VEGETABLE DRUGS CONTAINING ESSENTIAL OILS

Content

1. MACROMORPHOLOGICAL TESTS

Lavandulae flos — Lavender
Lavandula angustifolia Mill. — Lamiaceae (Labiatae)

Ph.Eur.

The drug consists of the dryed flowers. The flowers are stripped during the full flowering period from the inflorescens arranged in false whorls. Petals are usually falling out during the process, the drug consists mainly of the tubular-ovoid, ribbed, bluish grey calices; these have five teeth, four of which are short, while the fifth one forms an oval or cordate projecting lip. The petals, which in the drug are much crumpled, fused into a tube with a lower lip consisting of three small lobes and an upper lip comprising two larger erect lobes; the colour varies from deep bluish grey to a discoloured brown. Inside the corolla, there are four stamens and the superior ovary.
Odour: intenser, with a pleasant and aromatic scent.
Taste: bitter

Menthae piperitae folium — Peppermint leaf
Mentha piperita L. em Huds. — Lamiaceae (Labiatae)

Ph.Eur.

The drug consists of thin, brittle, ovate to lanceolate leaves, 3-9 cm long, with pinnate, often violet tinged venation and a sharply serrate margin. On examination with a hand lens, the glandular trichomes can be seen as yellow dots.
Odour: characteristic, very strong
Taste: spicy, aromatic, and cooling

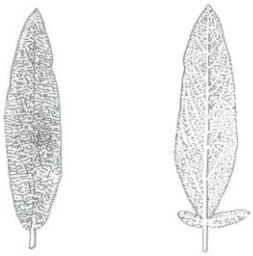
Menthae crispae folium — Spearmint leaf
Mentha spicata L. em Huds. *var. crispa* (Benth) Mansf. and *Mentha aquatica* var. *crispa* L. Benth. — Lamiaceae (Labiatae)

Ph.Hg.VII.

The material comprises much-crumpled very brittle leaf fragments in which the irregularly and coarsely serrate margin is not always easily recognized. The upper surface of the leaf is dark green and raised between the nerves, while the lower surface is light greyish green and punctate with scattered glands; the pinnate nervature is more prominent on the lower surface. There are occasional pieces of four-angled stem.
Odour: very spiny and characteristic
Taste: spicy, characteristic, not cooling (difference from peppermint)

Salviae officinalis folium — Sage leaf
Salvia officinalis L. — Lamiaceae (Labiatae)

Ph.Eur.



The long-petiolate, 3-10 cm long and up to 3 cm wide, elliptical, oblong-ovate, to lanceolate leaves are densely pubescent on both surfaces; they have a distinctly crenelated margin and deeply depressed venation which is very prominent on the lower surface, and a lamina which is rounded and sometimes singly or doubly auriculate at the base.
Odour: intensely spicy and aromatic
Taste: spicy, bitter and astringent

Melissae folium — Balm leaf
Melissa officinalis L. — Lamiaceae (Labiatae)

Ph.Eur.

The more or less long-petiolate leaves are ca. 8 cm long up to 3 cm wide, broadly ovate, and rounded or almost cordate at the base. The thin and somewhat crumpled lamina has a dark green upper surface, which is slightly pubescent, and a lighter green lower surface that is almost glabrous or only slightly pubescent along the veins and finely punctate. The margin is irregulary crenate or serrate ad the venation isthin and prominent on the lower surface.
Odour: spicy and aromatic, reminiscent of lemon; the odour may be very faint.
Taste: pleasantly spicy.

Rosmarini folium — Rosemary leaf
Rosmarinus officinalis L. — Lamiaceae (Labiatae)

Ph.Eur.

The leaves are sessile, tough, linear to linear-lanceolate, 1 cm to 4 cm long and 2 mm to 4 mm wide, with recurved edges. The upper surface is dark green, glabrous and grainy, the lower surface is greyish-green and densely tomentose with a prominent midrib.

Thymi herba Thyme
Thymus vulgaris L., *Thymus zygis* L. Lamiaceae (Labiatae)

Ph.Eur.

The drug consists of the stripped and dried leaves and flowers. The leaves are lanceolate to ovate, with an entire and revolute margin. The upper surface is green and the lower surface is grey tomentose with numerous glandular trichomes in depressions. There are no ciliate trichomes at the base of the short petiole. Only the calices of the violet flowers are recognizable; these have a short pubescence and white bristles at the base.
Odour: aromatic, strong and characteristic
Taste: aromatic and somewhat pungent.

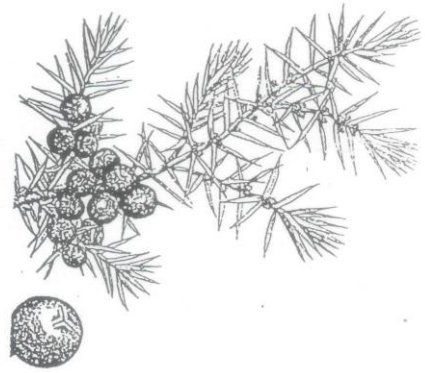
Eucalypti folium Eucalyptus leaf
Eucalyptus globulus Labill. Myrtaceae

Ph.Eur.

The leaves which are mainly greyish-green and relatively thick are elongated, elliptical and slightly sickle-shaped and usually up to 25 cm in length, and up to 5 cm in width. The petiole is twisted, strongly wrinkled and is 2 cm to 3 cm, rarely 5 cm, in length. The coriaceous, stiff leaves are entire and glabrous and have a yellowish-green mid-rib. Lateral veins anastomose near the margin to a continuous line. The margin is even and somewhat thickened. On both surfaces are minute, irregularly distributed, warty dark brown spots. Small oil glands may be seen in transmitted light.

Juniperi pseudofructus Juniper berry
Juniperus communis L. Cupressaceae

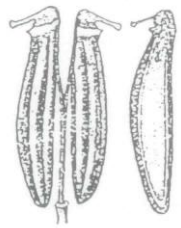
Ph.Eur.



The drug consists of the ripe, carefully dried, berry-like fruits, which are globose, violet to black-brown, often bluish-pruinose, and up to 10 mm in diameter. At the apex, there is a triadiate mark and depression, which indicate the sutures of the three scales. Quite often, the remains of the peduncle can be seen at the base of the fruit. Inside, embedded in a sticky fruit flesh, there are usually three, very hard, oblong, triangular seeds.
Odour: characteristically spicy
Taste: sweet, aromatic and spicy.

Carvi fructus Caraway
Carum carvi L. Apiaceae (Umbelliferae)

Ph.Eur.



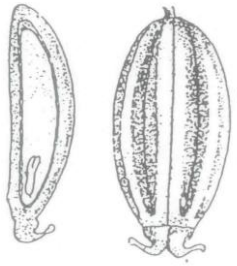
The drug consists of the mericarps of the original cremocarps (double achenes). They are glabrous, 3-6 mm long, ca. 1 mm thick, greyish brown, and mostly slightly, crescent shaped with both ends pointed. On the somewhat convex outer surface there are three, and on the edge of the slightly concave commisural surface two, straight and narrow, prominent light-coloured ridges. At the upper end, the pistil with its roundish cushion (pulvinus) is often still present.
Odour: aromatic
Taste: spicy and aromatic

Coriandri fructus Coriander
Coriandrum sativum L. Apiaceae
Ph.Eur.

