

**Ginger Rhizome - *Rhizoma Zingiberis***

**Ginger, Zinziber, Jamaica ginger - *Zingiber officinalis* Rosc.**

**Family *Zingiberaceae***

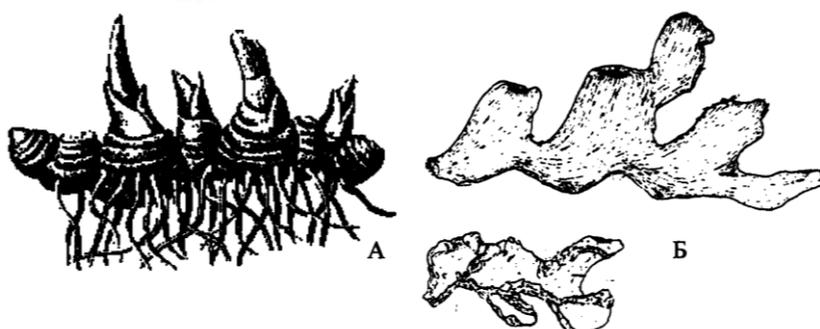


**Definition.** Rhizoma Zingiberis consists of dried rhizoma of *Zingiber officinalis*

**Description.** The scraped is represented in sympodially branched pieces known as "hand" or "races". There are 7-15 cm long, 1-1,5 cm broad and laterally compressed. The outer surface is buff-coloured and longitudinally striated or fibrous; it shows no sign of cork. The drug breaks with a short fracture, the fibers of the fibrovascular bundles often projecting from the broken surface. Ginger has an agreeable aromatic odour and a pungent taste.

The unscraped rhizome resembles the above in structure but is more or less covered by brownish layers of cork with conspicuous ridges; the cork readily exfoliates from the lateral surfaces but persists between the branches.

**Fig. 11.20. Flowering Ginger**



**Fig. 11.21. Ginger rhizome,**  
A - whole rhizome, B - refined rhizome

**Oil of Turpentine. "Spirit of turpentine" = *Oleum Terebintinae***

**Definition.** Volatile oil distilled from the oleoresin obtained from *Pinus palustris* Mill., Pinaceae and other species of *Pinus* yielding only terpene oils.

**Description.** Colorless liquid; characteristic odor and taste, both becoming more pronounced and less agreeable on aging or exposure to air.  $d_{25}^{25}$  0.854-0.868. Greater part distills between 154-170 deg.  $n_{20}^D$  1.4680-1.4780. Rotation is variable. Insol in water; sol in 5 vols alcohol; miscible with benzene, chloroform, ether, carbon disulfide, petr ether and oils.

**Caution.** Vapors can cause eye irritation, headache, dizziness, nausea. Inhalation and ingestion can cause bladder irritation. See also Turpentine.

**SESQUITERPENE-CONTAINING HERBAL DRUGS**

**Chamomile flower, Roman Chamomile = *Flores Chamomillae***

**Roman Chamomile = *Chamaemelum nobile* (L.) All. (*Anthemis nobilis* L.)**

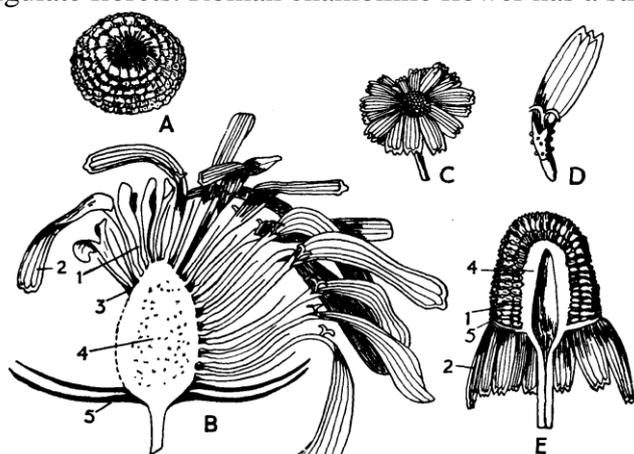
**Family *Asteraceae***

**Definition.** Roman chamomile flower consists of the dried flower-heads of the cultivated double variety of *Chamaemelum nobile* (L.) All. (*Anthemis nobilis* L.). It contains not less than 7 ml/kg of essential oil.

**Description.** It consists of flower-heads with a white to yellowish-grey colour, being composed of solitary hemispherical capitula, made up of a solid conical receptacle bearing the florets, each subtended by a transparent small palea.

