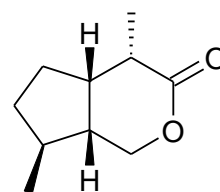


Iridoids

Iridoids (C_5H_8)₂ are a class of secondary metabolites found in a wide variety of plants and in some animals. They are monoterpenes biosynthesised from isoprene and they are often intermediates in the biosynthesis of alkaloids.

Chemically, the iridoids usually consist of a cyclopentane ring fused to a six-membered oxygen heterocycle. The chemical structure is exemplified by iridomyrmecin, a defensive chemical produced by the *Iridomyrmex* genus, for which iridoids are named.



Iridomyrmecin

Iridoids are found in many medicinal plants and may be responsible for some of their pharmaceutical activities. Most occur as glycosides: some free and as *bis* compounds. There are many seco-iridoids in which the pyran ring is open, and in a few the pyran ring oxygen is replaced by nitrogen.

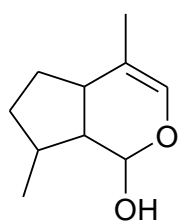
Iridoids are formed in plants by an alternative cyclization of geranyl diphosphate. The structures of these compounds are based on a cyclopentan-[C]-pyran skeleton, carbocyclic iridoids, and oxidative cleavage at the 7,8-bond of the cyclopentane moiety affords the so called secoiridoids.

On biogenetic grounds the iridoid formation may be considered to start from iridodial cation and follow diversification through 27 different routes. Iridoids have been used as chemical markers for the *Corniflorae*, *Gentianiflorae*, *Loasiflorae* and *Lamiiflorae* superorders.

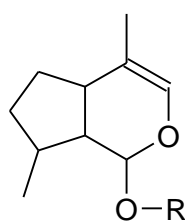
Classification

1. Cyclopentan types

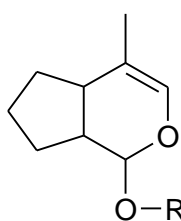
According to number of C atom in skeleton of aglycon they could be divided on 4 types: C₈, C₉, C₁₀ and C₁₄.



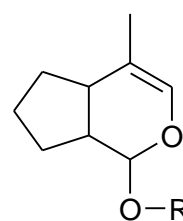
Iridodial



C₁₀-Iridoid

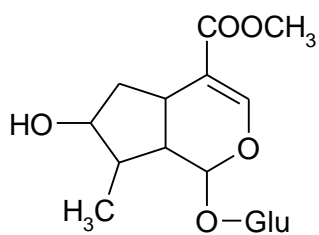


C₉-Iridoid

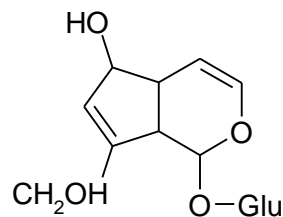


C₈-Iridoid

Iridoids are typically found in plants as glycosides, most often bound to glucose.

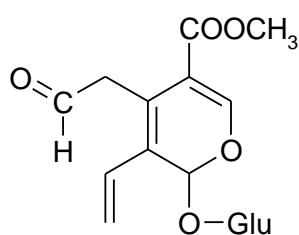


Loganic

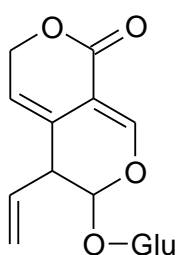


Aucubin

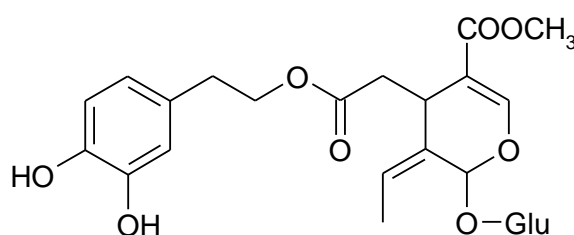
2. Secoiridoids. Cleavage of a bond in the cyclopentane ring gives rise to seco-iridoids.