The mericarps are usually tightly connected. The cremocarp is glabrous and has ten wavy, slightly raised primary ridges and eight straight, more prominent secondary ridges. The stylopod crowns the apex. The mericarps are concave on the internal surface. A small fragment of the pedicel may be present.

Foeniculi dulcis fructus Fennel
Foeniculum vulgare Mill. Apiaceae (Umbelliferae)

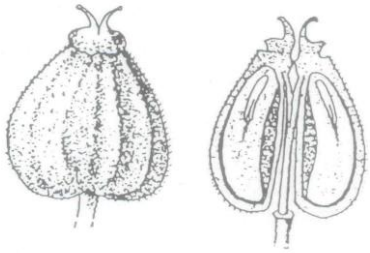
Ph.Eur.



The drug consists of the 3-12 mm long and 2-4 mm broad yellowish brown mericarps; occasionally, the mericarps are still attached to each other. Often, the remains of the pistil can be seen at the upper end of the stylopod. Each mericarp has 5 straight, projecting ridges which are particularly prominent on the commissural surface.
Odour: intensely spicy
Taste: aromatic and spicy, somawhat pungent.

Anisi fructus Aniseed
Pimpinella anisum L. Apiaceae (Umbelliferae)

Ph.Eur.



The drug consists of the ca. 2 mm long, greyish green to greyish brown, finely ridged and finely pubescent obpyriform and laterally somewhat compressed, stalked cremocarps (double achene). The mericarps have five more or less straight
Odour: reminiscent of anethole
Taste: sweetish, aromatic.

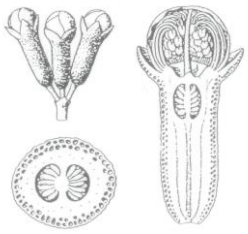
Zingiberis rhizome Ginger
Zingiber officinale Roscoe Zingiberaceae

Ph.Eur.

The whole rhizomes are about 5 cm to 10 cm long and 1 cm to 1.5 cm thick, sometimes split longitudinally. The scraped rhizome with a light-brown external surface shows longitudinal striations and occasional loose fibers; the outer surface of the unscraped rhizome varies from pale to dark brown and is more or less covered with cork which shows conspicuous, narrow, longitudinal and transverse ridges; the cork readily exfoliates from the lateral surfaces but persists between the branches.

Caryophylli flos Clove
Syzigium aromaticum L. Myrtaceae
Merr. et Perry

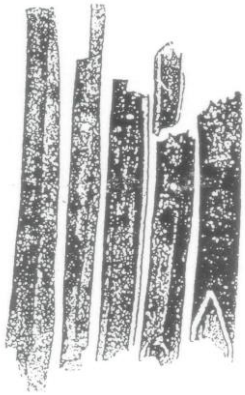
Ph.Eur.



The drug consists of the dried buds. These are dark brown, 12-17 mm long, and comprise the elongated and up to 4 mm wide hypanthium, with its four stout, projecting, calyx lobes. The four paler, yellowish brown petals form a hood (middle raw) underneath which there are numerous stamens. In the upper part of the hypanthium, there is the inferior bilocular ovary with numerous ovules. On bruising the clove with the fingernail, essential oil exudes from the spot where the pressure was applied.
Odour: strongly aromatic
Taste: pungently spicy.

Cinnamomi cortex Cinnamon
Cinnamomum aromaticum Nees. Lauraceae

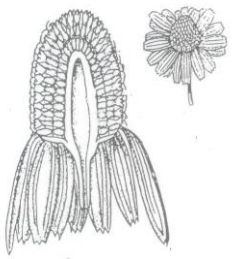
Ph.Eur.



The drug consists of the dried bask of the shoots of coppiced trees, freed from the outer cork and underlying parenchyma by scraping. The matt pieces of bark, 0.2-0.7 mm thick and in the form of single or double compound quills, are light brown on the outside and somewhat darker on the inside, the surface is longitudinally striated and the fracture is short and splintery.
Odour: characteristic and pleasantly aromatic
Taste: pungently spicy, somewhat sweet and mucilaginous, and only slightly sharp

Matricariae flos
Chamomillae anthodium — Matricaria flower
Chamomilla recutita L. — (Chamomilla flower)
(Syn. Matricaria recutita L.) — Asteraceae (Compositae)

Ph.Hg.VIII., Ph.Eur.,



The flower-heads have yellow tubular florets surrounded by a ring of white ligulate florets; the latter are often found on their own. The sharply conical receptacle of the inflorescence is hollow and it has no scales.
Odour: characteristic, strongly aromatic
Taste: somewhat bitter

Millefolii herba (Achilleae herba) — Yarrow
Achillea millefolium L., *Achillea* ssp. — Asteraceae (Compositae)

Ph.Eur.

The elliptical flower heads are ca. 3 mm broad and 5 mm long; and on the outside they have imbricately arranged and scarious-margined involucral bracts, they have 4-5 white or reddish ray (ligulate) florets, 3-20 disc (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.
Odour: aromatic, but not very strong
Taste: somewhat bitter and faintly aromatic

Absinthii herba — Wormwood
Artemisia absinthium L. — Asteraceae (Compositae)

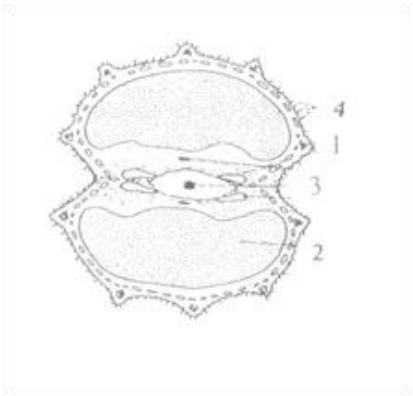
Ph.Eur.

The drug consists of the dried flowering tops of branches from plants with stems that are not more than 4 mm thick. Leaf fragments, pubescent on both surfaces and therefore appearing matt silvery grey, predominate, their origin, up to three times pinnately divided leaves, can to some extent be recognized in the ca. 2 mm wide, lanceolate fragments with a blunt to pointed tip. The yellow subspherical flowering heads bear a few ray florets and many tubular disc florets, party still in bud. The stem fragments are angled, silvery grey on the outside, and with pith inside.
Odour: aromatic and characteristic
Taste: aromatic and intensely bitter

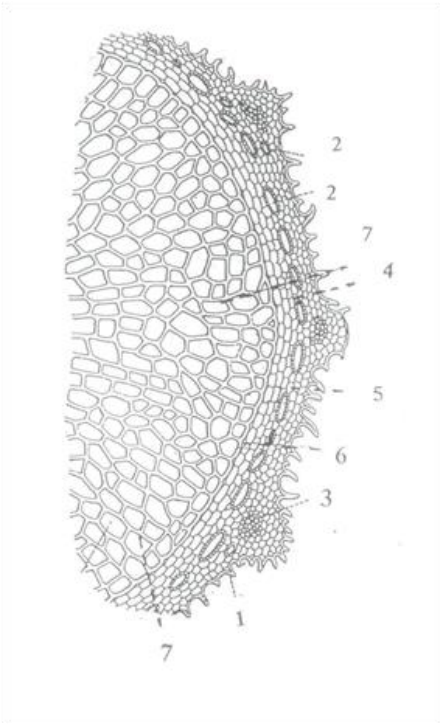
2. MICROSCOPIC TESTS

Anisi fructus - Cross section

The outline of cross-section of the mericarps is flat inside and convex outside. On the slightly five-costate external surface there are small, curved, strongly thickened trichomes with verrucose walls; in each rib there is a vascular bundle. In the mesocarp, on the flat side, there are two well-developed schizogenous volatile oil or balsam ducts, and on the bulging side 15 to 25 smaller ones; they are lined with polygonal epithelial cells of yellowish brown content. The vascular bundles leading into the carpophorum are in a more advanced stage of development and often accompanied by highly thickened fibers. In their neighbourhood, sclereids of various structure and lignified walls, as well as reticularly thickened fibers are present. The cells of the endocarp are transverselly elongated, with thin walls, arranged parallel and in line. On the flat part of mericarps the seed coat consists of several cell layers; on the convex side only of a single cell row, closely grown together with the endocarp. The edosperm consists of small white and mostly square cells with thickened walls; they contain fixed oil and aleuron granules in abundance. The latter are spherical or ovular, 5 to 15 μ in size and contain a major bloboid or 1 to 2 club-shaped calcium oxalate crystals.



