

PHENOLIC COMPOUNDS



Simple phenol derivatives

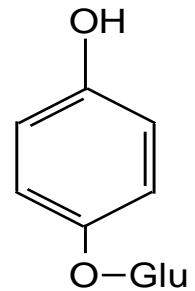
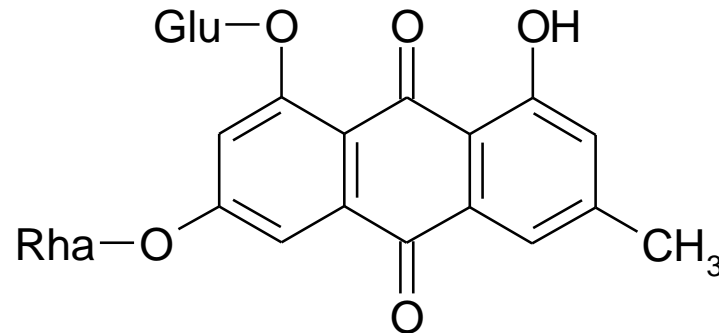
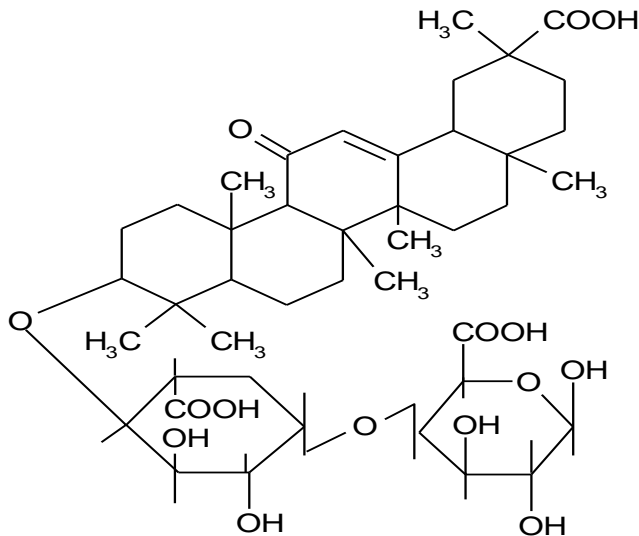


Plan

1. The general characteristic of glycosides
2. The general characteristic of phenolic compounds
3. Physical and chemical properties of simple phenols
4. Identification and quantitative determination
5. Medicinal plants and plant material containing simple phenol derivatives

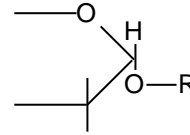
Glycosides

- Glycosides consist of a sugar residue covalently bound to a different structure called the *aglycone*.
- The sugar residue is in its **cyclic** form and the point of attachment is the **hydroxyl group of the hemiacetal function**.



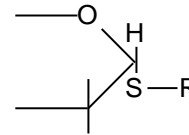
The sugar moiety can be joined to the aglycone in various ways:

1. Oxygen (*O-glycoside*)



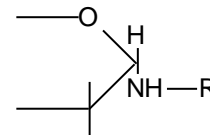
O-glycoside

2. Sulphur (*S-glycoside*)



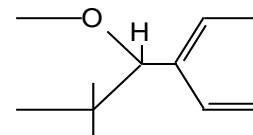
S-glycoside

3. Nitrogen (*N-glycoside*)



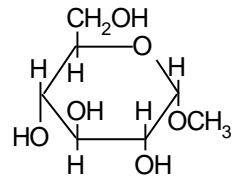
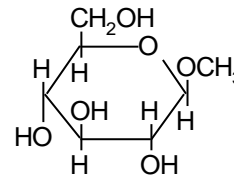
N-glycoside

4. Carbon (*C-glycoside*)



C-glycoside

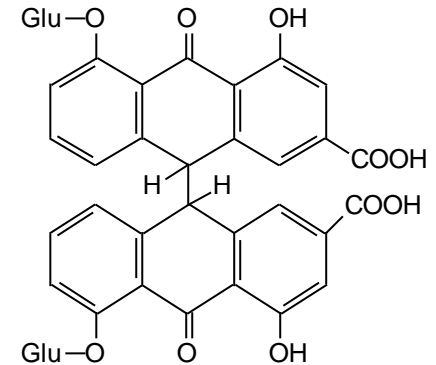
- α -Glycosides and β -glycosides are distinguished by the **configuration of the hemiacetal hydroxyl group**.

Methyl- α -D- glucopyranosideMethyl- β -D- glucopyranoside

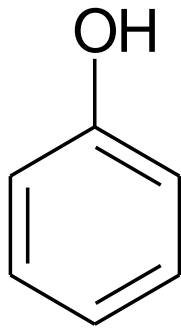
- O -Glycosides can easily be cleaved into sugar and aglycone by hydrolysis with **acids or enzymes**.
- Almost all plants that contain glycosides also contain enzymes that bring about their hydrolysis (***glycosidases***).

- Modern system of naming glycosides using the termination '-oside' (e.g. sennoside).

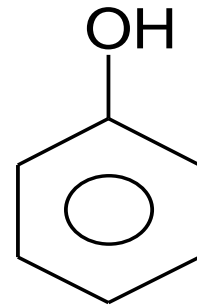
sennoside



- Although glycosides form a natural group in that they **all contain a sugar unit**, the **aglycones are of such varied nature and complexity** that glycosides vary very much in their physical and chemical properties and in their pharmacological action.



Phenol



Phenolic Glycosides

- Phenolic glycosides of many different types are widespread in nature.

Phenols are sometimes found to occur naturally in higher plants in the free state, but they are usually present as such, either in storage tissues (seeds or berries) or in drying or dead tissues (e.g. the heartwood of trees), but not in leaf or flower tissues.

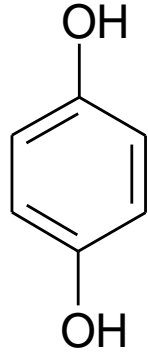
The only groups of phenolic compounds which are not combined with sugars as glycosides, are the polymeric lignins and leucoanthocyanidins.

The compounds in this group have aglycones containing phenolic groups together with either alcoholic groups or carboxylic acid groups.

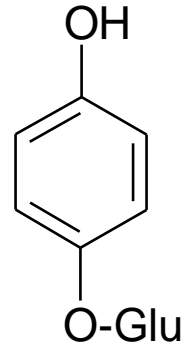
Classification

Skeleton	Compounds
Phenolic Compounds	
One aromatic benzene ring	
C_6	Simple phenols, phenolic glycosides
C_6-C_1	Phenolic alcohols, aldehydes or acids
C_6-C_2	Phenolic acetic acid
C_6-C_3	Hydroxycinnamic acids, coumarins, chromones
$(C_6-C_3)_2$	Lignans
Two aromatic benzene rings	
$C_6-C_1-C_6$	Xanthones
$C_6-C_1-C_1-C_6$	Stilbenes
$C_6-C_3-C_6$	Flavonoids
Quinones	
<i>One ring (C_6)</i>	Benzoquinone
<i>Two rings (C_{10})</i>	Naphthoquinones
<i>Three rings (C_{14})</i>	Anthraquinones
Polymeric Phenolic Compounds	
Tannins	
$(C_6-C_1)_n, (C_6-C_2)_n$	Hydrolyzable tannins
$(C_6-C_3-C_6)_n$	Condensed tannins
$(C_6-C_3)_n$	Lignins

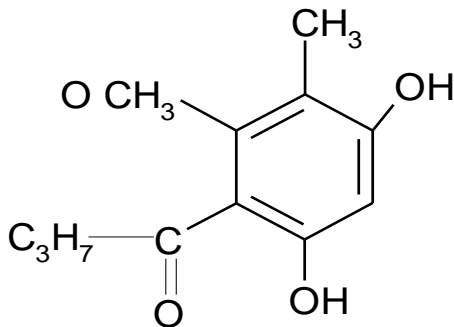
C₆ - Simple phenols, phenolic glycosides



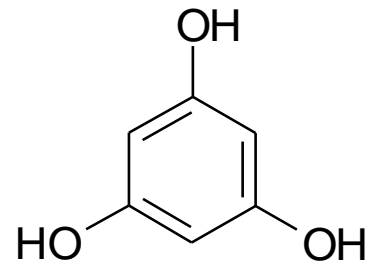
Hydroquinone



Arbutin

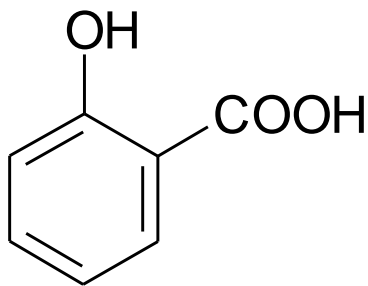


Aspidinol

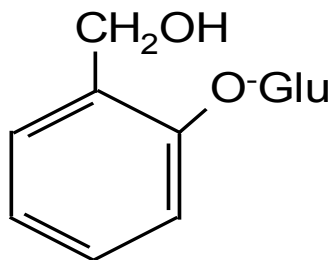


Phloroglucinol

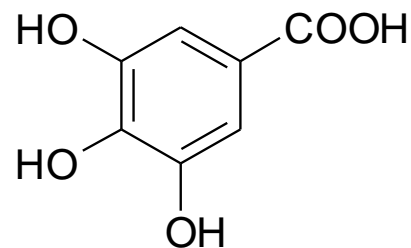
C₆ – C₁ - Phenolic alcohols, aldehydes or acids



