

Pharmacognosy

lab exercise 5



**Roots, rhizomes and leaves of
dicotyledonous plants**

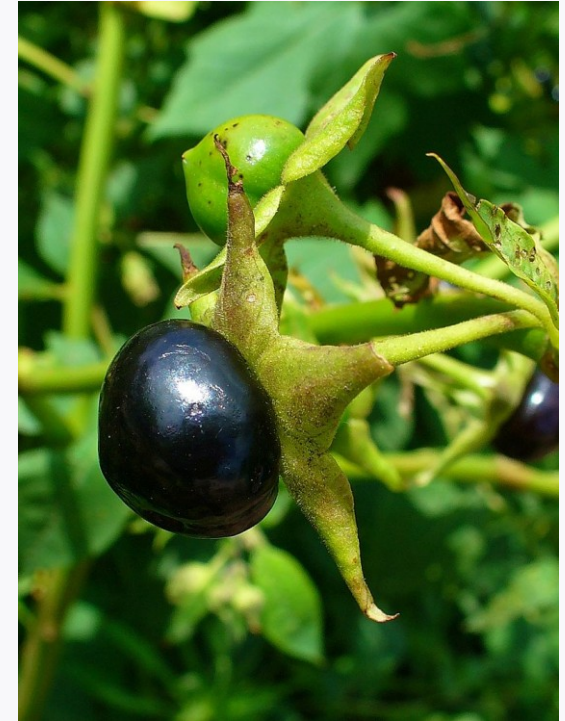


Belladonnae radix

- Mother plant: *Atropa belladonna*, Solanaceae
(deadly nightshade)



https://commons.wikimedia.org/wiki/File:Atropa_belladonna_001.JPG

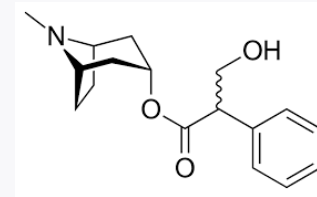


https://commons.wikimedia.org/wiki/File:Atropa_belladonna_004.JPG

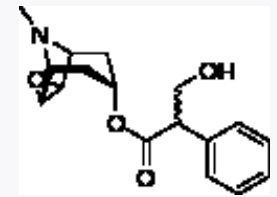
Belladonnae radix



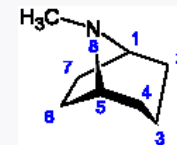
- **Macroscopy:** roots of different size, bright grey, longitudinally banded, wide wood and narrow cortex, on the section whitish, on the section raising dust (presence of starch), without odour, taste firstly sweet, then bitter
- **Content compounds:** 0.45-0.85 % **tropane alkaloids:** atropine, scopolamine, apoatropine, belladonine, cuscohygrine, starch
- Atropin is a racemic mixture of (+)- and (-) - **hyoscyamine** (the latter is the main alkaloid)
- **Usage:** isolation of alkaloids, parasympatolytic



