

**MORPHOLOGICAL, ANATOMICAL ANALYSIS OF ACYCLIC MONOTERPENS
CONTAINING MEDICINAL PLANTS AND HERBAL DRUGS**

Coriander fruit - *Fructus Coriandri*

Coriander - *Coriandrum sativum* L.

Family *Apiaceae* (*Umbelliferae*)

Definition. *Fructus Coriandri* consists of the dried fruits of *Coriandrum sativum* L.



Description. The drug usually consists of the whole cremocarps, which, when ripe are about 2-4 mm in diameter. Each cremocarp consists of two hemispherical mericarps, united by their margins. The apex bears two divergent styles. The ten primary ridges are wavy and inconspicuous: there are 12 more prominent, secondary ridges. The fruits have a straw - yellow colour, an aromatic odour and a spicy taste.

Fig. 11.3. A - flowering plant, b- rosette leaves, B-fruit of coriander (cremocarp)

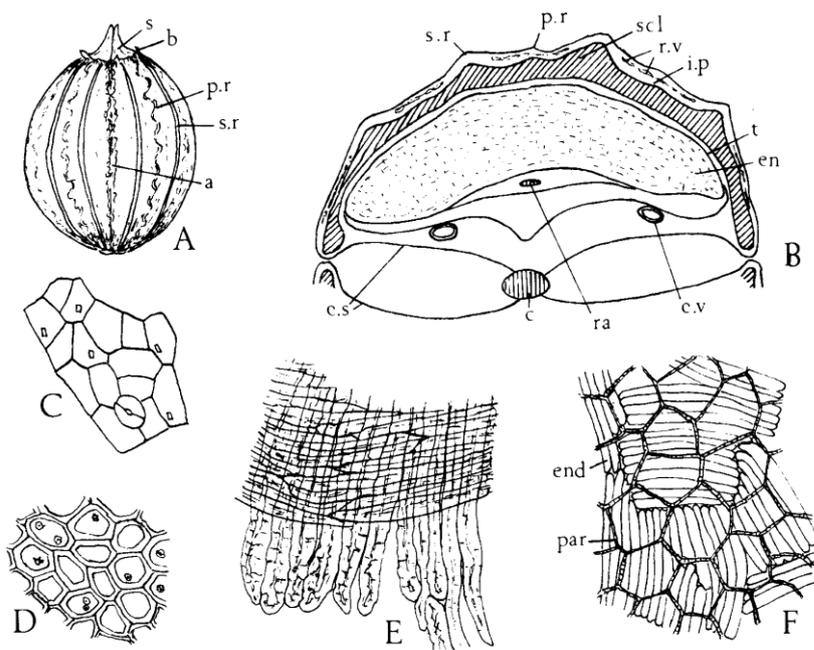


Fig. 11.4. Coriander.

A, whole fruit (x 8); B, transverse section of fruit (x 16); C, fragment of epicarp in surface view with stoma and small prismatic crystals of calcium oxalate; D, endosperm cells with microrosette crystals of calcium oxalate; E, layers of sclerenchyma from the mesocarp; F, lignified parenchyma of the mesocarp and underlying endodermis showing 'parquetry' arrangement (all x 200) a, line of attachment of mericarps; b, sepal; c, carpophore; cs, commissural surfaces; cv, commissural vitta; en, endosperm; end, endodermis; par, lignified parenchyma of mesocarp; pr, primary ridge; ra, raphe; r.v, remains of dorsal vittae; s, stylopod; sd, sclerenchyma; s.r, secondary ridge; t, testa.

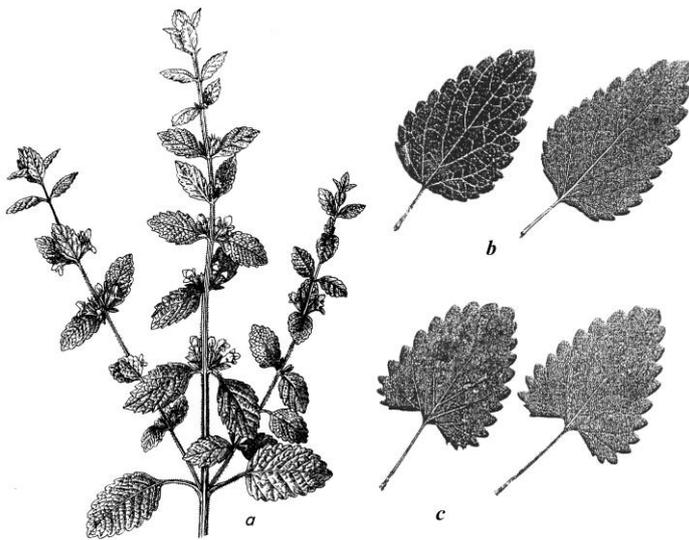
Common balm herb - *Herba Melissa*

Common balm leaf - *Folium Melissa*

Common balm - *Melissa officinalis* L.

Family *Lamiaceae* (*Labiatae*)

Definition. Melissa leaf consists of the dried leaf of *Melissa officinalis* L. It contains not less than 4.0 percent of total hydroxycinnamic derivatives expressed as rosmarinic acid ($C_{18}H_{16}O_8$, M_r 360.3), calculated with reference to the dried drug.



Description. Leaves are long-petiolate, up to 8 cm long and 3 cm wide. They have broadly ovate, and rounded or almost cordate base. The lamina has a dark-green upper surface which is slightly pubescent and a lighter green lower surface which is almost glabrous or only slightly pubescent along the veins and finely punctate. The margin is irregularly crenate or serrate and the venation is thin and prominent on the lower surface. The odour is aromatic, spicy, and reminiscent of lemon; the taste is pleasantly spicy.

Fig. 11.5. Common balm herb (a) and adulterants: b - *mellisa* leaves, c - *Nepeta* leaves

Anatomical characteristics. The powder shows fragments of the leaf epidermis with sinuous walls; short, straight, unicellular, conical covering trichomes with a finely striated cuticle; multicellular, uniseriate covering trichomes with pointed ends and thick, warty cuticles; eight-celled secretory trichomes of lamiaceous type; secretory trichomes with unicellular to tricellular stalks and unicellular or, more rarely bicellular, heads; diacytic stomata, on the lower surface only.

Adulterants: *Nepeta cataria*

Lavender flowers - *Flores Lavandulae*

Lavender - *Lavandula officinalis* L.

Family *Lamiaceae* (*Labiatae*)



Definition. Lavender flower consists of the dried flower of *Lavandula angustifolia* P. Mill. (*L. officinalis* Chaix). It contains not less than 13 ml/kg of essential oil, calculated with reference to the anhydrous drug.

