C H A P T E R - XIV

Pharmacognosy and Phytochemistry of NAREGAMIA ALATA Wight.

The root of Naregamia alata Wight (Meliaceae) is commercially known as the Goanese ipecac. It is used as a substitute of ipecac root in India (Claus, 1956; Chopra and Handa, 1958). The drug which is available in East Indies, contains starch, rosettes of calcium oxalate and an alkaloid 'Naregamine' (Claus, 1956). It also shows an orange coloured secretion in the cells. Watt (1891) mentions that the decoction of stem and leaf is used as a remedy for biliousness. He also reports usefulness of the stem and the leaf on rheumatism and itch in South Africa. It has been successfully used against dysentary.

A number of authors have described the root as emetic and expectorant. They find it useful against bronchitis and in the removal of mucous (Nadkarni, 1954; Chopra and Handa, 1958). According to them, 'Naregamine' is not related in any way to emetin and that it is an amorphous residue of a brittle consistency derived from

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the roots only. Root-bark contains wax, gum, aspergin and starch.

Pharmacognosy and systematic study of phytochemistry for this plant has not been done till today. Hence, study on these lines has been undertaken here.

Description and distribution :

It is a glabrous branching shrub reaching a height of 30-45 cm. Leaves are alternate and trifoliate. Flower is 2.5-3 cm. long, white, axillary and solitary. Calyx is hairy outside. It divides into five, imbricate lobes. Petals are five, spathulate and contorted in bud. Ten stamens have their filaments united to form a cylindrical tube which becomes slightly inflated at its apex; anthers possess appendages at their top. Ovary is ovoid, three celled with two pendulous ovules in each cell. Style is filiform and the stigma is capitate. Fruit is a loculicidal capsule.

It grows wild in the Western and Southern parts of India. It is collected from Kerala where it is locally called 'Nelanarakam'.

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M O R P H O L O G Y

Leaf (Plate XXVII, 1) :

Each leaflet is entire, obovate and sometimes oblique. It measures 2-5 cm. in length and 1-2 cm. width. The middle of the three sessile leaflets is usually larger than the two lateral leaflets. Margin is poorly ciliate. Apex is acute. Upper surface is green while the lower one is yellowish green. Prominent veins on the lower side bear hairs.

Petiole measures upto 2.5 cm. in length. It is winged.

Stem :

Main stem or a branch is 30-40 cm. long. Young stem at the growing point is green and angled; below it is pink to brick-red. Old stem is light grey in colour. The nodal line is prominent on the side which bears a leaf. Internodes are 0.5-3.0cm. long. Internodes exhibit straight, longitudinal striations. In young stem, such striations are prominent and may form shallow channels. In old stem, they develop irregular protrusions. Young stem is slightly pubescent.

Smoothened transverse surface shows a brown cork, yellowish wood and a white central pith or a hollow

space. Fracture is irregular and starchy.

Root:

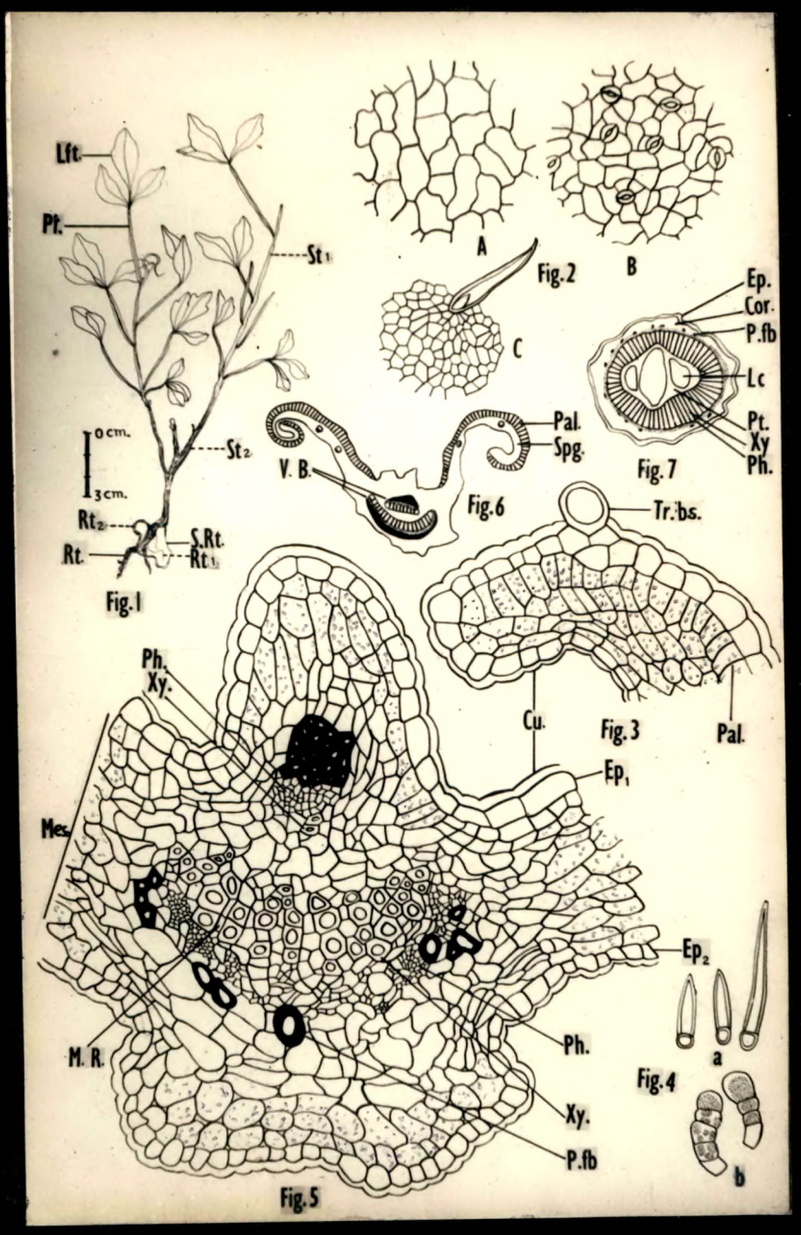
It is tortuous in growth. Main root which is grey and shows an uneven surface is usually short while secondary root may attain a length of 7-10 cm. The latter which is purple to brick-red and smooth, exhibits fine longitudinal striations. Tertiary roots are very thin and resemble the secondary roots in character.

