

PHARMACOGNOSTIC STUDIES ON THE GENUS *SOLANUM* LINN. PART I

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ABSTRACT

The pharmacognostic anatomical studies on the high solasodine yielding berries of *Solanum viarum* Dunal, *S. elaeagnifolium* Cav. and also the leaves of *S. trilobatum* Linn., *S. nigrum* Linn., root of *S. trilobatum* Linn. which are used in the indigenous system of medicine are presented.

INTRODUCTION

Recently the drug industry has given much importance to collection of plants which yield precursors for steroid drugs. Formerly these drugs were prepared from animals and were very costly for use by the common people of our country. Many of the pharmaceutical firms are now busy in finding out suitable sources besides animal products, and better methods for the production of steroid hormones and their intermediates. As a result many wild plants which were never considered important from medicinal point of view are now considered very useful as they are found to contain good percentage of solasodine or other steroidal sapogenins which are useful for commercial exploitation by the drug industries for the preparation of steroidal drugs some of which are medically known as cortisones. Further, many steroid analogues are being prepared which have anabolic, antibacterial, anti-cancer, antifungal, hypotensive, coronary-artery dilating or anti-inflammatory activities. Concerted attempts are being devoted to obtain steroid analogues for use as oral contraceptives and considerable success has been achieved in this line also (Singh *et al.* 1965). It is for this reason the pharmacognostic studies on different species of the genus *Solanum* have been taken up.

The present paper deals with the pharmacognostic anatomical studies of the berries of *Solanum viarum* Dunal and *S. elaeagnifolium* Cav.; the leaves of *S. trilobatum* Linn. and *S. nigrum* Linn. and the root of *S. trilobatum* Linn.

Materials—The materials for the present study have been received from the following sources:

1. *Solanum viarum* Dunal—Fruits

Indian Botanic Garden, Howrah and from Eastern Circle, Botanical Survey of India, Shillong.

2. *S. elaeagnifolium* Cav.—Fruits

Southern Circle, Botanical Survey of India, Coimbatore and Indian Botanic Garden, Howrah.

3. *S. nigrum* Linn.—Leaves

Howrah and 24-Parganas.

4. *S. trilobatum* Linn.—Leaves & roots

Howrah.

Solanum viarum Dunal (= *S. khasianum* Cl. var. *chatterjeanum* Sen Gupta)

Fruit: The plant although growing wild in different parts of India has very recently become important due to the presence of solasodine in the mature berries which is the precursor of the drug cortisone. For this reason various workers have studied the plant particularly the berries which can be exploited for the preparation of the drug. Chaudhuri & Rao (1964) have chemically studied the plant and found that the berries contain 0.7% solasonine *i.e.* about 0.5% solasodine. Hamied (1965) of CIPLA Laboratory also found 0.5% solasodine. Chaudhuri & Hazarika (1966) have studied seasonal variation on the alkaloid content and found that the maximum quantity of solasodine is present in the mature berries which are yellowish green. Although there is no variation in the alkaloid contents due to seasonal effects the percentage of solasodine is slightly more (about 0.57%) when the fruits are collected in May. It is Maiti *et al.* (1965) who have chemically studied the fruits in a different method by which they have been able to get the solasodine to the extent of 5.4% which was confirmed subsequently by Hamied (personal communication to late Rev. Fr. Dr. Santapau). Saini *et al.* (1965) have observed progressive accumulation of glycoalkaloid in the berries as they mature and claim highest yield *i.e.* 7.6% of glycoalkaloid from 54 days old fruits which are pale yellow. Saini (1966) is also of

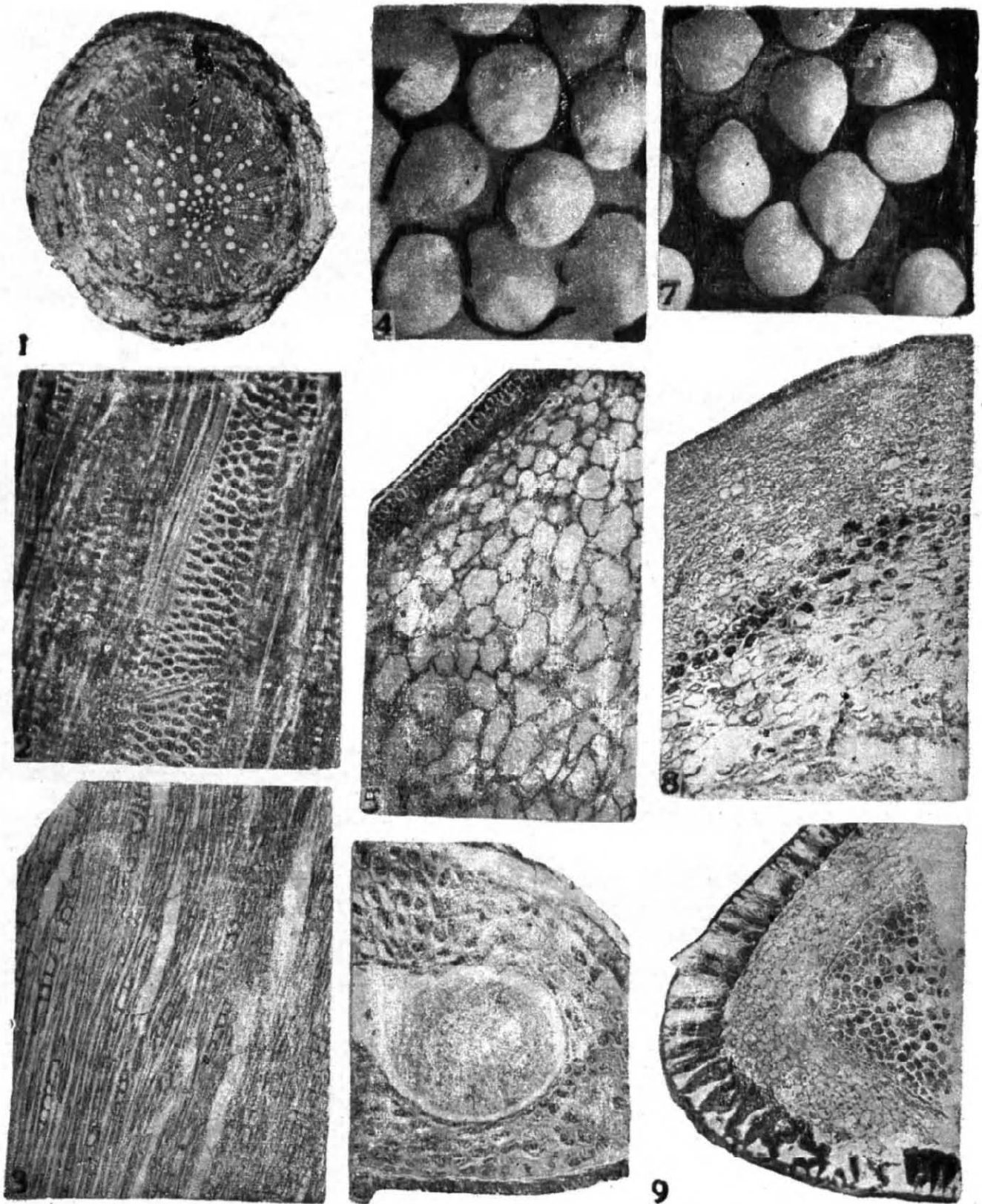


Plate I : 1-3. *Solanum trilobatum* Linn. 1. Transection of root. 2. Radial longitudinal section of portion of root. 3. Tangential longitudinal section of portion of root. 4-6. *Solanum viarum* Dun. 4. Seeds. 5. Transection of portion of pericarp. 6. Transection of portion of seed. 7-9. *Solanum elaeagnifolium* Cav. 7. Seeds. 8. Transection of portion of pericarp. 9. Transection of portion of seed. Fig. 1. ($\times c. 600$). Figs. 2 & 3. ($\times c. 1400$). Figs. 4 & 7. ($\times c. 5$). Figs. 5, 6, 8 & 9. ($\times c. 1000$).

