

Iridoids-containing medicinal plants and herbal drugs

MORPHOLOGICAL, ANATOMICAL AND CHEMICAL ANALYSIS OF IRIDOIDS-CONTAINING MEDICINAL PLANTS AND HERBAL DRUGS

Iridoids (bitters) are cyclopentan-[c]-pyran monoterpenoids. The name derives from *Iridomyrmex*, a genus of ants which produces these compounds as a defense secretion. All iridoids can be classified into 10 groups. Most occur as glycosides; some occur free and as bis compounds. There are many seco-iridoids, monoterpen-derivatives, sesquiterpen-derivatives and others. Most of iridoids are known as bitter principles.

Questions on topic "IRIDOIDS"

1. Which compounds are called bitters?
2. What physical chemical properties do bitters have?
3. What do underlie the classifications of the bitters?
4. Which bitters are called iridoid glycosides?
5. What does underlie the chemical classification of the iridoid glycosides?
6. Which methods of qualitative detection of iridoid glycosides are used?
7. Which methods of quantitative analysis of iridoids are used? What index does propose Europe Pharmacopoeia for quantitative analysis of bitters?
8. What kinds of pharmacological activities do bitters have? (What purposes are bitters employed for?)
9. How should herbal drugs contained bitters be picked up?
10. How should herbal drugs contained iridoid derivatives be stored?
11. List the Latin name of iridoids-containing herbal drugs

NB! *Iridoids cause the darkness of herbal drugs*

Chemical analysis of iridoid-containing herbal drugs

Identification tests

Place 1 g of powdered Plantain leaves (or another iridoid-containing drug) in a ground-glass conical flask add 10 ml of ethanol shake and allow to extract for 20 min, then filtrate.

1. **Test with Shtal's reagent.** Add 0.5 ml of Shtal's reagent to 1 ml of the extract, heat in a water bath for 1-2 min. Shtal's reagent: 5 ml of concentrated hydrochloric acid, 1 g of p-dimethylamino benzaldehyde dilute to 100 ml with ethanol in a volumetric flask. Green colour develops.
2. **Test with Trim-Chill's reagent.** Add 0.5 ml of Trim-Chill's reagent to 1 ml of the extract, heat in a water bath for 1-2 min. Trim-Chill's reagent: a mixture of concentrated hydrochloric acid, acetic acid, cuprum sulfate. Dark-blue coloring should be observed.

Determination of bitterness value (Eur. Ph.)

Medicinal plant materials that have a strong bitter taste ("bitters") and are employed therapeutically, mostly as appetizing agents. Their bitterness stimulates secretions in the gastrointestinal tract, especially of gastric juice.

Bitter substances can be determined chemically. However, since they are mostly composed of two or more constituents with various degrees of bitterness, it is first necessary to measure total bitterness by taste.

The bitter properties of plant material are determined by comparing the threshold bitter concentration of an extract of the materials with that of a dilute solution of quinine hydrochloride R. The bitterness value is expressed in units equivalent to the bitterness of a solution containing 1 g of quinine hydrochloride R in 2000 ml.

Safe drinking-water should be used as a vehicle for the extraction of plant materials and for the mouth-wash after each tasting. Taste buds dull quickly if distilled water is used. The hardness of water rarely has any significant influence on bitterness.

Sensitivity to bitterness varies from person to person, and even for the same person it may be different at different times (because of fatigue, smoking, or after eating strongly flavoured food).

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Therefore, the same person should taste both the material to be tested and the quinine hydrochloride solution within a short space of time. The bitter sensation is not felt by the whole surface of the tongue, but is limited to the middle section of the upper surface of the tongue. A certain amount of training is required to perform this test. A person who does not appreciate a bitter sensation when tasting a solution of 0.058 mg of quinine hydrochloride R in 10 ml of water is not suitable to undertake this determination.

The preparation of the stock solution of each individual plant material should be specified in the test procedure. In each test series, unless otherwise indicated, the determination should start with the lowest concentration in order to retain sufficient sensitivity of the taste buds.

