinolines [[](https://en.wikipedia.org/wiki/Alkaloid#cite_note-Saxton_122-81) | N-methylcoridaldine, noroxyhydrastinine  |
| Derivatives of 1- and 4-phenyltetrahydroisoquinolines  | Cryptostilin  |
| Derivatives of 5-naftil-isoquinoline [[](https://en.wikipedia.org/wiki/Alkaloid#cite_note-ref83-83) | Ancistrocladine |
| Derivatives of 1- and 2-benzyl-izoquinolines  | [Papaverine](https://en.wikipedia.org/wiki/Papaverine), [laudanosine](https://en.wikipedia.org/wiki/Laudanosine%22%20%5Co%20%22Laudanosine), sendaverine |
| [Cularine](https://en.wikipedia.org/w/index.php?title=Cularine&action=edit&redlink=1) group | Cularine, yagonine |
| [Pavines](https://en.wikipedia.org/wiki/Pavine_%28molecule%29) and isopavines | Argemonine, [amurensine](https://en.wikipedia.org/wiki/Amurensine%22%20%5Co%20%22Amurensine)  |
| Benzopyrrocolines  | Cryptaustoline  |
| Protoberberines  | [Berberine](https://en.wikipedia.org/wiki/Berberine), [canadine](https://en.wikipedia.org/wiki/Canadine%22%20%5Co%20%22Canadine), ophiocarpine, mecambridine, corydaline  |
| Phthalidisoquinolines  | [Hydrastine](https://en.wikipedia.org/wiki/Hydrastine), [narcotine](https://en.wikipedia.org/wiki/Narcotine%22%20%5Co%20%22Narcotine) (Noscapine) |
| Spirobenzylisoquinolines  | Fumaricine  |
| [Ipecacuanha](https://en.wikipedia.org/wiki/Psychotria_ipecacuanha) alkaloids | Emetine, protoemetine, ipecoside |
| Benzophenanthridines  | Sanguinarine, oxynitidine, corynoloxine |
| [Aporphines](https://en.wikipedia.org/wiki/Aporphine)  | [Glaucine](https://en.wikipedia.org/wiki/Glaucine), coridine, liriodenine  |
| Proaporphines | Pronuciferine, glaziovine  |
| Homoaporphines | Kreysiginine, multifloramin  |
| Homoproaporphines  |  |

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| Tropoloisoquinolines | Imerubrine  |
| Azofluoranthenes | Rufescine, imeluteine  |
| [Amaryllis](https://en.wikipedia.org/wiki/Amaryllis) alkaloids | [Lycorine](https://en.wikipedia.org/wiki/Lycorine), ambelline, tazettine, [galantamine](https://en.wikipedia.org/wiki/Galantamine%22%20%5Co%20%22Galantamine), montanine |
| [Erythrina](https://en.wikipedia.org/wiki/Erythrina) alkaloids | Erysodine, erythroidine |
| [Phenanthrene](https://en.wikipedia.org/wiki/Phenanthrene) derivatives | Atherosperminine  |
| [Protopines](https://en.wikipedia.org/wiki/Protopine)  | [Protopine](https://en.wikipedia.org/wiki/Protopine), oxomuramine, corycavidine  |
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| [Oxazole](https://en.wikipedia.org/wiki/Oxazole) derivatives[[](https://en.wikipedia.org/wiki/Alkaloid#cite_note-Plemenkov_241-100)Oxazole structure.svg |  | [Tyrosine](https://en.wikipedia.org/wiki/Tyrosine) → [tyramine](https://en.wikipedia.org/wiki/Tyramine%22%20%5Co%20%22Tyramine)[[](https://en.wikipedia.org/wiki/Alkaloid#cite_note-101) | Annuloline, halfordinol, texalinetexamine |