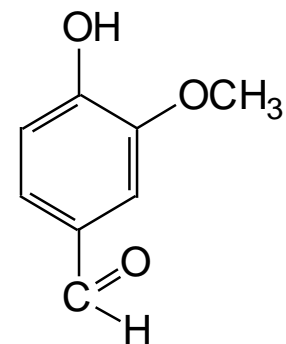
Salicylic acid



Salicin

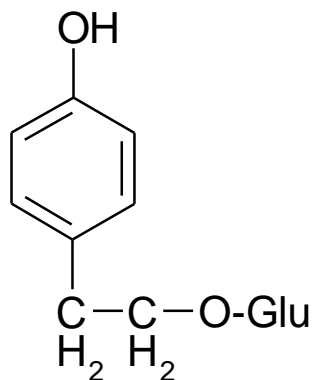


Gallic acid

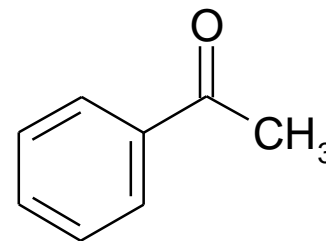


Vanillin

C₆ – C₂ Phenolic alcohols, acids, acetophenones

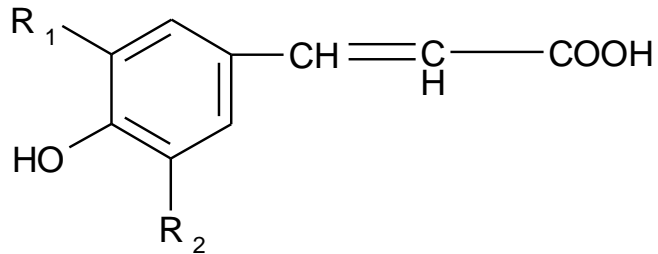


Rhodiololide



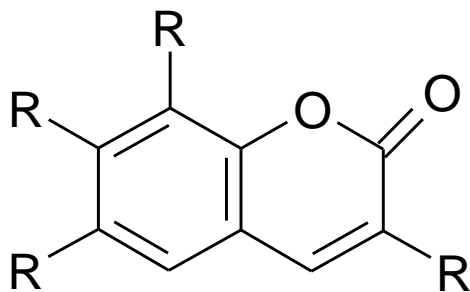
Acetophenone

C₆ – C₃ Hydroxycinnamic acids, coumarins, chromones

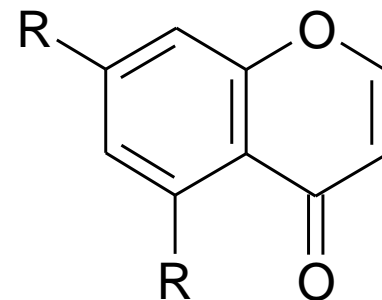


Hydroxycinnamic acids

acid	R ₁	R ₂
<i>p</i> -coumaric	-H	-H
caffeic	-OH	-H
ferulic	-OCH ₃	-H

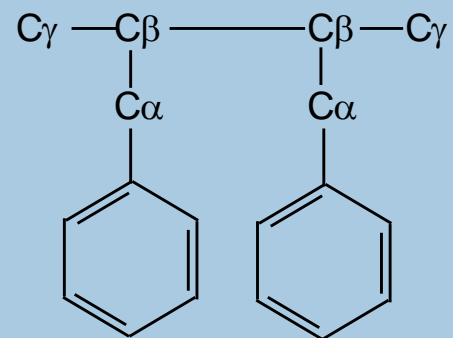


Coumarins

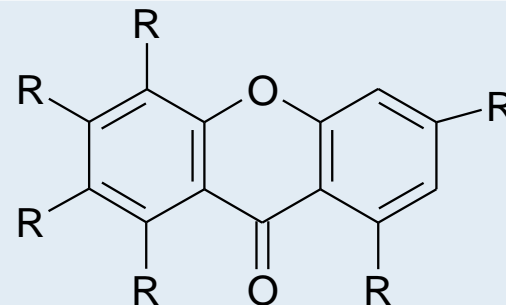


Chromones

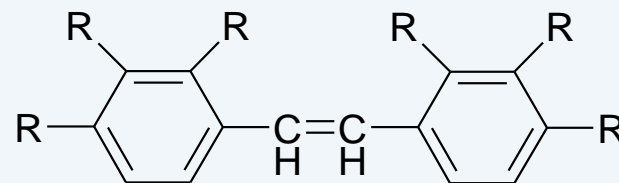
(C₆ – C₃)₂ Lignans



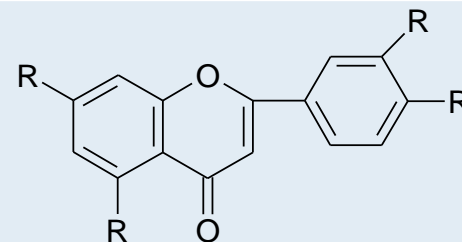
C₆ – C₁ – C₆ Xanthenes



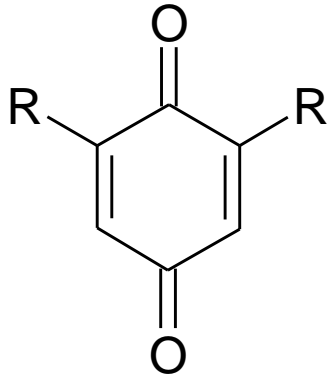
C₆ – C₂ – C₆ Stilbenes



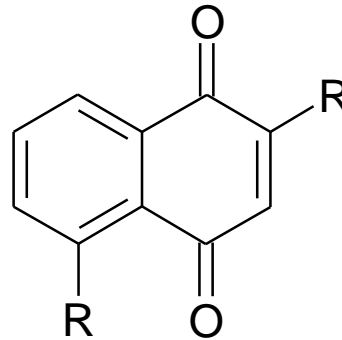
C₆ – C₃ – C₆ Flavonoids



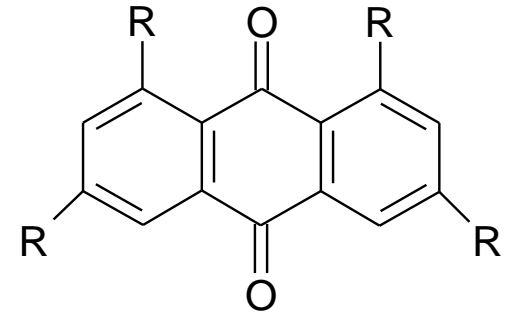
Quinones



Benzoquinone

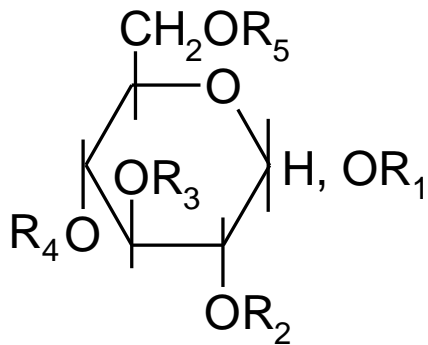


Naphthoquinone



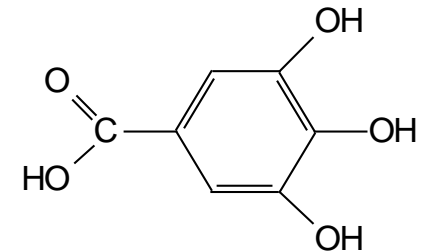
Anthraquinones

Tannins



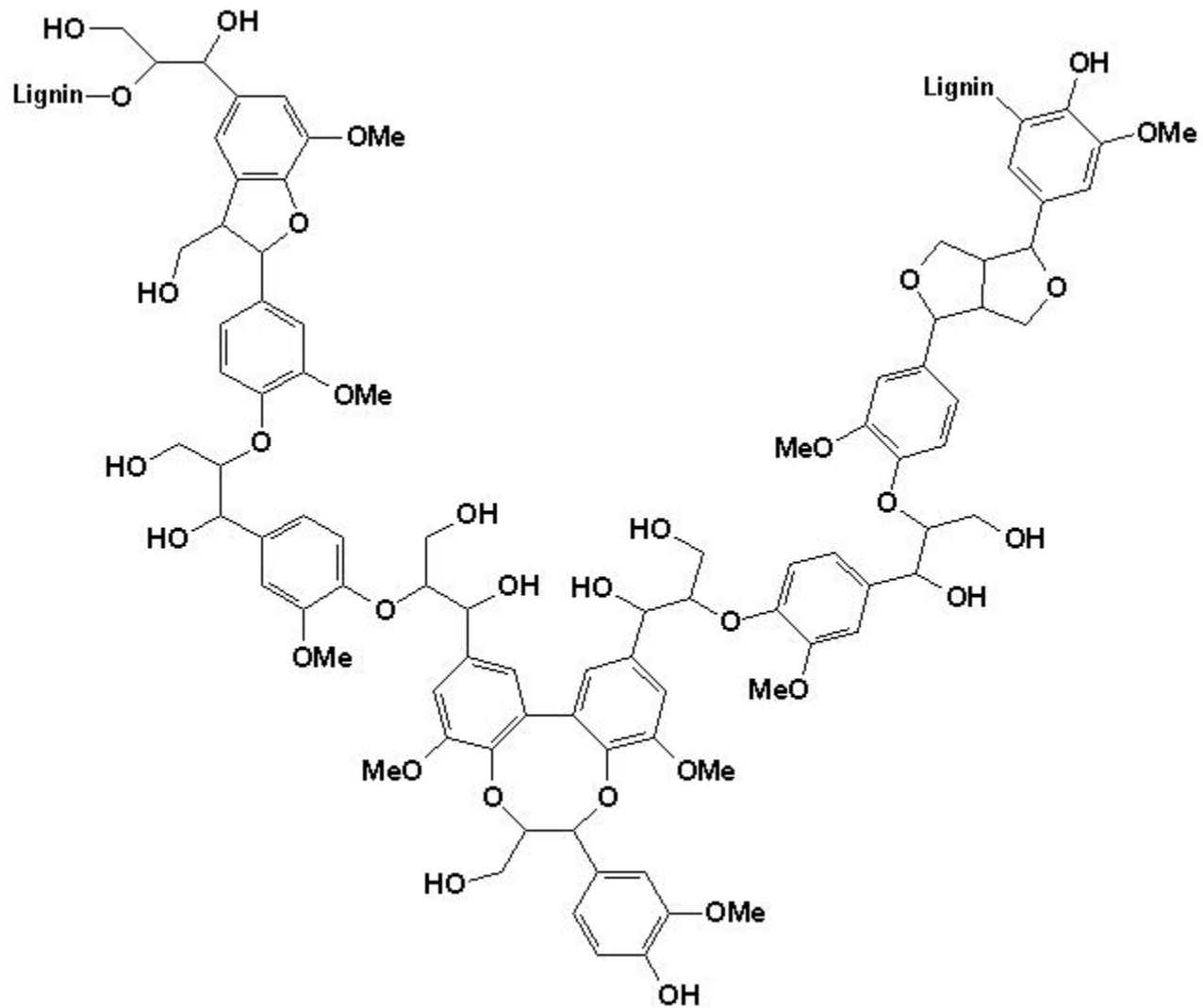
Chinese tannin (pentagalloyl-glucose)

$R_1=R_2=R_3=R_4=R_5$ – gallic acid



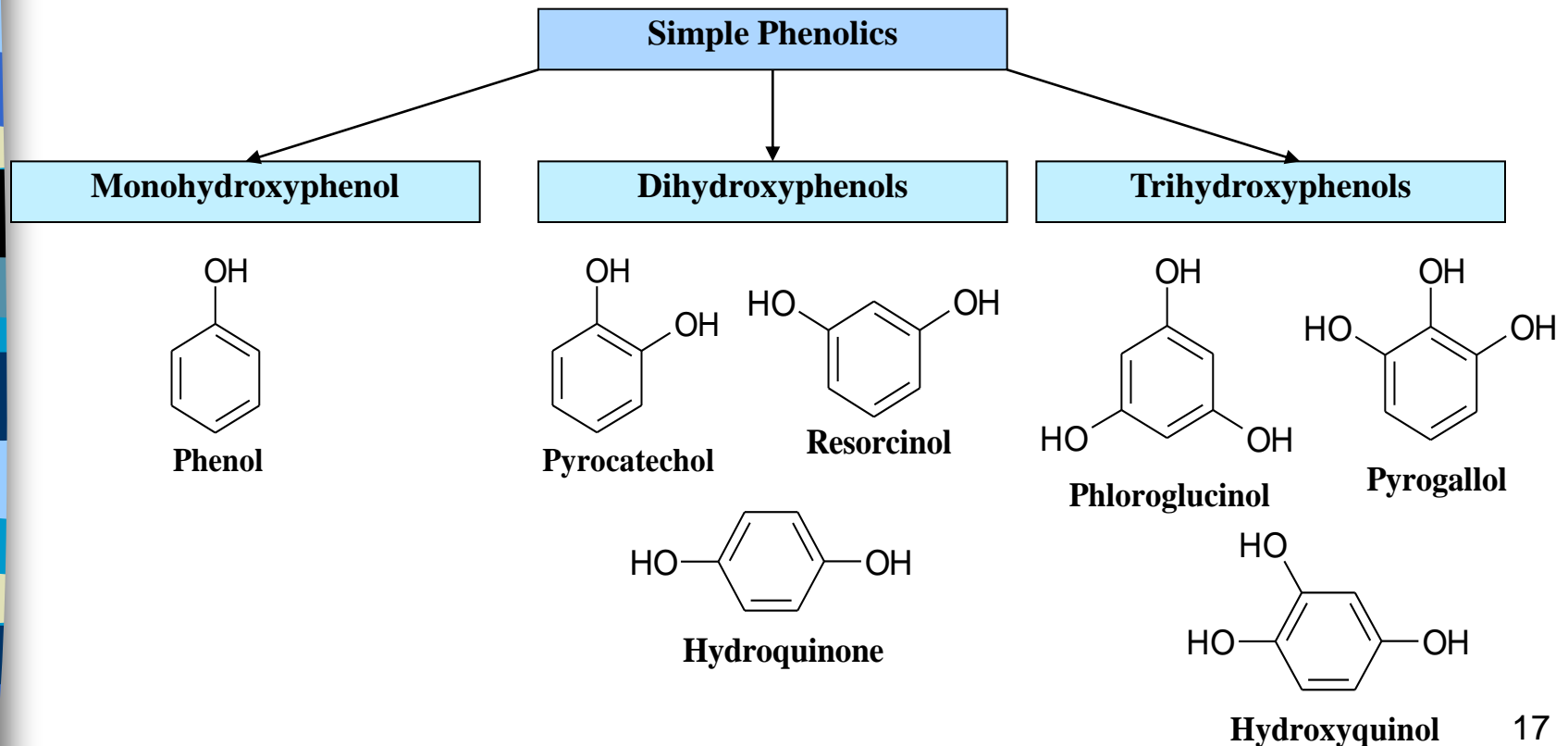
gallic acid

Lignin structure



SIMPLE PHENOLS