Bogbean leaf, Marsh-trefoil leaf - *Folium Menyanthidis trifoliatæ*

Menyanthes, Buckbean, Bog-bean, Marsh-trefoil, Water-shamrock - *Menyanthes trifoliata*

Family *Menyanthaceæ*

Definition. Folium Menyanthidis consists of dried leaves of *Menyanthes trifoliata*. **Bitterness value:** minimum 3000

Description. The leaves are ternate ("trefoil") with a ca. 10 cm long petiole, and the individual leaflets are 5-10 cm long, elliptic, glabrous and with an entire margin. The leaf fragments of the cut drug are grayish green, partly with the shriveled, brownish nerves: because on drying the aerenchyma shrives more, the fragments of the thicker petiole are wrinkled and longitudinally grooved. Very occasionally, petiole fragments with the three points where the leaflets were attached are recognized. Slight but distinct odour, very bitter and persistent taste.

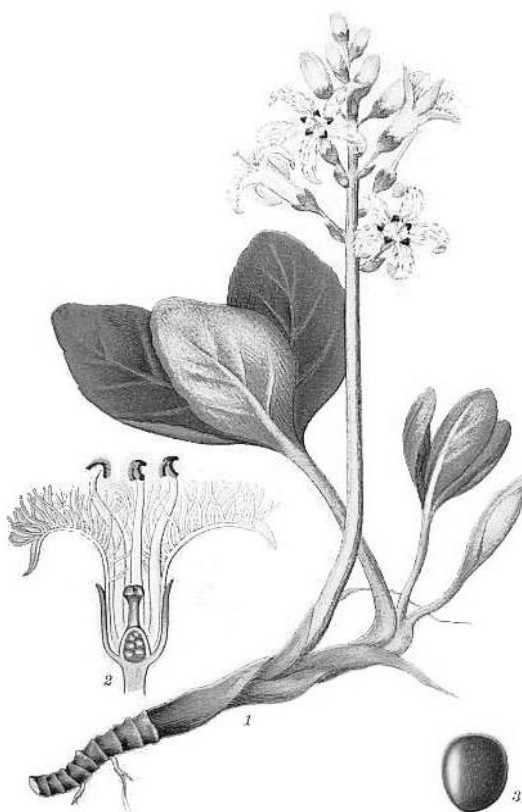
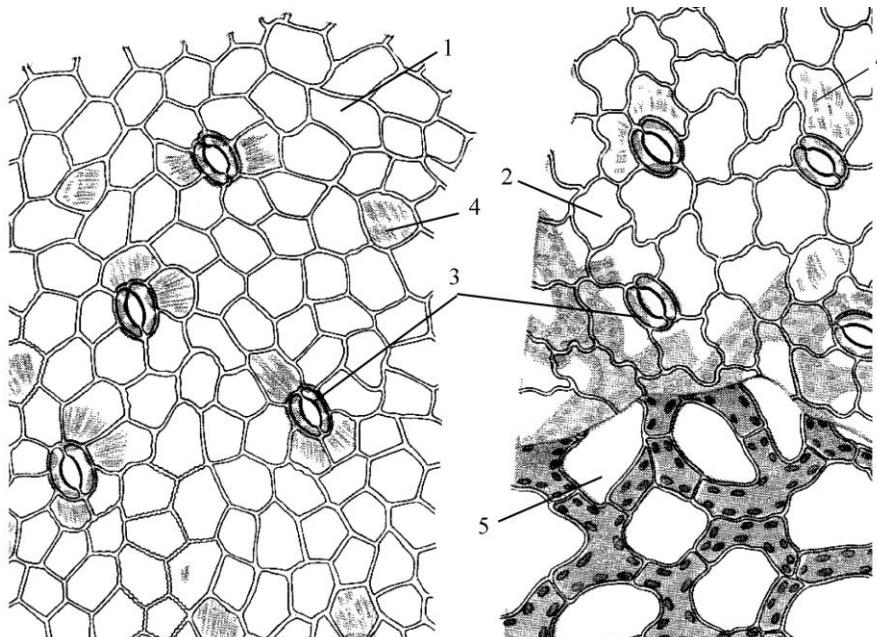


Fig. 10.1. Flowering bog-bean

Anatomical characteristics.