The capitula have a diameter of 8 mm to 20 mm; the receptacle is solid; the base of the receptacle is surrounded by an involucre consisting of two or three rows of compact and imbricated bracts with scarious margins. Most florets are ligulate, but a few pale yellow tubular florets occur in the central region. Ligulate florets are white, dull, lanceolate and reflexed with a

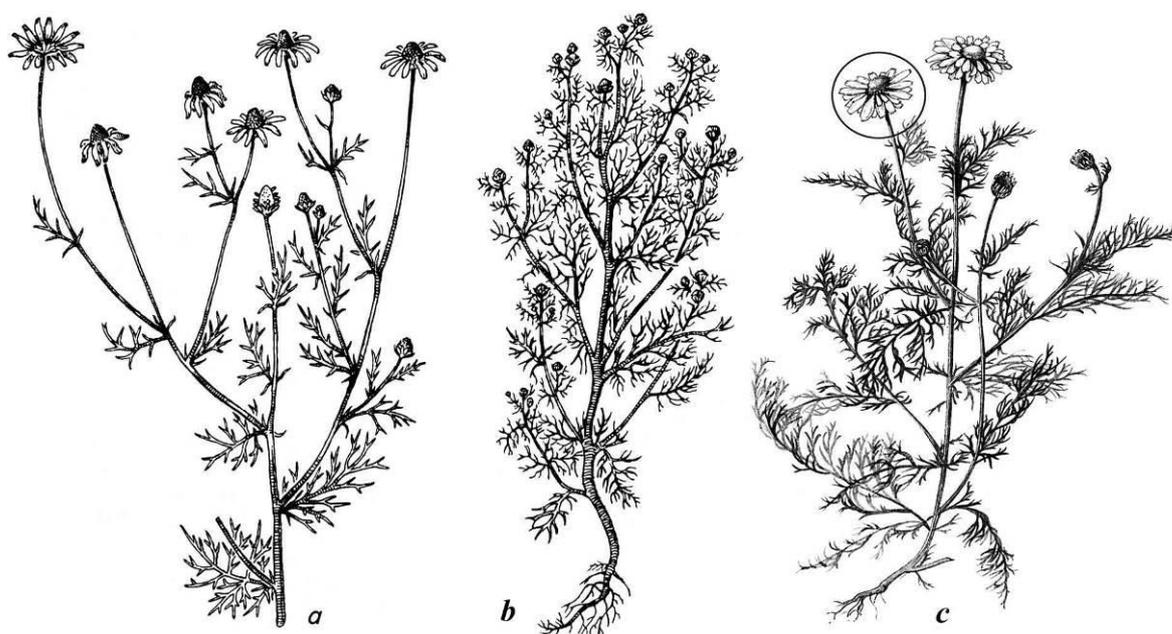
dark brown, inferior ovary, a filiform style and a bifid stigma; tubular florets have a five-toothed corolla tube, five syngenesious, epipetalous stamens and a gynoeceium similar to that of the ligulate florets. Roman chamomile flower has a strong and characteristic odour.



**Fig. 11.22.** A, Cultivated Roman chamomile; B, the same cut longitudinally; C, German chamomile; D, a ligulate floret of same; E, a German chamomile cut longitudinally. 1, Tubular floret; 2, ligulate floret; 3, palea; 4, receptacle; 5, bract of involucre.

**Anatomical characteristics.** Separate the capitulum into its different parts. Examine under a microscope, using chloral hydrate solution R. All parts of the flower-heads are covered with numerous small yellow glistening glandular trichomes. The involucre bracts and paleae have epidermal cells in longitudinal rows, sclerified at the base and they are covered with conical trichomes, about 500 µm long, each composed of three or four very short base cells and a long, bent, terminal cell about 20 µm wide. The corolla of the ligulate flowers consists of papillary cells with cuticular striations. The ovaries of both kinds of florets have at their base a sclerous ring consisting of a single row of cells. The receptacle and the ovaries contain small clusters of calcium oxalate. The pollen grains have a diameter of about 35 µm and are rounded and triangular with three germinal pores and a spiny exine.

**Tests.** *Diameter of the flower-heads.* Not more than 3 percent of flower-heads have a diameter smaller than 8 mm. *Deteriorated flower-heads.* Brown or darkened flower-heads are absent.