Simple phenolic compounds are a group of BAC, containing phenol and its derivatives without a side chain, which have the general formula C_6 .





Physical and Chemical Properties

- Crystals – *have a certain melting point*
- White or yellowish
- Soluble in water (*the more sugars it has in chain – the better soluble in water the compound is*), ethanol, methanol, ethyl acetate
- Glycosides possess optical rotation
- Undergo acid and enzymatic hydrolysis
- Phenolic acids are able to form depsides (*compounds composed of two or more monocyclic aromatic units linked by an ester bond*)
- Able to bind heavy metals' cations

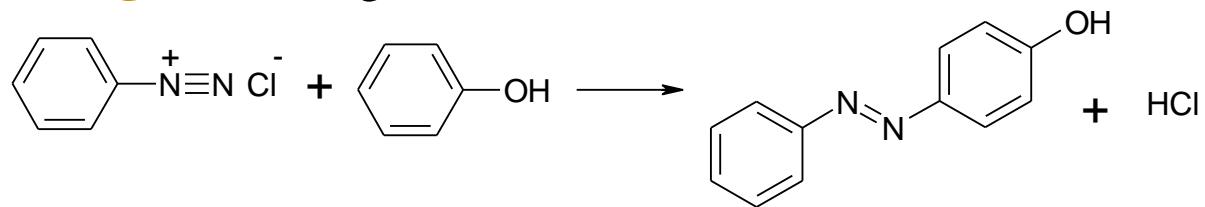
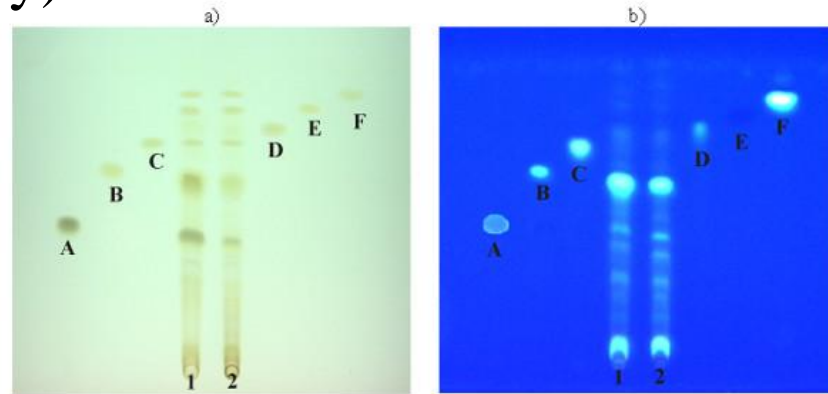
IDENTIFICATION

× **TLC** (thin-layer chromatography)

× **Quality reactions:**

× with heavy metals' cations (ferric ammonium sulphate, ferric (III) chloride, lead (II) acetate) – formation of precipitates or coloured solutions

× Azocoupling test (diazonium compound plus phenolic compounds – **red, crimson, orange** colouring)



Identification of arbutin

× iron (II) sulphate crystal – (**dark violet** precipitate),

× sodium phosphomolybdate in hydrochloric acid – (**dark blue** color)

QUANTITATIVE DETERMINATION

◆ Titration

- ◆ Acid-base (alkalimetry)

- ◆ Redox (bromatometry, iodometry – especially for arbutin according to the USSR Pharmacopoeia IX ed.)