Upper epidermal cells (1) polyhedral cells and thin wavy walls; 2 - lower epidermal cells with sinuous walls; near the veins notably wrinkled cuticle (4), hairs absent. Anomocytic stomata (3) with 4-7 neighboring cells and with the subsidiary cells showing radiating striations. Spongy parenchyma with intercellular air-spaces (5) (aerenchyma).

Dandelion Root - *Radix Taraxaci*

Common Dandelion, Lion's Tooth, Puff- or Blow Ball - *Taraxacum officinale* L.

Family - Asteraceae (Compositae)

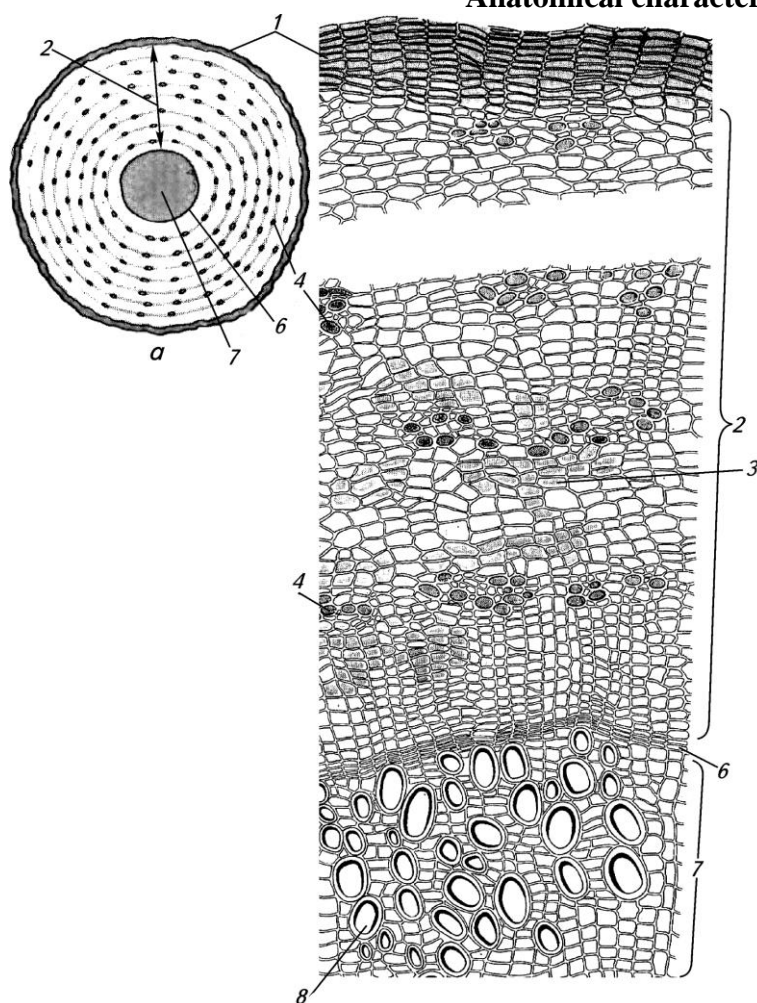
Definition. Radix Taraxaci consists of dried roots of *Taraxacum officinale* L.

Description. Cylindrical or somewhat flattened, gradually tapering, up to 15 cm. in length and from 5 to 15 mm. in diameter, usually in broken segments; externally blackish-brown, dark-brown or moderate yellowish brown, longitudinally wrinkled with few root or rootlet scars; crown simple or branched with numerous leaf-bases exhibiting annulate markings; fracture short and horny; internally bark light brown, containing concentrically arranged lighter and darker zones which represent parenchyma alternating with laticiferous vessels and sieve; wood light yellow and porous; odor slight; taste very bitter.



Fig. 10.2. Dandelion

Anatomical characteristics.



Transverse sections of macerated Dandelion root show the following peculiarities: External Cork (1) of up to 4 layers of tangentially-elongated cork cells (1) with brownish contents. Cork cambium (5). *Cortex* of several layers of more or less tangentially-elongated cells contains inulin (3). *Internal cork* is frequently found arising from secondary phellogens at various levels in this region. *Phloem*, a broad zone of brownish concentric layers of laticiferous vessels (8) and sieve tubes alternating with whitish parenchyma, the cells of which contain inulin. *Cambium* (6), comprising several layers of small meristematic cells.