the opinion that the glycoalkaloids are present in the mucilaginous layer all around the seeds which can be extracted with advantage when the fruits are fresh. All these have created curiosity amongst many pharmaceutical concern throughout India for a large scale cultivation of this plant for commercial exploitation.

Plant: Erect, much branched shrub, 1-1.5 m high. Stem prickly throughout, woody below. Leaves broadly ovate, ovate-cordate, acute or subacute, 16-26 × 9-17 cm, lobed hirsute or sparsely hirsute. Flowers 1-4, white or pale yellow, 2 cm in diameter. Berries globose, 2.5-3 cm in diameter, green with faint white variegation, maturing to yellow. Seeds about 3 mm in diameter, compressed, brown (Sengupta, 1961) (Plate I, 4).

Distribution: Khasia and Jaintia Hills of Assam; NEFA; Darjeeling and 24-Parganas in W. Bengal; Mayurbhanj in Orissa and Western Ghats—Mysore southwards.

Macroscopic characters: Globose berry 2.5-3 cm, green with faint white variegation when young, bright yellow when mature; smooth, glossy. Longitudinal section of fruit shows thick swollen axile placenta with numerous seeds embedded in the soft pericarp. Seeds compressed, suborbicular, covered with mucilage.

The pericarp on drying becomes shrivelled and leathery.

Microscopic characters: Transections of fruit show a prominent outer cuticle with wavy outline (Plate I, 5). Epidermal cells are 2-3 layered, small in size and somewhat thick-walled. Cells of the inner two layers show either rectangular or prismatic crystals. The multilayered epidermis is followed by 2-3 layers of collenchyma cells. The rest of the pericarp and the placenta are made up of thin-walled parenchyma cells, the outermost 2-3 layers and the cells of the placenta are somewhat closely packed. The innermost cells of the pericarp are somewhat loosely arranged. Vascular tissue is seen scattered among the parenchyma cells in the inner region of the pericarp and the placenta. Vessels show spiral thickenings.

The seed is covered by a prominent epidermis (Plate I, 6). The cells are thick-walled with narrow lumen. The tangential and the inner walls of these cells are highly thickened. The secondary walls are made up of lignin. The epidermis is followed by the crushed cells of the inner integument and perisperm cells. The endosperm cells fill the rest of the portion

enclosing in it a narrow curved embryo. The walls of the endosperm cells are thick and they are filled with granular contents. The cells of the embryo are thin-walled, rectangular or square shaped and are filled with fine granular contents.

Powder: Greyish brown in colour with slight pungent odour and slightly bitter and mucilaginous. The powder when examined under microscope is characterised by the presence of the following: Multicellular pointed trichomes, uni- or multicellular trichomes with glandular head; prickles, epidermal cells with stomata; all these belong to the calyx. Thick-walled group of cells from the pericarp with or without collenchyma cells attached to it; highly thick-walled cells of the testa with very small lumen are conspicuous. Cells containing oily globules are fairly distributed. Thick-walled endosperm cells and thin-walled embryo cells with granular contents and fragments of spiral vessels are also seen (Plate II).

Microchemical test: Microchemical test confirms the presence of calcium oxalate crystals in the inner epidermal cells of the pericarp. Some of the inner cells of the pericarp contain glycoalkaloid. The seed is heavily coated with mucilaginous substance which also confirms presence of glycoalkaloid.

***Solanum elaeagnifolium* Cav.**

Fruit: This is a Mexican plant introduced into India and is now growing wild in South India. While surveying other suitable species of *Solanum*, Maiti and Matthew (1967) found 3.4% of solasodine in the berries and consider the species as an ideal plant to be raised as a potential drug crop since this plant is practically without prickles and collection of berries is easier.

Distribution & habitat: The plant is native of Central U.S. to Mexico. Wildly introduced. In India, the plant is found along the railway tracks from N. Coimbatore station towards Walayar. It is reported as a weed in cultivated fields at Pollachi (personal information from Dr. A. N. Henry).

Plant: Coarse branching, perennial herbs or undershrubs up to 1 m tall, spineless or sparsely spiny, silvery-canescens with stellate hairs throughout. Leaves linear to oblong or oblong-lanceolate, 5-10 × 1-3 cm, entire or nearly sinuate. Flowers violet or blue, 2 cm in diameter. Berries globose, 1-1.3 cm in diameter, yellow or brownish.

Macroscopic characters: Globose berries with persistent calyx (Plate III, 1). Diameter 1-1.3 cm,