◆ Spectrophotometry

◆ TLC-densitometry

- ◆ Liquid chromatography (arbutin – according to the SPU), HPLC



PHARMACOLOGICAL EFFECTS

- Ⓢ Antioxidant (presence of phenolic hydroxyl group)
- Ⓢ Anti-inflammatory
- Ⓢ Immune stimulating
- Ⓢ Antibacterial
- Ⓢ Antiviral
- Ⓢ Keratolytic
- Ⓢ Cholagogue, Hepatoprotective
- Ⓢ Sedative

Bearberry leaf – *Uvae ursi Folia*

Bearberry – *Arctostaphylos uva-ursi* (L.) Spreng.

Fam. – *Ericaceae*

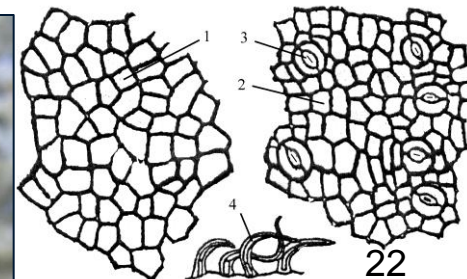
The plant is a procumbent evergreen shrub indigenous to Europe, Asia, and the northern United States and Canada.

The drug comes exclusively from wild population.

The spatulate and thick, leathery glabrous leaves are glossy green on the upper surface; they have an entire and partially revolute margin and the venation is distinct and finely reticulate. Very young leaves are pubescent, the unicellular covering trichomes being thick-walled and mostly covered. Odor slight. Taste astringent, slightly bitter.



Foto: Torbjörn Krönestedt





Act. const.

- Phenolic glycosides, with the hydroquinone monoglucoside arbutin as the main component (7-12%).
- Arbutin gallate esters
- Free gallic acid
- Tannins 15-20% with gallotannins and catechin type tannins;
- Flavonoids: hyperoside as well as other quercetin and myricetin glycosides;
- Triterpenes, including ursolic acid, the corresponding alcohol uvaol;
- Iridoid glycoside monotropein.

Uses

Inflammatory disorders of the lower urinary tract.

Preparations of bearberry leaves (tea 3 g/150 ml) have antibacterial action.

This action is associated with the aglycone hydroquinone released from arbutin in alkaline urine.

Side effects

Nausea and vomiting may occur in persons with sensitive stomachs.

Interaction with other drugs

Preparations of bearberry leaves should not be taken together with drugs that cause acidic urine since it reduces the antibacterial action.

Cowberry leaf – *Vitis idaeae Folia*

Cowberry – *Vaccinium vitis-idaea* L. (synonyms – lingonberry, foxberry, bearberry, mountain cranberry etc.)

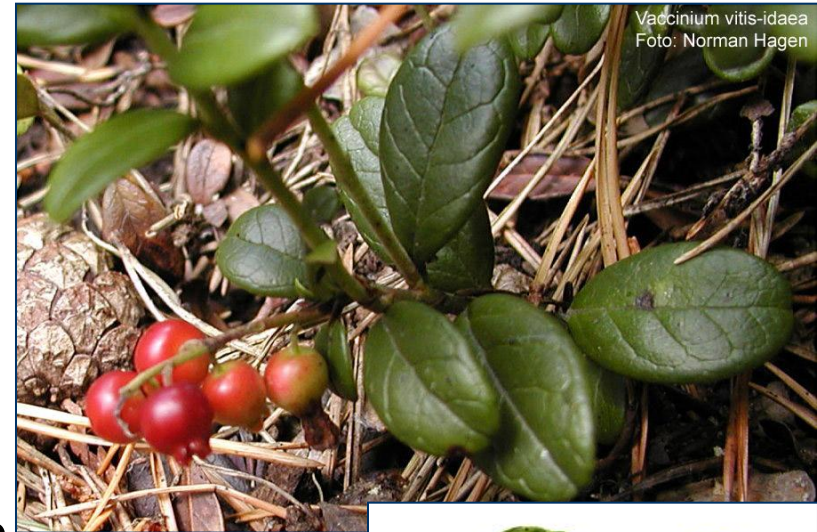
Fam. – *Ericaceae*

The plant is an evergreen shrub indigenous to Europe, Asia, and the northern United States and Canada.

The drug comes exclusively from wild population.

The elliptical and thick, leathery glabrous leaves are glossy green on the upper surface; they have an entire and revolute margin and the venation is distinct and pinnate, leaves are dark green on the upper surface; lower surface paler. Apex is dulled or sinuate. Lower surface bears many glands as dark brown spots.

Odor slight. Taste astringent, slightly bitter.



Vaccinium vitis-idaea
Foto: Norman Hagen





Act. const.

- Phenolic glycosides, with the hydroquinone monoglucoside arbutin as the main component (5-7%),
- Hydroxycinnamic acids,
- Flavonoids: quercetin and myricetin glycosides, hyperoside, catechins;
- Tannins (20%), with dominance of gallo catechins;
- Triterpenes, including ursolic acid, the corresponding alcohol uvaol;
- Iridoid glycoside monotropein.
- vitamin C.

Uses

Inflammatory disorders of the lower urinary tract.

Preparations (tea 3 g/ 150 ml) have antibacterial action. This action is associated with the aglycone hydroquinone released from arbutin in alkaline urine.

Side effects

The same as for bearberry leaves

Interaction with other drugs

The same as for bearberry leaves

Wild pansy herb – *Violae Herba*

Wild pansy – *Viola tricolor* L.,
V. arvensis Murray.

Fam. – *Violaceae*

Native to all temperate zones of Europe and Asia. To obtain the drug, the aerial parts of the plant are collected from wild populations during the flowering period. It is also cultivated to some extent in Holland and France.

Characteristic are the deep blue and bright yellow and/or pale violet to white, mostly curled up flowers and petals. Often present as well are yellow to yellowish brown, closed or longitudinally dehiscent three-valved loculicidal capsules with numerous pale yellow seeds. Pieces of the thin, roundish stem and pale green leaf fragments may be found.

Odor: very faint, characteristic.

Taste: Mucilaginous and mildly sweet.



Act. const.

- Salicylic acid and its derivatives , such as methyl salicylate (0,06 – 0,3%);
- Other phenolic carboxylic acids including *trans*-caffeic acid, *trans*- and *cis*-*p*-coumaric acids, etc.
- Mucilage – 10%;
- Tannins – 2,4 – 4,5%;
- Flavonoids – not less than 1,5% (glycosides of quercetin, luteolin, apigenin); Anthocyanidin glycosides;
- Coumarins;
- Carotenoids;
- Hemolytically active peptides.

Uses

Externally and internally as an adjuvant for various skin diseases, such as eczema, impetigo, acne.

There are indications from old folk medicine for catarrhs of the respiratory tract, inflammation of the throat (gargle) and feverish colds.

In folk medicine the drug is considered as “blood purifying” remedy; it supposedly displays a metabolism-promoting action and is therefore employed as an adjuvant for corresponding indications, as a diuretic, diaphoretic and purgative, as well as for rheumatism, gout, and arteriosclerosis.

Tea - 1,8 g (1 teaspoon) of herb / 150 ml boiling water

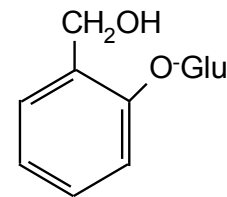
Willow bark – *Salicis Cortex*
Willow – *Salix purpurea* L.
Fam. – *Salicaceae*

Native to Europe and Asia.

The drug consist of the 1-2 mm thick and sometime channeled or curved bark pieces, having a glossy, greenish yellow outer surface which is smooth or often has longitudinal striations . The inner surface is almost pale yellow. The fracture is short in the outer part and coarsely fibrous in the inner part. Almost odorless. Astringent and bitter taste.



Salix acutifolia WILLD.
©Thomas Schoepke



salicin

Act const.

- Not less than 1,5-11% “salicylates” derivatives (according to Ph. Eur.) expressed as salicin; salicylic acid.
- Acids: *p*-hydroxybenzoic, caffeic, ferulic, *p*-coumaric.
- Flavonoids: glycosides of quercetin, luteolin, eriodictiol, naringenin.
- Tannin 8-20%.

Uses

Mild colds with fever, influenza, chronic rheumatic disorders, mild headaches and pain caused by inflammations. The salicylic acid is the active form and has antipyretic, analgesic, and antiphlogistic effects. Salicin is cleaved by the intestinal flora into saligenin (salicyl alcohol) and glucose. Saligenin is absorbed and metabolized in the blood and liver to salicylic acid.