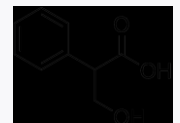
atropine



scopolamine

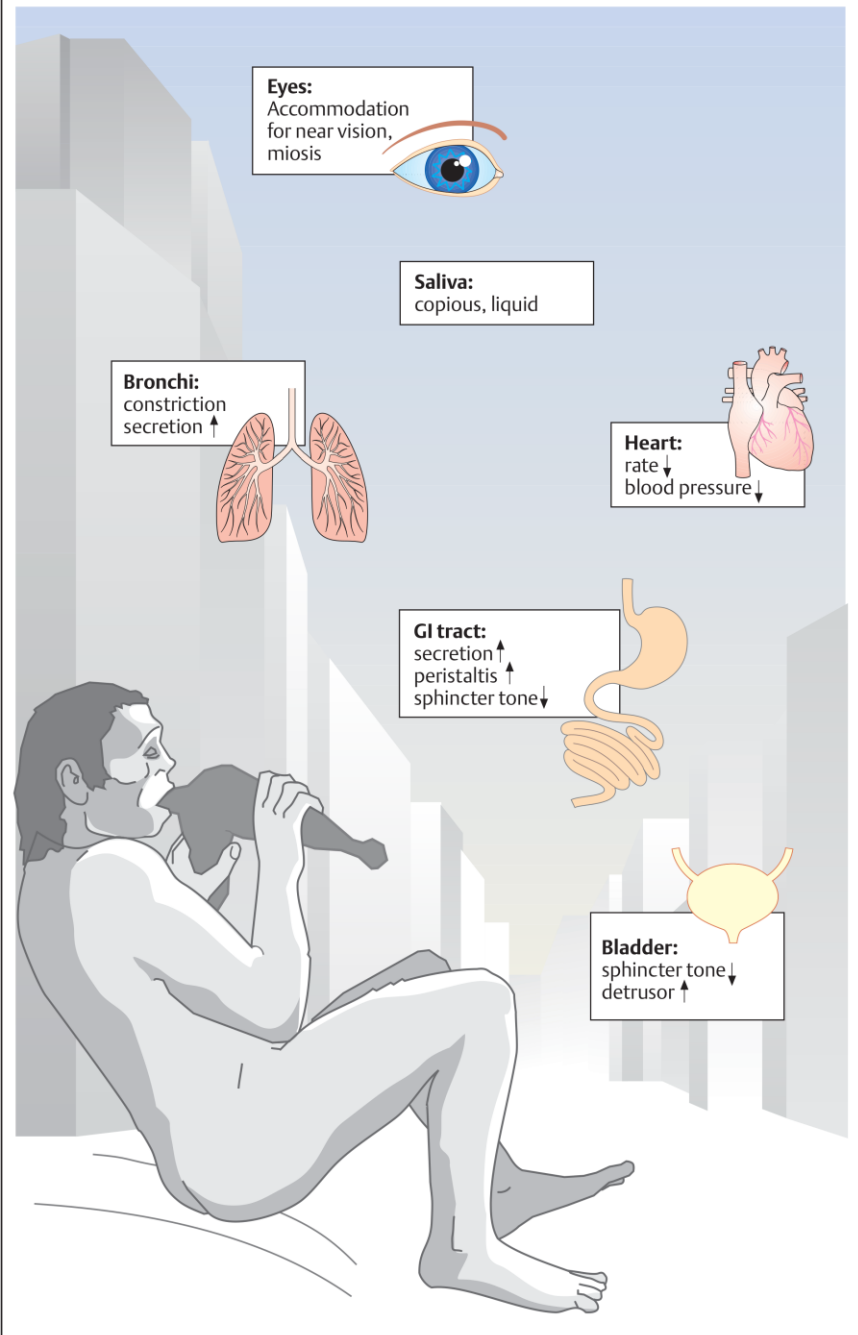


tropane

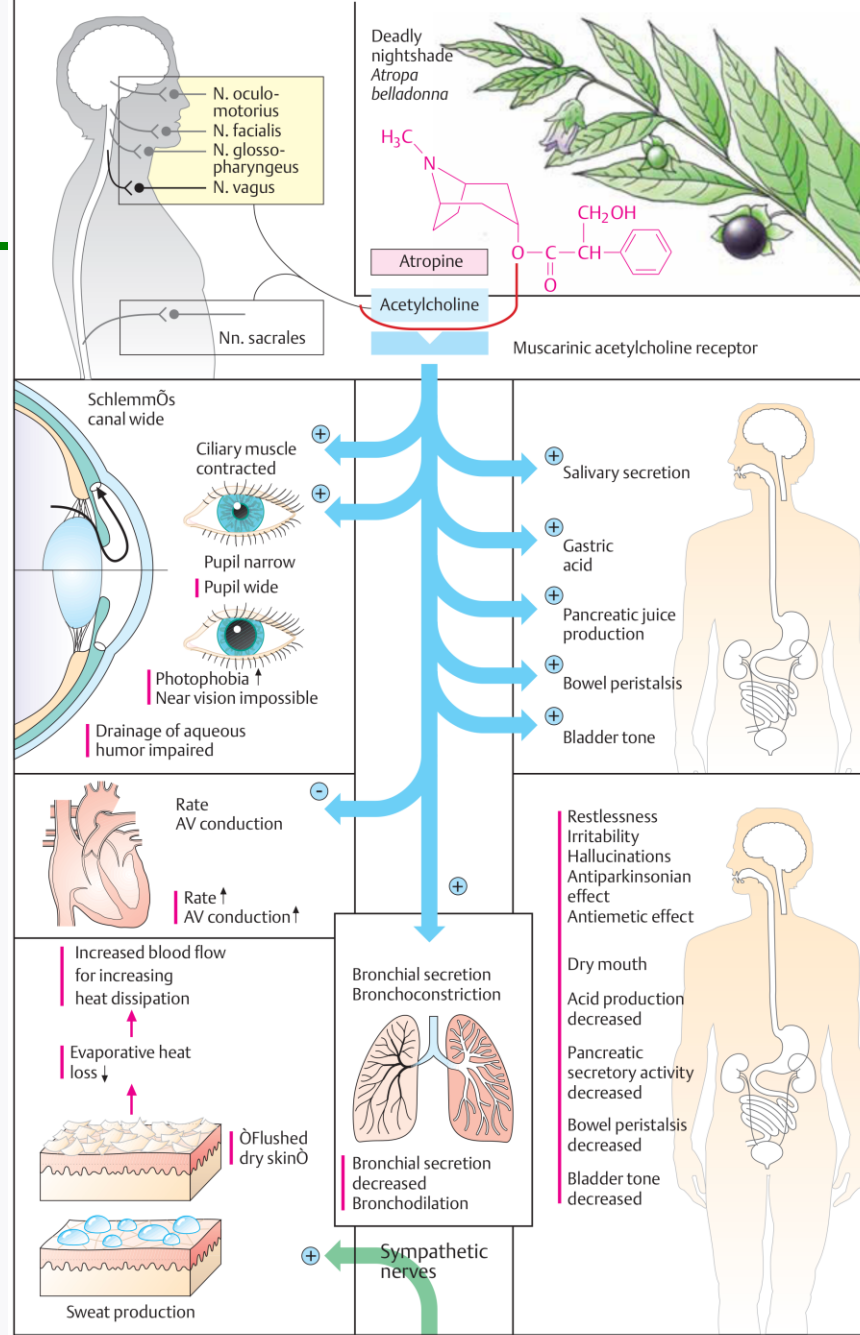


tropic acid

A. Responses to parasympathetic activation



A. Effects of parasympathetic stimulation and blockade



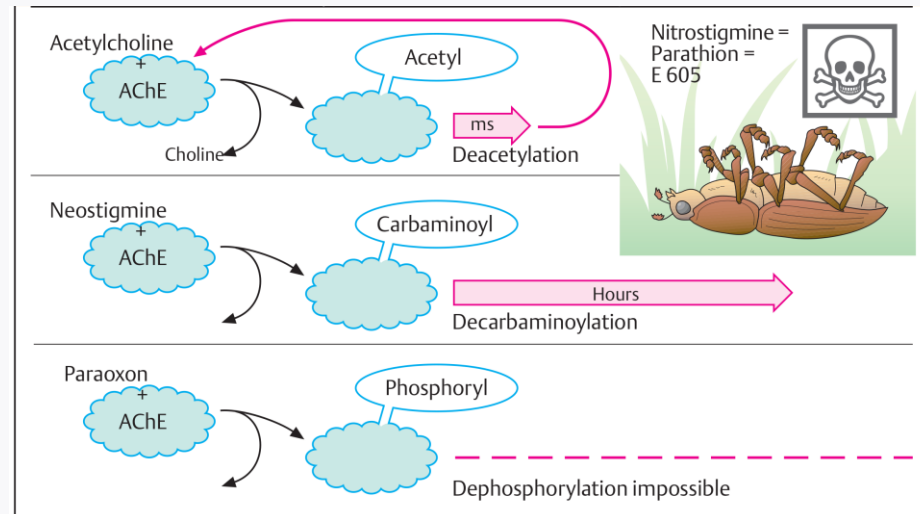
Belladonnae radix



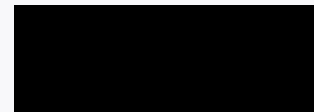
- **Atropine intoxication:** mydriasis, mouth dryness, hallucinations, terminal state- delirium and coma, death due to paralysis of vital centres

Atropine – mydriatic, antiemetic, antiparkinsonic, premedication to general anesthesia, antidotum for intoxication with parasympatomimetics (organophosphates – insecticides, chemical weapons)

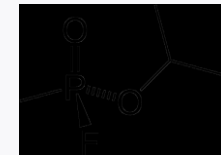
Scopolamine – sedates the CNS, spasmolytic



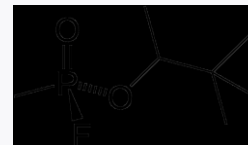
Luellmann, Color Atlas of Pharmacology © 2005 Thieme



