PHARMACOGNOSY OF AYURVEDIC DRUGS

KERALA

Published By

DEPARTMENT OF PHARMACOGNOSY
UNIVERSITY OF KERALA
TRIVANDRUM

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By

Prof. K. NARAYANA IYER M. A.

AND

M. KOLAMMAL M. Sc.

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Plate I

Saraca indica, Linn.

1. Twig with tender leaves
2. Twig with a leaf
3. Twig with inflorescence

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LIST OF ABBREVIATIONS

bf.	bast fibre
bt.	bast
cam.	cambium
c. c. c.	cell with coloured contents
ch. pl	chloroplast
ck.	cork
co.	cortex
crl. / crls.	crystal – crystals
crm.	ceratenchyma
c. s.	crystal sand
cy.	cavity
en.	endodermis
ep.	epidermis
gl. t.	glandular hair or trichome
lx. t.	latex tube
lt. / ltx.	latex
mr. / mdr.	medullary ray
mu. cy.	mucilage cavity
obl. ph.	obliterated phloem
ogl. / olgl.	oil globule
ph.	phloem
ph′.	primary phloem
phd.	phelloderm
ph. f.	phloem fibre
pi.	pith
pn.	phellogen
rn.	rind
rs. crl.	rosette crystal
rsn.	resin
s.	starch
sp.	space
scl.	sclerenchyma
ser. cl.	secretory cell or secretory reservoir or cavity
st. cl.	stone cell
svt.	sieve tube
v.	vessel
v. b.	vascular bundle
v. c̄. t.	vessel with tyloses
wd.	wood
wf.	wood fibre
xp / xy.par.	xylem parenchyma
xy.	xylem

TABLE OF TRANSLITERATION

Sans.	Eng.		Sans.	Eng.	
अ	A	a	ट्	Ṭ	ṭ
आ	Ā	ā	ठ्	ṬH	ṭh
इ	I	i	ड्	Ḍ	ḍ
ई	Ī	ī	ढ्	ḌH	ḍh
उ	U	u	ण्	Ṇ	ṇ
ऊ	Ū	ū	त्	T	t
ऋ	Ṛ	ṛ	थ्	TH	th
ए	E	e	द्	D	d
ओ	O	o	ध्	DH	dh
ऐ	AI	ai	न्	N	n
औ	AU	au	प्	P	p
०	Ṁ	ṁ	फ्	PH	ph
ः	Ḥ	ḥ	ब्	B	b
क्	K	k	भ्	BH	bh
ख्	KH	kh	म्	M	m
ग्	G	g	य्	Y	y
घ्	GH	gh	र्	R	r
ङ्	Ṅ	ṅ	ल्	L	l
च्	C	c	व्	V	v
छ्	CH	ch	श्	S′	s′
ज्	J	j	ष्	Ṣ	ṣ
झ्	JH	jh	स्	S	s
ञ्	N̂	ñ	ह्	H	h

DRAVIDIAN SPECIALS

ഉ	Ū	ū	ററ	T′	t′
ഒ	E′	e′	റ	R′	r′
ഓ	Ō	ō	ണ	N	ṇ′
			ഴ	Ẓ	ẓ

AS'OKA

Source plant* **Saraca indica** Linn.

Leguminosae –Caesalpinioideae–

Sanskrit text.

Descriptive synonyms.

गतशोकोऽशोकाह्वः पिण्डीपुष्पश्च रक्तको राजी ।
चित्रश्च कर्णपूरो मञ्जरिको हेमपुष्प इति ॥
निर्दिश्यते शोकनाशः चित्रस्तबकमञ्जरी ।
विशोको वीतशोकश्च शब्दैः पर्यायवाचकैः ॥ (अभिधानमञ्जरी)

Gatās′okoss′okāhvaḥ piṇḍīpuṣpas′ca raktako rājī |
Citr′as′ca kar′ṇapūro mañjariko hemapuṣpa iti ||
Nir′dis′yate s′okanās′aḥ citr′astabakamañjarī
Vis′oko vītas′okas′ca s′abdaiḥ paryāyavācakaiḥ ||
(Abhidhānamañjarī)

अशोको हेमपुष्पश्च वञ्चुलस्ताम्रपल्लवः ।
कङ्केलिः पिण्डपुष्पश्च गन्धपुष्पो नटस्तथा ॥ (भावप्रकाशः)

As′oko hemapuṣpas′ca vañcuḷastāmr′apallavaḥ
Kaṅkeḷī piṇḍapuṣpas′ca gandhapuṣpo naṭastathā ||
(Bhāvaprakās′aḥ)

अशोकः शोकनाशश्च विचित्रः कर्णपूरकः ।
विशोको रक्तको रागी चित्रषट्पदमञ्जरी ॥ (धन्वन्तरि निघण्डुः)

As′okaḥ s′okanās′as′ca vicitr′aḥ kar′ṇapūrakaḥ |
Vis′oko raktako rāgī citr′aṣaḍpadamañjarī ||
(Dhanvantari nighaṇṭuḥ)

अशोकः शोंकनाशः स्याद्विशोको वञ्जुलद्रुमः ।
मधुपुष्पोऽपशोकश्च कङ्केलिः कलिकस्तथा ॥
रक्तपल्लवकश्चित्रो विचित्रः कर्णपूरकः ।
सुभगः स्मराधिवासो दोषहारी प्रपल्लवः ॥

---

* The name as′oka is also applied to *Polyalthia longifolia* in Madras and certain other parts of India. It is not however known to be used as the source of As′oka.

रागी तरुर्हेमपुष्पो रामावामाङ्घ्रिघातकः ।
पिण्डीपुष्पो नटश्चैव पल्लवद्रुर्द्विविंशतिः ॥ (राज निघण्डुः)

As'okaḥ s'okanās'aḥ syādvis'oko vañculadrumaḥ ।
Madhupuṣpospas'okās'ca kaṅkeliḥ kalikasthathā ॥
Raktapallavakas'citr'o vicitı'aḥ kar ṇapūrakaḥ ।
Subhagaḥ smarādhivāso doṣahāṛī pı'apallavaḥ ॥
Rāgī tarui'hemapuṣpo rāmāvāmāṅghri ghātakaḥ ।
Piṇḍīpuṣpo naṭas'caiva pallavadrudvi viṃs'atiḥ ।
(Rāja nighaṇṭu)

Of the various synonyms indicated above *hemapuṣpa* indicates the red colour of the flowers; *citraṣadpadamañjari* denotes the variegated colour of inflorescence like that of a butterfly; *piṇḍīpuṣpa* and *stabakapuṣpa* indicate that the flowers are clustered into an inflorescence and *tāmr'apallava* indicates the copper colour of young leaves. *Gandhapuṣpa* means odorous flower, and another name *anganapriya* means dear to women.

Rāmāvāmāṅghri ghātakaḥ alludes to the popular belief that As'oka flowers profusely, if kicked by the left foot of beautiful women. *Smarādhivāsa* alludes to the Sanskrit poet's conception that As'oka flower is one of the five flower arrows of the God of Love. As'oka flowers in Vasantha which is the season of Kāma. It is said that one who lives under the tree will not get worried and people who look at the tree when in full bloom will forget their worries and become happy and contented and hence the name As'oka.

Ayurvedic properties and uses.

"अशोकः शीतलस्तिक्तो ग्राही वर्ण्यः कषायकः ।
दोषापचीतृषादाहकृमिशोषविषास्रजित् " ॥ (भावप्रकाशः)

As'okaḥ s'ītaḷastikto grāhī var'ṇyaḥ kaṣāyakaḥ ।
Doṣā pacıtṛṣādāhakṛmis'oṣaviṣāsr'ajit ॥ (Bhāvapr'akās'aḥ)

"अशोकः शीतलश्चार्शः कृमीन् हन्ति प्रयोजितः ।
अपचीं नाश्यत्येव सर्वव्रणविनाशनः ॥
अशोको मधुरो हृद्यः सन्धानीयः सुगन्धिकः । " (धन्वन्तरि निघण्डुः)

As'okaḥ s'ītaḷas'cār's'aḥ kṛmīn hanti pra'yojitaḥ ।
Apacīm nās'ayatyeva sar'vavr'ṇavinās'an'aḥ ॥
As'oko madhuro hṛdyaḥ sandhānīyaḥ sugandhikaḥ ।
(Dhanvantari nighaṇṭu)

"अशोकः शिशिरो हृद्यः पित्तदाहश्रमापहः ।
गुल्मशूलोदराध्माननाशनः कृमिहारकः ॥ " (राजनिघण्डुः)

As'okaḥ s'isiro hṛdyaḥ pittadāhas'r'amāpahaḥ ।
Guḷma s'ūlodarādhmānanās'anaḥ kṛmihārakaḥ ॥
(Rājanighaṇṭu)

According to Bhāvapr'akāsa As'oka is *s'itala* (cool), *tikto* (bitter) *grāhi* (constipative), *varṇyaḥ* (improving the complexion), *kasāyaka*, astringent, overcomes or cures the Doṣas, inflammation and enlargement of the cervical glands, allays thirst and burning sensation, worms (pathogenic organisms) and is useful in emaciation, poison and haemorrhage.

Rājanighaṇṭu has listed exhaustion *gulma* (phanton tumour) colic, enlargement of the abdomen and gas in the intestines among diseases cured by As'oka. Vermifuge properties are also attributed to it (Kṛimikāraka).

In the Āyurvedic practice As'oka is mainly indicated in uterine haemorrhage. For this purpose the part used is the bark. The flowers are used in the treatment of bleeding piles and scabies in children.

SARACA INDICA Linn.

(Syn. Jonesia asoca Roxb.)

Family Leguminosae –Caesalpinioideae–

Malayāḷam ... As'okam
Tamil ... As'okam – As'avu
Hindi ... Asok or Ashok

Distribution and Habitat

Saraca indica Linn. is distributed throughout India, particularly in Central and Eastern Himalayas, ascending to 2000 ft. in Kumaon, East Bengal, Khasi Hills, Chittagong and Aracan hills, forests of N. Circars, Orissa, Ganjam, Visagapattam etc. the ever-green forests of Konkan, Kanara and Mysore and southwards to Travancore. It is said to be indigenous in the eastern frontier of Bengal, but very rarely found in a wild state. It is considered one of the "finest" trees in India. Its mildly scented reddish orange blossoms against the dense dark green foliage present a gorgeous appearance when in flower and so, for the beauty of its form as well as for medicinal and religious purposes, it is most often cultivated.

Habit and general features

Saraca indica Linn. is a small to medium sized, handsome, evergreen tree-quite beautiful when in full bloom-with a somewhat erect, though not very straight trunk covered with greyish to dark brown scabrous bark and numerous spreading somewhat drooping branches bearing nearly sessile large abruptly pinnate leaves, one to two feet long, having two to three pairs of large oblong lanceolate leaflets, large dense corymbs of brilliant orange-red fragrant flowers, and rigidly coriaceous or almost woody smooth turgid pods about six inches long containing four to eight seeds. The plant usually flowers from January to March and fruits appear from May onwards.

External morphology

Leaves: alternate, abruptly pinnate, sessile or subsessile, usually more than a foot long, with the rachis smooth and six to nine inches long. The leaves when young are drooping and have a beautiful light rose to deep crimson colour. *Stipules*: connate, intra-

foliaceous; *leaflets*: —opposite, four to six pairs, two to three inches long, one to one and a half inches broad, glabrous, rigidly coriaceous, with slightly wavy margins, the lower pairs broad or oblong-lanceolate, the upper lanceolate.

Flowers: many, polygamous, apetalous, but pretty large and showy, on stout pedicels a quarter to half an inch long and aggregated in nearly sessile, short but large dense, almost globular generally laterally placed corymbose axillary panicles, three to four inches broad. Each flower has a small deciduous bract and subpetaloid, sub-persistant, oblong spathulate ascending amplexicaul reddish bracteoles. They have a beautiful orange colour as they open, but gradually the colour changes to red. *Calyx-tube* elongate, cylindric closed, with a crenulate or lobed disc at the summit within the mouth of the tube. *Calyx lobes* (sepals)–four, unequal ovate to oblong, petaloid, reddish, imbricate in bud. *Petals* absent *Stamens* – usually seven but may vary from five to eight, exserted; *filaments* – filiform, distinct about three to four times the length of the calyx lobes; *anthers* – reniform–oblong, incumbent, versatile, dehiscing longitudinally. *Ovary* – superior, stipitate with the stalk adnate below to one side of the disc, unilocular, many–ovuled; *style* long, filiform, declinate ending in a minute, capitate stigma.

Fruit: a rigidly coriaceous to nearly woody, somewhat smooth scimitar–shaped, dehiscent pod four to eight inches long and one and a half to two inches broad tapering at both ends and reticulated on one side, with the cavity continuous within, and containing four to eight large seeds. *Seeds* - non-endospermic, one to one and a half inches long, obovate or orbicular, slightly compressed, greyish. smooth; *embryo* – large with thick cotyledons.

Officinal parts.

Stem bark, or occasionally root bark; as well as flowers*

Description of stem bark.

In the younger stems and twigs the bark is very thin and has a greenish brown colour but in many places this colour is masked by ash white patches of lichens. The surface shows the presence of

* As the part used in Kerala is mainly stem bark, the description of stem bark alone is given here now.

many small rounded to oval projecting lenticels. The outer rind can be easily scraped. Fresh cut ends have a pale yellowish red tint.

Bark from the old stem is dark green in colour but this is often masked by bluish green and ash white patches of lichens. The external surface is rough and uneven due to the presence of prominent rounded to oval lenticels, formation of short vertical narrow fissures of varying lengths and partial exfoliation of the outer rind in thin flakes. The thickness of the entire bark varies from 5 mm. to 1 cm. according to the age of the stem. Fresh cut ends of the bark show distinctly three regions, a narrow outer brownish uneven layer which can be scraped off easily, a smooth middle yellowish red portion which is brittle and a cream yellow inner region that forms the bulk part of the bark. The entire cut suface turns reddish on exposure to air.

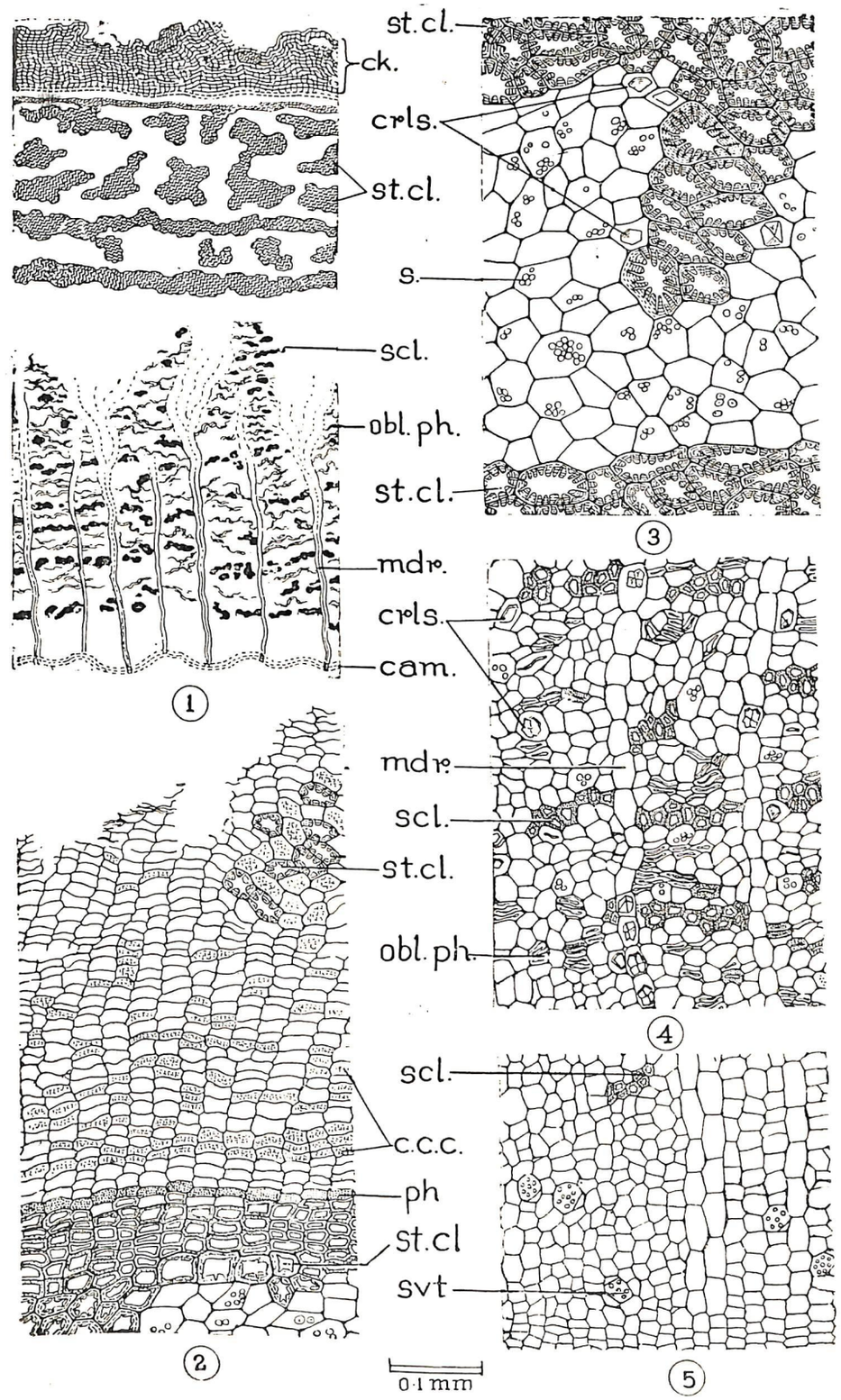
Taste and odour - The taste of the fresh bark is mildly astringent and acidulous. It has no characterestic odour.

Histology of barks 6 to 10 mm. in thickness.

In a transverse section, the outermost tissue namely the cork has a thickness of 1 to 1.5 mm. and consists of thirty or more rows of narrow slightly tangentially elongated cells with here and there adhering portions of the old cortical tissue composed of parenchyma cells and some stone cells. The outer rows of cork cells are much compressed and their cell walls are wavy. Most of these cells contain reddish brown contents. The innermost two to three rows of the cork are nearly rectangular and thin walled with the walls straight and yellow. They measure 14–22 μ x 10–14 μ. The *phellogen* consists of a single row of narrow tangentially elongted thin walled cells.

The middle bark which is mainly secondary cortex is composed of fairly large thin walled polygonal cells with small intercellular spaces and several prominent groups of stone cells. A few small rounded starch grains about 5 μ in diameter occur in most of the parenchyma cells, while others contain rhomboidal or hexagonal crystals of calcium oxalate of various sizes. The stone cells which form the most characteristic feature occur as nearly continuous tangential bands of varying thickness as well as in scattered prominent groups. The size and shape of stone cells vary.

Plate II



Histology of stem bark of *Saraca indica*, Linn.

Fig. 1. Diagrammatic sketch of T. S. of stem bark.
2. Cork, phellogen and developing stone cell layer just within.
3. Portion of middle bark showing parenchymatous tissue, and stone cell groups.
4. Inner bark. Part of old bast showing medullary rays, sclerenchyma

The inner bark which constitutes nearly half the thickness of the entire bark consists of phloem tissue, bast fibres and medullary rays. The phloem parenchyma cells are small, polygonal and thin walled. Compressed and nearly obliterated thin walled phloem elements with a light yellow colour occur in between the regular tissues. Alternating with the parenchymatous elements are also found small groups of fibre cells each group consisting of 4 to 11 cells arranged tangentially. Some of the phloem parenchyma cells contain small rhomboidal or polygonal crystals of calcium oxalate and other cells contain small rounded starch grains. The innermost rows of the bast are mainly composed of thin walled polygonal cells. The sieve tubes and companion cells are distinct. The *cambium* consists of one or two rows of narrow rectangular thin walled cells.

Medullary rays: These are narrow and mostly uni-or bi-seriate in the bast but broaden much towards their distal ends. The cells are definitely larger than the parenchyma cells. The ray cells of the inner bark adjoining the bast fibre groups are fairly large rectangular and radially elongate. Most of them contain crystals of calcium oxalate. As the rays reach the middle bark they broaden or expand and the ray cells appear tangentially elongated.

KARAÑJA*

Source plant. **Pongamia glabra** Vent.
Belonging to Leguminosae –Papilionatae–

Sanskrit Text.

Descriptive synonyms.

" करञ्जो नक्तमालश्च करजश्चिरिविल्वकः ।
घृतपूर्णकरञ्जोऽन्यः प्रकीर्यः पूतिकोऽपि चः ॥
स चोक्तः पूतिकरजः सोमवल्कश्च स स्मृतः । " (भावप्रकाशः)

Karañjo naktamālas'ca karajas'ciri vilvakaḥ ।
Ghṛtapūr'ṇakarañjosn'yaḥ pr'akīryaḥ pūtikospi ca ॥
Sa coktaḥ pūtikarajaḥ somavalkas'ca sa smṛtaḥ ।
(Bhāvapr'akās'aḥ)

" करञ्जो मञ्जरीपुष्पो लाजपुष्पः प्रकीर्यकः ।
छायाप्रियो नक्तभालः प्रकीर्या चोदकीर्यकः ॥
उदकीर्या कीर्यकश्च कच्छुदारश्च गुच्छकः ।
गुच्छो गजकरञ्जेति शब्दाः पर्यायवाचकैः ॥ " (अभिधानमञ्जरी)

Karañjo mañjarīpuṣpo lājapuṣpaḥ pr'akīryakaḥ ।
Chāyāpr'iyo naktamālaḥ pr'akīryā codakīryakaḥ ॥
Udakīryā kīryakas'ca kacchudāras'ca gucchakaḥ ।
Guccho gajakarañjeti s'abdāiḥ paryāyavācakāiḥ ॥
(Abhidhān'amañjarī)

---

* Two different plants known in Malayāḷam as *Ungu* and *Āvil* are used in Kerala for medicinal purposes as the source of Karañja. Of these Ungu is *Pongamia glabra* Vent. The name *Āvil* is applied to *Holoptelia integrifolia* Pl. The name *Āvil* is often confused with or considered the same as *Āvi* a name applied to species of *Cordia, C, myxa* etc. *Cordia myxa* and other species of *Cordia* are also occasionally used as Karañja by mistake or as a substitute on account of the similarity in their local names.

Seven or more varieties of Karañja are mentioned in Aurvedic texts such as Dahar Karañja, Nata Karañja, Kanta karañja (Karanjika) Makra karañja, Bish karañja, Amba karañja, Ghrtapurṇa karañja etc. It is not known whether these are mere varieties of one species or different species or genera since it has not been possible to obtain the plants for identification.

" करञ्जो नक्तमालश्च पूतिकश्चिरिविल्वकः
घृतपूर्णः करञ्जोऽन्यः प्रकीर्यो गौर एव च ॥ " (धन्वन्तरि निघण्टुः)

Karañjo naktamālas'ca pūtikas'cirivilvakaḥ
Ghṛtapūr'ṇaḥ karañjosn'yaḥ prakīryo gaura eva ca ॥
(Dhanvantari nighaṇṭuḥ)

" करञ्जो नक्तमालश्च पूतिकश्चिरविल्वकः
पूतिपर्णो वृद्धफलो रोचनश्च प्रकीर्यकः ॥ " (राज निघण्टुः)

Karañjo naktamālas'ca pūtikas'ciravilvakaḥ ।
Pūtipar'ṇo vṛddhaphalo rocan'as'ca pr'akiryakaḥ ॥
(Rāja nighaṇṭu)

Of the synonyms *pūtikaḥ putiparṇaḥ* etc. indicate the foul odour of the plant especially leaves; *ghṛtapūr'ṇakarañja* indicates the fatty substance found inside the seed; *mañjarīpuṣpaḥ, lājapuṣpaḥ gucchaka* etc denote the attractive, whitish flowers clustered into inflorescence; and *kacchudāra* its property of being useful in skin diseases (pruritus etc.)

Properties and uses.

" करञ्जः कटुकस्तीक्ष्णो वीर्योष्णो योनिदोषहृत् ।
कुष्ठोदावर्त्तगुल्मार्शो व्रणकृमिकफापहः ॥
तत्पत्रं कफवातार्शः कृमिशोथहरं परम् ।
भेदनं कटुकं पाके वीर्योष्णं पित्तलं लघु ॥
तत्फलं कफवातघ्नं मेहार्शः कृमिकुष्ठजित् ।
घृतपूर्णकरञ्जोऽपि करञ्जसदृशो गुणैः ॥ " (भावप्रकाशः)

Karañjaḥ kaṭukastīkṣṇo vīryoṣṇo yon'idoṣahṛt ।
Kuṣṭhodāvar'ttagulmārs'o vr'aṇakṛmikaphāpahaḥ ॥
Tatpatr'am kaphavātār's'aḥ kṛmis'othaharam param ।
Bhedanam kaṭukam pāke vīryoṣṇam pittalam laghu ॥
Tatphalam kaphavātaghn'am mehārs'aḥ kṛmīkuṣṭhajit
Ghṛtapūrṇakarañjo s pi karañjasadar'so guṇaiḥ ॥
(Bhāvaprakās'aḥ)

कुष्ठगुल्मोदरार्शोघ्नं कटुपाकि तथैव च ।
करञ्जकिंशुकारिष्टफलं जन्तुप्रमेहनुत् ॥
स्रंसनं कटुकं पाके लघुवातकफापहम् ।
शोफघ्नमुष्णवीर्यं च पत्रं पूतिकरञ्जम् ॥ (सुश्रुतम्)

Kuṣṭha gulmodarār'ṣoghn'am kaṭupāki tathaiva ca ।
Karañjakimṣukāriṣṭaphalam jantupı'amehan'ut ॥
Sı'amsan'am kaṭukam pāke laghuvātakaphāpaham ।
S'ophaghn'amuṣṇavīryam ca patr'am pūtikarañjajam ॥
(Sus'r'utam)

करञ्जश्चोष्णतिक्तः स्यात् कफपित्तास्रदोषजित् ।
व्रणक्लीहकृमीन् हन्ति भूतघ्नो योनिरोगहा ॥
चिरिविल्वः करञ्जश्च तीव्रो वातकफापहः । (धन्वन्तरि निघण्डुः)

Karañjas'coṣṇatiktaḥ syāt kaphapittāsı'adoṣajit ।
Vı'aṇapḷīhakṛmīn hanti bhūtaghn'o yon'irogahā
Cirivilvaḥ karañjas'ca tīvr'o vāta kaphāpahaḥ
(Dhanvantari nighaṇṭu)

करञ्जः कटुरुष्णश्च चक्षुष्यो वातनाशनः ।
तस्य स्नेहोऽतिस्निग्धश्च वातघ्नः स्थिरदीप्तिदः ॥ (राज निघण्डुः)

Karañjaḥ kaṭuruṣṇas'ca cakṣuṣyo vātanās'an'aḥ
Tasya snehosti snigdhas'ca vātaghn'aḥ sthiradīptidaḥ ॥
(Rāja nighaṇṭu)

घृतकरञ्जः कटूष्णो वातहृत् व्रणनाशनः ।
सर्वत्वग्दोषशमनो विषस्पर्शविनाशनः ॥ (राज निघण्डुः)

Ghṛtakaran'jaḥ kaṭūṣṇo vātahṛt vr'aṇanās'an'aḥ ।
Sar'vatvagdoṣas'aman'o viṣaspars'avin'ās'an'aḥ ॥
(Rāja nighaṇṭu)

करञ्जयुग्मं तु सरं दीपनं कफवातजित् । (हृदयप्रियः)

Karañjayugmam tu saram dīpan'am kaphavātajit ।
(Hṛdayapr'iya)

According to Bhāvapr'akās'a Karañja is pungent, active, hot in *virya*; cures vaginal diseases, skin-diseases, intestinal obstruction (antiperistalsis), gulma (phantom tumor etc); piles, ulcer, parasites, and *kapha*. Its leaves cure *kapha*, *vāta*, piles, parasites, and oedema; and cause purging. They are pungent on digestion, hot in *vīrya*, cause *pitta* and are light (easy to digest). The fruit overcomes *kapha* and *vāta*; cures urinary diseases (with excessive urination), piles, parasites and skin diseases.

The variety ghṛtapūr'ṇakarañja is also similar in properties to Karañja.

Properties and uses mentioned by other authors:

Cures abdominal enlargement (ascites etc.) is bitter; cures blood diseases and enlargement of spleen. Its oil is very useful in paralytic diseases; and it cures poisons. Caraka has included this under the group of drugs useful in skin diseases.

PONGAMIA GLABRA Vent.

Family Leguminosae –Papilionatae–

Malayāḷam	–	Pongu, Pongan, Pungu
Tamil	–	Pungu, Poongumaram
Hindi	–	Karañj, Sukhchain
English	–	Honge oil tree, smooth leaved Pongamia, and the Indian "Beech" tree (since the foliage is like that of beech)

Distribution and habitat.

Fairly common throughout India in tidal and beach forests and along tidal river banks, as well as banks of streams and rivers in inland forests of South and Central India. It is considered indigenous to Coramandel, Koncan, Deccan, Bengal, Assam etc. It is often cultivated for pollarding for mulch, as well as for its useful products, and also planted along roadsides as an avenue tree.

Habit and general features.

Pongamia glabra Vent. is a moderate sized to fairly large, graceful semi–evergreen, glabrous tree attaining a height of 40 to 50 feet or more. Its trunk is rarely straight and the branches spread irregularly in every direction. These terminate in fairly long usually drooping graceful, twiggy branchlets, that bear beautifully shiny or varnished alternate odd–pinnate leaves with 5 to 7 leaflets, and profusion of pinkish white flowers in simple axillary racemes, followed by thick woody smooth brownish turgid obliquely oblong slightly flattened indehiscent generally one–seeded pods.

The tree is deciduous for a short period during the cold season. It generally flowers twice during the year viz. October to December and February to March. The leaves, flowers, and oil cake, are extensively used as manure. The wood which is yellowish white, often streaked with grey and turning yellow on exposure is course, moderately hard, light but firm or tough and cross grained. It is often used for cart wheels and similar purposes.

All parts of the plant when crushed yield a yellow juice.

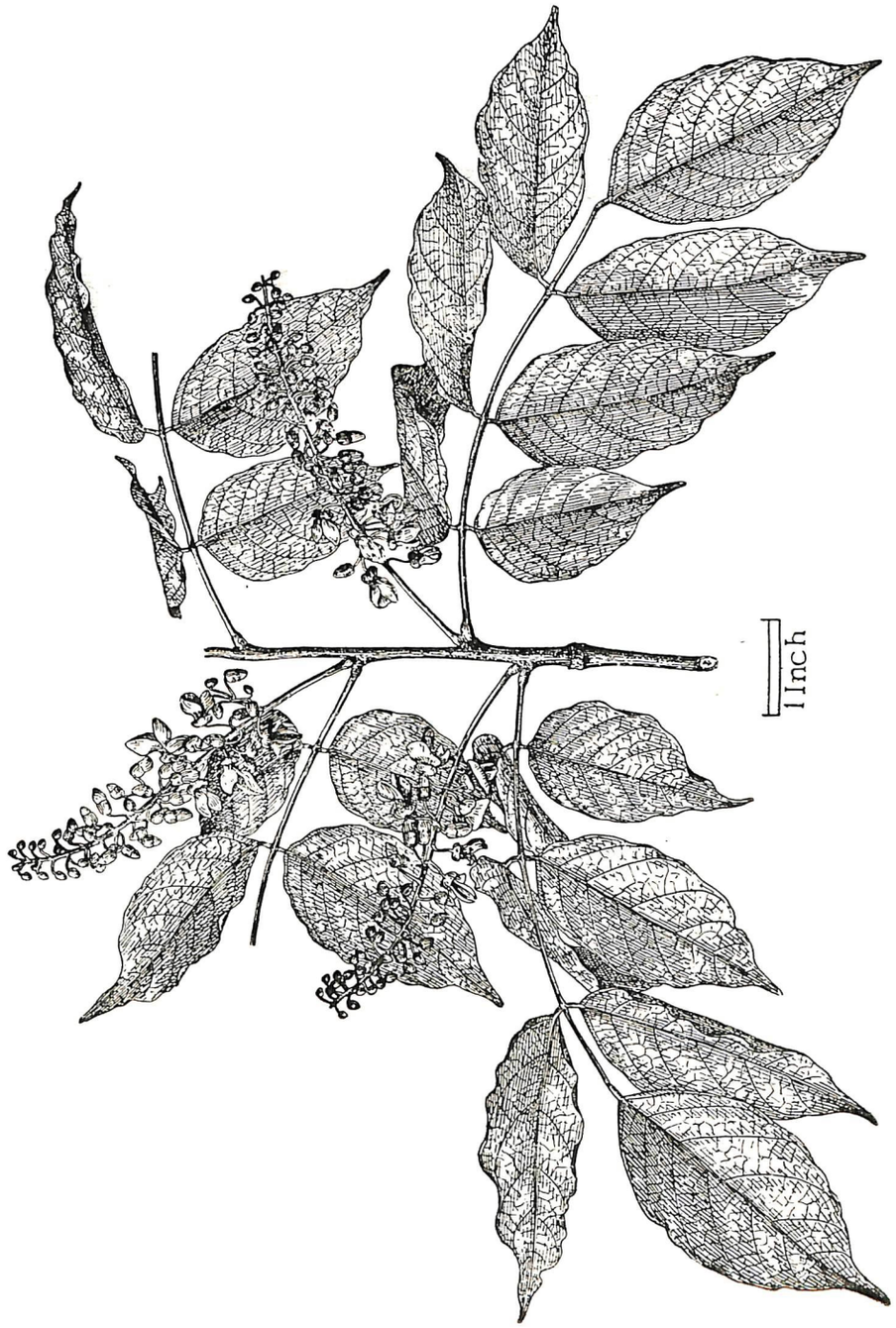


Plate III

Pongamia glabra, Vent.

External morphology

Leaves: alternate, stipulate, odd–pinnate six to twelve inches or more long; *petiole* – round, quite smooth, pulvinate at base; *rachis:* nearly five inches long; *leaflets* –opposite, large, from five to seven, in number varying in size, 2-4″ long, usually without stipels, reddish when young but on maturing turning bright green and shiny, ovate to elliptic-ovate or rarely oblong, tapering at both ends, entire, subcoriaceous, and shortly acuminate. They have a bitter taste.

Flowers: medium sized, pinkish white (or of a beautiful mixture of blue, white and purple), arranged in pairs or in fascicles of two to four, on short slender pubescent pedicels in many-flowered usually simple, peduncled axillary racemes nearly as long as the leaves: *pedicels* - a quarter to one third inch long; *bracts* - small, broad, lanceolate, caducous; each generally subtending two flowers. *Calyx* - obliquely cup shaped, slightly fourtoothed, of a dark purple colour about 1/10 inch long, and nearly as wide. *Corolla* - papilionaceous about half inch long, much exserted; *standard* - broad, suborbicular, silky on the back, somewhat deeply emarginate with at the base of the limb two curved folds or callosites that are decurrent along the claw; *wings* - obliquely oblong, slightly adnate above the claws to the obtuse *keel* petals that are convergent or slightly connate at the tip. *Stamens* 10, mon – adelphous, the posterior one free below but united above the middle with the rest; *anthers* - uniform, oblong versatile. *Ovary* - subsessile, two-ovuled, with a simple, incurved glabrous style ending in a capitate stigma.

Fruit: a thick woody, smooth, turgid ovate to obliquely oblong compressed, indehiscent one-chambered legume attenuate at both ends, one and a half to two inches long and one eighth to a quarter inch thick, brownish when dry and with the apex thick, blunt and slightly curved or bent down. *Seed* non endospermic, generally single or occasionally with an abortive second, rather thick though compressed, reniform to nearly round, smooth or wrinkled, and light grey with a small hilum; testa thin, smooth veined, light rosy red; *cotyledons* - very oily and bitter.

Officinal parts :

Stem bark, root and root bark, leaves fruit and oil from the seeds. Mainly the stem bark in Kerala*

Stem bark

In younger trunks and branches the surface of the bark is completely covered with crustose lichen patches of varying shades and sizes from ashy white to dark grey, very often mottled with dark brown to black dots specks and lines, or streaks. The development of such lichen patches results in the masking of the original ashgrey colour of the outer bark. Surface lenticellate. The development of longitudinal rows of numerous slightly warty lenticels of varying lengths results in the surface appearing slightly rough. Otherwise it may be considered fairly smooth since there are no cracks or fissures or any regular exfoliation of the outer bark. The thickness varies from about 1/10 of an inch in the case of branches six to nine inches thick, to nearly half an inch in stouter branches. The fresh cut surface has a very pale yellowish white colour with a narrow greenish zone at the periphery bounded by the outer bark or rind that appears as a black line outside. On dried barks the section presents narrow and shallow radial depressions very close to each other. In older and thicker barks the surface is more rough, the lichen patches gradually disappear and in still older and thicker barks the surface is almost completely devoid of lichen patches and in these the bark has a more or less uniform dark brown tint with knots or swellings here and there and with regular vertical lines or rows of short and long lenticel openings. *Outer bark* – very thin ashgrey slightly corky, brittle or crustaceous and easily removed, ordinarily less than half a millimeter in thickness and of a dark brown colour in section. It comes off in very thin small pieces of varying sizes on peeling, being not strong enough to be peeled off in larger pieces. Its inner surface is smooth and has a dark grey colour which is almost black in thicker barks and is seen beset with vertical rows of greyish white dots and streaks that represent the inner side of lenticels. The *middle bark* is comparatively narrow. There is a thin greenish tissue often with white transverse markings at its periphery immediately

*The parts used according to Pharmacographia indica, (Dymock), are the seeds, leaves and oil from seeds. They are used for skin diseases and in rheumatism and to destroy worms in sores.

within the outer bark or rind while the rest of the bark appears white. The *inner bark* comprises the bulk portion of the bark. This part is proportionately thicker in larger sized stems. It is whitish and appears tangentially lamellated.