Description. The drug is represented by the inflorescences, consisting of flowers, arranged in false whorls. Because, the petals readily fall off during the drying 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 are fused in to 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. The odour is intense with a pleasant and aromatic scent; the taste is bitter.

Fig. 11.6. Flowering lavender

Anatomical characteristics. The powder is bluish-grey. Examine under a microscope using *chloral hydrate solution R*. The powder shows covering trichomes bifurcating at one or more levels; secretory trichomes with short stalks and eight-celled heads of the *Labiatae* type; secretory trichomes with unicellular or multicellular stalks and unicellular heads; secretory trichomes with long uneven stalks and unicellular heads, separated from the peduncle by an

intermediary cell with a smooth cuticle; certain such trichomes show a crown of small spheroid cells just below the insertion point of the intermediary cell on the peduncle; fragments of warty epidermis from the inner surface of the petals; fragments of calyx epidermis with sinuous-walled cells and containing prismatic crystals of calcium oxalate; spherical pollen grains which have a diameter of about 45 μm and an exine with six slit-like germinal pores and six ribbon-like groins radiating from the poles.

Definition. Lavender oil is obtained by steam distillation from the fresh flowering tops of *Lavandula angustifolia* Miller (*Lavandula officinalis* Chaix).

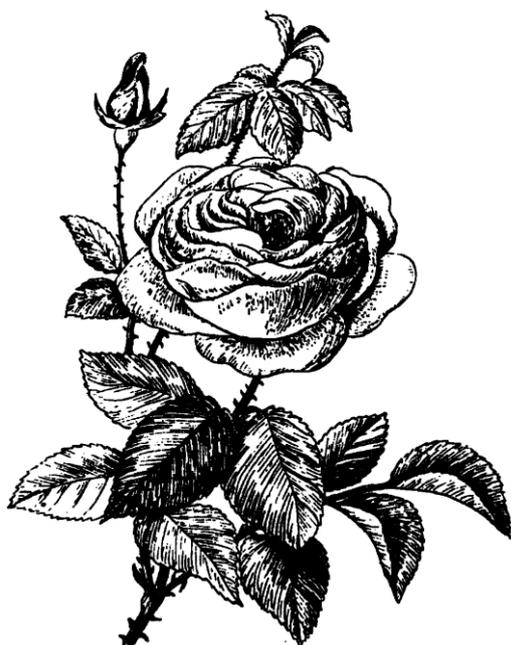
Characters. A colourless or pale yellow, clear liquid, with a characteristic odour, miscible with alcohol (90 percent V/V), with ether, and with fatty oils.

Rose flowers - Flores Rosae

Red Rose, French Rose, Provins Rose - *Rosa gallica* L.

Family Rosaceae

Definition. *Flores Rosae* consists of dried flowers of *Rosa gallica* L.



Description. The drug consists of a mixture of separate and broken petals and entire cones of numerous imbricated petals. Petals broadly ovate, summit retuse, margin entire and somewhat recurved, base obtuse, externally of a purplish-red to weak red colour in upper part, yellowish-brown to yellowish-orange in the claw; texture velvety; when dry brittle; odour rose-like; taste astringent and slightly bitter.

Fig.11.7. Flowering *Rosa gallica*

Rose flowers - Flores Rosae

Pale Rose, Cabbage Rose, Moss Rose - *Rosa centifolia* L.

Family Rosaceae

Parts used. The dried petals and nearly mature flower buds and the fresh flowers.

Habitat. Western Asia.

Description. The drug usually occurs as a mixture of unexpanded cone-shaped flower buds and some petals. Petals obovate or obcordate, retuse, pink; odour fragrant and rose-like; taste sweetish, slightly bitter and astringent.

Rose oil, Oil of Rose, Attar of Rose – *Aetheroleum Rosae*

Definition. The volatile oil distilled with steam from the fresh flowers of *Rosa gallica* L., *Rosa damascena* Miller, *Rosa alba* L., and *Rosa centifolia* L., and varieties of these species.

Rose Oil is distilled chiefly from the fresh flowers of *Rosa damascena* or Damascus Rose, *Rosa alba*, or White Rose, and *Rosa gallica* or Red Rose. It is permitted to be obtained also from *Rosa centifolia*. *Rosa damascena* and *Rosa alba* are shrubs cultivated mainly on the southern side of the Balkan Mountains in Bulgaria, the town of Kizanlik being the main centre of production. It is a colorless or yellowish liquid, viscous at 23°C., with a characteristic rose odour. If kept in a cool place it changes to a translucent crystalline mass, which may be liquefied by warming. It should be packaged and stored in well-filled, tight containers. It is used to

perfume ointments and other galenicals, especially cosmetics.

Lemon peel – Cortex (*Exocarpum*) *Limonis*

Lemon - *Citrus limon* (L.) Burmann

Family *Rutaceae*

Description. The outer, lemon yellow or dark yellow layer, separated from the fresh fruit by grating or paring, and consisting of the epidermis, numerous parenchyma cells containing yellow chromoplastids, and large oil reservoirs with globules of the volatile oil; odor fragrant, distinctive; taste aromatic.

Lemon oil, Oil of Lemon – *Aetheroleum Limonis*

Lemon Oil is the volatile obtained by cold expression from the fresh peel of the fruit of *Citrus Limon* filius with or without the previous separation of the pulp and the peel. It is a yellow or greenish yellow liquid having the odour and taste of the-outer part of fresh lemon peel; sp. gr. 0.849 to 0.855; opt. rot., +57° to +65.6° in a 100 mm. tube; ref. ind. 1.4740 to 1.4755 at 20°C.

Most of the oil of lemon used in U.S.A. is machine-produced and comes from California. Some hand pressed oil has been imported from Italy. It should not be dispensed if it has a terebinthinate odor.

MORPHOLOGICAL, ANATOMICAL ANALYSIS OF MONOCYCLIC MONOTERPENS CONTAINING MEDICINAL PLANTS AND HERBAL DRUGS

Peppermint leaf - *Folium Menthae piperitae*

Peppermint - *Mentha piperita* L.

