

## Systems for natural compounds classification

System alphabetical – used in ČL 2005

System pharmacobotanical – according to botanical (systematic) classification of mother plants

System pharmacochemical – according to the functional groups, according to the ratio of single elements, enlistment into group according to the main content compound

System biogenetical – according to the single biosynthetic pathways leading to the creation of metabolites (compounds derived from shikimic acid, acetic acid, mevalonic acid, amino acids, and specific sugars)

System farmakodynamic – according to the pharmacodynamic effect

System chemotaxonomic – based on the relation of plant chemistry (occurrence of certain metabolites) and their evolution

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## PHARMACOBOTANICAL SYSTEM BACTERIA

*Bacillus brevis*, *B. subtilis*, *B. polymyxa* → antibiotics

*Streptomyces* sp. → antibiotics (streptomycin = aminoglycoside, erythromycin = macrolide, nystatin = polyene, neomycin = oligosugar)

*Lactobacillaceae* → technical usage in industry (silážování, kyselé zelí...)

*Corynebacterium glutamicum* → production of glutamate

*Leuconostoc mesenteroides* → dextrans

Producers of enzymes – proteases and lipases (for example additives to washing powders)

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## PHARMACOBOTANICAL SYSTEM ALGAE

Mono-cellular or poly-cellular autotrophic organisms

Plastids – chromatophores (chlorophyll, xanthophylls, carotenoids, fucoxanthine)

Genera *Chlorella* a *Scenedesmus* – intensive protein production

Genus *Gelidium* – acidic mucilaginous substances, components of middle lamella

Agar-agar

swelling laxative

medium for gel infusions and electrophoresis

substrate for culture media

food industry

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PHARMACOBOTANIC SYSTEM  
**FUNGI**

Counting species – the largest plant group. They live both in water and on dry earth.  
Nutrition heterotrophic (parasites, saprophytes, symbionts)  
No plastids in cells, cell wal/membrane made of chitine.  
Reserve compounds – polyglycans.  
Wide spectrum of content compounds (importance for industry, health care, toxicology)

*Rhizopus*, *Mucor*, *Cunninghamella* (Mucoraceae) – stereospecific hydroxylation of steroidal skeleton (corticoids, steroidal hormones)  
Production of perfuming compounds – perfumer industry

Ascomycetes – *Saccharomyces ellipsoideus*, *S. cerevisiae* (Faex medicinalis – high content of B-vitamins, additive, brewing)

*Penicillium* → antibiotics, fungicides, cheese manufacturing

*Aspergillus sp.* → amylases and proteases for substitution therapy x *Aspergillus flavus*, *A. fumigatus*

*Claviceps purpurea* → *Secale cornutum* - peptidic alkaloids – uterotonic, spasmolytic

Basidiomycetes „true shrooms“ wood or meadow saprophytic fungi – nutrition, poisoning, psychoactive (hallucinations)

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PHARMACOBOTANIC SYSTEM  
**LICHENES**

Dual organisms (fungus + alga)  
„Lichen compounds“ – produced by fungal part, acids, depsides  
Litmus fermentation of depsides – 7-hydroxyphenoxazon

*Cetraria islandica* – *Lichen islandicus* – mucilaginous expectorant with disinfection effect

Hydrolysis of depsides – fragrances, used in cosmetics

*Parmelia furfuracea* – Mousse d' Arbre

*Evernia prunastri* – Mousse d' Chêne

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PHARMACOBOTANICAL SYSTEM  
**MOSES**

Therapeutically used chosen sphagnum (*Sphagnum*)  
Peat – balneotherapy

Effect by resorption for example of oestrogenic compounds, it is dubious.

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PHARMACOBOTANICAL SYSTEM  
**HIGHER PLANTS – SPERMATOPHYTA**  
PTERIDOPHYTA – breed by spores

**MOSSCLUBS** – *Lycopodium clavatum* - wolf's-foot clubmoss (alkaloid lycopodine), *Lycopodium* (Lycopodii spora) → conspergent of pills, fireworks  
– *Hupersia serrata* – alkaloids hupersines

**HORSETAILS** – *Equisetum arvense* – field horsetail (?saponins?, flavonoids, silicic acids, traces of alkaloids palustrine a nicotine). In cellular liquid accumulation of aluminium ions.