Texture the bark except for the rind or outer bark is tough and fibrous. It has a white granular fracture.

Taste and odour. The fresh barks have a feebly sweetish and mucilaginous taste at first, that soon becomes quite bitter combined with a sort of peculiar pungency which persist for some time especially inside the mouth and lips. The fresh cut bark has a faint aroma without any characteristic bad odour, but sometime after, a persisting offensive or disgusting odour is produced— an odour some what characterestic of certain other of leguminous plants (e. g. Abrus, Albizzia, Acacia, Cassia etc.) Hence probably the Sanskrit name Pootikarañja.

History of Stem bark. A transverse section of the stem (three inches in diameter) shows a moderately developed cork layer which peels off easily. The cork tissue which has a thickness of about 1 mm. is composed of more than twenty rows of thin walled rectangular cells, with pale yellow walls and brownish yellow contents. The cork cells in transverse section vary from 19 to 28 μ in length and about 8 μ in width.

The middle bark is a comparatively wider zone more than 2 mm. in thickness. At its periphery within the phellogen is a well developed phelloderm the peripheral five or more rows of cells of which are thin walled, slightly larger than the cells of the phellogen, and appear empty. The rows of cells next within contain small rhomboidal and pentagonal crystals of calcium oxalate. Large groups of stone cells arranged in a tangential manner forming a discontinuous annular band occur in the tissues of the middle bark next within the phelloderm. Similar stone cell groups of nine to twenty or more cells also occur towards the inside but in a scattered manner. The stone cells are fairly large and tangentially elongated, but are not uniform in size. They measure from 54 $\times$ 32 μ to 28 $\times$ 25 μ. The cortical parenchyma cells (length 36 to 56 μ width 28 to 40 μ) are polygonal or rectangular and slightly tangentially elongated. Most of them contain a few starch grains and

a few others have dark brown contents. Numerous crystals both cubical and rhomboidal are found in several of the parenchyma cells adjacent to the stone cell groups.

The *inner bark* comprises about 1/3 the thickness of the whole bark (being more than 2 mm. wide). This zone chiefly consists of alternating segments of phloem elements and mechanical cells and the radially extending medullary rays. The mechanical elements towards the outside are comparatively small, rounded stone cells and associated large sized fibre cells. In this region some of the phloem elements are found in a compressed and collapsed manner as thin tangential strips. Small starch grains and crystals occur within some of the thin walled phloem parenchyma cells. Towards the inside the fibre cells become less in number. They are smaller in size very thickwalled and occur either solitary or in groups of 2 or 3. The phloem parenchyma cells in this region are thin walled, polygonal and smaller in size. A few large sized thinwalled cells probably secretory in function occur amidst the parenchyma.

In the innermost part of the bast where the newly formed phloem elements are found no fibres are present. The sieve tubes and companion cells are very distinct. All the cells are thinwalled, small, and polygonal in shape. A few parenchyma cells contain small crystals of calcium oxalate.

Medullary rays are many, long, wavy usually two to four seriate and extend up to the middle bark, but they do not appreciably broaden at their distal ends. The ray cells are thinwalled and radially elongated, in the phloem measuring in transverse section 42–44 μ in length and 15–17 μ in width. The cells become shorter at the distal end of the ray. Most of the ray cells towards the outer part of the inner bark contain many rounded starch grains.

Root Bark.

Description of root – The root are thick and woody, light rusty brown externally, yellow within with the surface somewhat rough due to splitting and irregular longitudinal peeling off of the thin outer brownish skin and the presence of numerous soft or spongy warty lenticel openings that are irregularly scattered over the surface as well as arranged in regular transverse rows spaced one third to half an inch

apart. The entire bark in roots one to one and a half inches in diameter, is about one tenth of an inch thick. Its outer part is yellowish white with a short fracture, while the inner half is whiter and fibrous. *Outer bark* light or rusty brown, thin, membraneous, easily peeling off in thin flakes, the inner surface pale yellow with many small circular depressions each with a mamillary projection within. It has no characteristic taste or odour. *Middle bark* compact, brittle with short fracture, yellowish white, some what starchy with a very bitter taste. *Inner bark* whitish, tough and fibrous with a bitter and slightly pungent taste. Wood hard, yellowish when freshly cut and showing numerous closely spaced concentric striations.

Histology of root bark.

The following details are made out in a transverse section of the root bark. The cork or *phellem* the outermost tissue is fissured and hence the outline is irregular and the thickness of the cork zone not uniform. The cork zone is yellowish brown in colour and the number of rows of cells varies from five to twenty or more. The cells are all narrowly rectangular and tangentially elongated. The cell walls are thin and yellowish brown in colour. The *phellogen* consists of one row of narrow thin walled tangentially elongated cells.

Middle bark or cortex comprised of primary cortex and phelloderm occupies about 1/6th the thickness of the bark. The cells of this region are polygonal tangentially elongated and thin walled. Most of them contain small starch grains. A few others have yellowish contents. Few celled groups of stone cells forming discontinuous annular bands, as well as in a sparsely scattered manner occur in the peripheral half of the cortex. The stone cells vary in size and shape though mostly isodiametric or tangentially elongated. In some of the newly formed phelloderm cells and in some of those adjacent to the stone cell groups rhomboidal and pentagonal crystals of calcium oxalate occur.

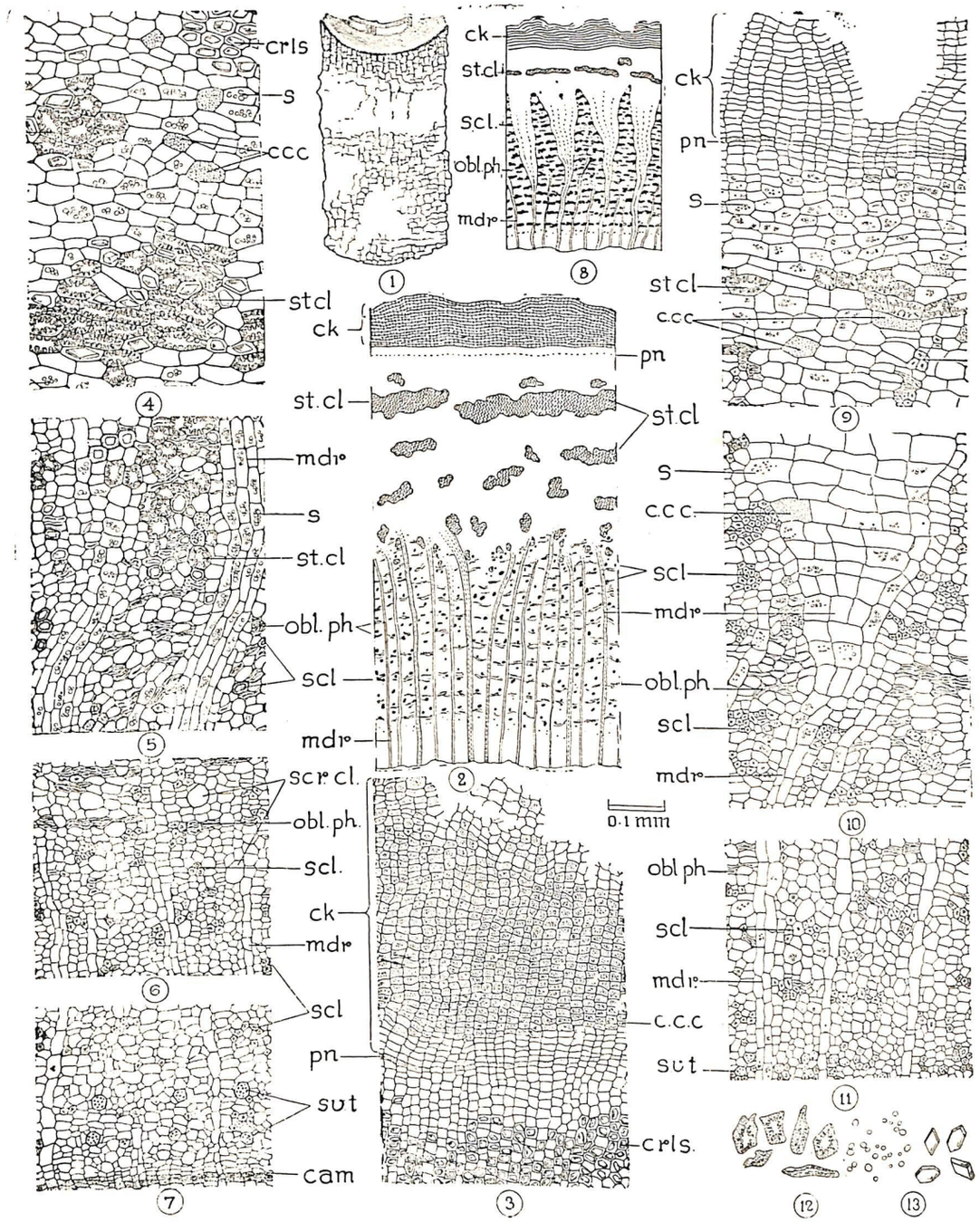
The *inner bark* or bast forms 2/3rd the thickness of the whole bark and is composed of tangential groups of bast fibres alternating with the regular phloem elements and the radially extending medullary rays. The medullary rays broaden much at the outer half of the inner bark so that the phloem elements with the bast fibres are found in conical strips with crushed up elements near

the periphery. Each group of fibres may contain from 3-15 or more thickwalled cells. The phloem parenchyma cells are small oval or polygonal and some of them contain starch grains. A few parenchyma cells contain very small rhomboidal crystals of calcium oxalate. Towards the innermost region of the inner bark the fibre groups are smaller in size. In the newly formed phloem tissue sieve tubes and companion cells are distinctly seen among the parenchyma.

Medullary rays. Many, mostly uniseriate and biseriate. They are nearly straight and extend throughout the thickness of the inner bark. At the inner most region the ray cells are radially elongated and thinwalled, but they gradually widen and become tangentially elongated at their distal ends. The rays widen considerably near the outer boundary of the inner bark. Several of the ray cells contain small starch grains and a few cells at the outermost region of the ray contain yellowish contents. Inner to the phloem is the cambium which separates the bark from the wood.

Oil: The oil expressed from fresh seeds, is thick, has a yellow to light orange brown colour and bitter taste. Its specific gravity at 18°C is 0·94. It solidifies at about 80°C.

Plate IV



Histology of stem and root barks of *Pongamia glabra*, Vent.

(Stem bark Figs 1—7)

1. External appearance of the stem bark.
2. Diagrammatic sketch of part of the T. S. of the stem bark.
3. Cork and the secondary cortex.
4. A portion of the middle bark.
5. Outermost bast region.
6. A portion of the inner bark showing the large sized cells.

(Root bark Figs. 8 to 12)

8. Diagrammatic sketch of the T. S. of the root bark.
9. A portion of the outer and the middle barks.
10. Inner bark with a ray expansion,
11. Young bast.
12. Stone cells.
13. Starch grains and crystals.

S'IGRU*

Source plant in Kerala

Moringa oleifera Lamk.

(Synonym – *Moringa pterygosperma* Gaertn-

(Family Moringaceae)

Sanskrit Text.

Descriptive synonyms.

शिग्रुर्मूलकपत्रो बहुलदलस्तीक्ष्णगन्धश्च ।
उपदंश: शीघ्रफलों बहुलत्वक् हरितशाक: स्यात् ॥
मधुशिग्रु: सितमरिचो मधुस्रव: कृष्णगन्धश्च ।
प्रोक्त: सौभाञ्जनक: शिग्रुकसंज्ञो मुरिंगीति ॥
सचेवचाछवृक्ष: स्यान्मुखवासाह्वयस्तथा ।
तथैव श्वेतमरिच: शब्दै: पर्यायवाचकै: ॥
कथित: स एव बहल: श्वेततरु: श्वेतमञ्जरी चेति ।
सौभाञ्जनकश्च हरितपर्यायैर्बहलपल्लवोऽनिलजित् ॥

(अभिधानमञ्जरी)

S'igrurmūlakapatı'o Bahuladalastī ṣṇagandhas'ca ।
Upadams'aḥ s'īghr'aphalo bahulatvak harita s'ākaḥsyāt ||
Madhus'igruḥ sitamarico madhusr'avaḥ kṛṣṇagandhas'ca ।
Pro'ktaḥ saubhāñjan'akaḥ s'igruka samñjo murimgīti ||

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* In the Sanskrit texts four varieties of Sigru namely those with white, yellow, blue and red flowers – are mentioned. The one commonly used is *Moringa oleifera* Lamk. Its flowers are cream white to yellow. A red-flowered variety of *M. pterigosperma* is mentioned by Roxburgh, This is most possibly *Moringa concaneneis* Nimmo (Flora indica p. 360) where the flowers are described as yellow streaked with red. The varieties indicated are probably only different varieties of *M. oleifera*, or of *M. concanensis* except that with blue flowers which may possibly be a different plant.

Moringa concanensis has a Sanskrit name *Madhus'igru.*

Sacevacā chavṛkṣaḥ syānmukhavā sāhvayastathā ।
Tathaiva s'vetamaricaḥ s'abdaiḥ paryāyavācakaiḥ ॥
Kathitaḥ sa eva bahaḷaḥ s'vetataruḥ s'vetamañjariceti ।
Saubhāñjan'akas'ca haritaparyāyai rbahaḷapallavo s n'ilajit ॥

(Abhidhān'amañjarī)

"शोभाञ्जनः शिग्रुस्तीक्ष्णगन्धकाक्षावमोचकाः ।
तद्बीजं श्वेतमरिचं मधुशिग्रुः स लोहितः ॥ "

(भावप्रकाश)

S'obhāñjan'aḥ s'igrustī kṣṇagandhakā kṣāvamocakāḥ ।
Tadbījam s'vetamaricam madhus'igruḥ sa lohitaḥ ॥

(Bhāva pr'akās'aḥ)

शिग्रुर्हरितशाकश्च शिग्रुको लघुपत्रकः ।
उपदंशक्षमो दंशः प्रोक्तो मूलकपर्ण्यपि ।।
सौभाञ्जनस्तीक्ष्णगन्धो मुखभंगोऽथ शिग्रुकः ।
श्वेतकः श्वेतमरिचो रक्तको मधुशिग्रुकः ।।

(धन्वन्तरि निघण्डुः)

S'igrur'harita s'ākas'ca s'igruko laghupatr'akaḥ ।
Upadams'akṣamo dam's'aḥ pr'okto mūlakapar'ṇyapi ॥
Saubhāñjan'astī kṣṇagandho mukhabhaṅgo s tha s'igrukaḥ ।
S'vetakaḥ s'vetamarico raktako madhus'igrukaḥ ॥

(Dhanvantari nighaṇṭu)

" शिग्रुर्हरितशाकश्च शाकपत्रः सुपत्रकः ।
उपदंशक्षमो दंशो ज्ञेयः कोमलपत्रकः ॥
बहुमूलो दंशमूलस्तीक्ष्णमूलो दशाह्वयः ।
शोभाञ्जनो नीलशिग्रुस्तीक्ष्णगन्धो जनप्रियः ॥
मुखामोदः कृष्णशिग्रुश्चक्षुष्यो रुचिरञ्जनः ।
श्वेतशिग्रुः सुतीक्ष्णः स्यान्मुखभंगः सिताह्वयः ॥
सुमूलः श्वेतमरिचो रोचनो मधुशिग्रुकः ।
रक्तको रक्तशिग्रुः स्यान्मधुरो बहुलछदः ।।
सुगन्धकेसरः सिंहो मृगारिश्च प्रकीर्तितः । (राजनिघण्डुः)

S'igrurharitas'ākas'ca s'ākapatr'aḥ supatr'akaḥ ।
Upadams'akṣamo dams'ojñeyaḥ komaḷapatr'akaḥ ॥
Bahumūlo dams'amūlastīkṣṇamūlo das'āhvayaḥ ।
S'obhāñjan'o nīlas'igrustikṣṇagandho jan'apriyaḥ ॥
Mukhāmodaḥ kṛṣṇas'igrus'cakṣuṣyo rucirañjan'aḥ ।
S'vetas'igruḥ sutīṣṇaḥ syānmukha bhaṅgaḥ sītāhvayaḥ ॥
Sumūlaḥ s'vetamarico rocan'o madhusigrukaḥ ।
Raktako raktas'igruḥ syānmadhuro bahuḷachadaḥ ॥
Sugandhakesaraḥ simho mṛgāris'ca pr'akīr'ttitaḥ ।

(Rāja nighaṇṭu)

Of the synonyms *bahuladaḷaḥ* indicates the large number of leaves, (leaflets), *bahulatvak* indicates that its bark is very thick, *tīkṣṇagandhaḥ* indicates the strong smell of the bark and the root and *dams'amula*–pungent root.

Upadams'akṣamaḥ denotes that its fruits, flowers and leaves are edible and used for preparing dishes. The leaves are used in Kērala for preparing special dishes for persons who have to be on diet under Ayurvedic treatment.

Properties and uses.

"शिग्रुः कटुः कटुः पाके तीक्ष्णोष्णो मधुरो लघुः ।
दीपनो रोचनो रूक्षः क्षारस्तिक्तो विदाहकृत् ॥
संग्राही शुक्लो हृद्यः पित्तरक्तप्रकोपनः ।
चक्षुष्यः कफवातघ्नो विद्रधिश्वयथुकृमीन् ॥
मेदोऽपचीविषप्लीहगुल्मगण्डव्रणान् हरेत् ।
श्वेतः प्रोक्तगुणो ज्ञेयो विशेषाद्दाहकृद्भवेत् ॥
प्लीहानं विद्रधिं हन्ति व्रणघ्नः पित्तरक्तकृत् ।
मधुशिग्रुः प्रोक्तगुणो विशेषाद्दीपनः सरः ॥ (भावप्रकाश)

S'igruḥ kaṭuḥ kaṭuḥ pāke tīkṣṇoṣno madhuro laghuḥ ।
Dīpan'o rocan'o rūkṣaḥ kṣārastikto vidāhakṛt ॥
Sam'grāhī s'ukḷaḷo hṛdyaḥ pittaraktapr'akopan'aḥ ।
Cakṣuṣyaḥ kaphavātaghn'o vidradhis'vayathukṛmīn

Medo s pacī viṣapḷīha gulma gaṇḍavraṇān haret ।
S'vetaḥ proktaguno jñeyo vis'eṣāddāhakṛdbhavet ॥
Pḷīhān'am vidradhim hanti vr'aṇaghn'aḥ pittaraktakṛt ।
Madhus'igruḥ pr'oktaguṇo viṣeṣāddīpan'aḥ saraḥ ॥

(Bhava prakās'ah)

शिग्रुवल्कल पत्राणां स्वरसः परमार्त्तिहृत् । (भावप्रकाश)

S'igruvalkalapatr'āṇām svarasaḥ paramār'ttihṛt ।

(Bhāva pr'akas'aḥ)

चक्षुष्यं शिग्रुजं बीजं तीक्ष्णोष्णं विषनाशनम् ।
अवृष्यं कफवातघ्नं तन्नस्येन शिरोर्त्तिनुत् ॥ (भावप्रकाश)

Cakṣuṣyam s'igrujam bījam tīkṣṇoṣṇam viṣanās'an'am ।
Avṛṣyam kaphavātaghn'am tannasyen'a s'iror'ttin'ut ॥

(Bhāva pr'akāsaḥ)

शिग्रुस्तिक्तः कटुश्चोष्णः कफशोफसमीरजित् ।
कृम्यामविषमेदोघ्नो विद्रधिप्लीहगुल्मनुत् ॥ (धन्वन्तरिनिघण्डु)

S'igrustiktaḥ kaṭus'coṣṇaḥ kapha s'ophasamīrajit ।
Kṛmyāmaviṣamedogbn'o vidradhipḷīhagulman'ut ॥

(Dhanvantari nighaṇṭu)

शिग्रुश्च कटुतिक्तोष्णस्तीक्ष्णो वातकफापहः ।
मुखजाड्यहरो रुच्यो दीपनो व्रणदोषनुत् ॥
शोभाञ्जनस्तीक्ष्णकटुः स्वादूष्णः पिच्छिलस्तथा ।
जन्तुवार्त्तिशूलघ्नश्चक्षुष्यो रोचनः परः ॥
श्वेतशिग्रुः कटुस्तीक्ष्णः शोफानलनिकृन्तनः ।
अंगव्यथाहरो रुच्यो दीपनो मुखजाड्यनुत् ॥
रक्तशिग्रुर्महावीर्यो मधुरश्च रसायनः ।
शोफाध्मानसमीरार्त्तिपित्तश्लेष्मापसारकः ॥ (राजनिघण्डु)

S'igrus'ca kaṭutiktoṣṇastīkṣṇo vātakaphāpahaḥ ।
Mukhajāḍyaharo rucyo dīpan'o vr'aṇadoṣan'ut ॥
S'obhāñjan'a stīkṣṇakaṭuḥ svādūṣṇaḥ pichilastathā ।
Jantuvātār'ti s'ūlaghnas'cakṣuṣyo rocan'aḥ paraḥ ॥

S'vtas'igruḥ kaṭustīkṣṇaḥ s'ophān'alanikṛntan'aḥ ।
Aṅgavyathāharo rucyo dīpan'o mukhajāḍyan'ut ॥
Raktas'igrurmahāvīryo madhuras'ca rasāyan'aḥ ।
S'ophādhmān'asamīrārttipittas'leṣmāpasārakaḥ ॥

(Rāja nighaṇṭu)

गृञ्जनो वातपित्तघ्नः शोफगुल्मज्वरापहः ।
तस्य पल्लवमप्येवं कृमिनेत्रविकारजित् ॥ (हृदयप्रियः)

Gṛñjan'o vātapittaghn'aḥ sopha gulmajvarāpahaḥ ।
Tasya pallavamapyevam kṛminetravikārajit ॥

(Hṛdayapr'iyaḥ)

वातपित्तकफसन्निपातजां नेत्रयोर्बहुविधामपि व्यथाम् ।
शीघ्रमेव जयति प्रयोजितः शिग्रुपल्लवरसः समाक्षिकः ॥
तीक्ष्णो गृञ्जनको ग्राहि पित्तिनां हितकृन्नसः । (अष्टाङ्गहृदयः)

Vātapittakapha san'n'ipātajam netrayor'bahuvidhamapi-
vyathām ।

S'īghr'ameva jayati pr'ayojitaḥ s'igru pallava rasaḥ
samākṣikaḥ ॥

Tīkṣṇo gṛñjan'ako grāhī pittinām hitakṛnnasaḥ ।

(Aṣtāṅgahṛdaya)

According to Bhāvapr'akāsa' *S'igru* is pungent, pungent on digestion, quick, hot, sweet, light, digestive, promoting taste, dry caustic, bitter, causing inflammation, arresting, promoting semen, agreeable (for heart). aggravating *pitta* and *rakta*. good for the eye, reduces *kapha* and *vāta*, ends abscess, swelling, worms (parasites) excess fat, enlargement of cervical glands, poison, spleen enlargement, phantom tumour, thyroid enlargement and ulcers. White *S'igru* has the above properties and in addition causes burning, ends spleen enlargement, abscess and ulcer; and increases *pitta* and *rakta*.

Madhus'igru besides possessing the general properties is particularly digestive and laxative. The juice of bark and leaves relieves extreme pain.

The seeds are known as *Svetamaricam* and are good for the eye, overcomes poison and is used for application through nose (*Siro, virecan'am.*)

According to other authors it also cures *āmavāta*, *ādhmān'a* and *mukhajādya*, rheumatic arthritis etc., gas in the abdomen and numbness in the mouth respectively.

The officinal parts are bark, leaves, – especially the tender leaves – and seeds.

MORINGA OLEIFERA Lamk.

(Syn. *Moringa pterygosperma* Gaertn.)
(Moringaceae)

Malayāḷam;	Murin'ga, Muriñña, Sigru
Tamil:	Murun'gai
Hindi:	Mungna, Sainjna, Shagna, Sondna, Sahajana, Soanjna etc.

Distribution and habitat.

Moringa oleifera Lamk. is found wild in the Sub-Himalayan tract from the Chenab to the Sarda, Forests of Western Himalayas Oudh, Northern Circars, Ganjam, Deccan, Carnatic, and the West Coast. It is cultivated all over India mainly for its fruit and leaves and occasionaliy as a support for the betel vine.

Habit and general features.

Moringa oleifera is a small or medium sized, very soft wooded deciduous tree thirty to forty feet high (but often shorter), the trunk and branches generally straight with thick corky greyish fissured bark, bearing large tripinnate leaves one to one and a half feet long having numerous small leaflets; many flowered panicles of fairly large cream white flowers at the ends of branches and cylindrical pendulous pod like fruits a foot or more long. The plant is in flower from October to December and bears fruits from January to April.

External morphology.

Leaves: Alternate, exstipulate, usually three-pinnate or rarely bi-pinnate, one to two feet or more long with four to six pairs, of opposite pinnae; the *rachis* – thickened and articulate at base; both leaf and pinnae, oddpinnate; *pinnules* – six to nine pairs, with very slender rachises, the odd or uppermost one unifoliate. There is often present on the rachis between each pair of pinnae and pinnules a linear hairy gland. *Leaflets:*– opposite, six to nine pairs on each pinnule, half to three quarters of an inch long and a quarter to half inch wide. They are entire, elliptic-ovate or obovate,

rounded or narrowed at base, obtuse at apex, smooth and green above, and paler beneath with the main nerves obscure. They fall off early. *Petiole*:– slightly sheathing at the base; *petiolules* slender.

Flowers: Pedicelled, bracteate, bisexual, cream-coloured or whitish-yellow, about one inch long, irregular, honeyscented, in many flowered axillary puberulous spreading panicles. *Bracts*–linear, shorter than the pedicels. *Calyx*:– cup-shaped, five-cleft, segments petaloid, unequal, linear-lanceolate, reflexed, puberulous outside, imbricate in bud and deciduous from the base. *Corolla*: of five free narrow linear-spathulate, veined petals half to three quarters of an inch long. They are unequal, the two upper and the laterals small and ascending, the lowest the largest. A disc is present lining the calyx-cup. *Stamens*: ten, perigynous, inserted on the margin of the disc, declinate, the five opposite the petals are perfect and bear simple peltate one celled anthers, those alternating are reduced to antherless filaments: *filaments*:– flat and hairy or villous at the base. *Ovary* – tricarpellary, stipitate, oblong, hairy, one-chambered containing numerous ovules arranged biseriate on three parietal placentae; *style* – cylindric, slender or filiform, tubular, ending in a truncate perforated stigma *Ovules* – many, biseriate on three parietal placentae.

Fruit: an elongate or linear pendulous, cylindrical 3–6 angled, longitudinally 9–ribbed, beaked, three valved pod–like loculicidal capsule, nine to eighteen inches or more long and half to three quarters of an inch thick. The fruits are greenish when young, but turn light brown when ripe. Fruit valves corky or pithy and pitted within. *Seeds* which may vary from eight to fifteen or more are placed in depressions in the valves. They are three angled the angles extending as short wings, about two centimeters long including the wings, and have a corky testa. They are non–endospermic and contain a straight embryo having plano convex cotyledons, a very short superior radicle and a many leaved plumule. The dried seeds are dark brown externally and whitish within. The kernel is white oily and bitter. The seeds yield a valuable fixed oil.

Officinal parts. Root and root barks, stem bark, leaves (tender ones) fruit, seeds, and gum. Of these only the root and root bark are generally sold by drug venders.

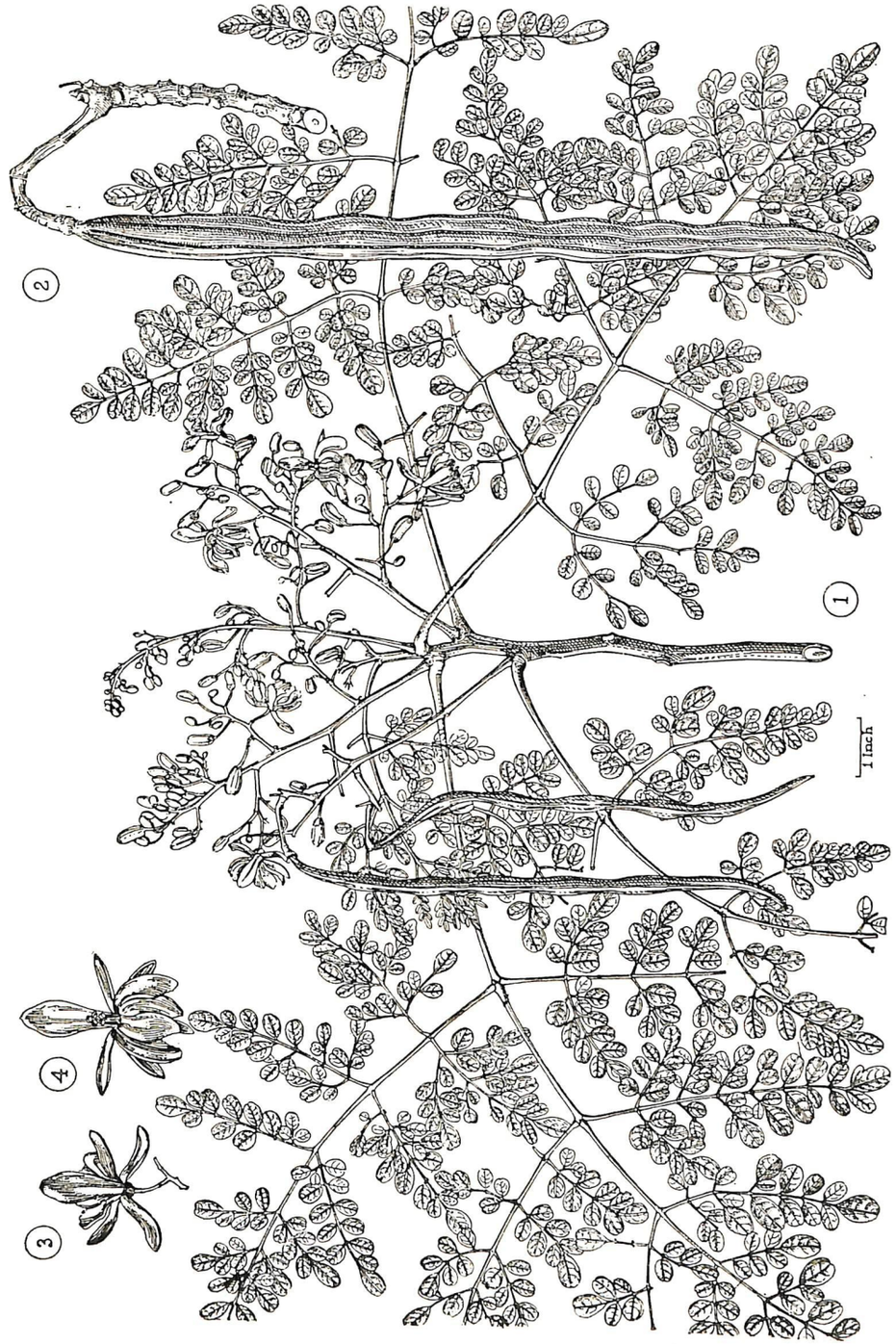


Plate V

Moringa oleifera, Lamk.

1. Flowering twig
2. Fruit.
Front view (3) of a flower. (4) and back view

Description of root and root bark

The roots are comparatively stout attaining a thickness of three to five inches or more. They are light greyish-brown externally. The surface appears somewhat reticulated and is marked with the tumid projections of discontinuous transverse rows of transversely extended lenticels 2 to 5 or 8 mm. long: the lenticel openings are not however flaring or wide open. The surface except for the lenticel projections and depressions due to irregularities of the ground is fairly even. The fresh bark ranges in thickness from about 5 mm. to more than a centimeter in very stout roots. It is quite soft and nearly succulent being easily pierced with a pin. The outer skin which is corky and thin being less than a hair's breadth in thickness can be scraped or peeled off in small bits. The tissue inside, which has a cream colour, quickly changes to a rosy tint on exposure. In fresh cut sections this rosy tinted tissue extends to nearly half the thickness of the entire bark. The inner part of the bark namely the portion nearest the wood is whitish or creamy white. The wood is very soft and easily cut. It is highly porous and yellowish.

The fresh bark has a disagreeably pungent, initially sweetish aromatic taste, and a rather heavy odour.

A kind of gum which may be collected in masses exudes from wounds in the root and stem. This gum on exposure to air takes on a light pink colour. The gum when dry has a reddish or purpiish brown colour and is found in vermiform pieces which are easily broken. These have a sweetish mucilaginous and astringent taste.

Histology of the root.

Root bark – The *phellem* or cork is composed of numerous rows of nearly regular rectangular cells that vary from 43 μ to 79 μ in length and 20 μ to 40 μ in width as seen in T. S. of the bark. The outermost rows of cells are slightly radially compressed. Their walls are light brown and appear wavy. Several of the cells have brownish granular contents. The innermost ten or twelve rows of cork cells are larger and nearly cubical with colourless walls. The *phellogen* is distinct and consists of a single row of narrow, thinwalled, rectangular or slightly tangentially elongated cells. A narrow zone of *phelloderm* is present just within the phellogen. The phelloderm cells are rectangular and thin walled. Several of these cells contain rosette

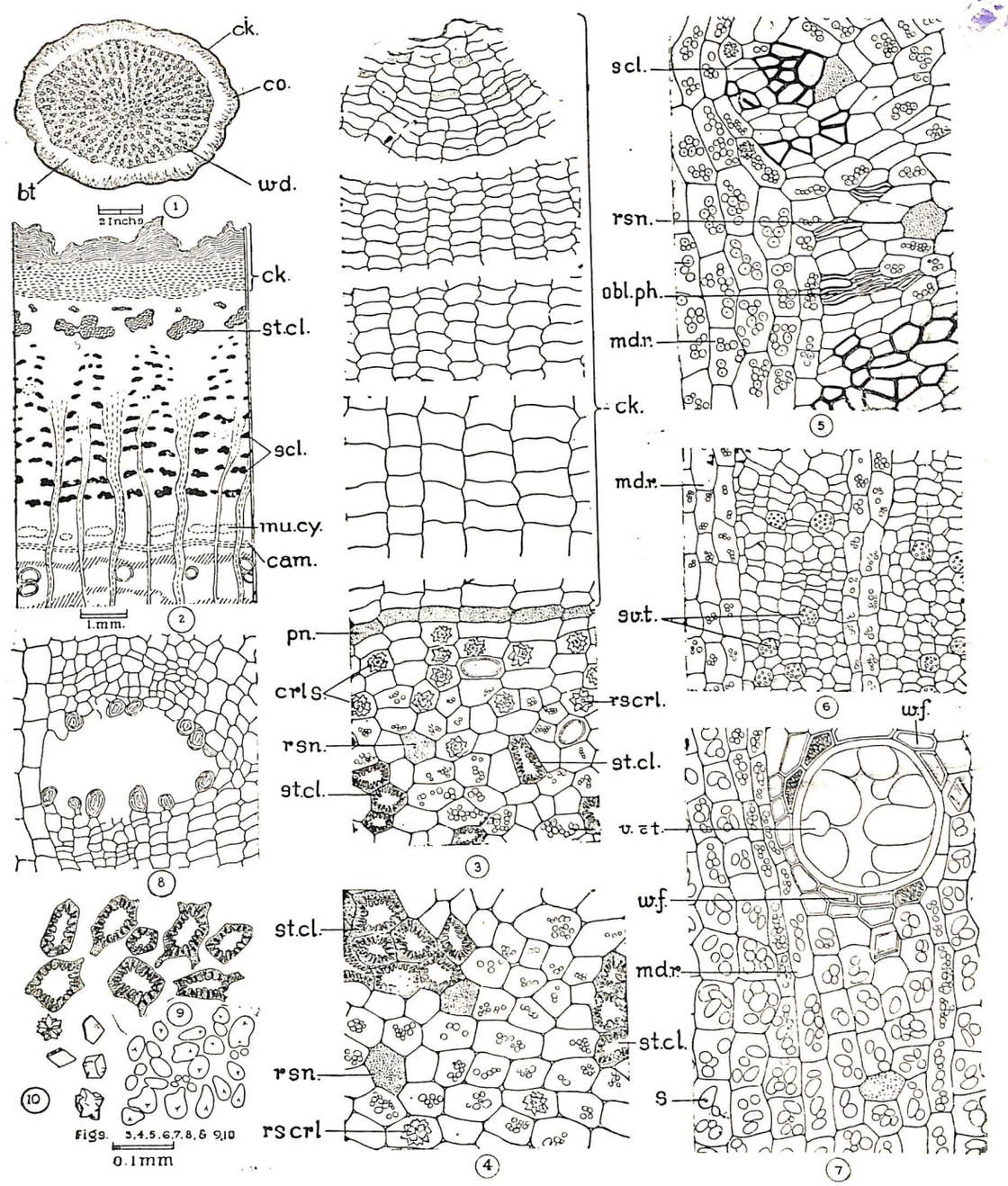
or sphaero-crystals of calcium oxalate. Others are rich in small rounded starch grains varying from 22 μ to 43 μ in diameter. The demarkation between the phelloderm and cortex is not quite distinct.