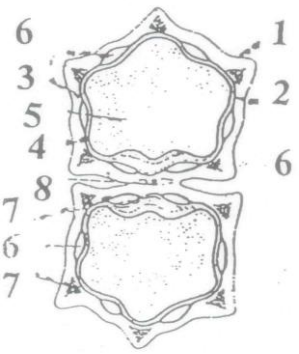
1 = Shizogenous volatile oil duct
2 = Endosperm
3 = Raphe
4 = Trichomes



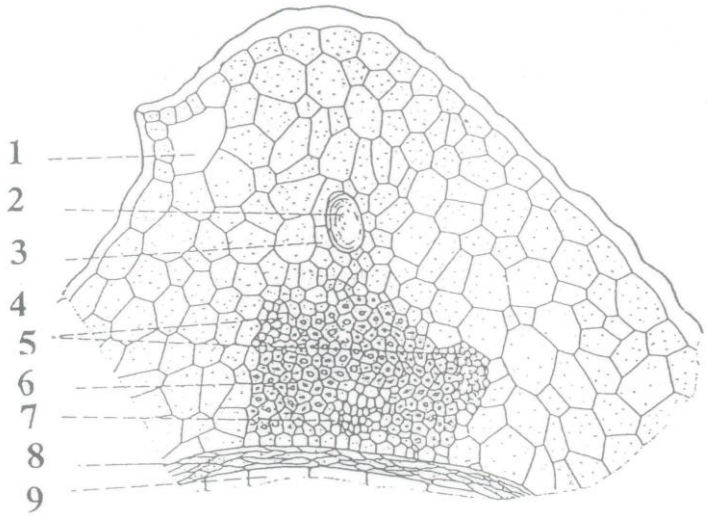
1 = Exocarp
2 = Shizogenous volatile oil duct
3 = Vascular bundle
4 = Mesocarp
5 = Endocarp
6 = Seed coat
7 = Endosperm

Carvi fructus - Cross section

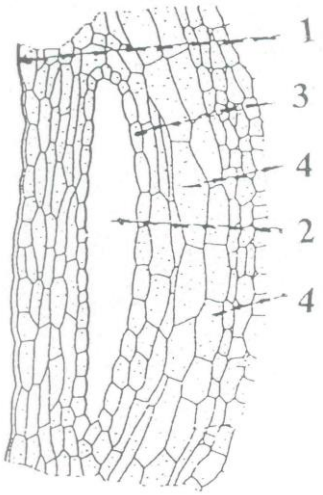
The mericarp is covered with a parallel srtriated cuticle. In cross-section the exocarp consists of a single layer of oblong or polygonal cells. The mesocarp consists manly of thin-walled parenchyma; in the direction of the hardly protruding five costae there is a small volatile oil duct and a vascular bundle surrounded by fibers; towards each of the four sulci a major essential oil duct lined with oval brown epithelial cells, and two major ducts on the ventral side 250 μm in size. The endocarp consists of tangentially elongated cells with thin walls.
The seed coat is composed of several layers. Below, are thick-walled polygonal cells of the endosperm containing fixed oil, large heterogeneous aleuron granules and club-shaped calcium oxalate crystals. The carpophore consists mainly of fibers outside the vascular bundles.



1 = Exocarp
2 = Mesocarp
3 = Endocarp
4 = Seed coat
5 = Endosperm
6 = Shizogenous volatile oil duct
7 = Vascular bundle
8 = Raphe



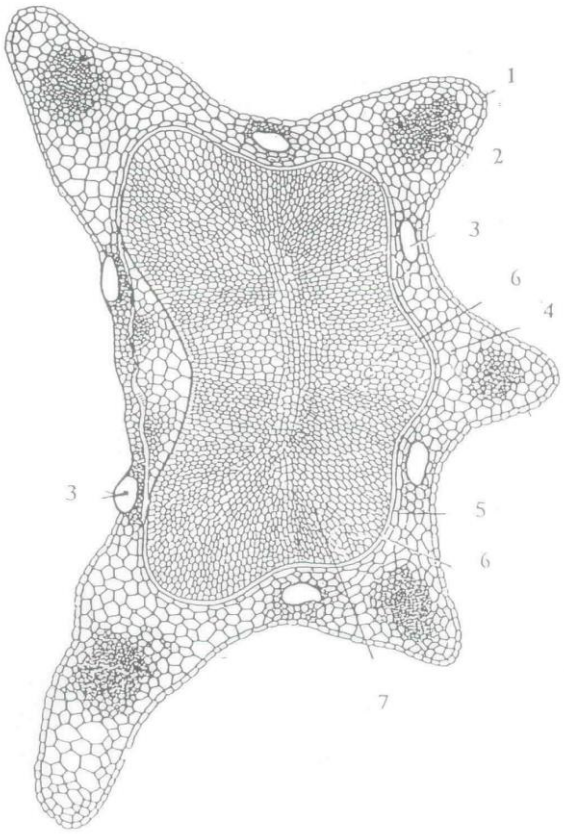
1 = Intercellulary
2 = Volatile oil duct
3 = Epithelial cells
4 = Exocarp
5 = Phloem
6 = Fiber group
7 = Xylem
8 = Endocarp
9 = Seed coat



1 = Exocarp
2 = Shizogenous volatile oil duct
3 = Epithelial cells
4 = Parenchyma

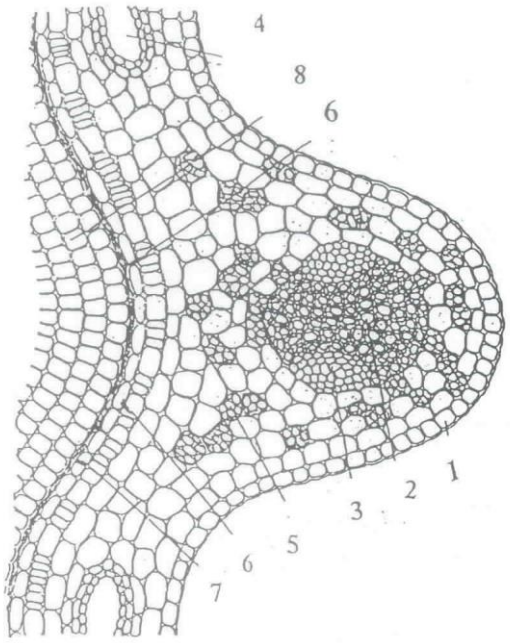
Foeniculi dulcis fructus - Cross section