**Fig. 11.23** a – German Matricary = *Matricaria recutita* L., b - *Matricaria matricarioides*, c - Roman chamomile = Roman chamomilla

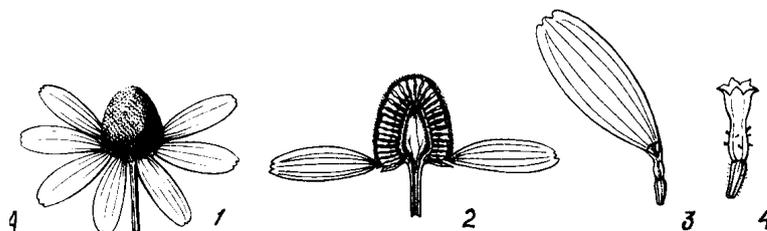
**Matricary flowers, German chamomile flowers - Flores Chamomillae**

German chamomile, Matricary - *Matricaria recutita* L. (*Chamomilla recutita* (L.) Rauschert)

### Family Asteraceae (Compositae)

**Definition.** Matricaria flower consists of the dried-flower heads of *Matricaria recutita* L. (*Chamomilla recutita* (L.) Rauschert). It contains not less than 4 ml/kg of blue essential oil.

**Description.** The bracts of the involucre are obovate to lanceolate, with a brownish-grey scarios margin. The receptacle is essentially conical and hollow, without paleae. The base of the corolla of ligulate florets consists of a light yellow to brownish-yellow tube extending to an elongated-oval, white ligule. The corolla of tubular florets is yellow and broadens at the apex, where it splits into five teeth; its base is yellowish-brown to brown. The odor is strong, aromatic; the taste is bitterish-spicy, slightly mucilage-like.



**Fig.11.24.** 1 - Matricary flowers, 2 - conical and hollow receptacle, 3 - ligulate florets and 4 - tubular florets

**Anatomical characteristics.** Separate the capitulum into its different parts. Examine under a microscope using chloral hydrate solution R. The outer epidermis (abaxial) of the involucre bracts shows a scarios margin with a single layer of radially elongated cells and a central part made up of chlorophyll tissue covered with elongated epidermal cells with sinuous lateral walls, stomata and secretory trichomes. Surrounding the vascular bundles are numerous elongated, pitted sclereids with a fairly large lumen. In surface view, the corolla of ligulate florets and tubular florets show isodiametric or elongated cells with a more or less wavy wall and a few glandular trichomes. The outer part of the epidermis of the ligulate florets consists of papillary cells with cuticular striations radiating from their tips. In the mesophyll, very small clusters of calcium oxalate are sometimes seen. Four main veins run lengthwise through the entire mesophyll, sometimes accompanied by one or two other veins, which are shorter and run parallel to the main veins. The two main median veins both split into two near the tip and, with the lateral veins, anastomose two by two, forming three arcs at the three terminal teeth of the ligule. The ovaries, oval to spherical, of both kinds of florets, have at their base a sclerous ring consisting of a single row of cells. The epidermis of the ovary is made up of elongated cells with sinuous walls between which are inserted secretory trichomes. The ovaries contain numerous very small clusters of calcium oxalate. In the tubular florets, the lower part of each stamen filament is surrounded by thick-walled cells. The epidermal cells of the ends of the two stigmata are very papillose. The pollen grains have a diameter of about 30  $\mu$ m and are rounded and triangular, with three germinal pores and a spiny exine.

### Arnica flower - Flores Arnicae

**Arnica Flowers,** European Arnica, American Arnica, Wolfs Bane, Mountain Tobacco, Leopard's Bane – *Arnica montana* L, *A. foliosa*, *Arnica fulgens* Pursh, *A. sororia* Greene, and *A. cordifolia* Hooker (American Arnica)

**Family Asteraceae (Compositae)**



**Definition.** Arnica flower consists of the whole or partially broken, dried flower-heads of *Arnica montana* L. It contains not less than 0.40 percent *m/m* of total lactone sesquiterpenes expressed as helenalin tiglate, calculated with reference to the dried drug.

**Fig. 11.25.** Flowering *arnica* (A), ligulate floret (B) and tubular floret (C)

**Characters.** The capitulum when spread out, is about 20 mm in diameter and about 15 mm deep, and has a peduncle of 2 cm to 3 cm in length. The involucre consists of eighteen to twenty-four elongated lanceolate bracts, with acute apices, arranged in one or two rows: the bracts, 8 mm to about 10 mm long, are green with yellowish-green external hairs visible under a lens. The receptacle, about 6 mm in diameter, is convex, alveolate and covered with hairs. Its periphery bears about twenty ligulate florets 20 mm to 30 mm long; the disc bears a greater number of tubular florets about 15 mm long. The ovary, 4 mm to 8 mm long, is crowned by a pappus of whitish bristles 4 mm to 8 mm long. Some brown achenes, crowned or not by a pappus, may be present. It has an aromatic odour.