Tea – 2-3 g (2 teaspoons) of the drug / 150 ml boiling water

Side effect

Possible gastrointestinal discomforts due to the tannins present in the drug.

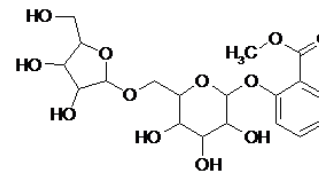
Meadowsweet herb– *Filipendulae ulmariae* Herba

Meadowsweet – *Filipendula ulmaria* (L.) Maxim

Fam. - *Rosaceae*

Act. Const.

- Salicylates: salicylic aldehyde, salicylic acid, methylsalicylate, and glycosides gaultherin, spiraein;
- Flavonoids: quercetin, apigenin, rutin, hyperoside, anthocyanidins;
- Phenylcarboxylic acids: *p*-coumaric, caffeic, vanillic, ellagic acids;
- Tannins;
- Volatile oils.



Gaultherin

Uses

The **infusion** has diaphoretic, diuretic, anti-inflammatory, analgesic properties and is indicated in cases of flu, gout, rheumatism.

Externally can be used for healing wounds and ulcers.



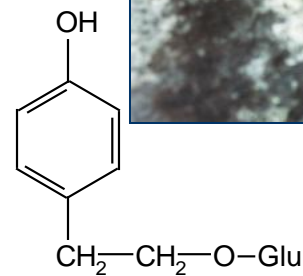
Rhodiola root and rhizome – *Rhodiola roseae* *Rhizomata et radices*

Rhodiola (Golden root) – *Rhodiola rosea* L.

Fam. - *Crassulaceae*

Act. Const.

- Phenylethanoids: tyrosol, salidroside;
- flavonoids: herbacein, gossypetin, kaempferol derivatives;
- Phenylpropanoids: rosin, rosarin, rosavin and cinnamyl alcohol.
- Volatile oils 0,05%
- microelements: Mn



salidroside

Uses

Rhodiola liquid extract – “brain tonic” to eliminate fatigue and improve work capacity. It has adaptogenic properties.

Adaptogens increase an organism’s resistance to physical, chemical and biological stressors, and have a normalizing influence on bodily systems. ³¹



Echinacea root – *Echinaceae Radix*

Echinacea herb – *Echinaceae purpureae Herba*

Coneflower - *Echinacea purpurea* (L.) Moench.

***E. angustifolia* DC**

***E. pallida* Nutt.**

Fam. - *Asteraceae*

The drug consist of dried and sometimes twisted , cylindrical, reddish brown longitudinally wrinkled roots, including the rhizome. The fracture is short and fibrous, the cross section shows a thin cortex whitish yellow xylem with grayish black radial striations.

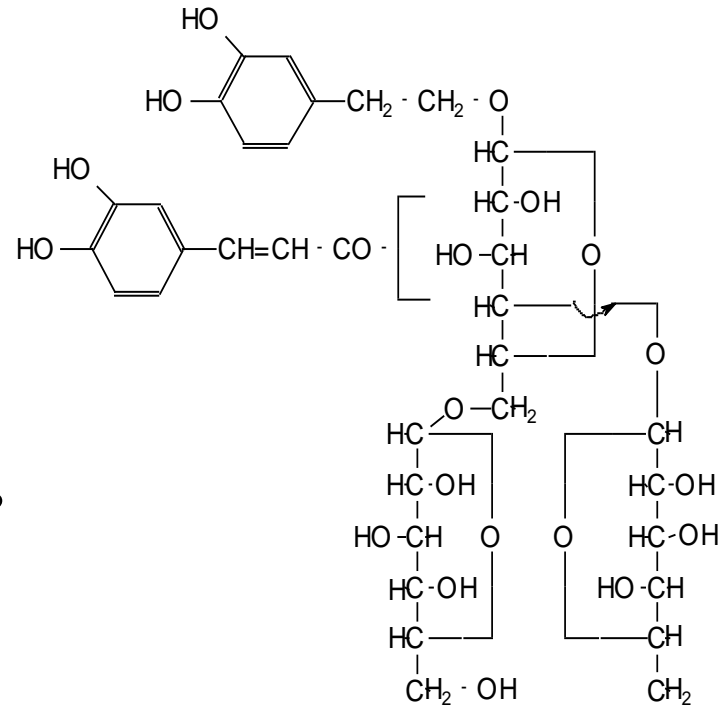
Odor: faintly aromatic, characteristic.

Taste: slightly sweet , than bitter followed by a tingling.



Act. const.

- Caffeic acid derivatives including Echinacoside (0,3-1,7 %)
- Cichoric acid, chlorogenic acid, dicaffeoylquinic acid;
- Polysaccharides (inulin)
- Immune modulating glycoproteins
- Alkylamides 0,01-0,15%,
- Volatile oil 0,1%
- Polyacetylenes



Echinacoside

Uses

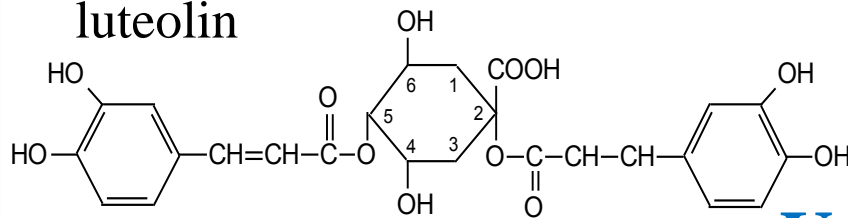
Research has focused on immunomodulatory activity, although other activities such as antiviral, antifungal, anti-inflammatory have also been explored.

Tincture; “Immunal”

**Artichoke leaf – *Cynarae Folia*,
Cynarae Anthodia
 Artichoke – *Cynara scolymus* L.
 Fam. - *Asteraceae***

Act.const.

- Caffeoylquinic acid derivatives -0,02-2%, consisting of mono- and dicaffeoylquinic acids with cynarin, which is formed from di-O-caffeoyl-D-quinic acid by interchange of ester radicals during aqueous heat extraction;
- Sesquiterpenoid bitter compounds- up to 4%;
- Flavonoids - 0,5%, particularly glycosides of luteolin



Cynarin

Uses

Functional dispeptic disorders.

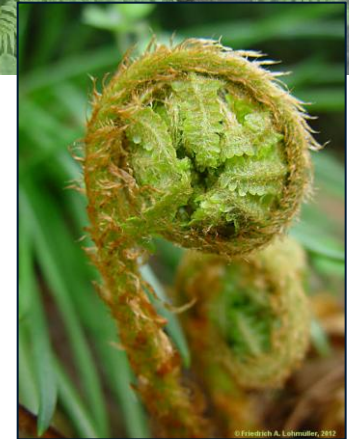
Normalization of disturbed liver and gall bladder function, influence on lipid metabolism by lowering the total cholesterol.

«Chophytol», «Choliver» -



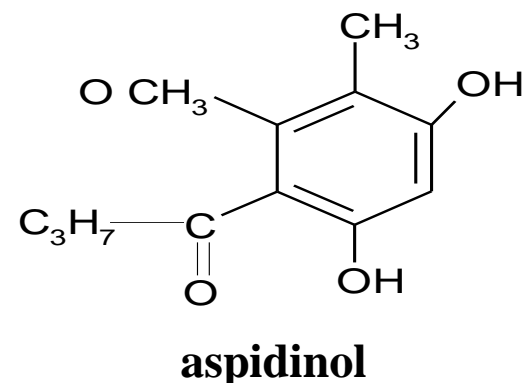
Male fern rhizome – *Filicis maris Rhizomata*
Male fern – *Dryopteris filix-mas* (L.) Schott.
Fam. - *Dryopteridaceae*

The dried rhizome occurs in brownish black ovoid cylindrical pieces about 6 to 15 cm long and 3-4 cm in diameter. They are only rarely branched. The surface is closely covered by the frond bases, being arranged in two sets of crossing spirals. Each frond base is about 3 to 6cm long and 5-8mm thick, slightly covered with 2 lateral longitudinally ridges. Both the young fronds and frond bases are clothed externally with numerous brown chaffy scales. Odorless. It has disagreeable, nauseous and bitter taste.



Act.const.

- Filicic acid, aspidinol, flavaspidic acid, flavaspidinol, and albaspidin,
- Fixed oil 6%;
- Filicitannic acid 7-8%
- resin,
- Starch.



Uses

Thick extract – anti-helminthic (vermicide) agent. In large doses it is an irritant poison.

Cannabis herb – *Cannabis Herba* *Cannabis* – *Cannabis sativa* L.

(*synonyms* - Bhang, Dagga, Ganja, Hashish, Indian hemp, Marijuana)

Fam. - *Cannabaceae*

Act. Const.

- Cannabinoids: C₂₁ aromatic hydrocarbons – tetrahydrocannabinol (THC), cannabidiol, cannabinol, cannabigerol, cannabivarin etc.;
- Seeds contain fatty oil, proteins, phytin, trace amounts of cannabinoids.