Family *Lamiaceae* (*Labiatae*)



Fig. 11.8. Flowering peppermint (a) and mint leaf (b)

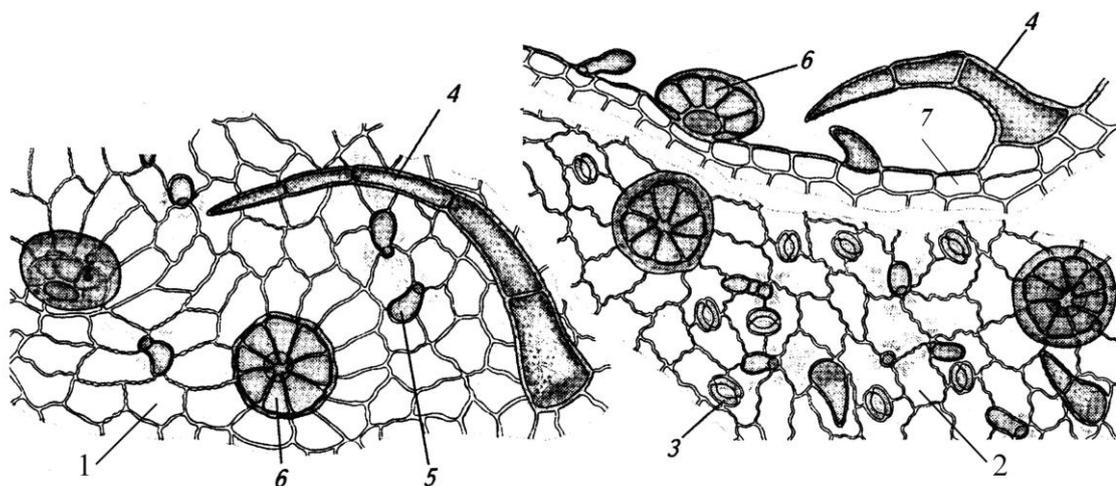
Definition. Peppermint leaf consists of the whole or cut dried leaves of *Mentha piperita* L. The whole drug contains not less than 12 ml/kg of essential oil. The cut drug contains not less than 9 ml/kg of essential oil.

Characters. Peppermint leaf has a characteristic and penetrating odour and a characteristic aromatic taste; it is green to brownish-green, with brownish-violet veins in some varieties. The petioles are green to brownish-violet.

Description. The leaf is entire, broken or cut, thin, fragile; the entire leaf is 3 cm to 9 cm long and 1 cm to 3 cm wide and often crumpled. The lamina is oval or lanceolate, the apex acuminate, the margin sharply dentate and the base asymmetrical. Venation is pinnate, prominent on the lower surface, with lateral veins leaving the midrib at about 45°. The lower surface is slightly pubescent and secretory trichomes are visible under a lens, as bright yellowish points. The petiole is grooved, usually up to 1 mm in diameter and 0.5 cm to 1 cm long.

Peppermint leaf has a characteristic and penetrating odour and a characteristic aromatic taste (the taste is burning). When chewing leaves the constituents leave the feeling of cold in the mouth.

Anatomical characters



The powder shows the following diagnostic characteristics: leaf-tissue fragments with cells (1) of the epidermis having sinuous-wavy walls and the cuticle striated over the veins and diacytic stomata (3) predominantly present on the lower epidermis; epidermis fragments from near the leaf margin with isodiametric cells (7) straighter-walled showing distinct beading and pitting in anticlinal walls; covering trichomes short, conical, unicellular or bicellular, or elongated, uniseriate with three to eight cells (4) with striated cuticle; glandular trichomes (6) of two types: unicellular base with small, rounded unicellular head 15µm to 25 µm in diameter; unicellular base with enlarged oval head 55 µm to 70 µm in diameter composed of eight radiating cells; dorsiventral mesophyll fragment with a single palisade layer and four to six layers of spongy parenchyma; yellowish crystals of menthol under the cuticle of secretory cells. Calcium oxalate crystals are absent.

Definition. **Peppermint oil** is the volatile oil distilled with steam from the fresh overground parts of the flowering plant of *Mentha piperita* L., (rectified by distillation and neither partially nor wholly dementholized). It yields not less than 5% of esters, calculated as menthyl acetate, and not less than 50% of total menthol, free and as esters.

Characters. A colourless, pale yellow or pale greenish-yellow liquid with a characteristic odour and taste followed by a sensation of cold, miscible with alcohol, with ether and with methylene chloride. **Acid value.** Not more than 1.4, determined on 5.0 g dissolved in 50 ml of the prescribed mixture of the solvents. **Relative density:** 0.900 to 0.916. **Refractive index:** 1.457 to 1.467. **Optical rotation** The angle of optical rotation is -10° to -30° .

The percentages are within the following ranges: limonene 1.0 to 5.0 percent; cineole 3.5 to 14.0 percent; menthone 14.0 to 32.0 percent; menthofuran 1.0 to 9.0 percent; isomenthone 1.5 to 10.0 percent; menthyl acetate 2.8 to 10.0 percent; **menthol 30.0 to 55.0 percent**; pulegone not more than 4.0 percent; carvone not more than 1.0 percent

Sage leaf - *Folium Salviae*

Sage - *Salvia officinalis* L.

Family *Lamiaceae* (*Labiatae*)

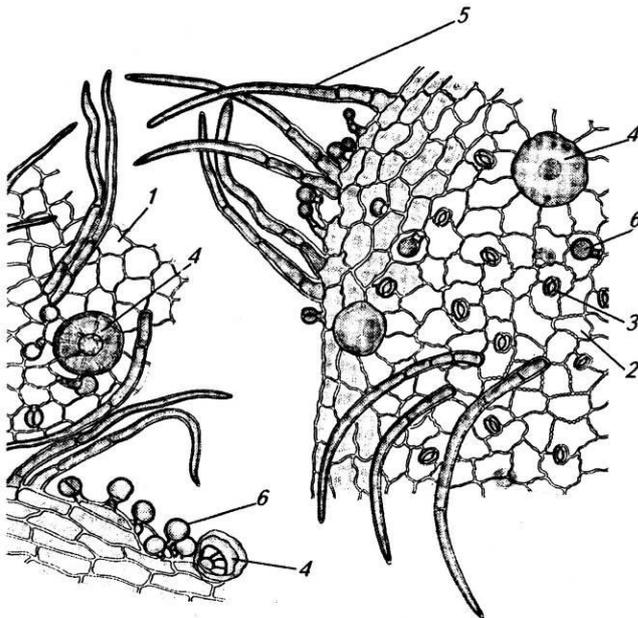
Definition. *Folium Salviae* consists of dried leaf of *Salvia officinalis* L., it contains not less 1.5% volatile oils.



Description. Leaves are petiolate, oval or lanceolate in shape. They have obtuse apex, cordate base and crenate margin. At the base of blade there are one or two oblong lobes ("auricles"). The surface of the leaves is velvety. The leaves are densely tomentose on both surfaces, more on the lower surface than on the upper. The leaves are grey - green in colour, finely downy. The odour is strong, aromatic, spicy and on rubbing clearly reminiscent of eucalyptus oil (high cineol content!). The taste is aromatic, spicy, somewhat bitter, and slightly astringent.