Smoothened transverse surface of the root shows a brownish cork, a whitish phelloderm and a central yellowish xylem core. Fracture is short and starchy. Odour is pungent and aromatic.

H I S T O L O G Y

Leaf :

A leaflet is dorsiventral as the mesophyll is differentiated into palisade and spongy tissues. Cells of the upper epidermis are rectangular. Their outer walls are slightly convex and are protected by cuticle externally (Fig. 3). Unicellular covering trichomes and multicellular glandular trichomes emerge from the dermal cells (Plate XXVII 4a & 4b). The former and the latter measure 153-248-348 μ and 68-80-94 μ respectively. Covering trichomes are confined to the margin and around the veins on the


Lft.
Pt.
St1
St2
0 cm.
3 cm.
Rt2
Rt.
S.Rt.
Rt1
Fig. 1
A
B
Fig. 2
C
Ep.
Cor.
P.fb
Lc
Pt.
Xy
Ph.
Fig. 7
Pal.
Spg.
V. B.
Fig. 6
Tr. bs.
Cu.
Fig. 3
Pal.
Ph.
Xy.
Ep1
Mes.
Ep2
M. R.
Ph.
Xy.
P.fb
Fig. 5
a
b
Fig. 4

P L A T E - XXVII

(Figs. 1 - 7 : Naregamia alata Wight)

Fig. 1 - Entire plant. x $\frac{1}{2}$

Fig. 2 - 2A - Upper epidermis. x 440.

2B - Lower epidermis with stomata. x 440.

2C - Epidermal cells around a trichome. x 260.

Fig. 3 - T.s. leaf, margin portion. x 780

Fig. 4 - 4a - Covering trichomes. x 440.

4b - Glandular trichomes. x 440.

Fig. 5 - T.s. midrib. x 780.

Fig. 6 - T.s. winged petiole. x 70.

Fig. 7 - T.s. stem (diagrammatic). x 30.

x-x-x-x-x-x-x-x

Cor. - cortex; Cu. - cuticle; Ep. - epidermis;

Ep_1 - upper epidermis; Ep_2 - lower epidermis;

Lc. - lacunae; Lft. - leaflet; Mes. - mesophyll;

M.R. - medullary ray; Pal. - palisade; Ph. - phloem;

Pt. - petiole or pith; P. fb. - pericyclic fibre;

Rt., Rt_1. & Rt_2 - root; Spg. - spongy; St_1 & St_2 - stem;

Tr. bs. - trichome base; V.B. vascular bundle;

Xy. - xylem.

upper surface. The multicellular glandular trichomes are confined to areas around the veins on the lower surface. In surface view, the dermal cells of both the surfaces show slightly wavy walls. Ranunculaceous stomata are confined to lower epidermis only (Plate XXVII, 2A & 2B). Dermal cells around a covering trichome are comparatively smaller (Plate XXVII, 2C).

A single layer of long columnar and closely packed palisade cells, lies below the upper epidermis. Rest of the lamina is occupied by 5-6 layers of oval or slightly elongated cells of the spongy tissue. Generally, they become compact (Plate XXVII, 3). A number of conjoint and collateral vascular bundles, cut in various planes, lies in the spongy tissue. Nonlignified pericyclic fibres are present on the outer side of each of the bundle.

Epidermis of the midrib, runs over a sharp projection on the upper side (Plate XXVII, 5). Two layers of palisade cells, in continuation with those of the lamina are present in the midrib. The conjoint and collateral vascular bundles are embedded in parenchymatous cortex of the midrib (Plate XXVII, 5). That of the abaxial side is bigger than the second and is composed of 9-10 radially arranged vessels and intervening xylem parenchyma towards the centre; equal number of phloem groups is present, each one lying on the outer side of a radiating row of vessels

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(Plate XXVII,5). Nonlignified fibres, solitary or in groups of 3-4 lie on the outer periphery of the abaxial vascular bundle. The second of the adaxial side is very small; it is composed of 2-4 vessels facing the centre and a small group of phloem towards the outer side. It is also protected by a group of nonlignified fibres.

Isolated cells of the spongy tissue in lamina and midrib-cortex contain rosettes of calcium oxalate crystals. A few cells also show an orange coloured contents.

Leaf constants :

Stomatal index for the lower epidermis is 10-12.5. Palisade ratio is 6.8, while the vein islet number works out to be 6-8.

Petiole :

Transection of the petiole reveals its winged nature. Tissues of lamina are identical to those of the leaflet lamina (Plate XXVII, 6). Midrib portion shows the presence of two well developed vascular bundles embedded in parenchymatous cortex. Abaxial bundle is as big as that found in the leaflet while the adaxial one is comparatively well developed with 6-8 rows of vessels. Nonlignified fibres form uninterrupted protective arches on the outer side of both the abaxial and the adaxial bundles (Fig. 6).

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B - Stem :

Portion of the stem taken from its apical region at position St_1 (Plate XXVII, 1); shows secondary growth. Epidermis is protected externally by a thick cuticle and unicellular trichomes. The latter rssembles those found in the leaf. Phellogen originates in the subepidermal region. (Plate XXIII, 2). Parenchymatous cortex is 9-10 cells deep; endodermis remains indistinct. Small tangentially arranged groups of lignified pericyclic fibres are present around the vascular tissues (Plate XXVII, 7). Secondary phloem consists of polygonal, closely arranged cells (Plate XXVIII, 2). Xylem is comparatively a wider zone and consists of vessels, tracheids, fibres, medullary rays and xylem parenchyma. Protoxylem can be seen on the periphery of wide parenchymatous pith. 1-2 layers of characteristic cambial cells are placed in between the xylem and the phloem.

Transection of an old stem taken at a position St_2 (Plate XXVII, 1) at its base, shows development of a wide periderm. It consists of 10-20 layers of tangentially elongated radially arranged lignified and suberised cork cells on the outer side. Phelloderm is 3-4 layered. Cortex is parenchymatous and 9-10 layers deep (Plate XXVIII, 3). Pericyclic fibres are present around the vascular tissues. Phloem consists of the usual elements. Cambium is 1-2 layered.