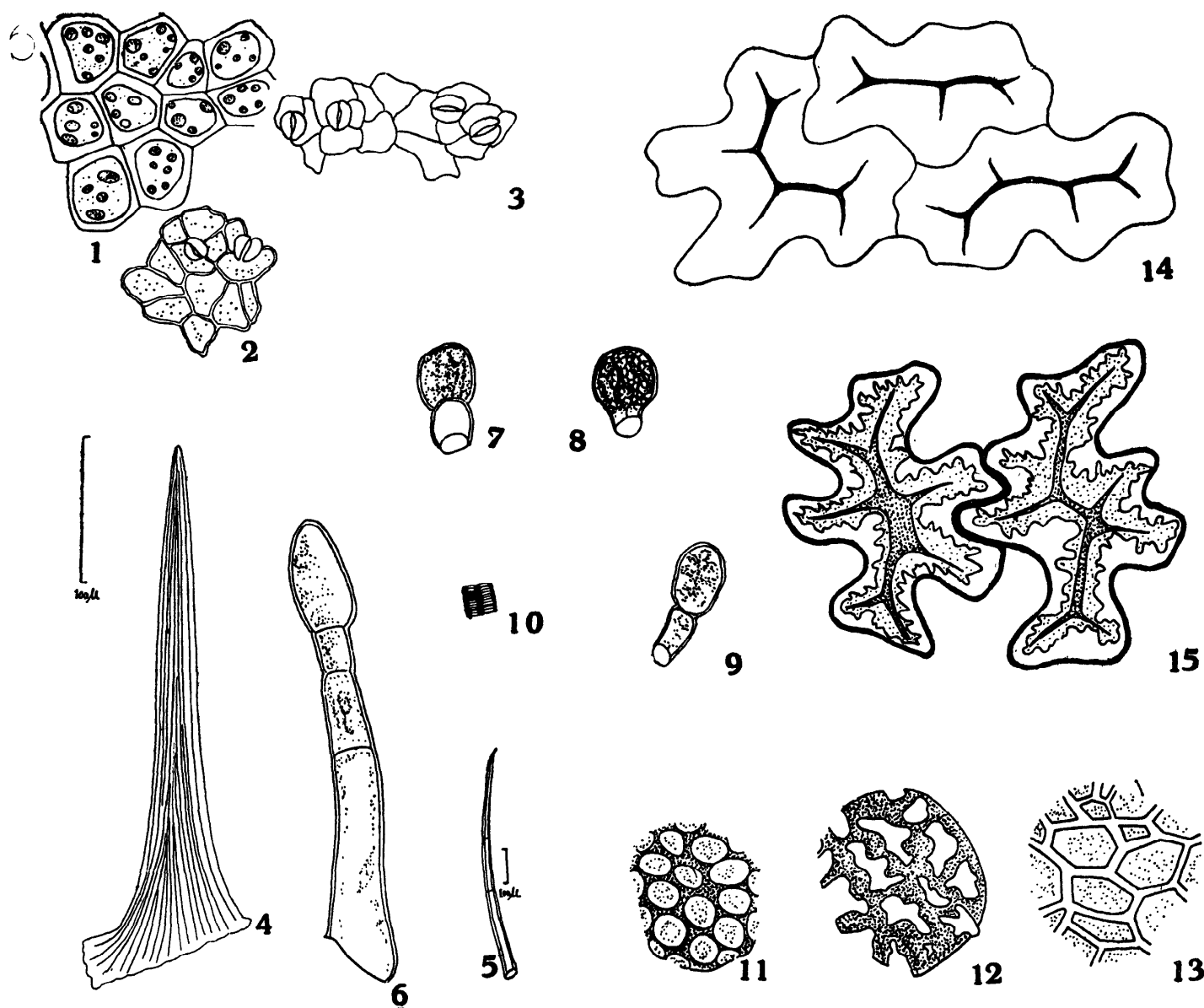


Plate II : *Solanum viarum* Dun.—Fruit Powder. 1. Cells from pericarp. 2 & 3. Epidermal cells with stomata. 4. Prickle. 5. Multicellular pointed hair. 6. Multicellular glandular head hair. 7, 8 & 9. Glandular head hair with unicellular stalk. 10. Fragment of vessel. 11 & 12. Collenchyma cells. 13. Cells from endosperm. 14 & 15. Surface view of highly thickened cells from testa.

colour greenish yellow to brownish, smooth. Longitudinal section of the fruit shows thick axile placenta with numerous seeds embedded in the soft pericarp. Seeds brown, 2-3 mm in diameter, suborbicular, more or less flat (Plate I, 7). The seeds are coated with a mucilaginous substance. The fruits on drying become glossy and retain the colour; very rarely the pericarp becomes shrivelled.

Microscopic characters: Transverse section through the pericarp shows the following structural

characteristics. Outermost cuticle is followed by 2-3 layers of small epidermal cells having thick walls. Prismatic crystals are found in the second and third layer of cells. Below the multilayered epidermis there are 3-5 layers of collenchyma cells which are tangentially elongated. The remaining portion of the pericarp consists of thin-walled round or oval parenchymatous cells; the outermost layers are closely packed. Most of these cells are filled with cell contents (Plate I, 8). Vascular tissue is seen in

the inner region of the pericarp. Vessels show spiral thickening.

Transection of seed shows a single outer prominent layer, the epidermis, the lateral and inner tangential walls of which are strongly lignified. The tangential wall thickenings gradually become narrow towards the periphery and at the tip the primary wall is seen almost without secondary thickening. The lumen here is broader than that of *Solanum viarum*. The epidermis is followed by a few layers of thin-walled cells of the perisperm or the inner integument. The endosperm is many layered,

hexagonal compactly arranged cells, the walls of which are thick (Plate I, 9). They are filled with granular contents. Portions of the narrow curved embryo are seen in sectional view in one or two places within the endosperm. The cells of the embryo are small thin-walled and filled with fine granular contents.

Powder : Colour reddish brown with a faint odour and without any appreciable taste.

The powder when examined under the microscope is characterised by the presence of whole or broken pieces of stellate hairs and pedicel; groups

