

Subclassis: CARYOPHYLLIDAE

Ordo: Chenopodiales

Families belonging to the order Chenopodiales are characterized by the presence of **betalains**: reddish, purplish or yellowish, indole-derived pigments that functionally replace the anthocyanins found in other angiosperms. Betalains were first extracted from common beet (*Beta vulgaris*).

Familia: Phytolaccaceae – Pokeberry / Pokeweed family

The Phytolaccaceae consist of herbaceous plants with a **thickened taproot** (storage root). Representatives are native to America and South Africa. In Hungary the genus *Phytolacca* is adventitious, with two widespread species: American pokeweed (*Ph. americana*) and Indian pokeberry (*Ph. esculenta*). The flowers are bisexual, the gynoecium is apocarpous, the fruit is a blackish-purple berry. The purple colour of the vegetative and reproductive parts is attributed to **betalains**, which accumulate especially in the fruits.

American pokeweed (*Ph. americana*) is a large herbaceous perennial plant growing up to 3 m in height, native to North America. The berries were once used as food-colorants. However, the plant contains toxic substances like lectins and **triterpene saponins** (phytolaccoside A-G).

Familia: Aizoaceae – Mesembryanthemum family

The Aizoaceae consist of annual or perennial herbs, rarely shrubs or trees, rarely spiny. Members of the family grow in tropical and subtropical regions, primarily in South Africa, less so in Australia. The plants are mostly xeromorphic, with **succulent leaves**, often with a pebble-like appearance. **Betalain pigments** are present, anthocyanins absent. Economic importance includes numerous ornamental cultivars, some (e.g. *Sceletium*) with medicinal properties, and some used as table greens. The fleshy leaves of New Zealand spinach (*Tetragonia tetragonoides*) are consumed as vegetable – also in Hungary.

Sceletium tortuosum is a succulent herb commonly found in South Africa. The plant has been used as a mood-altering substance from prehistoric times. *Sceletium* is known to elevate mood and decrease anxiety (anxiolytic), stress and tension, attributed to alkaloids like mesembrin. It has also been used as appetite suppressant by shepherds. In intoxicating doses it can cause euphoria, initially with stimulation and later with sedation. The plant is not hallucinogenic.

Familia: Portulacaceae – Purslane family

The Portulacaceae have a cosmopolitan distribution, with the highest diversity in semi-arid regions of the southern hemisphere. The plants are mostly **succulents**, with prostrate stems, fleshy leaves and considerable amounts of **mucilage**. Some are cultivated as ornamentals, while others are grown as vegetables. A good example is common purslane (*Portulaca oleracea*), which is eaten as a leaf vegetable throughout much of Europe, Asia and Mexico. The plant contains more omega-3 fatty acids than any other leafy vegetable plant.

Familia: Chenopodiaceae – Goosefoot family

Chenopodiaceae comprises annual or perennial herbaceous species, which are sometimes succulent. Due to their high level of adaptability, they occur almost everywhere, from saline to nitrate-rich soils. A special morphological feature is **polycambiality**, i.e. several concentric rings of xylem and phloem (or concentric rings of vascular bundles) are formed in the course of secondary root thickening. Besides the thickening taproot, the lower parts of the stem also contribute to the formation of the special storage root. The special glandular trichomes (“**bladder trichomes**”) are also of diagnostic value. The perianth of the greenish flowers is formed by tepals, which often become fleshy and fuse with the fruits (capsules or nutlets) or the axis of the inflorescence, forming false **multiple fruits**. Family members accumulate **betalains**, some of them contain alkaloids, while others are rich in sodium- and potassium-salts.

The genus *Chenopodium* contains several plants of moderate importance as food crops, used as leaf vegetables, similarly to the closely related spinach (*Spinacia oleracea*). Edible *Chenopodium* species include white goosefoot (*Ch. album*) and Good King Henry (*Ch. bonus-henricus*). Today there is increased interest in goosefoot seeds, which are suitable as part of a gluten-free diet. Goosefoot pollen, in particular of the widespread *Ch. album*, is an allergen to many people, and a common cause of hayfever. Epazote or wormseed (*Ch. ambrosioides*), a herb native to America, is used as a leaf vegetable and for its carminative properties. Oil of chenopodium (*Oleum chenopodii*), applied as an anthelmintic (kills intestinal worms), is derived from the variety *Ch. ambrosioides* var. *anthelminthicum*.