Transverse section of a portion of the phloem showing two zones of laticiferous vessels (8).

Xylem, filling the center of the root and composed of a matrix of nonlignified wood fibers and xylem cells among which are scattered numerous tracheae, the latter up to about 84 mkm in diameter. The rhizomes mainly differ from the roots by showing a small pith in the center.

Tangential sections, cut through the phloem and mounted in weak iodine, show a network of branching laticiferous vessels with brownish contents, which anastomose with one another. Accompanying these latex carrying elements are sieve tubes.

These and their callus plates may readily be made out by mounting a similar section in corallin soda solution, when the callus sieve plates take on a pink coloration. Radial-longitudinal sections show that the tracheae of the xylem are for the most part reticulate. The wood fibers accompanying them have simple and oblique pores.

Pharmacopoeia test for inulin (Molish reaction) with dandelion roots - see "Carbohydrates".

Centaury herb - *Herba Centaurii*

Common centaury - *Centaureum erythraea* Rafn.

Family – *Gentianaceae*

Definition *Herba Centaurii* consists of whole or cut flowering dried aerial parts of *Centaureum erythraea* (syn. *C. minus*, *C. umbellatum*). **Bitterness value** not less than 2000.

Description. The hollow cylindrical light green to dark brown stem has longitudinal-ridges, and is branched only in its upper part. The sessile leaves are intire, decussately arranged, and have an ovate to lanceolate lamina, up to about 3cm long. Both surfaces are glabrous and green to brownish-green. The inflorescence is diaxially branched. The tubular calyx is green and has five lanceolate, acuminate teeth. The corolla consists of a whitish tube divided in five elongated lanceolate pink lobes, about 5 mm to 8mm long. Five stamens are present attached to the top of the corolla tube. The ovary is superior and has a short style, a broad bifid stigma and numerous ovules. Cylindrical capsules about 7mm to 10mm long, with small brown markedly rough seeds are frequently present. Odour: faint and characteristic. Taste: very bitter.



Fig. 10.3. Relative species **a** - *Centaureum erythraea* and relative species: **b** - *C. pulchellum*, **c** - *C. vulgare*

Gentian root – Radix Gentianae

Gentian - *Gentiana lutea* L.

Family – Gentianaceae

Definition. Gentian root consists of the dried, fragmented underground organs of *Gentiana lutea* L.

Bitterness value not less than 10000.

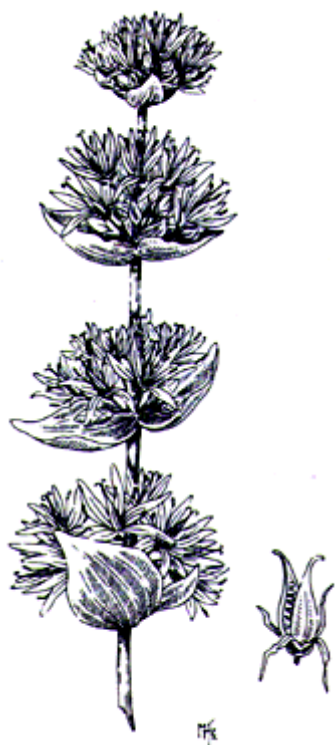
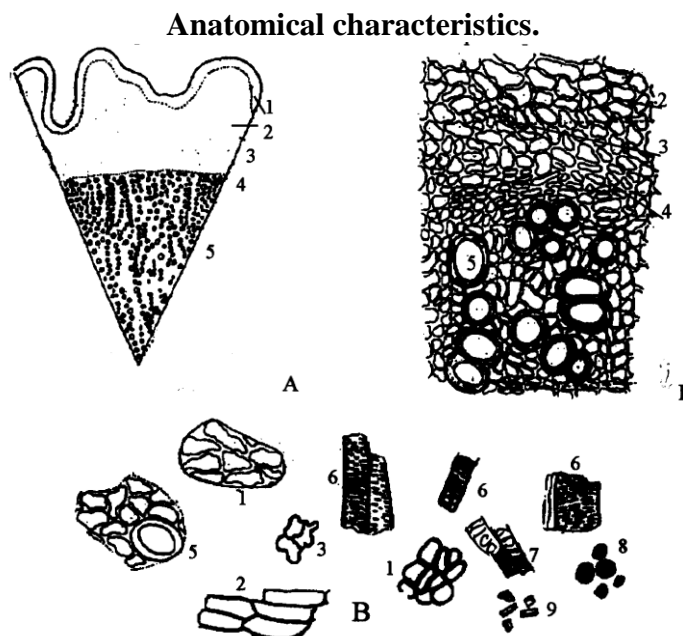