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| [Isoxazole](https://en.wikipedia.org/wiki/Isoxazole)derivativesIsoxazole structure.png |  | [Ibotenic acid](https://en.wikipedia.org/wiki/Ibotenic_acid) → [Muscimol](https://en.wikipedia.org/wiki/Muscimol%22%20%5Co%20%22Muscimol) | Ibotenic acid, Muscimol |
| [Thiazole](https://en.wikipedia.org/wiki/Thiazole) derivativesThiazole structure.svg |  | [1-Deoxy-D-xylulose 5-phosphate](https://en.wikipedia.org/wiki/1-Deoxy-D-xylulose_5-phosphate) (DOXP), [tyrosine](https://en.wikipedia.org/wiki/Tyrosine), [cysteine](https://en.wikipedia.org/wiki/Cysteine%22%20%5Co%20%22Cysteine)  | Nostocyclamide, thiostreptone  |
| [Quinazoline](https://en.wikipedia.org/wiki/Quinazoline) derivativesQuinazoline numbered.svg | 3,4-Dihydro-4-quinazolone derivatives | [Anthranilic acid](https://en.wikipedia.org/wiki/Anthranilic_acid) or [phenylalanine](https://en.wikipedia.org/wiki/Phenylalanine) or [ornithine](https://en.wikipedia.org/wiki/Ornithine%22%20%5Co%20%22Ornithine) [[](https://en.wikipedia.org/wiki/Alkaloid#cite_note-107) | [Febrifugine](https://en.wikipedia.org/wiki/Febrifugine)[[](https://en.wikipedia.org/wiki/Alkaloid#cite_note-ref120-108) |
| 1,4-Dihydro-4-quinazolone derivatives | Glycorine, arborine, glycosminine[[](https://en.wikipedia.org/wiki/Alkaloid%22%20%5Cl%20%22cite_note-ref120-108)  |
| Pyrrolidine and piperidine quinazoline derivatives | [Vazicine](https://en.wikipedia.org/w/index.php?title=Vazicine&action=edit&redlink=1) (peganine)  |
| [Acridine](https://en.wikipedia.org/wiki/Acridine) derivativesAcridine.svg |  | [Anthranilic acid](https://en.wikipedia.org/wiki/Anthranilic_acid) | Rutacridineacronicine |

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| [Quinoline](https://en.wikipedia.org/wiki/Quinoline) derivativesQuinoline numbered.svg | Simple derivatives of quinoline derivatives of 2 – [quinolones](https://en.wikipedia.org/wiki/Quinolones%22%20%5Co%20%22Quinolones) and 4-quinolone | [Anthranilic acid](https://en.wikipedia.org/wiki/Anthranilic_acid) → 3-carboxyquinoline [[](https://en.wikipedia.org/wiki/Alkaloid#cite_note-ref127-114) | Cusparine, [echinopsine](https://en.wikipedia.org/w/index.php?title=Echinopsine&action=edit&redlink=1" \o "Echinopsine (page does not exist)), evocarpine |
| Tricyclic terpenoids | Flindersine |
| Furanoquinoline derivatives | [Dictamnine](https://en.wikipedia.org/w/index.php?title=Dictamnine&action=edit&redlink=1), fagarine, skimmianine |
| [Quinines](https://en.wikipedia.org/wiki/Quinine) | [Tryptophan](https://en.wikipedia.org/wiki/Tryptophan) → [tryptamine](https://en.wikipedia.org/wiki/Tryptamine%22%20%5Co%20%22Tryptamine) → [strictosidine](https://en.wikipedia.org/wiki/Strictosidine%22%20%5Co%20%22Strictosidine) (with [secologanin](https://en.wikipedia.org/wiki/Secologanin%22%20%5Co%20%22Secologanin)) → korinanteal → [cinhoninon](https://en.wikipedia.org/w/index.php?title=Cinhoninon&action=edit&redlink=1" \o "Cinhoninon (page does not exist))  | [Quinine](https://en.wikipedia.org/wiki/Quinine), [quinidine](https://en.wikipedia.org/wiki/Quinidine%22%20%5Co%20%22Quinidine), [cinchonine](https://en.wikipedia.org/wiki/Cinchonine%22%20%5Co%20%22Cinchonine), cinhonidine  |

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| [Indole](https://en.wikipedia.org/wiki/Indole) derivativesIndole numbered.svg *: [indole alkaloids](https://en.wikipedia.org/wiki/Indole_alkaloids%22%20%5Co%20%22Indole%20alkaloids)* |