**FERNS** – *Dryopteris filix mas* – common male fern (butanone phloroglucine derivatives in internal glandular trichomes – taenifuge, condensed tannins, flavonoids, leucoanthocyanins)

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PHARMACOBOTANICAL SYSTEM  
**GYMNOSPERMS**

**CONIFERS**

- Accumulation of polyphenols
- Condensed tannins
- Flavonoids
- Essential oils in schisogennic tubules, contain usually monoterpenes and diterpenes
- Resins
- Cylitol (pinitol, sequojitol) offent contained in needles

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PHARMACOBOTANICAL SYSTEM  
**ANGIOSPERMS**  
Angiospermae = Magnoliopsida

They have flowers, their parts are testicles covering little eggs.  
Testicle is a part of pistil, which is during maturation changed on fruit.

1. Monocotyledonous (Monocotyledonidae = Liliatae)
2. Dicotyledonous (Dicotyledonidae = Magnoliatae)

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PHARMACOBOTANICAL SYSTEM  
MONOCOTYLEDONOUS PLANTS

**LILIACEAE** (3 500 species)

- *Veratrum* – false hellebore – steroidal esters and glyko-alkaloids, cevane alkaloids
- *Colchicum* – autumn crocus – alkaloids
- *Urginea maritima* – sea squill, sea onion, *Convallaria majalis* – Lily of the valley – cardioactive glycosides
- *Allium sativum* - garlic, *Allium cepa* - onion – essential oils
- *Aloe* – anthraglycosides

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PHARMACOBOTANICAL SYSTEM  
DICOTYLEDONOUS PLANTS

**RANUNCULACEAE** (2 000)

- *Aconitum* – aconit – diterpenic alkaloids
- *Adonis* – pheasant’s eye – cardioactive glycosides
- *Helleborus* - hellebore – cardioactive glycosides
- *Thalictrum* - rue – isoquinoline alkaloids
- *Ranunculus* - buttercup – poisonous glycoside protoanemonine

**PAPAVERACEAE** - POPPY FAMILY (700) lactifers with latex

- *Papaver somniferum* - poppy – Opium – morfinane and benzylisoquinoline alkaloids.
- *Chelidonium* - celandine – alkaloids
- *Fumaria* – fumitory, earthsmoke – alkaloids

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PHARMACOBOTANICAL SYSTEM  
DICOTYLEDONOUS PLANTS

**BRASSICACEAE** -CRUCIFERS (3 000)

- *Brassica nigra* – black mustard – thioglycosides, glucosinolates
- *Sinapis alba* – white mustard – thioglycosides
- *Brassica oleracea botrytis* var. *italica* - broccoli – diindolylmethan
- *Erysimum diffusum* – diffuse wallflower, *Cheiranthus cheiri* – Aegean wallflower – cardioactive glycosides

**PRIMULACEAE** - (800)

- *Primula elatior* – true oxlip, *P. veris* - cowslip – triterpenoid saponins
- *Primula obconica* – poison primrose – benzoquinone primine – strongly irritating the skin
- *Cyclamen europaeum* - sowbread – poisonous saponine

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## PHARMACOBOTANICAL SYSTEM

### DICOTYLEDONOUS PLANTS

#### ROSACEAE - ROSES (3 000)

Condensed tannins, triterpenic acids, cyanogenic glycosides, flowers contain essential oils

**VICIACEAE, FABACEAE - LEGUMES FAMILY (10 000)** - on the roots nitrogenous bacteria; many times honey-producing

- *Glycine max* - soya – proteins, oil, isoflavonoids
- *Genista* – dayer's broom, *Laburnum anagyroides* – golden rain – quinolizidine alkaloids

**POLYGONACEAE – KNOTWEED FAMILY (800)** - different forms of calcium oxalate

- *Rheum* - rhubarb – anthraglycosides, tannins
- *Fagopyrum sagittatum* - buckwheat – photosensibilising naphthodianthrones

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## PHARMACOBOTANICAL SYSTEM

### DICOTYLEDONOUS PLANTS

**ASTERACEAE – SUNFLOWER FAMILY (20 000)** - inuline, essential oils, lactifers with latex, inflorescence, fruits achenes

- *Matricaria chamomilla* - chamomile – essential oil, flavonoids
- *Artemisia* - wormwood – bitter substances of germacrene type
- *Senecio* - ragworts – pyrrolizidine alkaloids (hepatotoxic, cancerogenic)

**MALVACEAE (1 500)**

- *Althaea officinalis* - marshmallow – mucilage
- *Malva* - mallow – mucilage

**APIACEAE - UMBELLIFERS (3 000)** essential oils, flowers in umbels

- *Angelica officinalis (archangelica)* – garden angelica – photosensibilising coumarins
- *Ferula* – stinking gum, *Ferula asa foetida* – gummiresine
- *Aethusa cynapium* – poison parsley, *Cicuta virosa* – water hemlock – toxic polyines