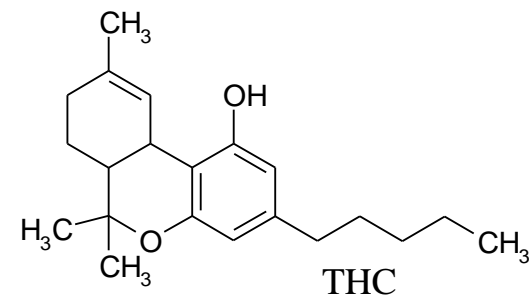
Uses

A psychoactive drug! Causes addiction.

Possesses sedative, analgesic and somniferous properties.

Synthetic cannabinoids – dronabinol and nabilone – are used in anorexia associated with weight loss in patients with AIDS and nausea and vomiting associated with cancer chemotherapy

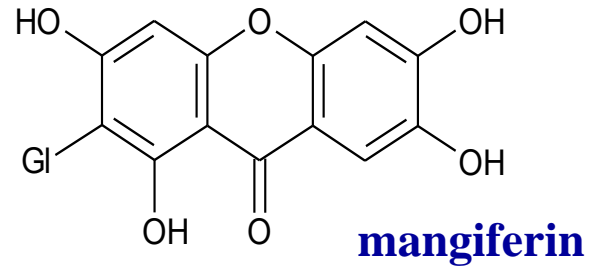
Caution! Chronic abuse of cannabis has been associated with decrease in motivation, cognition, judgement, and perception.



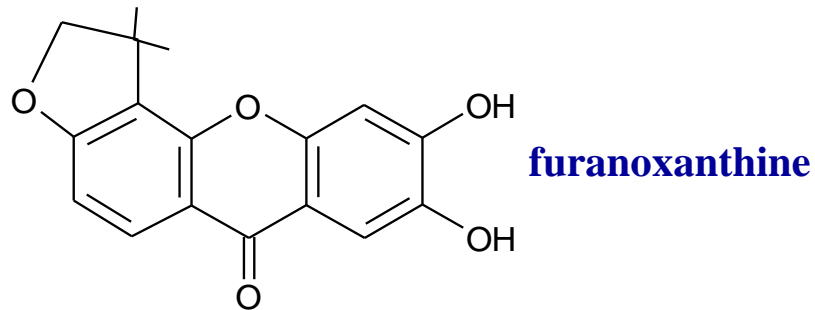
Xanthone derivatives are group of phenolic biologically active compounds with general formula $C_6-C_1-C_6$ (dibenzo- γ -pyrone).

Classification

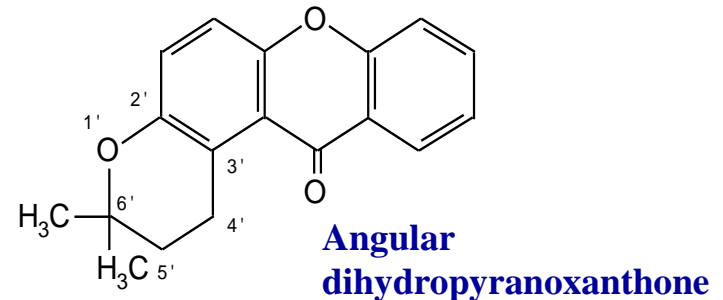
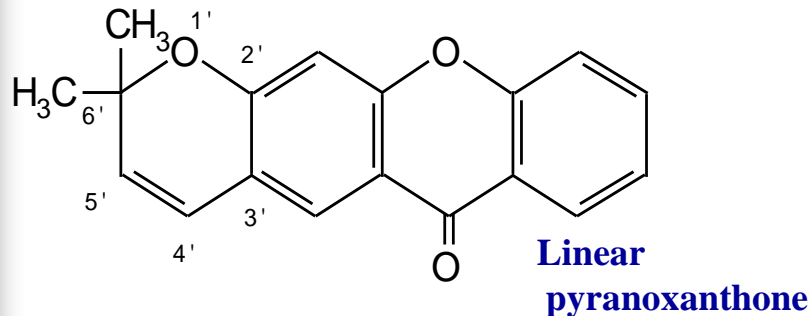
1. True xanthone



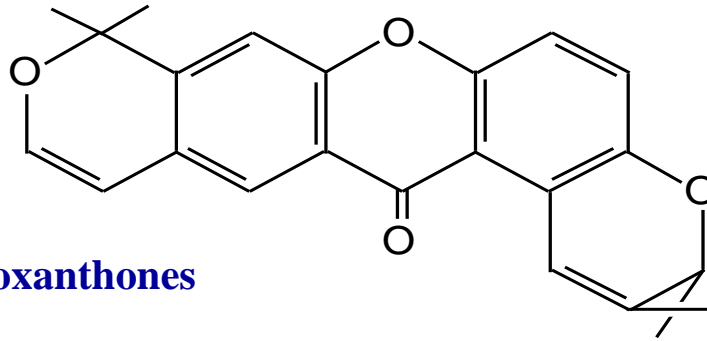
2. Furanoxanthone



3. Pyranoxanthones *linear* and *angular*

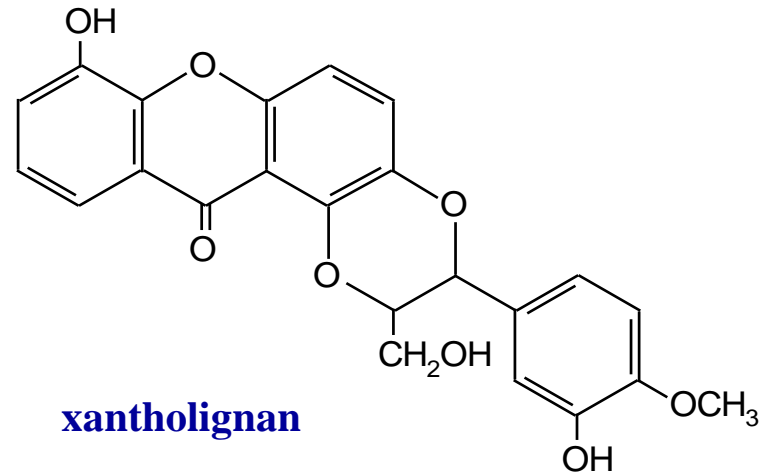


4. Dipyranoxanthenes



dipyranoxanthenes

5. Xantholignoids



xantholignan



Physicochemical properties of xanthenes

- × Yellow crystals,
- × Aglycones of xanthenes are soluble in chloroform, acetone, methanol, ethanol. They are not soluble in water;
- × Glycosides are readily soluble in water, alcohols and not soluble in chloroform;
- × fluoresce yellow and yellow-green in UV-light.

Action

- × Antiviral,
- × Antifungal,
- × Antiinflammatory
- × Antibacterial
- × Tonic CNS,
- × Cardiotonic,
- × Diuretic.

Imperforate St John's-wort herb - *Herba Hyperici maculati*

Imperforate St John's-wort- *Hypericum maculatum*
Fam. - *Clusiaceae* (*Hypericaceae*)

Act. Const.

- Xanthones;
- Flavonoids: quercitrin, rutin, quercetin,
- condensed anthroquinones : hypericin,
- Tannins,
- Essential oil



Uses

Infuse - bactericidal action

Bloodwort herb- *Herba Centaurii*

Bloodwort(common centaury) - *Centaurium erythraea* (*C. umbellatum*, *C. minus*)

Fam. - *Gentianaceae*

Occurs scattered to widespread in Europe, North America, North Africa and western Asia.

The drug consist of the aerial parts of the flowering plant with quadrangular and hollow stem fragments of mostly yellowish color and up to 8mm long, reddish flowers with tubular calyx. The corolla is fused to a whitish tube divided into 5 elongated, pink lobes. The pieces of the opposite and small entire margined and glabrous leaves are less conspicuous. Odor is faint and characteristic; taste is strongly bitter.





Act. Const.

Small amounts of the intensively bitter secoiridoid glycosides (swertiamarin , gentopicroside, ets)

Flavonoids – 0,4%;

Highly methoxilated xanthone derivatives;

Phenolic carboxylic acids;

Triterpenes ;

Phytosteroles.

Uses

Exclusively as bitter remedy for stimulated the appetite, for increasing the secretion of gastric juice, especially in chronic dyspeptic states.

In folk medicine it is also used as a roborant and tonic.

Urological combination product – **“Canephron”**

Hedysarum (Sweetvetch) herb- *Herba Hedysari*
Hedysarum (Sweetvetch) - *Hedysarum alpinum*
Fam. - *Fabaceae*

It is native in Russia.

Act. Const.