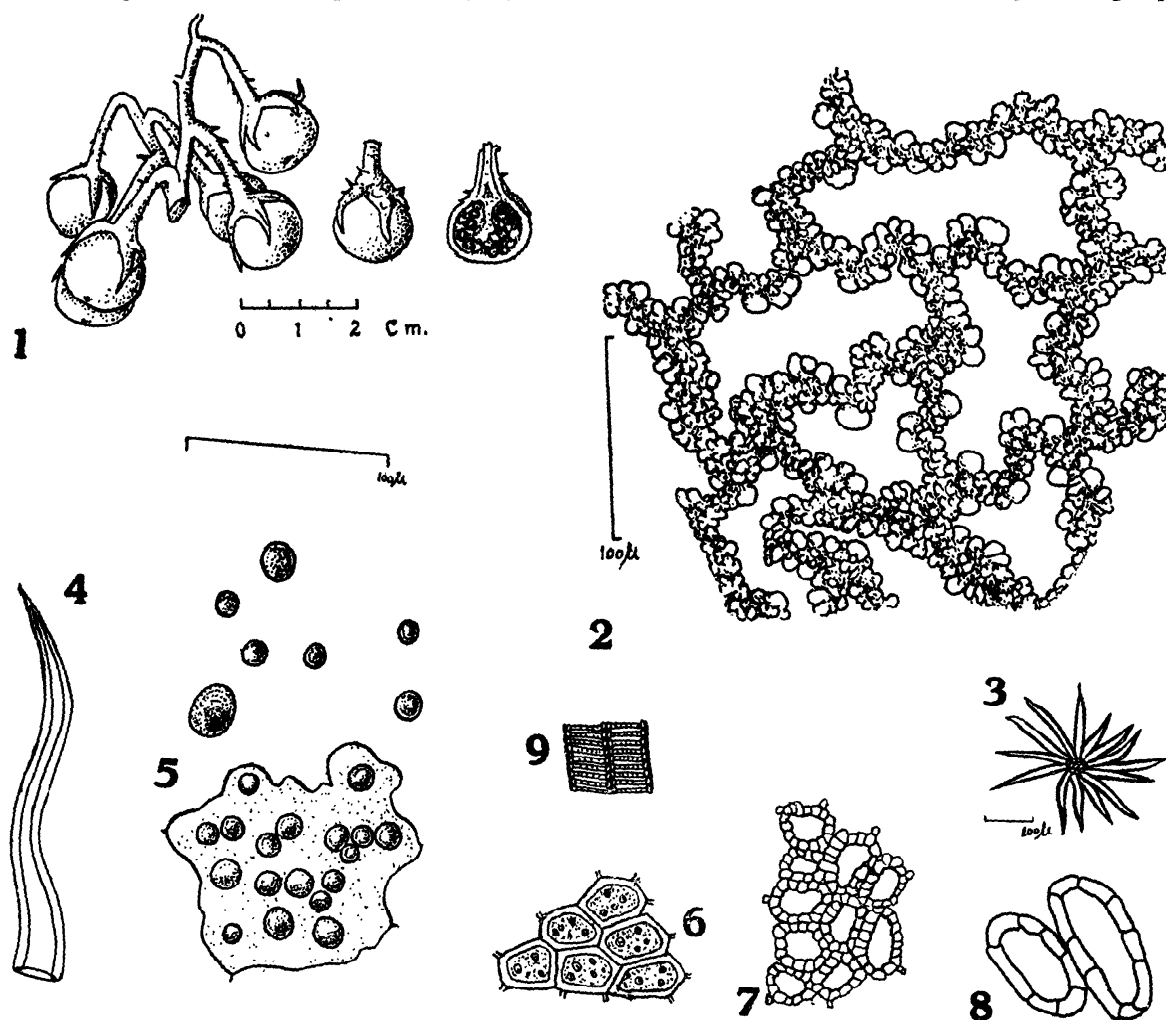


Plate III : *Solanum elaeagnifolium* Cav. 1. Berries. 2-8. Fruit Powder. 2. Surface view of cells from testa showing peculiar secondary wall thickening. 3. Stellate hair. 4. Broken piece of stellate hair. 5. Oil globules. 6. Cells from endosperm. 7 & 8. Thick-walled cells from pericarp. 9. Fragment of vessel.

of small thick-walled cells of the pericarp either with cell contents or with crystals. Cells of the testa are conspicuous with large irregular cavity and the secondary walls showing beaded thickening; isolated or small groups of thick-walled cells are also seen. Endosperm cells with granular contents, parenchyma and collenchyma cells of the pericarp, spiral vessels of the vascular system and cells containing many oil droplets are also seen (Plate III).

Microchemical test: Microchemical tests on the sections of the pericarp reveal the presence of starch grains in the inner region of the pericarp which are completely absent in the outer region. Glycoalkaloids are present in the inner region of the pericarp in the form of brownish oil globules. Prismatic crystals of calcium oxalate are present in the inner epidermal cells. Presence of oily substance has also been confirmed in the inner region of the pericarp. Seeds are covered with a slimy substance which contains glycoalkaloid.

***Solanum nigrum* Linn.**

Leaf: *Solanum nigrum* Linn. (Hindi: *Makoi*; Sans.: *Kakamachi*; Tam.: *Manattakhali*; Tel.: *Kamanchi*) is a herb common throughout India. The leaves are used for headache and diseases of the nose. The decoction and an aqueous extract are said to be used in the treatment of dropsical affections. The juice of the leaf is considered as diuretic and a chief medicine in the mouth sore of the children. According to Charaka (Avinash Chandra, 1896) the leaves fried with ghee gives much relief when applied to boils. Fresh leaves slightly heated and applied to testis gives relief to hydrocele. The decoction of leaf in $\frac{1}{2}$ to 2 drams is used in skin diseases, piles, gonorrhoea and old liver and spleen troubles. (Kirtikar & Basu, 1935; Biswas & Ghosh, 1951; Nadkarni, 1954; Dymock *et al.*, 1889-93, Avinash Chandra, 1896).

Plant: Annual erect herb. Stem glabrous or sparingly pubescent. Leaves ovate or oblong. Flowers small, in extra-axillary, sub-umbellate, 3-8-flowered cymes. Berries 0.5 cm in diameter, purplish-black. Seeds small discoid, yellow (Kirtikar & Basu, 1935; Hooker, 1889).

Distribution & habitat: Common throughout India in moist shady places.

Macroscopic characters: Leaves 2.5×2.5 cm, ovate lanceolate, subacute or acuminate, thin with a coarsely toothed or wavy margin (Plate IV, 1). They strongly resemble small stramonium leaves (Wallis, 1960; Kirtikar & Basu, 1935).

Microscopic characters: Transection as well as surface preparations of the leaf show the following structural characteristics when studied under the microscope.

Upper epidermis: The cells of the upper epidermis are more or less oval or egg-shaped, tangentially elongated with thin cuticle. Multicellular pointed trichomes are found on the upper epidermis (Plate IV, 3, 7). In surface preparation large number of multicellular pointed trichomes are seen on the midrib, along the veins and on the hyaline margins of the leaf. In other regions they are scattered. The upper epidermal cells are somewhat irregular in outline. Stomata are scattered. Besides normal stomata, half and constricted stomata are also found scattered. (Plate IV, 4). The upper epidermal cells measure $19.49.4 \mu \times 11.4-15.2 \mu$.

Palisade parenchyma: The palisade cells are prominent and single layered. They are as usual filled with chloroplastids (Plate IV, 3). The palisade cells measure $34.2-53.2 \mu \times 11.4-19 \mu$.

Spongy parenchyma: These cells are loosely arranged in between palisade parenchyma and the lower epidermal cells, 3-5 cells thick with air spaces. The cells contain chloroplastids. Few spirally thickened vessels are seen in the upper spongy region here and there representing the veins (Plate IV, 3). The spongy parenchyma cells measure $11.4-38 \mu \times 11.4-22.8 \mu$.

Lower epidermis: The cells are more or less similar in size and shape to those of upper ones although smaller cells are also found. Stomata are more frequent in this region. In lower epidermis uni or multicellular glandular head trichomes are often seen which is a characteristic feature of the leaf (Plate IV, 5, 8). The lower epidermal cells measure $19.30.4 \mu \times 11.4-19 \mu$.

Midrib: Transection through the midrib shows the following structural characteristics. The epidermal cells are more or less elliptical or oval with thin cuticle. Multicellular pointed trichomes are found on both sides in the epidermis. Next to the epidermal cells are 2-3 layers of collenchyma cells. The rest of the midrib is filled with thin-walled parenchymatous cells, enclosing a bi-collateral vascular bundle which is somewhat crescent shaped. Rows of vessels are separated by ray-like parenchymatous cells. Phloem tissue is seen in patches on either side of the vessels (Plate IV, 2).