Fig. 11.9. Flowering sage (a) and sage leaves (b)

Anatomical characteristics



The specimen of leaf from the surface. The upper epidermal cells (1) have slightly wavy walls with beaded thickenings. The lower epidermal cells (2) have wavy walls. Stomata (3) are typical of Lamiaceae - family and are present on both surfaces, but are most common on the lower one. Essential oil glands (4) are numerous, they consist of 8 cells, arranged radially. There are simple and glandular hairs. Simple hairs (5) are numerous, smooth; they consist of 2-4 cells; at the base cells are short with thickened walls and the upper most cell is long, and curved with thin walls. Glandular hairs (6) can be of two types, one with one-celled pedicel and one - celled, rarer two-celled head; and the other with one-celled - tree-celled pedicel and one-celled globular head. Glandular hairs usually occur along the veins and along the margin of the leaf.

Three-lobed sage leaf = *Folium Salviae fruticosae*

Three-lobed sage = *Salvia fruticosa* Mill. (*S. triloba* L. fil).

Family *Lamiacea*

Definition. Three-lobed sage leaf consists of the whole or cut, dried leaves of *Salvia fruticosa* Mill. (*S. triloba* L. fil). The whole drug contains not less than 18 ml/kg of essential oil, and the cut drug not less than 12 ml/kg of essential oil, both calculated with reference to the anhydrous drug.

Characters. Three-lobed sage leaf has a spicy odour when ground, similar to eucalyptus oil.

Description The lamina of the whole three-lobed sage leaf is about 8 mm to 50 mm long and about 4 mm to 20 mm wide, and oblong-ovate to lanceolate. The margin is finely crenate and undulate but indistinct owing to the dense hairy covering on both surfaces. The base is obtuse and sometimes bears one or two more or less developed lobes. The upper surface is grey-tomentose pubescent, the lower surface is densely white-tomentose pubescent; the venation is indistinct. The densely white-tomentose pubescent petiole is about 1 mm in diameter.

Fig. 11.10. Leaf of three-lobed sage

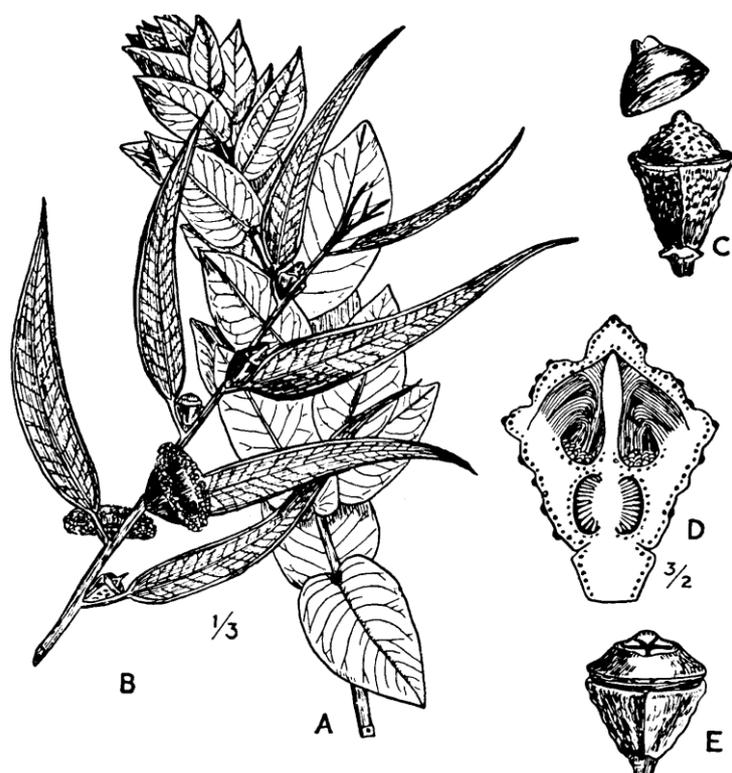
Anatomical characteristics. The powder shows very numerous, whole and fragmented, covering and glandular trichomes, scattered and attached to fragments of the epidermises; covering trichomes articulated, uniseriate, thick-walled and bluntly tapering, those on the upper epidermis straight, those on the lower epidermis longer, tortuous and more densely packed; glandular trichomes, some with a unicellular or bicellular head and a stalk consisting of from one to four cells, the majority having a short, unicellular stalk and a head composed of eight radiating cells with a raised common cuticle; the upper epidermis with pitted and beaded cells, somewhat polygonal, with a few diacytic stomata; the lower epidermis with sinuous-to wavy-walled cells and numerous diacytic stomata.

Gum-tree leaf - *Folium Eucalypti*

Gum-tree, Blue gum, Fever tree - *Eucalyptus globules Lab., Eucalyptus fructicetorum F. von Mueller (Eucalyptus polybractea R.T. Baker) and Eucalyptus smithii R.T. Baker*

Family *Myrtaceae*

Definition. Eucalyptus leaf consists of the whole or cut dried leaves of older branches of *Eucalyptus globulus* L. The whole drug contains not less than 20 ml/kg of essential oil and the cut drug not less than 15 ml/kg of essential oil, both calculated with reference to the anhydrous drug.

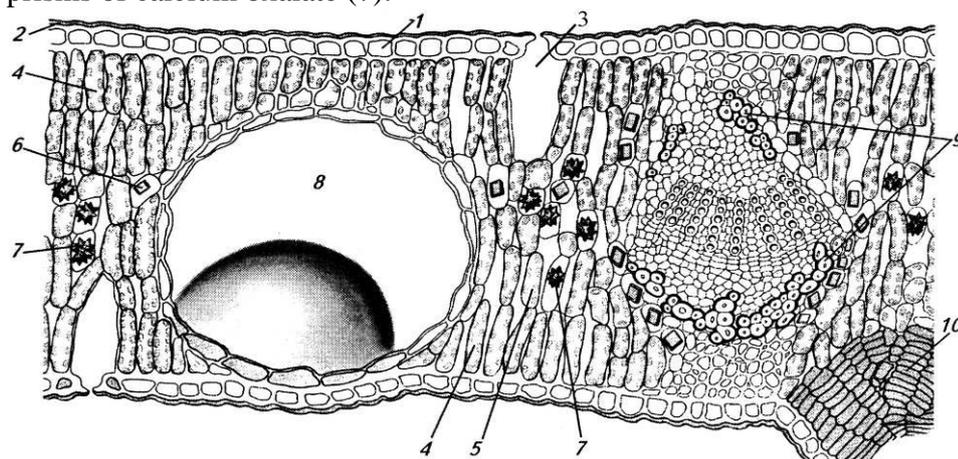


Description. The drug consists only of the mature leaves and not the oval juvenile ones. The more or less scimilar-shaped, thick, grey – green, petiolate leaves up to the 25 cm long, with the midrib clearly visible particularly on the lower surface. Leaves are entire, naked; their surface is covered with brown spots of corked tissue. The are grey-green in colour and sometimes with reddish-violet shade. The odour is strongly aromatic, especially on rubbing, reminiscent of camphor. The taste is spicy – somewhat bitter, astringent.