**Anatomical characteristics.** The powder shows the following characteristics. The epidermises of the bracts of the involucre have stomata and trichomes, which are more abundant on the outer (abaxial) surface. There are several different types of trichomes: uniseriate multicellular covering trichomes, varying in length from 50  $\mu\text{m}$  to 500  $\mu\text{m}$ , particularly abundant on the margins of the bract; secretory trichomes with uni- or biseriate multicellular stalks and with multicellular, globular heads, about 300  $\mu\text{m}$  long, abundant on the outer surface of the bract; secretory trichomes with uniseriate multicellular stalks and with multicellular, globular heads, about 80  $\mu\text{m}$  long, abundant on the inner surface of the bract. The epidermis of the ligulate corolla consists of lobed or elongated cells, a few stomata and trichomes of different types: covering trichomes, with very sharp ends, whose length may exceed 500  $\mu\text{m}$ , consisting of one to three proximal cells with thickened walls and two to four distal cells with thin walls; secretory trichomes with biseriate multicellular heads; secretory trichomes with multicellular stalks and multicellular globular heads. The ligule ends in rounded papillose cells. The epidermis of the ovary is covered with trichomes: secretory trichomes with short stalks and multicellular globular heads; twinned covering trichomes usually consisting of two longitudinally united cells, with common punctuated walls; their ends are sharp and sometimes bifid. The epidermises of the calyx consist of elongated cells bearing short, unicellular, covering trichomes pointing towards the upper end of the bristle. The pollen grains have a diameter of about 30  $\mu\text{m}$  and are rounded, with a spiny exine; they have three germinal pores.

#### **Absinthium herb - *Herba Absinthii***

**Wormwood, Absinth, Maderwort, Mugwort, Mingwort - *Artemisia absinthium* L.**

**Family Asteraceae (Compositae)**

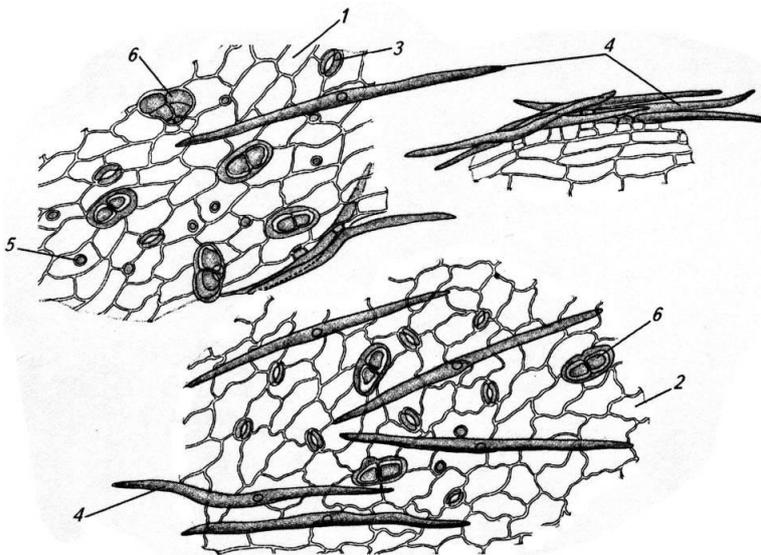
**Definition.** Wormwood consists of the basal leaves or slightly leafy, flowering tops, or of a mixture of these dried, whole or cut organs of *Artemisia absinthium* L. It contains not less than 2 ml/kg of essential oil, calculated with reference to the dried drug.



Fig. 11.26. Flowering absinth (a) and its adulterant *Artemisia vulgaris* (b)

**Description.** Stems and leaves gray-green, silky hairy and glandular throughout; the largest leaves 10 to 12 cm. in length and of almost equal breadth, 2- to 3-pinnately lobed or divided, the ultimate segments oblong or obovate, obtuse, entire or slightly toothed; upper leaves becoming gradually shorter petioled, small and narrower, the uppermost only about 2 cm. long and resembling the ultimate segments of the larger lower ones; heads greenish-yellow, racemose-paniculate, from 3 to 4 mm. in breadth, globose-ovoid, with a hemispherical involucre fragments of mesophyll; tracheae with spiral markings; or simple pores; few lignified sclerenchyma fibers; pollen grains spheroidal, up to 30 mkm in diameter; rosette aggregates of calcium oxalate about 10 mkm in diameter.