Portions of leaves from apex, middle and base were cut and cleared in chloral hydrate solution

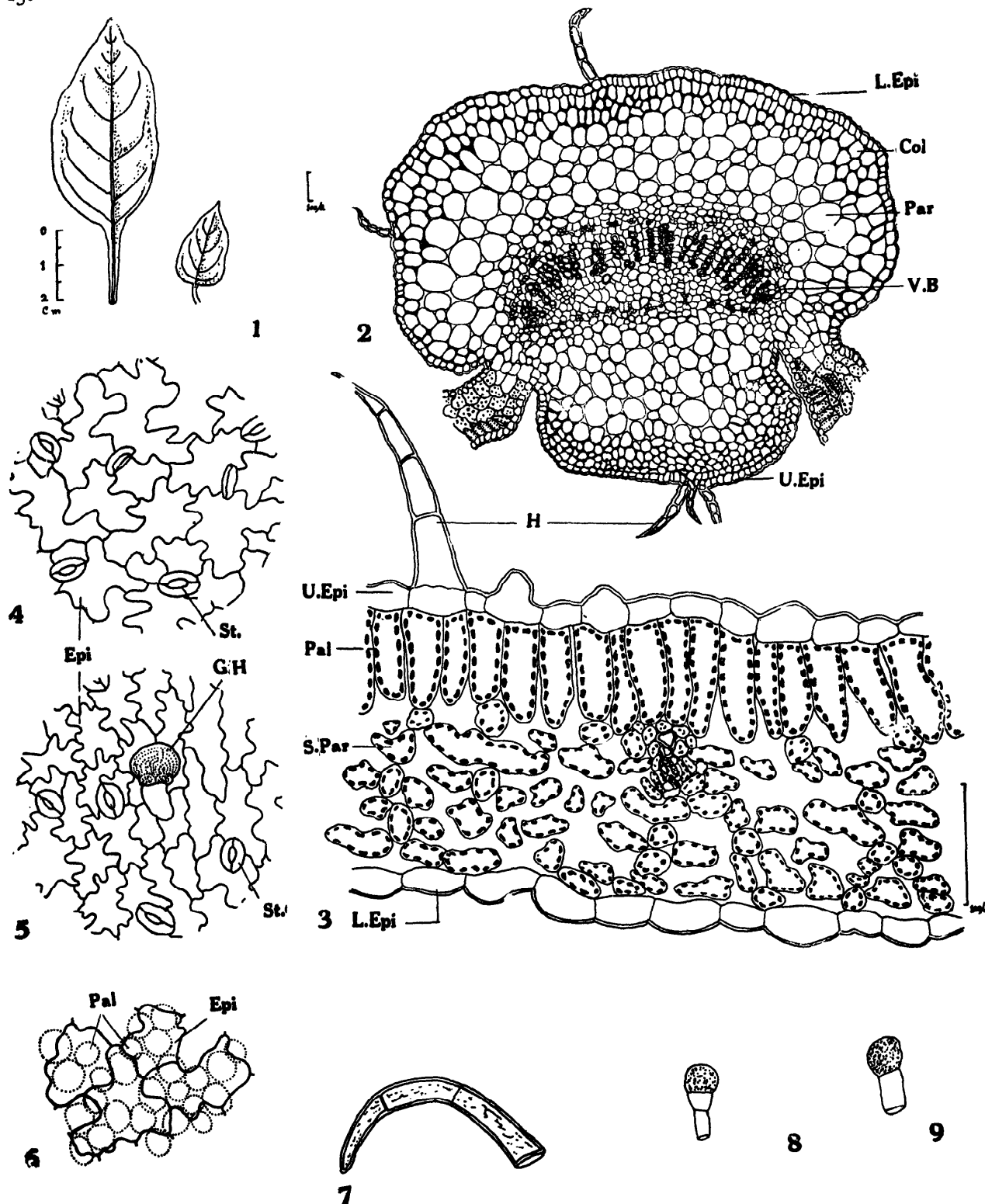


Plate IV : *Solanum nigrum* Linn. 1. Mature and young leaf. 2. Transection through midrib of leaf. 3. Transection of a portion of lamina. 4. Surface view of upper epidermis. 5. Surface view of lower epidermis. 6. Surface view of upper epidermis with palisade. 7. Multicellular pointed trichome. 8. Glandular head hair with bicellular stalk. 9. Glandular head hair with unicellular stalk. Col-Collenchyma ; Epi-Epidermis ; GH-Glandular head hair ; H-Hair ; L. Epi-Lower epidermis ; Pal-Palisade cells ; S. Par-Spongy parenchyma ; St-Stomata ; U. Epi-Upper epidermis ; V. B-Vascular bundle.

as usual for quantitative microscopy. The results of these studies are shown in Table I.

Powder: Deep green with slightly pungent odour and without any appreciable taste. The powder examined under the microscope is characterised by the presence of small leaf fragments showing the detailed anatomical characters, epidermal cells with stomata, annular and spiral vessels, multicellular pointed trichomes and uni or multicellular glandular head trichomes. Small portion of leaf showing veins are also seen (Plate V).

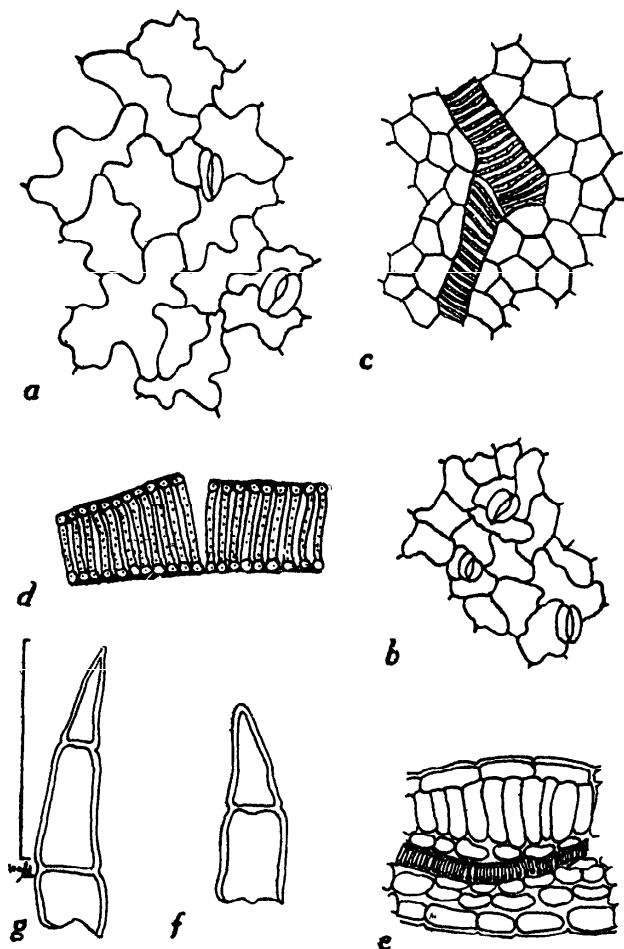


Plate V : *Solanum nigrum* Linn.—Leaf Powder. a. Surface view of upper epidermis. b. Surface view of lower epidermis. c. Portion of leaf showing vessels. d. Fragment of vessel. e. Leaf fragment showing anatomical details. f. & g. Fragments of pointed hair.

***Solanum trilobatum* Linn.**

Leaf: *Solanum trilobatum* Linn. (Uriya: Nabhan-kuri; Tel.: Mullamuste, Mchchinta uste; Tam.: Tudavullay, Thuthuvelai; Sans.: Alarke) is a trailing undershrub. Different parts such as roots, leaves

and tender shoots are used in the indigenous system of medicine. The roots and leaves are bitter which are given in consumptive cases in the form of decoction or powder. Siddha physicians consider this drug as a specific and prepare a ghee from this for use in tuberculosis, and use as food for all kinds of lungs diseases. In Southern India the leaves are used as vegetables and their consumption is believed to improve the intellect (Ainslie, 1826; Nadkarni, 1954; Chopra, 1958; Watt, 1889-90).