The exocarp consists of a single layer of cells, tangentially elongated on the convex side, with slightly thickened external walls. The cells of the flat side are also elongated, but thin-walled and mostly compressed.
The mesocarp consists of several layers; it is, in general, a sometimes reticularly thickened parenchyma, without intercellularies. Towards the sulci one or occasionally two, and on the flat side two or rarely 3 to 4 essential oil ducts. These schizogeneous secretion ducts contain yellow secretion and are lined with yellow epithelium. Single vascular bundles towards each costa, consisting of thin-walled vessels in the middle and of phloem elements situated to the right and left (bicollateral vascular bundles). In the middle of the flat side of the mericarp also a bundle consisting almost entirely of fibers. Large, tangentially elongated endocarp cells arranged in a parqet-like pattern, furtherbelow the several-layered seed coat with its epidermis grown together with the pericarp. The internal layers consist of thin-walled isodiametrical, compressed cells, yellow to brown in colour. On the flat side of the mericarps the seed coat is wider since the parenchymatous cells are less flattened. In the middle of this tissue, there is the raphe bundle. The endosperm consists of small-sized thin-walled polygonal cells containing small drops of tixed oil, heterogeneous aleuron granules 2 to 10 μm in size and club-shaped calcium oxalate crystals.

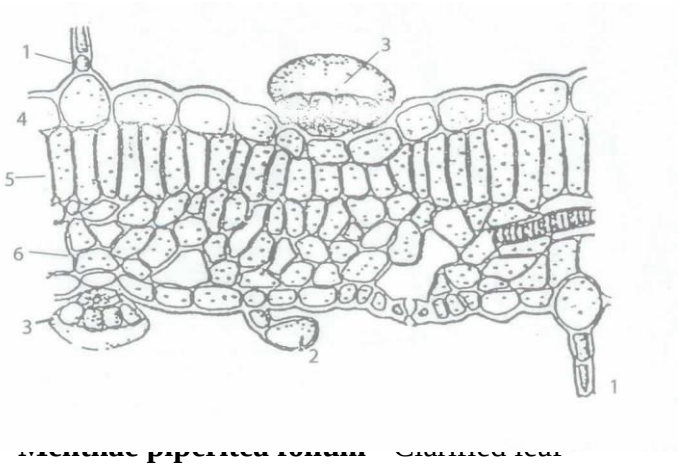


1 = Exocarp
2 = Vascular bundle
3 = Volatile oil duct
4 = Mesocarp
5 = Endocarp
6 = Seed coat
7 = Endosperm

1 = Exocarp
2 = Xylem of vascular bundle
3 = Phloem of vascular bundle
4 = Shizogenous volatile oil duct
5 = Mesocarp
6 = Endocarp
7 = Seed coat
8 = Endosperm

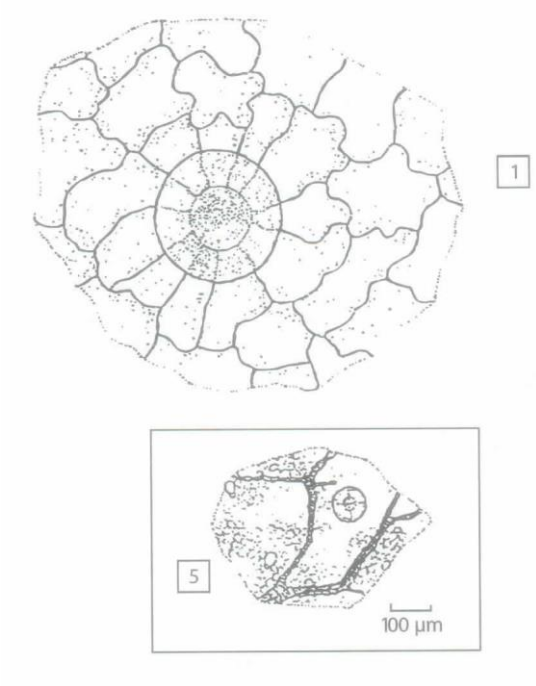


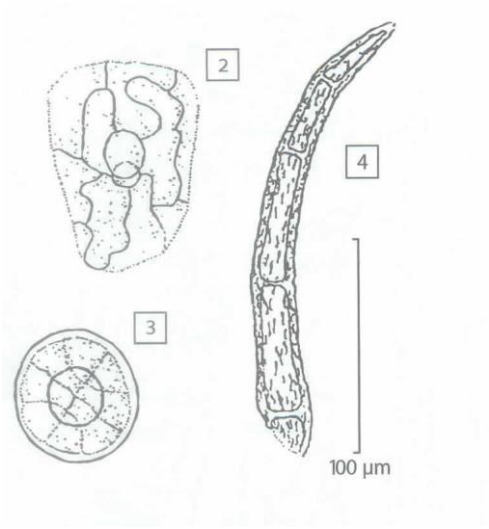
Menthae piperitae folium - Cross section



1. Covering trichome
2. Glandular trichome
3. Labiatae trichome
4. Epiderm
5. Palisad parenchym
6. Spongy parenchym

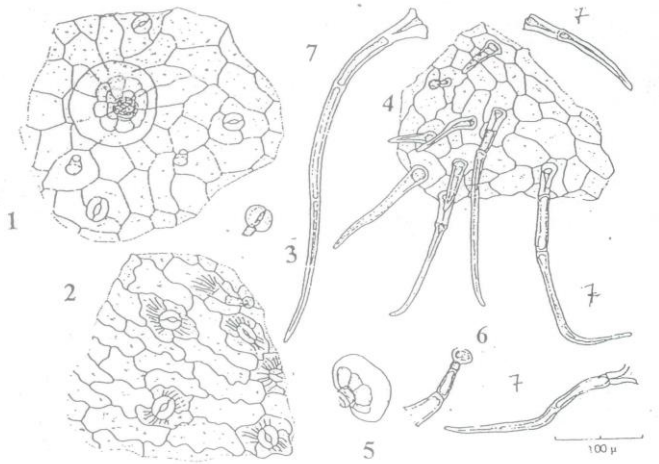
Menthae piperitae folium - Glandular leaf