Fig. 11.11. *Eucalyptus globulus*.

A, Branch bearing juvenile (young) leaves; B, mature (older) branch with flowers; C, bud with outer lid; D, longitudinal section of bud with inner lid only; E, fruit.

Microscopical characters. A transverse section of leaf in chloralhydrate. Eucalyptus leaf has an isolateral structure. On both sides there are 3-4 layers of palisade mesophyll (4) and in the middle there is spongy mesophyll (5). The palisade tissue and spongy mesophyll contain druses and prisms of calcium oxalate. The cells of epidermis on both sides are covered by a layer of cuticle (2). There are conceptacles of schizolysogenous type (8), containing essential oil. Near the midrib bundle there is a zone of collenchyma (10). The midrib bundle (9) and larger veins are almost surrounded by a zone of lignified pericycle fibres and a sheath of parenchymatous cells containing prisms of calcium oxalate (7).



Eucalyptus oil

Definition. Eucalyptus oil is obtained by steam distillation and rectification from the fresh leaves or the fresh terminal branchlets of various species of *Eucalyptus* rich in 1,8-cineole. The species mainly used are *Eucalyptus globulus* Labill., *Eucalyptus fructicetorum* F. von Mueller (*Eucalyptus polybractea* R. T. Baker) and *Eucalyptus smithii* R. T. Baker.

Characters. *Aetheroleum Eucalypti*. A colourless or pale-yellow liquid with an aromatic and camphoraceous odour and a pungent and camphoraceous taste, followed by a sensation of cold. It contains not less than 70.0 percent m/m of 1,8-cineole (eucalyptol) (EPh).

Relative density: 0.906 to 0.925. **Refractive index:** 1.458 to 1.470. **Optical rotation.** The angle of optical rotation is 0° to +10°. **Solubility in alcohol.** It is soluble in 5 volumes of alcohol (70 percent V/V) *R*. The percentages are within the following ranges: α-pinene: 2 to 8 percent, β-pinene: less than 0.5 percent, α-phellandrene: less than 1.5 percent, limonene: 4 to 12 percent, 1,8-cineole: not less than 70 percent, camphor: less than 0.1 percent.

Caraway Fruit - *Fructus Carvi*

Caraway - *Carum carvi* L.

Family *Apiaceae*

Definition. *Fructus Carvi* consists of dried fruits of *Carum carvi*

Description. The drug usually consists of mericarps separated from the pedicel (double achenes). The fruit are slightly curved, brown and glabrous about 4 - 7 mm long, 1 - 2 mm wide tapered at both ends. They are crowned with a stylopod often with style and stigma attached. Each mericarp shows fine almost equal sides, five narrow primary ridges. The odour is strong, aromatic. The taste is aromatic and spicy

Anatomical characteristics. A transverse section of a caraway mericarp (Fig. 11.12, B) shows five primary ridges, in each of which is a vascular strand with associated pitted sclerenchyma and having a single secretory canal at the outer margin of each. The six vittae which appear somewhat flattened and elliptical in transverse section may attain a width of 350 p.m; they extend from the base of the fruit to the base of the stylopod. They are lined with small, dark reddish brown cells and contain a pale yellow or colourless oleoresin (Fig. 11.12, B, C). The raphe lies on the inner side of the endosperm, which is non-grooved. Occupying the majority of the transverse section is the endosperm, with thickened cellulose walls (having also deposits of a β-(1,4)-mannan as a reserve polysaccharide) and containing fixed oil and aleurone grains having one or two microsettes of calcium oxalate. The embryo, which is situated near the apex of the mericarp, will only be seen in sections passing through that region.

More detailed examination shows that the outer epidermis of the pericarp is glabrous and has a striated cuticle. The mesocarp consists of more or less collapsed parenchymia and lacks the reticulated cells of fennel. The endodermis (or inner epidermis of the pericarp) (Fig. 11.12, F) consists of a single layer of elongated cells, arranged more or less parallel to one another and not showing the 'parquetry' arrangement of coriander.

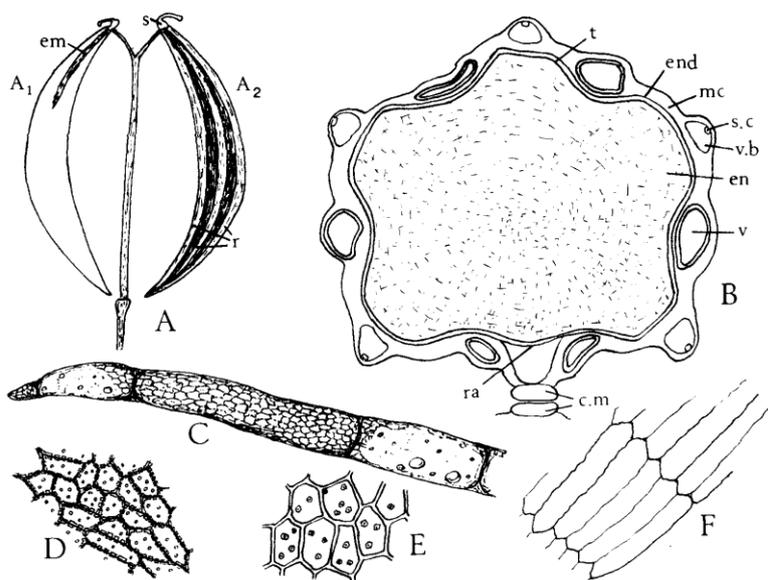


Fig.11.12. Caraway. A, mericarps showing attachments to carpophore; A₁, mericarp sectioned longitudinally to show position of embryo; A₂ mericarp side view (X 8); B, transverse section of mericarp (X 50); C, portion of vitta isolated by alkali maceration (x 25); D, sclereids of mesocarp; E, endosperm cells with micro-rosette crystals of calcium oxalate; F, endocarp layer in surface view (all X 200); *cm*, commissural meristeles; *em*, embryo; *en*, endosperm; *end*, endocarp; *mc*, mesocarp; *r*, three of five primary ridges; *ra*, position of raphe; *s*, stylopod, *sc*, secretory canal; *t*, testa; *v*, vitta; *yb*, vascular bundle with associated finely pitted sclerenchyma.

Orris rhizome - *Rhizoma Iridis*

Orris, Florentine Orris - *Iris germanica* L.