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Secondary xylem is well developed and in an old stem shows 3-4 annular growth rings (Plate XXVIII, 7). Xylem consists of all the usual elements. Vessels are lignified and show circular bordered pits. Spiral, reticulate and a few tracheidal vessels can also be found (Plate XXVIII, 1). Tracheidal vessels are lignified but possess a few bordered pits. Fibres are elongated, tapering at the ends and bear a few pits (Plate XXVIII, 1); septate fibres are not uncommon. Pith is wide and parenchymatous. Occasionally cells of the pith break to form 1-3 lacunae (Plate XXVII, 7). Rosettes of calcium oxalate and starch is present in cells of the cortex.

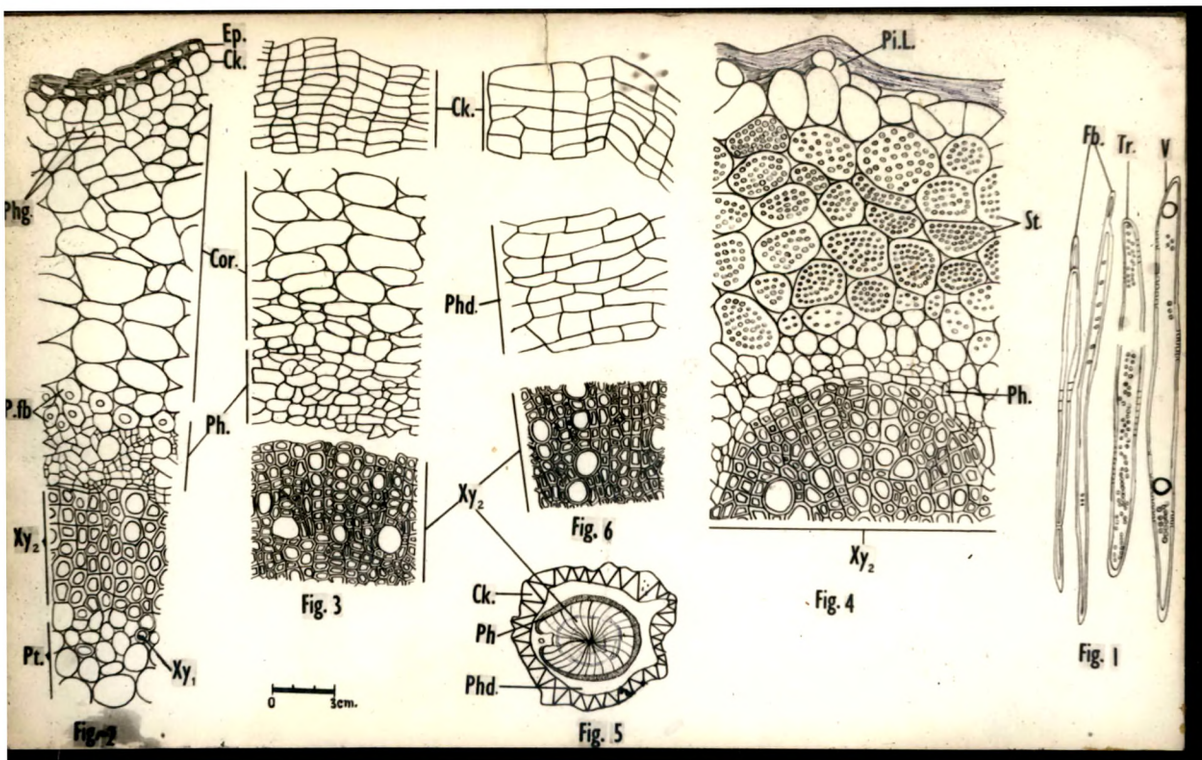
T A B L E - 30

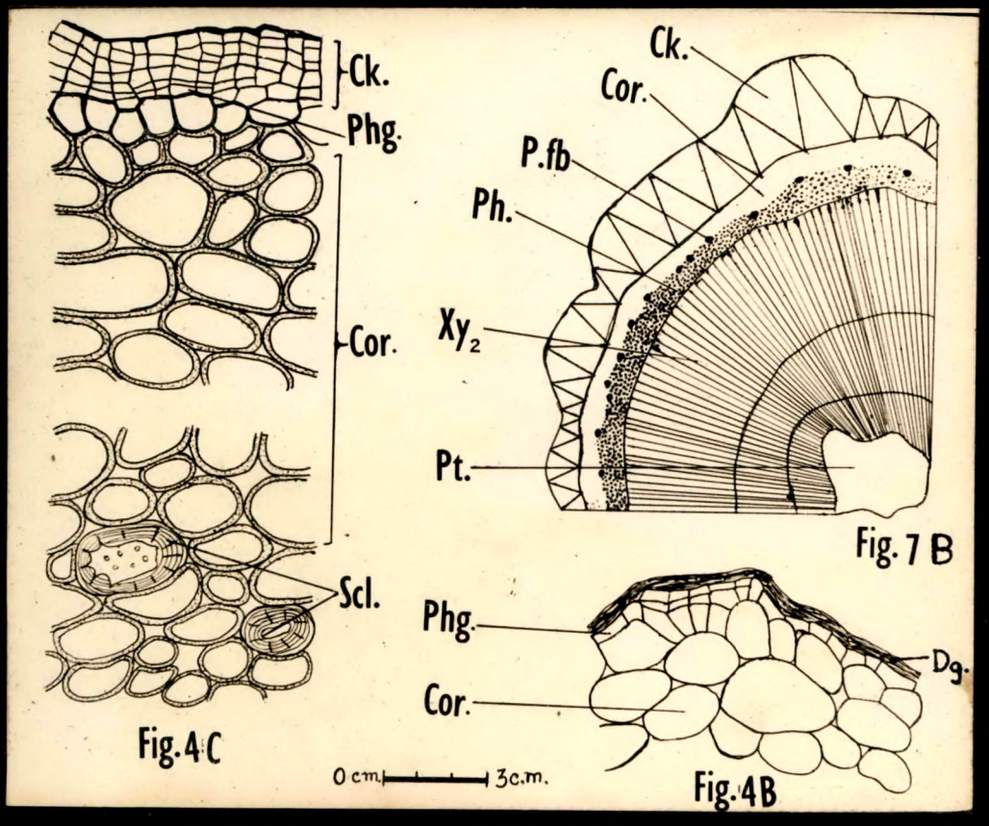
Measurements of Stem Elements

Elements	Length	Width
Vessel	201-260-313-373-443 μ	18.8-23.5-28 μ
Tracheid	188-259-296-388-456 μ	14-20-23.5 μ
Fibre	197-329-390-468.5-564 μ	9.5-16-23.5 μ

C - Root :

Young root of 600-640 μ diameter taken from position Rt_1 (Plate XXVII, 1), shows secondary growth


Ep.
Ck.
Phg.
Cor.
P.fb
Ph.
Xy2
Pt.
Xy1
Fig. 2
Ck.
Phd.
Fig. 3
Xy2
Fig. 6
Ck.
Ph
Phd.
Fig. 5
0
3cm.
Pi.L.
St.
Ph.
Xy2
Fig. 4
Fb.
Tr.
V
Fig. 1


Ck.
Phg.
Cor.
Scl.
Fig. 4 C
Ck.
Cor.
P.fb
Ph.
Xy2
Pt.
Fig. 7 B
Phg.
Cor.
Dg.
0 cm.
3c.m.
Fig. 4B

P L A T E - XXVIII

(Figs. 1 - 7 : Naregamia alata Wight)

Fig. 1 - Stem maceration. x 440.