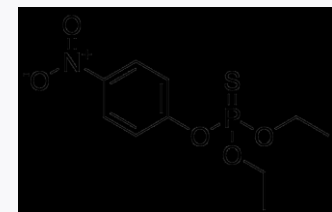
acetylcholine



sarine



soman

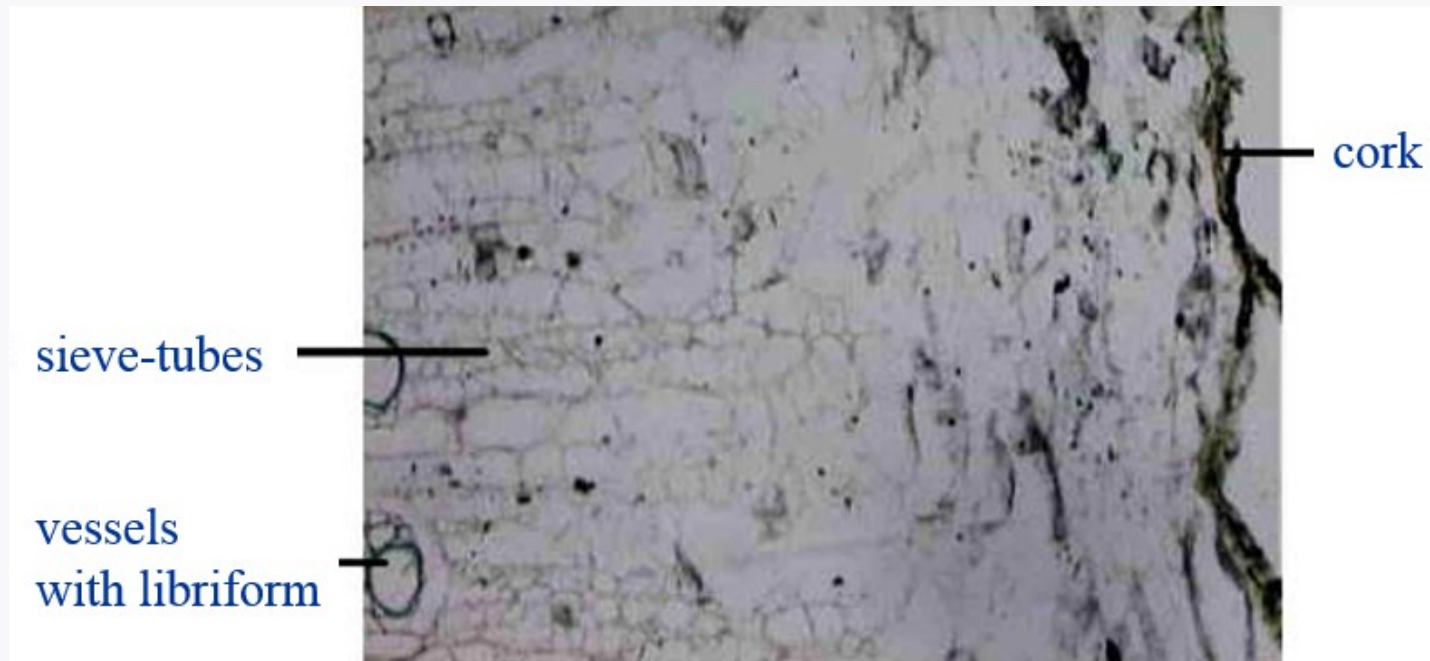


parathion



Belladonnae radix

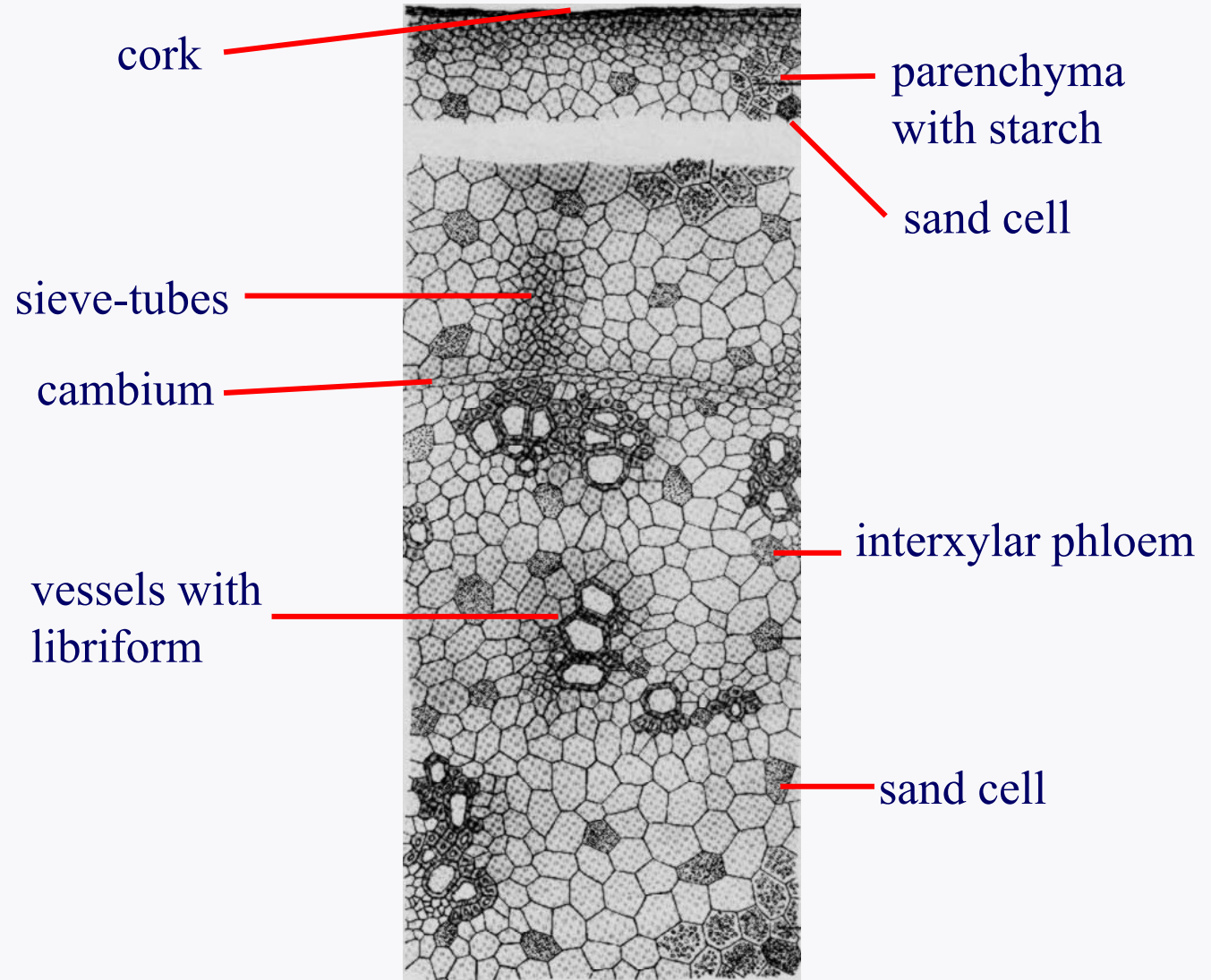
- **Microscopy:** cork with tangentially prolonged cells, secondary cortex with parenchyma, starch and sand cells (calcium oxalate), visible cambium, upon cambium sieve-tubes, under cambium vessels with libriform, sand cells and parenchyma with starch, **typical sign** – in wood disseminated sieve-tubes: interxylar phloem, bicollateral vascular bundles





Belladonnae radix

■ Microscopy:





Gentiana radix CzPh 2017

- Mother plant: *Gentiana lutea*, **Gentianaceae** (great yellow gentian)

Gentianae tinctura CzPh 2017



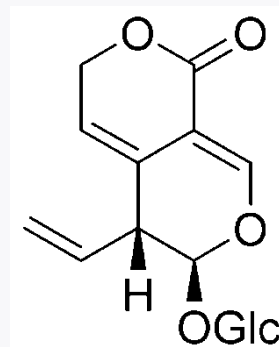
https://cs.wikipedia.org/wiki/Soubor:Gentiana_lutea_DSCF1579.JPG



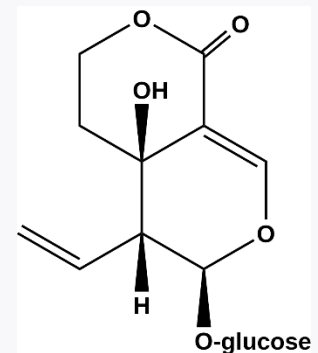
Gentiana radix CzPh 2017



- Macroscopy: cylindrical root, poorly branched, on the surface brown-grey, on the section yellow-brown-red-yellow, longitudinally wrinkled, scarification after side-roots, weak odour (dried figs), taste firstly sweetish than bitter
- Content compounds: **bitter substances** (gentiopicrin, amarogentin, swertiamarin), yellow pigment gentisin, no starch
- Usage: amare-stomachic