Secologanic

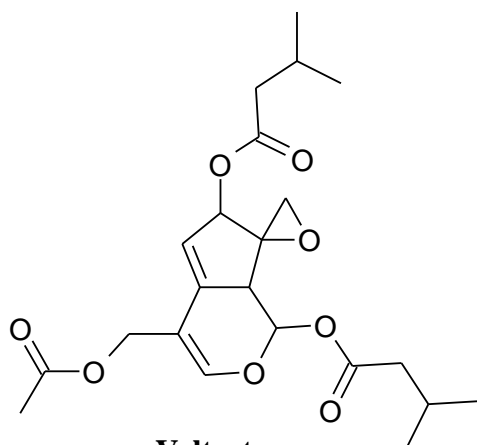


Gentiopicroside

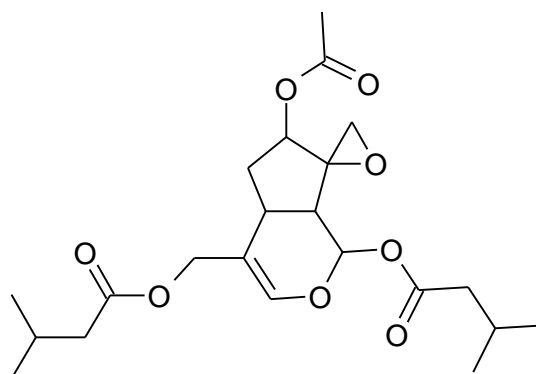


Oleuropein

3. Iridoids of plants from family *Valerianaceae*. Bicyclic monoterpenes or valepotriates (“*Valeriana* - Epoxy - triester”).



Valtrate



Dihydrovaltrate

4. Iridoids-alkaloids – complex of indole alkaloids, containing as non-amine part iridoid (determined in plants from the families *Rubiaceae*, *Apocynaceae*)

Physical and chemical properties of iridoids

Iridoids are usually odourless, colourless crystalline, bitter compounds. They are soluble in water, ethanol, acetone, methanol. They occur as glycosides or complex epoxides in plants. Aglycons of iridoids are non-stable: they are sensitive to enzymes and acids, while acetylated iridoids to alkali. When treated by acids or under the influence of enzymes in the presence of oxygen, iridoids form coloured (dark blue or violet-blue) insoluble in water products.

Isolated and purified, iridoids exhibit a wide range of bioactivities, including cardiovascular, antihepatotoxic, cholorectic, hypoglycemic, analgesic, anti-inflammatory, antimutagenic, antispasmodic, antitumour, antiviral, immunomodulator, and purgative activities.

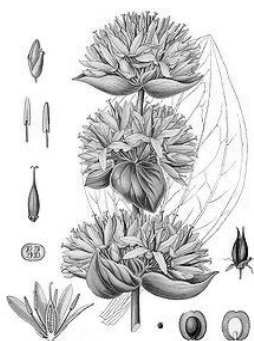
The iridoids are produced by plants primarily as a defence against herbivores or against infection by microorganisms. To humans and other mammals, iridoids are often characterized by a deterrent bitter taste.

Bioactivities of iridoids

Iridoids exhibit a wide range of bioactivities including stimulation of secretions in the gastrointestinal tract, especially of the gastric juice, cholorectic, purgative, antimicrobial, antiviral, anti-inflammatory and analgesic, immunomodulator, sedative (*valepotriates*), diuretic (*catalpol and catalposide*), antimutagenic, antitumor (*valtrate*), cardiovascular, hypoglycemic, antispasmodic.

Medicinal Plant and Raw Material Containing Bitter Principles

Bitter principles (*Amara*) are heterogenous compounds of bitter taste. The chemistry of bitter principles has been studied in many cases incompletely. This group comprises natural vegetable products belonging to different chemical groupings.



GENTIAN ROOT - *GENTIANAE RADIX*

Gentian - *Gentiana lutea* L., Fam. *Gentianaceae*.

Synonym(s): Yellow gentian.

Plant. It is an up to more than 1 m in height perennial, herbaceous mountain plant. It has opposite, oval, bluish green, robust leaves; axillary flowers with 5, rarely more, yellow petals.

Area of distribution. France, Spain, the Balkans, Ukraine (Carpathian Mountains) (where the roots are obtained from wild plants). There are small-scale plantations in France and Germany (where the plant is fully protected). Yellow gentian grows in the mountains and would remain from the times of glaciation. It grows in fields and pastures over altitude of 800 m, evoking big candlesticks someone would have placed here and there.