The *Cortex* is wide and consists of about thirty or more rows of cells. The cells of the cortex are not uniform in size; the length of a cell varies from 40 μ to 84 μ and width from 40 μ to 50 μ. The cortical cells are densely packed with starch grains. A few cells contain rhomboidal or rosette crystals of calcium oxalate. Some of the cells contain oil globules and others coloured resinous matter. Scattered in the cortex of young roots are large stone cell groups. Those towards the periphery form discontinuous annular bands. Each group consists of three to nine or more rounded to rectangular cells. The stone cells are not uniform in shape and size. Rounded stone cells have a diameter of 54 μ and rectangular cells vary from 54 μ to 100 μ in length and 40 μ to 86 μ in width. Mucillaginous cavities are present towards the interior of the cortex. These appear to be lysigenous in origin. Numerous fibres occur in groups and are scattered below the stone cell layer. These fibres have uneven ends and specialised end forkings.

The inner bark or *bast* has also the thickness of the middle bark. There are groups of large thick walled fibres alternating with phloem elements towards the outer region. There are also groups of compressed or obliterated phloem in this region. A few of the phloem parenchyma cells contain crystals and others contain starch grains. In this region also there are many mucilage cavities. These are however not so well developed as in the stem bark. *Phloem.* In the recently formed phloem the cells are thin walled small and almost polygonal and the sieve tubes and companion cells are distinct. Bast fibres are practically absent in this part.

Medullary rays. many, long, two to four seriate. Some of them expand widely when reaching the middle bark. The cells are thin walled radially elongated and rich in starch grains and have a radial length varying from 53 μ to 108 μ. Those in the wood region are more radially elongated but thin walled. The cells become shorter and wider at their distal ends. The ray cells in the cortex are nearly rectangular and equal to the cortical cells in size.

Plate VI



Histology of root bark of *Moringa oleifera*, Lamk.

Fig. 1. Diagrammatic sketch of the T. S. of the root.
2. Diagrammatic sketch of a portion of the T. S of the root bark.
3. Outer bark and a part of the middle bark.
4. A portion of the middle bark.
5. Old bast region.
6. Young bast region.
7. Wood region with a vessel showing tyloses.
8. A mucilage cavity in the inner bark.
9. Stone cells.
10. Crystals and starch grains.

Wood. In the wood the vessels are large nearly round in transverse section and mostly arranged in single series. Some of the parenchyma cells adjoining the vessels show a type of reticulate thickening. In young roots continuous concentric rings of wood fibres are seen alternating with bands of thin walled parenchymatous cells containing starch grains. These rings are crossed by the radially extending rays. In older roots the fibres are poorly developed in proportion to the parenchymatous elements. A few of these parenchyma cells contain resinous matter.

Description of Stem bark

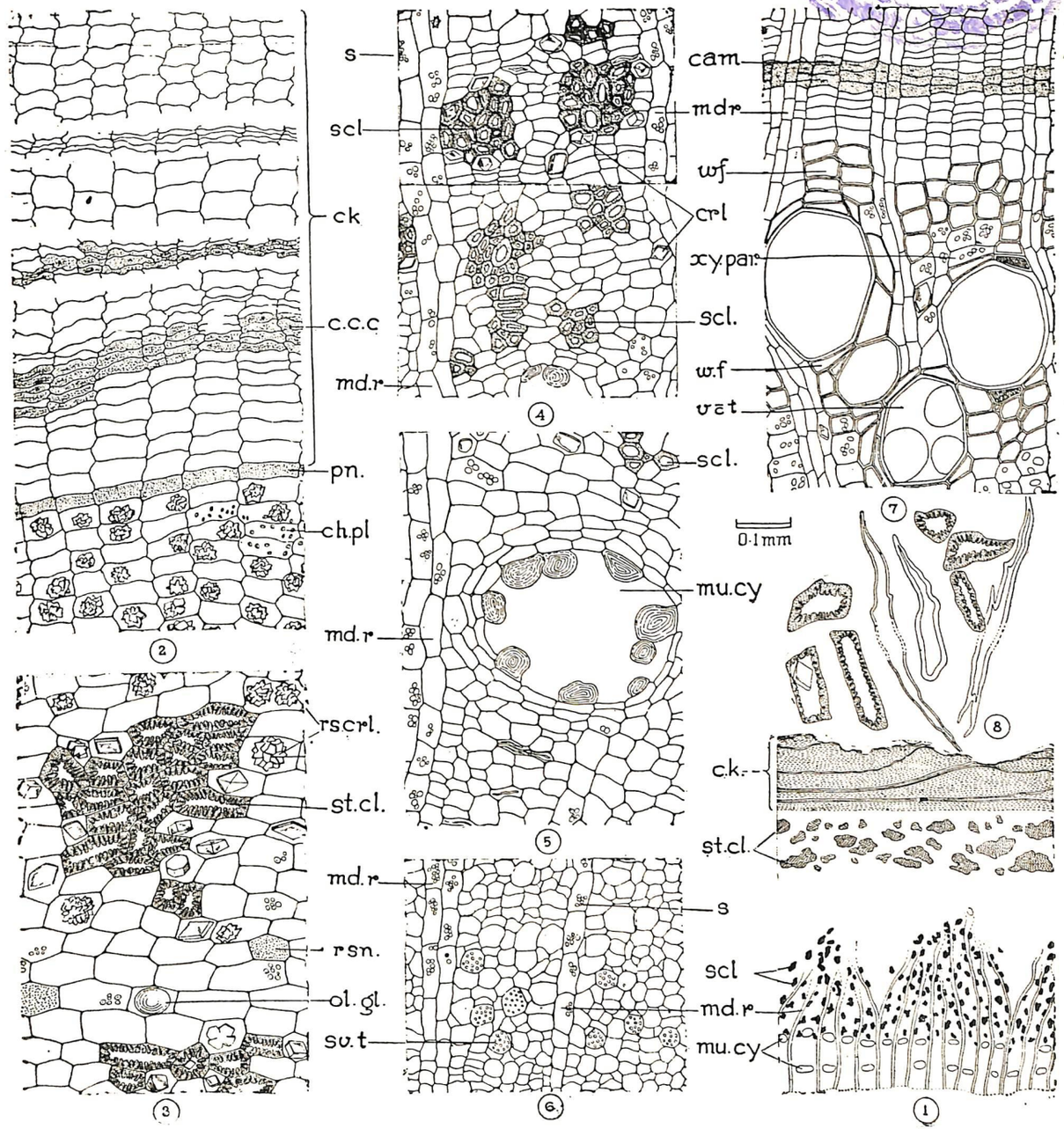
The stem bark has a thickness varying from less than half an inch to one inch or more, the thickness varying according to the age of the stem or branch. Barks from older portions are slate grey or dark green and covered with ash grey crustose lichen patches. Young barks are greenish to greenish brown in colour and often blotched with patches of ash white lichens. The older barks appear rough on account of the formation of vertical fissures of varying lengths and partial exfoliation of the outer rind in places. The entire bark is easily separated from the wood in fresh roots. In the fresh condition the cut surface is cream coloured. The corky rind or outer bark is a millimeter or more in thickness. It can be easily separated as small flakes and exposes a light rose to yellowish coloured smooth somewhat uneven tissue with greenish patches. In cut sections the rind has a dark brown colour and appears lamellated; the middle bark appears cream white but speckled with numerous small spots and the inner bark which is somewhat leathery also cream white and characterised by the presence of wedges of fibrous tissue. Tiny drops of mucilage that turn reddish brown on exposure to air exude from this region in fresh cut sections. These appear in annular rows slightly outside the wood.

Histology

The transverse section of the stem bark reveals the following details under the microscope. The *phellem* or cork which is the outermost tissue is one or two mm. in thickness and can be differentiated into two to three or more strata or tiers, each one separated from the next by a narrow band of compressed cells. The cork cells have dark brown cell walls. The newly formed five or six rows of cork

just outside the phellogen are slightly larger than those of the phellogen. They are rectangular, thin walled, arranged in regular series or radial rows and appear colourless. Outer to this layer is a zone of compressed cork cells consisting of eight to ten or more rows of tangentially elongated cells with yellowish brown contents and wavy brownish cell walls. This is followed towards the outside by a layer of larger nearly rectangular slightly compressed cells without contents, with their walls wavy and somewhat greenish yellow in colour. This in turn is followed by a band of eight or more rows of compresed cork cells and outside this are ten to twelve or more rows of almost cubical or rectangular cells with straight walls, some of which are coloured slightly green. The outermost zone of compressed cork tissue has a brownish tint. This is composed of an inner part consisting of six or more rows of very narrow highly compressed cells and an outer region of twelve to eighteen rows of almost cubical to rectangular cells with wavy and yellowish brown walls. The *phellogen* consists of a single row of thin walled, rectangular or tangentially elongated colourless cells found just inner to the phellem. The *phelloderm* just within is not uniform in thickness, the number of rows of cells varying in different places. The phelloderm cells are nearly cubical to rectangular, slightly larger than the phellogen cells, and have thin colourless walls. Most of these towards the inside contain rosette crystals of calcium oxalate, while the outermost two or more rows especially in places where the phelloderm is thick contain small green chloroplasts. Inner to the phelloderm tissue is the cortex which is much wider than the cork. The cortical cells are all thin walled rectangular or slightly tangentially elongated and somewhat larger than the phelloderm cells. There are several groups of pale yellow coloured stone cells scattered in the peripheral part of the cortex. Most of the groups are large and consist of six to twenty or more stone cells which vary in size and shape. The cortical cells, adjacent to or surrounding these stone cell groups, contain large crystals of calcium oxalate most of which are cubical rhomboidal or hexagonal or of the rosette type. A few cells contain coloured contents which is the resinous matter present and also oil globules. Some other cells contain small starch grains. The quantity of starch grains in the cells of the stem bark is less than that in the root bark. The inner part of the cortex shows the presence of numerous fibre groups.

Plate VII



Histology of stem bark of *Moringa oleifera*, Lamk.

Fig. 1. Diagrammatic sketch of the T. S. of the stem bark.
2. Outer bark region with a part of the secondary cortex.
3. Middle bark region. 4. A portion of the inner bark region.
5. A portion of the bark with a mucilage cavity. 6. Young bast region.
7. Portion of the wood with the cambium. 8. Stone cells and fibres.

The inner bark has almost half the thickness of the entire bark. It consists of fibre groups or bast fibres, phloem, medullary rays and mucilage cavities. In each fibre group there are four to twenty or more cells. These fibre groups form nearly concentric discontinuous zones separated by the medullary rays. Radially each fibre group alternates with phloem tissue. The older primary phloem tissues towards the cortical region that alternate with the outermost two or three zones of fibre groups are found in a compressed and obliterated condition. The phloem parenchyma cells adjoining the sclerenchyma cells contain small rhomboidal or cubical crystals of calcium oxalate. A characteristic feature of the bark is the presence of many big lysigenous mucilage cavities in this region. Some of the cavities are filled with mucilege. In the recently formed phloem, which appeare colourless, the parenchyma cells are small, thinwalled, and almost polygonal and the sieve tubes are large and easily distinguishable. Mucilage cavities also occur in this region.

Medullary ray: many, long and two to three or more seriate, though occasionally uniseriate. They extend from the inner bark up to the cortex. The rays are straight and run nearly parallel in the inner part, that is in the recently formed phloem but beyond it they appear wavy and tend to converge together in the cortex in groups of six to nine. The ray cells towards the inside are radially elongated but become tangentially elongated as the rays converge in the cortical region. Most of the cells are loaded with starch grains while some of those adjoining the fibre groups contain small crystals of calcium oxalate.

Moringa gum

The fresh gum as it exudes is somewhat opaque and dull white. On exposure to air it soon becomes pink finally turning purplish red to reddish brown outside. Considerable quantities of the gum may exude from portions of the stem or root injured by insects and in a somewhat diseased condition. The gum occurs in pieces of varying size, generally somewhat vermicular in form. They are easily broken and the interior is whitish in the larger pieces. In small bits it is reddish throughout. When quite dry the gum is very friable but in damp weather it is tough and holds about 20% of its weight of water. The gum swells up to a jelly when placed in water and then gradually dissolves. It has a bland to feebly sweetish mucilaginous taste but no characteristic odour.

MORINGA CONCANENSIS Nimmoo.

Sanskrit	...	Madhu s'igru
Concan, Rajputana	...	Sainyah
Tamil	...	Kāttu muriṅgai

Distribution and habitat

On dry hills of Rajputana, Sind, Berar, the Concans, Northern Circars, Deccan from Vizagapattam to Guntur, Kurnool. Coimbatore etc.

Habit and general features

Moringa concanensis Nimmoo is a glabrous tree, very similar to *Moringa oleifera* in habit with thick corky bark and soft white wood, but with larger and rounder leaflets and pale yellowish flowers with reddish streaks. Flowering period : October to December.

External morphology

Leaves alternate, exstipulate, up to about one and a half feet long, usually bipinnate or rarely tripinnate. Primary pinnae four to six pairs, from four to eight inches long, opposite, distantly spaced. The primary rachis is thickened at the base. It as well as the secondary rachises are articulated and provided with a gland at each articulation. The pinnae as well as the leaflets are opposite and oddpinnate. Leaflets 4 to 6 pairs with an odd one at the tip. They are broadly-elliptic or sub-orbicular, three quarters to one and a half inches long, and from half to one inch broad, obtuse at both ends, often emarginate or retuse at apex, pale beneath, with 4–8 pairs of slender but distinct secondary nerves. The leaflet is articulated to a slender petiolule 1/12th to 1/3rd inch long.

Flowers fairly large, pedicelled, irregular, thinly pubescent, yellow streaked with red in lax divaricate thinly pubescent axillary panicles that may reach 1½ feet in lenth. *Pedicels* one third to half an inch long articulated to the flower. *Bracts* minute, caducous. *Calyx* one third to half an inch long thinly tomentose, segments white, oblong, reflexed. *Petals* yellow, veined with red, oblong or oblongspathulate the lowest about five eighths of an inch long.

tamens five fertile with four to five alternating staminodes; *filaments* hairy at base. *Ovary* tricarpellary, one chambered.

Fruit an elongate straight acutely triquetrous, beaked one chambered three valved loculicidal capsule one to one and a half feet long, slightly constricted between the seeds. Valves hard, half to two thirds of an inch broad, corky and pitted within. *Seeds* many in the pits of the valves. They are white or pale yellow, two thirds to three quarters of an inch long, very broadly trigonous with thin membraneous wings and corky testa.

CITRAKA

Source plants* **Plumbago rosea** Linn. and **Plumbago zeylanica** Linn. belonging to Plumbaginaceae.

Sanskrit text

Descriptive synonyms

चित्रकोऽनलनामा च पीठो व्यालस्तथोषणः । (भावप्रकाशः)

Citr'akosnalanāmā ca pīṭho vyāḷastathoṣaṇaḥ ।
(Bhāva pr'akās'aḥ)

चित्रको दहनो व्यालः पाठीनो दारुणोऽग्निकः ।
ज्योतिष्को वल्लरी वह्निः पाली पाठी कटुः शिखी ॥
कृष्णारुणोऽनलो द्वीपी चित्रभानुश्च पावकः । (धन्वन्तरि निघण्डु)

Citr'ako dahan'o vyāḷaḥ pāṭhī n'o dāruṇo s gnikaḥ ।
Jyotiṣko vallarī vahniḥ pāḷī pāṭhī kaṭuḥ s'ikhī ॥
Kṛṣnāruṇo s n'alo dvīpī citr'abhānus'ca pāvakaḥ ।
(Dhanvantari nighaṇṭu)

चित्रकोऽग्निश्च शार्दूलश्चित्रः पाली कटुः शिखी ।
कुशानुर्दहनो व्यालो ज्योतिष्कः पालकस्तथा ॥
अनलो दारणो वह्निः पावकः शबलस्तथा ।
पाठी द्वीपी च चित्राङ्गो ज्ञेयः शूरश्च विंशतिः ॥ (राजनिघण्डुः)

Citr'ako s gnis'ca s'ār'dūlas'citr'aḥ pāḷī kaṭuḥ s'ikhī ।
Kṛṣ'ān'urdahan'o vyāḷo jyotiṣkaḥ pālakastathā ॥

---

* The botanical source of *Citraka* according to Dymock and others is *Plumbago zeylanica* Linn. In Kerala the white flowered *P. zeylanica* which grows wild as well as the red flowered *P. rosea* whieh is cultivated are used. Preference is however given to *P. rosea*; *P. zeylanica* being used only when the former is not available.

According to some ancient authorities there are three varieties of *Citraka*, namely those having white, red and black or dark flowers. Some others mention one more variety with yellow flowers.

An'alo dāraṇo vahn'iḥ pāvakaḥ s'abaḷastathā ।
Pāṭhī dvīpī ca citrāṅgō jñeyaḥ s'ūras'ca vims'atiḥ ॥
(Rāja nighaṇṭu)

यथास्वं चित्रकः पुष्पैर्ज्ञेयः पीतसितासितैः ।
यथोत्तरं स गुणवान् विधिना च रसायनम् ॥ (अष्टाङ्गहृदयम्)

Yathāsvam citr'akaḥ puṣpairjñeyaḥ pītasitāsitaiḥ ।
Yathottaram sa guṇavān vidhin'ā ca rasāyan'am ॥
(Aṣṭānga hṛdayam)

" स द्विधा शुक्लारुणभेदेनेति बहवः रक्त एव प्रशस्तः ।
सितासितारुणभेदेन त्रिधेति केचित् । " (अष्टाङ्गहृदयकोशः)

Sa ḍvidhā s'ukḷāruṇa bheden'eti bahavaḥ
rakta eva pras'astaḥ ।
Sitāsitāruṇabheden'a tridheti kecit ।
(Aṣṭāngahṛdayakos'aḥ)

Of the synonyms *agni* and the other synonyms of fire *dāhuna dāruna* etc. indicate the very caustic (burning) action of the drug. Other names like *vyālaḥ* etc, indicate the cruel (strong) action of the drug. *Dāraṇa* and *dāruṇa* indicate that the drug is capable of furrowing action on the skin. The name *citr'akah* means multicoloured, but how far this meaning signifies any feature of the plant is not clear.

Properties and uses.

चित्रकः कटुकः पाके वह्निकृत् पाचनो लघुः ।
रूक्षोष्णो ग्रहणीकुष्ठशोथार्शः कृमिकासनुत् ।
वातश्लेष्महरो ग्राही वातघ्न श्लेष्मपित्तहृत् । (भावप्रकाशः)

Citr'akaḥ katukaḥ pake vahn'ikṛt pācan'o laghuḥ ।
Rūkṣoṣṇo grahaṇīkuṣṭha s'othārs'aḥ kṛmikāsan'ut ।
Vātas'leṣmaharo grāhī vātaghn'aḥ sleṣmapittahṛt ।
(Bhāva pr'akās'aḥ)

चित्रकोऽग्निसमः पाके कटुकः कफशोफजित् ।
वातोदरार्शोग्रहणीक्षयपाण्डुविनाशनः ॥ (धन्वन्तरि निघण्डुः)

Citr'ako s gn'isamaḥ pāke katukaḥ kaphas'ophajit ।
Vātodarār's'o grahanīkṣayapaṇḍu vin'ās'an'aḥ ॥
(Dhanvantari nighaṇṭu)

चित्रकोऽग्निसमः पाके कटुः शोफकफापहः ।
वातोदरार्शोग्रहणीकृमिकण्डूतिनाशनः ॥ (राजनिघण्डुः)

Citr'ako s gnīsamaḥ pāke kaṭuḥ s'ophakaphāpahaḥ ।
Vātōdarār's'o grahaṇīkṛmikaṇḍūtināś'an'aḥ ॥
(Rāja nighaṇṭu)

त्वग्दोषिणां मेहिनां च तथैवोदररोगिणाम् ।
कृष्णं हितं विजानीयात् श्वित्रिणां च विशेषतः ॥
ग्रहण्यर्शोविकारघ्नमतिसारविनाशनम् ।
वयसः स्थापनं मेध्यं श्वेतपुष्पं विनिर्दिशेत् ॥
मेधाभिवर्धनश्चैव जाठराग्निप्रदीपनः ।
तेजो वर्णकरश्चैव कफहा पीतचित्रकः ॥ (नावनीतके)

Tvāgdoṣiṇām mehin'ām ca tathaivodararogiṇām ।
Kṛṣṇam hitam vijānīyāt s'vitriṇām ca vis'e ṣataḥ ॥
Grahaṇyar's'o vikāraghn'amatisāra vin'ās'anam ।
Vayasaḥ sthāpan'am medhyam s'vetapuṣpam vin'irdis'et ॥
Medhābhivardhan'as'caiva jāṭharāgn'ipr'adīpan'aḥ ।
Tejo var'ṇakaras'caiva kaphahā pītacitr'akaḥ ॥
(Nāvanītake)

चित्रकस्तिलपर्णी च कफशोफहरे लघू । (सुश्रुतम्)

Citr'akastilapar'ṇī ca kaphas'ophahare laghū ।
(Sus'r'utam)

चित्रकोऽग्निसमः पाके शोफार्शः कृमिकुष्ठहा । (हृदयप्रियः)

Citr'ako s gnisamaḥ pāke s'ophārsaḥ kṛmikuṣṭhahā ।
(Hṛdaya pr'iya)

According to Bhāvaprakās'a *citr'aka* is pungent, arresting (astringent), promotes digestive fire, is digestive, light dry, and hot. It overcomes or is useful in sprue, skin diseases flatulence, oedema, piles, worms (pathogenic organisms) cough, *vāta s'leṣma* predominance; and *vāta, pitta and kapha.*

Other attributes mentioned by various authorities are :– cures enlargement of the abdomen (ascites etc) consumption, anemia, itching, diabetes and allied diseases with excess urine, lucoderma (especially the black flowered Citraka) and diarrhoea. The white flowered one is said to promote longevity and intellect and the yellow flowered variety complexion also.

"The white flowered variety (*P. zeylanica*) is frequently used as a stimulant adjunct to other preparations in the form of a combination called *trmada*. It also enters into the composition of numerous medicines for dyspepsia. It is said to exercise a beneficial effect on piles. It acts as a powerful sudorific".

Plumbago Zeylanica Linn.

Malayāḷam	–	Tumba kodiveli. Vellakodiveli., Kodiveli
Tamil	–	Cithiramulam, Karimai, Kodiveli.
Hindi	–	Chitra, Chitraka, Chita
English	–	White flowered leadwort, Ceylon leadwort

Distribution and habitat.

The plant is met with in a wild condition in the plains in most parts of India growing in waste places, roadsides etc. It is not known to be cultivated.

Habit and general features

Plumbago zeylanica Linn. is a much branched diffuse rambling or subscandent undershrub, two to four feet high with several nearly uniform spreading perennial roots, from which seemingly arise a number of smooth narrow terete striated, jointed, somewhat declining stems and tender flexuous branches about the size of a quill bearing simple alternate short stalked, entire, ovate or ovate–oblong, wavy membraneous leaves tapering abruptly into the petiole, and terminal and axillary spikes of sub-sessile, pure white flowers an inch or more long with a conspicuously glutinous glandular persistent calyx. The plant is in flower most parts of the year.

External morphology.

Leaves. simple, alternate, exstipulate, short-petiolate, one and a half to three inches long and slightly less than an inch to two inches broad, ovate or ovate–oblong, the base shortly and abruptly attenuated into the short petiole, acute at apex, entire, wavy, thin or membraneous and smooth. The petiole is channelled or grooved above, and sometimes slightly winged, with a number of very sticky glands at its upper part and its base often auricled and clasping the stem.

Flowers:– pure white, subsessile with bract and bracteoles borne on simple or branched terminal and axillary spikes half to one foot long. The rachis of inflorescence is covered with very short glutinous hairs or glands. The bracts are considerably larger and

* Indicated as the source plant of *citraka in* books on Indian Materia medica. It is known as *Swetacitraka* to distinguish it from *P. rosea* which is called Raktacitraka or Lalcitra.

Plate VIII

Plumbago zeylanica, Linn.

1. Flowering twig
2. Bracts and bracteoles showing glands

about ten times longer than the bracteoles. They are also covered with sticky glandular hairs. *Calyx*-tubular, gibbous or inflated, one third to half an inch long and about a tenth of an inch in thickness and shortly five toothed at its apex. It is persistent and covered all over with slender stalked glutinous glands that aid in the dispersal of the fruit. *Corolla*–white, gamopetalous hypocrateriform with a very long and slender tube three quarters to one inch long, and a rotate five lobed limb with the lobes roundish about one third inch long and patent or spread out. *Stamens* five hypogynous, nearly free, the *filaments* linear about as long as the tube of the corolla dilated and connate at base into a lobed nectar secreting disc; *anthers* exserted beyond the throat, dorsifixed, oblong or linear, two cleft at base. *Ovary* – ovate or oblong, narrowed at apex; *style* slender glabrous at base, divided into five filiform stigmatic branches which are densely beset with many rows of glands on the inner side and stigmatose nearly throughout their length.

Fruit: enclosed within the persistent calyx. It is an one–seeded membraneous capsule with the pericarp thin below and thick and hardened above: its dehiscence, at first irregularly circumcisal or breaking at base, afterwards valvately splitting from the base to the middle. *Seed* – solitary, ovate or oblong.

Officinal part : The roots.

The roots of *P. zeylanica* and *P. rosea* form an important drug of the itinerant herbalists and are sold by all crude drug sellers.

Description of root.

The roots of *P. zeylanica* vary from less than a quarter to about three quarters of an inch in diameter and two to three feet or more long. They have as in the case of *P. rosea*, only very few lateral branches but are comparatively narrower. The fresh roots are fairly uniform about 0·5 inch in thickness, nearly smooth and light brown externally. An yellow juice exudes from cuts in the fresh roots In a fresh cut section the wood cortex and cork are well differentiated. The outer skin is thin and brownish, the cortex appears cream to light yellow with numerous small scattered spots or specks and the central woody part has a lighter tint. Paste of fresh roots applied to the skin causes blister. They have an acrid and biting taste.

The dried roots as sold in the bazaar occur as cylindrical pieces less than half an inch in thickness and of varying lengths.

They are reddish brown in colour and have fairly thick shrivelled smooth or irregularly fissured brittle bark marked here and there with small projections that represent scars of rootlets. The roots have a short fracture. The cut surface appears concentrically striated. The wood in the centre is close grained hard and tough with a reddish brown colour. The roots are acrid and have a disagreeable odour.

Histology of the root

A transverse section of the root which is circular in outline shows a very thin *cork* consisting of five to seven rows of small cubical to rectangular cells some of which contain dark brown contents. Their cell walls are light yellow in colour, those of the outermost row of cells being darker. The *phellogen* which can be distinguished in some specimens is composed of a single row of almost cubical cells. Within the phellogen is a thin zone of *phelloderm* consisting of two or three rows of small thinwalled rectangular cells. Some of these cells contain dark yellow contents which give an yellow stain to water and several others contain starch grains. The *cortex* is wide and about 1·4 mm. in thickness. The cortical cells are large, polygonal or slightly tangentially elongated, but the cells are not uniform in size. A characteristic type of radial division is seen in some of the cells. Most of the cells are densely packed with starch grains while a few cells contain the yellow cell contents. In the inner part of the cortex are present small fibre cells. These occur either in groups, each group composed of two to five or more small sized cells or as single cells scattered here and there. The phloem situated just inner to the fibre groups is very narrow. Its cells are small polygonal and thinwalled. Cells containing the yellowish contents are not found in this region. The wood in the centre is comparatively narrow. It has a light yellow colour. The xylem vessels are not wide and are arranged mostly radially in single file. Wood fibres are many and thickwalled. Medullary rays are few They are almost straight, one to four-seriate and reach up to the cortex. The ray cells are radially elongate and filled with starch grains. The primary xylem is tetrarch. The presence of starch grains in abundance in the cells of the cortex and medullary rays, the nature of the medullary rays which are comparatively narrow as well as the occurrence of fibre groups are features characteristic of the roots of *P. zeylanica*.

Plumbago Rasea Linn. *

Syn. **P. Coccinia Boissed**

Family Plumbaginaceae

Malayāḷam	–	Schettikodiveli, Chuvannakodiveli
Tamil	–	Cenkodiveli, Cithiramulam
Hindi	–	Chitra, Raktachitra, Lalchitra, Lalchitrak, Lalchita
English	–	Rosecoloured leadwort.

Distribution and habitat.

The plant though considered a native of Coromandel and other parts is found in a cultivated state in many parts of India being commonly grown in many gardens. It is doubtfully considered growing wild in the valleys of Sikkim add Khasia.

Habit and general features.

Plumbago rosea Linn. is a pretty subscandent shrub growing to more than six feet high with several erect branching herbaceous to semi-woody terete striate stems and flexible branches arising from a system of perennial lateral tuberous roots, and bearing alternate exstipulate short petiolate oblong leaves and fairly long terminal spikes of bright red flowers. It resembles in general habit *P. zeylanica* but has larger leaves and flowers. The plant is in flower nearly throughout the year. The whole plant especially the root is highly acrid on account of which the latter was formerly known as *radix vesicatoria*.

External morphology.

Leaves – simple, alternate, exstipulate. short petiolate, entire, wavy, membraneous, smooth, ovate-oblong, narrowed and slightly obtuse at apex, base narrowed abruptly passing on to the very short petiole. *Petiole* - amplexicaul not usually auricled at base.

Flowers: of a beautiful scarlet or bright red colour, about one and a half inches long, in long loose twiggy spikes that are terminal as well as axillary from upper leaves. The spikes continue to elongate

even after flowering reaching a length of one or two feet. Rachis of spikes glabrous or smooth. *Bracts* and *bracteoles* nearly equal ovate. cuspidate, much shorter than the calyx: They are also smooth. The bracteoles are often connate at base between the flower and axis. *Calyx* – reddish, subsessile, short, cylindric, tubular gibbous shortly and acutely five toothed, five ribbed, beset with small persistent stipitate bifarious gummy glands all along the five ribs. *Corolla* – scarlet, gamopetalous, hypocrateriform, tube of corolla slender, much longer than the calyx, limb rotate, five lobed or parted. *Stamens* – five, hypogynous with their filaments united at the base into a lobed nectariferous disc surrounding the ovary; *anthers* linear, two cleft at the base, *Ovary* – ovate or oblong, *style* – filiform hairy at base with five filiform stigmatic branches whose inner faces are beset with many rows of glands.

The *fruit* which is enclosed within the persistent calyx is an one-seeded membraneous, capsule or utricle at first breaking irregularly at the base and then valvately dehiscing from base upwards with the valves cohering at the top. *Seed* – solitary, ovate or oblong.

Officinal parts: The root bark as well as the entire roots.

Description: The root system consists of many, long and fairly stout roots, half to three quarters of an inch in thickness, two to three feet or more long and having only few lateral branches. They are somewhat rigid, almost uniformly cylindrical though sometimes irregularly bent or curved. They are light yellowish brown externally. Surface generally smooth, but often with short transverse shallow fissures at the region of the bends. The transversely cut surface of a young fresh root is whitish throughout but that of a mature root has a light red colour at the periphery. A small quantity of a light yellow juice exudes from the fresh cut surface of the root. The roots have a thin skin. The cortex or middle portion, which forms the bulk part of the root is whitish and the wood in the centre is narrow and darker. Dried roots are darker or nearly black. A paste made with the root bark, if applied to the skin will blister the skin in a few hours.

Histology The transverse section of the root is nearly circular. The *cork* which forms the outermost tissue is a very narrow zone formed of about five rows of small, thinwalled cubical to rectangular

Plate IX

Plumbago rosea, Linn.

1. A twig
2. Inflorescence
2a. Bracts and bractioles enlarged
3. Root system
3a. A root slightly enlarged

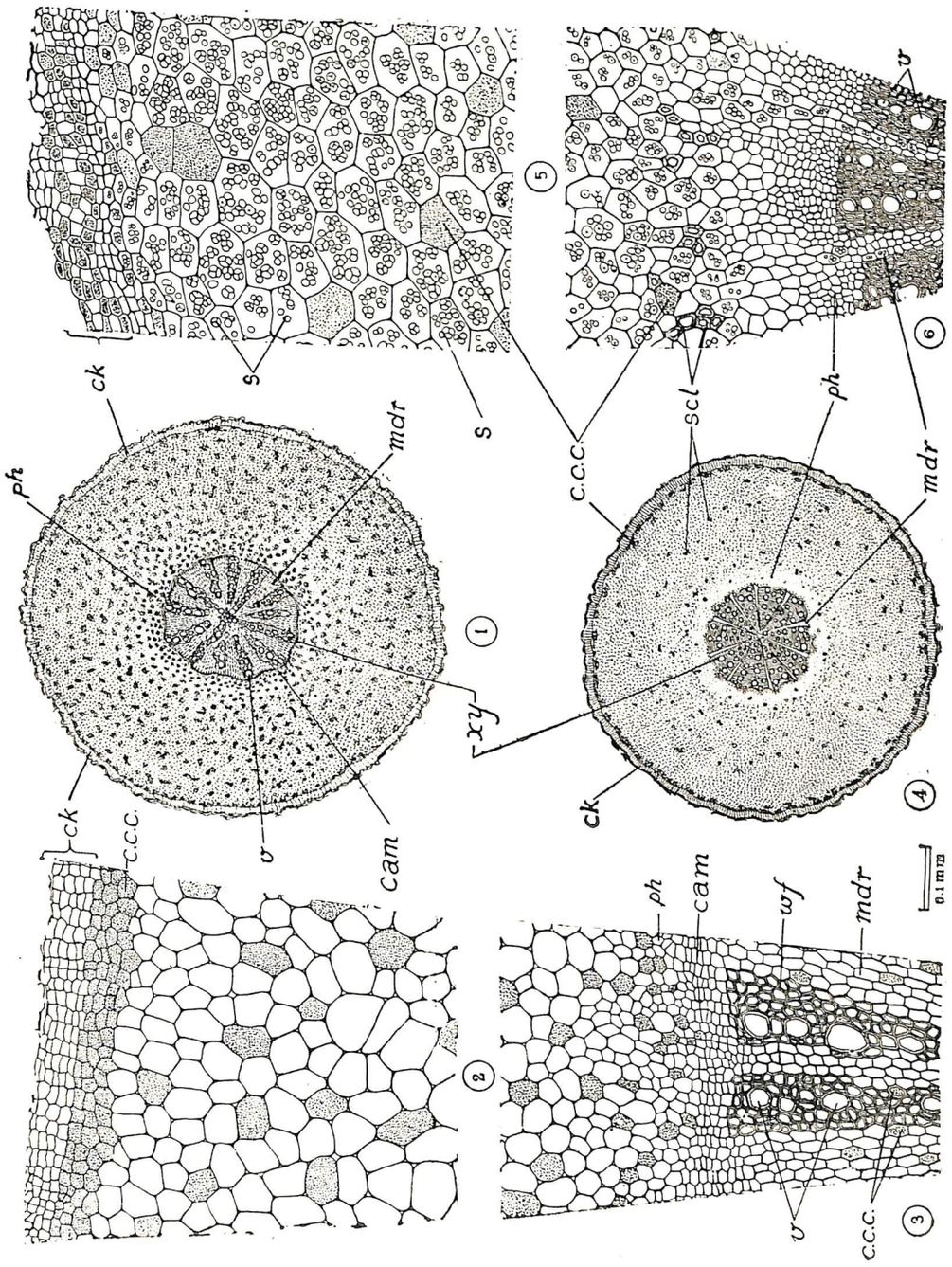
cells with their walls light yellow to yellowish brown in colour. The *cortex* is very wide and forms the bulk part of the root. Its cells are not uniform in size or shape. The peripheral four or more rows of cells of the cortex just within the cork have dark yellow contents. The greater part of the cortex consists of thinwalled rounded, polygonal tangentially elongate cells with well defined intercellular spaces. (Some of the cells show the characteristic type of radial division.) The cells are normally devoid of starch grains. Scattered in the cortex there are many cells with yellow or reddish yellow contents. The innermost rows of cortical cells are nearly regular and rounded. There is no clear demarcation between the cortex and bast.

The bast is comparatively narrow. The phloem parenchyma cells are very small, thinwalled and polygonal. Most of the cells contain the yellow contents. Mechanical elements of any sort are not found in the bast. The *Cambium* consists of one or two rows of thinwalled narrow rectangular cells. *Wood* – The elements of wood occur as thin radial wedges. The xylem vessels are arranged mostly in single file in radial rows and are surrounded by mechanical cells (fibres) There are ten to twelve broad medullary rays. These start from the centre of the wood and alternate with wedges of xylem. The ray cells are radially elongated and thinwalled. Some of them contain the reddish yellow contents. There is no pith in the centre. The primary xylem is tetrach. The absence of starch grains in the cells of the cortex and medullary rays, the broader nature of the medullary rays, as well as the absence of mechanical elements in the bast are features that differentiate the root of *P. rosea from* that of *P. zeylanica.*

Comparison of the histology of the roots

Plumbago zeylanica	*Plumbago rosea*
Cork	
5–7 rows of small cubical or rectangular cells with light yellow walls	4–5 rows of small cubical cells with yellowish brown walls.
Cortex	
Most of the cells are packed with starch grains	Cells are more rounded with very conspicuous intercellular spaces. Starch grains absent
Only a few cells have the colouring contents	Most of the cells have the colouring contents
Phloem	
Small groups of fibres are present	Fibres are absent
Cells with colourad contents are absent	Cells with the yellow contents are present
Medullary rays	
Fewer in number and narrower	Many and broader
1–4 seriate	4–6 seriate
Ray cells contain starch grains	No starch grains in the ray cells. A few ray cells have the yellow colouring matter.