Plant: Trailing or subscandent undershrub. Stems with numerous short, strong recurved prickles. Leaves 3-5 lobed, ovate or subcordate. Cymes lateral on short peduncles, 2-8-flowered; calyx lobes ovate, prickly; corolla large, white to purple. Berries globose, scarlet smooth. Seeds flat, slightly pitted (Hooker, 1885; Cooke, 1958; Gamble, 1957; Prain, 1963; Kirtikar & Basu, 1935).

Habitat & distribution: The plant is frequently found in the Western Peninsula from Konkan southwards. It is also met with in tidal swamps in the Malay Peninsula from Arracan to Malacca and Ceylon (Hooker, 1885; Gamble, 1957; Cooke, 1958; Prain, 1963; Haines, 1961).

Macroscopic characters: The leaves are ovate in outline, sinuate or 3-5 lobed, obtuse, truncate or subcordate at base, 7.5 × 4 cm. Petiole 1.5-4 cm, colour green.

Microscopic characters: Transection as well as surface preparations of the leaf show the following structural characteristics, when studied under the microscope.

Upper epidermis: The cells of the upper epidermis are more or less oval or egg shaped, tangentially elongated with thin cuticle. The cells do not contain starch grains. Surface preparation shows that the upper epidermal cells in many places of the leaf are either without any stomata or if present very few in numbers (Plate VI, 4, 5). The upper epidermal cells measure $19-31\mu \times 22-38\mu$. In surface preparation stellate hairs are found scattered in the upper epidermis (Plate VI, 8, 9).

Palisade parenchyma: The palisade cells form a single row of columnar cells rich in chloroplastids. Besides chloroplastids the cells contain starch grains. The palisade cells measure $15-23\mu \times 53-84\mu$ (Plate VI, 3).

Spongy parenchyma: These cells are loosely arranged in between the palisade parenchyma and the lower epidermal cells and 5-7 cells thick. Large air spaces are found in between those cells. The

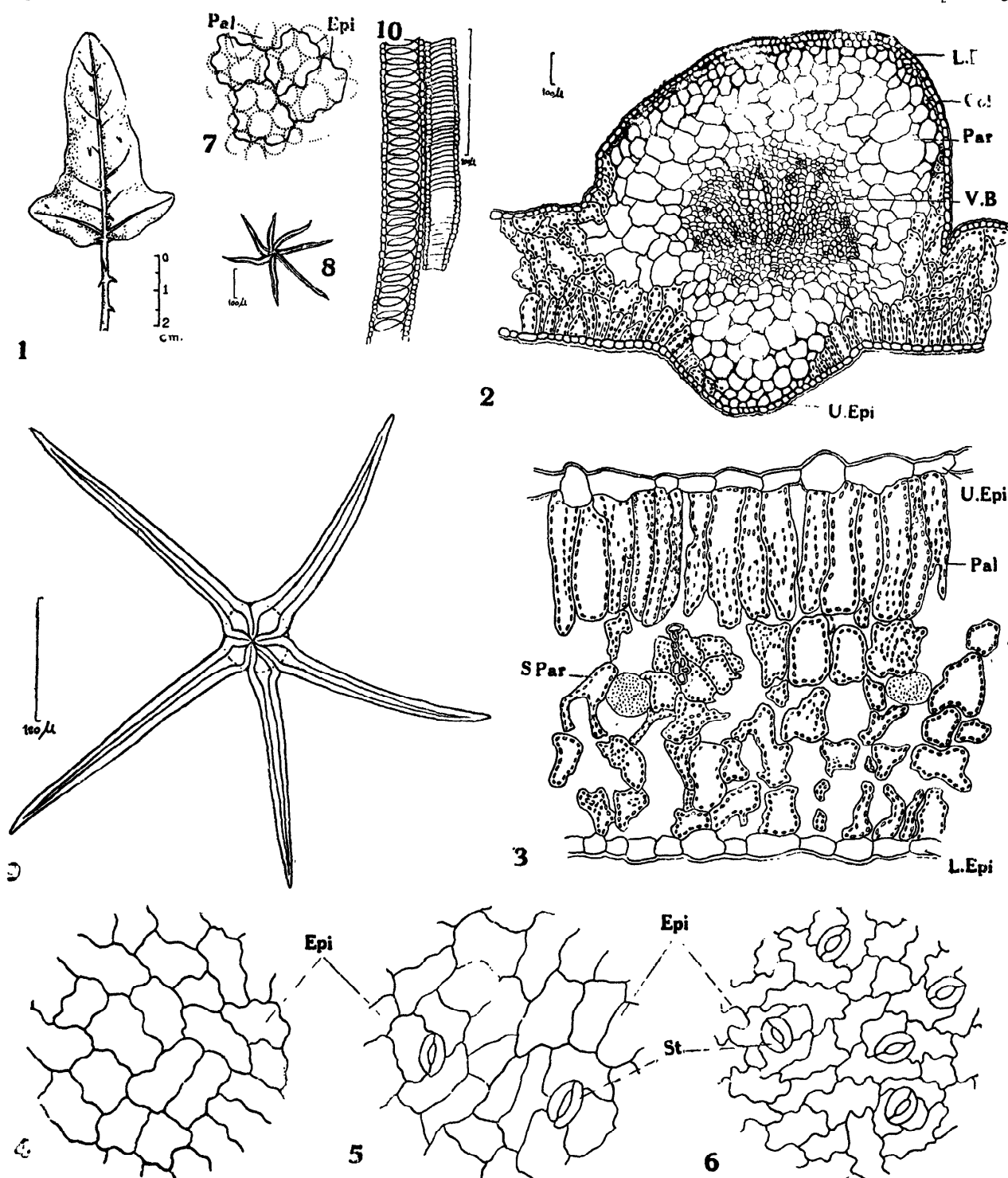


Plate VI : *Solanum trilobatum* Linn. 1. Entire leaf. 2. Transection through midrib of leaf. 3. Transection of portion of lamina. 4. Surface view of upper epidermis without stomata. 5. Surface view of upper epidermis with stomata. 6. Surface view of lower epidermis with stomata. 7. Surface view of upper epidermis with palisade cells. 8 & 9. Stellate hairs. 10. Vessel fragments.
Col-Collenchyma ; Epi-Epidermis ; L. Epi-Lower epidermis ; Pal-Palisade cells ; S. Par-Spongy parenchyma ; St-Stomata ; U. Epi-Upper epidermis ; V. B-Vascular bundle.

cells are of different size and shape. Some of them are more or less rectangular while others are elongated either tangentially or radially. The spongy parenchyma cells contain chloroplastids. Starch grains are also found in these cells fairly distributed. Near about the middle of the spongy parenchyma lie the vascular bundles which are of simple type. Vessels are either annular or spiral. Besides the vascular bundles a few large thin-walled cells are seen filled with fine granular contents. Such cells are seen arranged in a row amongst the spongy parenchyma. The spongy parenchyma cells measure $26-38 \mu \times 19-38 \mu$ (Plate VI, 3).