Family Iridaceae



Description. The drug is represented in dorsiventrally flattened pieces about 5 - 10 cm in length and 2- 3 cm in diameter. The drug is whitish in colour and having been peeled, is free from cork. The age of the rhizome is indicated by the number of constrictions, which represent the regions of winter growth. On the upper surface there are lines of small vascular bundles left by the leaves and on the lower surface are numerous root scars. The odour is pleasant, aromatic, like violets. The taste is slightly bitter and somewhat pungent.

Fig. 11.13. Flowering orris

Buchu leaves = *Folium Barosmae*

Buchu, Bucco; bucku; buku. = *Barosma betulinum* Bartl et Wendl (*Diosma crenulata* (L.) Hook., - *Barosma crenulata* Hook., *Barosma serratifolia* Will.)

Family Rutaceae

Definition. Dried leaves of *Barosma betulina* Bartl. Wendl. (short buchu) or of *B. crenulata* (Linn) Hooker (oval buchu), or of *B. serratifolia* Willd. (long buchu), The whole drug contains not less than 13 ml/kg of essential oil calculated with reference to the anhydrous drug.

Drscription. Low shrubs with glandular-punctate twigs and angled branches. The leaves are small, opposite, coriaceous and pellucid-punctate. The leaves are obovate or rhomboidally obovate (*B. betulina*) or linear-lanceolate (*B. serratifolia*) with more or less serrulate margins. The flowers are pink to white. The fruit consists of g follicles.

The leaves of *B.crenulata*, *B.betulina* and *B.serratifolia* are small, shortly petiolate, green to greenish-yellow in colour, and supplied with numerous oil glands which are readily visible on the holding to the light.

Round or short buchu consists of the leaves and small percentage of the stems, fruits and flowers of *Barosma betulina*. The leaves are 12-10mm long and 4-15mm broad. They are rhomboid –obovate in shape, with a blunt and recurved apex. The margin is dentate in the upper two-thirds of the leaf and serrate towards the base. A large oil glands is situated at the base of each marginal indentation and at the apex, while numerous smaller ones are scattered throughout the lamina. The leaves when dry are brittle and coriaceous, but on moistening become cartilaginous or mucilaginous. Odour and taste strong and characteristic. Reddish – brown fragments of stems, up to about 5cm in length, brown fruits with five carpels and flowers with five whitish petals are usually presents; but excessive amount of these must be regarded as an adulteration.

Oval buchu is obtained from *Barosma crenulata*. The leaves, which are accompanied by a certain amount of stem, are 15-30mm long and 7-10 mm broad. The shape is more or les oval; the apex is blunt but not recurved and possesses a terminal oil gland; marginal serration very minute.

Long buchu is obtained from *Barosma serratifolia* Willd. The leaves are 12-40mm long and 4-10 mm broad, the linear lanceolate in shape; the apex is truncate and possesses a terminal

oil gland; the margin is serrate.

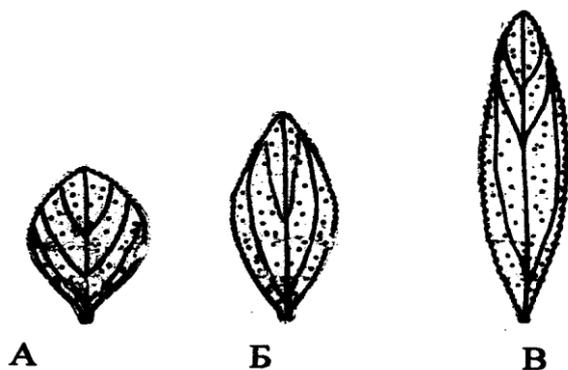


Fig. 11.14. Buchu leaves: A - leaves of oval buchu, Б - leaves of long buchu, B - leaves of buchu serratifolia

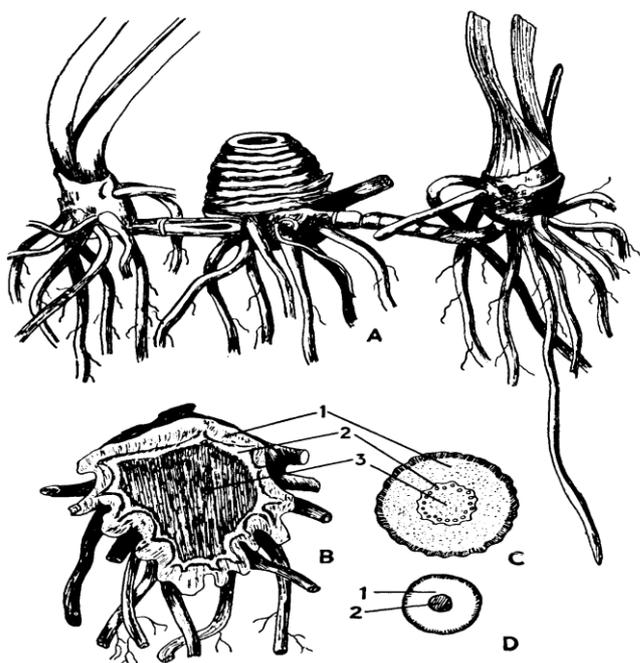
MORPHOLOGICAL AND ANATOMICAL ANALYSIS OF BICYCLIC MONOTERPENES-CONTAINING MEDICINAL PLANTS AND HERBAL DRUGS

Valerian's rhizome with root - *Rhizoma cum radicibus Valerianae*

Valerian, Cat's Valerian - *Valeriana officinalis L.*

Family *Valerianaceae*

Definition. Valerian root consists of the whole underground parts of *Valeriana officinalis L.s.l.*, including the rhizome surrounded by the roots and stolons, or by fragments of these parts. It contains not less than 5 ml/kg of essential oil for the whole drug and not less than 3 ml/kg of essential oil for the cut drug, both calculated with reference to the dried drug.



Description. The rhizome is obconical to cylindrical, up to 50 mm long and up to 30 mm in diameter; the base is elongated or compressed, usually entirely covered by numerous roots. The apex usually exhibits a cup-shaped scar from the aerial parts; stem bases are rarely present. In longitudinal section, the pith exhibits a central cavity transversed by septa. The roots are numerous, almost cylindrical, of the same colour as the rhizome, 1 mm to 3 mm in diameter and sometimes more than 100 mm long. A few filiform fragile secondary roots are present. The fracture is short. The stolons show prominent nodes separated by longitudinally striated internodes, each 20 mm to 50 mm long, with a fibrous fracture. The odor is characteristically valeric acid like, becoming stronger on ageing. The taste is camphoraceous and slightly bitter.