Fig. 10.4. Flowering gentian

Description. The drug consist of the brownish, reddish brown or deep brown roots, which are up to several centimeters thick and often fragments of the rhizome, which is transversely wrinkled on the surface: the root are longitudinally grooved. In the transverse section of the broken drug there is relatively narrow bark (with a coarsely wrinkled cork) and a distinct ring of cambium delimiting the xylem. Odour: Weak and peculiarly sweetish, reminiscent of dried gins. Taste: At first sweetish, then persistently and intensely bitter.

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The powder shows the following diagnostic characters (B): fragments of the subero-phellodermic layer, consisting of thin-walled yellowish brown cork cells (2) and thick-walled collenchyma (phello-derm) (3); fragments of cortical and ligneous parenchymatous cells with moderately thickened walls containing droplets of oil (8) and small prisms and minute needles of calcium oxalate (9); fragments of lignified vessels with spiral or reticulate thickening.



Hops strobile – *Strobili Lupuli*, *Flos Lupuli*

Hops, Hop Vine, *Lupulus* - *Humulus lupulus* L.

Family – *Cannabaceae* (*Moraceae*)

Definition Hop strobile consists of the dried, generally whole, female inflorescences of *Humulus lupulus*.

Description. Hop strobiles are generally isolated and 2 cm to 5 cm long, petiolate, ovoid, made up of many oval, greenish-yellow, sessile, membranous, overlapping bracts. The external bracts are flattened and symmetrical. The internal bracts are longer and asymmetrical at the base because of a fold generally encircling an induviate fruit (achene). The ovary or rarely the fruit, the base of the bracts and especially the induvial fold, are covered with small orange-yellow glands. It has a characteristic, aromatic odour.

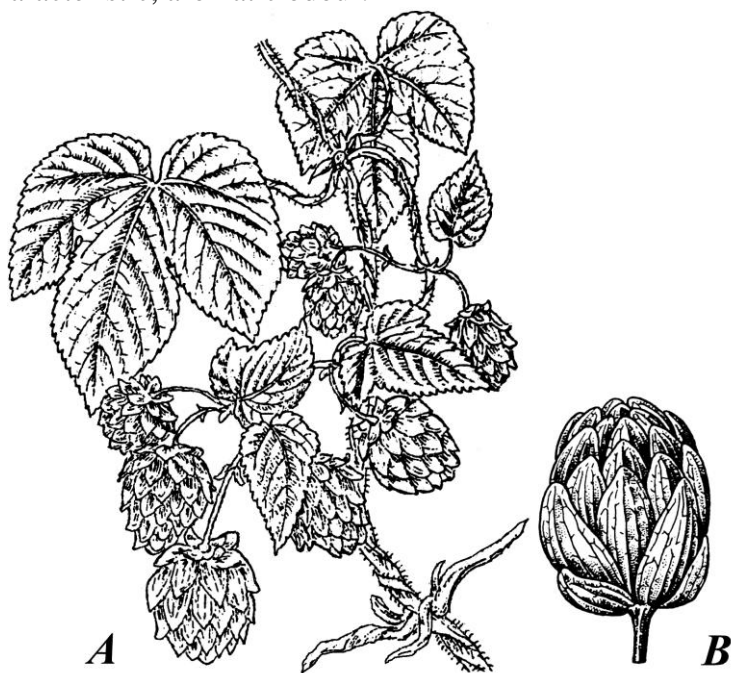
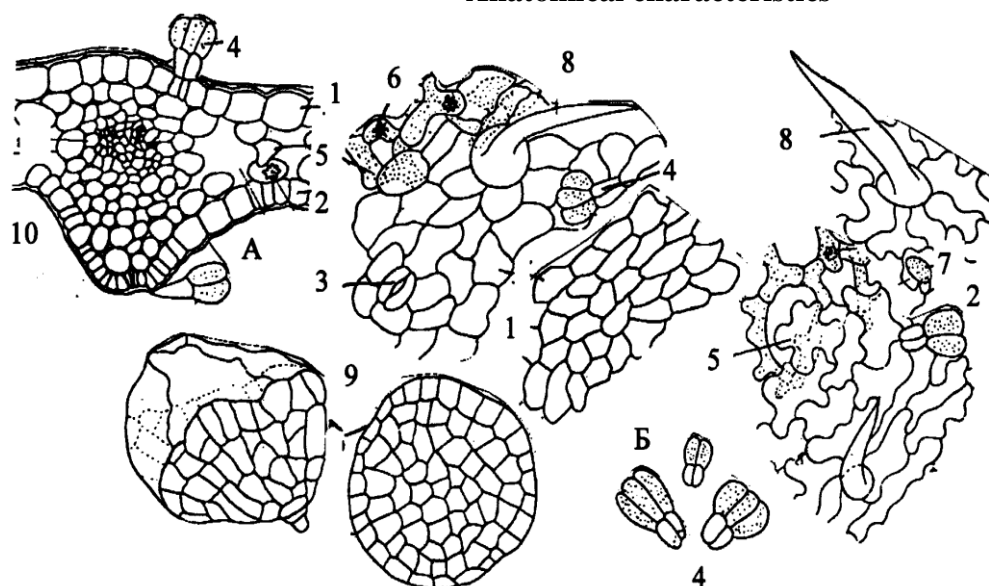