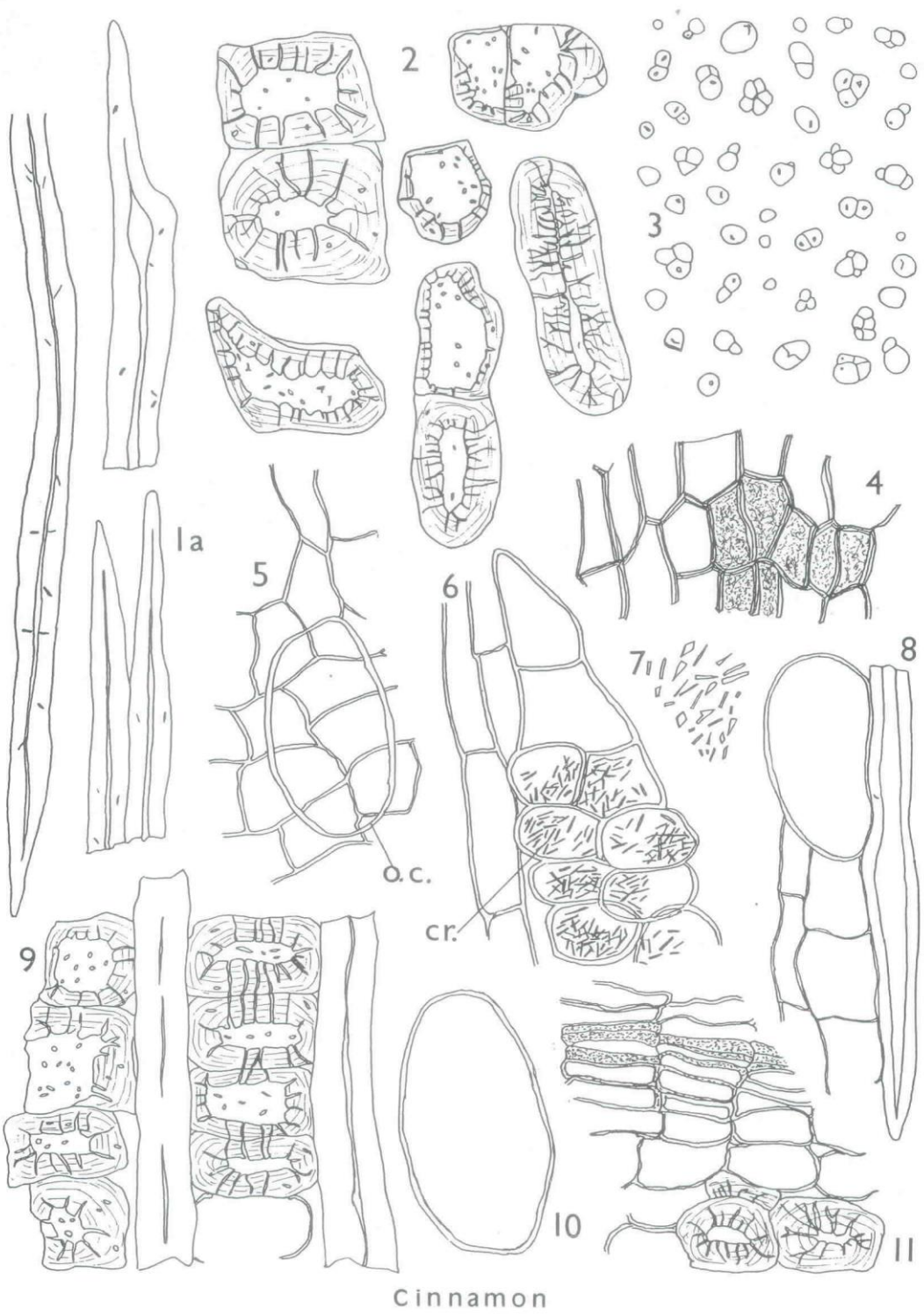
1. Outer epiderm with trichome
2. Epiderm fraction with glandular trichome
3. Labiatae trychome of 8 cells
4. Covering trichome consists of several cells of thickened wall
5. Fraction of leaf with glandular trichomes

Salviae folium - Powder preparations



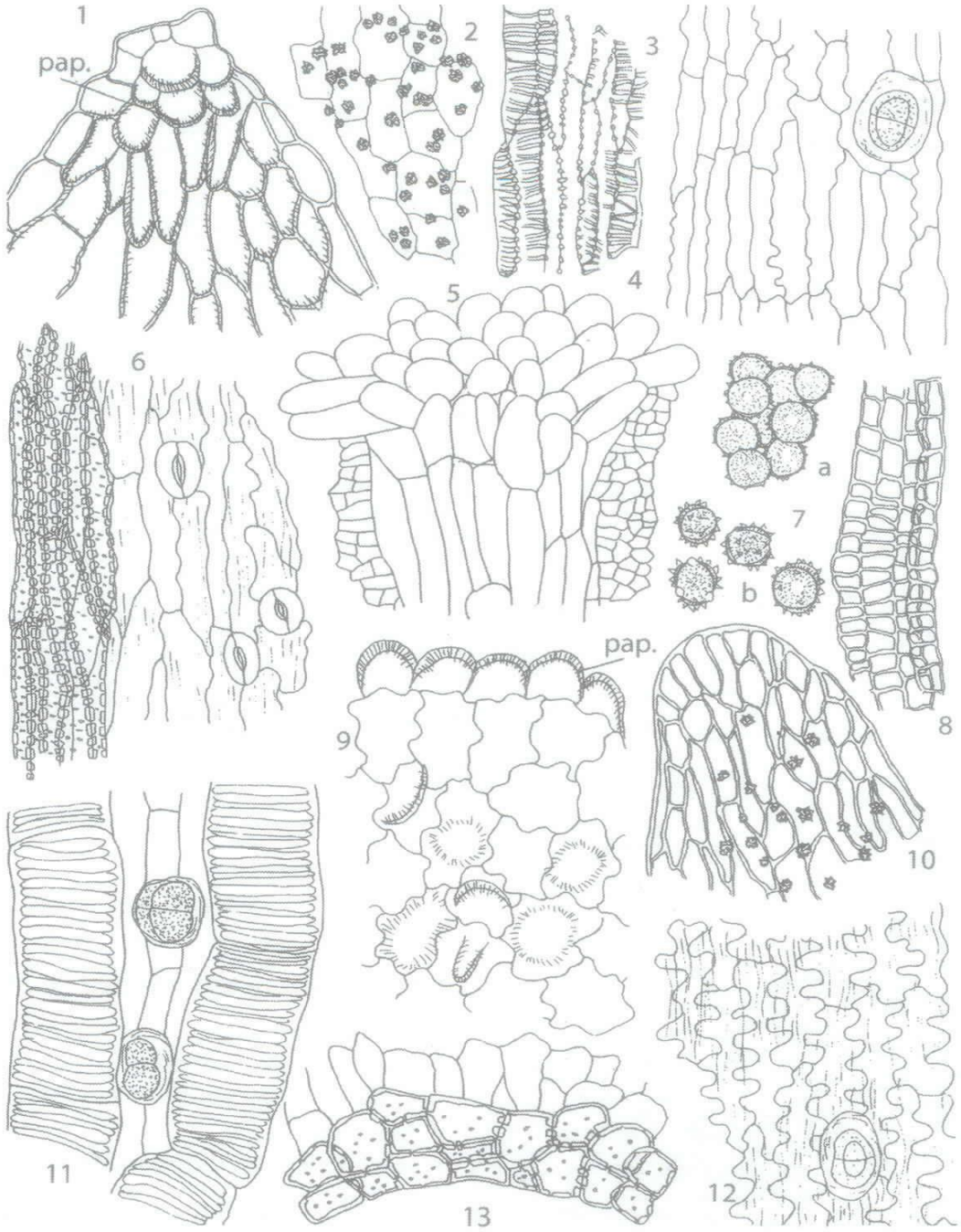
1 = Upper epidermis in surface view showing diacytic stomata and multicellular-headed glandular trichome.
2 = Lower epidermis in surface view showing diacytic stomata.
3 = Glandular trichome.
4 = Part of the epidermis in surface view showing numerous covering trichomes.
5 = Glandular trichome in side view.
6 = Capitale glandular trichome.
7 = Covering trichome.