#### Anatomical characteristics



The powder shows many T-shaped trichomes (4) with a short uniseriate stalk consisting of one to five small cells, perpendicularly capped by a very long, undulating terminal cell tapering at the ends; fragments of epidermises with sinuous to wavy walls, anomocytic stomata (3) and secretory trichomes (6) each with a short, biseriate, two celled stalk and a biseriate head with two or four cells; fragments of the tubular and ray florets, some containing small cluster crystals of calcium oxalate; numerous paleae each composed of a small cell forming a stalk and a very long, cylindrical and thin-walled terminal cell

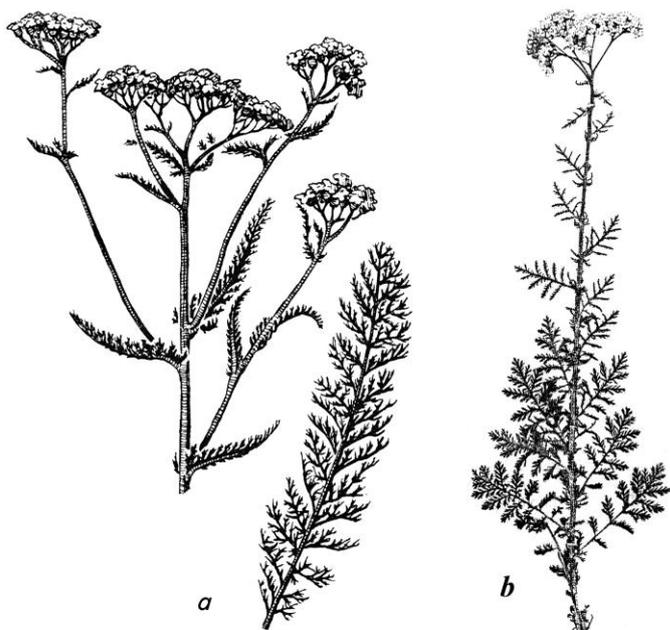
about 1 mm to 1.5 mm long; spheroidal pollen grains, about 30  $\mu\text{m}$  in diameter, with three pores and a finely warty exine; groups of fibres, small vessels with spiral and annular thickening, larger vessels with bordered pits and parenchyma with moderately thickened and pitted walls, from the stem.

#### Yarrow herb - *Herba Millefolii*

Yarrow, Milfoil, Thousand-leaf, Old-man's Pepper - *Achillea millefolium* L.

Family *Asteraceae* (*Compositae*)

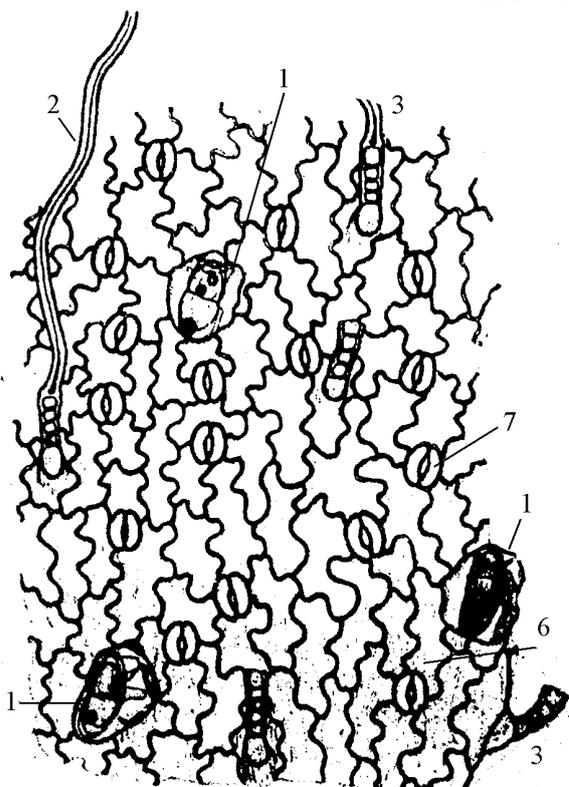
**Definition.** Yarrow consists of the whole or cut, dried flowering tops of *Achillea millefolium* L. It contains not less than 2 ml/kg of essential oil and not less than 0.02 percent of proazulenes, expressed as chamazulene ( $\text{C}_{14}\text{H}_{16}$ ;  $M_r$  184.3), both calculated with reference to the dried drug.