gentiopicrin

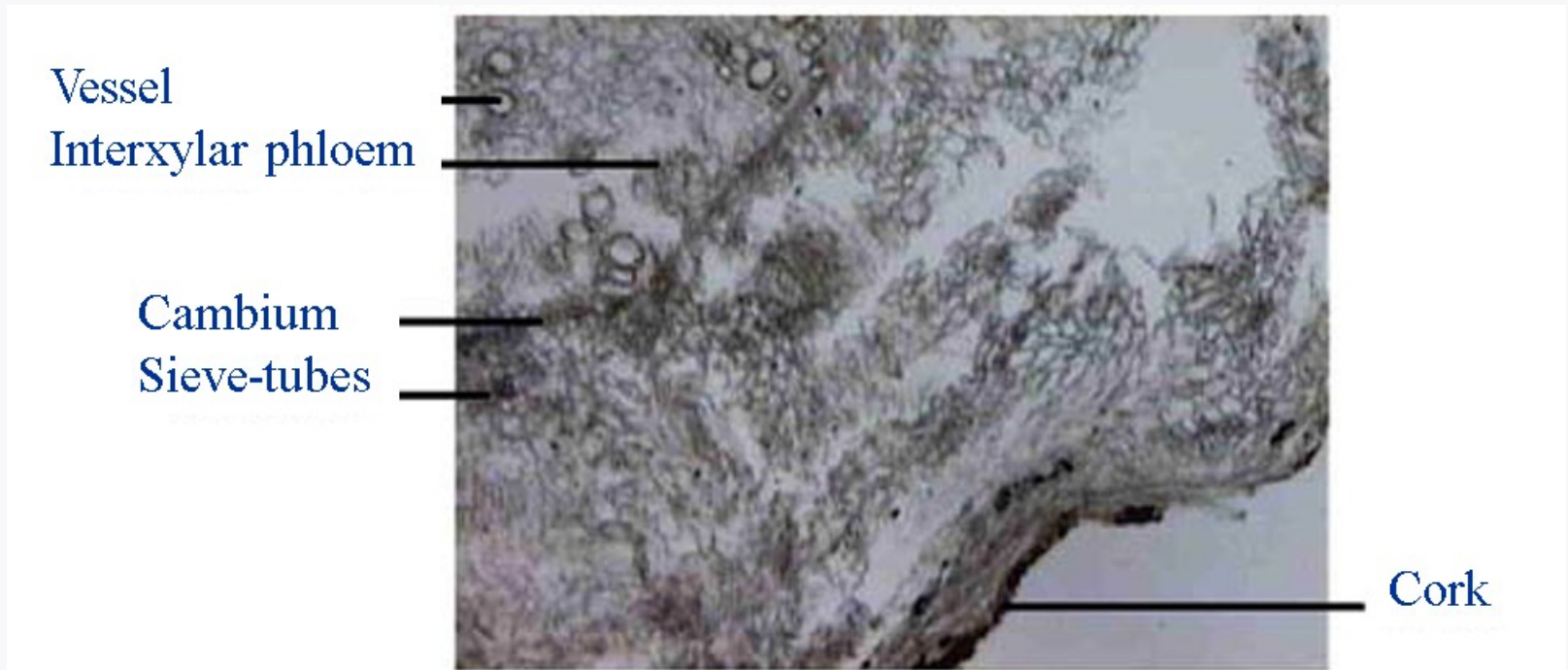


swertiamarin



Gentiana radix CzPh 2017

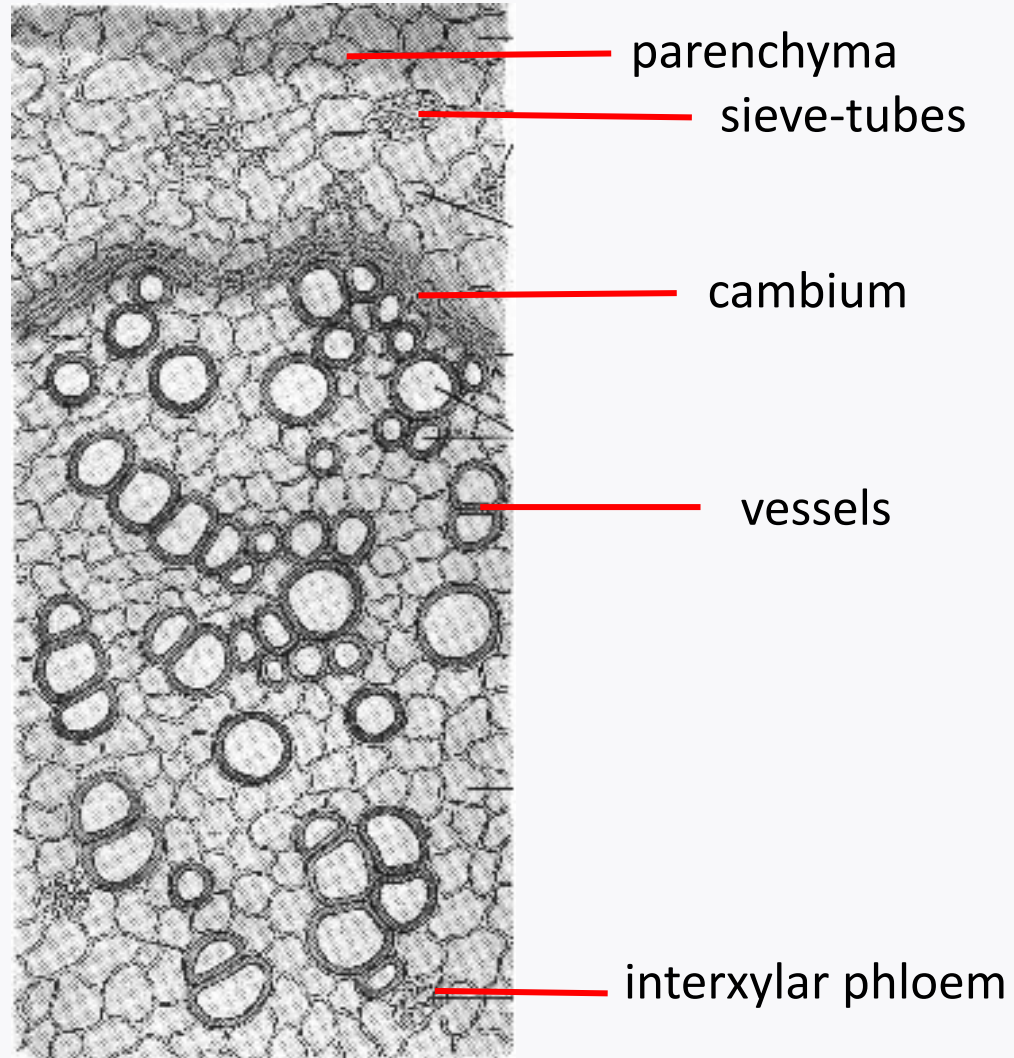
- **Microscopy:** 4-6 lines of thin-wall cork, thin-wall bark parenchyma, bicollateral vascular bundles, phloem fibers missing, vessels separated and isolated or creating groups, no sclerenchyma (libriform), no starch (or only low amount), possible microcrystalline calcium oxalate. No well differentiated parenchyma rays.





Gentiana radix CzPh 2017

■ Microscopy:



Ratanhiae radix CzPh 2017



- Mother plant: *Krameria triandra*, Krameriaceae (Rhatany)

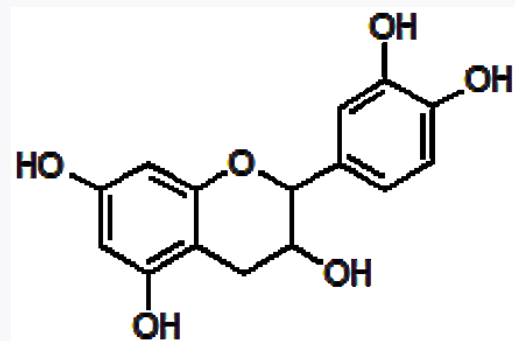
Ratanhiae tinctura CzPh 2017



Ratanhiae radix CzPh 2017



- Macroscopy: long non-branched roots, very hard, red-brown colour, bark of old roots is squamously ruptured, bark of young roots smooth with sharp transversal rifts, easily separated from wood, fracture in bark shortly wavy, in wood fragmentized, drug without odour, astringent taste
- Content compounds: catechine tannins, starch, sugars
- Usage: astringent, antidiarrhoic



Katechin (3-flavanol)



Ratanhiae radix CzPh 2017

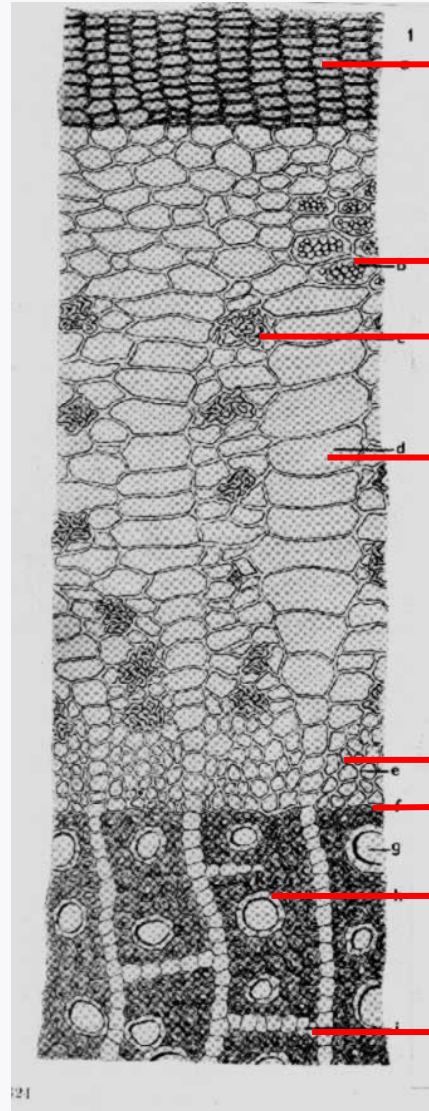
- **Microscopy:** characteristic wide cork with cells close to each other, simple parenchyma rays, in cortex part seen funnel-shaped broadening, in secondary cortex aggregates of phloem fibers and starch cells, upon cambium sieve-tubes, under cambium vessels with libriform, connecting strips of wood parenchyma (for intake of water and nutrients in time of dry weather), **vascular bundles collateral**





Ratanhiae radix CzPh 2017

■ Microscopy:



cork

starch

phloem fibers

medullar rays

sieve-tubes

cambium

vessel with libriform

connecting strips of wood
parenchyma



Levistici radix CzPh 2017

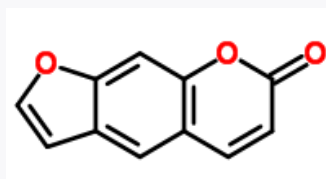
- Mother plant: *Levisticum officinale*, Apiaceae (lovage)



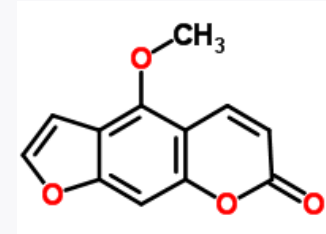
Levistici radix CzPh 2017



- Macroscopy: stronger roots, bright grey-brown to yellow-brown colour, section usually smooth with visible wide yellow-white bark and narrow bright yellow wood, spicy odour, sharp spicy taste
- Content compounds: **essential oil**, furanocoumarines, organic acids
- Usage: diuretic, carminative, stomachic



psoralen

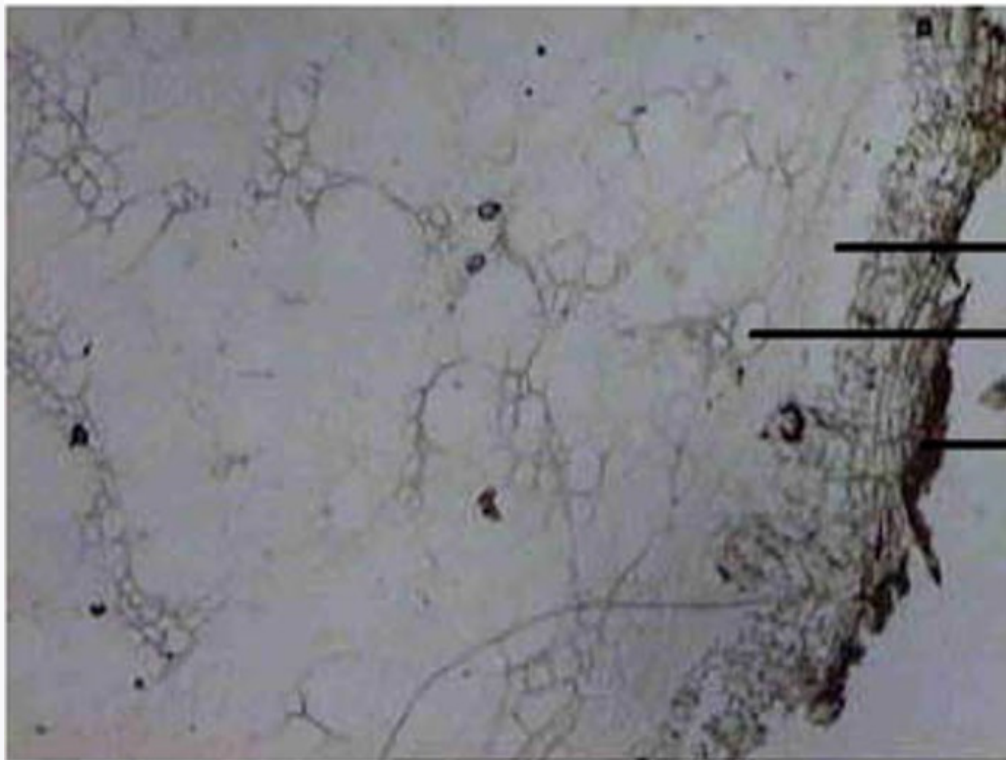


bergapten



Levistici radix CzPh 2017

- **Microscopy:** transversal section: cork – several layers, under air bubbles (elasticity of root), primary cortex – tangential cells, secondary cortex – channels with volatiles, medullar rays, sieve-tubes, cambium, vessels, parenchyma