Fig. 2 - T.s. stem. x 780.

Fig. 3 - T.s. old stem showing part of cork, cortex, phloem and xylem. x 440.

Fig. 4 - 4A- T.s. young root showing starch in cortex cells. x 780.

4B- Outermost layers of young root showing the origin of phellogen. x 440.

4C - T.s. young root, cork, phellogen and sclereids in the cortical region. x 440.

Fig. 5 - T.s. old root showing growth rings (diagrammatic). x 30.

Fig. 6 - T.s. old root, showing parts of cork, phelloderm, and xylem. x 440.

Fig. 7 - T.s. old stem, showing growth rings (diagrammatic). x 70.

x-x-x-x-x-x-x-x

Ck. - cork; Cor. - cortex; Dg. - degeneration-like mass; Ep. - epidermis; Fb. - fibre; Ph. - phloem; Phd. - phelloderm; Phg. - phellogen; Pt. - pith; P.fb. - pericyclic fibre; Pi.L. - piliferous layer; Scl. - sclereid; St. - starch; Tr. - tracheid; V. - vessel; Xy. - xylem; Xy_2 - secondary xylem.

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(Plate XXVIII, 4A). The growth is slow and the phellogen has not yet developed. Externally the young root has a piliferous layer followed by 130-180 μ wide cortex. Parenchymatous cells of cortex show distinct intercellular spaces. Endodermis remains indistinct. Phloem zone is usually very narrow; it is represented by 2-3 layers of polygonal cells (Plate XXVIII, 4A, 7). Cambium is one layered. Central xylem core is 190-290 μ in diameter. The protoxylem elements are indistinguishable. In a thicker root 960 μ in diameter, phellogen develops from the outer cortical cells just below the piliferous layer (Plate XXVIII, 4B). A few cells of the secondary root cortex modify into isodiametric pitted sclereids. Such sclereids are lignified and scattered (Plate XXVIII, 4C). A few small groups of pericyclic fibres also develop around the vascular tissues.

Old root of 2880 μ diameter develops a wide zone of periderm (Plate XXVIII, 5). Cork region is 480 μ wide and consists of about 30 layers of tangentially elongated, thin-walled cork cells, which are suberised as well as lignified (Plate XXVIII, 6). Phellogen is 1-2 layered. Phelloderm and cortex together are made up of about 15 layers of tangentially elongated cells. Secondary phloem is well developed as compared to that in the young root. Xylem portion shows four annual growth rings (Plate XXVIII, 5); it is 1280 μ in diameter and is composed of

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vessels, tracheids, fibres and meduallary rays. Vessels, tracheids and fibres are lignified. The former two show bordered pits. Tracheids and fibres show only a few pits on their wall. The fibres have tapering ends and some of them are septate or forked at the ends.

Sclereids and pericyclic fibres which are observed in a secondary root are absent in the main root. Starch is abundant in the cells of the cortex and phelloderm.

T A B L E - 31

Measurements of Root Elements

Elements	Length	Width
Vessel	211-240-289-330.5-403 μ	14.4-23.5-34 μ
Tracheid	172-245-321-390-446.5 μ	14-19-28 μ
Fibre	322-381.6-437-477-545 μ	14-19-23.5 μ

Phytochemical Investigations on
Stem and Root of
NAREGAMIA ALATA Wight

E X P E R I M E N T A L

Extractives :

35 g. of the 40 (B.S.) mesh powder of the root and stem was successively extracted in the soxhlet extractor with the usual solvents. The percentage yield of various extractives was as follows : petroleum ether (b.p. 60-80°), 2 ; ether, 0.09; chloroform, 0.03; benzene, 0.3; alcohol, 4·0 and water, 3.0.

Flourescent analysis :

Extractives with petroleum ether, chloroform, benzene and alcohol gave a common yellowish green flourescence.

Petroleum ether extract :

Root and stem were dried under shade and a 40 (B.S.) mesh powder was prepared. It was then extracted with petroleum ether (b.p. 60-80°). Most of the solvent from the extract was removed by distillation under reduced pressure followed by spontaneous evaporation. Solvent treatment of the resultant semi-solid mass did not give any definite product. A portion of the semi-solid mass was then

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saponified with N/2 alcoholic potash. The unsaponifiable matter was extracted with ether. Both the unsaponifiable and saponifiable matters were examined as described below:

Isolation of ~~Hyeno~~eneic sane :

The unsaponifiable matter was refluxed with alcohol whereby a brown solid separated. This, after treatment with ethyl acetate, alcohol, methanol and petroleum ether, gave a white crystalline substance A, (m.p. 35-38°). This on repeated crystallisations from petroleum ether melted at 40.5°. Substance A, was soluble in most of the organic solvents except water. It did not give positive tests for sterol and did not react with acetic anhydride, hydroxylamine hydrochloride, alkaline potassium permanganate and bromine in chloroform.

Found: C, 85.04%; H, 14.8%; Mol. wt. 290 (mast); $C_{21}H_{44}$ requires C, 85.1%; H, 14.9%; mol. wt. 296.

Mixed melting point with an authentic sample of h~~yeno~~eneico sane remained undepressed.

Isolation of β-sitosterol :

After the removal of Substance A from the alcoholic filtrate, the mother liquor was concentrated and evaporated spontaneously. The semisolid mass was dissolved

in acetone and kept in refrigerator overnight, when a yellow solid (m.p. 131-133°) separated. The solid after repeated crystalisations from methanol gave colorless flakes of Substance B, m.p. 135-37°. It was fairly soluble in benzene, alcohol, ether, etc., and gave positive sterol tests including Liebermann-Burchard, Moleschott's and Salkowski tests (Allen, 1948).