**Description.** The elliptical flower-heads are 3 mm broad and 5 mm long; and outside they have imbricately arranged and scarious – margined involucre bracts; they have 4-5 white or reddish ray (ligulate) florets, 3-20 disk (tubular) florets, and many narrow scarious bracts on the domed receptacle. The leaves are several times pinnately divided, so that the lamina consists mainly of thread-like or thin segments. The longitudinally ridged stem has pith and is more or less covered with matted hairs.

**Fig. 11.27. Flowering Yarrow (a) and its adulterant (relative spicie) *Achillea nobilis* (b)**

#### Anatomical characteristics



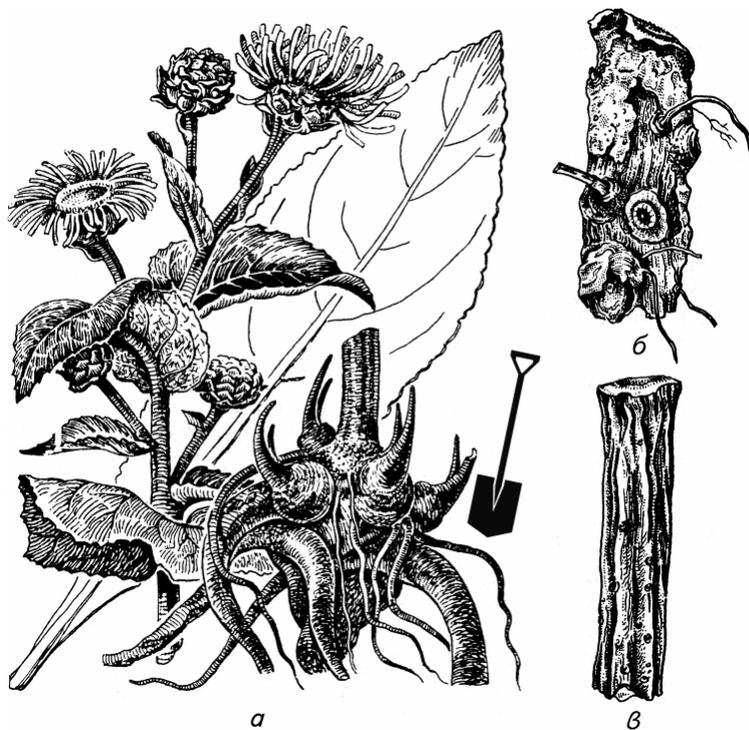
The powder shows fragments of the stems, leaves and bracts bearing very rare glandular trichomes (1) with a short stalk and a head formed of two rows of three to five cells enclosed in a bladder-like membrane and uniseriate covering trichomes (2) consisting of four to six small, more or less isodiametric cells at the base and a thick-walled, often somewhat tortuous terminal cell, about 400  $\mu\text{m}$  to greater than 1000  $\mu\text{m}$  long; fragments of the ligulate corolla with papillary epidermal cells; small-celled parenchyma from the corolla tubes containing cluster crystals of calcium oxalate; groups of lignified and pitted cells from the bracts; spherical pollen grains, about 30  $\mu\text{m}$  in diameter, with three germinal pores and spiny exine; groups of sclerenchymatous fibres and small vessels with spiral or annular thickening, from the stem.