Cinnamomi cortex



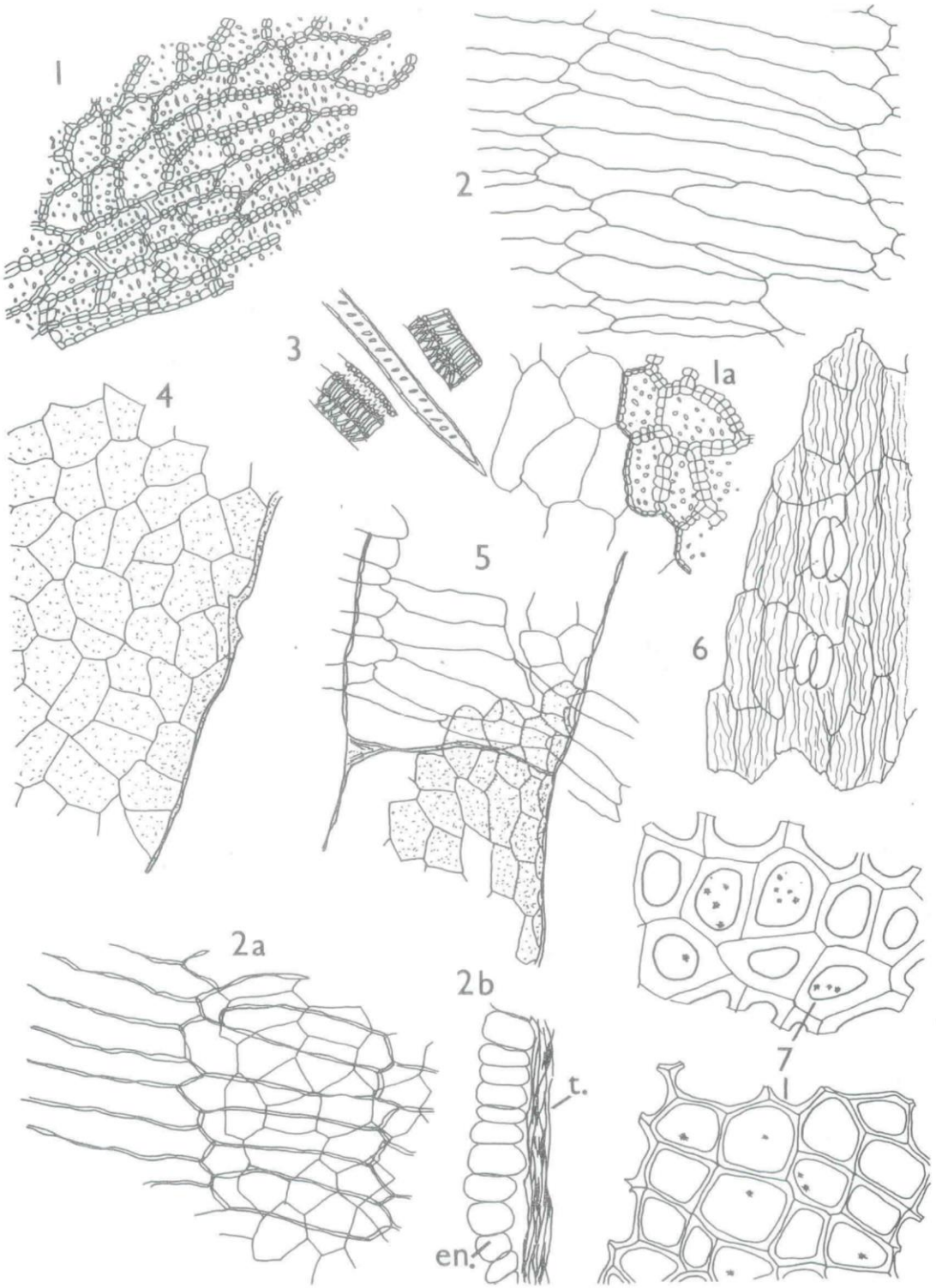
1 Fibers.
1a Part of a small group of fibers.
2 Sclereids.
3 Starch granules.
4 Cork in surface view.
5 Phloem parenchyma and an oil cell (o.c.).
6 Part of a medullary ray with some of the cells containing acicular crystals of calcium oxalate (cr.), and associated phloem parenchyma in tangential longitudinal section.
7 Calcium oxalate crystals.
8 Part of a fiber with an associated oil cell and phloem parenchyma.
9 Part of group of fibers and sclereids from the pericycle.
10 A single oil cell.
11 Part of the cork and cortex in sectional view

Matricariae flos



1 Inner epidermis of a lobe of the corolla of a tubular floret in surface view showing a group of papillae (pap.) near the apex.
2 Cells from the inner tissue of the ovary wall containing cluster crystals of calcum oxalate.
3 Fibrous layer of the anther in surface view.
4 Outer epidermis of the corolla of a tubular floret in surface view showing glandular trichome.
5 Papillose stigma and part of a style in surface view.
6 Part of a bract in surface view showing the thin-walled cells and stomata from the marginal region and elongated sclereids from the central region.
7 (a) A group of immature pollen grains.
8 Part of the filament of an anther in surface view.
9 Inner epidermis of the corolla of a ligulate floret in surface view showing cells of the margin with papillae (pap.).
10 The tip of an anther lobe in surface view showing cluster crystals of calcium oxalate in the underlying tissue.
11 Part of the ovary wall in surface view.
12 Outer epidermis of the corolla of a ligulate floret showing striations and a glandular trichome.
13 Sclereids from the base of the ovary wall.

Carvi fructus



Caraway

×330

1 Part of a group of sclereids from the mesocarp.
1a Thicker-walled sclereids with adjacent thin-walled parenchyma.
2 Endocarp in surface view.
2a Endocarp in surface view with underlying testa.
2b Endocarp (en.) and testa (t.) in sectional view.
3 Elements of the fibro-vascular tissue.
4 Fragment of a vitta.
5 Part of a vitta showing a transverse septum, with underlying endocarp in surface view.
6 Epicarp in surface view showing stomata and striated cuticle.
7 Endosperm containing microrosette crystals of calcium oxalate.

3. PHYSICOCHEMICAL AND CHEMICAL QUALITY TESTS

3.1. Organoleptic characteristics of essential oils. Colour, odour, taste

Macroscopical test: Study the colour, transparency and consistency of 1 ml essential oil in a dry, colourless (16 x 160 mm) test-tube.

Odour: Drop 1-2 drops of essential oil to a 1 x 6 cm filter paper strip and smell it after drying.

Taste: Mix 1 drop of essential oil with 2 g of sucrose, shake it with 500 ml water, then taste it.