The beet (*Beta vulgaris*) is best known in its numerous cultivated varieties, like the root vegetables beetroot and sugar beet, or the leaf vegetables chard and spinach beet. The roots of **beetroot** or garden beet (*B. vulgaris* convar. *conditiva*) can be eaten raw or cooked. Beetroots are a rich source of antioxidants and nutrients, as well as of betain, which is important for cardiovascular health. **Sugar beet** (*B. vulgaris* convar. *altissima*) is an excellent source of sucrose (with up to 20% sucrose in the roots), and it is grown commercially throughout the temperate regions (in tropical areas sugar cane is used as a sucrose source).

Some plant classifications include Chenopodiaceae in Amaranthaceae, on the basis of evidence from molecular phylogenies.

Familia: Amaranthaceae – Amaranth family

The Amaranthaceae has a largely worldwide distribution, members are common in some deserts, alkaline regions, tropical areas and some temperate regions. The Amaranthaceae consist of annual or perennial herbs, vines and shrubs. The stems are sometimes jointed or succulent. The leaves are simple and often succulent. The flowers are small, actinomorphic, with a single whorl of perianth. The fruit is a nutlet, berry, capsule or multiple fruit. The seeds are mostly starchy-perispermous with curved embryo. In the course of secondary growth, concentric circles of vascular tissues are formed. **Betalain** pigments are present, anthocyanins absent. Photosynthesis often follows the C4 or CAM pathway.

Amaranthus, commonly known as amaranth, is a cosmopolitan genus of herbs. Although several species are considered weeds (e.g. common or red-root amaranth (*A. retroflexus*)), amaranths are at the same time valued as leaf vegetables, cereals and ornamentals. Several species, including pendant amaranth (*A. caudatus*), purple amaranth (*A. cruentus*) and princess feather (*A. hypochondriacus*), are raised for amaranth grains (pseudograins) in Asia and the Americas. Since they are not members of the grass family and do not contain gluten, they are highly edible by gluten intolerant individuals.

Ordo: Opuntiales / Cactales

Familia: Cactaceae – Cactus family

The Cactaceae consist of perennial shrubs or trees that are **native to America**, mostly in arid, desert regions. The stems are typically **succulent**, and may be cylindrical, flattened cladodes (e.g. prickly-pears) or radially plicate (e.g. barrel cacti). The leaves are often replaced by **spines**, but in some species (e.g. *Pereskia*) the simple, succulent leaves are persistent and well-developed. Leaf spines arise from wart-like emergences called **aeroles**. The stem is often densely covered with trichomes in order to reduce evaporation. The flowers are often large, bisexual, actinomorphic. The perianth consists of numerous, spirally arranged tepals, grading from outer bract-like to inner petal-like structures. The stamens are numerous; the gynoecium is syncarpous, with an inferior ovary. The fruit is a **berry**, often edible. Flowers are pollinated by bees, moths, hummingbirds or bats. Betalain pigments are present, anthocyanins absent. Cacti contain substantial amounts of **mucilage** (water is stored bound to mucilage). Active compounds include protoalkaloids and saponins. Photosynthesis is **CAM** (Crassulacean Acid Metabolism), in which stomata are open at night (when carbon dioxide is fixed and stored), and closed during the day to conserve water.

Economic importance includes numerous cultivated ornamentals and edible species. *Opuntia* species are eaten for their fruits (prickly-pears) and stems (nopales), and the fruits of *Pereskia* species are also edible. Peyote (*Lophophora williamsii*), a small, spineless cactus, is used as a hallucinogen and in religious ceremonies (e.g. Religion of the Native American Church). It contains psychoactive protoalkaloids, particularly mescaline.

Ordo: Caryophyllales

Familia: Caryophyllaceae – Carnation family

The Caryophyllaceae consist of annual or perennial herbs, rarely shrubs, lianas or trees, with a worldwide distribution, especially in the northern hemisphere. The stems often have **swollen nodes**. The **leaves** are mostly **opposite** (decussate) and simple. The inflorescence is of dichasial cymes or solitary flowers. The flowers are actinomorphic, pentamerous. The perianth is heterochlamydeous: the calyx is often synsepalous with 5 sepals; the corolla is apopetalous and often clawed, with 5 petals. The stamens are 5-10; the gynoecium is syncarpous, with a superior ovary. Floral formula: * Ca_5 or $(5) Co_5 A_{5+5} G_{(2-5)}$. The fruit is a **capsule with teeth**, the seeds are often with sculptured seed coat and are perispermous. **Anthocyanin pigments** are present, betalains absent. Members are rich in **triterpenoid saponins**. Anomalous secondary growth with concentric rings of vascular tissue occurs in some taxa.