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## PHARMACOBOTANICAL SYSTEM

### DICOTYLEDONOUS PLANTS

**LAMIACEAE (5 000)**

(r. *Lamium*, *Lavandula*, *Mentha*, *Melissa*, *Salvia*, *Thymus*)

- Superficial glandules with essential oils – mono- and sesquiterpenes
- Polyphenols – depsides
- Rosmarinic acid – „tannin“ of Lamiaceae
- Iridoids

**SOLANACEAE (2 300)** - alkaloids of three types

- *Atropa* – deadly nightshade, *Hyoscyamus* – black henbane, *Datura* - thornapple – tropane alkaloids
- *Nicotiana* – pyridine alkaloids
- *Solanum* - steroid alkaloids (*S. laciniatum*)
- *Lycopersicon esculentum* – tomato – vitamins, carotenoids

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## PHARMACOBOTANICAL SYSTEM

### DICOTYLEDONOUS PLANTS

#### **APOCYNACEAE – DOGBANE FAMILY (2000)**

- *Catharanthus roseus* – Madagascar periwinkle – bisindol monoterpene alkaloids
- *Vinca minor* – lesser periwinkle – eburnamine alkaloids
- *Rauwolfia* - snakeroot – alkaloids
- *Strophanthus* - cardioactive glycosides
- *Thevetia* – yellow oleander – cardioactive glycosides

#### **ARALIACEAE – ARALIA FAMILY (300)**

- *Panax* - ginseng – steroidal saponins
- *Eleutherococcus* – siberian ginseng – dtto
- *Hedera helix* – common ivy – dtto

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## PHARMACOBOTANICAL SYSTEM

### DICOTYLEDONOUS PLANTS

#### **RUBIACEAE – MADDER FAMILY (1200)**

- *Cinchona* - quinine alkaloids
- *Cephaelis* - isoquinoline monoterpene alkaloids
- *Pausinystalia* - indole alkaloids
- *Coffea* - coffee – purine bases

#### **RUTACEAE – RUE OR CITRUS FAMILY (2500)**

- *Ruta graveolens* – common rue – flavonoids, alkaloids
- *Citrus* – essential oils, flavonoids
- *Pilocarpus* - jaborandi – parasympathomimetic alkaloids, ophthalmologic
- *Murraya* – curry tree - prenylated bisindols

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## PHARMACOBOTANICAL SYSTEM

### DICOTYLEDONOUS PLANTS

#### **LAURACEAE – (2 250) tubules with essential oils**

- *Cinnamomum ceylanicum*, *C. Cassia* - cinnamon – cinamom aldehyd
- *Cinnamomum camphora* – camphor laurel – camphor
- *Laurus nobilis* – bay laurel – essential oils, aporphine alkaloids

#### **BERBERIDACEAE – (650)**

- *Berberis vulgaris* - barberry – isoquinoline alkaloids
- *Podophyllum peltatum* - mayapple – lignans

#### **ERYTHROXYLACEAE – (200)**

- *Erythroxylon coca* - coca – possess 190 chemovars, pseudotropane alkaloids

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PHARMACOBOTANICAL SYSTEM  
DICOTYLEDONOUS PLANTS

**LOGANIACEAE (700)**

- *Strychnos nux vomica* – nux vomica – strychnine
- *Strychnos toxifera, castelnayi* – bisindol alkaloids

**CANNABACEAE (3)**

- *Humulus lupulus* - hop – bitter acids, essential oil, flavones
- *Cannabis sativa* - hemp – cannabinoids (THC)

**EUPHORBIACEAE (600)**

- *Ricinus communis*- castor plant – oil, alkaloid, phorbol, lectines
- *Croton tiglium* – purging croton – oil, phorbol esters
- *Mallotus* - phloroglucine derivatives

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PHARMACOBOTANICAL SYSTEM  
DICOTYLEDONOUS PLANTS

**CAESALPINIACEAE – CAESALPINIOIDEAE (2800)**

- *Cassia senna* - senna – anthraglycosides
  - *Krameria triandra* - rhatany – tannins
  - *Tamarindus indica* - tamarind – sugars
  - *Ceratonia siliqua* – carob tree – sugars
- From Greek word *keration* derived name carat (0,200 g).

**SCROPHULARIACEAE – FIGWORT FAMILY (1600)**

- *Digitalis lanata* - foxglove – cardioactive glycosides
- *Verbascum* - mullein – saponins
- *Veronica officinalis* - speedwell – tannins
- *Euphrasia rostkoviana* – common eyebright – flavonoids

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