Found : C, 84.05%; H, 12.13%; Mol.wt. 410 (Rast); $C_{29}H_{50}O$ requires C, 84.01%; H, 12.15%; mol. wt. 414.7.

Substance B, (0.25 g.), was refluxed on a sand bath with acetic anhydride, (7 ml.) and fused sodium acetate (2.5 g.). The resulting mass was treated with cold water and the aqueous solution neutralised with sodium bicarbonate. The precipitate obtained was washed thoroughly with water and recrystallised twice from methanol, when it melted at 126-7°. The melting point of the substance did not rise further or repeated crystalisations.

Found: C, 81.2%; H, 11.6%; $C_{31}H_{52}O_2$ requires C, 81.5%; H, 11.4%.

Isolation of stearic and palmitic acids:

The saponifiable matter was dissolved in water, acidified with hydrochloric acid and the precipitated fatty acids were extracted with ether. The ethereal solution

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was washed with water, treated with anhydrous sodium sulphate and evaporated to dryness.

The mixed fatty acids were separated into solid and liquid fractions by Twitchell's[1921] lead salt alcohol method. Saturated acids, on fractional and repeated crystallisations from 95% alcohol, gave two sunstances, C (m.p. 67.5-68.5°) and D (m.p. 63-64°).

Substance C :

Found : C, 75.92%; H, 12.72%; $C_{17}H_{36}O_2$ requires C, 76.05%; H, 12.68%; 0.23 g. of the acid required 8.2 ml. of 0.1N potassium hydroxide for neutralisation. The molecular weight calculated from the data is 280.3.

Mixed melting point with an authentic sample of stearic acid remained undepressed. Substance C has been identified as stearic acid.

Substance D :

Found: C, 74.93%; H, 12.62%; $C_{16}H_{32}O_2$ requires c, 75%; H, 12.5%; 0.66 g. of the acid required 12.5 ml. of 0.1 N potassium hydroxide solution for neutralisation. The molecular weight calculated from this data is 256.4.

Mixed melting point with an authentic sample of palmitic acid remained undepressed. Substance D has been indentified as palmitic acid.

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Alcohol Extract :

Further work on this extract is in progress.

S U M M A R Y

Leaf is trifoliate. Each leaflet is dorsiventral. Externally, the leaflet is protected by a thick cuticle and unicellular trichomes; glandular multicellular trichomes are also present. Palisade of the lamina is continuous in the midrib. Out of the two vascular bundles forming the stele, the abaxial one is well developed; both have nonlignified fibres on their outer sides. Calcium oxalate rosettes and cells with red contents are present. Petiole is winged. It is structurally similar to the leaflet.

Young stem is externally protected by a thick cuticle and unicellular covering trichomes. Normal secondary growth sets in early. Phellogen develops from the outer cortical layers. In an old stem, cork is about 20 layers thick. Xylem shows 1-3 growth rings. Pith may show lacunae. Rosettes of calcium oxalate and starch is present.

Young root shows secondary growth. Cortex of secondary roots shows a few sclereids. Phellogen originates from cortex below the piliferous layer. In an old root, cork develops upto 30 layers. Xylem shows 1-3 growth rings. Starch is abundant in the root.

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Hyeneic osane, β-sitosterol, and two fatty acids, viz. stearic and palmitic are isolated from Petroleum ether extract. There were further confirmed by their melting point, mixed melting point and by paper [illegible].

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PHARMACOGNOSTIC STUDY OF *CAPPARIS MOONII* WIGHT. FRUITS

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Received 2 September 1959

A pharmacognostic study of the fruits of *Capparis moonii* is made. Flourescent analysis and microchemical tests for starch, alkaloids and tannins have also been carried out.

Capparis moonii Wight, (*Capparidaceae*) known as 'rudanti' grows widely on Western Ghats especially in Canara district of Mysore State.[1] In the countryside of Mysore State the fruits are used for healing sores, burns and wounds.[2] Half-mature fruits have been found effective in the treatment of pulmonary tuberculosis.[3] *Cressa cretica* (*Convolvulaceae*) is also described as 'rudanti' and its fruits are recommended in respiratory diseases.[4] No other investigations, excepting the clinical results, have been reported.

MATERIAL AND METHODS

Fruits were supplied by M/s. Himalaya Drug Co., Bombay and Mr. Vats, Khandala. Free-hand sections of the pericarp, pulp and the seed were cleared with chloral hydrate and made permanent after staining with phloroglucinol and hydrochloric acid. Microchemical tests were carried out according to Trease.[5]

Macroscopy:

Capparis moonii is a large climbing shrub growing widely on the Western Ghats and in Canara and Khandala. The stalked berries measure from 5 to 10 cm. in diameter. Colour is green-gray to red. Young fruits are smooth while the older ones are granular rough. At times, a prominent ridge passes half-way round the circumference (Fig. 1).

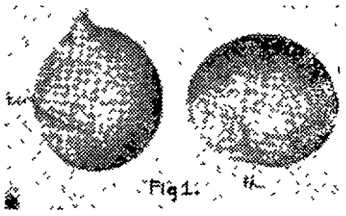

Fig. 1
Fruits of *Capparis moonii* — entire. x 1/3.
Fr. — Ridge.

The berry has a hard woody pericarp which is about 0.7 to 0.8 cm. thick. Seeds which are exalbuminous, many and reniform, are embedded in the pulp (Fig. 2).

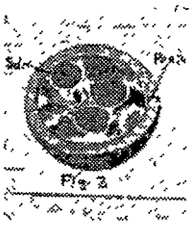

Fig. 2
Fruit cut from the middle to expose pericarp, seeds and the central pulp. x 1/3.
Per. — Pericarp;
Sd. — Seed.

these groups may unite to form a small strip; otherwise they get separated by radially elongated parenchymatous cells (Fig. 4).

The tissues below the sub-hypodermal stone cells is parenchymatous. It includes more frequently groups of two to many stone cells. The parenchyma around and near the stone cells are isodiametric. This tissue also shows the presence of a few vascular bundles which are cut transversely, longitudinally or obliquely (Fig. 4). The phloem parts of these vascular bundles along with the surrounding parenchyma cells usually get crushed and are observed as yellow or yellow-gray masses in dry fruits. (Fig. 5). Groups of sub-hypodermal stone cells are bigger and more numerous towards the outer side and they become smaller and fewer towards the inner side (Fig. 5).