Air bubble

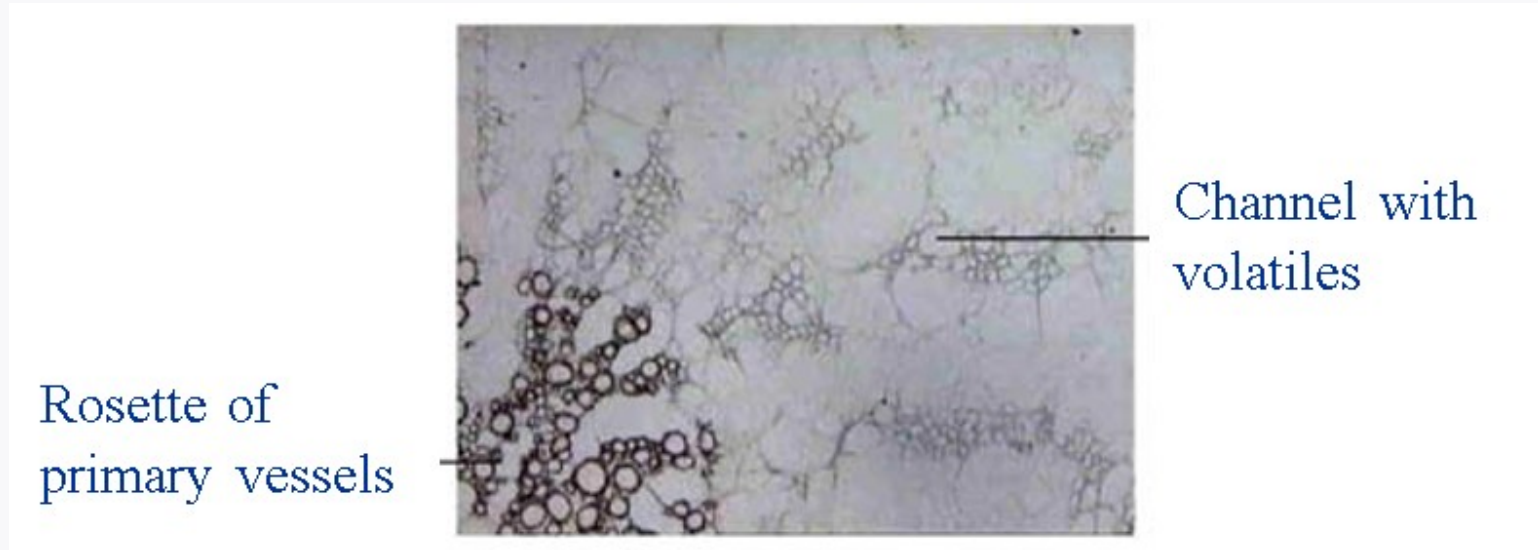
Channel with
essential oil

Cork



Levistici radix CzPh 2017

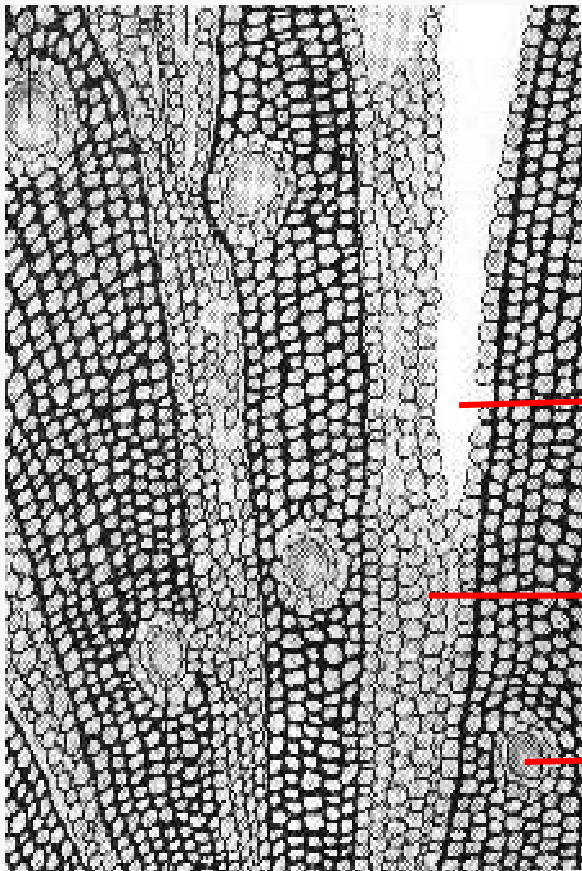
- Microscopy:





Levistici radix CzPh 2017

■ Microscopy:



sieve-tubes

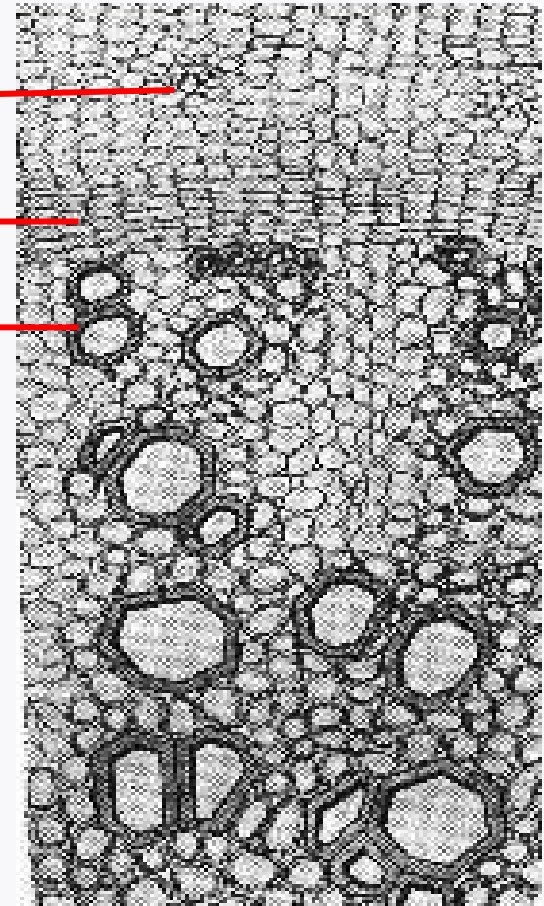
cambium

vessels

air bubble

medullar ray

channel with
volatiles



Petroselinum radix CzPh 2017



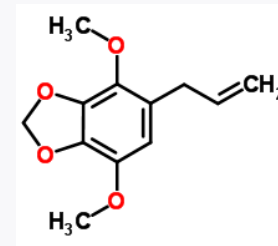
- Mother plant: *Petroselinum crispum*, **Apiaceae** (parsley)



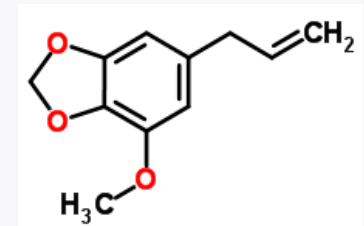
Petroselinia radix CzPh 2017



- **Macroscopy:** simple spindle-like root, externally yellow-white, longitudinally wrinkled, transversally ringed, section not clear, bark white-yellowish, wood yellow, characteristic aromatic odour, sweet taste, weakly spicy. Easily decomposed and attacked by insect
- **Content compounds:** essential oil (phenylpropanoids), flavonoids, mucilage and sugars
- **Usage:** diuretic, carminative, stomachic, antiseptic



apiol

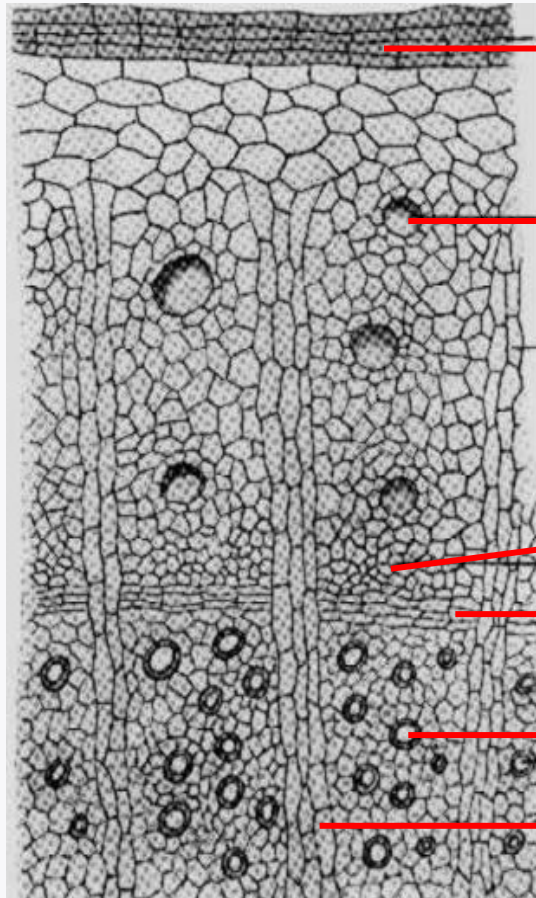


myristicin



Petroselinum radix CzPh 2017

- ◆ **Microscopy:** cork, in cortex pat channels with volatiles, medullar rays, sieve-tubes, cambium, vessels, wood parenchyma