**Elecampane root and rhizome - *Rhizoma et radix Inulae***

**Elecampane, Scabwort - *Inula helenium* L.**

**Family Asteraceae (Compositae)**

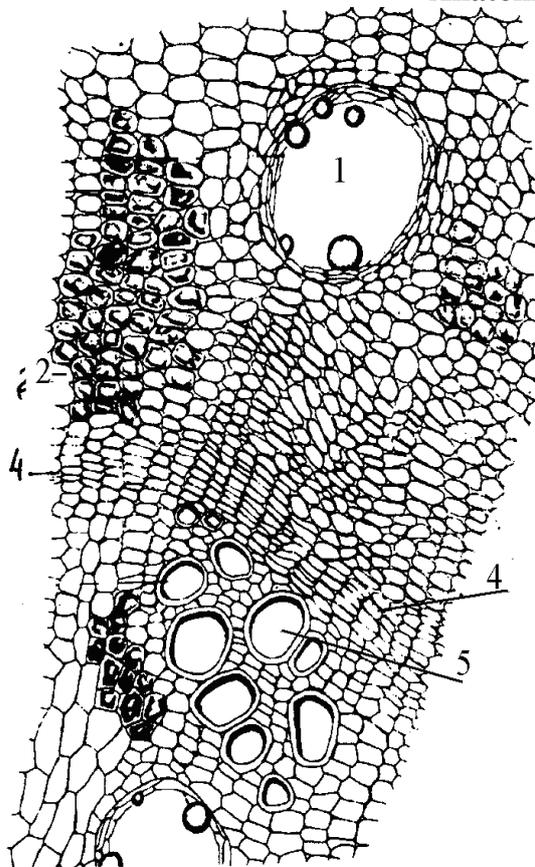
**Definition.** Rhizoma et radix Inulae consists of dried underground part of *Inula helenium* L., it contains not less 1.8% of volatile oils.



**Fig. 11.28.** Flowering elecampane (A) and its rhizome (B) and root (C)

**Description.** Rhizome fleshy and fusiform when entire, branching, usually cut into longitudinal or oblique or occasionally transverse pieces, to which may be attached one or more roots; of variable length and up to 4 cm. in diameter; externally grayish brown to dark-brown, longitudinally wrinkled, with occasional buds or stem scars; inner or cut surface somewhat concave, the edges incurved with the overlapping bark yellowish-brown to grayish-brown, longitudinally striate and more or less fibrous near the cambium zone; fracture short and horny; inner surface light brown and showing circular or elliptical markings; roots cylindrical and tapering, frequently twisted up to 15 cm. in length and 1.6 cm. in diameter; odor characteristically aromatic, taste aromatic, then acrid and pungent.

#### Anatomical characteristics



Transverse sections of rhizomes exhibit the following characteristics passing from periphery toward the center: *Cork*, of several rows of thin-walled, brownish, tabular cells. *Cork*. *Cambium* (4), of meristematic cells. *Cortex* (2), a zone of many layers of parenchyma cells containing inulin masses. *Pericycle*, of several layers of parenchyma cells. In old rhizomes this region contains many discontinuous groups of sclerenchyma fibers. *Phloem*, consisting of radially arranged phloem patches separated by broad medullary-rays. Circular oleoresin reservoirs (1) are arranged in nearly radial rows and form interrupted circles in this region and the cortex. *Cambium*, of meristematic cells. *Xylem*, in young rhizomes, consisting of radiate wedges separated by broad medullary-rays which contain oleoresin reservoirs. Each xylem patch consists of a matrix of inulin-containing wood parenchyma (2), imbedded in which are a number of pitted and reticulate tracheas associated occasionally with a few strongly lignified wood fibers. Xylem in old rhizomes shows narrow medullary rays and thick-walled, lignified wood fibers replacing wood parenchyma. Pith, consisting of large-celled parenchyma containing inulin in smaller amounts than in the cortex. Intercellular-air-spaces in this zone are large.

**Calamus Root - *Rhizoma Calami***

**Sweetflag, Sweet Flag, Sweet Root - *Acorus calamus* L.**

**Family *Araceae***

**Definition.** Rhizoma Calami consists of dried rhizome of *Acorus calamus* L.

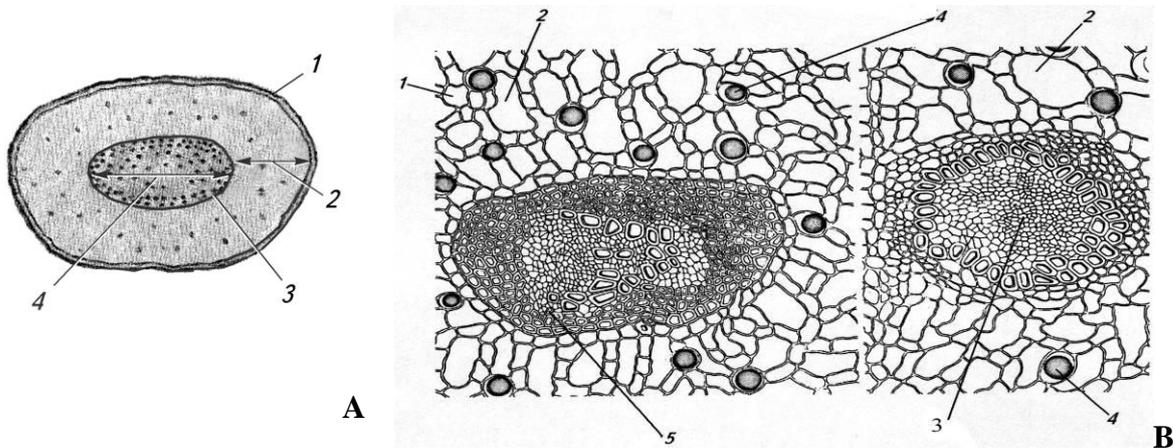


*Fig. 11.29. Calamus* (A) and its rhizome (B)