Plate X



Histology of roots of *Plumbago zeylanica* Linn (Figs. 4 to 6)
Plumbago rosea, Linn (Figs. 1 to 3)

Fig. 1. Diagrammatic sketch of the root in T. S.
2. Cork and cortex.
3. A portion of the root showing phloem and xylem groups with the medullary ray cells and cambium
4. Diagrammatic sketch of the root in T. S.
5. Portion of the root showing the cork and the cortex.
6. Portion of the root showing the fibre cells and phloem tissue and a portion of the wood

KUṬAJA

Source plant in Kerala*

Holarrhena antidysenterica Wall,

(Apocynaceae)

Sanskrit Text

Descriptive synonyms

"वत्सकः कुटजः शक्रो वृक्षको गिरिमल्लिका ।
बीजानीन्द्रयवास्तस्य तथोच्यन्ते कलिङ्गकाः ॥
बृहत्फलः श्वेतपुष्पः स्निग्धपत्रः पुमान् भवेत् ।
श्यामा चारुणपुष्पी स्त्रीफलवृन्तैस्तथाणुभिः ॥" (चरकः)

"Vatsakaḥ kuṭajaḥ s'akr'o vṛkṣako girimallika
Bījān'ındrayavāstasya tathocyante kaliṅgakāḥ
Bṛhatphalaḥ svetapuṣpaḥ sn'igdhapatı'aḥ pumān bhavet
S'yāmā cāruṇapuṣpī str'īphalavṛntaistathāṇubhiḥ
(Carakaḥ)

According to Caraka there are two varieties of *Kuṭaja* – namely a masculine one which is said to have smooth leaves, white flowers and large fruit and a feminine variety that is darker or blackish (?) with reddish flowers and smaller fruit or fruit stalk. The correct botanical source of *Kuṭaja* is *Holarrhena antidysenterica* Wall. which has white flowers.

Two other Apocynaceous plants namely *Wrightia tomentosa* Roem. and Schult and *Wrightia tinctoria* R. Br. that also bear the same or similar vernacular names are frequently used as the source of *Kuṭaja* or as substitutes. It is very doubtful whether they have the same medicinal properties. They may be distinguished easily by the nature of their fruits and seeds. In *H. antidysenterica* the two follicular fruitlets are separate and the seeds have their *coma* or tuft of hairs at the end furthest from the place of attachment of the funicle. In *W. tomentosa* the follicles are stout and remain connate or united and separate only when quite ripe, and in *W. tinctoria* the follicles are slender and remain normally connate at the tip only. In the seeds of both the species of *Wrightia* the attachment of the coma or tuft of hairs is nearest their stalks.

A third species *W. coccinia* Sims. is found in the foothill tracts of the eastern Himalayas with handsome scarlet flowers. Whether this may probably be the feminine variety referred to by Caraka has to be investigated.

"कुटजः स्त्रीपुरुषभेदेन द्विधा भवति ।
उभयोरपिसमानगुणता ज्ञातव्या ।" (अष्टाङ्गहृदयकोशः)

"Kuṭajaḥ str'īpuruṣabheden'a dvidhā bhavati
Ubhayorapi samān'a guṇata jñātavyā"
(Aṣṭāṅgahṛdayakos'aḥ)

"कुटचेन्द्रवृक्षवृक्षकगिरिजकलिङ्गाह्वमल्लिकापुष्पाः ।
गिरिमल्लिकेन्द्रयवकौ वत्सकपर्यायवाचकाः शब्दाः ॥
तद्बीजानि कलिङ्गभद्रयवाश्चेति शक्राह्वाः ।
प्रागिन्द्रनाममिलितैः शब्दैर्यववाचकैश्च कथ्यन्ते ॥" (अभिधानमञ्जरी)

"Kuṭacendravṛkṣavṛkṣakagirijakaliṅgāhvamallikāpuṣpaḥ
Girimallikendrayavakau vatsaka paryāyavācakāḥ s'abdāḥ
Tadbījān'i kaliṅgābhadrayavās'ceti s'akr'āhvāḥ
Pr'āgindranāmamilitaiḥ s'abdairyavavācakais'ca kathyante"
(Abhidhān'amañjarī)

"कुटजः कूटजः कौटो वत्सको गिरिमल्लिका ।
कलिङ्गः शक्रशाखी च मल्लिकापुष्प इत्यपि ॥
इन्द्रो यवफलः प्रोक्तो वृक्षकः पाण्डुरद्रुमः ॥ (भावप्रकाशः)

Kuṭajaḥ kūṭajaḥ kauṭo vatsako girimallikā
Kaliṅgaḥ s'akr'as'ākhī ca mallikāpuṣpa ityapi
Indro yavaphalaḥ pr'okto vṛkṣakaḥ pāṇḍuradrumaḥ
(Bhāvaprakās'aḥ)

"कुटजः कौटजः कौटो वत्सको गिरिमल्लिका ।
कलिङ्गो मल्लिकापुष्प इन्द्रवृक्षोऽथ वृक्षकः ॥" (धन्वन्तरि निघण्डुः)

Kuṭajaḥ kauṭajaḥ kauṭo vatsako girimallikā
Kaliṅgo mallikāpuṣpa indravṛkṣo s tha vṛkṣakaḥ
(Dhanvantari nighaṇṭu)

फलानि तस्येन्द्रयवाः शक्राह्वाः स्युः कलिङ्गका ।
तथा वत्सकबीजानि प्रोक्ता भद्रयवास्तथा ॥
वल्लजं गह्वरं चैव सा चोक्ता कृष्णतण्डुला । (धन्वन्तरि निघण्डुः)

Phalān'i tasyendrayavāḥ s'akr'āhuāḥ syuḥ kaliṅgakāḥ
Tathā vatsakabījān'i proktā bhadrayavāstathā
Vallajam gahvaram caiva sa coktā kṛṣṇātaṇḍulā
(Dhanvantari nighaṇṭu)

कुटजः कौटजः शक्रो वत्सको गिरिमल्लिका ।
कलिङ्गो मल्लिकापुष्पः प्रावृष्यः शक्रपादपः ॥
वरतिक्तो यवफलः संग्राही पाण्डुरद्रुमः ।
प्रावृषेण्यो महागन्धः स स्यात् पञ्चदशाभिधः ॥ (राज निघण्डुः)

Kuṭajaḥ kauṭajaḥ s'akr'o vatsako girimallikā
Kaliṅgo mallikāpuṣpaḥ pr'āvṛṣyaḥ s'akr'apādapaḥ
Varatikto yavaphalaḥ samgrāhī pāṇḍuradrumaḥ
Pr'āvṛṣeṇyo mahāgandaḥ sa syāt pañcadas'ābhidhaḥ
(Rāja nighaṇṭu)

इन्द्रयवा तु शक्राह्वा शक्रबीजानि वत्सकः ।
तथा वत्सकबीजानि भद्रजा कुटजा फलम् ॥
ज्ञेया भद्रयवा चैवं बीजान्ता कुटजाभिधा ।
तथा कलिङ्गबीजानि पर्यायैर्दशधाभिधा ॥ (राज निघण्डुः)

Indrayavā tu s'akr'āhvā s'akr'abījān'i vatsakaḥ
Tathā vatsakabījān'i bhadrajā kuṭajā phalam
Jñeyā bhadrayavā caivam bījāntā kuṭajābhidhā
Tathā kaliṅgabījān'i paryāyairdas'adhābhidha
(Rāja nighaṇṭu)

Of the synonyms *kuṭajaḥ*, *kūṭajaḥ*, *kauṭaḥ* and *girijaḥ* indicate that this grows generally on mountain tops. *Girimallikā* and *mallikāpuṣpaḥ* indicate the likeness of flower to that of *mallika* (*vallimulla* - Malayāḷam name). *Mahāgandhaḥ* refers to the strong smell

of the flower. *Pr'āvṛṣyaḥ* and *pr'āvṛṣeṇyaḥ* indicate that this springs up in rainy season. *Varatikta* refers to the extreme bitter taste; *pāṇḍuradrumaḥ* refers to its whitish yellow colour; *yavaphalaḥ* denotes the elongated shape of the seeds like that of *yava*, *kaliṅgaḥ* denotes that it occurs largely in Kaliṅgades'a or modern Orissa and *samgrāhī* refers to its constipating action.

Properties and uses.

रक्तपित्तकफघ्नस्तु सुकुमारेष्वनत्ययः ।
हृद्रोगज्वरवातासृग्विसर्पादिषु शस्यते ॥ (चरकः)

Raktapittakaphaghn'astu sukumāreṣvan'atyayaḥ
Hṛdrogajvara vātāsṛgvisarpādiṣu s'asyate (Carakaḥ)

कुटजः कटुको रूक्षो दीपनस्तु वरो हिमः ।
अर्शोतिसारपित्तास्रकफतृष्णाऽमकुष्ठनुत् ॥ (भावप्रकाशः)

Kuṭajaḥ kaṭuko rūkṣo dīpanastu varo himaḥ
Ar's'otisāra pittāsr'akapha tṛṣṇā s makuṣṭhan'ut
(Bhāva prakās'aḥ)

कुटजः कटुकस्तिक्तः कषायो रूक्षशीतलः ।
कुष्ठातिसारपित्तास्रगुदजानि विनाशयेत् ॥ (धन्वन्तरि निघण्डुः)

Kuṭajaḥ kaṭukastiktaḥ kaṣāyo rukṣasītaḷaḥ
Kuṣṭhātisārapittāsr'agudajān'i vin'as'ayet.
(Dhanvantari nighaṇṭu)

शक्राह्वाः कटुतिक्तोष्णास्त्रिदोषघ्नाश्च दीपनाः ।
रक्तार्शस्यतिसारघ्न्ति शूलवमीस्तथा ॥ (धन्वन्तरि निघण्डुः)

akr'āhvāḥ kaṭutiktoṣṇāstr'idoṣaghnās'ca dīpanāḥ
Raktār's'āmsyatisāramca ghn'anti s'ūlavamīstathā
(Dhanvantari nighaṇṭu)

कुटजः कटुतिक्तोष्णः कषायश्चातिसारजित् ।
तत्रासितोऽस्रपित्तघ्नस्त्वग्दोषार्शोनिकृन्तनः ॥ (राज निघण्डुः)

Kuṭajaḥ kaṭutiktoṣṇaḥ kaṣāyas'cātisārajit
Tatr'āṣito s sr'apittaghn'astvagdoṣār's'onikṛntan'aḥ
(Rāja nighaṇṭu)

इन्द्रयवा कटुस्तिक्ता शीता कफवातरक्तपित्तहरा ।
दाहातिसारशमनी नानाज्वरदोषशूलमूलघ्नी ॥ (राज निघण्डुः)

Indrayavā kaṭustiktā s'ītā kaphavātaraktapittaharā
Dāhātisāras'aman'ī nān'ājvaradoṣas'ūlamūlaghnī
(Rāja nighaṇṭu)

अर्शोतिसारशूलघ्नः कटुरिन्द्रयवोग्निकृत् । (हृदयप्रियः)
Ar's'otisāras'ūlaghn'aḥ kaṭurindrayavognikṛt
(Hṛdayapr'iyaḥ)

According to Bhāvapr'akās'a *kuṭaja* is pungent, dry, promoter of digestion, very cool and overcomes piles, diarrhoea. *raktapitta* (general hemorrhage), *kapha*, thirst, *āma* (incompletely digested chyle etc.) and skin disease.

According to other authors it is also useful in heart disease, fever, *vātarakta*. *visar'pa*, bleeding piles, dysentery, colic, vomitting and *tr'idoṣa*. It is also bitter and astringent.

The bark has astringent and tonic properties, but as obtained its chief repute is as a remedy in dysentery. It has also been extensively employed as an intiperiodic. It is described in the nighaṇṭus as bitter, astringent, cold and digestive; a remedy for piles, dysentery, bile, leprosy and phlegmatic tumours. Sus'ruta says it is expectorant, an antidote to poisons, cures dysuria, urinary and skin diseases, checks nausea and vomitting, removes pruritus, improves the condition of bad ulcers, relieves pains in the stomach and checks the derangement of the three humours viz. *vāta*, *pitta* and *kapha*. The seeds known as *indrayava*, *bhadrayava*, *vatsakavija or sakravija* are considered to be astringent, febrifuge and anthelmintic.

Holarrhena antidysenterica Wall.

(Apocynaceae)

(Syn. *Echites antidysenterica* Roxb.; *Holarhena codaga* G. Don.

Wrightia antidysenterica Grah.)

Malayāḷam	Kodagappāla, Kutakappāla.
Tamil	Kutakappālei; Kulappālai; Kodagappālei, Vēppālai
Hindi	Karchi, Dudhi, Kaureya, Koira; Kachri, Kura, etc.

Distribution and habitat

The plant is found throughout the drier or deciduous forest areas of India at low elevations and ascending to 3500 ft. elevation in the tropical Himalayan tract from the Chenab eastwards. It often grows gregariously and is common in Sal forests, the Aravalli hills south of the Dewair pass, Bihar, Central provinces as well as in South Konkan and Kerala. It can be successfully grown in most reclaimed waste land with a moderate rain fall.

Habit and general features

Holarrhena antidysenterica Wall. is a small to medium sized deciduous tree, attaining a height of 40 ft. or more though often not bigger than a tall shrub, bearing fairly large, opposite, short-petioled membraneous ovate-oblong, prominently veined leaves; cymose clusters of large white some what fragrant flowers, and pairs of narrow slender footlong pendulous follicles. The shoots when young are often tomentose. The plant produces root suckers in plenty. It flowers at different times in different parts, usually from February to May, or occasionally in June to July, and September to November. The wood is white, soft, even grained and marked with faint annual rings, very many fine medullary rays, and numerous small pores in radial lines.

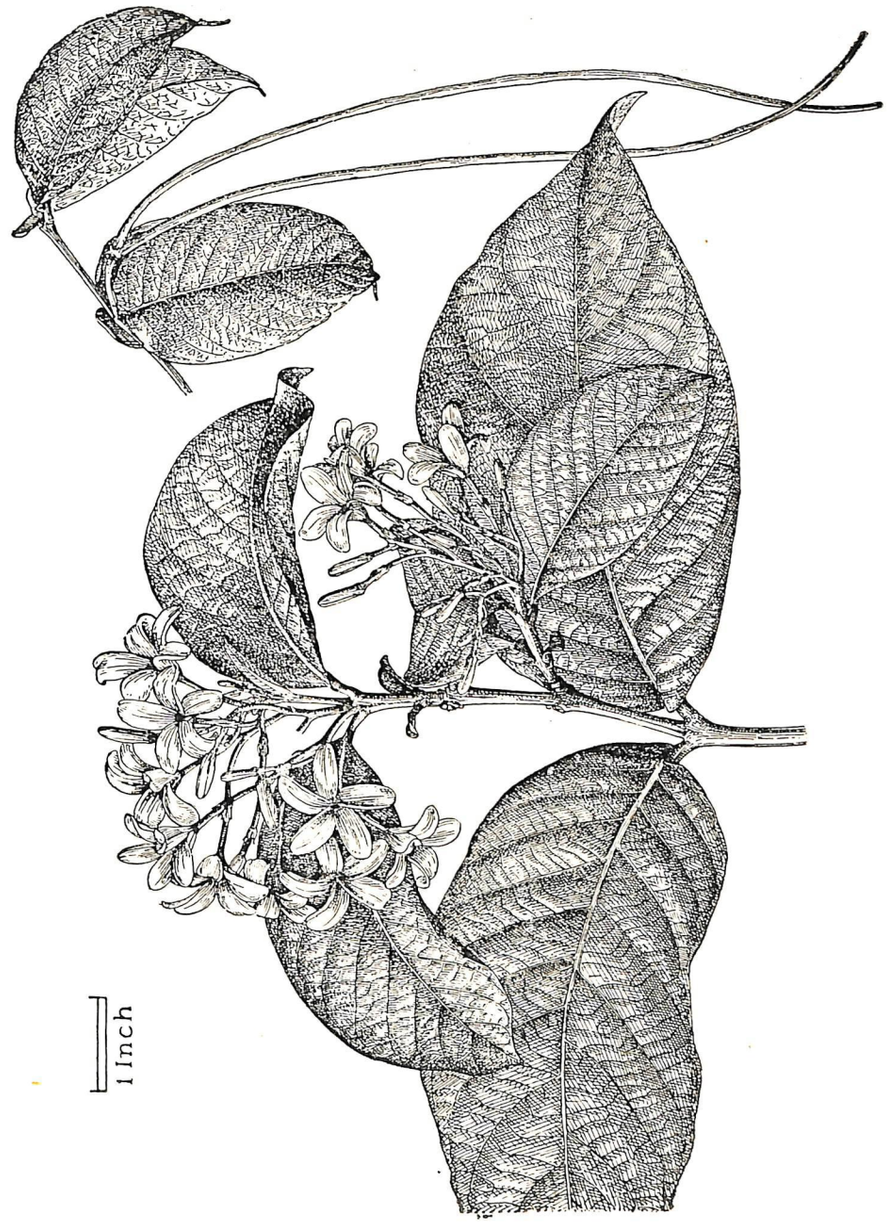


Plate XI

Holarrhena antidysenterica, Wall.

1. A twig with flowers
2. Fruits

External morphology

Leaves: Simple, opposite, exstipulate, short-petioled, – the petioles less than a quarter inch long – broadly ovate, ovate-oblong or elliptic–oblong, 4 to 10 or 12 inches long and 2 to 5 inches broad, obtuse rounded or rarely acute at base, obtusely acuminate at apex, pale green, membraneous, glabrous or pubescent and with ten to fourteen pairs of strong stout arched secondary nerves.

Flowers: white, one to one and a half inches in diameter, puberulous, very slightly fragrant, on slender pedicels subtended by small ciliate bracts and arranged in terminal or sub–axillary many-flowered corymbose cymes, with a spread of three to six inches. *Calyx* – five-partite, lobes small about 1/10 of an inch long, lanceolate or oblong lanceolate, acute or acuminate, imbricate in bud, all or the inner only generally with one to two glands within at base. *Corolla* – regular, gamopetalous, salvershaped, puberulous outside; *tube* – very slender, cylindric, half to twothirds of an inch long and slightly dilated below the middle opposite to the stamens; *throat* – contracted, hairy inside, mouth not closed with a ring of hairs; *lobes* – strap shaped about as long as the tube, oblong or obovate rounded at apex somewhat pubescent and twisted, overlapping to the left in bud. *Stamens* five, inserted between the base and middle of the tube, included; *filaments* – very short, slender; *anthers* – lanceolate, rounded at base, very acute or apiculate. *Disc* absent. *Carpels* – two, distinct; *ovaries* – two, ovate acute; *ovules* – many in each carpel; *style* – short filiform; *stigma* – oblong-fusiform, simple, the tip entire or bifid.

The *fruit* consists of two slender, elongate, terete, parallel, coriaceous, obscurely torulose, follicular mericarps, eight to sixteen inches long and a quarter to less than half an inch in thickness, blotched with long narrow white patches. The two fruitlets are connected by their tips when young, but ultimately they become free, slightly in-curved and divergent or spreading. Each follicle encloses many seeds arranged in two series inside. The *seeds* are about half an inch long, narrow, elongated, oblong or linear, glabrous and of a light yellowish brown colour. Each seed is flattened or compressed, one side convex, the other side concave with a longitudinal striation with the funicle lodged in the concavity and is tipped at its apex with a coma of long silky brown hairs. The seeds are easily broken.

They are non-endospermic or with scanty albumin. Embryo straight with broad plaited involute cotyledons that are cordate at base, and a short superior cylindric radicle.

Officinal parts:* Stem bark, root bark, as well as seeds. Both bark and seeds are used in combination with other ingredients.

The bark according to Dymock and co-authors "is one of the most important articles in the Hindu Materia Medica" and under various names as *conessi bark*, *codagapala*, *corte-de-pala* and *Tellichery bark* was formerly exported to Europe.

Description of stem bark

The appearance and thickness of the bark varies according to the age of the trunk or branch. Young barks are thin smooth and greyish, while those from older branches or stems are a quarter to half an inch or more in thickness, pale brown or snuff coloured to dark brown and somewhat rough on account of exfoliation of small flakes. This is more characteristic of the older barks where several layers of rhitidoma are developed. In all the older barks the orignal surface colour is mostly masked by profuse growth of patches of closely appressed crustose lichens some of which are ash grey and others brownish or blue green. Lenticels not generally prominent.

The entire bark when dry as well as the pieces that flake off are brittle. The cut surface of the older barks has a fairly pronounced cinnamon colour. The inner surface of the fresh bark is smooth and cream coloured or light yellow. Small quantities of latex exude from the inner part of the cut surface in fresh barks. Within the outer bark in fresh barks there is generally present a greenish tissue or zone that appears as an irregular ring in transverse section. Within this is a fairly thick flesh – coloured to light reddish portion and this is followed by a whitish to cream yellow region which represents the inner bark. In transverse section of both these regions especially in the inner bark except in the innermost part several con-

*The seeds as well as bark are often confounded, with the seeds and bark of *Wrightia tinctoria* to which they bear a general resemblance: the latter are however said to be inert.

centric striations can be made out, along which the bark may be easily separated.

The stem barks as sold in the bazaar occur as thick often, twisted or quilled, rugose pieces, internally soft, and quite brittle.

Taste and odour

The barks especially the fresh ones have a slightly bitter initial taste which soon becomes intensively increased. They do not possess any characteristic odour.

Histology of stem bark

The outer most tissue present in the stem bark of *Holarrhena antidysenterica* namely the outer bark has a thickness of about one mm. in barks about twelve mm. thick. The *cork* consists of 5 to 10 rows of almost rectangular cells having brown walls and yellowish contents. Inner to this there are two rows of narrow rectangular clear or colourless cells representing the *phellogen*. The *phelloderm* cells which are slightly smaller than the cortical cells are thinwalled and rectangular. Most of them contain rhomboidal crystals of calcium oxalate and some others contain small rounded starch grains. The cortical cells are large polygonal or tangentially elongated. They also contain rounded starch grains. Scattered in the cortex are a number of large stone cell groups. These form an almost continuous band at the inner region of the middle bark. Here the stone cells are arranged tangentially. The parenchymatous cells near the stone cell groups contain rhomboidal crystals of calcium oxalate. The inner bark which forms the major portion of the bark consists of several tangential rows of stone cells, the phloem elements and medullary rays. The stone cell groups are arranged in tangential rows separated by the medullary rays. The stone cells comprising the groups are large but not uniform in shape and size. They are generally long and are arranged radially. In some of the small sized stone cells rhomboidal crystals of calcium oxalate are present. The cells of the phloem parenchyma in between the rows of stone cell groups though not uniform in size, are small thinwalled and almost polygonal with very small intercellular spaces. Most of them are packed with starch grains and a few cells contain small rhomboidal crystals. The cut ends of several laticiferous ducts with

brownish contents can be made out in this tissue. In the most recently formed phloem which forms the inner most part of the bark the cells are slightly smaller than those in middle bark and thin walled. Small sized crystals occur in a very few cells. Sieve tubes and companion cells are distinctly made out in the phloem. No mechanical elements are found in this region but cut ends of laticiferous ducts are present.

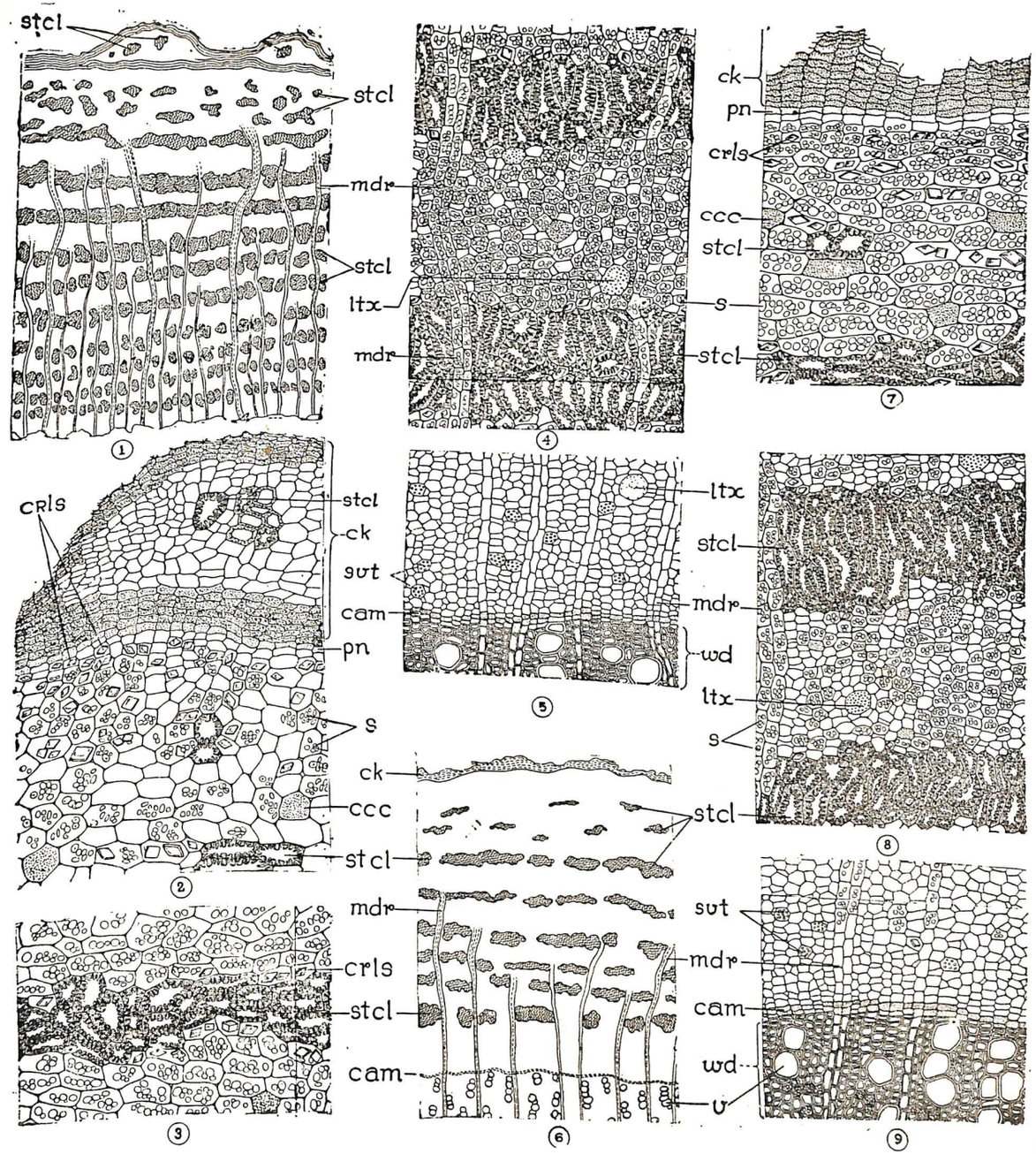
Medullary rays: many, long. They are one to three-seriate and extend from the innermost part of the bark up to the cortex. Most of them are straight, while a few are slightly wavy. All the ray cells are thin walled radially elongated and contain starch grains. The ray cells in the phloem region are smaller in size. The cells gradually enlarge towards the distal end of the rays and their starch grain content also increases.

Root bark

The root bark resembles to some extent that of the older stems but is of a deeper and more rusty brown colour. It is thin when compared with the stem bark. It is also thin when compared to the thickness of the root. In roots about 5 cms. thick the bark is less than 5 mm. in thickness. The surface of the root is dark brown to reddish brown and somewhat rough on account of the presence of many small rounded warty or projecting lenticels. The bark is easily separable from the wood. The bark tissue just within the outer skin has a reddish brown colour while that nearer the wood has a pale or cream-yellow colour. The wood is light yellow. A transversely cut surface of the root clearly shows the outer dark brown cork region the middle reddish brown region and the inner light yellow wood region.

Histology: In a transverse section of the root bark, the outermost tissue namely *cork* is thin and formed of four to ten or more rows of slightly longitudinally elongated thin walled rectangular cells having dark brown contents. Inner to the cork is the *phellogen* composed of a row of thin walled narrow tangentially elongated colourless cells. There is a *phelloderm* of four or more rows of cells just inner to the phellogen composed of cells slightly smaller than the cortical cells. Most of them contain rhomboidal crystals of calcium oxalate. The cortical cells are large slightly tangentially elongated

Plate XII



Histology of stem and root barks of *Holarrhena antidysenterica*, Wall.

Stem bark (Figs. 1 to 5)

1. Diagrammatic sketch of the T S. of the stem bark.
2. Outer bark and a part of the cortex.
3. Middle bark showing the stone cell layer.
4. Inner bark showing tangential bands of stone cell groups and cut ends of latex tubes.
5. Young bast, cambium and adjacent portion of wood.

Root bark (Figs. 6 to 9)

6. Diagrammatic sketch of the T. S. of the root bark.
7. Cork and a part of middle bark with the stone cell groups.
8. Inner bark showing the alternating bands of stone cell groups and phloem elements.
9. Young bast along with adjoining portion of wood.

and thin walled. Most of them are packed with starch grains. Some others are filled with dark reddish contents. Distributed in a scattered manner within the cortex are many stone cell groups. The stone cells vary in size and shape. Some of the groups are so arranged to form nearly continuous rings towards the centre of the middle bark. There may be one or more such rings of stone cells in some specimens. Each group is composed of many stone cells most of which are tangentially elongated. The inner bark which comprises nearly half the thickness of the entire bark, consists of the regular phloem elements with alternating rows of stone cell groups, the medullary rays and latex tubes. There are four to five or more rows of stone cell groups. Most of the stone cells in these groups are radially elongated. Some of the small almost rounded stone cells contain rhomboidal crystals of calcium oxalate. The phloem in between the two radially elongated stone cell groups consists mostly of phloem parenchyma a limited number of sieve tubes and cut ends of several latex tubes. The phloem parenchyma cells are small thinwalled and polygonal. Most of them contain starch grains. A few cells contain the reddish contents. The cut ends of latex tubes are wider than the surrounding cells, some of which appear compressed. In the more recently formed phloem namely that nearest the wood, the parenchyma cells are polygonal thinwalled and very regularly arranged but do not show the presence of starch though crystals may occur. The sieve tubes and companion cells are very distinct. Latex tubes are not evident. The cambium consists of one or two rows of narrow rectangular or tangentially elongated colourless cells.

The *medullary rays* are many in number and one to three seriate. They are nearly straight. All the ray cells are radially elongated, thinwalled and packed with starch grains.

Description of seeds. The seeds occur within long follicles about the thickness of a stout quill. Each follicle contains many seeds. These are narrow and elongate about one and a half centimeters long and two to three millimeters wide, and superficially resemble those of oats. They are smooth or glabrous have an yellowish brown or cinnamon colour and are provided with a tuft of hairs or *coma* at the end farthest from the footstalk. These soon fall off. In the seeds bought from the bazaar therefore, the coma may not be usually present but at one end is a kind of shallow neck representing the place

of attachment of the coma. The seeds are somewhat compressed, convex on one side and concave or channelled and marked with a longitudinal pale line *the raphe* on the other. The outer envelope or testa is thin and papery. Within the testa is a whitish albumin and the embryo, consisting of a cylindric conical radicle and two broad or foliaceous cotyledons.

The seeds are easily broken between the fingers. They have a bitter taste and a somewhat disagreeble odour.

Wrightia tinctoria R. Br.

Apocynaceae

Malayāḷam — Kotakapāla
Tamil — Vetpalai
Hindi — Mithaindarjou

Telugu: Chite – ancalloo. (Roxb.) jedda pala
Kāla kūta (Cooke's Bombay Flora)

Distribution. The Rajamundry hills, Carnatic, the Circars etc.

Habit A small or middle sized deciduous tree, the trunk when old 1½ to 2 ft in diameter often irregular in shape and covered with scaly or scabrous bark, its branches irregularly disposed or bent in various directions, the smaller branches and twigs opposite glabrous or puberulous and ash coloured. Milky latex exudes freely from wounds on tender branches and leaves. The tree sheds its leaves during the cold season. About the beginning of April fresh leaves are formed together with the flowers. The seeds ripen in the following January. Its wood is "remarkably white, close grained, and coming near to ivory than that of any other." (Roxb.)

External morphology

Leaves : Numerous, simple, opposite, exstipulate, short petioled, pretty smooth, pale green, entire and variable in size and shape. It may be elliptic–ovate, elliptic-lanceolate, obovate oblong or oblong lanceolate. 3–6 inches long and 1–2½ inches broad (according to Roxb. from 6 – 10 in. by 3–4 in), acuminate, or caudate, the base acute or rounded and with 6–12 pairs of main nerves, which are faint till the leaves mature, by which time they appear strong. The young leaves are puberulous beneath. *Petiole* – 1/8 to 1/6 in. long.

Inflorescence : A somewhat globose terminal panicle up to 5 in. in diameter with slender spreading dichotomous branches and minute ovate bracts.

Flowers: Fragrant, perfectly white when expanded ½ – ¾ in. (1–1½ inch according to Roxb.) in diameter. *Calyx* – persistent, glabrous, glandular inside, divided near to the base into five equal

segments about 0.1 inch long, that are semiorbicular or oblong with rounded apex and membraneous margins. *Corolla* – gamopetalous, regular salver shaped with a short slightly gibbous tube about 1/8 inch long and a five lobed limb, with the segments spreading, about ⅓ in. long, oblong or linear-oblong, obtuse and twisted in bud. Crowning the mouth of the corolla tube is a well developed corona of numerous whitish ramous linear scales some inserted on the corolla lobes and others inserted with the filaments. *Stamens*–five; *filaments* epipetalous, very short, rigid, inserted within the mouth of the tube and within the corolla; *anthers* - exserted, fairly large, arrowshaped laterally connate to form a very firm conical hood or cover for the stigma, and their lower parts inwardly covered with fine white hairs. *Pistil*-bicarpellary, the ovaries seemingly united; the style equal to the length of the corolla tube and ending in a bilobed stigma covered with transparent gluten by which it adheres to the inside of the anthers.

Fruit: of two very long, slender cylindric, glabrate or smooth, striate, pendulous follicles slightly tapering at both ends and cohering at their tips each 6–18 in. (12–20 inches according to Roxb.) long and ¼ – 1/3 inch in diameter. *Seeds* – numerous, ½ – ¾ inch long, linear, slender, glabrous pointed at apex and with a deciduous coma of fine silky hairs often more than 1½ inch long nonendospermous; embryo inverse with rolled up cotyledons.

The leaves furnish a kind of indigo which is used for dying.

Wrightia tomentosa Roem & Schult.

Apocynaceae

Kāla inderjav, Tambadakudā
(Cooke's Flora of Bombay) (Hindi)
Telugu: Poota–jeelaroo (Roxb.)
Hindi: Dūdhi

Distribution: Tropical India from the Indus eastwards and southwards to Ceylon ascending to 2000 ft. in the Himalayas and to 4000 ft in the Nilgiris.

Habit. A small usually crooked deciduous tree attaining a height of 25–30 ft. with opposite divaricate scabrous branches and pubescent branchlets, and abounding in yellow milky latex which exudes in plenty from every part of the plant when wounded: the young parts densely tomentose. *Bark* – greyish yellow to rust coloured, corky, with small light coloured specks.

External morphology

Leaves: simple, opposite, short petioled, exstipulate, entire or rarely obscurely serrulate, often densely downy to velvety tomentose on both surfaces when young, dark brown when dry, oval elliptic or elliptic oblong, from 3–6 by 1½ – 2½ inches (from 2–3 inches long and 1½–2 inch broad according to Roxb.) acuminate or caudate acuminate, base acute, having 8–14 or more pairs of main nerves. *Petiole* – 0.2 to 0.3 inch long.

Inflorescence: a many flowered peduncled terminal corymbose cyme with minute caducous bracts.

Flowers: regular, about 1 inch across when fully open, white or pale yellow when on the trees, but turning yellow soon after separation and with a fleshy orange coloured corona of scales. *Calyx* – short, pubescent outside, with 5–10 glandular scales inside at the base, five partite with the segments about 1/8 inch long broadly ovate obtuse or rounded and with ciliate membraneous margins. *Corolla*–whitish or pale yellow, regular, salvershaped; *tube* cylindric slightly gibbous firm,

somewhat fleshy, 1/5 to 1/4 inch long, *lobes*-linear, oblong or obovate-oblong, rounded at the apex ½ to 5/8 inch long, overlapping to the left: *coronal scales* variable 5–10, fleshy orange coloured, oblong entire or often laciniate into obtuse segments. *Stamens* – five, inserted at the top of the corolla tube; *filaments* short dilated or broad at base and terminating in a broad rigid tapering or pointed connective; *anthers* white, sagittate, the cells with short solid spurs at the base conniving around and adhering to the stigma. *Pistil* – bicarpellary, the ovaries seemingly connate, style filiform, ending in a ovoid glutinous stigma; *ovules* numerous.

Fruit: of two straight cylindrical, laterally compressed connate follicles with a groove on each side at the junction of the carpels; each follicle 8–12 inches long and 0.5 to 0.7 inch thick with the surface somewhat rough or scabrous with white specks. The follicles separate when fully ripe before dehiscence.