Description. The drug consists of the brownish or reddish brown roots, which are up to several centimetres thick and often fragments of the rhizome, which transversely wrinkled on the surface; the roots are longitudinally grooved. In the transverse section of the broken drug, there is a relatively narrow bark (with a coarsely wrinkled cork), a distinct ring of cambium delimiting the xylem. The odour is weak and peculiarly sweetish, reminiscent of dried figs; the taste is sweetish at first, then persistently and intensely bitter.

Constituents. The root contains: secoiridoids bitter principles: the main component is gentiopicroside (1 to 3,5 %). The root has a very high bitter value 58000000.

Other constituents are xanthone derivatives (gentisin, isogentisin, gentioside, etc.); the darker internal colour of the dried European root as compared with the dried Japanese product, may be due to greater hydrolysis of the colourless glycosides to the yellow xanthenes during the drying process. Besides saccharose and the trisaccharide gentianose, there is the bitter-tasting gentiobiose (5 -8%); phytosterols and pectins, or similar gel-forming substances, which may be responsible for the considerable swelling that the drug undergoes when moistened are also present. The alkaloids that have been described in the literature, e.g. gentianine, are probably artefacts arising during work-up. The small amount of the essential oil obtained on distillation has a complex composition. Starch is absent.

Uses. Gentian has antiasthenic, anti-inflammatory and antipyretic properties. By stimulating the taste buds of tongue and influencing especially the encephalic phase of secretion, the drug brings about reflex promotion of the gastric juice and saliva production; it is also has cholagogic effect. Used externally the plant heals sores. It is used chiefly in numerous prepared gastrointestinal remedies, as the powdered drug or extract, tincture, percolate, etc., e.g. Aciphyt® (drops), Gastricard® (tablets, drops), Ventrodigest® (tablets), etc., but also in the cholagogues or roborants and tonics. Homoeopathic dilutions of gentian root are also present in more than a dozen preparations.

Among the UK multi-ingredient products containing gentian root and/or extracts of it are: Lanes Kalms Tablets, Potter's Appetiser, Indigestion, and Stomach Mixtures; Seven Seas Nerve Tablets; Effico® contains compound gentian infusion.

Gentian is extensively used to make liqueurs. Gentian is used in cosmetic for its softening and purifying properties. It is moreover a good tonifying agent. Gentian is also recommended for its

astringent properties. The plant is a good ingredient in shampoos and lotions for greasy, damaged and delicate, dull and limp hair; body milks; soothing hand creams.

Contraindications: Stomach and duodenal ulcer.

Side Effects: In predisposed persons headache may develop.

Pharmacopoeial and Other Monographs: DAB, Ph Helv., BHP, Ph. Eur. 6.4, BP 2009.



BOGBEAN LEAF - *MENYANTHIDIS FOLIUM*

Bogbean - *Menyanthes trifoliata* L., Fam. *Menyanthaceae*.

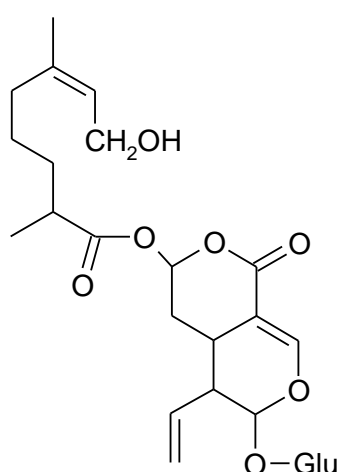
Synonym(s): Buckbean, Marsh trefoil leaf.

Plant. Perennial marsh plant, up to 30 cm in height, with termitic leaves. Flowers are white, petals are bearded on the inside.

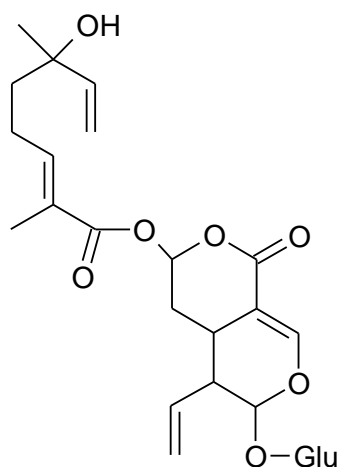
Area of distribution. Damp localities in the northern temperate zone. The drug is imported from the former USSR. Poland, former Yugoslavia, and Hungary.