Lower epidermis: The lower epidermal cells are more or less similar to upper epidermis but are comparatively smaller in size. These cells do not contain any starch grains. In surface preparation the lower epidermal cells are wavy and contain a large number of stomata (Plate VI, 6) as compared to upper epidermal cells. The cells measure $15-23 \mu \times 18-23 \mu$.

Midrib: Transection through the midrib shows the following structural characteristics. The epidermal cells are more or less elliptical or oval with thin cuticle. Next to the epidermal cells are 2-3 layers of collenchyma cells. Near about the middle of the midrib lie the vascular bundle which is bi-collateral. The row of vessels are separated by large thin-walled cells. The rest of the midrib is filled with thin-walled large parenchymatous cells with or without intercellular spaces. The walls of these cells are either round or wavy (Plate VI, 2).

Portions of leaves from apex, middle and base were cut and cleared in chloral hydrate solution for the study of the vein-islet and vein-termination numbers as well as for determining the number of epidermal cells and stomata present per square millimeter of leaf surface in both upper and lower sides so as to ascertain the stomatal index. The results of these studies are given in Table II.

Powder: Deep green in colour, odour somewhat pungent. The powder examined under the microscope is characterised by the presence of annular and spiral vessels, small groups of epidermal cells with or without stomata, palisade cells and a few scattered broken or complete stellate hairs (Plate VII).

***Solanum trilobatum* Linn.**

Root: Macroscopic character: The roots are 1.5 to 5 mm in diameter. External colour greyish yellow,

internal colour light grey. Fracture hard, somewhat fibrous. Thicker ones woody (Plate VIII, 1).

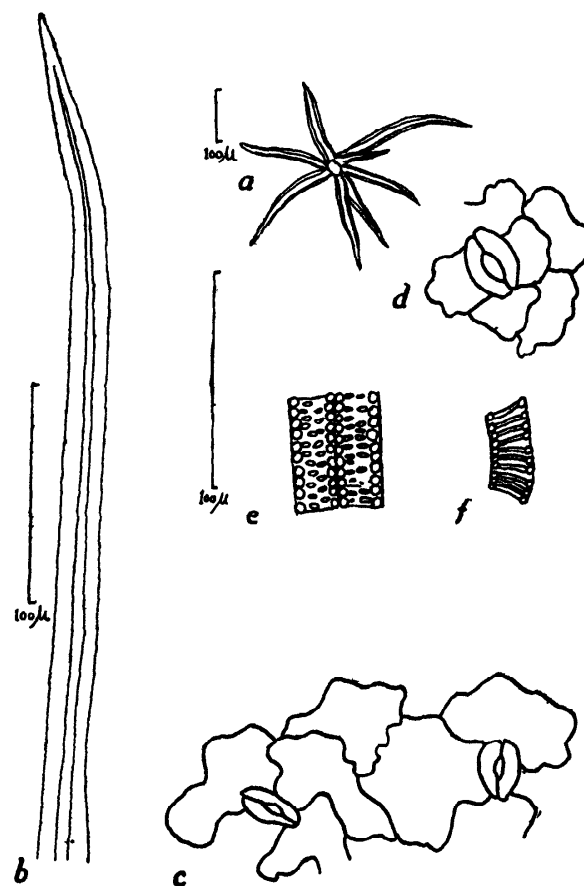


Plate VII : *Solanum trilobatum* Linn.—Leaf Powder. a. Stellate hair. b. Broken piece of stellate hair. c. Surface view of upper epidermis with stomata. d. Surface view of lower epidermis with stomata. e. & f. Fragments of vessels.

Microscopic characters: Root of about 1.5 mm diameter shows the following characteristics in transection. Outer periderm consists of 2-4 layers of cells which occupy about one-fifth of the root. The two layers of phellem show a distorted appearance. They are rectangular, tangentially arranged, and thin-walled. The phellogen is represented by a single layer of cells which are thin-walled. The phelloderm is followed by the primary cortical cells, 3-5 cells thick. These cells are small and thin-walled. The secondary phloem, cambium and the primary cortex occupy about one-fifth of the root. A few lignified cells are also seen scattered in the phloem region. The bulk of the root is represented by the secondary xylem or wood which occupy the remaining part of the root (Plate I, 1). The wood