Seeds: numerous, oblong, slender, compressed 0.5 to 0.7 inch long, attenuated at the apex with at its lower end a pure white deciduous coma 1–1½ in long, composed of delicately fine silky hairs: nonendospermic. *Embryo*: with broad convolute cotyledons and a short superior radicle.

NĪLĪ

Source plants :*

Indigofera tinctoria Linn., **I. sumatrana Gaertn.**
belonging to Leguminosae – Papilionatae.

Sanskrit text

Descriptive synonyms

नीली तु नीलिनी तूणी काला दोला च नीलिका ।
रञ्जनी श्रीफली तुच्छा ग्रामीणा मधुपर्णिका ॥
क्षितका कालकेशी च नीलपुष्पा च सा स्मृता । (भावप्रकाशः)

Nīlī tu nīlin′ī tūṇī kālā dolā ca nīlikā
Rañjan′ī s′r′ıphalī tucchr′ā grāmīṇā madhupar′ṇikā
Kṣītakā kālakes′ī ca nīlapuṣpā ca sā smṛtā
(Bhāvapr′akās′aḥ)

नीलिन्युक्ता नीलिका नीलपत्री नीला नीली नीलयष्टी विषघ्नी ।
चण्डाल्यज्ञा रञ्जनी भारवाही काला काली चास्पृशा शोधनीति ॥
(अभिधानमञ्जरी)

Nīlin′yuktā nīlikā nīlapatr′ī nīla nīlī nīlayaṣṭī viṣaghn′ī
Caṇḍālyajñā rañjan′ī bhāravāhī kālā kalī cāspṛs′ā s′odhan′iti
(Abhidhān′amañjarī)

नीलिनी नीलिका काला ग्राम्या तूणी विशोधनी ।
तुत्था श्रीफलिका मेला भारवाही च रञ्जनी ॥ (धन्वन्तरि निघण्टुः)

Nīlin′ī nīlikā kālā gramyā tūṇī vis′odhan′ī
Tutthā s′r′ıphalikā melā bhāravāhī ca rañjan′ī
(Dhanvantari nighaṇṭuḥ)

नीली नीला नीलिनी नीलपत्री
तुत्था राज्ञी नीलिका नीलपुष्पी ।

* Of the two plants indicated as the source *Indigofera tinctoria* is considered the white variety and *I. sumatrana* the dark or blue black variety. The latter when available is preferred.

काली श्यामा शोधनी श्रीफला च
ग्राम्या भद्रा भारवाही च मोचा ॥ (राजनिघण्टुः)

Nīlī nīlā nīlin'ī nīlapatr'ī
Tutthā rājñī nīlikā nīlapuṣpī
Kālī s'yāmā s'odhan'ī s'r'īphalā ca
Grāmyā bhadrā bhāravāhī ca mocā (Rāja nighaṇṭuḥ)

Of the synonyms *nīli*, *nīla*, *kāla* etc. indicate that the plant is blue black ie. dark in colour. *nīlayasti*, *nīlapatri* and *nīlapuṣpi* indicate bluish or dark colour of the stem leaves and flowers respectively. *Rañjan'ī* denotes the dye it contains. The synonyms *viṣaghnī* and *s'odhan'ī* indicate respectively the antitoxic and laxative properties of *nīli*.

Properties and uses

नीलिनी रेचनी तिक्ता केश्या मोहभ्रमापहा ।
उष्णा हन्त्युदरप्लीहवातरक्तकफानिलान् ॥
आमवातमुदावर्त्तं मदञ्च विषमुद्धतम् । (भावप्रकाशः)

Nīlin'ī recan'ī tiktā kes'yā mohabhr'amāpahā
Uṣṇā hantyudarapl̥īhavātaraktakaphān'ilān
Āmavātamudāvar'ttam madañca viṣamuddhatam
(Bhāvapr'akās'aḥ)

नीली तिक्ता रसे चोष्णा कटिवातकफापहा ।
केश्या विषोदरं हन्ति वातासृक्कृमिनाशिनी ॥ (धन्वन्तरि निघण्टुः)

Nīlī tiktā rase coṣṇā kaṭivātakaphāpahā
Kes'yā viṣodaram hanti vātā sr̥k kr̥mināś'in'ī
(Dhanvantari nighaṇṭuḥ)

नीली तु कटुतिक्तोष्णा केश्याकासकफामनुत्
मरुद्विषोदरव्याधिगुल्मजन्तु ज्वरापहा ॥ (राज निघण्टुः)

Nīlī tu kaṭu tiktoṣṇā kes'ya kās a kaphāmanut
Marudviṣodara vyādhi gulmajantu jvarāpahā
(Rāja nighaṇṭuḥ)

नीली केश्या वातपित्तकण्डूव्रणविनाशिनी (हृदयप्रियः)

Nīlī kes'yā vātapittakaṇdūvraṇavin'ás'in'ī (Hr̥dayapr'iyaḥ)

According to Bhāvāpr'ākās'a *nīli* is *recanī* or purgative in action, *tikta* or bitter, *uṣna* or hot or destructive, *kes'ya*, improves hair, and cures or is useful in *meha* (urinary diseases with excessive urine) and giddiness, abdominal enlargement. (ascitis etc.), enlargement of spleen, *vātarakta*, *kapha*. *vāta*. *amavāta*. (gout etc.), *udāvarta*, (intestinal obstruction, antiperistalsis etc.) alcoholic intoxication, and very severe poison.

Other properties and uses mentioned by other authors are:– *nīli* is pungent, kills worms, cures cough, fever, ulcer, *gulma* (phantom tumor etc.) and pruritus. It is considered *mohabr'ahmāpahā* or non-sedative.

In Kerala in Ayurvedic practice *nīli* is mainly used as an antitoxic and promoter of hair growth.

Indigofera tinctoria Linn.

(Leguminosae–Papilionatae)

Malayāḷam	...	Amari, Ameri, Nīli
Tamil	...	Averi, Avarri
Hindi	...	Jinjini, Nil, Nīlini, Nīli, Nīla and Nīlika.

Distribution and habitat

The plant is found both cultivated as well as in the wild condition in Bengal, the Circars, Deccan, Konkan, Carnatic and along the West Coast. It was cultivated on a large scale in many parts of north India for extracting the dye *indigo* from its leaves. before the introduction of synthetic dyes but is now seldom grown on a large scale.

Habit and general features

Indigofera tinctoria Linn. is an erect suffruticose pubescent shrub two to four feet or more high with a short stem and twiggy but firm woody terete branches light greenish brown to somewhat silvery grey in colour bearing alternate pinnate leaves with 3 – 6 pairs of fairly large oblong or obovate leaflets, small pale reddish-brown to reddish-yellow flowers in 8 – 12 or more flowered axillary racemes that are usually much shorter than the leaves and nearly straight, smooth, narrow somewhat terete, dark brown reflexed pods, three quarters to one inch long and about 0·1 inch thick.

External morphology

Leaves: alternate, stipulate : – stipules, small subulate, imparipinnate, one to three inches long; *petioles* – half to one inch long; *leaflets* – usually nine, occasionally seven to eleven or thirteen, the lateral ones opposite half to one inch long and a quarter to half an inch wide oblong, elliptic - oblong or obovate-oblong, with a very short mucro, membraneous light or pale greenish above, slightly glaucous beneath, and turning greyish blue or black on drying.

Inflorescence: axillary: the rachis much shorter than the leaves generally about one inch long, greyish-green, bearing 8 – 12 or more flowers and scarcely lengthening in fruit.

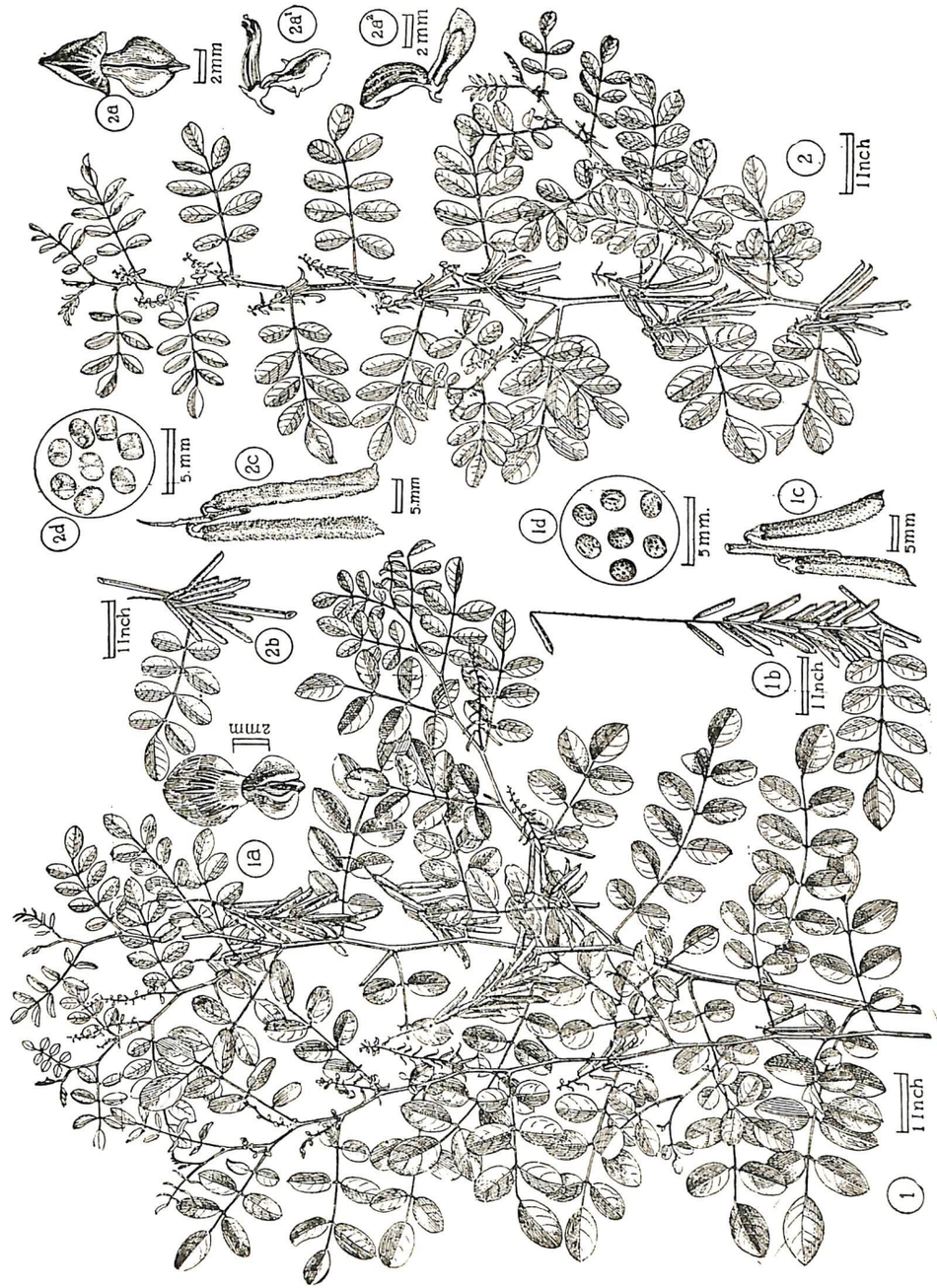


Plate XIII

***Indigofera tinctoria*, Linn.**

2. Twig with inflorescence
2a, 2a¹ and 2a² flowers 2b. Rachis bearing fruits
2c. Fruits enlarged 2d. Seeds.

***Indigofera sumatrana*, Gaertn.**

1. Twig with Inflorescence
1a. Flower 1b. Rachis bearing fruits
1c. Fruits enlarged 1d. Seeds.

Flowers: small, under 0.3 inch long, yellowish - brown or rose-coloured. *Calyx* – minute, 1/24 th of an inch long, gamosepalous with a silvery grey pubescence and five cleft with the segments or teeth broad acute and almost as long as the tube. *Corolla* – 1/8 to 1/6 th inch rose to yellowish brown: *standard* – rounded, emarginate, brownish outside; *wings* – adherent to keel, rose-coloured; *keel* petals greenish furnished with a spur on each side, at length often bending back elastically. *Stamens* – di–adelphous, nine and one, *anthers* – uniform. *Ovary* – sessile, eight to ten or more ovuled with a short incurved style ending in a capitate stigma.

Fruits: These are found, aggregated in the basal halves of the rachises and are mostly straight or slightly upwardly curved, slender, linear, cylindrical or sometimes slightly torulose, glabrescent deflexed pods, three quarters to one inch or more long and 1/12th to $\frac{1}{10}$ th of an inch thick. The pods are pale greenishgrey when young but turn dark brown on ripening and contain about twelve seeds in each. *Seeds* – cylindrical, nearly truncate at both ends, with a smooth, faintly rugose yellowish brown testa and about $\frac{1}{12}$ th of an inch long and $\frac{1}{20}$ of an inch wide.

Officinal parts: Root, leaves, or the entire plant.

Description

The root system consists chiefly of a tap root with its lateral secondary roots and their branches which go fairly deep into the soil. The tap root is however more prominent and comparatively larger and stouter. The roots are long, woody and quite strong. They are pale yellow to light yellowish-brown in colour with the surface nearly smooth except for the presence of a few scattered lenticels. The root attains a diameter of about half an inch or more. The transversely cut surface has a very pale yellow colour with the woody central portion forming its bulk part. The bark is thin and is easily separable or peeled off from the wood. The root bark is slightly bitter in taste.

Histology of the root.

A transverse section of the root which is circular in outline shows a very thin layer of cork outside, a broad central wood portion

and a not very wide middle region composed of cortex and bast. The entire bark has a thickness of about or less than 1/5th the diameter of the root. The outermost tissue namely the *cork* is very narrow. It consists of only a few-four to seven–rows of thinwalled rectangular or tangentially elongated cells with colourless walls, with often one or more rows of light brown compressed or crumpled and worn out older elements of cork adhering at a few places outside. A few rows of *phelloderm* (secondary cortex) are found inner to the phellogen. Its cells are, moderately large, thinwalled and tangentially elongated. Most of them are fully packed with starch grains. Some of the cells which are proportionately much larger contain globules of oil that nearly fill the cell and appear light bluish.

The entire *cortex* is comparatively wide and formed of broadly rectangular to polygonal thin walled cells. The cortical cells too are packed with starch grains. Groups of narrow thick walled fibre cells forming narrow wedges with their apices towards the outside are present in the cortex. In some of the cells adjoining the fibre groups are found small rhomboidal or hexagonal crystals of calcium oxalate. The fibre groups just above the recently formed phloem tissue are large being composed of a larger number of cells. The bast or phloem tissue is comparatively a narrow zone. A few of the phloem parenchyma cells contain crystals of calcium oxalate. Strips of obliterated phloem tissue are found towards the outer border of the functioning phloem. The medullary rays are many in number and extend up to the cortex. They are mostly uni or biseriate or occasionally three seriate. The ray cells in the phloem region are rectangular, only slightly radially elongated, while those near the cortex are tangentially elongated. Almost all the ray cells are packed with starch grains while a few of them contain crystals of calcium oxalate. In *Indigofera sumatrana*, the phloem is comparatively wider and composed of larger cells with the sieve tubes and companion cells quite distinct. The ray cells are distinctly radially elongate some of them nearly double the width in length, and a larger number contain crystals of calcium oxalate.

A distinct cambium consisting of two or three rows of narrow thinwalled tangentially elongated cells can be made out.

Wood: The wood forms the bulk part of the root. It is characterised by the presence of discontinuous concentric rings of very thickwalled fibre cells alternating with zones of wood parenchyma cells both regions intercepted by the medullary rays. There are many vessels distributed throughout the wood. These occur singly or in groups of two to three. They are comparatively very wide but short. The xylem parenchyma cells are also thick walled. Most of them are packed with starch grains and a few cells contain small rhomboidal crystals of calcium oxalate.

The medullary ray cells in the wood are thickwalled slightly radially elongated and packed with starch grains. Some of them contain solitary rhomboidal crystals.

Indigofera sumatrana Gaertn.

Distribution : Same as *for I. tinctoria Linn.*

Description of the plant.

A shrub three to six feet high with the stem and branches slender, terete dark or purplish brown, and covered with very fine appressed grey hairs.

Leaves: imparipinnate, up to about three inches in length; the petioles about half an inch long: *stipules*- small, subulate; *leaflets* – opposite, usually nine, sometimes less, or eleven to thirteen, half to three quarters of an inch long and one third to half an inch or more wide petiolules of lateral leaflets less than 0·1 inch. long, that of the terminal leaflet nearly one third inch, oblong or elliptic – oblong with a short mucro, thin or membraneous, pale green but distinctly darker than those of *I. tinctoria* turning greyish blue on drying and thinly clothed with grey appressed hairs.

Inflorescence: Axillary racemes, bearing numerous flowers. The rachis is as long as or more often longer than the leaves and elongates to nearly double the length – to about six inches – when the fruits mature.

Flowers: subsessile, small about, 2.5 mm. long. *Calyx* – less than or about 1 mm, wide yellowish brown finely hairy inside, with fine triangular acute valvate teeth. *Corolla* yellowish brown outside; *standard* – brownish yellow, with prominent vertical stripes; *wings* spread out, rose coloured, *keel* petals greenish. Stamens 10. Ovary many - ovuled.

Fruits: Generally less than one inch in length and about 0·1 inch in thickness, linear straight apiculate glabrous, cylindrical or very slightly torulose, greenish with a rosy tint on onside when young, but turn dark brown through out when the seeds mature. Each fruit may contain from 8 - 12 or more seeds.

Seeds : Cylindrical, the ends more or less rounded, some what dark grey or greyish brown with slightly pitted testa: in size very slightly smaller than those of *I. tinctoria*.

Histology of root.

A transverse section of the root is more or less circular in outline with a very thin periderm, a moderately wide middle region the comprising cortex and bast, and a wider central wood portion. The *phellem* or cork consists of seven to twelve or more rows of cells. The cells are somewhat rectangular, tangentially elongated and thin-walled. The cell walls of the outer most one or two rows are yellowish brown and wavy. Within the phellogen is a narrow zone of secondary cortex with fairly large cells. Some of them contain rounded to oval globules of oil of a light bluish colour and some others contain hexagonal crystals of calcium oxalate. Most of the cells are packed with simple rounded, starch grains. The entire cortex is comparatively wide and formed of broadly rectangular to polygonal thin walled cells which are rich in starch grains. Groups of thickwalled, sclerenchyma cells are present in the cortex. These groups are wedge-shaped with their broad ends facing the wood. Some of the cortical cells in between these fibre groups contain small, rounded oil globules. Some of the cortical cells near the sclerenchyma groups contain small rhomboidal or hexagonal crystals of calcium oxalate.

The bast is composed of thinwalled phloem parenchyma, sieve tubes and companion cells, and groups of fibre cells. A few phloem parenchyma cells contain small rhomboidal crystals of calcium oxalate. These cells are nearly double the size of the cells present in *I. tinctoria*. In the newly formed phloem region the sieve tubes and companion cells are very distinct. Some of the phloem parenchyma contain small granules of starch and some others have small rhomboidal crystals of calcium oxalate. Medullary rays are many, long mostly uni-and bi-seriate and extend as far as the cortex. The ray cells are thinwalled radially elongated and packed with starch grains. Some of the ray cells in the phloem region contain crystals of calcium oxalate.

The wood is characterised by the presence of alternating nearly annular bands of thickened fibre cells and thickwalled parenchyma containing starch grains. Vessels are irregularly distributed but do not occur in large groups. In longitudinal section they appear pitted and vary from 54 to 162 μ in length. The wood fibres

are arranged in large groups that form almost concentric rings but for the separation by the medullary rays. The parenchyma cells between the fibre groups are larger in transverse section than the fibre cells, slightly thickwalled and loaded with starch grains. The ray cells in the wood are not very thickwalled. They are radially more elongate than those in the bast. Some of them contain rhomboidal crystals and others are filled with starch grains.

Comparison of *Indigofera tinctaria* Linn. and *I. Sumatrana* Gaertn.

Habit. Similar in both though *Indigofera sumatrana* may be considered somewhat more robust. It has also distinctly darker leaves, stems and branches.

Inflorescence and flowers. The rachis of the inflorescence is considerably shorter than the leaf in *I. tinctoria* and it does not appreciably elongate afterwards. In *I. sumatrana* the rachis is almost as long as or usually longer than the leaves and it elongates to nearly double the length by the time the seeds are mature.

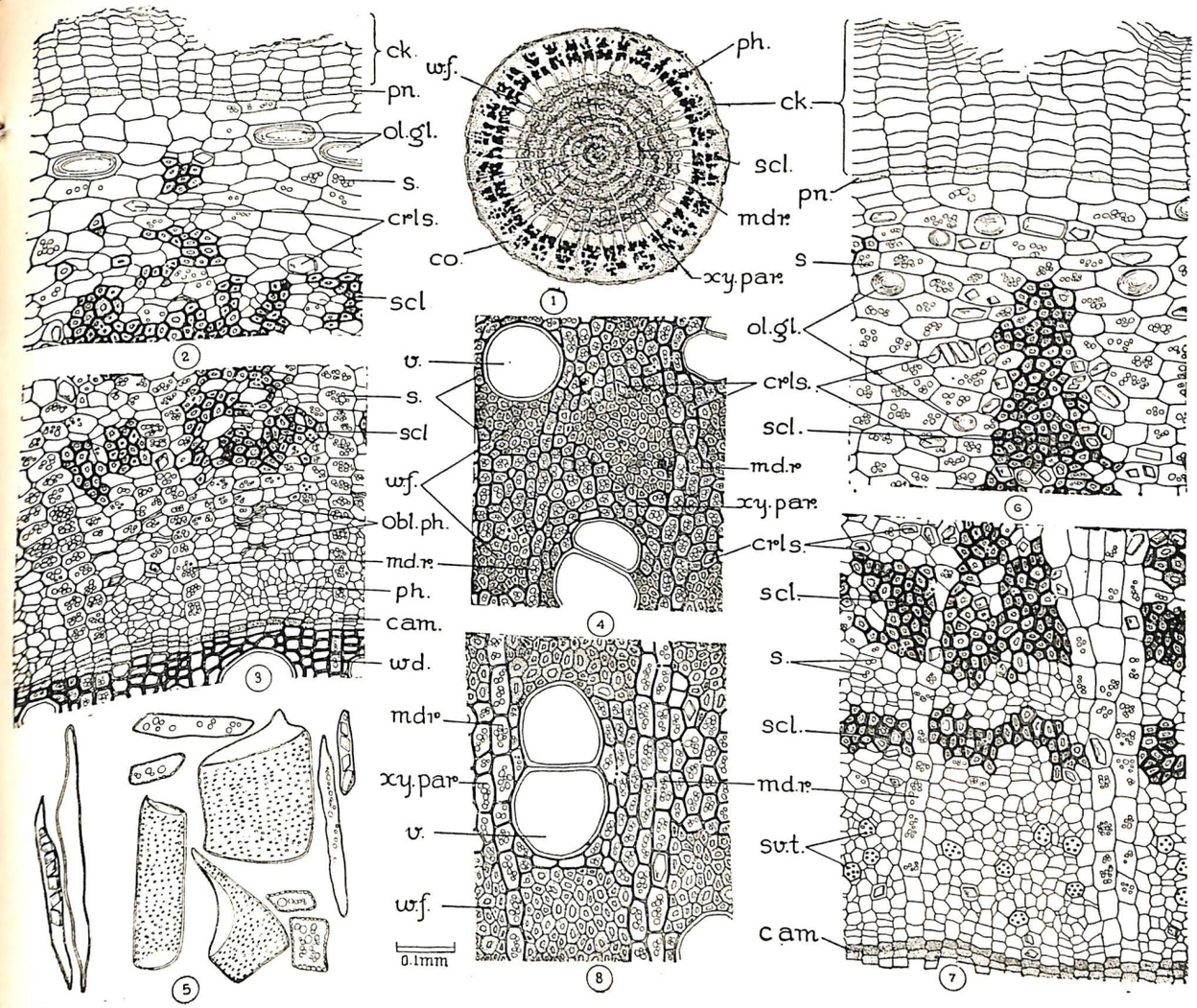
Histology of the roots.

The *cork* is a narrow zone in both. It consists of 4 – 8 rows of cells in *I. tinctoria* and about 7–12 rows in *I. sumatrana*.

Cortex-General structure similar in both. In both large cells containing oil globules occur, These are larger and usually restricted to the peripheral part of the cortex in *I. tinctoria*, and are smaller and found distributed throughout the cortex in *I. sumatrana*. Rhomboidal and polyhedral types of calcium oxalate crystals occur in both plants. They are more abundant in *I. sumatrana*. Most of the cortical parenchyma cells are fully loaded with simple spherical or oblong starch grains in both. Towards the periphery of the cortex wedge shaped fibre groups with their apices pointing outwards occur in both. These groups in *I. sumatrana*. are comparatively larger containing a greater number of cells.

Bast, The cells of the phloem are comparatively larger and the sieve tubes and companion cells more distinct in *I. sumatrana*. Crystals of calcium oxalate occur in the parenchyma in both, but more abundant in *I. sumatrana*.

Plate XIV



Histology of roots of *Indigofera tinctoria*, Linn. *Indigofera sumatrana*, Gaertn.

Indigofera tinctoria, Linn. (Figs. 1 to 5)

Fig. 1. Diagrammatic sketch of the T. S. of a root.
2. Cork and a part of cortex.
3. A portion of the cortex and phloem, and the cambium.
4. A portion of the wood.
5. Cells from the macerated tissue of the wood.

Indigofera sumatrana, Gaertn. (Figs. 6 to 8)

Fig. 6. Cork and a part of cortex.
7. Part of the cortex and the phloem region with the cambium.
8. A portion of the wood.

Medullary rays. The medullary ray cells are rectangular but not radially very elongate in *I. tinctoria* where as they are distinctly radially elongate in *I. sumatrana*. A larger number of ray cells contain calcium oxalate crystals in *I. sumatrana*.

The wood vessels have a wider lumen in *I. tinctoria*.

KĀKAMĀCĪ.

Source plant* in Kerala **Solanum nigrum Linn.**

(belonging to Solanaceae)

Sanskrit text

Descriptive synonyms

काकमाची ध्वांक्षमाची काकाह्वा चैव वायसी । (भावप्रकाशः)

Kākamācī dhvāmkṣamācī kākāhvā caiva vāyasī
(Bhāvapr'akās'aḥ)

काकमाची ध्वाङ्क्षमाची काकाह्वा चैव वायसी ।
कट्वी कटुफला चैव रसायनवरा स्मृता ॥ (धन्वन्तरि निघण्डुः)

Kākamācī dhvāṅkṣamācī kākāhvā caiva vāyasī
Kaṭvī kaṭuphalā caiva rasāyan'avarā smṛtā
(Dhanvantari nighaṇṭu)

काकमाची ध्वाङ्क्षमाची वायसाह्वा च वायसी ।
सर्वतिक्ता बहुफला कटूँफला च रसायनी ॥
गुच्छिफला काकमाता स्वादुपाका च सुन्दरी ।
वरा विद्रावणी चैव मत्स्याक्षी कुष्ठनाशिनी ॥
तिक्तिका बहुतिक्ता च नाम्नमष्टादश स्मृताः । (राजनिघण्डुः)

Kākamācī dhvāṅkṣamācī vāyasāhvā ca vāyasī
Sar'vatiktā bahuphalā kaṭphalā ca rasāyan'ī
Gucchaphalā kākamātā svādupākā ca sundarī
Varā vidrāvaṇī caiva matsyākṣī kuṣṭhanās'in'ī
Tiktikā bahutiktā ca nāmnāmaṣṭādas'a smṛtāḥ
(Rāja nighaṇṭu)

* The Sanskrit name Kākamāci and some of its synonyms are also applied to *Solanum dulcamera* Linn. which is supposed to have properties similar to those of *S. nigrum* Linn.

Of the synonyms *kākamācī* and similar others associated with the word 'crow' indicate that fruits of the plant are very much liked by crows; *gucchaphalā* denotes that fruits are arranged in bunches; *bahuphalā* indicates there are numerous fruits; *kaṭuphalā* denotes the pungent taste of fruits; and *varatiktā* and *sarvatiktā* the bitter taste of the plant as a whole.

Different varieties white, black, red, large and small are mentioned and their properties are considered the same. The one found in these regions has its fruits black when ripe.

Properties and uses.

काकमाची त्रिदोषघ्नी स्निग्धोष्णा स्वरशुक्रदा ।
तिक्ता रसायनी शोथकुष्ठार्शोज्वरमेहजित् ॥
कटुर्नेत्रहिता हिक्काछर्दिहृद्रोगनाशिनी । (भावप्रकाशः)

Kākamācī tr'idosaghn'ī snigdhoṣṇā svaras'ukḷadā
Tiktā rasāyan'ī s'othakuṣṭhār's'ojvaramehajit
Kaṭur'netr'ahitā hikkāchar'di hṛdroganās'inī
(Bhāva pr'akās'aḥ)

काकमाची त्रिदोषघ्नी सरा स्वर्यासतिक्तका ।
हन्ति दोषत्रयं कुष्ठं वृष्या सोष्णा रसायनी ॥ (धन्वन्तरी निघण्डुः)

Kākamācī tridoṣaghn'ī sarā svaryāsatiktakā
Hanti doṣatr'ayam kuṣṭham vṛṣyā soṣṇā rasāyan'ī
(Dhanvantari nighaṇṭu)

काकमाची कटुस्तिक्ता रसोष्णा कफनाशिनी
शूलार्शः शोफदोषघ्नी कुष्ठकण्डूतिहारिणी ॥ (राजनिघण्डुः)

Kākamācī kaṭustiktā rasoṣṇā kaphanās'in'ī
Sūlār's'aḥ s'ophadoṣaghn'ī kuṣṭhakaṇḍūtihāriṇī
(Rāja nighaṇṭu)

त्रिदोषशमनी वृष्या काकमाची रसायनी ।
नात्युष्णा शीतवीर्या च भेदिनी कुष्ठनाशिनी ॥ (हृदयप्रिय)

Tridoṣaśaman'ī vṛṣyā kākamācī rasāyan'ī
Nātyuṣṇā śītavīryā ca bhedin'ī kuṣṭhanāśinī
(Hṛdayapr'iyaḥ)

According to Bhāvapr'akāśa kākamācī is demulscent, hot, bitter and a tonic, (alterative). It overcomes the vitiation of the three *dosas*; promotes or improves voice and semen, cures oedema, leprosy (skin diseases), piles, fever, urinary diseases with increased urination, hiccough, vomitting and heart disease. According to other authors it is also laxative.

It is at the present time generally used in the treatment of skin diseases. It is also valued as diuretic.

Solanum nigrum Linn.

(Solanaceae)

Malayāḷam	–	Manattakkāli
Tamil	–	Unda takkali, Matathamkali, Manattakkāli
Hindi	–	Makoi, Gurkamai

Distribution and habitat

The plant is found throughout India. It is a cosmopolitan weed of all districts from sea level to 7000 feet elevation. It is quite common in gardens, cultivated land and roadsides.

Habit and general features

Solanum nigrum Linn. is an erect suffrutescent divaricately branched unarmed nearly glabrous variable annual herb, one to three feet high, with slightly woody, greenish stems and branches, bearing, glabrous, ovate, or ovate-lanceolate, entire juicy, membraneous leaves arranged alternately or in unequal pairs at each node, supra-axillary clusters of small white drooping flowers, and clusters of small globose, shiny, purplish black or reddish berries. The plant is in flower and fruit throughout the year.

External morphology

Stem and branches erect or suffrutescent, glabrous or nearly so, greenish, roundish or sometimes slightly angular. Branches mostly divaricate.

Leaves: simple, exstipulate, alternate or in unequal pairs at a node, petiolate, thin and membraneous, yet somewhat juicy, ovate or ovate-lanceolate, entire or sometimes sinuate to dentately lobed or occasionally toothed, somewhat tapering at both ends though with a more acute or even acuminate tip, up to about three and a half inches long and two inches broad. The fresh leaves have a slightly sour acrid taste. Petiole less than an inch in length.

Flowers: ebracteate, comparatively very small whitish, about a quarter of an inch in diameter regular in subumbellate clusters of three to ten, borne on slender drooping pedicels 1/8 to 1/3 inch long at

the end of a rather stout, short, supra-axillary peduncle. *Calyx*- about 1/8 inch, saucer-shaped, persistent, glabrous or sparsely pubescent, with five small oblong obtuse teeth. *Corolla* - white, rarely somewhat lightly purplish, about 1/3 inch in diameter, nearly glabrous, divided below the middle into five oblong sub acute lobes. *Stamens* - five; *filaments* epipetalous, free, short, flattened and hairy at the base; *anthers* - yellow, oblong, obtuse and notched at the apex; *ovary* - globose, two chambered with many ovules, *style* - cylindric, hairy at base, ending in a capitate stigma.

The *fruits*: which occur in subumbellate drooping clusters of 3 to 10 are small, globose, shiny, purplish black-or in some varieties reddish or orange yellow - many seeded berries, each about a quarter of an inch in diameter. They have a thin but tough, skin or epicarp, and are greenish and sour when unripe, but become almost sweet when quite ripe. *Seeds* – many, discoid, about 1/20th of an inch in the purplish juicy pulp.

Officinal parts: Whole plant and fruits.

Description of root

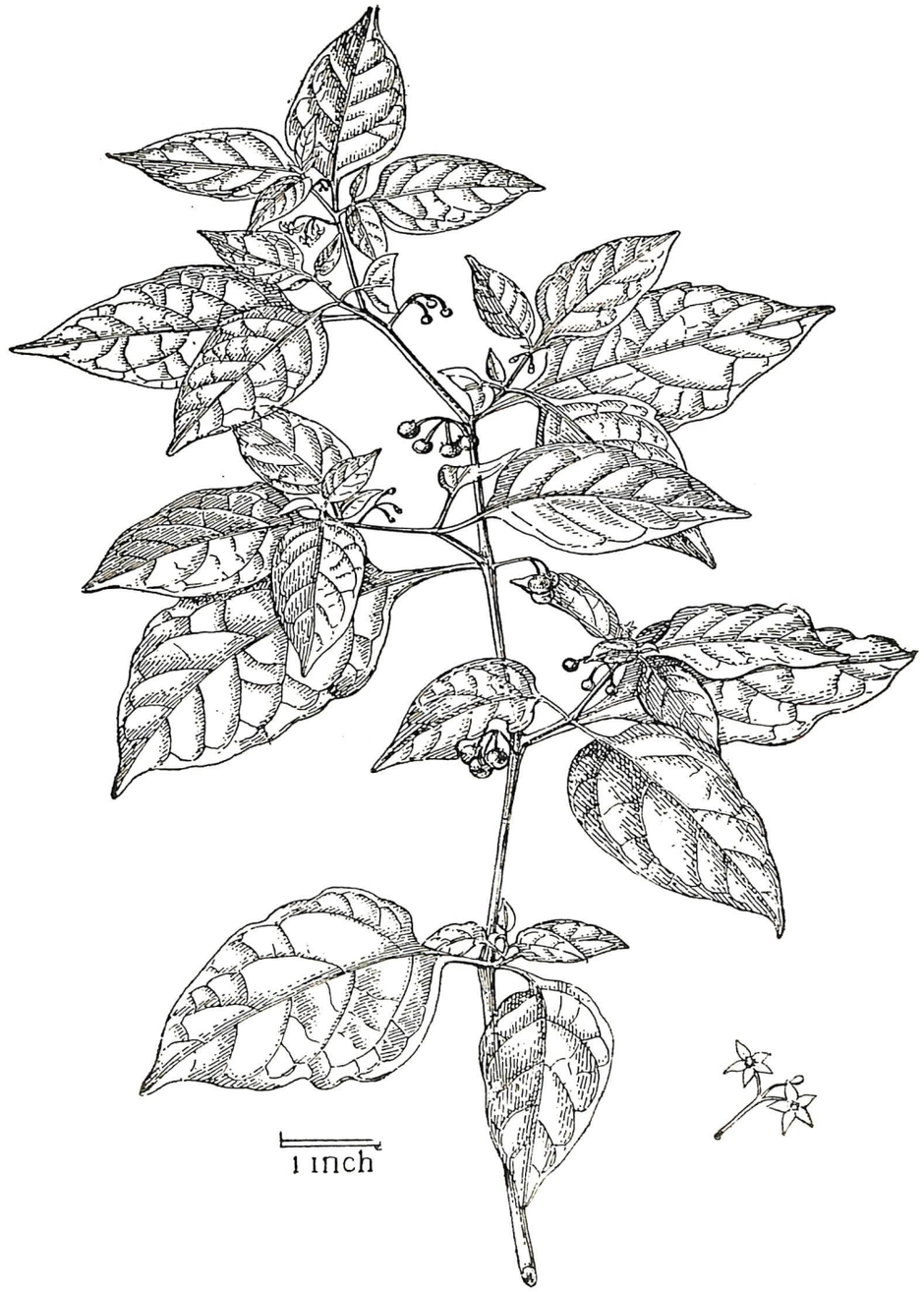
The root system consists of a long stout tap root with a few branches and a number of small lateral roots arising from the basal part of the root. The tap root which is long and woody is smooth, pale brown in colour and varies in thickness from $\frac{1}{4}$ to $\frac{1}{2}$ inch. It has comparatively thin bark which can be easily peeled off. The outer surface of the bark is light brown but the inner surface is whitish and very soft. The wood which forms the major part of the root has a pale yellow colour. A few lenticels are found towards the basal part of the root.