Description. The leaves are ternate ("trefoil"), with 1 ca. 10 cm long petiole, and the individual leaflets are 5-10 cm long, elliptic, glabrous and with an entire margin. The leaf fragments of the cut drug are grayish green, partly with the shriveled, brownish nerves: because on drying the aerenchyma shrivels more, the fragments of the thicker petiole are wrinkled and longitudinally grooved. Very occasionally, petiole fragments with the three points where the leaflets were attached are recognizable. There is no odour. The taste is very bitter.

Constituents. The bitter substances are the secoiridoid glycosides dihydrofoliamenthin,



Dihydrofoliamenthin



Menthiafolin

ment

hiafol

in

and

logan

in,

foliamenthin.

The

alkaloids

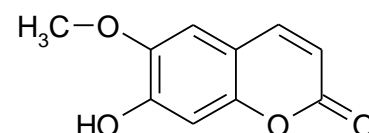
gentianine and geritranidine are

possibly artefacts arising during

the isolation procedure.

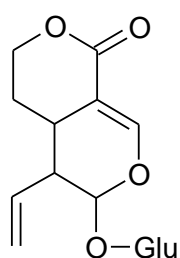
Flavonoids,

particulare



Scopoletin

hyperoside



Sweroside

and rutoside, coumarins in small amounts are also present.

Uses. Bogbean is stated to possess bitter and diuretic properties. It has been used for rheumatism, rheumatoid arthritis, and specifically for muscular rheumatism associated with general asthenia.

Contraindications: Excessive doses may be irritant to the gastrointestinal tract, causing diarrhoea, griping pains, nausea and vomiting.

Pharmacopoeial and Other Monographs: BHP 1996, BP 2009, Complete German Commission E, Martindale 35th edition, Ph. Eur. 6.4, SPU.



CENTAURY HERB –CENTAURII HERBA

Centaury - *Centaureum erythraea* Rafn., Fam. *Gentianaceae*.

Synonym(s): *Centaureum minus* Auct, *C. umbellatum* Gilib., Common Centaury, *Erythraea centaurium* (L.).

Plant. A biennial, only 30 cm in height producing a basal rosette of elliptical to spatulate leaves in the first year and a branched (lowering stem bearing small sessile, 5-part pinkish red, tubular flowers in flat umbels in the second year.

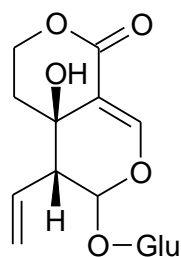
Area of distribution. Scattered to widespread in Europe, North America, North Africa, and western Asia. The drug is imported from Morocco, former Yugoslavia, Bulgaria, and Hungary.

Description. Prominent features of the drug, which consists of aerial parts of the flowering plant, are the mostly yellowish, 4-angled, hollow pieces of stem and the up to 8 mm long reddish flowers. Fragments of the small, entire, and glabrous opposite leaves, on the other hand, are less conspicuous. Occasionally waved dehiscent fruits are present, together with the loose, very small seeds discharged from them. Another characteristic feature is the anthers, which become spirally twisted after releasing their pollen.

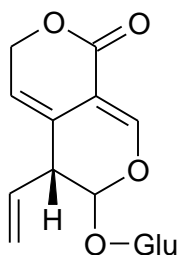
Constituents. Small amounts of intensely bitter-tasting secoiridoid glycosides, gentiopicroside (about 2%) as major, others include centapicrin, gentioflavoside, sweroside and swertiamarin; intensely bitter m-hydroxybenzoyl esters of sweroside and catapicrin.

Among triterpenoids it includes α - and β -amyrin, erythrodiol, crataegolic acid, oleanolic acid and sitosterol.

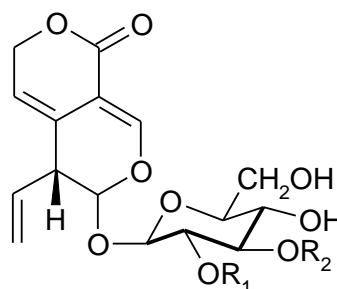
Herb contains highly methylated xanthenes, including eustomin and 8-demethyleustomin; phenolic acids - vanillic, syringic, p-coumaric, ferulic, sinapic and caffeic; pyridine-type alkaloids; traces of gentianine, gentianidine, gentioflavine and flavonoids, fatty acids, alkanes and waxes.