The testa of the seed which is crustaceous, consists of 4 to 6 rows of stone cells only. Tegmen is thin and papery. Cotyledons contain fixed oil which gives red colour with sudan red.

Flourescent analysis:

When examined under ultraviolet light the whole fruit externally was yellow; the broken pericarp, deep red; and the central pulp, brownish pink.

Microchemical tests:

Starch: The section of the pericarp shows equitable distribution of starch grains when treated with iodine water.

Tannin: The section of the pericarp shows the presence of tannin especially in the parenchymatous cells when treated with ferric chloride. Further, phlobatannin and non-phlobatannin tests are negative. With iron complex test, it shows the presence of pseudo-tannins. The nature of this pseudotannins as catechin is confirmed by the match-stick and vanillin hydrochloric acid tests. The central pulp contains very little tannin.

Alkaloids: Powdered drug is extracted with ammoniacal chloroform and the extract evaporated. The residue is dissolved in dilute HCl. The resultant solution is tested with Meyer's, Dragandorff's, Hager's, Marme's and tannic acid solutions. All the above tests are negative indicating the absence of alkaloids.

Powdered drug:

Powdered drug shows the presence of the following structures under the microscope: (1) Stone cells of various shapes and sizes. They show numerous pits on their thick and lignified cell walls. They measure 32-64-100-142-160 μ in diameter (Fig. 6). (2) Epidermis in surface view is penta- or hexagonal and the cells are filled with brown pigment (Fig. 7). (3) Simple starch grains are also present. Their shape is oval, spherical or obovoid with a concentric or excentric hilum. They measure 19 to 38 μ. A few grains measure 60 μ or 72 μ in diameter (Fig. 8). (4) Spiral, annular and reticulate vessels are also observed. They measure 92-114-174-256-308 μ in length and 16-24-28 μ in width.

ACKNOWLEDGEMENT

We express our thanks to M/s. Himalaya Drug Co., Bombay, and Mr. Vats, Khandala, for the supply of the material. We also thank Dr. R. P. Patel, Principal, L. M. College of Pharmacy, for granting us the facilities in carrying out this work.

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PHARMACOGNOSTIC STUDY OF THE STEM-BARK OF *ZANTHOXYLUM RHETSA* DC.

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Macroscopical and microscopical characters of the stem-bark of *Zanthoxylum rhetsa* DC. have been studied.

In America, the dried barks of *Zanthoxylum americanum* Mill. and *Z. Clava-herculis* Lenne. (Family: *Rutaceae*) are known in commerce as northern and southern prickly ash barks respectively and have been a domestic remedy for the treatment of rheumatic affections, toothache and colic[1]. In India, *Z. rhetsa* DC., is reported[2] to grow in the western peninsula from Coromandal and the Konkan southwards. Its roots and bark are reputed in Goa as 'purgative of kidneys'. They are claimed to remove 'kapha', to cure asthma and bronchitis and to be useful in heart diseases and toothache[3]. The plant is prescribed in diarrhoea and dyspepsia. Its antibacterial activity has also been reported[4].

Recently, the chemical and pharmacological investigations of the stem-bark of *Z. rhetsa* have been reported. Mehta, Mehta and Rana[5] isolated lupeole, an unidentified white crystalline alkaloid from the Karwar variety of the bark. Previously, Chatterjee and Mitra[6] isolated lupeole and four alkaloids from the same bark but obtained from a different source. Patel and Desai[7] found the Karwar variety of the bark to possess cholinergic and spasmolytic activities. No pharmacognosy of the bark has been reported and hence the present work was undertaken.

MATERIALS AND METHODS

The bark, supplied by Mr. V. B. Desai of the Pharmacology Department, was originally collected from Karwar in N. Canara. It was soaked in a mixture of water, alcohol and glycerin (in equal parts) for about ten days. Transverse, longitudinal and tangential hand sections were cleared with chloral hydrate and made permanent in the usual way after staining with safranin and fast green. Maceration was carried out according to Schultze's method.

Macroscopy: The bark consists of flats and slightly recurved pieces and measure about 7cm. long, 5cm. wide and 10mm. thick. The outer surface has a thick, yellowish cork and makes about one half of the total thickness of the bark. The inner surface is rough and shows prominent longitudinal striations.

The cork shows irregular rounded cone-like outgrowths (Fig. 1). The sharp

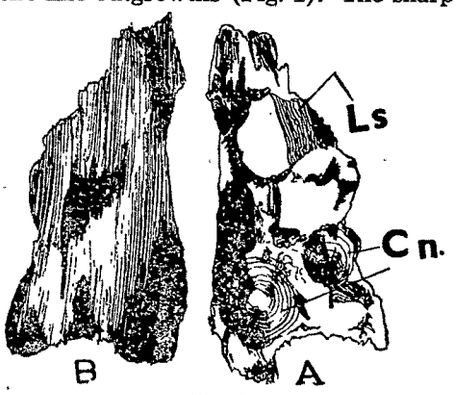

Fig. 1
Dorsal (A) and ventral (B) views of the bark x 1.

pointed apex of such cones are the remains of the spines which get detached automatically. Sides of the cork show a laminated appearance.

Fracture of the bark is fibrous. Taste is first acrid and then persistently slightly bitter.

Microscopy:—Cork which is the outermost tissue is stratified (Fig. 2) with about 7 to 25 alternating bands of smaller cells in 2 to 7 layers and of larger cells in 7 to 15 layers. Smaller cells of the stratified cork are brick-shaped with their

rous but mostly smaller and bigger groups of sclereids. Such groups are bigger in the cortex than in the phelloderm (Figs. 2 and 5). Phelloderm also shows solitary sclereids (Fig. 3). The sclereids are mostly tangentially elongated though isodiametric ones also occur. They are with small lumen, thick and lignified and show well-marked stratification and are traversed by pit-canals which may be branched (Fig. 7). In longitudinal sections the sclereids show three to four clefts (Fig. 6). They measure 82-164-226-304-360 μ in length and 32-44-71-89-119 μ in width. Groups of sclereids are surrounded by thin-walled, small parenchymatous cells each containing a small crystal of calcium oxalate (Figs. 5 and 6). In addition to the calcium oxalate crystals, other sphæro-crystalline masses also occur abundantly in the parenchymatous cells (Figs. 3, 5 and 6). Such crystals mostly occur in relation to the cell wall. They may be solitary or two in a cell and measure 6.6-15.5 μ in diameter. Pericycle is indistinct.