When dry the roots shrink and as a result narrow longitudinal furrows are formed on the bark and become brown in colour. The bark can be peeled off as small pieces even from dry roots and the inner surface of the peeled off bark has a shiny white colour. The wood has an yellowish white colour.

Histology of root

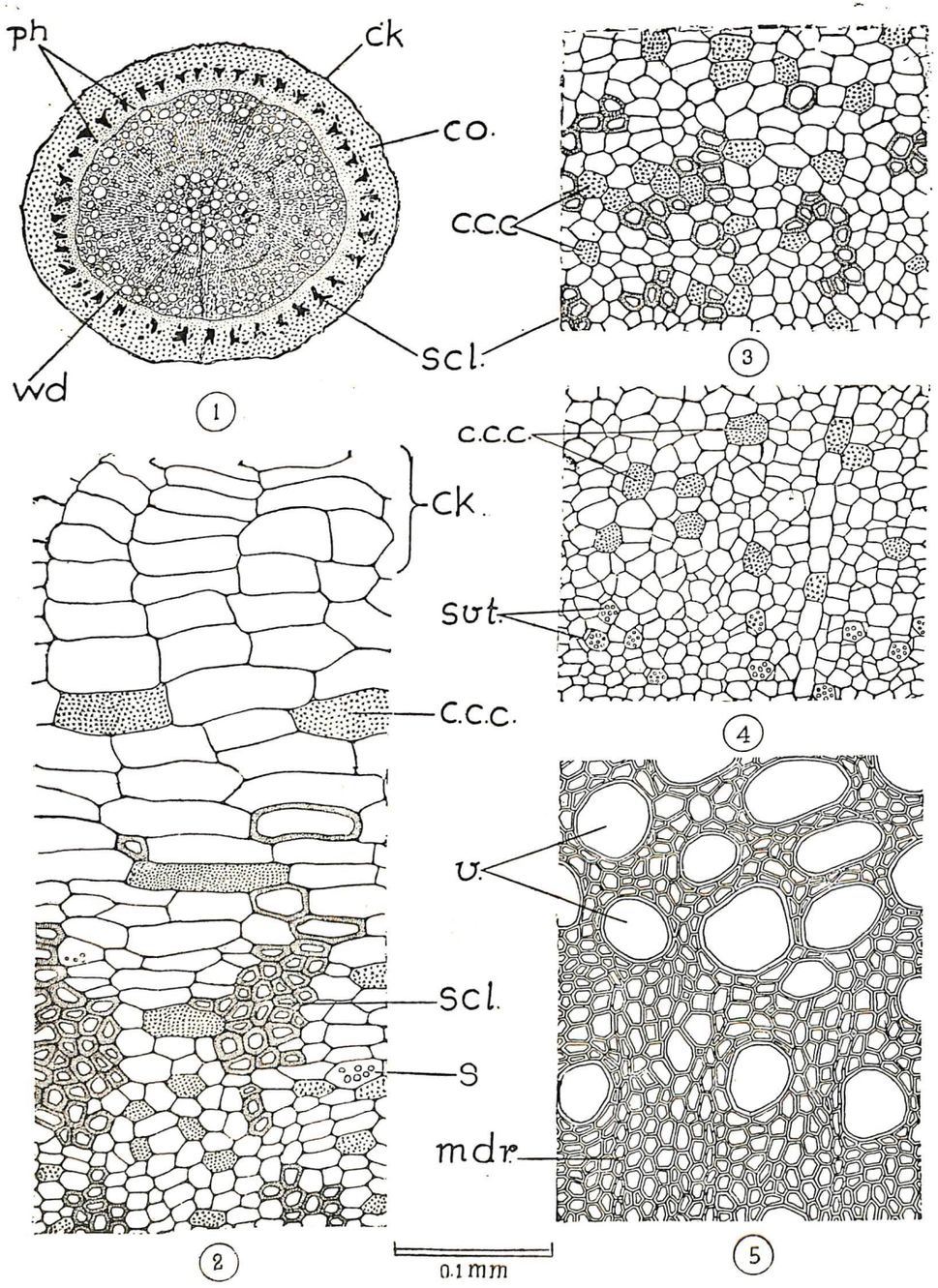
A transverse section of the root of *Solanum nigrum* is circular in outline with a central broad wood and a narrower outer bark

Plate XV



Solanum nigrum, Linn.

Plate XVI



Histology of root of *Solanum nigrum*, Linn.

Fig. 1. Diagrammatic sketch of the T. S. of the root.
2. Cork and cortex.
3. Bast showing small groups of fibre cells.
4. A part of the young bast.
5. Wood.

portion which is about one third the thickness of the wood. The wood is very porous and the medullary rays appear as a number of very thin lines radiating from the centre of the root.

The *cork zone* is very thin and consists of a few (two to four rows of cells with brownish walls. The cells are mostly narrow thin-walled, nearly rectangular and tangentially elongated, but all the cells are not uniform in shape. *Phellogen* is not distinctly seen. Inner to this is the cortex consisting of large slightly elongated thin walled cells. These are larger towards the periphery. Groups of sclerenchyma cells occur towards the inner region, each group consisting of about 8 to 20 or more cells. Occasionally solitary sclerenchyma cells also occur. Most of the cortical cells are filled with the black contents seen also in other species of *Solanum*. The cortical cells adjoining the sclerenchyma groups are smaller and polygonal or slightly tangentially elongated. The cells towards the interior appear smaller. In the very young roots most of the cells of the cortex are packed with starch grains, but they are found only sparcely and in fewer cells in those of old roots. The *bast* or phloem region is about 1/3rd thickness of the cortex and the cells are small thin walled and polygonal in shape. Most of them also contain the black contents. Sieve tubes and companion cells are not so large and clear as those in the other species of *Solanum*. The cambium consists of a row of narrow thinwalled rectangular cells.

Wood – Inner to the cambium is the wood region which forms the major portion of the root. Vessels are arranged in groups of two or three in radial rows. The xylem parenchyma cells are all thickwalled. In some specimens the wood portion is comparatively large. At the centre of the wood and at the periphery the vessels are large and without any regular arrangement but in the middle region the vessels are fewer and smaller and arranged in radial rows. Here the medullary rays are very clear.

Medullary ray – Many, mostly uniseriate, nearly straight and reach up to the cortex. In the wood the ray cells are radially rectangular and somewhat thickwalled. In the phloem region the ray cells are slightly larger than the phloem parenchyma cells thinwalled and radially elongated. Most of the ray cells in the phloem are filled with the black substance. Beyond the phloem region the rays widen and the ray cells are tangentially elongated.

BṚHATĪ.

Source plants* in Kerala

1. Solanum insanum Willd.
2. Solanum melongena Linn. and its wild varieties
3. Solanum xanthocarpum Sch. & Wendl.
4. Solanum aculeatissimum Jacq.
5. Solanum indicum Linn.
6. Solanum torvum Swartz.

belonging to Solanaceae.

Sanskrit text

Descriptive synonyms

वार्त्ताकि क्षुद्रभण्टाकी महती बृहती कुली ।
हिङ्गुली राष्ट्रिका सिंही महोष्ट्री दुष्प्रधर्षिणी ॥
कण्टकारी तु दुस्पर्शा क्षुद्रा व्याघ्री निदिग्धिका ।
कण्टालिका कण्टकिनी धावनी बृहती तथा ॥ (भावप्रकाशः)

Vār'ttākī kṣudrabhaṇṭākī mahatī bṛhatī kuḷī
Hiṅgulī rāṣṭr'ikā simhī mahoṣṭr'ī duṣpradhar'ṣiṇī
Kaṇṭakārī tu duspars'a kṣudrā vyāghr'ī nidigdhikā
Kaṇṭālikā kaṇṭakin'ī dhāvan'ī bṛhatī tathā (Bhāvaprakās'aḥ)

बृहती राष्ट्रिका सिंही वार्त्ताकी चाकुली कुली ।
आक्रान्ताख्या पीतफला ज्ञेया ह्रस्वफलेति च ॥
बृहत्यन्या विषाख्या व्याघ्री द्वीपी कहो टिका ।
क्षयप्रसादिनी स्थूलवार्त्ताकी धावनी स्मृता ॥ (अभिधानमञ्जरी)

Bṛhatī rāṣṭr'ikā simhī vārttākī cākuḷī kulī
Ākr'āntākhyā pītaphalā jñeyā hrasvaphaleti ca
Bṛhatyan'yā viṣākhyā vyāghr'ī dvīpī kahoṭikā
Kṣayapr'asādin'ī sthūlavār'ttākī dhāvan'ī smṛtā
(Abhidhān'amañjarī)

* *Solanum xanthocarpum* and *S. indicum* are the plants mentioned as the botanical source of *Bṛhatī* in authoritative books on Indian Materia Medica.

बृहती सिंहिका क्रान्ता वार्त्ताकी राष्ट्रिका कुली ।
विषदा स्थूलकण्टाकी महती तु महोटिका ॥ (धन्वन्तरि निघण्टुः)

Bṛhatī simhikā kr'āntā vār'ttākī rāṣṭr'ikā kulī
Viṣadā sthūlakaṇṭākī mahatī tu mahoṭikā
(Dhanvantari nighaṇṭuḥ)

बृहती महती क्रान्ता वार्त्ताकी सिंहिका कुली ।
राष्ट्रिका स्थूलकण्टा च भण्टाकी तु महोटिका ॥
बहुपत्री कण्टतनुः कण्टालुः कट्फला तथा ।
डोरली वनवृन्ताकी नामान्यस्याश्चतुर्दश ॥ (राजनिघण्टुः)

Bṛhatī mahatī kr'āntā vārttākī simhikā kulī
Rāṣṭrikā sthūlakaṇṭā ca bhaṇṭākī tu mahoṭikā
Bahupatr'ī kaṇṭatanu'ḥ kaṇṭālu kaṭphalā tathā
Ḍoralī van'avṛntākī nāmān'yasyā s'catur'das'a
(Rāja nighantuḥ)

Of the synonyms *pītaphalā* indicates the yellowish colour of the fruits when ripe. *kaṇṭakārī*, *kāṇṭāḷā*, *duspars'ā* etc., denote that the plant is covered with thorns.

Two plants known in Malayāḷam as *cer'uvazutin'a*, a wild variety of *S. melongena* bearing smaller fruits, and *kaṇṭakāri-cuṇṭa*, *Solanum xanthocarpum* as well as *S. aculeatissimum* are taken in this area as *bṛhatī*. The synonym *dvīpī* indicates that there are two varieties, white and black. *Ānacuṇṭā* and / or *kāṭṭucuṇṭā* are other plants very similar in habit to *S. melon gena* occasionally used as its substitutes.

Properties and uses :

Caraka has included *bṛhatī* under the following groups:

(i) Kaṇṭhyam (improver of voice)
(ii) Hikkānigraham (relieving hiccup)
(iii) S'vayathuharam (curing oedema) and
(iv) Aṅgamar'dapr'as'aman'am (allaying pain in the body)

बृहती ग्राहिणी हृद्या पाचनी कफवातकृत् ।
कटुतिक्तास्य वैरस्य मलारोचकनाशिनी ॥
उष्णा कुष्ठज्वरश्वासशूलकासाग्निमान्द्यजित् । (भावप्रकाशः)

Bṛhatī gr'āhiṇī hṛdyā pācan'ī kaphavātakṛt
Kaṭutiktāsya vairasya malārocakanās'in'ī
Uṣṇā kuṣṭhajvaras'vāsas'ūlakāsāghnimāndyajit
(Bhāva pr'akās'aḥ)

सिंहिका कफवातघ्नी श्वासशूलज्वरापहा ।
छर्दिहृद्रोगमन्दाग्निमामदोषांश्च नाशयेत् ॥
बृहती ग्राहिणी सोष्णा वातघ्नी पाचनी तथा । (धन्वन्तरि निघण्टुः)

Simhikā kaphavātaghn'ī s'vāsas'ūlajvarāpahā
Char'di bṛdrogamandāgnimāmadoṣāms'ca nās'ayet
Bṛhatī grāhiṅī soṣṅā vātaghn'i pācanī tathā
(Dhanvantari nighaṇṭuḥ)

बृहती कटुतिक्तोष्णा वातजिज्वरहारिणी ।
अरोचकामकासघ्नी श्वासहृद्रोगनाशिनी ॥ (राजनिघण्टुः)

Bṛhatī kaṭutiktoṣṇā vātajijvarahāriṇī
Arocakāmakāsaghn'ī s'vāsahṛdroganās'in'ī (Rāja nighaṇṭuḥ)

कुक्षिरुग्ज्वरवातघ्नं दीपनं बृहतीद्वयम् ।
तत्फलं कृमिकुष्ठघ्नं रूक्षं वातकफौ जयेत् (हृदयप्रिय)

Kukṣirug jvaravātaghn'am dīpan'am bṛhatīdvayam
Tatphalam kṛmikuṣṭhaghn'am rūkṣam vātakaphau jayet
(Hṛdayapriya)

फलानि बृहतीनां तु कटुतिक्तलघूनि च ।
कफपित्तहरं व्रण्यमुष्णं तिक्तमवातलम् ॥ (सुश्रुतम्)

Phalānī brhatīn'ām tu kaṭutiktalaghūn'ī ca
Kaphapittaharam vr'aṇyamuṣṇam tiktamavātaḷam
(Sus'r'utam)

According to Bhāvapr'akās'a *bṛhatī* is constipating (arresting), agreeable (for heart ?) digestive, overcomes *kapha* and *vāta*, is pungent and bitter, removes bad taste in the mouth, vitiated *doṣās* and want of taste for food. It also cures skin diseases, fever, difficult breathing, pain, (especially in the abdomen), cough and dyspepsia. *Bṛhatī* is hot.

Other properties mentioned by different authors :– cures vomitting, *hṛdroga* (heart (?), diseases and *āmadosa* (internal toxins formed as a result of poor digestion). Its fruit destroys pathogenic organisms and cures skin diseases. The fruits are also useful in treating ulcers.

Root, fruits and leaves are the officinal parts. The whole plant is also taken.

Solanum insanum Willd. *

(Syn. *Solanum melongena* Linn. Var. *insanum*, Prain.)

(Solanaceae)

Malayāḷam ... Karuttacunda, (dark variety)
Velutta cunda white variety

Tamil ... Cundai, Karuppu cundai, Velutha cundai.

Distribution and habitat.

The plant considered a wild form of S. *melongena* (?) is distributed almost throughout the tropical regions of India in the plains districts as well as to about one thousand feet elevation in the hills in places with low or scanty to moderate rainfall. It is commonly but never abundantly found growing as a weed in dry waste lands roadsides and similar places that are not too moist or clayey. It is in flower and fruit in all seasons of the year.

Habit and general features.

Solanum insanum Willd. is a very prickly semiwoody grey pubescent undershrub with a short stem and several semi-erect or more often somewhat trailing mostly forked branches that may radiate out to two feet or more in length. The branches however seldom produce roots at the nodes even when they contact the ground. The entire plant is armed with short, straight or slightly curved, compressed sharp, prickles about 0.2 inches long. Two varieties, differentiated as black and white, are met with. In the "black" variety the stems and branches, the petioles, as well as the prickles, have a purplish green hue and the fruits when young are light green and variegated with dark green patches or stripes, whereas in the "white" variety the shoots are of the normal green colour and the fruits are devoid of any dark green blotches. There is general resemblance in all other features. The ripe fruits are of the same size and similar in both types being yellow globose and under 1 in, in diameter.

* In many parts of Kerala *Solanum insanum* Willd. is most frequently used as the source of *brahati*. According to the difference in the general colour of the shoots especially that of the fruits, two varieties are recognised namely, (i)a dark or "black" variety "*karutta cunda*" and (ii) "white" variety known as "*velutta cunda*" Though both varieties are used, the latter is generally preferred whenever available.

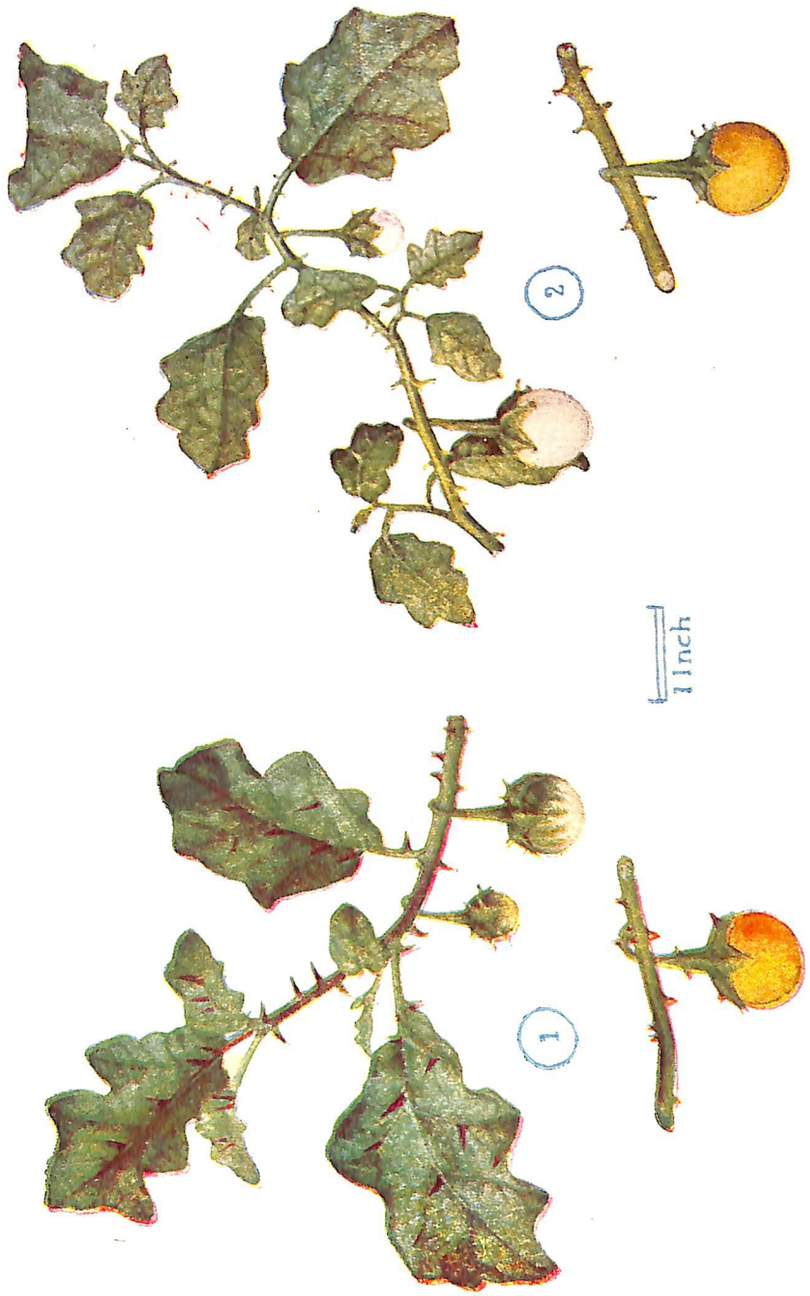


Plate XVII

Solanum insanum, Willd.

1. Black variety
Twig with fruits; A ripe fruit

2. White variety
Twig with fruits; A ripe fruit

External morphology.

The *root system* consists of the normal deep growing tap root and a number of surface feeding secondary roots and their branches.

The *stem and branches* are cylindrical, semiwoody, sparsely stellately hairy and armed with sharp straight or curved, green or purplish-green prickles less than 0.2 inch in length.

Leaves: simple, alternate, exstipulate, petiolate- ovate to elliptic ovate, oblique at base, acute, irregularly lobed, herbaceous stellately hairy spiny along the ribs on both sides, and up to four inches long and two to three inches broad. *Petiole* - half to one or one and a quarter inch long and sparsely beset with small straight prickles.

Flowers: ebracteate, nearly always solitary on supra axillary, pedicels about 0.5 inch long or occasionally in few (two to five) flowered unipaired cymes. They are light purplish, regular, about three quarters of an inch wide, bisexual or polygamous and hypogynous. *Calyx* - gamosepalous, persistent and slightly enlarging in fruit; five lobed or cleft: lobes triangular, acute, slightly reflexed in fruit and armed with a few prickles. *Corolla* - light purplish, regular, rotate, about an inch in diameter, deeply five-cleft, the lobes equal, broadly triangular and spreading. *Stamens* - five, free, epipetalous; *filaments* - short and flat; anthers dorsifixed, two celled dehiscing by apical pores. *Gynoecium* - bicarpellary syncarpous; *ovary* - superior, globose, bilocular, with numerous ovules on swollen axile placentae: *style* - short, slender, stellately hairy below ending in a greenish capitate or slightly bilobed stigma.

Fruit: a smooth globose berry about three quarters of an inch in diameter, uniformly light green or greenish and mottled with darker green blotches or stripes when young and yellow when ripe. They are somewhat bitter and acrid. Seeds numerous, discoid $\frac{1}{10}$th of an inch in diameter, smooth or minutely pitted.

Officinal parts: roots, fruits and leaves, or occasionally the plant.

Description of root.

The roots of both the 'white' and black varieties are similar in external as well as anatomical features. The root system consists of a

stout tap root with a few branches. The roots are long and woody and brownish but are comparatively smaller than those of *Solanum indicum* or *Solanum torvum*. The surface is not quite smooth. There are many lenticels at the bases of the stouter roots. These lenticels are small almost rounded and appear as small dots or warts on the bark. The bark in proportion to the thickness of the wood is fairly thick. It can be easily peeled off. When dry the roots shrivel and the bark slightly adheres to the wood, but even then it can be peeled off in small pieces without great difficulty. The inner surface of the bark has a silvery white lustre characteristic of many members of the genus. In dried roots the thin brown outer layer of the bark can be easily scraped off.

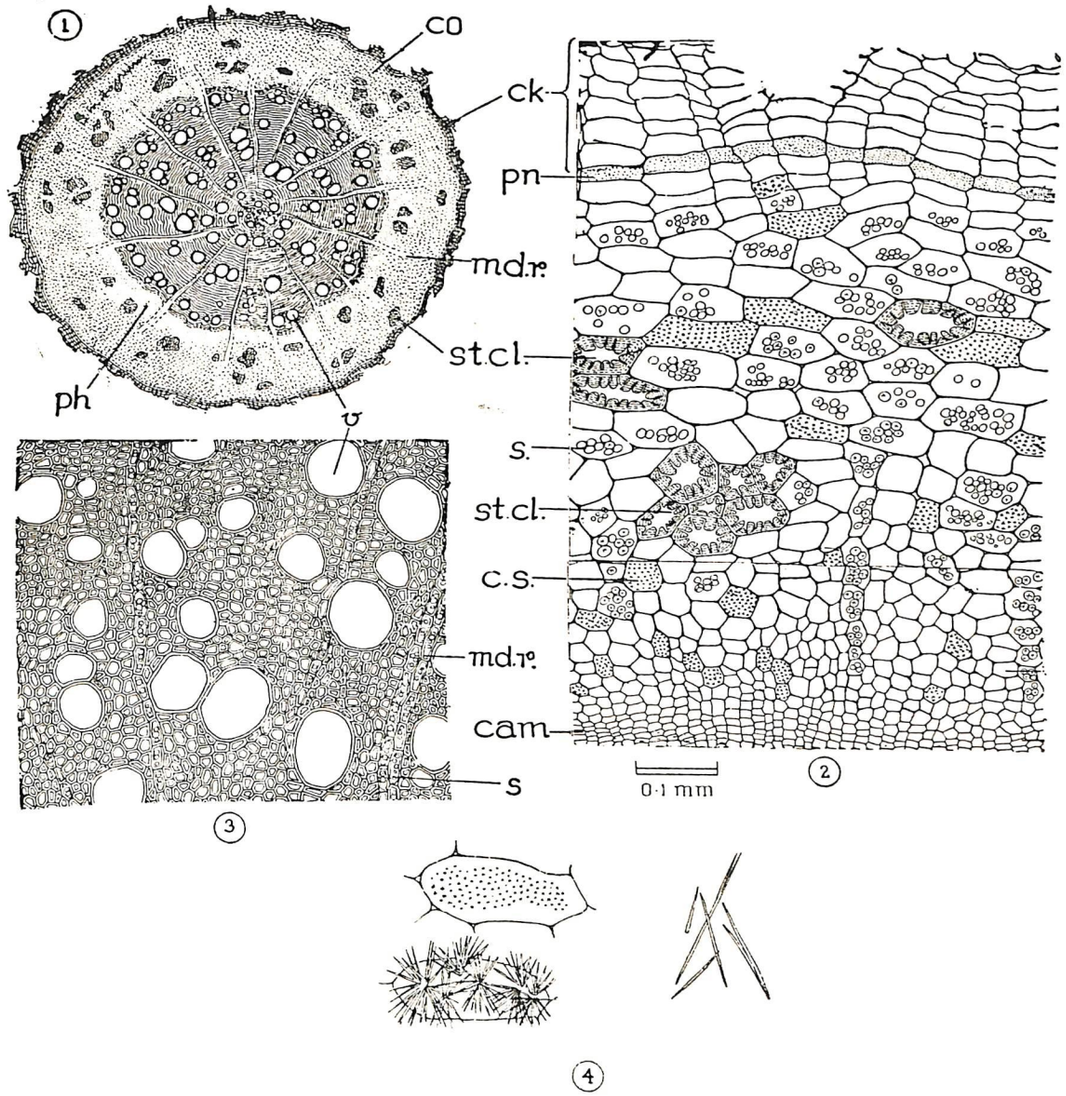
A clean cut transverse section of a fresh root shows a thin brownish outer membraneous layer, a pale yellow middle region and a pale or cream yellow inner woody part. In sections of dried roots the outer brown part closely adheres to the rest of the bark and is seen only as a thin lining. The middle bark appears greyish white and the wood in the centre yellowish white. Pores are not clearly visible as in the wood of *Solanum torvum*.

Histology of root.

The histological details are similar in the roots of both the white and dark varieties. The outermost tissue is the cork or *phellem* which is composed of a very limited number of rows-very often less than ten–of narrow rectangular cells with thin yellowish brown walls. Some of the cells contain an yellowish powdery substance. The *phellogen* which can be differentiated is composed of one row of thin walled rectangular cells.

The *cortex* (middle bark) comprises almost half the thickness of the entire bark. The cells are fairly large and tangentially elongated with rounded corners. Most of the cells are loaded with starch grains. Some of the cells contain the characteristic black powdery substance (crystal sand). Well defined groups of thickwalled stone cells are scattered within the cortex, each group containing from six to eight cells. Isolated stone cells also occur. The stone cells are not uniform in size. The cortical cells gradually decrease in size towards the inside. The demarcation from the phloem is not clear.

Plate XVIII



Histology of the root of *Solanum insanum*, Willd.

Fig. 1. Diagrammatic sketch of the T. S. of the root.
2. A portion of the root showing cork, cortex and phloem.
3. A portion of the wood.
4. A cell with the crystal sand before and after the reaction with sulphuric acid and the acicular crystals.

The phloem tissue or *bast* is comparatively very narrow. The phloem parenchyma cells are very small, thinwalled and cubical to polygonal in outline. Some of them contain the black powdery substance. Sieve tubes and companion cells are not quite distinct. Mechanical elements are generally absent in this region. The *cambium* consists of two or three rows of very narrow thinwalled rectangular cells. The wood consists of many vessels, arranged in a scattered manner, small thick walled parenchyma cells, wood fibres and medullary rays. The vessels occur singly or in groups of two or three. There is no pith in the centre.

The medullary rays are mostly uni-and biseriate. They are mostly straight but do not widen or expand in the cortex. The ray cells are thinwalled and radially elongated and are packed with starch grains, but those in the wood are thickwalled, more elongated and with larger starch grains.

Solanum melongena Linn *

Syn. S. longum Roxb.

(Solanaceae)

Malayāḷam	...	Vaẓutana
Tamil	...	Vaẓutanai
Hindi	...	Baingan, Baigun
English	...	Long Brinjal,

Distribution and habitat.

Numerous varieties of this "universally useful and excellent" plant, producing edible pulpy fruits of various sizes and form, are found widely cultivated throughout tropical India and the warmer parts of the world. It is rarely found in a truly wild condition, though varieties considered wild bearing smaller friuts are often found growing as road-side weeds and as forest undergrowth. The latter are often referred to in Malayāḷam as *ceruvazutana* (smaller brinjal.)

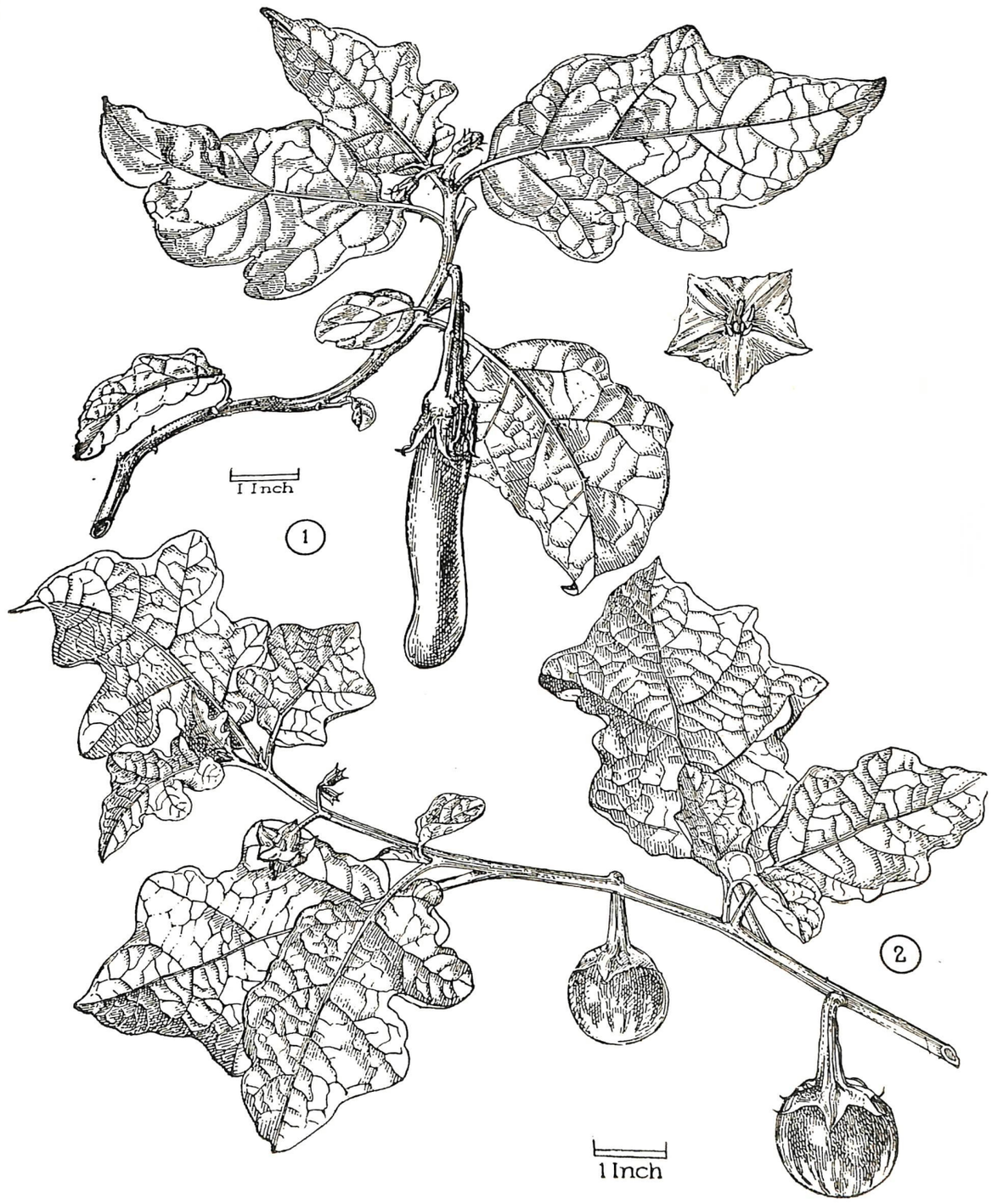
Habit and general features

Solanum melongena Linn. is an erect or suffrutescent perennial (an annual under cultivation,) sparsely prickly shrub from two to four feet or more high, with or more often without a prominent main stem, and having greyish or greenish grey woody, forked branches bearing fairly large simple, entire lobed leaves. Those under cultivation are mostly unarmed or may have only a few prickles, but the varieties considered as the wild types are definitely prickly. The plant produces flowers and fruits all through the year.

External morphology. Leaves simple, short-petioled, alternate or in sub-opposite unequal pairs at each node, large, from four to six inches long and three to four inches broad, obliquely ovate, entire or more often angularly sinuated to shallowly or even deeply pinnately lobed, acute or subcordate and unequal sided at base, surface downy covered with soft stellate pubescence, and somewhat sparsely

* The roots of the wild as well as cultivated varieties of *S. melongena* are used as *Bṛhatī*,

Plate XIX



Solanum melongena, Linn.

1. Cultivated type 2. Wild type

prickly along the veins. The degree of hairyness and number of prickles varies in different varieties. *Petiole* about one inch in length.

Inflorescence:– a few – flowered, lateral or supra-axillary, corymbose, unilateral cyme or paired cymose corymbs in which generally only the basal one or two flowers are perfect or fertile and fruiting.

Flowers – medium - sized, regular, blue, lilac, or whitish ebracteate on pedicels about one inch long which become reflexed in fruit. *Calyx* – gamosepalous, campanulate, five-lobed; lobes in flower a quarter to half inch long, elliptic, lanceolate or linear-oblong, prickly, especially in the wild varieties. The calyx slightly enlarges and becomes slightly fleshy in fruit. *Corolla* – gamopetalous, rotate one to one and a quarter inch in diameter, often with a yellow star shaped central region, shortly five to nine-cleft or lobed : lobes plicate in bud and sparsely pubescent to somewhat hairy on the outside of the plaits. *Stamens* – five, free: *filaments* short epipetalous, the *anthers* dehisce by apical pores. *Ovary* – superior, globular; *style* – stellately pubescent or villous, rarely glabrous, *stigma* capitate.

Fruit a smooth, shiny, pulpy, fulsome, thin but somewhat tough-skinned, berry one to nine inches or more long and of varying thickness. It shows considerable variation in size and colour under cultivation. It is often large, and globular, ovate-oblong, ellipsoid, or elongate and nearly cylindrical, in shape; white or white with greenish or purplish stripes or blotches to yellow or dark purplish when young and yellow when ripe. *Seeds* – numerous, small, thinly discoid and minutely pitted.

Officinal part: The root.

Description: The root system is woody, branched and consists of a short main root and a number of long fairly stout or prominent spreading flexuose lateral roots. They range in diameter from a quarter to one inch, (or more) and have a characteristic light greyish white colour occasionally blended with a light rose tint. In fresh roots, the surface is normally regular and smooth without prominent lenticels, fissures or cracks but sometimes with small shallow irregular depressions of various forms due to soil factors. Dry roots appear longitudinally shrivelled, transversely striated and very

minutely and closely pitted. In the older and stouter roots as well as in the basal parts of roots, a few prominent transversely extended lenticels of varying length may be found. The surface appears smooth except for these lenticels. The entire bark is comparatively thin, from 1/10th to 1/8th the thickness of the root, (rarely more than 1/6th of an inch in the stout roots) and leathery. It is easily peelable when fresh but firmly adherent to the wood in the dried roots. It has a thin corky soft and friable, easily scraped, light greyish, skin or outer bark. Just within this and clearly exposed on scraping, is a thin tissue that in dried roots appears silvery white, or lustrous due to the numerous minute shiny spots or streaks. The presence in dried roots of this lustrous silvery white tissue seems to be a feature common to most species of *Solanum*. The tissues of the bark further inside normally do not show this feature though occasionally the entire bark of the dry root may appear lustrous. In obliquely transverse section of the bark, numerous minute patches or groups of greenish-grey to brownish-yellow granular bodies are frequently seen, especially towards the interior. Ordinarily there is very little fibrous tissue in the bark.