cork

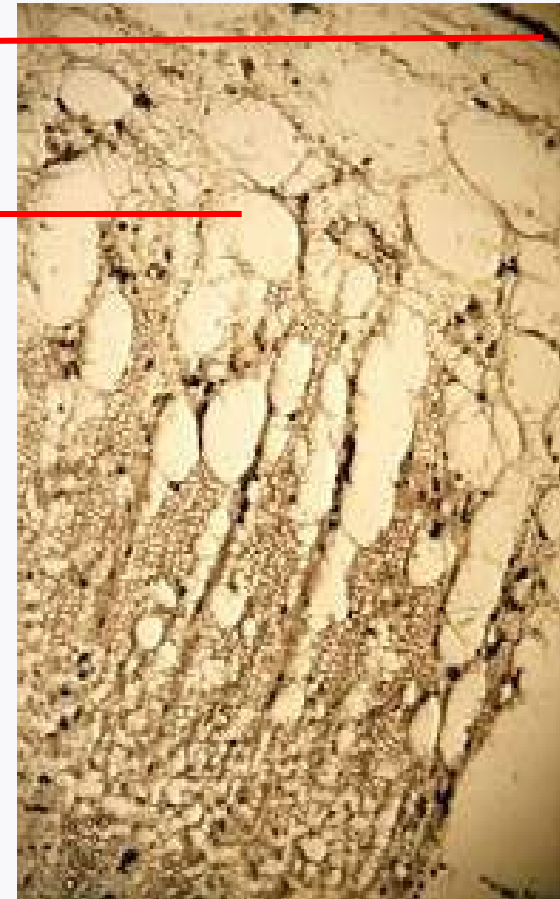
channel

sieve-tubes

cambium

vessels

medullar ray





Taraxaci radix cum herba CzPh 2017

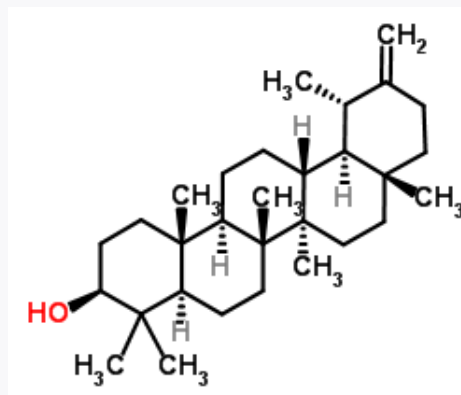
- Mother plant: *Taraxacum officinale*, Asteraceae (dandelion)





Taraxaci radix cum herba CzPh 2017

- **Macroscopy:** post-like roots, hardly wrinkled, poorly branched, on the surface grey-brown to red-brown, fragile, on the section whitish bark and dark lactifers and lemon-like yellow wood without rays, drug must not smell, bitter taste
- **Content compounds:** **bitter compounds**, mucilage, sugars, inuline, mineral compounds
- **Usage:** amare, cholagogue, diuretic, metabolic, antidiabetic (insulin secretagogue activity *in vitro*; *in vivo* decreased serum glucose concentrations)

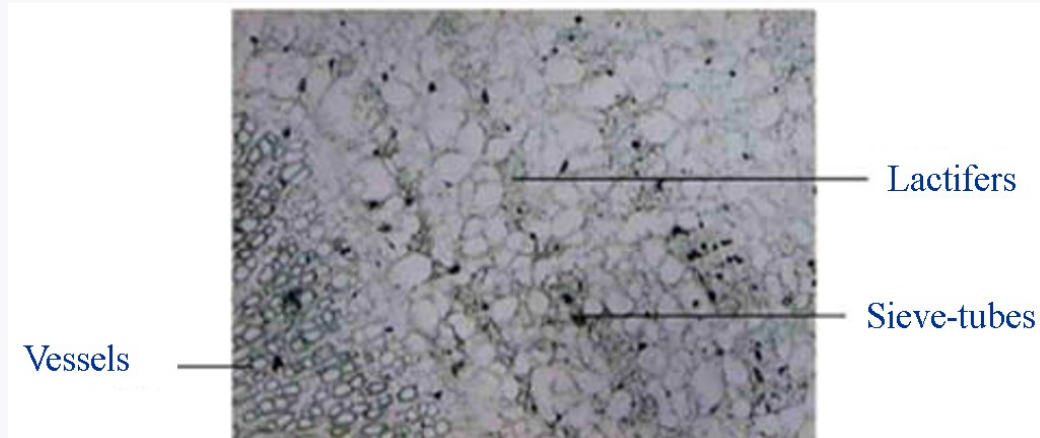


taraxasterol



Taraxaci radix cum herba CzPh 2017

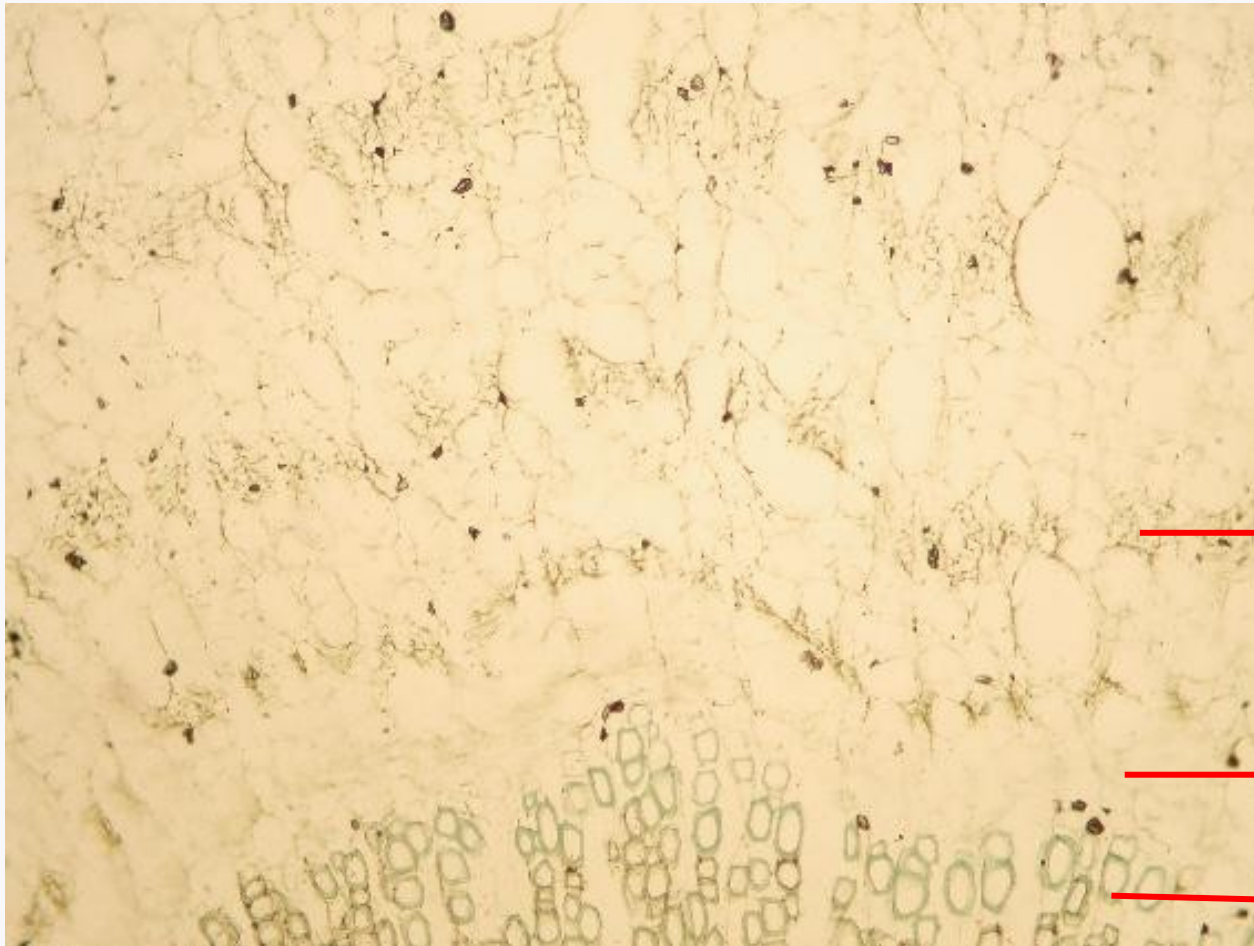
- **Microscopy:** narrow multi-layer cork, wide bark with strips of lactifers in concentric rings accompanied by sieve-tubes, cambium, vessels, medullar parenchyma, vascular bundles collateral