Carnation (*Dianthus*) species are well-known ornamentals, with several cultivars.

The crushed leaves and roots of common soapwort (*Saponaria officinalis*) have been used as soap for a long time, thanks to their high saponin content. The roots (*Saponariae rubrae radix*) are used as expectorant, along with the roots (*Saponariae albae radix*) of baby's-breath (*Gypsophila paniculata*).

Ruptureworts (*Herniaria* species) are drought tolerant species, covering the ground with their prostrate stems. Smooth rupturewort (*H. glabra*) and hairy rupturewort (*H. hirsuta*) are used as diuretic and anti-inflammatory agents in the urogenital tract.

Common corncockle (*Agrostemma githago*) used to be a common weed in cereal fields. The whole plant, but especially the seeds are rich in triterpene saponins, the main

compound being githagosid, which causes the inflammation of the digestive tract, later the urinary system, and in higher doses can be fatal (damaging the central nervous system and the respiratory system).

Ordo: Polygonales

Familia: Polygonaceae – Knotweed / Buckwheat family

The Polygonaceae consist of annual or perennial herbs, shrubs, lianas, vines or trees, with a worldwide distribution, especially in the northern temperate hemisphere. The stems often have swollen nodes. The leaves are usually spiral, simple, and when stipulate, stipules are typically connate (grow together) into a sheath extending above the node, termed an “**ocrea**”. The flowers are small, actinomorphic, pedicellate, the pedicels often articulated (jointed), an “**ocreola**” often subtending individual flowers. The flowers are bisexual (*Rheum*, *Fagopyrum*) or unisexual (*Rumex*). The perianth is **homochlamydeous**, consisting of 3+3 or 5 tepals. The stamens are 3+3 or 8, often of two lengths. The gynoecium is syncarpous, with a superior ovary. Nectaries are often present (e.g. *Fagopyrum*), consisting of a nectariferous disk at the base of stamens. The fruit is usually a 3-sided achene or nutlet, sometimes with an accrescent perianth (perianth remains on the fruit, surrounding it). The seeds are endospermous, oily and starchy. **Anthocyanin** pigments are present, betalains absent. Other characteristic chemical compounds include **anthraquinone** derivatives, **oxalic acid**, often in the form of calcium oxalate crystals, **tannins** and **flavonoids**.

Members of the genus *Polygonum* are considered weeds, but at the same time serve as drug sources, due to their valuable tannin composition. Such species include common knotgrass (*P. aviculare*), water-pepper (*P. hydropiper*), and bistort (*P. bistorta*), which is a protected species in Hungary. *P. aviculare* can also be used in **phytoremediation**, i.e. to clean soils polluted with metals or radiating substances, by accumulating the pollutants in the plant body.

Rhubarb (*Rheum*) species are native to Asia, cultivated as ornamentals and food plants. The fleshy petiole is used to make pies, jellies and jams. All parts of the plant contain oxalic acid and anthraquinone glycosides. The raw or cooked leaf blades can be poisonous if consumed in large enough amounts. The rhizomes of Chinese rhubarb (*Rh. palmatum*) and *Rh. officinale* are used as laxatives, due to their anthraglycoside content.

Sorrels (genus *Rumex*) comprise about 200 species. The leaves of most species contain oxalic acid and tannin, and many have astringent or slightly purgative qualities. Sheep’s sorrel (*R. acetosella*), common sorrel (*R. acetosa* (var. *hortensis*)) and broad-leaved dock (*R. obtusifolius*) are consumed as leaf vegetables. The extracts of alpine dock or monk’s rhubarb (*R. alpinus*) can be efficiently used to treat wounds.

Common buckwheat (*Fagopyrum esculentum*) and tartary buckwheat (*F. tataricum*) are domesticated food plants, considered as cereals (although not related to true cereals in the grass family). The shoots are important sources of flavonoid glycosides like rutin, hyperoside and quercitrin. **Rutin** content may reach 3-5%, making them suitable for large-scale pharmaceutical processing. It has to be noted, however, that the shoots contain also the naphthodianthrone **fagopyrin**, which is known for its photosensitizing effect (the skin becomes more sensitive to sunlight).