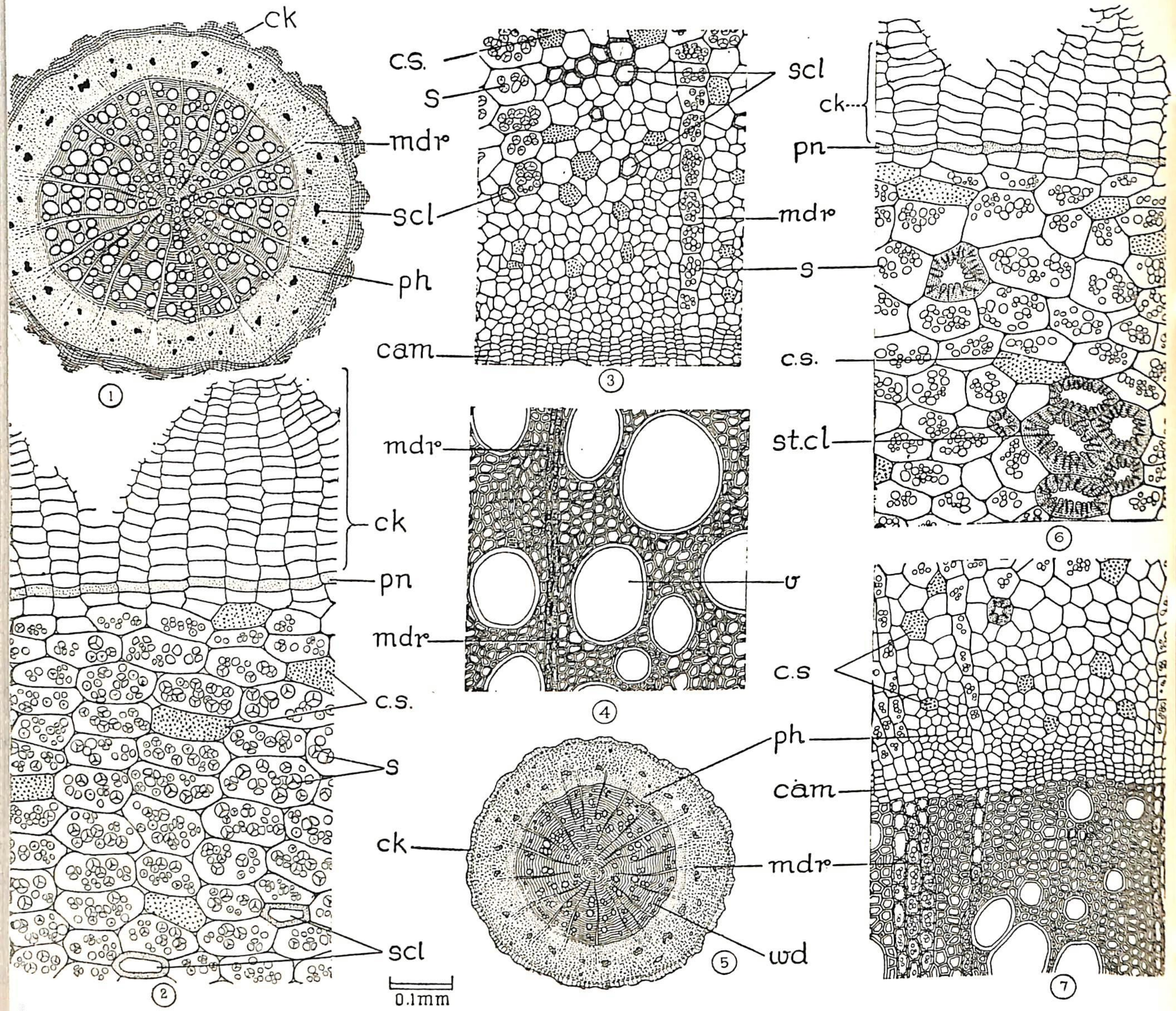
In clean cut transverse sections of the fresh root the above regions can be made out fairly well. Beginning from the periphery there is (i) a thin strip of light greyish brown outer bark, (ii) the middle bark - a region with numerous very narrow crescentic or irregularly wavy, specks or streaks with a silvery white lustre arranged in close intermittent tangential series and appearing striatified, the comparative thickness of this lustrous white tissue varies in different roots, as also that of the inner part or region. (iii) the inner bark with brownish or greyish brown granular bodies and (iv) the dull light brown or light yellow coloured diffusely porous wood without pith and with many medullary rays.

The root has a short fracture. In fresh condition the living bark has a feebly bitter and a faint pungent or acrid taste (a variable factor) but no special odour.

Histology of the root.

Root: In a transverse section of the root the outer thin cork zone is seen to consist of 15 to 20 rows of thinwalled almost rectangular tangentially elongated cells devoid of any contents. There are a number of furrows or indentations which reach almost up to the

Plate XX



Histology of the roots of *Solanum melongena* Linn.

Cultivated Type Figs. 1 to 4 **Wild Type Figs. 5 to 7**

1. Diagrammatic sketch of the T. S. of the root.
2. Cork and cortex.
3. Phloem tissue and cambium.
4. Portion of the wood.
5. Diagrammatic sketch of the T. S. of the root.
6. Cork and cortex showing stone cells.
7. Phloem tissue along with a part of wood.

base of the cork tissue. This gives the cork a wavy or irregular outline. Below the phellem is the *phellogen* composed of a row of narrow rectangular cells and a zone of phelloderm cells which gradually merge into the cortex.

The cortical cells are fairly large and tangentially elongated with rounded corners. The intercellular spaces in between the cortical cells are readily visibile. Most of the cells are fully loaded with large sized starch grains. Some of the cortical cells have a deep bluish black contents which on close examination appears as minute powdery inclusions of light black colour (crystal sand). Isolated cells of sclerenchyma are found scattered in the cortex. They are of varying thickness and size. Some are thinwalled while, others are moderately thick walled. They occur also in groups of three or more just above the phloem. The cortical zone merges imperceptably into the bast or phloem.

The parenchyma cells of the phloem are smaller than those of the cortex, more closely arranged and thinwalled. Some of them contain the characteristic black powdery inclusion. Small sized sclerenchyma cells isolated or in groups of two to three are seen here too towards the periphery. The newly formed phloem elements forming the innermost region are very small, polygonal and thinwalled. Here also some of the parenchyma cells contain the black powdery inclusion.

Medullary rays. Mostly straight or rarely wavy and one to three seriate. All of them extend to the cortical region. Only a few of them start from the centre of the wood. The medullary ray cells in the wood region are narrow, thickwalled and radially elongated. The ray cells in the phloem region are thinwalled and rectangular. They gradually widen and become more or less tangentially elongated in the cortical region. The ray cells in the wood as well as in the phloem are loaded with a large number of starch grains. *The cambium* consists of three or four rows of cells which in T. S. appear narrow thinwalled and rectangular *Wood* – very highly porous and woody.

The vessels are many and of varying sizes, ranging from very small to fairly large. They occur in groups of two to three or more in radial as well as tangential rows and also singly scattered here and there. The xylem parenchyma cells are few in number compared to the development of wood fibres and like the latter are thickwalled.

SOLANUM MELONGENA

*** (Wild varieties** (3) with smaller fruits)

Malayalam	....	Ceru vazutana
Tamil	...	Ceru vazutanai

Distribution and habitat: A few plants which may be considered as wild varieties of *S. melongena* are often met with in several parts of south India growing as weeds in dry forest areas or uncultivated ground or waste lands. These are also occasionally found under cultivation.

Habit and general features.

The plant is generally a suffrutescent perennial prickly shrub two feet or more high, but never growing as tall as some of the cultivated varieties. It has a short main stem and many greenish grey woody forked branches armed with many slightly recurved, pointed, prickles. The leaves resemble those of *S. melongena* but are smaller and more prickly and the friuts are oval or spherical not more than two inches in diameter.

External morphology

Leaves: simple, alternate, petioled, large 4 to 6 inches long and three to four inches broad oblique at base, somewhat acute and often pinnately lobed. *Petiole* 1 to 1½ inch long. Surface of the leaves when young is covered with soft grey pubescence. There are a few prickles about a quarter inch in length on the petiole and along the veins on both surfaces but they are more on the upper, than on the lower surface.

Inflorescence: few-flowered, lateral or supra-axillary paired, cymose corymbs.

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* The roots of a few more kinds of *Solanum* that bear smaller, spherical or ovoid fruits about the size of or slightly larger than a hen's egg which may be wild types of *Solanum melongena* or different species known in Malayalam as *Ceru vazhutana* or (smaller brinjal) are now frequently being used as the source of one of the *Brhati* pair, the other one of the pair then being usually *Solanum melongena* which is called *Ven vazhutana*. The plant described is one such type.

Flowers: medium sized, regular, ebracteate, pinkish on short pedicels. These are, less than half an inch long in the flower but lengthen and get reflexed in fruit. *Calyx*-gamosepalous. slightly accrescent, companulate, five-lobed, each lobe elliptic lanceolate less than a quarter of an inch long, sparsely prickly outside. *Corolla*-pinkish, about one inch in diameter, rotate, shortly five-cleft or lobed with a light yellow star at the centre. *Stamens*-five, free, erect; filaments attached to the corolla; *anthers*-yellow, bilobed dehiscing by apical pores. *Ovary* - superior, globular, bicarpellary containing numerous ovules with the terminal style stellately pubescent and slightly bent near the stigma.

Fruit: a smooth, nearly spherical or rounded to ovoid or oblong leathery skinned berry light green and variegated with darker green blotches or olive green when young, but yellow when ripe. The size and length of the fruit slightly varies. The unripe fruit is acrid and somewhat bitter. *Seeds* – numerous, very small, discoid and thin.

Officinal part : Root

Description. The root system closely resembles the root system of *S. melongena* – cultivated variety.

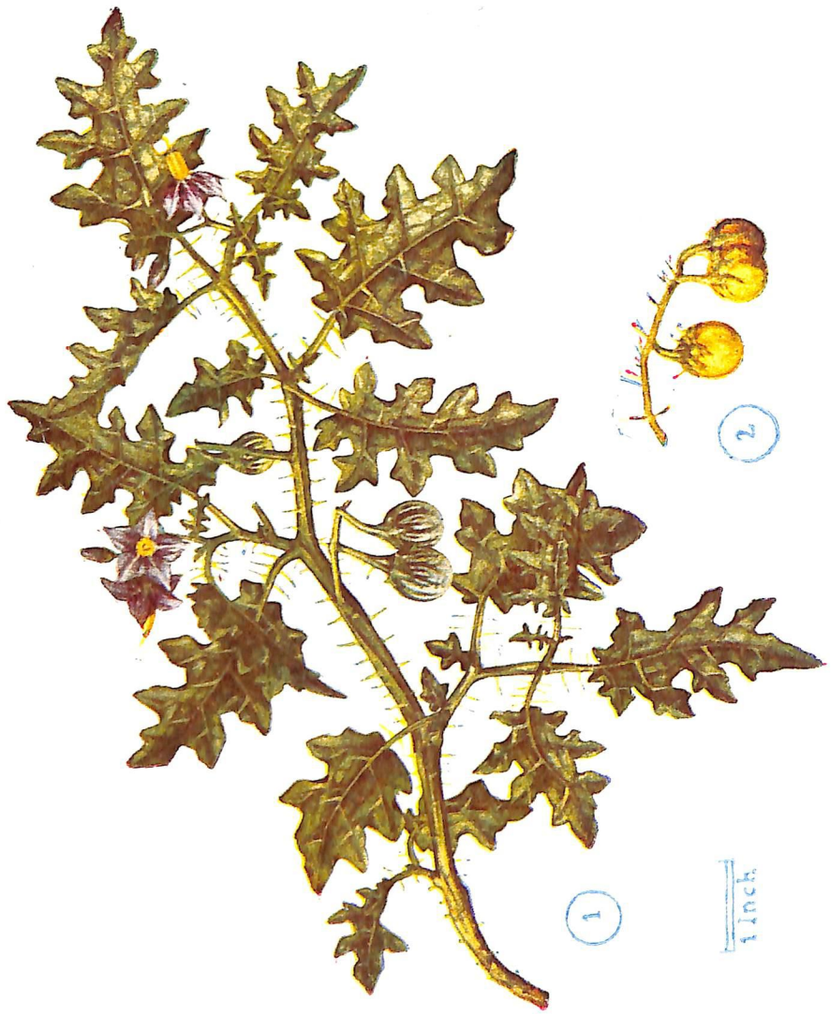
Histology of root A transverse section of the root shows a cork or *phellem* comparatively thinner than that in the cultivated variety, composed of six to ten or more rows of thinwalled rectangular cells. Inner to the cork is a *phellogen* consisting of a single row of narrow thinwalled, tangentially elongated cells. The *cortex* which forms the major portion of the bark consists of fairly large, spherical or oblong to slightly tangentially elongated thinwalled cells with very clear intercellular spaces. Most of them are loaded with simple, rounded starch grains that are slightly smaller than those of the cultivated variety. Some of the cells are filled with the characteristic black powdery contents (crystal sand). Large sized stone cells occuring singly as well as in groups are found scattered in the cortex.

The inner bark or *bast* is very thin when compared with the cortex and is mostly composed of regular thinwalled phloem elements. Scattered in the peripheral part of the bast are a few small solitary stone cells. Some of the phloem parenchyma cells contain the black powdery or amorphous substance crystal sand. A cambium consist-

ing of one or two rows of narrow, rectangular thinwalled cells is present outside the wood or xylem.

The wood in the centre forms the bulk part of the root. It is fairly hard and consists of numerous vessels of various sizes wood fibres and parenchyma vessels are found in small groups of two and three. The greater part of the wood is formed of thick walled wood fibres.

Medullary rays - many, one to three seriate – most of them start from the centre of the wood and reach up to the cortex. The ray cells in the wood region are radially elongated and thickwalled while those in the phloem region are thinwalled. The ray cells gradually widen at the distal ends of the rays appearing tangentially elongated in the cortex. Almost all the ray cells both in the wood and bark region are fully loaded with starch grains.



Solanum xanthocarpum. Sch & Wendl.

1. Twig with flowers and fruits. 2. Ripe fruits.

Plate XXI

Solanum Xanthocarpum Sch. & Wendl. *

Syn. *S. Jacquine* Willd

(Solanaceae)

Malayāḷam	–	Kaṇṭam kattiri, Kaṇṭakāricuṇṭa
Tamil	–	Kandankattari
Hindi	–	Kateli, Khatai, Buiringani (Bombay)

Distribution and habitat.

The plant is found in all dry districts in the plains as well as low hills throughout India from Punjab and Assam to Cape Comorin. In south India it is found abundantly along the Coromandel coast and in the districts of Tinnevelly and Kanyakumari. Every type of soil and situation which is not too moist seems to suit it, and it is commonly found growing wild as a weed of roadsides and waste lands, on rubbish heaps and similar situations near villages. The plant is in flower and fruit mostly throughout the year.

Habit and general features. Solanum xanthocarpum Sch. & Wendl. is a conspicuous very prickly, low diffuse suffrutescent, perennial herb or undershrub, rarely exceeding one foot in height with practically little stem, but having numerous irregularly ramous or trailing woody divaricate slightly triangular, flexuose branches that spread close to the ground, often rooting at the nodes and covering a circular area two to four feet in diameter. The whole plant is thickly armed with strong broad based sharp compressed straight whitish or yellowish white prickles nearly half an inch long. The shoots when young are covered with stellate down but become barely glabrous when mature. They bear ovate or ovate-oblong sinuately lobed or pinnatifid sparsely pubescent to glabrescent prickly membraneous leaves which are dark green above and considerably lighter or paler below.

Indicated as one of the Brhati pair in books on Indian Materia medica

* According to Roxb. *Solanum Jacquine* Willd. which closely resembles *S. xanthocarpum* differs from the latter in being more prickly the prickles stronger and also having small fruits and longer flowers.

In Kerala a recently introduced plant *Salanum aculeatissimum* that some what resembles *S. xanthocarpum* but with an erect habit and slightly larger reddish fruits, is now very frequently used as a substitute though without any authority.

External morphology

Leaves: petiolate, alternate or in unequal pairs at each node, but never truly opposite, from two to four or five inches long and one and a half to three inches wide, membraneous, ovate-oblong or rarely elliptic, acute, shallowly to deeply sinuate or even pinnatifid, the clefts often many and extending half way down to the midrib; surface dark-green above paler below, sparsely stellately pubescent or glabrescent and beset on both sides with numerous straight sharp light yellowish prickles, that are nearly half inch long. *Petiole* about one inch in length.

Flowers- ebracteate, pedicelled, regular, perfect, bright blue or bluish purple or lilac or very rarely white, solitary or in short peduncled extra axillary few flowered cymes. Pedicels short. The pedicels and calyx are stellately pubescent when young but become glabrous later. *Calyx* – gamopetalous, prickly, about one third of an inch in the flower persistent, scarcely enlarging in fruit, five lobed, lobes ovate, ovate–oblong or linear lanceolate, usually abruptly acute. *Corolla* purple or bluish, gamopetalous, rotate, about three quarters of an inch long and an inch in diameter, pubescent outside, shallowly five-lobed. *Stamens five* filaments free about $\frac{1}{16}$ in long, epipetalous; anthers, $\frac{1}{3}$ inch long, oblong lanceolate open by apical pores. *Ovary* superior, ovoid, glabrous two chambered with numerous ovules on thick placentae.

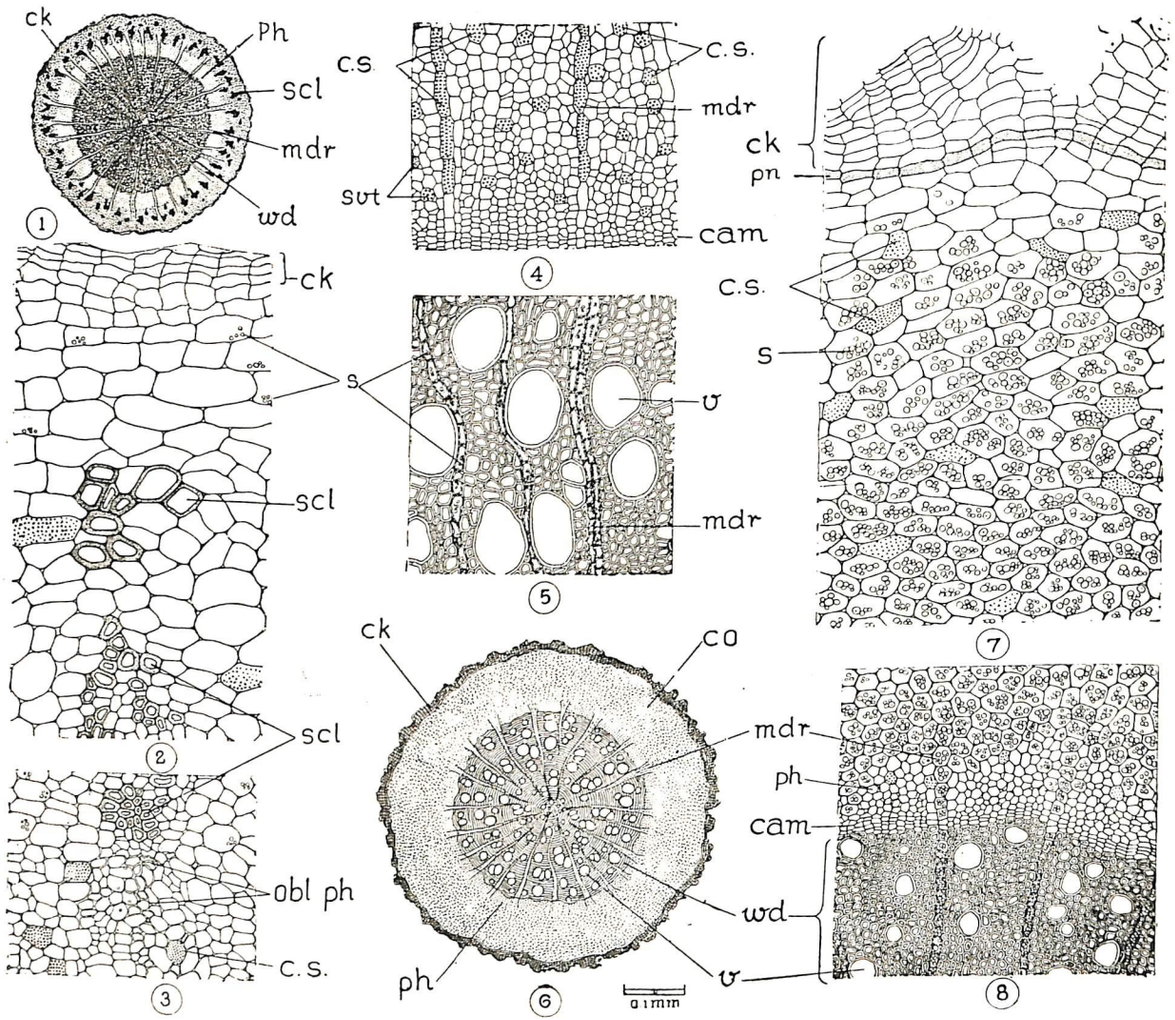
Fruit- a glabrous, very nearly globular drooping berry surrounded by the calyx from half to less than three quarters of an inch in diameter. The unripe fruits are variegated with green and white stripes and have an acrid and pungent taste. The mature fruits are of different shades of yellow or rarely white with light green streaks veins or blotches. *Seeds*-small reniform, less than one twelfth of an inch in diameter, smooth, of a light brown or yellowish brown colour.

Officinal parts: The entire plant is considered officinal, but the roots and fruits are the parts mostly used.

Description of roots.

The roots are long, fairly thick, hard and of a light brown colour. The surface is not quite smooth being beset with many minute rootlets and a few lenticels. The thickness of the outer bark of the root is about 1/3 the thickness of the central wood region. The surface skin is quite thin and on scraping it a silvery white tissue is

Plate XXII



Histology of roots of ***Solanum Xanthocarpum***, Sch. & Wendl.
Solanum aculeatissimum, Jacq.

(Figs. 1 to 5) Solanum xanthocarpum.

Fig. 1. Diagrammatic sketch of the T. S. of the root.
2. Cork and cortex.
3. Old phloem tissue.
4. Young bast with the cambium.
5. A portion of the wood.

(Figs. 6 to 8) Solanum aculeatissimum.

6. Diagrammatic sketch of the T. S. of the root.
7. Cork and cortex.
8. A portion of the Phloem and wood with the cambium.

exposed. The wood is cream yellow and minutely porous. The entire root, especially the bark is very bitter to taste.

Histology. A transverse section of the root is circular and its outline regular, with the wood in the centre surrounded by the bark. The outermost tissue is the cork which is not so well developed as in the other species of *Solanum*. It is very thin and consists of only two or three rows of narrow, nearly rectangular thin walled empty cells with light brown walls. The cortex which forms almost half the thickness of the bark, consists of thinwalled, comparatively large rounded to tangentially elongated cells with small intercellular spaces and scattered groups of sclerenchyma cells towards the interior. Each group of sclerenchyma consists of four to twenty or more thickwalled cells of which the peripheral cells are generally larger than the innermost ones. Some of the cortical cells contain the characteristic black powdery contents (crystal sand). In the bast which is about the same thickness as the cortex the older phloem elements which are situated just inner to the sclerenchyma groups are found in a slighly compressed condition. The recently formed phloem elements show regular arrangement. Their cells are thinwalled, small and polygonal. The sieve tubes and companion cells are very distinct. Some of the phloem parenchyma cells also contain the black powdery contents (crystal sand). A distinct ring of cambium formed of two rows of small narrow, rectangular thinwalled cells is present inner to the phloem.

The wood- forming the central part of the root and is composed of a large proportion of wood fibres, small amount of xylem parenchyma and numerous medium sized vessels in addition to the medullary rays. The vessels are fairly uniformly distributed throughout the wood. Both the wood parenchyma and medullary ray cells are thickwalled.

Medullary rays- These are many, long and mostly uni-or biseriate. Most of the rays start from the centre of the wood and reach up to the cortex. Within the wood the ray cells are radially elongated and have thick pitted walls and most of them contain small starch grains. In the bast region the ray cells are thinwalled, radially elongated and several of them contain the black powdery contents or crystal sand. The ray cells become broader towards their distal ends becoming tangentially elongated in the cortex.

Solanum aculeatissimum Jacq.*
(Solanaceae)

Malayāḷam	...	Kandakari cunda
Tamil	...	Kandakaricundai

Distribution and habitat.

The plant though an introduced one is now found growing as a weed of waste places in Kerala and several other states. It superficially resembles *Solanum xanthocarpum* one of the Bṛhatī pair and so is occasionally cultivated on the impression that it is the latter and goes under the name Kantakaricunda a local name of *Solanum xanthocarpum*.

Habit and general features.

Solanum aculeatissimum Jacq. is a very prickly weakly woody undershrub two or more feet high with a somewhat frail short erect stem and several weak, more or less trailing branches. These grow close to the ground, and produce roots at the nodes as well as the internodal regions that come in contact with the soil. It bears simple alternate fairly large lobed sparsely hairy dark green membraneous prickly leaves, small whitish flowers borne singly or in few flowered branches and smooth globose drooping berries about an inch in diameter, that when young are greenish but take on an orange to brick red colour when ripe. The plant is in flower and fruit throughout the year and when full of ripe fruits is very conspicuous and attractive even from a distance. The whole plant including flower and fruit is armed with sharp slender or thin straight yellowish-white prickles.

External morphology

Leaves: simple, petiolate *petioles*, one to two inches long and beset with many prickles longer than those on the stem and branches alternate or in unequal pairs but never truly opposite, broadly ovate shallowly five lobed, three to five or more inches long and about three inches broad, dark green and sparsely hairy above paler below, and beset with prickles along the midrib and lateral veins on both

*An introduced plant now most frequently being used in Kerala as Brhati in place of *Solanum xanthocarpum* under the mistaken impression that they are same or wherever the latter is not easily available.

Plate XXIII

Solanum aculeatissimum, Jacq.

sides. The prickles about one third of an inch long are slightly shorter than those on the petioles but longer than those in the branches.

Inflorescence: a few flowered supra axillary, short peduncled cymose cluster.

Flowers: ebracteate, regular, perfect, white on pedicels about half inch long. *Calyx* – gamosepalous, prickly outside, five lobed, persistent, about one fifth of an inch in the flower but slightly enlarging in fruit, deeply five cleft with each segment ovate or ovate-oblong and acute. *Corolla* – gamopetalous, white regular about one inch across, rotate, deeply five cleft, the lobes about half inch long and reflexed. *Stamens* – five, free epipetalous with short filaments; *anthers*, longer than the filaments – (about 1/5th of an inch long) two celled and open by apical pores *Ovary*. – superior, bi-carpellary, two-chambered with numerous ovules on thick axile placentae; *style* – single short, about 0·3 inch, long ending in a capitate stigma.

Fruits: smooth, globose, dropping berries, one inch or more in diameter. When young they are light green or variegated with light and dark green stripes but take on an attractive deep orange to brick red colour on ripening; *seeds* – many, very thin, slightly winged, smooth round about 0.2 inch in diameter.

Officinal parts: Root and fruits, or occasionally the entire plant.

Description of root.

The root system consists of a stout tap-root, several long secondary roots about 0.3 inches thick, which do not grow deep, and their lateral rootlets. They are not so hard or strong as in other species and have a light brown colour. The outer surface is smooth in young roots but prominently longitudinally wrinkled or shallowly furrowed in older roots. The roots being not very hard or woody are easily cut. The cut surface has a pale yellow colour. The entire bark in proportion to the wood is thicker than in other species being nearly as thick as the wood. It has a bitter taste.

Histology of root.

A transverse section of the root is ciruclar in outline and shows a thin layer of an yellowish brown cork surrounding the cortex which

forms the major part of the bark. The centre of the root is occupied by the wood which is wider than the cortical region.

The cork zone or *phellem* is fissured at several places. It is less than 0.05 an inch in thickness and composed of 8 to 10 or more rows of rectangular cells 54 μ to 72 μ x 27 μ to 37 μ and devoid of contents. The walls of the cork cells have an yellowish brown colour. The *phellogen.* is composed of a single row of narrow rectangular cells. The *cortex* forms the widest part of the bark. Its cells at the periphery are slightly tangentially elongated, while those towards the inside are nearly polygonal in outline. Almost all the cortical cells are fully packed with small rounded starch grains that have a diameter of 10 to 25 μ. Certain cells in the cortex are filled with the characteristic black powdery substance the crystal sand while others contain small starch grains. Mechanical elements are absent. A *cambium* consisting of one or two rows of thinwalled very narrowly rectangular cells is present.

Wood: occupies the centre of the root and is composed of fibres, vessels, medullary rays and parenchyma cells. Vessels as seen in T. S. appear in a scattered manner. They may be solitary or occur in groups of two to three or more. The wood parenchyma cells are thick walled. Some of them contain, starch grains.

Medullary rays. numerous, mostly straight or rarely wavy, and one to three or more seriate, the majority being uniseriate. Only some of them start from the centre of the wood. The ray cells in the wood are radially elongated and thick walled (22 x 14 μ) while those towards their distal ends are thinwalled. All the ray cells are packed with large rounded starch grains.

Distinguishing features: The large cortical cells rich in starch-grains and absence of stone cells or fibres in the bark and bast region are differentiating features.

Solanum indicum Linn.*

(Solanaceae)

Malayāḷam	....	Puttaricuṇṭa, cerucuṇṭa
Tamil	...	Putharichuṇṭai, cerucuntai Karimulli
Hindi	...	Kadaeri badi

Distribution and habitat.

The plant is found all over tropical India from sea level to about 2000 feet elevation growing in waste lands, along roadsides and similar other places where there is good sunshine. It does not tolerate shade or too much of moisture.

Habit and general features

Solanum indicum Linn. is a very prickly, ramous perennial undershrub two to five feet high with a short stout purplish stem and several woody branches. Prickles fairly large, long, compressed at base slightly recurved and quite sharp or acute. The entire shoot or at least the young parts are usually downy being covered with minute stellate hairs. It bears simple, alternate, lobed leaves, supra axillary clusters of pale blue flowers and small orange coloured berries about a third of an inch in diameter. Considerable variation is however found in the degree of pubescence as well as in the size and shape of the leaves. The plant is in flower and fruit nearly throughout the year.

External morphology :

Leaves : alternate, solitary, or sub-opposite in unequal pairs, pelioled, greyish green, varying from two to six inches in length and one to three inches, in width, shape various : normally ovate, or oblong, and sinuately lobed (lobes usually few and shallow, but sometimes deep, or even pinnatifid), base oblique or unequal sided surface stellately woolly or downy beneath, but less so above and armed with many stout compreseed recurved prickles along the veins. *Petiole*; half to one inch long, prickly.

****Solanum indicum* Linn. is indicated as source of Brhati in books on Indian Materia Medica. It is quite probably one of the *Bṛhatī* pair the ancients used.**

The *inflorescence* :– is a many flowered supra axillary short peduncled, polychasium with its lateral branches monochasial the flowers therein arranged zigzag in two vertical planes in a scorpioid corymbose manner. *Pedicels* one to one and a half inches long, stellately woolly, usually unarmed or with small straight prickles.

Flowers: medium sized, ebracteate, regular, pale purple or pale-blue. *Calyx* – about one sixth of an inch long armed with prickles slightly enlarging and often strengthened in fruit, deeply five-cleft, with the segments woolly, triangular, acute and reflexed. *Corolla* – about one inch or less in diameter, and $\frac{1}{3}$ in. long, regular, rotate, deeply fivecleft with the lobes broadly triangular and tomentose outside. *Stamens* – five, free, *filaments* very short, *anthers* oblong lanceolate and shed the pollen by small apical pores. *Ovary* - glabrous or hairy at top; *style* – stellately pubescent, curved at the top.

Fruits: smooth, globose berries about 0.3 inch in diameter, in clusters of ten to twenty or more on erect stalks. They are at first light green or variegated with light and dark green stripes but become deep–orange–yellow to orange–red on ripening. *Seeds* – many, one eighth to one sixth of an inch in diameter, very nearly smooth or minutely pitted.

Officinal part: The roots, fruits and leaves or occasionally the entire plant.

Description of Root. The root system is well developed and consists of the tap root and many secondary roots and their branches which grow deep into the soil. The secondary roots are long, fairly large woody and strong, like the tap root. Fresh roots have a light yellow or yellowish brown colour, and are fairly smooth, except for the presence of many rootlets. The surface appears longitudinally striated. There is a thin soft outer skin which can be easily scraped off, exposing a silvery white tissue. The cut surface has an yellowish white colour. The bark compared to the woody part is thin. The entire bark when fresh is easily separable from the wood. Dried roots are somewhat brittle and easily broken across.

The roots do not have any sensible special or characteristic taste or odour.

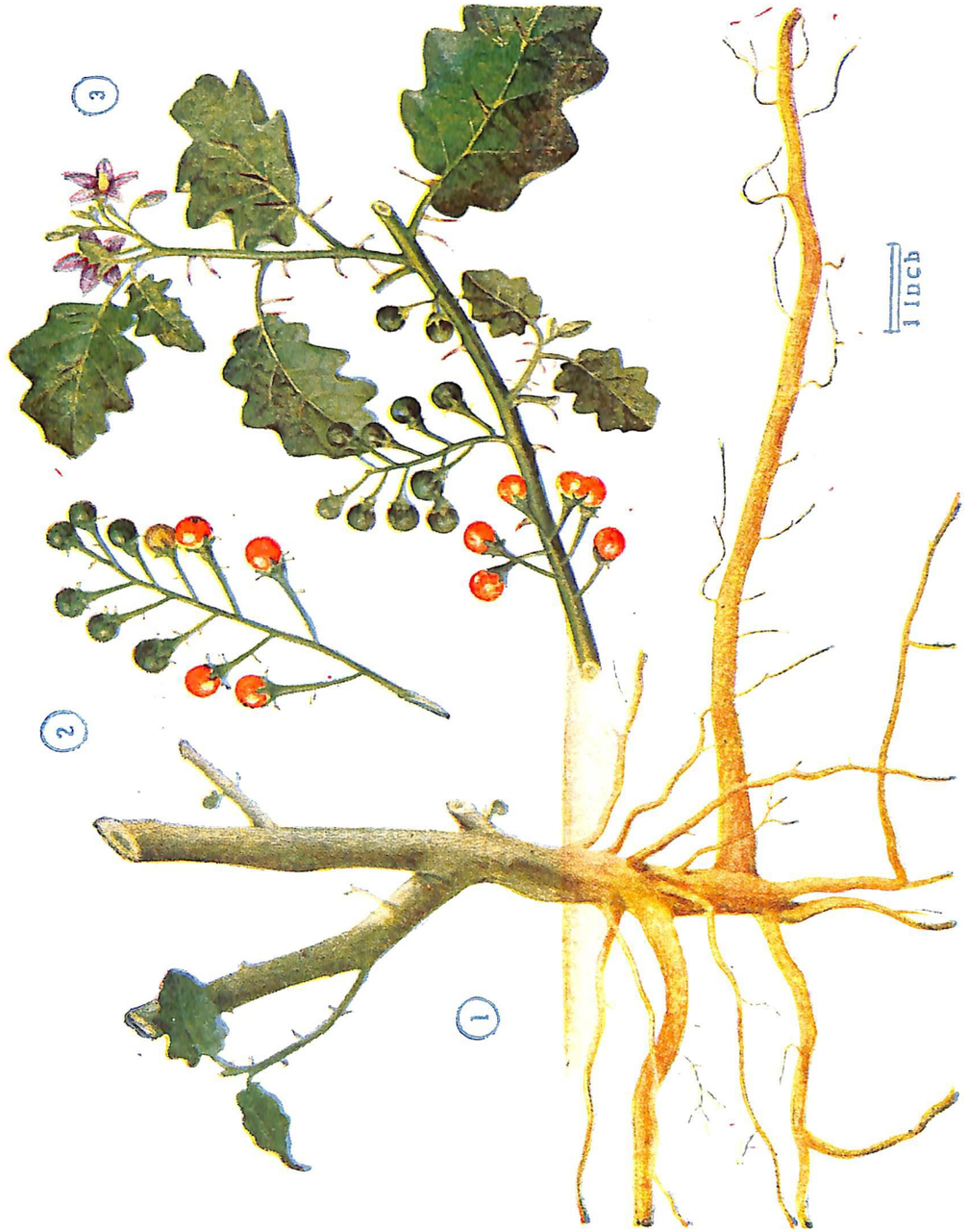
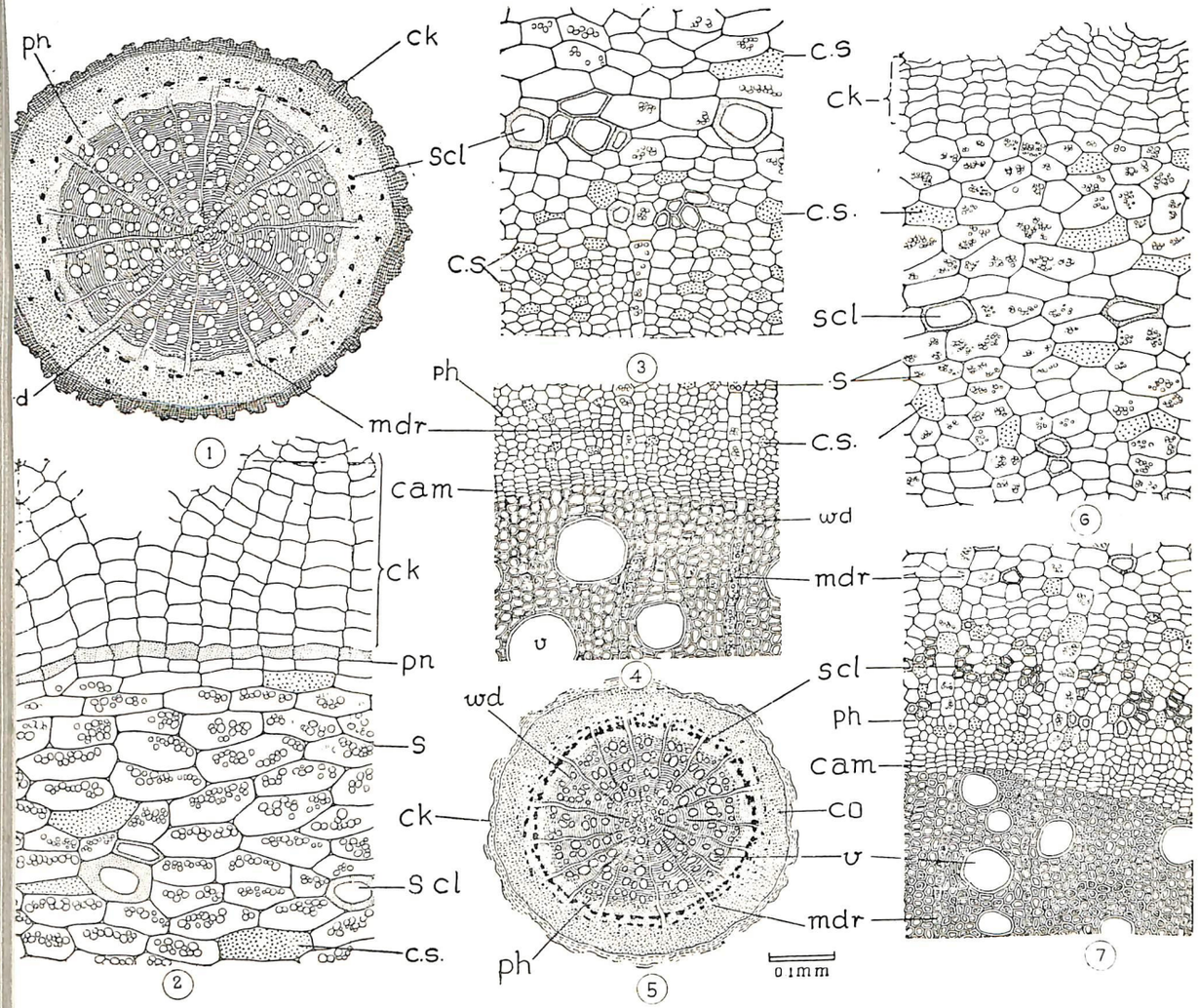


Plate XXIV

Solanum indicum, Linn

3. Twig with fruits and flowers
2. Fruits
1. Root system

Plate XXV



Histology of the roots of

Solanum torvum S. W. Figs. 1 to 4.