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| *Semiterpenoid indole alkaloids* |
| [Ergot alkaloids](https://en.wikipedia.org/wiki/Ergoline) | [Tryptophan](https://en.wikipedia.org/wiki/Tryptophan) → chanoclavine → agroclavine → elimoclavine → [paspalic acid](https://en.wikipedia.org/w/index.php?title=Paspalic_acid&action=edit&redlink=1" \o "Paspalic acid (page does not exist)) → [lysergic acid](https://en.wikipedia.org/wiki/Lysergic_acid) | [Ergotamine](https://en.wikipedia.org/wiki/Ergotamine), ergobasine, ergosine |
| *Monoterpenoid indole alkaloids* |
| *Corynanthe* type alkaloids | [Tryptophan](https://en.wikipedia.org/wiki/Tryptophan) → [tryptamine](https://en.wikipedia.org/wiki/Tryptamine%22%20%5Co%20%22Tryptamine) → [strictosidine](https://en.wikipedia.org/wiki/Strictosidine%22%20%5Co%20%22Strictosidine) (with [secologanin](https://en.wikipedia.org/wiki/Secologanin%22%20%5Co%20%22Secologanin)) | Ajmalicine, sarpagine, vobasine, [ajmaline](https://en.wikipedia.org/wiki/Ajmaline), [yohimbine](https://en.wikipedia.org/wiki/Yohimbine), [reserpine](https://en.wikipedia.org/wiki/Reserpine%22%20%5Co%20%22Reserpine), [mitragynine](https://en.wikipedia.org/wiki/Mitragynine),group [strychnine](https://en.wikipedia.org/wiki/Strychnine) and ([Strychnine](https://en.wikipedia.org/wiki/Strychnine) [brucine](https://en.wikipedia.org/wiki/Brucine%22%20%5Co%20%22Brucine), aquamicine, [vomicine](https://en.wikipedia.org/w/index.php?title=Vomicine&action=edit&redlink=1" \o "Vomicine (page does not exist)) |
| [Iboga](https://en.wikipedia.org/wiki/Iboga)-type alkaloids | [Ibogamine](https://en.wikipedia.org/wiki/Ibogamine), [ibogaine](https://en.wikipedia.org/wiki/Ibogaine%22%20%5Co%20%22Ibogaine), [voacangine](https://en.wikipedia.org/wiki/Voacangine%22%20%5Co%20%22Voacangine) |
| [Aspidosperma](https://en.wikipedia.org/wiki/Aspidosperma)-type alkaloids | [Vincamine](https://en.wikipedia.org/wiki/Vincamine), [vinca alkaloids](https://en.wikipedia.org/wiki/Vinca_alkaloids%22%20%5Co%20%22Vinca%20alkaloids), vincotine,  |

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| [Imidazole](https://en.wikipedia.org/wiki/Imidazole) derivatives[[](https://en.wikipedia.org/wiki/Alkaloid#cite_note-Plemenkov_241-100)Imidazole structure.svg |  | Directly from [histidine](https://en.wikipedia.org/wiki/Histidine%22%20%5Co%20%22Histidine) | [Histamine](https://en.wikipedia.org/wiki/Histamine), pilocarpine, pilosine, stevensine |
| [Purine](https://en.wikipedia.org/wiki/Purine) derivatives9H-Purine.svg |  | [Xanthosine](https://en.wikipedia.org/wiki/Xanthosine) (formed in purine biosynthesis) → 7 methylxantosine → 7-methyl [xanthine](https://en.wikipedia.org/wiki/Xanthine%22%20%5Co%20%22Xanthine) → [theobromine](https://en.wikipedia.org/wiki/Theobromine%22%20%5Co%20%22Theobromine) → [caffeine](https://en.wikipedia.org/wiki/Caffeine) | [Caffeine](https://en.wikipedia.org/wiki/Caffeine), [theobromine](https://en.wikipedia.org/wiki/Theobromine%22%20%5Co%20%22Theobromine), [theophylline](https://en.wikipedia.org/wiki/Theophylline), [saxitoxin](https://en.wikipedia.org/wiki/Saxitoxin%22%20%5Co%20%22Saxitoxin)[[1](https://en.wikipedia.org/wiki/Alkaloid#cite_note-134) |