Fig. 10.5. A - Hops. B - Hop strobiles

Anatomical characteristics



The powder shows the following diagnostic characters: fragments of bracts and bracteoles covered by polygonal, irregular epidermal cells (1) with wavy walls; unicellular, conical, straight or curved covering trichomes (8) with thin, smooth walls; rare anomocytic stomata (3);

fragments of mesophyll containing small calcium oxalate cluster crystals (2); many characteristic orange-yellow glandular trichomes with short, bicellular biseriate stalks, bearing a part widening into a cup, 150 µm to 250 µm in diameter, made up of a hemispherical layer of secretory cells with a cuticle that has been detached and distended by the accumulation of oleoresinous secretions (9); fragments of elongated sclerenchymatous cells of the testa with thick walls showing striations and numerous pits. Not numerous glandular trichomes (4) may be founded among fragments of powder.

The numerous large yellow glands (9) which are very characteristic; each is composed of a number of thin-walled cells arranged in a single, hemispherical layer with a common cuticle which, on the concave surface, is raised to form a dome although this is often collapsed; the cells secrete a yellowish-brown oleo-resin into the space between the walls and the raised cuticle and this gives the characteristic colour to the glands.

Olive leaf = Folium Oleae

Olive = Olea europea L.

Family Oleaceae

Definition Dried leaf of *Olea europaea* L. *Content*: minimum 5.0 per cent of oleuropein ($C_{25}H_{32}O_{13}$; M_r 540.5) (dried drug).

Description A. The leaf is simple, thick and coriaceous, lanceolate to obovate, 30 mm to 50 mm long and 10 mm to 15 mm wide, with a mucronate apex and tapering at the base to a short petiole; the margins are entire and reflexed abaxially. The upper surface is greyish-green, smooth and shiny, the lower surface paler and pubescent, particularly along the midrib and main lateral veins.

Devil's claw = Radix Harpagophyti

Devil's claw = Harpagophytum procumbens DC

Family Pedaliaceae

Definition Devil's claw consists of the dried, transverse slices of the tubes of *Harpagophytum procumbens*

Description Irregularly circular slices of tuber 2-4cm and sometimes up to 6cm in diameter and 2-5cm thick; cork reddish-brown to dark brown, longitudinally wrinkled; transverse surface yellowish-brown to brown, radiate and concentric, central region raised, fracture short. No odour; extremely bitter taste.