**Description.** Rhizome horizontal; in peeled, subcylindrical, entire or longitudinally spin segments, up to 22 cm. long and up to 2 cm. thick; very pale orange to weak yellowish-orange to pinkish-brown or pinkish-white, the upper surface longitudinally furrowed, lower surface with circular, pitted scars of rootlets arranged in irregular, zigzag lines; fracture short, sharp and corky; inner surface whitish or pinkish-white and spongy, showing an elliptical endodermis separating the outer

cortex from the central cylinder, both of these regions exhibiting yellowish dots; odor aromatic; taste pungent and bitter.

**Anatomical characteristics**



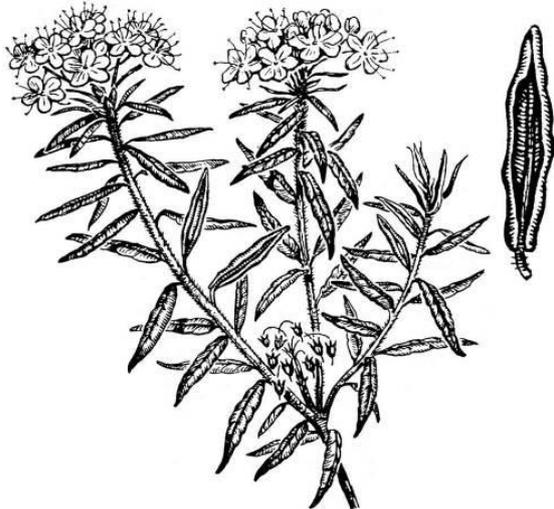
Transverse sections of the unpeeled *Calamus* exhibit an outer epidermis or cork (A,1) beneath which is to be seen a broad cortex separated from a large central cylinder or stele by an endodermis (B,5). The cells of the endodermis possess thin walls and Casparyan spots. The outer region of the cortex consists of collenchyma cells, the inner region of the cortex and all of the pith comprised largely of chains of rounded parenchyma cells surrounding large intercellular-air-spaces (B,2). A number of concentric bundles (B,3,5) with fibers occur scattered in the cortex. An occasional root trace bundle may also be evident. Most of the parenchyma cells contain small, spheroidal starch grains, but within each chain of these cells will be noted one or more spheroidal secretion sacs with suberized walls and yellowish-orange volatile oil content (B,4). Phlocentric vascular bundles without fibers are scattered throughout the stele and occur more numerous just beneath the endodermis, where they appear crowded.

*Calamus Rhizome*. Transverse section shows: crystals of calcium oxalate; secretion sacs containing volatile oil; central cylinder; phloem, xylem, intercellular-air-spaces; concentric fibrovascular bundle of phlocentric type.

**Shoots of Labrador tea - *Cornus Ledi palustris***

**Labrador tea - *Ledum palustre* L.**

**Family *Ericaceae***



**Description.** The raw material consists of shoots, leaves and fruits. Leaves are alternate, short-petiolate, leather-like; linear-oblong or oblong-elliptical in shape, entire; their margins are curved inwardly. The upper side of leaves is dark-green or brownish-green, shining; the lower ones are covered with rust-tomentose pubescence. Fruits are polyspermous, oblong bolls. The odor is sharp, specific. The plant is poison, the taste is not determined.

*Fig. 11.30. Flowering shoot and leaf of Labrador tea*

**Turmeric rhizome - *Rhizome Curcuma***

**Turmeric - *Curcuma longa* L.**

**Family *Zingiberaceae***

**Description.** The primary rhizomes are ovate or pear-shaped; secondary rhizomes are cylindrical. Lateral rhizomes are about 4-7 cm long and 1-1,5 cm thick. Their outer surface is yellowish-grey in colour, fracture is yellow.

Turmeric has an aromatic odour and worm somewhat bitterish taste.