Swertiamarin



Gentiopicroin



$R_1 = m\text{-hydroxybenzoyl}$, $R_2 = \text{acetyl}$

Centapicroin

Uses. Centaury is reputed to act as a bitter, aromatic and stomachic remedy. Traditionally, it has been used for anorexia and dyspepsia. Drug: Canephron N, Herbion Drops for the Stomach, Original Grosser Bittner Balsam.

Contraindications: Centaury is contra-indicated for individuals with peptic ulcers.

Pharmacopoeial and Other Monographs: BHP 1996, BP 2009, Complete German Commission E, ESCOP 2003, Martindale 35th edition, Ph. Eur. 6.4.



DANDELION ROOT – *TARAXACI RADIX*

Dandelion - *Taraxacum officinale* Weber, Fam. *Asteraceae*.

Synonym(s): Lion's Tooth, *Leontodon taraxacum* L., *Taraxacum*.

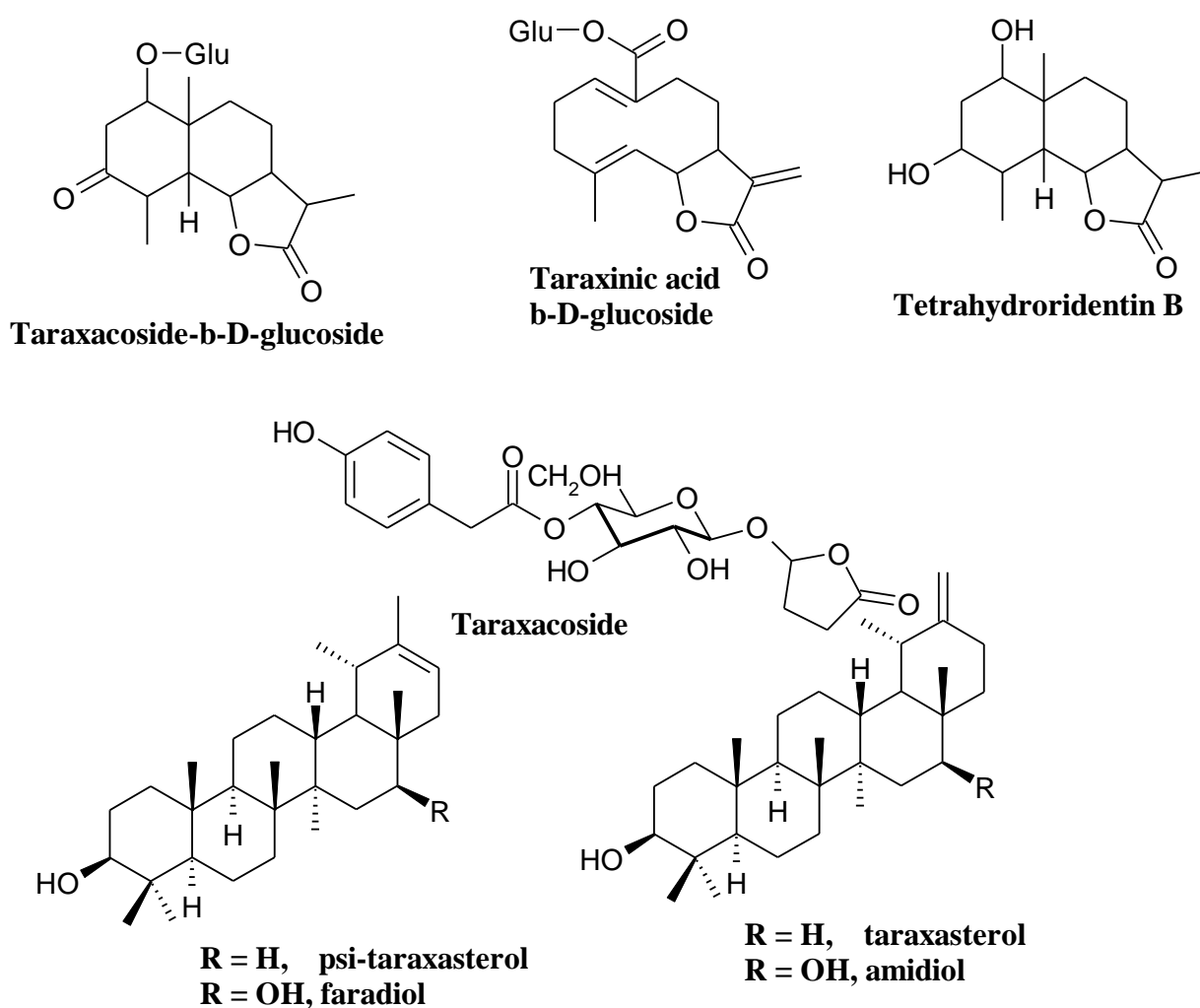
Plant. A cosmopolitan in meadow along roadsides with a stout taproot and runcinate, basal leaves. The flowering heads consist only of ligulate flowers, the white pappus enabling the achenes to float in the air. Latex presents throughout the plant.