■ Xanthone: mangiferin

Isomangiferin

glucomangiferin

Glucoisomangiferin

- Flavonoids
- Coumarines,
- Tannins



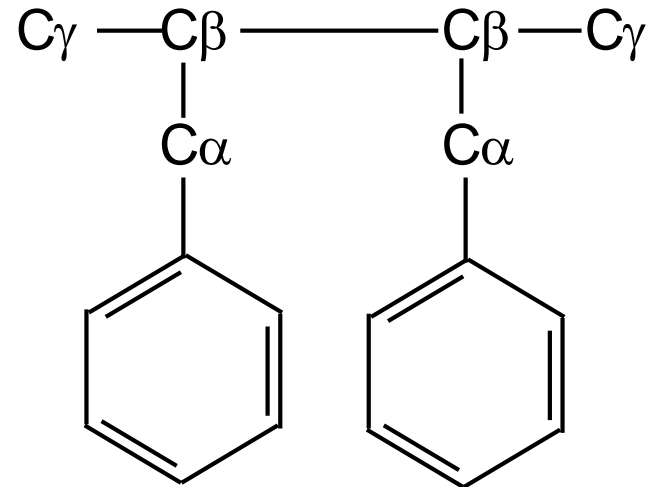
Uses

«Alpizarin» - Antiviral, general health-improving₄₄

The lignans are a group of phenolic compounds found in plants, phenylpropanoids $(C_6-C_3)_2$, which fragments are connected by C—C-linkage between C_β of side chains.

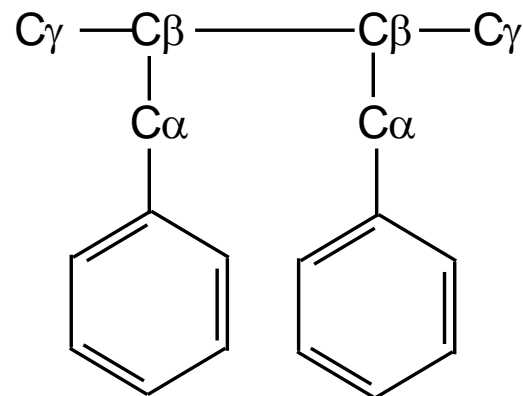
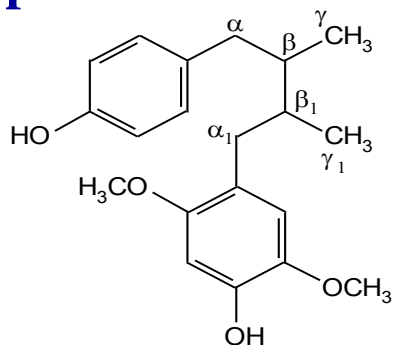
Classification

1. True lignans
2. Neolignans
3. Lignoids

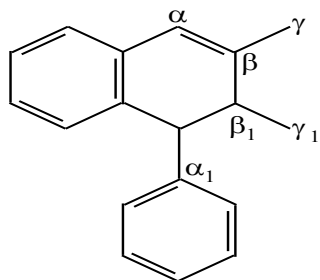


1. *True lignans* contain (C₆-C₃)-fragments connected together as «end to end».

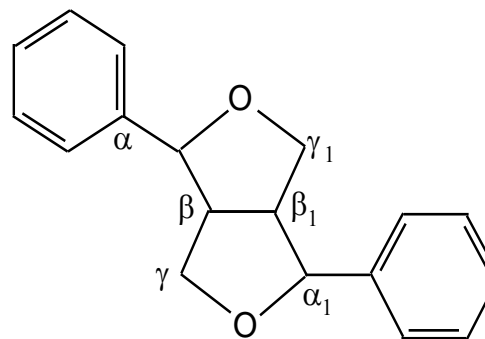
1. Diarylbutane type



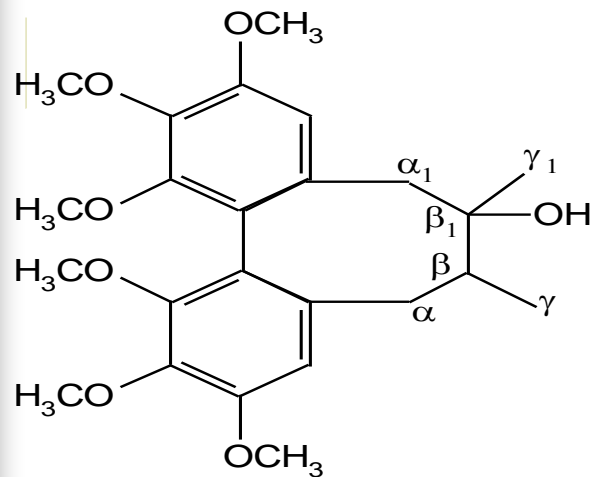
2. Dihydro naphthalene type



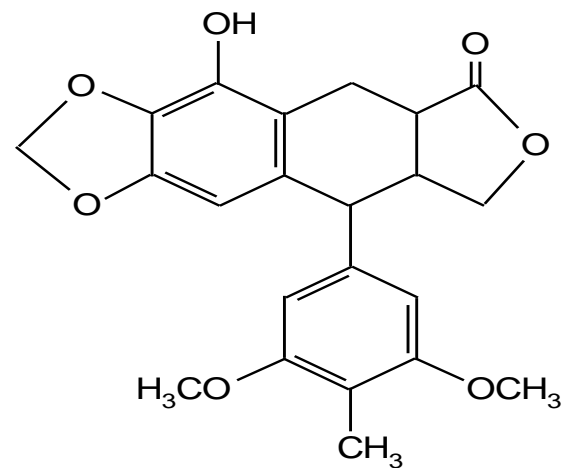
3. Dioxadicyclo octane type



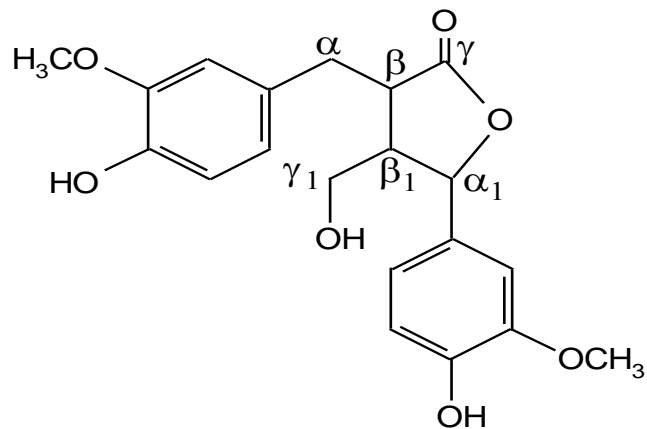
4. Diaryl octane type



5. Tetrahydro naphthalene type

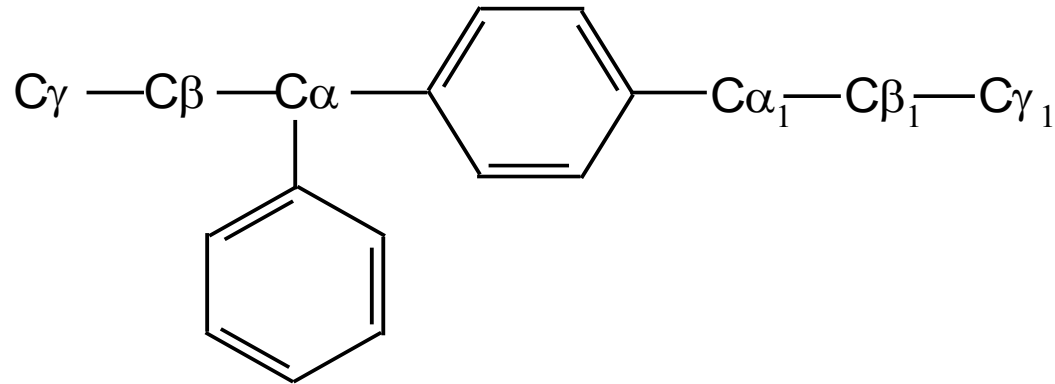


6. Diaryltetrahydro furane type

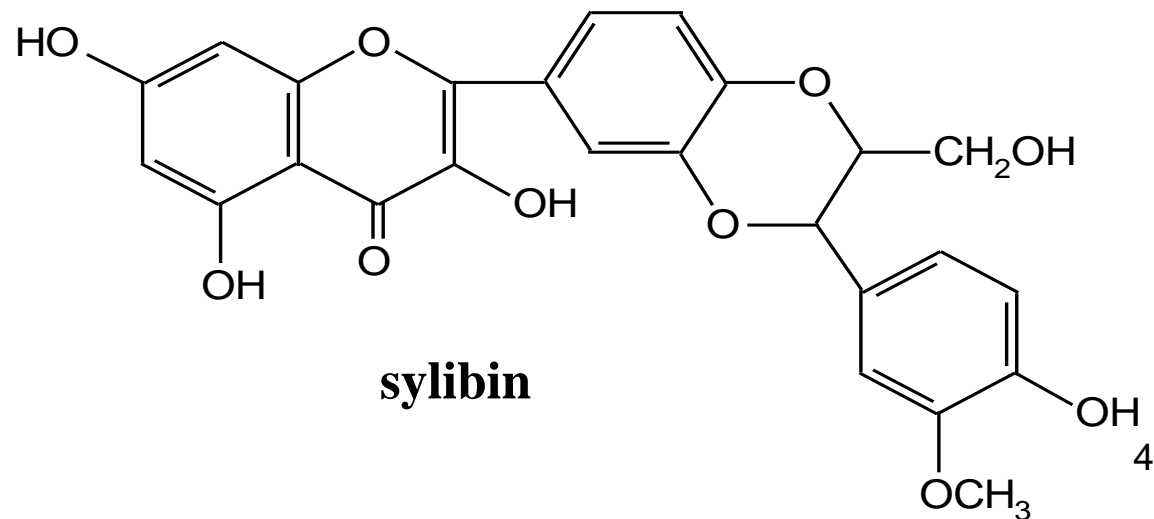


2. *Neolignans* contain (C₆-C₃)-fragments connected together as «head to end».

neolignan



3. *Lignoids* - contain (C₆-C₃)-fragments connected to different phenolic compounds (flavolignans, xantholignans, coumarinolignans).