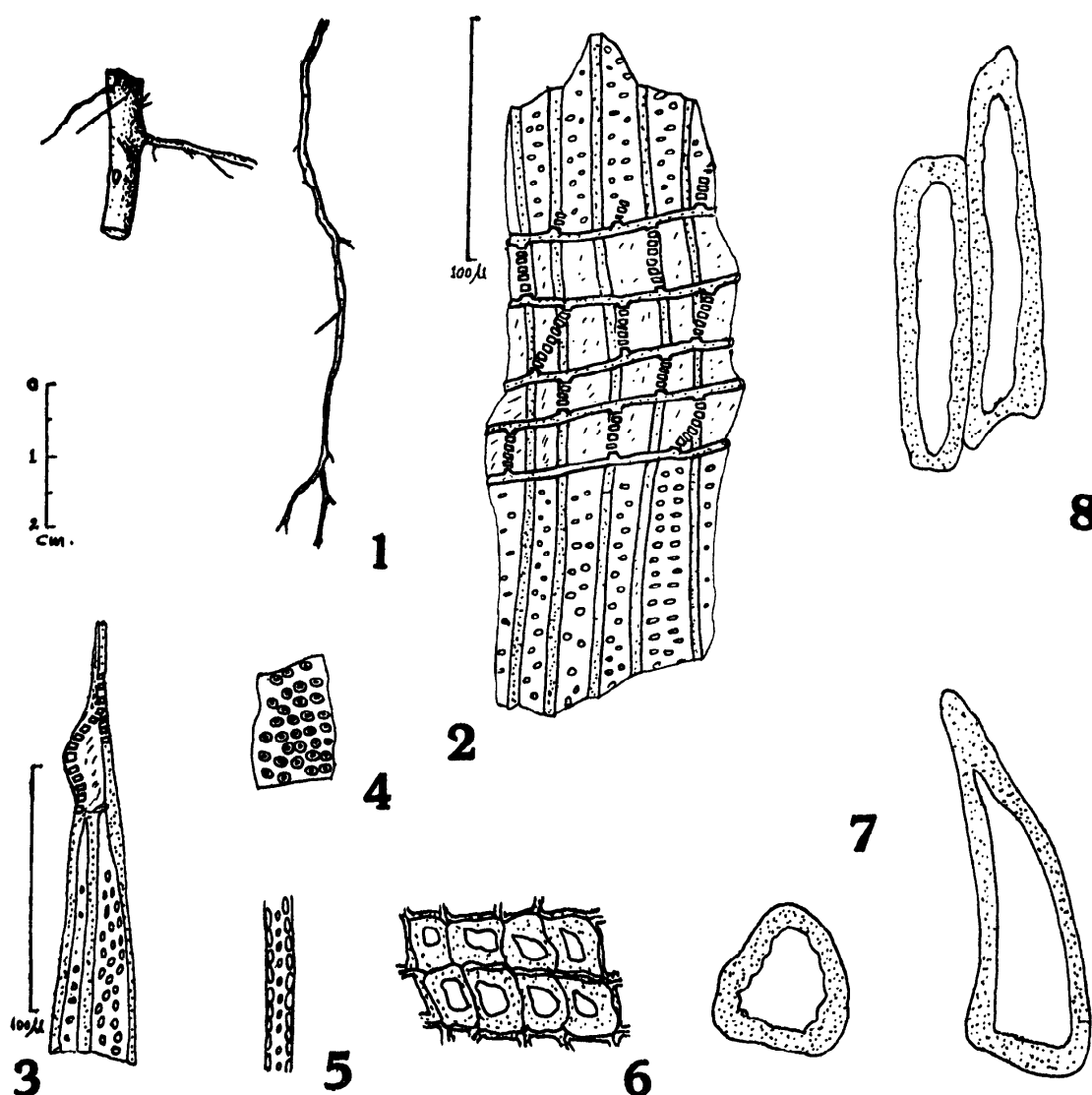


Plate VIII : *Solanum trilobatum* Linn. 1. External morphology of root. 2-8. Root powder. 2 & 3. Fragments of Trachieds with wood ray cells. 4 & 5. Vessel fragments showing bordered pits. 6. Group of thick-walled cells. 7 & 8. Thick-walled cells from phloem region.

consists mostly of trachieds with bordered pits. Vessels are scattered irregularly throughout the xylem, occurring either singly or in groups of two or more. Xylem rays are single layered, radially arranged and thin-walled. The primary xylem is diarch.

In longitudinal sections the trachieds are thick-walled and narrow with tapering ends and bordered pits. The vessels appear as continuous tubes with vessel segments varying in form. They are frequently 3-4 times as long as wide. The cross walls may be

horizontal or frequently at a slight angle. The pits are of bordered type and comparatively bigger than those in trachieds (Plate I, 2). The xylem rays are seen as strips usually one cell in width but very rarely 2-3 cells in width. In the tangential-longitudinal section the ray cells are wider in the middle and always tapering and terminating in a single cell at either ends (Plate I, 3).

Powder: Light grey in colour, without any appreciable odour and taste. The powder when examined under the microscope is characterised by the

presence of small portion of wood showing trachieds with medullary ray cells, isolated thick-walled lignified cells and fragments of trachieds and vessels (Plate VIII, 2-8).

Table I : Study of the Leaf Constants : *Solanum nigrum*

	E	S	S. I.	V. I.	V. T.	P. R.
a	78	15	16			3.50-8.5
b	78	16	17			3.75-7.25
c	87	15	15			4-9
d	139	39	22			
e	154	48	23			
f	157	43	22			
g				7	8	
h				8	11	
i				9	10	

a, b, c=upper apex, middle and base ; d, e, f=lower apex, middle and base ; g, h, i=apex, middle and base.

Table II : Study of the Leaf Constants : *Solanum trilobatum*

	E	S	S. I.	V. I.	V. T.	P. R.
a	132					2.5-3.25
b	157					2.5-3.75
c	144					3.5-4.5
d	204	36	15			
e	226	38	14			
f	227	45	16			
g				8	8	
h				8	8	
i				8	6	

a, b, c=upper apex, middle and base ; d, e, f=lower apex, middle and base ; g, h, i=apex, middle and base.

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REFERENCES

- AINSLIE, W. *Materia Indica*. London, 1826.
 ABINASH CHANDRA, K. *Charaka Samhita*. Part-I. (English translation) Calcutta, 1896.
 BISWAS, K. AND S. GHOSH. *Bharatiya Banasadihi*. Calcutta, 1951.
 BRIGGS, L. H., R. C. GAMBLE AND J. L. HOARE. *Solanum alkaloids*. Part XV. The constituents of some *Solanum* species and a re-assessment of Solasodamine and Solauricine. *J. Chem. Soc.* 4645-4649. 1961.
 CHAUDHURI, S. B. AND P. R. RAO. Solasodine from *Solanum khasianum* Cl. *Indian J. Chem.* 2 : 424. 1964.
 — AND J. N. HAZARIKA. Seasonal variations in the alkaloid contents of *Solanum khasianum* Cl. *Curr. Sci.* 25 : 187. 1966.
 CHOPRA, R. N., I. C. CHOPRA, K. L. HANDA AND L. D. KAPOOR. *Indigenous Drugs of India*. Calcutta, 1958.
 COOKE, T. *The Flora of the Presidency of Bombay*. Reprinted edition, Calcutta, 1961.
 DYMCK, W., C. J. H. WARDEN AND D. HOOPER. *Pharmacographia Indica*. London, 1889-93.
 GAMBLE, J. S. *Flora of the Presidency of Madras*. Reprinted edition, Calcutta, 1957.
 HAINES, H. H. *The Botany of Bihar and Orissa*. Reprinted edition, Calcutta, 1961.
 HAMIED, J. K. *Indian Drugs*. 2 : 37. 1965.
 HOOKER, J. D. ET AL. *Flora of British India*. London, 1883.
 KIRTIKAR, K. R. AND B. D. BASU. *Indian Medicinal Plants*. Allahabad, 1935.
 MAITI, P. C., S. MOOKERJEE AND R. MATTHEW. Solasodine from *Solanum khasianum*. *J. Pharm. Sci.* 54 : 1828-1829. 1965.
 — AND R. MATTHEW. Rich sources of Solasodine. *Curr. Sci.* 36 : 126. 1967.
 NADKARNI, K. M. *Indian Materia Medica*. Bombay, 1954.
 PRAIN, D. *Bengal Plants*. Reprinted edition, Calcutta, 1963.
 SAINI, A. D., M. MUKHERJEE AND R. C. BISWAS. Studies on the physiology of *Solanum khasianum* Cl. *Indian J. Pl. Phys.* 8 : 103-110. 1965.
 — Alkaloid contents of *Solanum khasianum* Cl. *Curr. Sci.* 38 : 600. 1966.
 SENGUPTA, G. Taxonomic note on *Solanum khasianum* Cl. and description of a new variety under it. *Bull. bot. Surv. India.* 3 : 411-415. 1961.
 SINGH, H., W. PAREIRA, JR. AND V. V. PARASHAL. Sapogenins and Steroid Drugs. *Indian J. Pharm.* 27 : 150-157. 1965.
 VISWAPPAUL, TEJ SINGH AND K. L. HANDA. Indian *Solanum* species as possible starting materials for the synthesis of Cortisone and Steroid Sex Hormones. *Ibid.* 20 : 247. 1958.
 WALLIS, T. E. *Text book of Pharmacognosy*. London, 1965.
 WATT, G. *Dictionary of Economic Products of India*. Calcutta, 1889-93.