Area of distribution. Native throughout the northern hemisphere, with many varieties and microspecies; introduced into South America. The drug is collected from both wild and cultivated plants. The main suppliers are Bulgaria, former Yugoslavia, Romania, Hungary, and Poland; it is also obtained in the UK.

Description. The drug consists of the dried, entire dandelion plant, harvested before the flowering. The dark brown to blackish pieces of root have coarse longitudinal wrinkles on the outside. In transverse section, there are several concentric zones with tangentially connected brown laticifers in the broad greyish white to brownish cortex. The darker cambial surrounds a lemon-yellow porous, not radiate xylem, which in some fragments may also be fissured. The

fracture is cartilaginous and short, not fibrous. The odour is faint and characteristic, taste is somewhat bitter.

Constituents. chlorogenic acid, cichoric acid, monocaffeoyl tartaric acids, taraxacoside, linoleic acid, linolenic acid, oleic acid and palmitic acid; Coumarins: cichoriin and aesculin; Flavonoids: Luteolin-7-glucoside and luteolin-7-diglucosides. Minerals: K 4.5% in leaf, 2.45% in root. It contains resin, undefined bitter complex (taraxacin); Terpenoids: sesquiterpene lactones taraxinic acid (germacranolide) esterified with glucose, and eudesmanolides. Other constituents include carotenoids, choline, inulin, pectin, phytosterols (e.g. sitosterol, stigmasterol, taraxasterol, homotaraxasterol), sugars (e.g. fructose, glucose, sucrose), triterpenes (e.g. b-amyrin, taraxol, taraxerol).



Uses. Dandelion is stated to possess diuretic, laxative, cholagogue and antirheumatic properties. It has been used for cholecystitis, gallstones, jaundice, atonic dyspepsia with constipation, muscular rheumatism, oliguria, and specifically for cholecystitis and dyspepsia. The German Commission E approved use of root and herb for disturbance of bile flow, stimulation of diuresis, loss of appetite and dyspepsia. Root is used in combination with celandine herb and artichoke for epigastric discomfort due to functional disorders of the biliary system.

Contraindications: Treatment with dandelion is contraindicated for patients with occlusion of bile duct, gall bladder empyema and obstructive ileus.

Side Effects: Animal studies indicate dandelion to be of low toxicity. Contact allergic reactions to dandelion have been documented, and animal studies have reported dandelion to have a weak sensitizing capacity. Sesquiterpene lactones are thought to be the allergenic principles in dandelion. These compounds contain an exocyclic α -methylene β -lactone moiety, which is thought to be a prerequisite for allergenic activity of sesquiterpene lactones.

Pharmacopoeial and Other Monographs: BHC 1992, BHP 1996, Complete German Commission E, ESCOP 2003, Martindale 35th edition, WHO monographs on medicinal plants commonly used in the Newly Independent States (2010).



HOPS FRUIT –LUPULI STROBILI

Hops - *Humulus lupulus* L., Fam. *Cannabaceae*.

Synonym(s): *Humulus*, *Lupulus*.

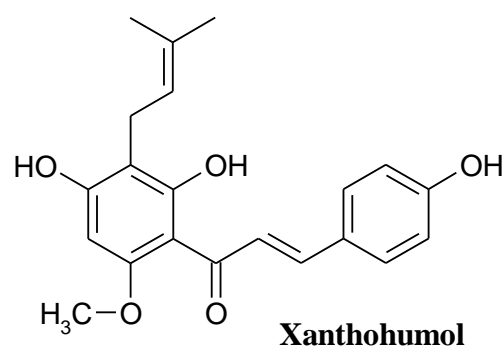
Plant. A 3 - 6 m tall (in cultivation up to more than 10 m) dioecious vine, twining to the right. 3-7-lobed long petioled leaves are coarsely pubescent, with a coarsely serrate margin. Female flowers are in stalked cone-like spikes.