Taraxaci radix cum herba CzPh 2017

■ Microscopy:



Sieve-tubes and
lactifers

Cambium

Vessels



MACROSCOPY



Ginseng radix CzPh 2017

- Mother plant: *Panax ginseng*, Araliaceae (ginseng)

Ginseng extractum siccum CzPh 2017

Notoginseng radix CzPh 2017

- Mother plant: *Panax pseudoginseng*, Araliaceae



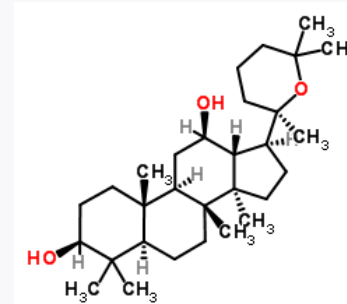
Ginseng radix CzPh 2017



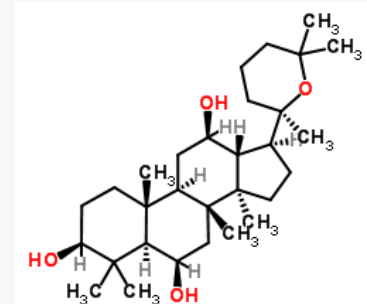
- Macroscopy: branched, spindle-like, externally bright brown-yellow to yellow-white, longitudinally wrinkled roots, in upper part ring-like strangled, hard and fragile, on the section grainy, yellow-white, flour-like dusted with brown-yellow cambial ring, specific odour, firstly sweet taste, later very bitter
- Content compounds: **saponine glycosides** - **ginsenosides**, starch, sugars, vitamins B
- Usage: adaptogene, tonic, geriatric



©Kazuo Yamasaki



panaxadiol



panaxatriol



Rhaponticae radix CzPh 2017

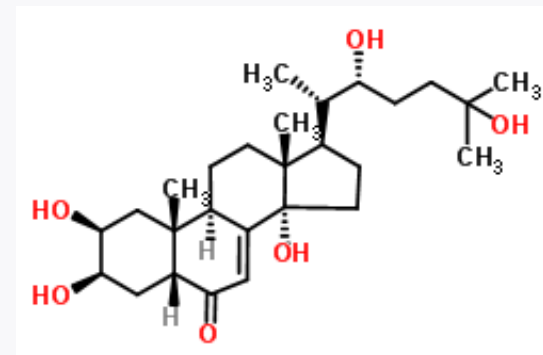
- Mother plant: *Leuzea carthamoides* (syn. *Rhaponticum carthamoides*), Asteraceae (Maral Root)



Rhaponticae radix CzPh 2017



- Macroscopy: large part of small roots with central rhizome, black-brown colour, on the section yellowish, characteristic weak odour, taste slightly sweetish, resinous
- Content compounds: **steroids - phytoecdyszones**
- Usage: adaptogene, tonic, psychostimulant

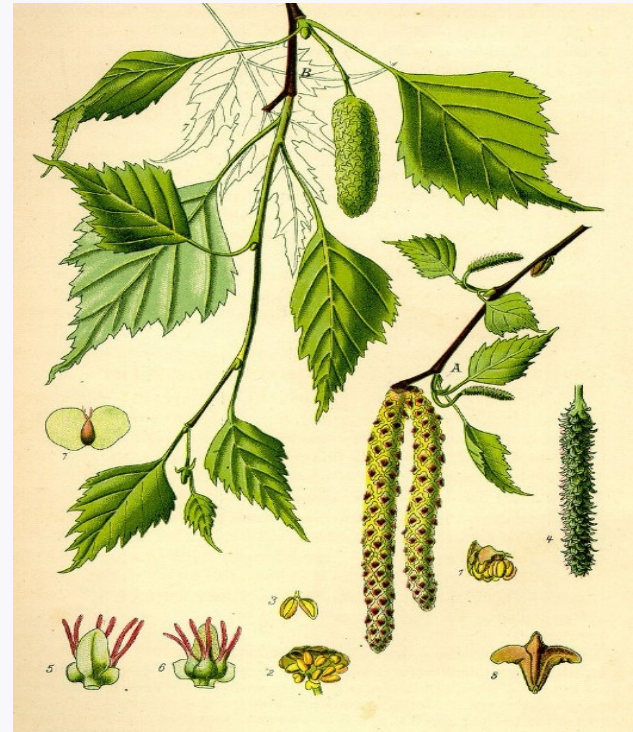


fytoecdyzone



Betulae folium CzPh 2017

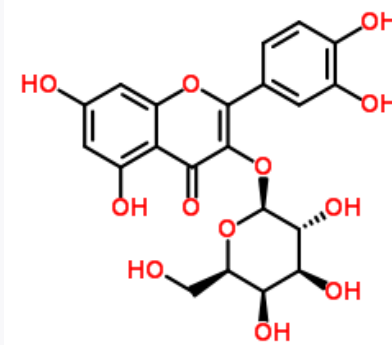
- Mother plant: *Betula pendula*, *B. pubescens*, Betulaceae (birch tree)



Betulae folium CzPh 2017



- Macroscopy: leaves lengthily stalked, 3-edged, double serrated margins, on the face dark green, on the reversed side brighter, characteristic netting veins, veins light brown to white, without odour, weak bitter taste
- Content compounds: **flavonoids** (hyperoside, quercetin), essential oil, organic acids, betulinic acid
- Usage: diuretic (saluretic)



hyperoside



Digitalis purpureae folium CzPh 2017

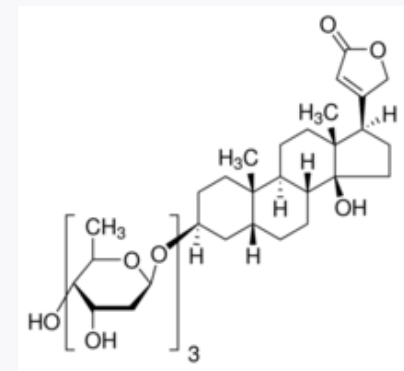
- Mother plant: *Digitalis purpurea*, Plantaginaceae (Purple foxglove)





Digitalis purpureae folium CzPh 2017

- **Macroscopy:** leaf blade from oval lanceolate to broad oval, upper side bright green, lower side gray felt-like, margin irregular notched, toothed or serrated, veins pinnated, on the lower side protruded, without odour, unpleasant bitter taste
- **Content compounds:** **cardioactive glycosides:** primary glycosides (purpureaglycosides A, B), secondary glycosides (digitoxin)
- **Usage:** cardiotonic, isolation of glycosides



digitoxin



Digitalis lanatae folium CzPh 2017

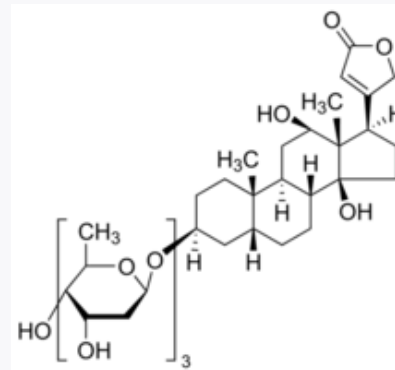
- Mother plant: *Digitalis lanata*, Plantaginaceae (Grecian foxglove)





Digitalis lanatae folium CzPh 2017

- Macroscopy: leaves sharpened, local hairy, without odour, bitter taste
- Content compounds:
cardioactive glycosides:
lanatosides A, B, C, E; digitoxin, digoxin
- Usage: cardiotonic, isolation of glycosides

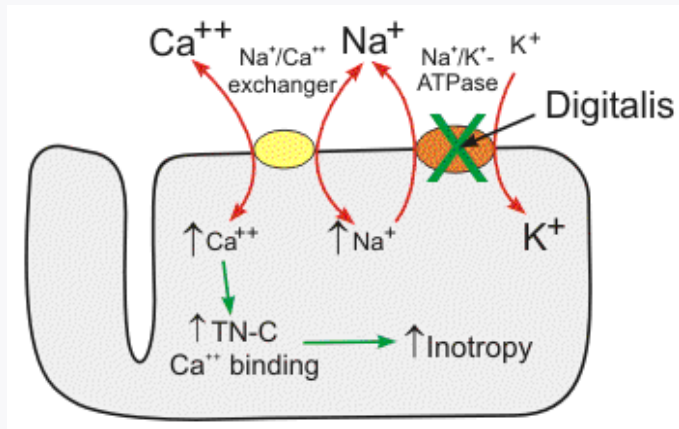


digoxin

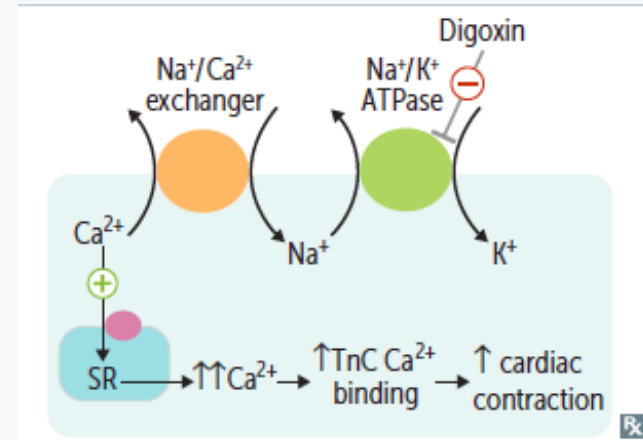




Cardioactives – mechanism of action and toxicity

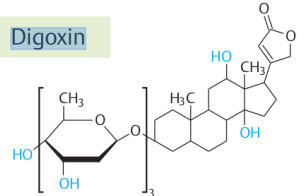
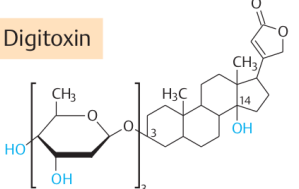