Phloem, which is the last tissue, is smaller in size as compared to the outer tissues (Fig. 2). It consists of sieve tubes. parenchyma, medullary rays, fibres and sclereids. Throughout this tissue, large bands of collapsed cells occur (Figs. 2, 8, 9 and 10). This mostly consists of sieve tubes and some parenchyma, as no sieve tubes are traced in transverse and longitudinal sections. Sieve tubes can however be observed after warming the sections with 2% KOH solution. The collapsed tissue appears slightly lignified. Groups of phloem fibres and sclereids occur throughout the phloem (Fig. 2). Fibres have small lumen, tapering ends and thick walls. They are lignified and stratified and show a few simple pits. In transverse section one to two cleft-like pits are observed. Majority of the phloem fibres are septate (Fig. 7). They measure 564-780-964-1162-1444 μ in length and 200-289-377 μ in width. Groups of fibres are surrounded by a crystal sheath of thin-walled parenchyma cells each containing a crystal of calcium oxalate (Figs. 9 and 10) measuring 15.5-24.4 μ.

Sclereids occur as few groups in phloem (Figs. 2, 8 and 9) and show the same characters as those of the cortex.

Phloem is traversed by medullary rays which have radially elongated and thin-walled parenchymatous cells. Parts of the rays may get crushed along with the adjoining phloem tissue to form collapsed transverse bands (Fig. 2). Tangential sections show the maximum heights of medullary rays as 11-12 cells and width as 2-3 cells (Fig. 9).

Cells of phloem parenchyma are big, thin-walled and isodiametric. They also show sphæro-crystalline masses (Fig. 10).

Microchemical tests: The sphaero-crystalline masses are insoluble in acetic and hydrochloric acids as also in water, chloral hydrate and ammonia. However, they are soluble in 5% KOH with yellow-orange colour and in sulphuric acid with yellow colour changing to brown.

These tests indicate the probable nature of the sphaero-crystalline masses to be hesperidin[8]. Isolation of this material and further chemical investigation are in progress.

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PHARMACOGNOSTIC STUDY OF *MERREMIA EMARGINATA*, HALLIER.

In India, *Herpestis monniera* (Linn.) H. B. & K. *(Scrophulariaceae)* and *Hydrocotyle asiatica* (Linn.) *(Umbelliferae)* are known as *'Brahmi'* and used from ancient times as a brain tonic. Their pharmacognosy has been reported by Prasad[1]. In North Gujarat and Saurashtra, *H. asiatica* does not grow wild. In the above regions entire plant of *Merremia emarginata* Hallier (*Syn. Ipomea reniformis* Choisy; *Evolvulus emarginatus,* Burm.) is sold and used as *'Brahmi'*[2]. Further, it is used in a number of diseases of the kidney, bladder, lungs, uterus etc.[2 3]

As no pharmacognosy of *M. emarginata* has been reported uptill now, the present work was undertaken.

Merremia emarginata is an annual herb with many filiform, creeping and hairy branches which root at the nodes. *M. emarginata* and *H. asiatica* closely resemble each other morphologically; the leaves are similar to *H. asiatica* except that they are rather broader when compared to their long axis. Each leaf is ovate-cordate in shape, with an emarginate apex and crenate margin. Old leaves at times develop a red margin. They possess a strong smell and a slightly acrid taste. Root is a tap root. Adventitious roots help the plant to cover a large area.

Both *M. emarginata* and *H. asiatica* belong to different families and naturally differ from one another anatomically. *M. emarginata* grows in a more moist environment which can be ascertained by the presence of large air spaces in the cortex and the pith of the stem and ~~the~~ cortex, the root. The change in the vascular tissue from root to stem is of *Mirabilis* type[4].

Stem of *M. emarginata* shows the presence of two celled epidermal trichomes, prominent air spaces in the cortex and pith, distinct endodermis, small groups of pericyclic fibres, perimedullary phloem, starch and calcium oxalate crystals which are absent in the stem of *H. asiatica.*

Leaf of *M. emarginata* shows the presence of glandular hairs and rubiaceous stomata which are absent in *H. asiatica.*

Palisade ratio for *M. emarginata* is 19 to 23.5 while that for *H. asiatica* is 3.25 to 4 to 5.75. Stomatal index for the upper epidermis of *M. emarginata* is 11 to 16 and that for the lower epidermis is 16 to 20. Vein islet number in case of *M. emarginata* is 16 to 18.

Young roots of *M. emarginata* show tetrarch or triarch stele. Adventitious roots which arise from the pericyclic region of the stem and branches do not come out obliquely but travel straight through the cortex for a distance.

Micro-chemical tests:—With Sudan III, resin which is more in the pith of the stem and in the midrib, is stained golden yellow. The aqueous extract of the powder shows the presence of reducing sugars and glycosides[5]. The alcoholic filtrate of the powdered drug gave positive tests with Liebermann Burchard[6] and Hesse's[7] tests, thus indicating the presence of sterol. Tests for mucilage and alkaloid were negative.

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12 January 1960.

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PHARMACOGNOSY OF *WITHANIA SOMNIFERA* DUNAL

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Received 23 February 1959

Pharmacognostic study of leaf, stem and young and old root of *Withania somnifera* Dunal has been carried out. It is suggested to revise the present monograph on *Withania* roots of I. P.

Withania somnifera Dunal, belonging to the family *Solanaceae* and known as *asvaghandha, asan or asguned,* is a reputed medicinal plant. All parts of the plant but more especially the roots are used in medicine. The roots are official in Indian Pharmacopoeia.[1]

The roots of the drug have been the subject of several chemical and pharmacological investigations.[2, 3, 4, 5] Some pharmacognostic description of the roots has been mentioned by Dutta and Mukerji.[6] Neuwald and Loges[7] mentioned the distinguishing pharmacognostic characters of *Withania* roots and *Rauwolfia serpentina* roots.

Kurup[8] found from alcoholic extract of the leaves, a pale yellow crystalline solid which in dilution of 1:600,000 completely inhibited the growth of *S. aureus.*

In the published literature, the pharmacognosy of stem bases, which are always associated with the roots in the commercial drug, has not been mentioned. Further, pharmacognosy of leaf has not been reported. Hence, a study of leaf, stem and root has been carried out.