Area of distribution. Exclusively from cultivated female plants grown in many parts of the temperate zones, including Western Europe, India, China, and the USA.

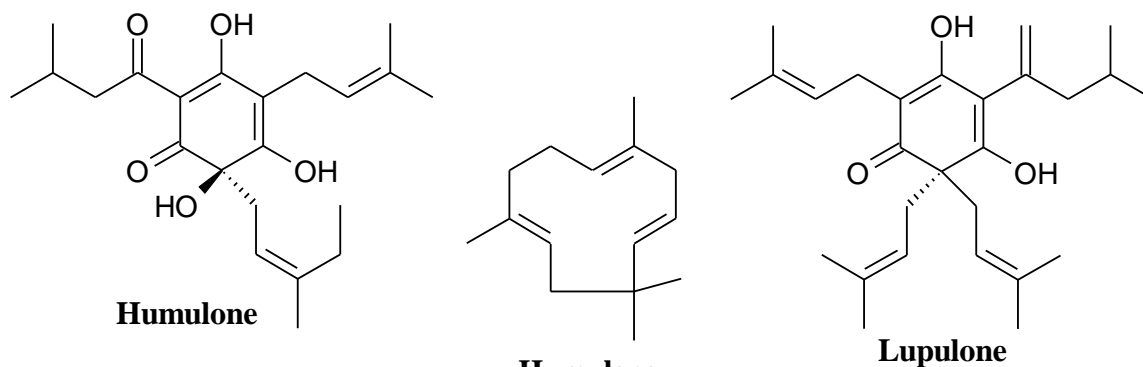
Description. Hops consist of the 2-4 cm long, yellowish green female inflorescence (the hop or 'cone' or strobile), which is built up from imbricated oval bracts, in the axils of each of which are two female flowers, each one surrounded by a small oblique ovate bract. The leaf fragments of the drug clearly show the golden-yellow shining glandular trichomes (hop grains). The odour is intensely spicy. The taste is somewhat bitter and harsh. Hop grains are the glandular trichomes obtained from the hops by sieving. They form a greenish yellow to orange-yellow sticky powder.

Odour: Characteristic, strongly spicy. Taste: Spicy and bitter.

Constituents: Bitter substances (acylphloroglucides) present in the resin, which is located in glandular trichomes (15 -30% in hops, 50 80% in hop grains). The most important component of the resin is the bitter substances humulone and lupulone. Many other bitter substances have been isolated in pure form. All the bitter substances are fairly labile compounds and on storage are slowly converted to components of the hard resin (mainly oxidation products). Essential oil (in hops 0.3 - 1%, in hop grains 1- 3%) is chiefly mono- and sesquiterpenes (myrcene, linalool, farnesene, caryophyllene. etc.; so far,



more than 150 aroma substances have been identified). Tannins are also present, in the form of oligomeric proanthocyanidins (2-4% in hops, little in hop grains); and flavonoids (kaempferol and quercetin mono- and diglycosides, hop specific chalcone). A potent phytoestrogen has also been detected. Small amounts of phenol-carboxylic acids (ferulic and chlorogenic, etc.) are present.



Uses. Hops are stated to possess

sedative, hypnotic and topical bactericidal properties. Traditionally, they have been used for neuralgia, insomnia, excitability, mucous colitis, topically for crural ulcers, and specifically for restlessness associated with nervous tension headache and/or indigestion. Hops are used in combination with valerian root for nervous sleeping disorders and conditions of unrest. Drug: Novo-Passit; Doppelherz Vitalotonik; Sanason, Urolesan, Valocordin.

Contraindications: Allergic reactions have been reported for hops, although only following external contact with the herb and oil.

Drug interactions. There are some conflicting data on the oestrogenic activity of hops, and 8-prenylnaringenin, documented as a constituent of hops, has been shown to have oestrogenic activity in preclinical studies. Herbs with oestrogenic effects may stimulate breast cancer growth. However, this requires confirmation.

Pharmacopoeial and Other Monographs: BHC 1992, BHP 1996, BP 2009, Complete German Commission E, ESCOP 2003, Martindale 35th edition, Ph Eur 6.4.