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| *Alkaloids with nitrogen in the side chain (protoalkaloids)* |
| β-[Phenylethylamine](https://en.wikipedia.org/wiki/Phenylethylamine%22%20%5Co%20%22Phenylethylamine) derivatives[[](https://en.wikipedia.org/wiki/Alkaloid#cite_note-ref90-87)Phenylethylamine numbered.svg |  | [Tyrosine](https://en.wikipedia.org/wiki/Tyrosine) or [phenylalanine](https://en.wikipedia.org/wiki/Phenylalanine) → [dioxyphenilalanine](https://en.wikipedia.org/w/index.php?title=Dioxyphenilalanine&action=edit&redlink=1) → [dopamine](https://en.wikipedia.org/wiki/Dopamine) → [adrenaline](https://en.wikipedia.org/wiki/Adrenaline) and [mescaline](https://en.wikipedia.org/wiki/Mescaline) [tyrosine](https://en.wikipedia.org/wiki/Tyrosine) → [tyramine](https://en.wikipedia.org/wiki/Tyramine%22%20%5Co%20%22Tyramine) phenylalanine → 1-phenylpropane-1,2-dione → [cathinone](https://en.wikipedia.org/wiki/Cathinone%22%20%5Co%20%22Cathinone) → [ephedrine](https://en.wikipedia.org/wiki/Ephedrine) and [pseudoephedrine](https://en.wikipedia.org/wiki/Pseudoephedrine) | [Tyramine](https://en.wikipedia.org/wiki/Tyramine), [ephedrine](https://en.wikipedia.org/wiki/Ephedrine), [pseudoephedrine](https://en.wikipedia.org/wiki/Pseudoephedrine), [mescaline](https://en.wikipedia.org/wiki/Mescaline), [cathinone](https://en.wikipedia.org/wiki/Cathinone), [catecholamines](https://en.wikipedia.org/wiki/Catecholamines) ([adrenaline](https://en.wikipedia.org/wiki/Adrenaline), [noradrenaline](https://en.wikipedia.org/wiki/Noradrenaline),  |
| [Colchicine](https://en.wikipedia.org/wiki/Colchicine) alkaloids Colchicine.svg |  | [Tyrosine](https://en.wikipedia.org/wiki/Tyrosine) or [phenylalanine](https://en.wikipedia.org/wiki/Phenylalanine) → [dopamine](https://en.wikipedia.org/wiki/Dopamine) → [autumnaline](https://en.wikipedia.org/w/index.php?title=Autumnaline&action=edit&redlink=1" \o "Autumnaline (page does not exist)) → [colchicine](https://en.wikipedia.org/wiki/Colchicine%22%20%5Co%20%22Colchicine)   | [Colchicine](https://en.wikipedia.org/wiki/Colchicine),  |
| [Muscarine](https://en.wikipedia.org/wiki/Muscarine)  Muscarine.svg |  | [Glutamic acid](https://en.wikipedia.org/wiki/Glutamic_acid) → 3-ketoglutamic acid → muscarine (with [pyruvic acid](https://en.wikipedia.org/wiki/Pyruvic_acid%22%20%5Co%20%22Pyruvic%20acid))[[140]](https://en.wikipedia.org/wiki/Alkaloid#cite_note-141) | [Muscarine](https://en.wikipedia.org/wiki/Muscarine), allomuscarine, epimuscarine, epiallomuscarine  |
| Benzylamine Benzylamine.svg |  | [Phenylalanine](https://en.wikipedia.org/wiki/Phenylalanine) with [valine](https://en.wikipedia.org/wiki/Valine%22%20%5Co%20%22Valine), [leucine](https://en.wikipedia.org/wiki/Leucine%22%20%5Co%20%22Leucine) or [isoleucine](https://en.wikipedia.org/wiki/Isoleucine%22%20%5Co%20%22Isoleucine)  | [Capsaicin](https://en.wikipedia.org/wiki/Capsaicin), [dihydrocapsaicin](https://en.wikipedia.org/wiki/Dihydrocapsaicin%22%20%5Co%20%22Dihydrocapsaicin), nordihydrocapsaicin,  |

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| --- |
| *Polyamines alkaloids* |
| [Putrescine](https://en.wikipedia.org/wiki/Putrescine) derivativesPutrescine.svg |  | [ornithine](https://en.wikipedia.org/wiki/Ornithine) → [putrescine](https://en.wikipedia.org/wiki/Putrescine%22%20%5Co%20%22Putrescine) → [spermidine](https://en.wikipedia.org/wiki/Spermidine%22%20%5Co%20%22Spermidine) → [spermine](https://en.wikipedia.org/wiki/Spermine%22%20%5Co%20%22Spermine) []](https://en.wikipedia.org/wiki/Alkaloid#cite_note-146) | Paucine  |
| [Spermidine](https://en.wikipedia.org/wiki/Spermidine) derivativesSpermidine.svg |  | Lunarine, codonocarpine |
| [Spermine](https://en.wikipedia.org/wiki/Spermine) derivativesSpermine.svg |  | Verbascenine,  |
|  |
| *Peptide (cyclopeptide) alkaloids* |
| Peptide alkaloids with a 13-membered cycle  | Nummularine C type | From different amino acids  | Nummularine C, Nummularine S  |
| [Ziziphine](https://en.wikipedia.org/w/index.php?title=Ziziphine&action=edit&redlink=1) type | Ziziphine A, sativanine  |
| Peptide alkaloids with a 14-membered cycle | Frangulanine type | Frangulanine, scutianine J  |
| Scutianine A type | Scutianine A  |
| Integerrine type | Integerrine, discarine D  |
| Amphibine F type | Amphibine F, spinanine   |
| Amfibine B type | Amphibine B, lotusine  |
| Peptide alkaloids with a 15-membered cycle  | Mucronine A type |  |
| *Pseudoalkaloids ([terpenes](https://en.wikipedia.org/wiki/Terpenes%22%20%5Co%20%22Terpenes) and*[*steroids*](https://en.wikipedia.org/wiki/Steroids)*)* |
| Diterpenes Isoprene.svg | Lycoctonine type | [Mevalonic acid](https://en.wikipedia.org/wiki/Mevalonic_acid) → [izopentenilpyrophosfate](https://en.wikipedia.org/w/index.php?title=Izopentenilpyrophosfate&action=edit&redlink=1" \o "Izopentenilpyrophosfate (page does not exist)) → [geranyl pyrophosphate](https://en.wikipedia.org/wiki/Geranyl_pyrophosphate%22%20%5Co%20%22Geranyl%20pyrophosphate)  | [Aconitine](https://en.wikipedia.org/wiki/Aconitine), [delphinine](https://en.wikipedia.org/wiki/Delphinine) |
| [Steroids](https://en.wikipedia.org/wiki/Steroids)[[](https://en.wikipedia.org/wiki/Alkaloid#cite_note-151)Cyclopentenophenanthrene.svg |  | [Cholesterol](https://en.wikipedia.org/wiki/Cholesterol), [arginine](https://en.wikipedia.org/wiki/Arginine%22%20%5Co%20%22Arginine) | Solasodine, [solanidine](https://en.wikipedia.org/wiki/Solanidine%22%20%5Co%20%22Solanidine), veralkamine,   |