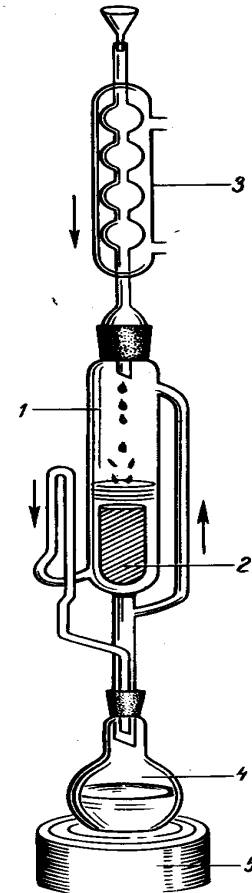


Physical and chemical properties of lignans

- × Colorless crystals;
- × They are soluble in chloroform, benzene, ether, methanol, ethanol; They are not soluble in water;
- × Give blue and yellow fluorescence in UV-light.

Action

- × Tonic,
- × Adaptogenic,
- × Antineoplastic,
- × Antihemorrhagic,
- × Antimicrobial,
- × Hepatoprotective.



Eleuthero root – *Rhizomata et radices Eleuterococci*
Eleuthero - *Eleutherococcus senticosus*
Fam. - *Araliaceae*

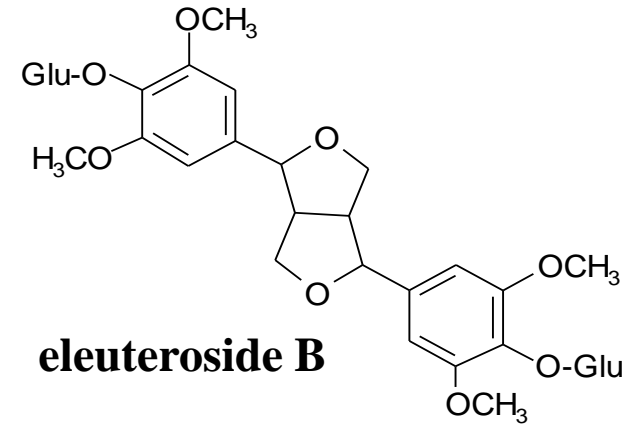
Native to northeastern Asia, occurring primarily in eastern Siberia.

The rhizomes are 1,5-4 cm wide, and of irregular cylindrical shape. The surface is rough, longitudinally wrinkled and grayish brown. The bark, about 2 mm thick, closely adheres to the xylem. The fracture is coarsely fibrous, particularly in the internal part of the xylem, with short, thin fibers in the bark. The hardwood is light brown and the sapwood is pale yellow. The lower surface bears numerous, adventitious roots which are 3,5-15 mm in diameter. The root surface grayish brown is rather smooth and the fracture is slightly fibrous and light yellow. Odor is characteristic and slightly acrid; Taste is bitter and astringent.



Act.const.

- Lignans: sesamin, syringaresinol, eleuteraside B, etc.
- Phenylpropanoids: coniferin, caffeic acid, chlorogenic acid,
- Triterpene saponins 0,125%;
- Sterols: sitosterol;
- Coumarins;
- Polysaccharides;



Uses

As a tonic for invigoration and strengthening in cases of fatigue or declining capacity for work and concentration, as well as during convalescence.

Extract.

Magnolia-vine fruit- *Fructus Schizandrae*

Magnolia-vine seed- *Semina Schizandrae*

Magnolia-vine- *Schizandra chinensis*

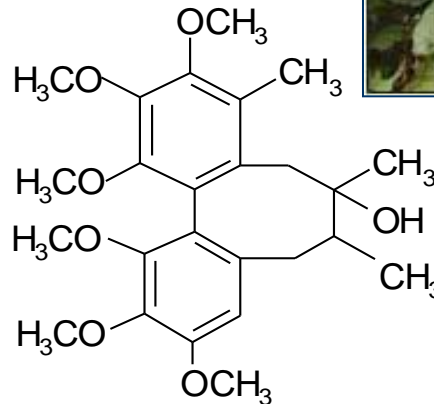
Fam. - *Schizandraceae*

Act. Const.

- Lignans: schizandrin,
- Organic acids: citric, malic,
- flavonoids,
- antraquinones,
- saponins,
- vitamins: C (up to 500 mg%),
- Essential oil (2%),
- Fixed oil (33%)



schizandrin



Uses

Tincture (from seeds), **infusion** (from fruits) - tonic, adaptogenic.

May apple rhizome with roots –
Rhizomata cum radicibus Podophylli
May apple - *Podophyllum peltatum*
Fam. - *Berberidaceae*

The pieces of rhizome are about 5 to 20 cm long and are usually unbranched occasionally pieces show branching and then often have the form of a Y. The rhizome is sub-cylindrical with enlargements. The surface is large reddish – brown and smooth except at the enlargements which have on the upper surface a circular concave stem-scar. The fracture is short and starchy, yellowish. Odor is slight characteristic; Taste is bitter and acrid.

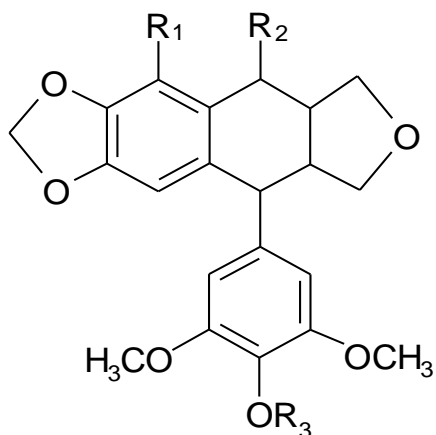


Podophylli rhizoma
©Peter Brinkmann,
Simon Forster & Thomas Schoepke



Act. Const.

- Podophyllum resin – 2-8%
- lignans: podophyllotoxin, α -peltatin, β -peltatin,
- Starch,



$R_1 = H, R_2 = OH, R_3 = CH_3$ -

podophyllotoxin

$R_1 = OH, R_2 = R_3 = H$ - α -peltatin,

$R_1 = OH, R_2 = H, R_3 = CH_3$ - β -peltatin

Uses

“Podophyllin”, “Podophyllotoxin” – antineoplastic;
purgative, cholagogue

Milk thistle seeds - *Semina Silybi*

Milk thistle - *Silybum marianum*

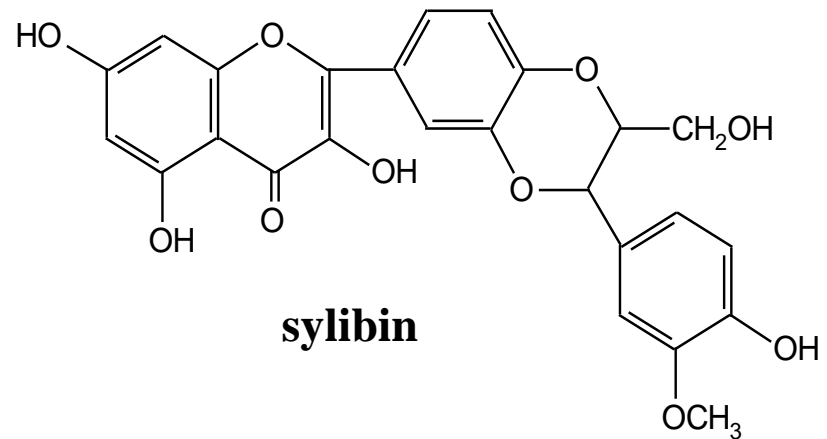
Fam – *Asteraceae*

The drug consist of the obliquely obovate fruits (cypsela) which are 6-7mm long, up to 3mm wide and 1.5mm thick. The testa is shiny brownish black or matte grayish brown with dark or grayish white dots. At the upper end is a yellowish, cartilaginous protuberance and at the lower end, to the side a canaliculate hilum. The silvery pappus is absent from the drug. Odor is hardly perceptible; Taste is oily and bitter.



Act. Const.

- flavolignans: calculated on sylibin - 2%
- Flavonoids: taxifolin,
- Fatty oil – 20- 30 %,
- Protein - 25-30%,
- Sterols - 0,63%,
- Mucilage



Uses

For the prophylaxis and treatment of toxic metabolic liver damage (from alcohol or industrial poisons), liver dysfunction, and after hepatitis, in chronic diseases such as cirrosis.

«**Sylibor**», «**Legalon**», «**Liv-52**», «**Carsyl**», «**Hepabene**»



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