<https://www.cvpharmacology.com/cardiostimulatory/digitalis>



<https://www.memorangapp.com/flashcards/229226/8%2F30+Inotropes/>

A. Cardiac glycosides

	Enteral absorption	Elimination	
Digoxin 	~80%	t _{1/2} : 2–3 days prolonged with decreased renal function	→ better control
Digitoxin 	100%	t _{1/2} : 5–7 days independent of renal function	→ Slow waning of intoxication

Intoxication signs:

Cardiac arrhythmia
Altered color vision (red-yellow)

Toxicity is increased by:

Low K⁺ = hypokaliemia (!diuretics!)
High Ca²⁺ = hypercalcemia

Interactions with many medicines



Farfarae folium CzPh 2017

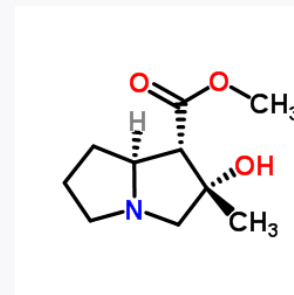
- Mother plant: *Tussilago farfara*, Asteraceae (Coltsfoot)



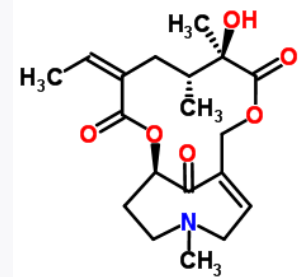
Farfarae folium CzPh 2017



- Macroscopy: leaves palm-like, lobular, toothed, upper side yellow-green, lower side white felt-like, trichomes aggregated, without odour, weak bitter mucilage taste
- Content compounds: mucilage, inulin, tannins, pyrrolizidine alkaloids (tusilagin, senkirkin)
- Usage: mucilaginoso, expectorant, antitussic



tusilagin



senkirkin



Fragariae folium

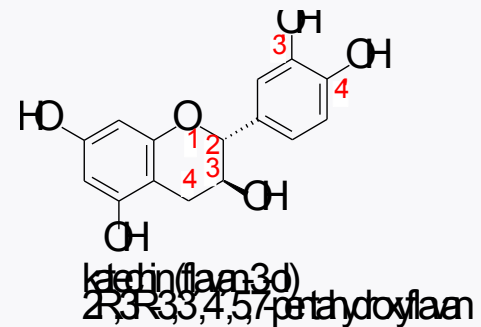
- Mother plant: *Fragaria vesca*, Rosaceae (Wild strawberry)





Fragariae folium

- Macroscopy: lengthily leafstalked trifoliate leaves, sharply serrated, its teeth are visible pinkish hydathodes, upper side light green, lower side silverish hairy, without odour bitterish mucilaginous taste
- Content compounds: **condensed tannins**, flavonoids, volatiles, organic acids
- Usage: astringent, diuretic





Rubi fruticosi folium

- Mother plant: *Rubus fruticosus*, Rosaceae (blackberry)



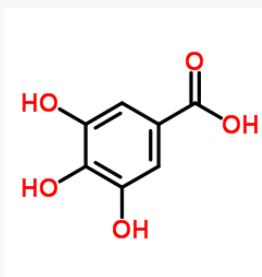


Rubi fruticosi folium

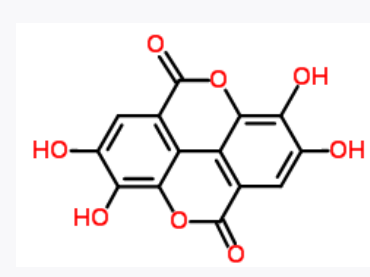
- Macroscopy: 3-5 foliate oval leaves with sharply serrated margin, upper side dark green, lower brighter, poorly hairy, leafstalk and vein with back curved thorns, without odour, astringent taste



- Content compounds: **hydrolysable tannins**, flavonoids, organic acids



gallic acid



ellagic acid

- Usage: astringent, antidiarrhoic



Rubi idaei folium

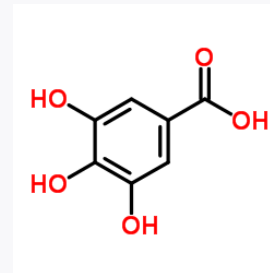
- Mother plant: *Rubus idaeus*, Rosaceae (raspberry)



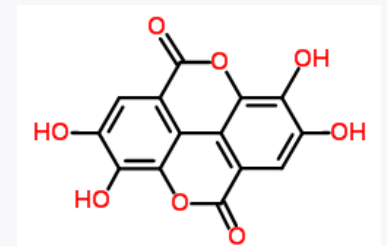


Rubi idaei folium

- **Macroscopy:** 3-5 foliate leaves oval shaped, shortly sharpened with serrated margins, upper side dark green, lower side densely felt-like hairy, protruded viens, leafstalk and main vein with smooth thorns, without odour, mild astringent taste
- **Content compounds:** tannins, organic acids, mineral compounds, flavonoids
- **Usage:** mild astringent, spasmolytic, cholagogue, diuretic



gallic acid



ellagic acid



Hamamelidis folium CzPh 2017

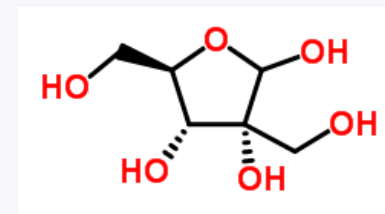
- Mother plant: *Hamamelis virginiana*, Hamamelidaceae (Witch Hazel)





Hamamelidis folium CzPh 2017

- Macroscopy: leatherlike soft leaf with short stalk, leaf blade broad oval, at the base oblique, asymmetric, at the end sharpened, brownish-green, blade margin serrated or toothed, veins pinnated, protruding on the lower side, with trichomes, without odour, astringent taste
- Content compounds: **elagic tannins** - **hamamelitanins**, flavonoids, saponins, essential oil
- Usage: astringent, antidiarrhoic, haemostyptic



hamamelose



Malvae folium CzPh 2017

- Mother plant: *Malva mauritiana*, *Malva neglecta*, *Malva sylvestris*, *Malvaceae* (High mallow, Marshmallow)





Malvae folium CzPh 2017

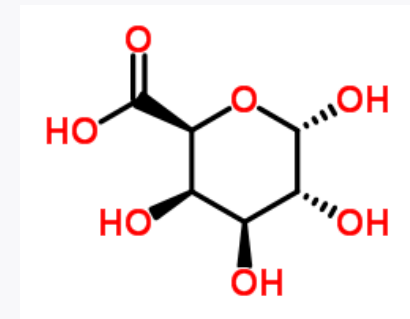
- Macroscopy: without odour, mucilaginous taste
 - *M. mauritiana* – big oval leaves, rounded, blade 5 sectioned, blunt lobes, toothed
 - *M. neglecta* - 5-7-lobular leaves, from reniform to rounded, blunt lobes, notched toothed, upper side bald, lower hairy.
 - *M. sylvestris* – rounded leaves, blade palm-like 3-7 lobular, lobes from triangular to elongated, notched, width bigger than length





Malvae folium CzPh 2017

- Content compounds: **membrane mucilage**, tannins, essential oil, phytosterols
- Usage: mucilaginous, emollient, antiphlogistic, mild astringent



galacturonic acid



Zingiberis radix (rhizoma) CzPh 2017

- Mother plant: *Zingiber officinale*, Zingiberaceae (ginger)



https://commons.wikimedia.org/wiki/File:Althaea_officinalis.jpeg

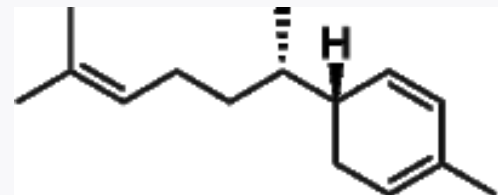


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Zingiberis radix (rhizoma) CzPh 2017

- Macroscopy: rhizome on the surface grey, poorly wrinkled, longitudinally stripped, aromatic typical odour, taste warm spicy and pungent
- Content compounds: **volatiles** (zingiberene), **resins** (gingerols, gingerdiols), phenylalkanones, phenylalkanones
- Usage: tonic, stomachic, diaphoretic, spice



zingiberen