Fig. 11.15. Roots of Valeriana officinalis, A, Rootstock with two stolons; B, longitudinal section of rhizome; C, transverse section of stolon; D, transverse section of young root. 1, bark; 2, wood; 3, pith.

The development of the drug's characteristic odour during drying and storage results from a breakdown of the unstable valepotriates and the hydrolysis of esters of the oil to give isovaleric acid as a product, see below.



Fig. 11.16. Flowering valerian (A) and its adulterants *Filipendula ulmaria* (B), *Vincetoxinum officinale* (C)

Anatomical characteristics. A transverse section of the rhizome shows a thin periderm, a large parenchymatous cortex which is rich in starch and an endodermis containing globules of volatile oil. Within a ring of collateral vascular bundles lies large pith containing scattered groups of sclerenchymatous cells.

A transverse section of a root shows an epidermis bearing papillae and root hairs, and an exodermis containing globules of oil. The cortex and pith, the latter well-developed in old roots, contain starch. The starch is present mainly in compound grains with 2-4 components, measuring 3-20 μm in diameter.

Adulterants. 1. *Vincetoxinum officinale*; 2. *Filipendula ulmaria*

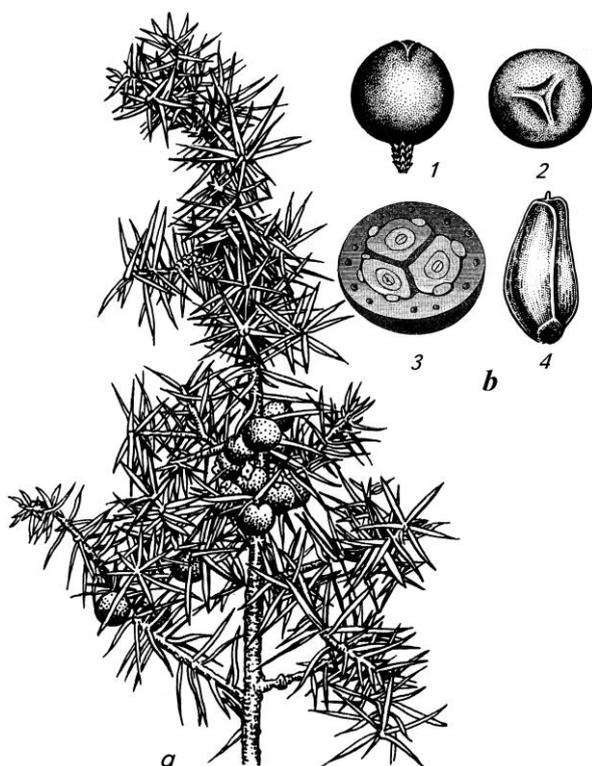
Fruits Juniper, Juniper berries, Horse Savin Berries - *Fructus Juniperi*

Juniper - *Juniperus communis* L.

Family *Cupressaceae*

Definition. Juniper consists of the dried ripe cone berry of *Juniperus communis* L. It contains not less than 10 ml/kg of essential oil, calculated with reference to the anhydrous drug.

Description The berry-shaped cone is globular up to 10 mm in diameter, violet-brown to blackish-brown, frequently with a bluish bloom. It consists of three fleshy scales. The apex has a three-rayed closed cleft and three not very clearly defined projections. A remnant of peduncle is frequently attached at the base. The fleshy part is crumbly and brownish. It contains three, seldom two, small, elongated, extremely hard seeds that have three sharp edges and are slightly rounded at the back, acuminate at the apex.



The seeds are fused with the fleshy part of the cone berry in the lower part on the outside of their bases. Very large, oval oil glands containing sticky resin lie at the outer surface of the seeds. B. Reduce to a powder. The powder is brown.

Fig. 11.17. Juniper (a) with fruits (b, 1-3 - fruit, 4 - semen)

Anatomical characteristics. Examine under a microscope, using *chloral hydrate solution* R. The powder shows fragments of epidermis of the cone berry wall containing cells with thick, pitted colourless walls and brown glandular content, occasionally with anomocytic stomata (2.8.3); fragments of the three-rayed apical cleft of the cone berry with spaces and epidermal cells interlocked by papillous outgrowths; fragments of the hypodermis with collenchymatous thickened cells; fragments of the mesocarp consisting of large thin-walled parenchymatous cells, usually rounded, with large intercellular spaces and irregular, large, usually scarcely pitted, yellow idioblasts (barrel cells); fragments of schizogenous oil cells; fragments of the testa with thick-walled, pitted colourless sclereids containing one or several prism crystals of calcium oxalate; fragments of the endosperm and embryonic tissue with thin-walled cells containing fatty oil and aleurone grains.

Juniper Oil = *Aetheroleum Juniperi* is the volatile oil distilled with steam from the dried ripe fruit of *Juniperus communis* L. A colorless or faintly green or yellow liquid with the odour of juniper berries and an aromatic, bitter taste; sp. gr. 0.854 to 0.879 at 25°C.; optical rotation, 0° to not more than -15° in a 100 mm. tube at 25°C.; refractive index, 1.4740 to not more than 1.4840 at 20°C.

Adulterants *Juniperus oxycerdrus*, *J. gratus*; *Juniper sabina* – is very toxic!

Rosemary herb - Herba Rosmarini

Rosemary - *Rosmarinus officinalis*

Family *Lamiaceae* (*Labiatae*)

Definition. Rosemary leaf consists of the whole or cut dried leaf of *Rosmarinus officinalis* L. It contains not less than 12 ml/kg of essential oil, calculated with reference to the anhydrous drug.

Description. The leaves are sessile, tough, linear to linear-lanceolate, 10 mm to 40 mm long and 2 mm to 4 mm wide, and have recurved edges. The upper surface is dark green and glabrous, the lower surface is greyish-green and densely tomentose with a prominent midrib. The odour is aromatic, characteristic; almost camphor-like the taste is bitterish-spicy than 40°C.