الاصطناع الحيوي للبيروليدين :



الاصطناع الحيوي للنيكوتين :



و سنشرح طريقة الاصطناع الحيوي للنيكوتين :

الاصطناع الحيوي للنيكوتين يتطلب اتحاد حلقتين عطريتين غير متجانستين هما حلقة البيروليدين و حلقة البيريدين . دراسات الاستقلاب توضح بان حلقة البيريدين تشتق من حمض النيكوتين Nicotinic acid

بينما حلقة البيروليدين تشتق من شاردة N-methyl-∆1-pyrrolidium

الاصطناع الحيوي لهيكل الحلقتين يعتمد على طريقتين :

* طريق NAD من اجل نيكوتينيك اسيد
* طريق التروبان Tropane من اجل شاردة البيروليديوم

طريق NAD في جنس نبات *Nicotiana* :.

1 – اكسدة اسبارتيك اسيد الى الفا ايمينو سوكسينات α-imino succinate بواسطة انزيم اسبارتات اوكسيداز Aspartate Oxidase (AO)

2 – يتحد المركب السابق مع glyceraldehyde-3-phosphate و يتشكل حلقة بوجود انزيم كينولينات سينتاز quinolinate synthase (QS) ليعطي كينولينيك اسيد quinolinic acid

3 – يتفاعل بعد ذلك الكينولينيك اسيد مع فوسفوريبوكسيل بيروفوسفات phosphoriboxyl pyrophosphate و بواسطة انزيم transferase (QPT) phosphoribosyl quinolinic acid و يتشكل مركب nicotinic acid mononucleotide (NaMN)

4 – يتحول بعد ذلك الى نيكوتينيك اسيد و الذي يمكن ان يتحول الى نيكوتيناميد بواسطة انزيم nicotinamidase

شاردة البيروليديوم الداخلة في تركيب النيكوتين هي مركب وسطي كذلك في الاصطناع الحيوي للقلويدات المشتقة من نواة التروبان

الاصطناع الحيوي لهل يتم على الشكل التالي :

1 – يبدا من الحمض الاميني Ornithine بعملية ازالة الكاربوكسيل بواسطة انزيم اورنيتين ديكاربوكسيلاز

Ornithine decarboxylase (ODC ) ليعطي مركب Putrescine

2 – البوتريسين يتحول بعد ذلك الى N-methyl putrescine اضافة ميتيل بوجود SAM و بواسطة انزيم

Putrescine N-methyltransferase (PMT)

3 – المركب السابق يزال منه الامين و يتحول الى 4-methylaminobutanal بوجود انزيم

N-methylputerscine oxidase (MPO)

4 – المركب السابق يتحلقن بعد ذلك ليشكل مركب N-methyl-∆1-pyrrolidium

المرحلة الاخيرة في اصطناع النيكوتين هي الاتحاد بين الحلقتين و تتم على الشكل التالي :

1 – يتحول النيكوتينيك اسيد الى 2,5-dihydropyridine من خلال 3,6-dihydronicotinic acid

2 – 2, 5 ديهيدروبيريدين الوسطي يتحد مع شاردة البيريديوم ليعطي النيكوتين