Diagrammatic sketch of the T. S. of the root.
Cork and cortex
A portion showing the fibre groups in the cortex just above the phloem tissue
Phloem tissue with a part of wood.

Solanum indicum Linn Figs. 5 to 7

5. Diagrammatic sketch of the T. S. of the root.
6. Cork and cortex.
7. Phloem and wood regions along with the cambium,

Histology of root.

A transverse section of the root of *Solanum indicum Linn.* is more or less circular in outline. The bark is about 1/6th of the thickness of the root. It shows an outermost, thin, yellowish brown cork consisting of a limited number-three to six rows-of thinwalled tangentially elongated rectangular cork cells. The outer border of the cork layer is not even on account of the presence of a number of shallow longitudinal grooves.

Inner to the cork is the cortex which is a wide zone. The cortical cells are large, thinwalled and tangentially elongate. Most of them are fully packed with starch grains. Several of the cortical cells contain a black powdery amorphous substance (crystal sand). Scattered through the peripheral part of the cortex are isolated sclerenchyma cells. Small groups of sclerenchyma occur towards the interior.

The phloem tissue found next within the cortex is narrow and composed of small cubical to polygonal thinwalled cells. Groups of sclerenchyma cells of smaller size are seen in this region, each group consisting of three to thirteen cells. Some of the phloem parenchyma cells here also contain the black powdery contents (crystal sand). Inner to the phloem is the cambium consisting of one or two rows of narrow thinwalled rectangular cells.

Medullary rays: many, and all of them extend to the cortex. They are mostly uniseriate though two or three seriate rays also occasionally occur. The ray cells in the phloem region are thinwalled radially elongate and larger than the neighbouring cells. They gradually widen and become tangentially elongated at their distal ends, when they reach the cortex. Almost all the ray cells are fully packed with starch grains. A few of them contain the black powdery contents instead of the starch grains. The ray cells in the wood region are thick walled rectangular, or radially elongate and contain starch grains.

Wood-occupies the bulk part of the root and is composed of vessels, parenchyma, fibres and medullary rays. The vessels which are of varying sizes occur in small groups of two or three and also as isolated units. The wood contains a large proportion of thick-walled fibres. The xylem parenchyma cells which are also thick walled are richly stored with starch grains.

Solanum Torvum Swartz.*

(*Solanaceae*)

Malāyaḷam – Paracunda, Ānacunda

Distribution and habitat.

The plant is found mostly throughout tropical India, in the plains as well as in the hills up to about 3000 feet elevation. It is quite common in most parts of Kerala thriving under mesophytic conditions along the roadsides, waste lands and near human habitations.

Habit and general features.

Solanum torvum Sw. is a fairly tall, sparsely prickly shrub four to ten feet high. It produces several semi-woody or herbaceous branches from near the ground level and resembles *Solanum melongena* in habit and leaf form and in the nature of its fruits *Solanum indicum*. It can however be easily differentiated from either of these. Its leaves have only a few (one or two) prickles on the midrib beneath. Its cymes are denser and the flowers always white.

External morphology.

The stem and branches as well as the petioles are only very sparingly beset with prickles. The prickles are strong and flattened.

Leaves:– alternate or subopposite in unequal pairs, ovate, or sub-rectangular, often unequally cordate at base, sinuate-lobate,- the lobes few large triangular and shallow-three to seven inches or more long and two to five inches broad, stellately fulvous-tomentose beneath and softly hairy above and normally devoid of prickles except for one or two along the midrib below.

Petiole- about an inch or more long, slightly prickly. *Inflorescence*- supraaxillary or lateral, many-flowered.

The *Flowers*: which are pedicellate, regular, bisexual, whitish and medium sized (about one inch in diameter) are somewhat densely arranged in two vertical rows in a zigzag or scorpioid manner on the

*The roots of *Solanum torvum* are occasionally used as adulterant to those of *S. melongena*.

Plate XXVI

Solanum torvum, Sw.

lateral branches of a short dichotomously branching peduncle. The entire inflorescence is generally unarmed and has a slightly viscous glandular pubescence.

Calyx- persistent, five-lobed, the lobes, in flower lanceolate, about one sixth inch long and sparingly hairy. *Corolla-* regular, rotate, or flat 0.75 to 1.25 inches in diameter (sparingly) stellately pubescent outside with five triangular lobes. *Stamens-* five: *filaments* free, epipetalous, anthers open by apical pores. *Ovary*-bi-carpellary with numerous ovules. The *fruits*, borne on thickened clavate stalks are smooth, shiny, thick-skinned many-seeded, roundish to ovate berries, one third to half an inch in diameter. They are light green or greenish yellow when young and nearly black when ripe. The calyx lobes in the fruit are slightly less than half the length of the berry and appear patent or spreading. *Seeds*-many, smooth, scarcely a tenth of an inch in diameter.

Officinal part: Root.

Description- The root system of *Salanum torvum* is woody and branched. It consists of a stout main root and a number of fairly long lateral roots that arise from the basal part of the latter. These range from a quarter to less than one inch in diameter and have a light greyish yellow colour. The surface is fairly smooth except for the presence of lateral rootlets and scattered eruptions of lenticels and very shallow longitudinal fissures in the older basal portions. The entire bark is thick when compared to those of the other species. It is leathery and easily peeled off in fresh as well as in the dry conditions. The outer skin is quite soft, thin and easily scrapable. The removal of the skin exposes a thin starchy white tissue-the middle bark. The innermost region of the bark which is thick has a firm tough or leathery texture and a light brown tint. The centre of the root is occupied by a wide core of wood, light or pale yellow in colour, and diffusely porous in cross section. The dry roots are light brown in colour and in transversely cut sections the entire bark has a brownish tint with a dark brown outline. The wood has a pale yellow colour.

Histology of the root

A transverse section of the root is nearly circular in outline. The cork zone is very thin and composed of six to eight or

more rows of rectangular tangentially elongated thinwalled cells. The cell outlines are regular. A few of the peripheral rows have brownish walls. Each cell measures 27 μ to 43 μ x 20 μ to 27 μ. A *phellogen* composed of a single row of narrow rectangular or slightly tangentially elongated cells is present inner to the cork. Inner to the phellogen is a very thin zone of seondary cortex. Its cells are slightly larger and longer than the cortical cells.

Cortex- comparatively wide and composed of thinwalled parenchyma cells mostly tangentially elongated and rich in starch grains (about 5 μ in diameter) Some of the cortical cells are filled with the characteristic black powdery mass. Groups of sclerenchyma cells are found scattered through the cortex. The sclerenchyma cells located towards the periphery of the cortex are larger and highly thickened, and occur either solitary or in few celled groups. Towards the interior they occur in small groups of four to six cells and the cells are slightly smaller than those at the periphery. Inner to the cortex is the phloem which is a very narrow zone with the cells small thinwalled and polygonal. Sieve tubes and companion cells are not very distinct. Most of the phloem parenchyma cells contain the black powdery substance. (crystal sand) A *cambium* of two rows of thinwalled narrow, rectangular cells is present. The *wood* is composed of a large number of vessels with wide lumen occurring in groups of two or three in radial rows, an abundance of thickwalled wood fibres, xylem parenchyma cells some of which contain small starch granules, and the medullary rays which are uni and biseriate. Most of the rays extend up to the region in the cortex wherein the selerenchyma groups occur. The ray cells in the wood are fairly thick walled, radially elongate measuring 42 μ to 54 μ in width. and fully loaded with starch grains. Those in the phloem region are thinwalled and shorter than those of the wood. The cells at the distal ends of the rays are slightly tangentially elongated.

Ficus tsiela Roxb.*

(Urticaceae)

Malayāḷam ... Kal-itti

Distribution and habitat.

Distributed mainly in Gujarat and the Deccan peninsula and from Kurnool southwards. It is found in the deciduous and evergreen Ghat forests from 1000 to 3500 feet elevation as well as in the low lands. It is occasionally planted as an avenue tree along with *Ficus bengalensis* and *Ficus religiosa* in the drier parts of the Madras state. The plant though reported occurring in the High ranges, Ariankavu etc. is not very common in Kerala. Flowering time– March to April

Habit and general features

Ficus tsiela Roxb. is an entirely glabrous, large sized spreading shady tree growing to a height of about 80 feet, and resembling in general habit the peepul tree. It is often epiphytic when young and has few or no aerial roots. Its trunk and branches are covered with smooth greenish-grey bark. The leaves are long petioled and occur in tufts at the ends of the branchlets. They resemble those of *Ficus religiosa* to some extent but are however narrower and without a long acuminate tip. The fruit receptacles are sessile, paired, globose, smooth or a little turbinate, purple or purplish-brown when ripe and occur crowded towards the ends of the branches arising from the axils of leaves or scars of fallen leaves.

External morphology

Leaves: alternate, stipulate, long-petioled, two to four and a half inches (rarely up to six inches) by one to two inches, broadly ovate to ovate-oblong or ovate-lanceolate, firm and coriaceous in texture, margin entire, thick and cartilagenous with a thickened marginal nerve, both surfaces smooth and shiny, base narrowed or rounded, three ribbed and tip acute, or obtusely cuspidate. Secondary nerves

*Used occasionally as a source plant of *Plaksa*. Refer third number of the Pharmacognosy of Ayurvedic drugs for Ayurvedic notes.

indistinct, 6–10 or more pairs, of which the lowest pair is basal; the intermediate nerves few and very slender, tertiary nerves obscure–with numerous simple parallel nerves the nerves becoming distinct when the leaves dry up. *Petioles* 1.5 to 3 inches long, a little compressed. *Stipules* one third to one inch, ovate–acuminate. They do not leave a distinct cicatrice or mark after fall.

The fruit receptacles are paired and are found crowded towards the ends of the branches in the axils of leaves or at the region of the leaf scars, each with three minute broadly ovate scarious basal bracts. They are sessile, globose, one half to two thirds of an inch in diameter, smooth or a little turbinate, and purple or purplish–brown to dull black when ripe. The opening or umbilicus is shut up with scales. Male, female and gall flowers occur in the same receptacle.

Staminate flowers few, sessile, with three ovate-acuminate perianth segments; monandrous; filaments thick, shorter than the broadly ovate anther. *Pistillate flowers* mostly sessile, they have short perianth and a broadly ovate reniform ovary with long style and cylindric stigma. *Gall flowers* sessile or pedicelled with three short perianth segments and a narrow sterile ovary in the centre.

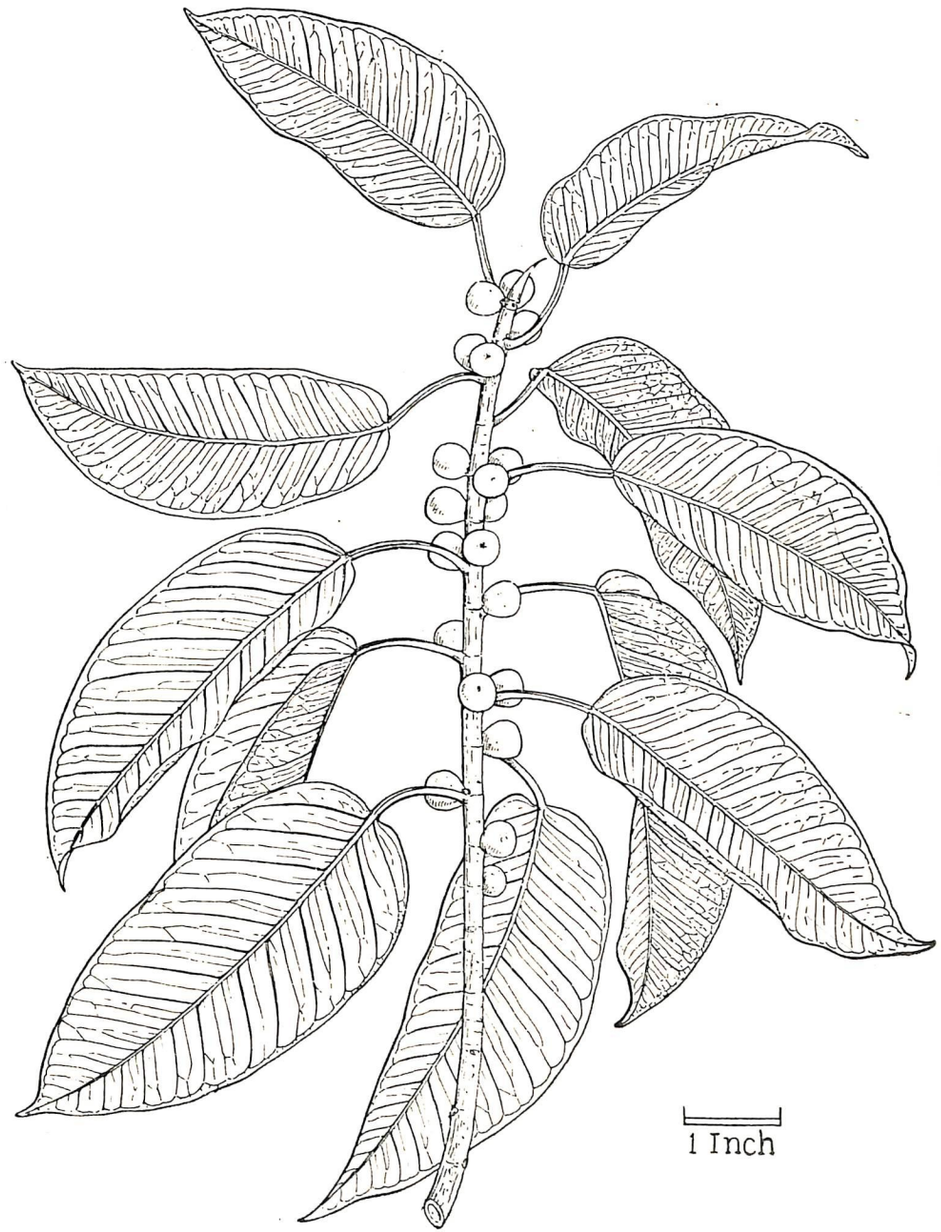
Officinal part: Stem bark, root bark*

Description of stem bark.

Bark from the older stem of *Ficus tsiela* is grey white in colour but at places where the outer skin has been removed appears light green. The surface skin is very thin and flakes off as small pieces by longitudinal splitting. These flakes are very thin and membraneous, greyish white in colour and can be easily powdered into minute grains. This outer tissue can be removed by scraping. The surface of the bark is studded with many minute, brownish, round or oval shaped lenticels. They are not very prominent but appear as blackish dots scattered irregularly over the surface of the bark. The portions where the outer skin is removed are smooth and green in colour.

*Stem bark is mostly used.

Plate XXVII



***Ficus Tsiela*, Roxb.**

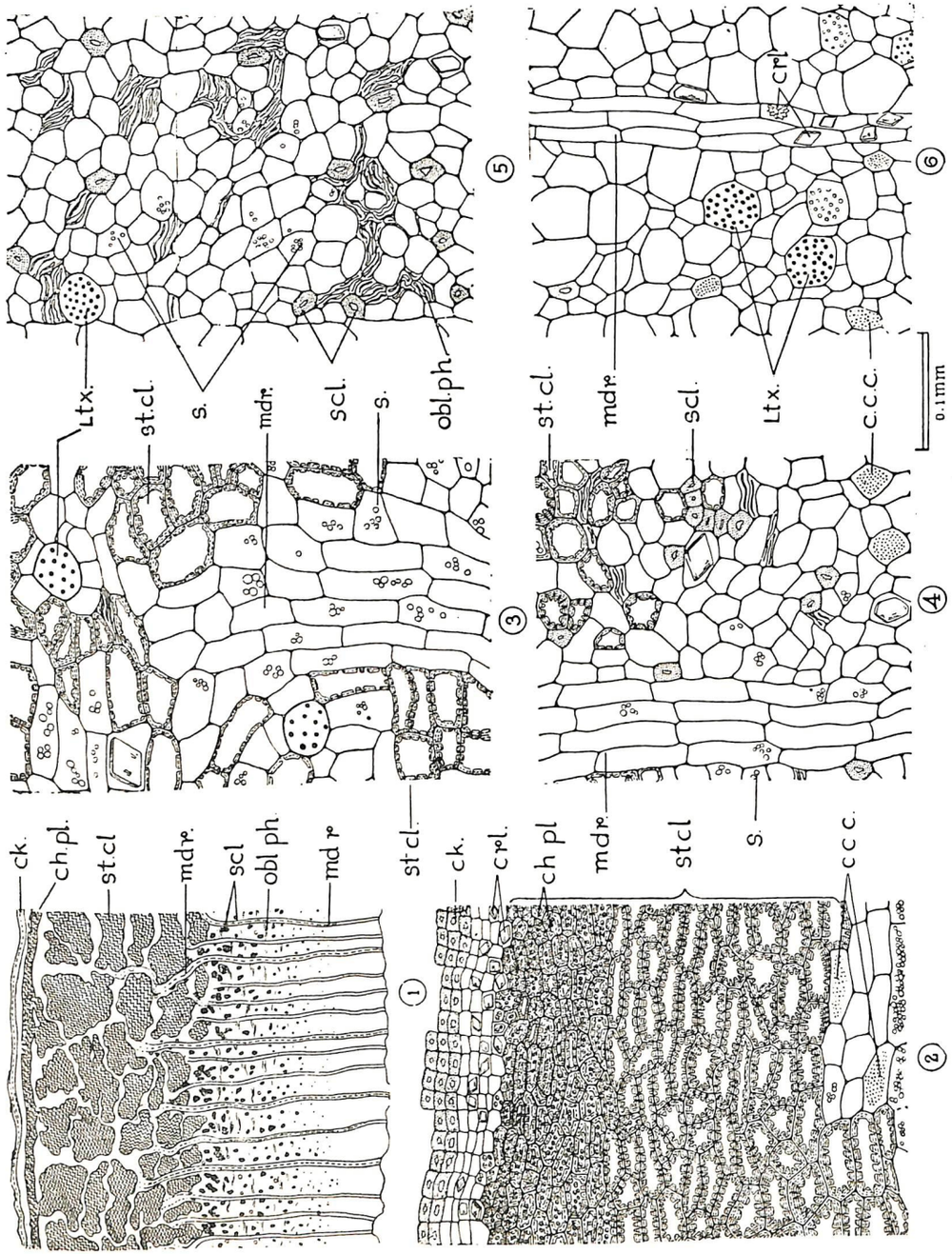


Fig. 1. Diagrammatic sketch of the T. S. of the stem bark.
2. Cork and inner stone cell layer showing the chloroplasts.
3. Middle bark — A portion of the innermost region.
4. The outermost portion of the inner bark.
5. Old bast region with the latex tube.
6. Young bast region.

The entire bark is very thick and may attain a thickness of 2 to 2½ inches with its outer surface grey and the inner surface smooth and yellowish white. Plenty of white latex exudes from the cut ends or injured parts of the fresh bark. The fresh cut end shows an outer thin greenish brown layer and a middle thick flesh coloured portion with granular spots and an inner rosy-white fibrous region.

On drying the cut end of the bark darkens and has a brown colour, with the exuded and dried up latex forming minute brown granules on the cut end. The whole bark is leathery in texture.

This bark closely resembles the bark of *Ficus talboti* but here the bark has a thin greyish white outer layer the removal of which exposes the greenish tissue.

Histology of stem bark.

In transverse sections of stem barks the cork forming the outermost tissue is seen to be formed of very few two to three or five rows of rectangular cells. The cell walls are considerably thick and there is only a narrow lumen in the centre of the cell. The phellogen consists of a single row of thin walled, colourless cubical to rectangular cells and just within the phellogen is a phelloderm of three to four or more rows of thin walled rectangular cells of the same size as the phellogen cells. Some of these cells contain small rhomboidal crystals of calcium oxalate and a few cells of the innermost row of this layer contain small chloroplasts. Next within is a nearly continuous zone of compactly arranged small sized sclereids, the cells appearing rectangular or slightly tangentially elongated in transverse section. Many of them contain chloroplasts.

Inner to this zone of sclereids are several scattered closely spaced groups of large sized stone cells. These however do not form a continuous zone. The stone cells vary in size and shape and are devoid of chloroplasts. The parenchymatous cells in between the sclereid groups as well as those situated inside are rectangular and tangentially elongated and thin walled. Some of these cells contain a reddish brown colouring matter and others contain starch grains. The cut ends of a number of laticiferous elements can be made out in this region.

The inner bark forms almost half the thickness of the entire bark. At the periphery of the inner bark a few small sized stone cells and a few thick walled sclerenchyma cells occur amidst the parenchyma cells. The stone cells are rounded and smaller than those of the middle bark, but are not very thick walled. A very limited number of parenchyma cells contain small rounded starch grains or rhomboidal crystals of calcium oxalate. Collapsed elements of phloem are found in between the other cells in the older peripheral portion. Cells with the reddish contents are also present in this region. Towards the inside of the bast also narrow strips of collapsed or obliterated tissue occur alternating with the regular phloem tissue. Solitary sclerenchyma cells occur scattered in this region but stone cells are absent. Cut ends of latex cells are present. The most recently formed phloem is devoid of any thick walled element. It is composed of sieve tubes and companion cells and small and large thin walled, polygonal, parenchyma cells. Some of the smaller parenchyma cells contain the reddish contents.

Medullary rays. Many, long, wavy and 2 to 5 or 6 seriate. They extend up to the middle bark. The ray cells are thinwalled and radially elongate towards the inside but become larger as the ray passes from the phloem tissue upwards to the middle bark. Some of the ray cells in the phloem portion contain small rhomboidal as well as rosette crystals of calcium oxalate, while the ray cells at the upper region contain small spherical starch grains.

Ficus talboti King.*

(Urticaceae)

Malayāḷam	–	Itti: Kal-itti.
Tamil	–	Itti: Kalitti:
Sanskrit	–	Plakṣa.

Distribution and habitat.

This tree has been reported as occurring in the evergreen forests of the Western Ghats, in Belgaum, the southern Ghat forests of N. Canara and in the Kerala State as well as in the neighbourhoods of Puliyara and Ariancavu in the Madras State, but it is nowhere very common.

Habit and general features.

Ficus talboti King., is a very large, quite glabrous evergreen tree usually epiphytic when young and almost devoid of aerial roots growing up to a hundred feet the trunk and branches with smooth greenish rather thick, bark, bearing entire, slightly wavy elliptic to elliptic-oblong thinly coriaceous shiny leaves two to four inches long and half to two inches broad and axillary pairs of sessile obovoid smooth fruit receptacles that turn yellowish green when ripe. The fruit receptacles are formed in September to October and occasionally also in February to March.

Wood – whitish with numerous concentric layers of light tissue alternating with broader and darker belts.

External morphology.

Leaves: alternate, petioled, stipulate, – stipules ovate, about 0·25 inches long, blade two to five inches long and half to two and a half inches broad, quite glabrous above and faintly reticulate below, narrowly elliptic-ovate or oblong, entire, thinly coriaceous, narrowed at base, shortly acutely caudate to caudate acuminate at apex with the caudicle up to 0·6 inch long and often curved or partially twisted, three to five ribbed with six to nine pairs of fairly prominent lateral nerves: *petiole* - half to one and a quarter inch long.

**Ficus talboti* King., is another plant used as the source of *plakṣa*. See No. 3 of the Pharmacognosy of Ayurvedic Drugs-Series, for details of Ayurvedic information.

The *fruit receptacles* are sessile and occur in axillary pairs each having three ovate acute basal bracts. They are obovoid slightly depressed at apex, about one third of an inch in diameter smooth or dotted with scattered minute warts and greenish yellow when ripe. Male, female and gall flowers occur in the same receptacle. The staminate flowers are sessile few in number and found near the mouth of the receptacle. Each flower has three broadly ovate perianth segments and one stamen. The pistillate flowers have three lanceolate perianth segments and an ovary with a short lateral style.

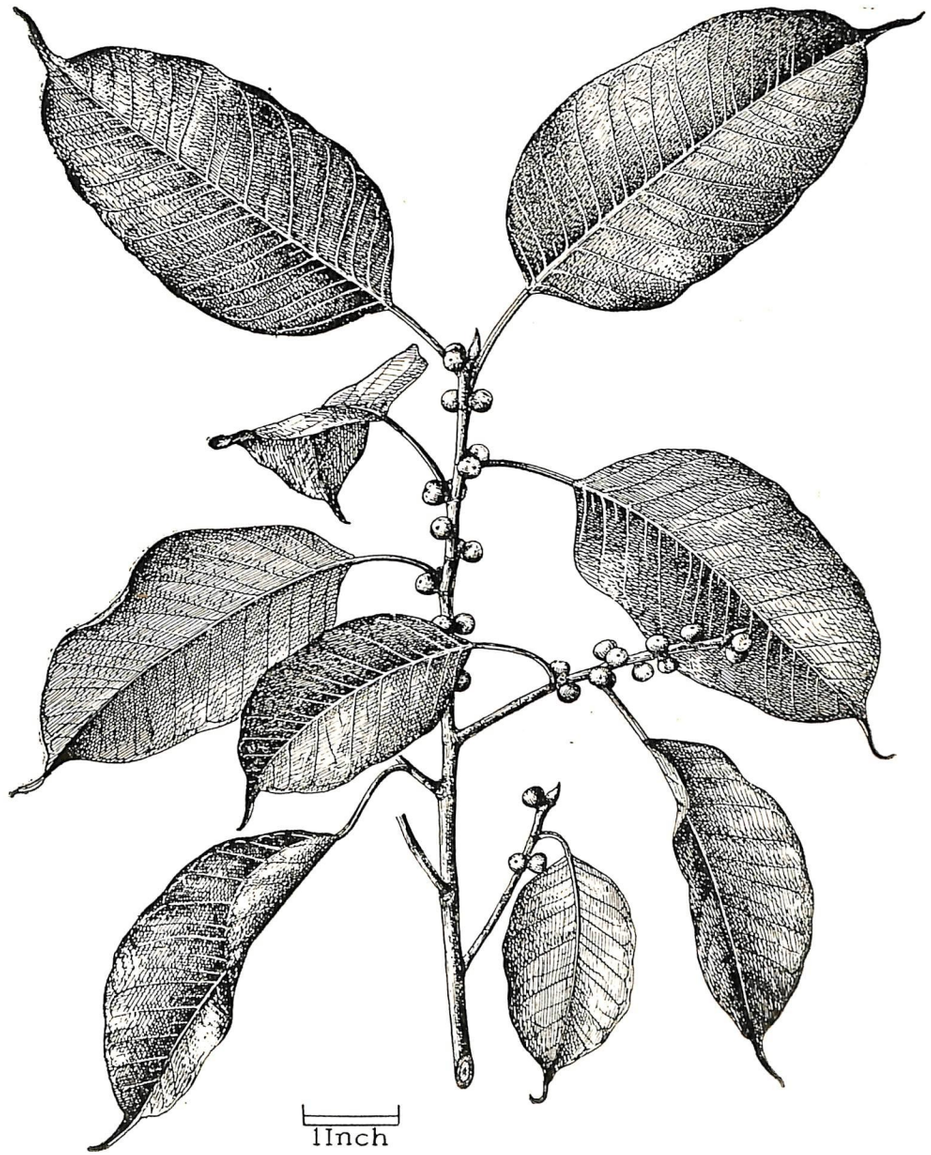
Officinal parts: Bark from older stems and branches.

Description.

Stem bark fairly smooth. Those from older stems and branches are grey, ashy white or very light yellowish brown and sparsely covered with thin closely adherent whitish or greyish lichen patches. The surface skin or rind is very thin and flakes off in small pieces as in *F. glomerata*. The flakes thus removed are thin translucent, somewhat friable, ashy white to light grey or with a slight yellowish tint, and are composed of a large number of layers. They are also easily rubbed off on scraping. This characteristic of the bark that makes them remain smooth is a special feature noted only in few other cases such as *F. glomerata*. Minute lenticels are also noted on barks from old trunks. These are not prominent, but appear as very small blackish or brownish slightly warty dots irregularly scattered over the surface. In the case of barks from younger trees or branches the colour is more greenish due to the presence of a well developed greenish tissue immediately within the some what translucent surface skin. The latter has a light brown colour and easily separates in small pieces or flakes on scraping. The longitudinal folding and subsequent splitting of this outer skin is noted here also but the surface does not show the presence of the minutely warty lenticels.

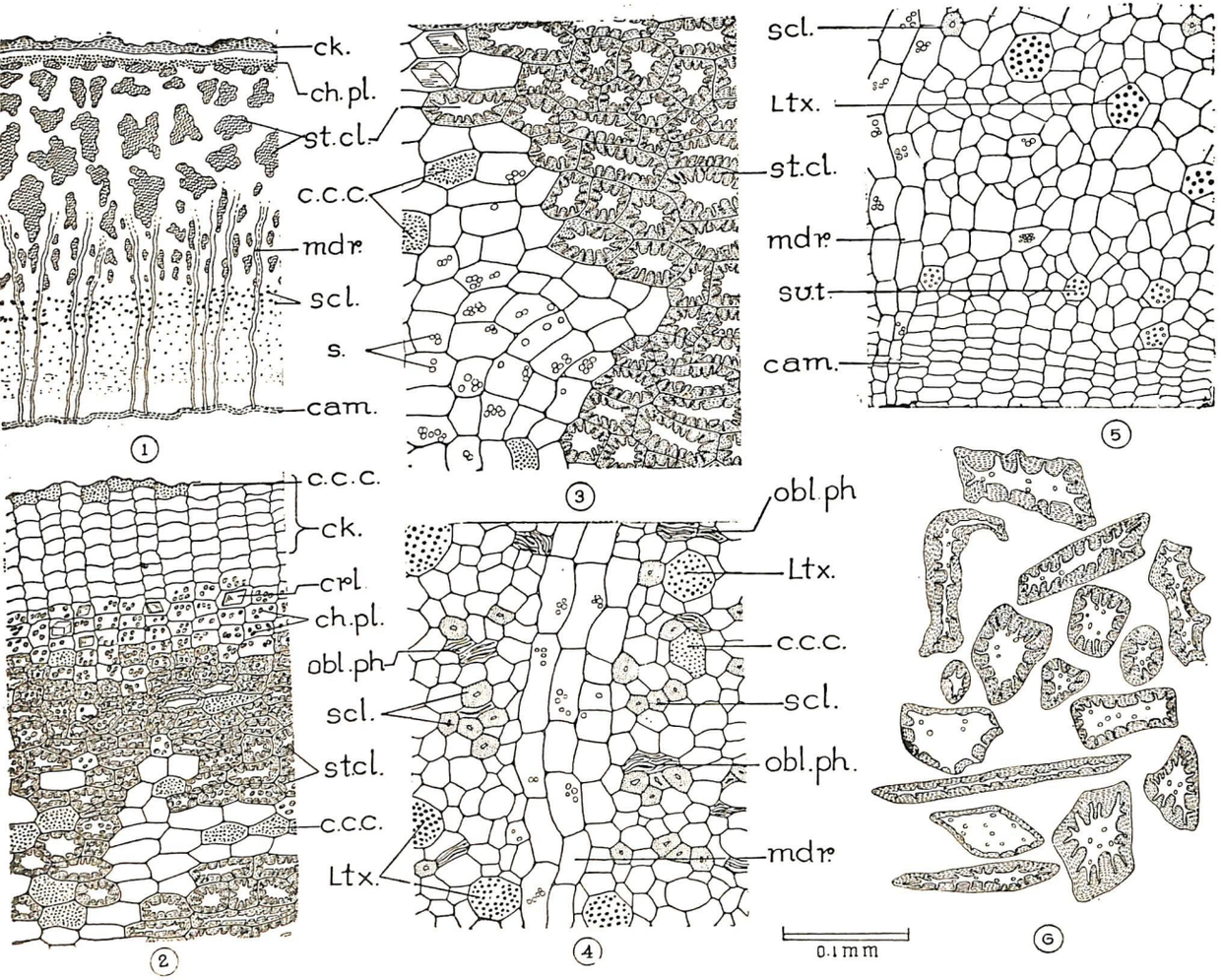
The entire bark is comparatively very thin, being about one eighth of an inch thick in stems two inches or more in diameter. The outer bark though forming a very thin tissue about the thickness of a tissue paper, is found to be composed of several thin layers. The rest of the bark constituting the living tissue is composed of cortex and bast. The bark may attain a thickness of one inch or more in the older trunks. The cut surface of fresh bark has a nearly uniform light rosy or fleshy tint that disappears on drying with a

Plate XXIX



Ficus Talboti, King.

Plate XXX



Histology of stem bark of *Ficus talboti*, King.

Fig. 1. Diagrammatic sketch of the T. S. of the stem bark.
2. Cork and a part of the middle bark with the chloroplasts.
3. Middle bark region showing part of a stone cell group.
4. Inner bark showing the old phloem tissue and latex tubes.
5. Young bast and the cambium.
6. Stone cells.

distinct greenish tinge near the extreme periphery. On examination with lens the outer half of the living bark appears granular without any lamellation, the inner part is more compact and lamellated with the innermost region distinctly fibrous and sticky. The bark as a whole has a fairly tough or leathery texture and a short fracture which is granular outside, but fibrous inside. On examining the inner fibrous part it is found that the fibres run obliquely and the different layers cross each other, the whole thus forming a very compact and firm strong leathery tissue. Taste slightly astringent (compared to other barks).

Histology of stem bark.

The outermost tissue namely cork or *phellem*, even in well-developed barks of *Ficus talboti* is very thin consisting of only a limited number – 5 to 8 or 10 rows of very narrow, thin walled and nearly cubical or rectangular cells. Some of the cells of the peripheral rows contain a reddish colouring matter. Below the cork the phellogen is not always distinct. Inner to the phellogen is a narrow strip or layer of thin walled cells of nearly the same size as the phellogen cells containing chloroplasts. A few other cells in the region contain cubical or rhomboidal crystals of calcium oxalate.

The middle bark forms about half the thickness of the whole bark. A large number of groups of stone cells are scattered in this region. Just inner to the chloroplast layer there is present a narrow zone of sclereids, the cells of which are about the same size as those containing chloroplasts. Some of these also contain a few chloroplasts. The stone cell groups towards the interior are large and composed of large sized cells of different shapes. The parenchyma cells are thin walled and appear polygonal rectangular or slightly tangentially elongated in section and some of them contain starch grains. A few other cells contain a reddish brown contents and others near stone cells contain crystals. The inner bark forms almost half the thickness of the bark. It consists of small polygonal thin-walled phloem parenchyma cells sieve tubes fibres and latex tubes. A few of the parenchyma cells contain starch grains. In this region can be made out small scattered groups of sclerenchyma, each group composed of two to five almost rounded and very thickwalled cells, cut ends of several large latex tubes as well as a few cells with

coloured contents. At the outer portion of the bast narrow strips of compressed and partially obliterated phloem can be made out. The groups of sclerenchyma cells are very few towards the inside where the cells are polygonal thinwalled and sieve tubes are distinct. A cambium of two or more rows of narrow rectangular thinwalled cells is present.

Medullary rays. Many in number. They extend up to the middle of the middle bark where they slightly widen or expand. Most of the rays are two to three seriate but occasionally five seriate rays may also be present. The ray cells are thinwalled and mostly packed with strach grains. They are radially elongated in the region of the phloem but gradually increase in size towards the periphery. They are seen to be shorter and slightly tangentially elongated in the middle bark.

Distinguishing features.

Morphological.

The smooth ashy white to light yellowish brown or grey surface studded with scattered brownish or blackish minute specks (slightly warty lenticels). the quite thin easily scraped and some what translucent, light brown gray thin and papery outer skin found exfoliating in very small flakes due to development of longitudinal folds fissures or cracks, the presence of a distinct dark green tissue just within the comparatively thin outer skin, the leathery nature of the entire bark, the colour of the cut surface, light flesh coloured when fresh but turning light brown on drying, and the nature of the fracture – short and granular outside and leathery inside as well as the slightly astringent taste.

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