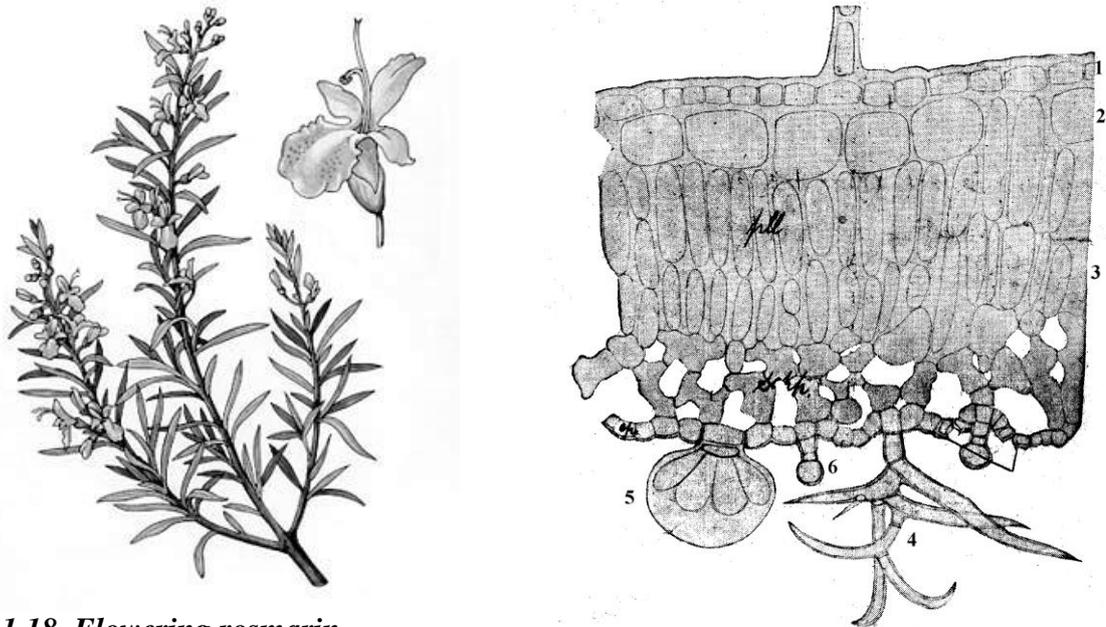


Fig. 11.18. Flowering rosmarin

Anatomical characteristics. The powder shows fragments of lower epidermis with beaded, straight to sinuous-walled cells and numerous diacytic stomata; fragments of the upper epidermis with the cells straight-walled (1), slightly thickened and pitted, with an underlying hypodermis (2) composed of from one to several rows of large, irregular cells with thickened anticlinal walls; below the hypodermis is a one or two-layered palisade arranged to form a large, crescent-shaped area; numerous multicellular, covering trichomes (4) which are mainly branched; glandular trichomes (5, 6) of two types, the majority (5) with a short, unicellular stalk and a radiate head composed of eight cells, others (6), less abundant, with a unicellular stalk and a spherical, unicellular or bicellular head

Cardamom fruit - *Fructus Cardamoni*

Cardamom - *Elettaria cardamomum* White and Maton

Family *Zingiberaceae*

Definition. Fructus Cardamoni consists of dried fruit of *Elettaria cardamomum*

Description. The cardamom fruit is ovoid or oblong woody capsule, about 1-2 cm long. The colour of capsule is yellow. The apex is shortly beaked and may show floral remains, while the base is rounded and shows the remains of the stem. Internally the capsule is three-celled, a double row of seeds attached to axial placentas occurring in each cell. Capsule has no odour and taste. Each seed is about 4 mm in length and 3 mm in breadth and somewhat angular. The colour varies from a dark reddish-brown in ripe seeds to a much paler colour in the unripe ones. Cardamom seeds have a strong aromatic odour and a pleasant aromatic, although somewhat astringent taste.

Anatomical characteristics. Sections of the seed (Fig. 11.19) show a very thin membraneous arillus, enveloping the seed and composed of several layers of collapsed cells, yellow in colour and containing oil. The brownish testa is composed of the following layers: (1) An outer epidermis consisting of a single layer of cells rectangular in transverse section, longitudinally elongated and with prosenchymatous end walls in surface view; light yellow in colour and having slightly thick end walls. (2) A single or double layer of parenchymatous cells, elongated at right angles to the long axis of the overlying epidermal cells (see Fig. 11.19, B). (3) A single layer of large parenchymatous cells containing volatile oil; in the region of the raphe there are two layers of oil cells separated by the raphe meristele. (4) Several layers of small flattened parenchymatous cells, their structure often partially obliterated. (5) An inner epidermis of sclerenchymatous cells, radially elongated, with anticlinal and inner walls very strongly thickened and reddish-brown in colour. Lumen bowl-shaped and containing a nodule of silica

(see Fig. 11.19, H). The operculum or embryonic cap is composed of two or three layers of these sclerenchymatous cells, continuous with those of the inner epidermis. The micropyle is a narrow canal passing through the operculum. Within the testa is a well- developed perisperm composed of parenchymatous cells packed with minute globular starch grains, 4 i.m in diameter and containing in the centre of each cell a small prismatic crystal of calcium oxalate. The perisperm encloses the endosperm and embryo, both composed of thin-walled cells rich in protein.

Cardamom pericarps or husks which have been used for the adulteration of powdered drugs may be identified in the form of powder by the pitted fibres and spiral vessels of the fibrovascular bundles and by the abundant, empty parenchymatous cells.

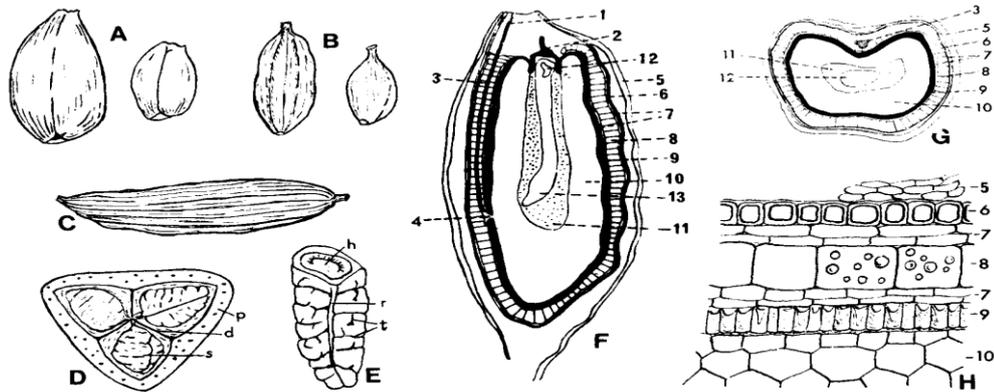


Fig. 11.19. Cardamom fruits and seeds. A, Mysore; B, Alleppy green; C, long wild native (all X 1) D, transverse section of fruit (X 15); E, whole seed (about X 4); F, longitudinal section of seed; G, transverse section of seed; H, arrangement of cells in transverse section of seed coat. *d*, Dissepiment of fruit; *p*, pericarp; *r*, raphe; *s*, seed, *t*; wrinkled testa. 1, Funicle; 2, operculum or embryonic cap; 3, raphe; 4, chalaza; 5, arillus; 6, epidermis of testa; 7, parenchyma layers of the testa; 8, oil cell layer; 9, sclerenchymatous layer of testa; 10, perisperm; 11, endosperm; 12, embryo; 13, haustorium.