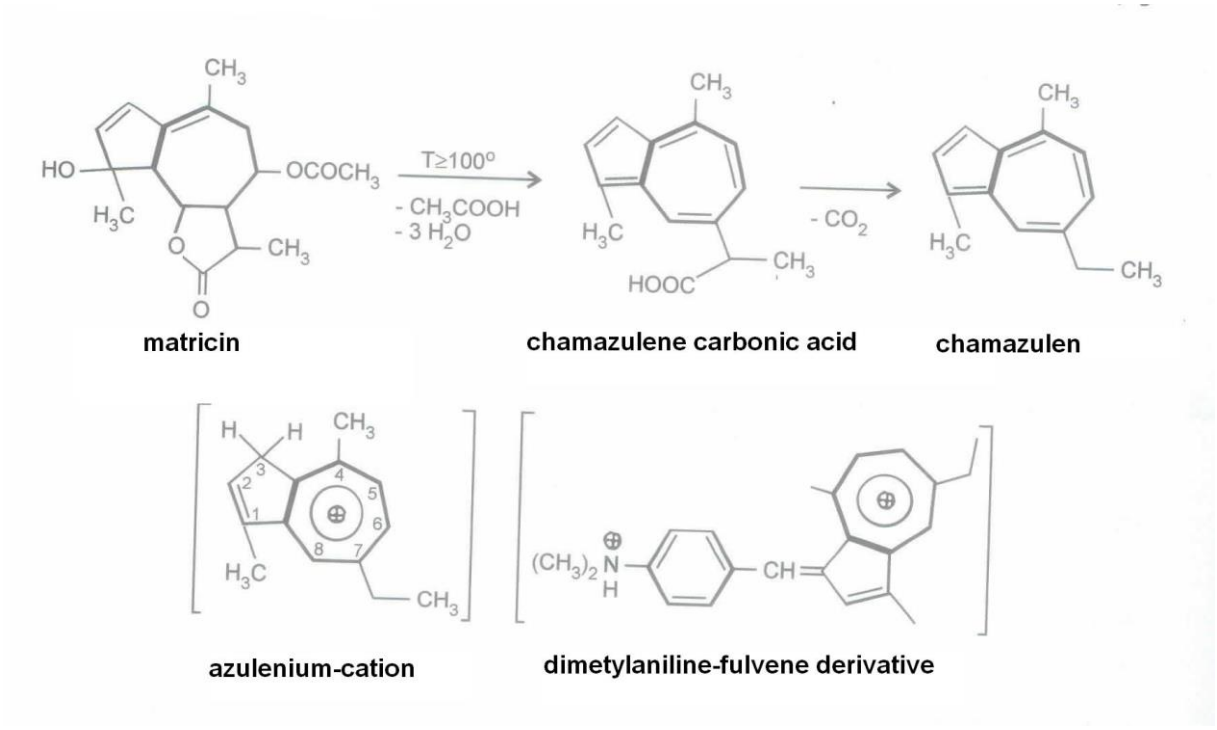
3.2. Refractive index

Determine the refractive indices of the essential oils by Abbe-refractometer.

3.3. Test tube reactions.

Detection of proazulenes in Chamomillae anthodium and Millefolii herba based on EP-reaction.

Extract 1 g powdered Matricariae flos or Millefolii herba with 10 ml $CHCl_3$ in a porcelain mortar by rubbing. After filtration, evaporate the solvent in a porcelain dish under the hub. Add to the residue the mixture of 1 ml water and 2.5 ml EP reagent (p-dimethylaminobenzaldehyde + H_3PO_4 + CH_3COOH). Pour the reaction mixture into a test tube and keep it at 100 °C on water bath for 5 min. After cooling, add 5 ml of petroleum eter and shake it. The lower phase (water phase) is blue or greenish-blue.
Note: azulenes are present in Matricariae flos and Millefolii herba as **proazulenes** (e.g. matricin in Matricariae flos) which will be transformed to **chamazulene** in the presence of acids. Reaction with dimetylaminobenzldehyde results in a dimethylanilin-fulven derivative. Petroleum ether removes pigments from the reaction mixture.



3.4. Detection of proazulenes by histochemical reaction.

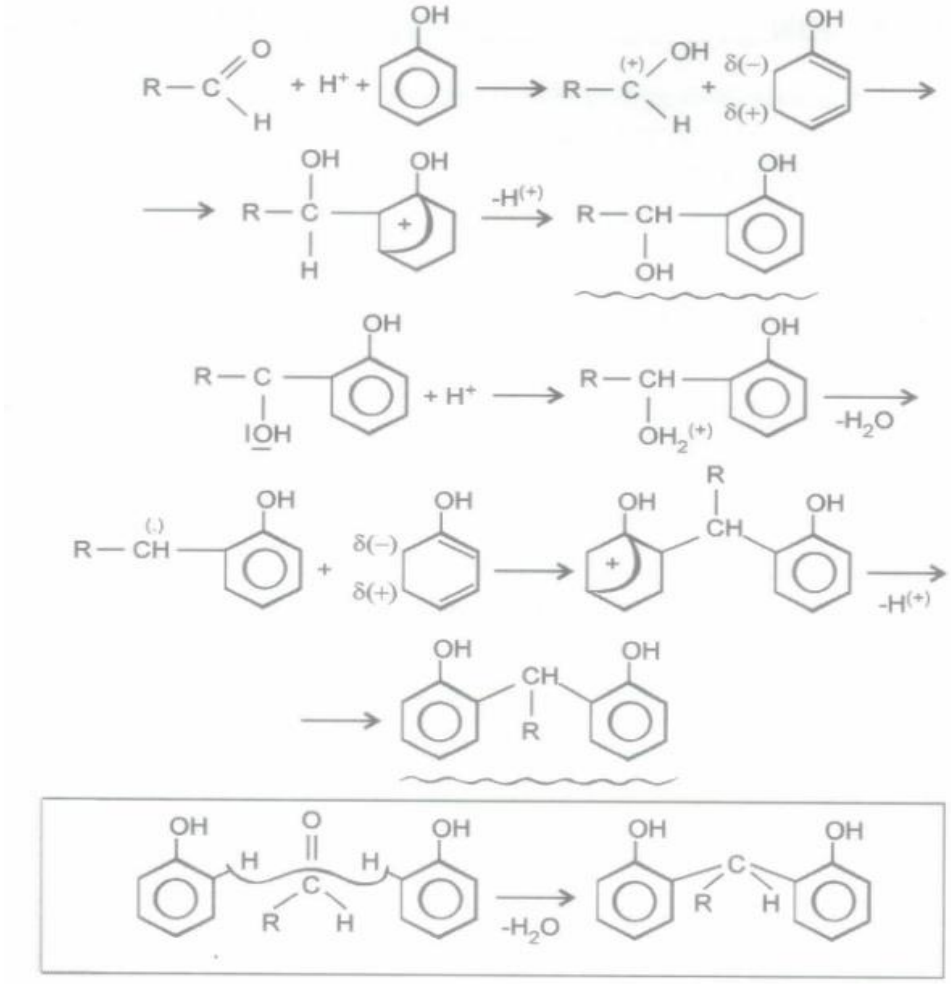
Keep some chamomile flowers in a tank containing Cl_2-gas (1 g $KMnO_4$, HCl).
Essential oil containing glandular trichomes become blue by the formation of chamazulene.

3.5. Thin layer chromatographic studies of essential oils.

Samples:
- Dilute the essential oils prepared by steam distillation 20 times with ethanol. Use 20 µl for TLC.
- Test essential oils: 100 µl essential oil + 5.0 ml $CHCl_3$ (20 µl)
  In the case of Matricariae aetheroleum use n-hexane as solvent
- Standards: 50 mg + 5.0 ml $CHCl_3$ (5 µl)

Chromatographic parameters:
Sorbent: Silicagel-GF254 (0.25 mm), Merck (6 x 10 cm)
Solvents: n-hexane–ethyl acetate 90:10
n-hexane
Reagents:
A) General Reagents:
- **Vanillin-sulphuric acid** (5.0 ml a/ +5.0 ml b/ solution)
  a/ 3 g vanillin in 100 ml ethanol (96% ^{v}/v)
  b/ 6 g sulphuric acid in 100 ml ethanol (96% ^{v}/v)

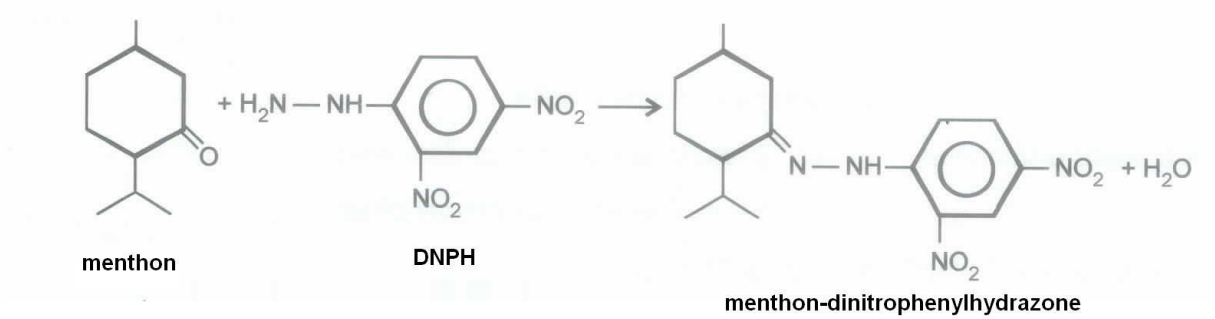
Heat at 100 °C till the appearance of the spots!
Reactions:



B) Specific reagents

- **Aldehydes, ketones: DNPH (dinitrophenylhydrazine)**

(1 g DNPH dissolved in 40 ml of water-concentrated sulphuric acid (1:1) solution, + 60 ml water)



menthon DNPH menthon-dinitrophenylhydrazone

C)

- **EP reagent for the detection of chamazulene**

(0.25 g p-dimethylaminobenzaldehyde dissolved in mixture of 45.0 ml glacial acetic acid + 5.0 ml concentrated phosphoric acid + 45.0 ml water)

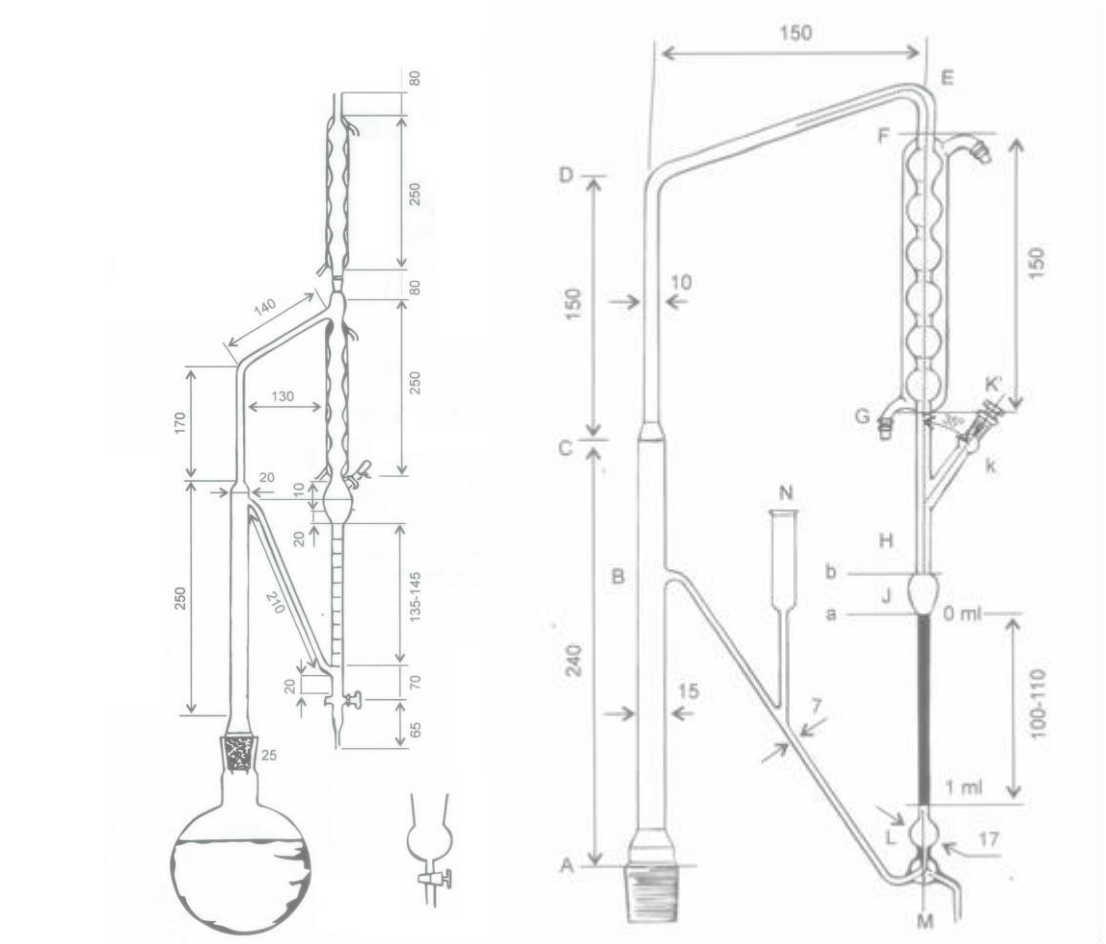
Protocoll of thin-layer chromatography

Drug	**Essential oils**	**Solvent**	**Reagent**	**Standard**
Lavandulae flos	Aetheroleum lavandulae	n-hexane − ethyl acetate (9:1)	vanillin-sulphuric acid	linalool
Coriandri fructus	Aetheroleum coriandri	n-hexane −ethyl acetate (9:1)	vanillin-sulphuric acid	linalool
Carvi fructus	Aetheroleum carvi	n-hexane −ethyl acetate (9:1)	DNPH (sulphuric acid)	carvone
Matricariae flos	Aetheroleum chamomillae	n-hexane − ethyl acetate (9:1) n-hexane	1. vanillin-sulphuric acid 2. EP	1. α-bisabolol 2. gvajazulene
Menthae piperitae folium	Aetheroleum menthae piperita	n-hexane −ethyl acetate (9:1)	1. vanillin-sulphuric acid 2. DNPH (sulphuric acid)	1. menthol 2. menthon
Menthae crispae folium	Aetheroleum menthae crispae	n-hexane − ethyl acetate (9:1)	1. vanillin-sulphuric acid 2. DNPH (sulphuric acid)	1. menthol 2. menthone 2. carvone

4. QUANTITATIVE DETERMINATION

4.1. Quatitative determination of essential oil contetnt of plant drugs. (Ph.Hg. VII.)

Apparatus: Ph.Hg.VII. and Ph.Eur. (PhHgVIII.).



Ph.Hg. VII. Ph.Eur.

Distillation time: 2.5 hours

Plant drug	Quantity of plant drug	Quantity of water	Method	Expected essential oil content g/100g	ml/100g
Matricariae fols	20	500	gravimetry	0.4	
Lavandulae flos	20	500	volumetry		1.5
Carvi fructus	10	400	volumetry		2.5
Menthae piperitae folium	15	500	volumetry		1.5
Menthae crispae folium	20	400	volumetry		1.0
Coriandri fructus	20	400	volumetry		0.8