MATERIAL AND METHODS

The material used was purchased from the local market as '*Asan*' and also received from Central Drugs Laboratory, Calcutta. Further, fresh plant was collected and identified by us as *W. somnifera* according to Cooke[9] and Hooker.[10] It was found that the drug from commerce and Calcutta consisted of tuberous roots.

Free-hand sections were taken for the leaf, stem base, stem and root and after staining with safranin, were made permanent. Root was macerated according to Schultz's[11] process.

Description of the plant:—The plant is a perennial, branched, erect undershrub, with a tap root system whose thickness is upto or more than 5 cm. Aerial part is covered thinly by wooly hairs. Stem and a number of branches emerge from the top of the root. Lower leaves are alternate but the upper ones are opposite (Fig. 1A). Flowers are yellowish-green and in axillary groups of one to three to six. (Fig. 1B). Calyx is hairy on its outer side, gamosepalous and possesses five long and linear teeth. Calyx-base is deltoid. Corolla is gamopetalous and possesses five lanceolate and acute lobes. Stamens are five in one whorl, epipetalous and alternating with corolla lobes. Ovary is two-celled and the two carpels are obliquely placed. Ovules are many on an axile placenta. Stigma is bi-fied. Fruit is a berry, red when ripe and enclosed in a globose, slightly five angled inflated calyx having five connivent calyx-teeth above (fig. 1A).

Morphology

Leaf:—Leaves have a small petiole which is grooved at the tip. Both the surfaces are dull greenish and are usually clothed with hairs. They measure 5 to 10 cm. by 2.5 to 5 cm. and are ovate with acute apex, oblique base, wavy margin and reticulate venation (fig. 1).

Stem:—Stems and branches are variously thickened according to their age and go vertically upwards. Nodes are prominent only on the side from where petiole arises. Internodes are about 1.5 to 3 cm. long. They are cylindrical, green and show longitudinal wrinkles, Young branches possess many whitish hairs. Transversely cut surface shows yellow-grey cork, whitish-yellow

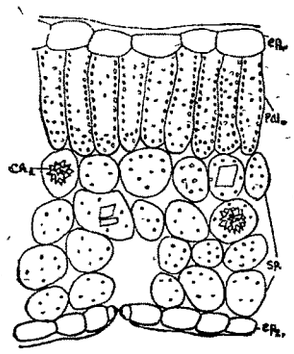

Fig. 2. T.S. of lamina part of the leaf x 175.

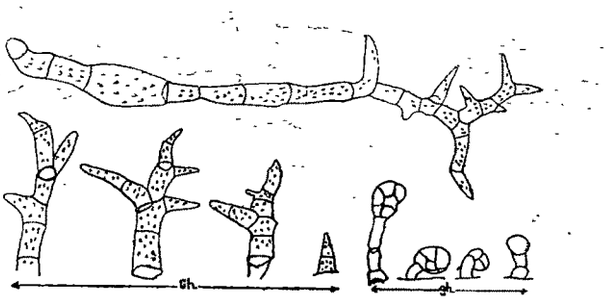

Fig. 3. Glandular and covering hairs of leaf and stem x 100.

Fig. 4
Lower epidermis with stomata x 110.

Isolated parenchymatous cells in the cortex and in the pith are filled with black granular mass of microsphenoid calcium oxalate crystals. Few starch grains are present in some of the parenchymatous cells.

Root (young):—Cork consists of about two to six rows of isodiametric, nonlignified and suberised cells which are radially arranged. Phellogen is indistinct. Phellöderm is a broad zone consisting of about eight to nine rows of tangentially elongated and somewhat radially arranged compact cells (fig. 6). Phloem parenchyma cells are isodiametric with their cell walls curved and have intercellular spaces. Cambium is of four to eight rows of tangentially elongated cells and mostly forms storage parenchyma on both the outer and inner sides. Secondary xylem is a wide zone consisting mostly of xylem parenchyma in which scattered groups of vessels associated with tracheids and fibres are present. Frequency of vessel and tracheid formation increases with the age of the root. Thus, even in a young root though scattered in xylem parenchyma, vessel containing areas are bigger and more near the cambium. Xylem parenchyma consists of roundish cells with no intercellular spaces. In the centre, primary xylem forms a thick woody core. Near this core interxylary phloem is observed as small groups. Vessels occur singly or in groups of two to four. They measure 176-203-250-315-326μ in length and 27-38-50-61-73μ in width. They show mostly bordered pits with slit-like openings. Spiral and annular vessels are also observed. Tracheids show oblique bordered pits and are 211-296-323-376-400μ in length and 15-19-21-23-27μ in width. Tracheids are often accompanied by xylem fibres which measure 420-507-595-717-770μ in length and 15-16-18-23-25μ in width.

A few medullary rays with radially elongated parenchymatous cells traverse the conducting tissues and are uniseriate or multiseriate (fig. 6).

Root (old):—In old roots, the cork cells are exfoliated or crushed so that only few rows of cork cells are observed (fig. 7). They are isodiametric and nonlignified. Phellogen of two to four diffuse rows is noticeable Phelloderm layers are increased to about twenty. They are tangentially elongated and are compact parenchymatous cells which are somewhat radially arranged (fig. 7.).

Phloem forms the outermost zone of vascular tissue below the phelloderm. It consists of sieve tubes, companion cells and phloem parenchyma. There are no fibres in the phloem tissue. Cambium is

Fig. 9
Starch grains or root. x 120.

7.8-23μ in diameter. Identical starch grains are observed in old roots also, but they are fewer in number.

Calcium oxalate crystals:—Some of the parenchymatous cells especially those of phelloderm and xylem parenchyma of root and cortex and pith of stem contain black granular masses of microsphenoid crystals of calcium oxalate (figs. 4, 5 & 6). Dutt and Mukerjee[6] and I.P.[1] mention absence of crystals. Neuwald and Loges[7] mention that dark granular masses are present in parenchymatous cells. We found that these dark masses are insoluble in acetic acid but soluble in hydrochloric acid and with 75% sulphuric acid forms acicular crystals. Thus, the dark masses are identified as calcium oxalate crystals.

Alkaloids:—Most of the cells of phelloderm, medullary rays, phloem parenchyma as all parenchyma cells of secondary xylem are filled with alkaloid, which is determined by Wagnar's test.

DISCUSSION

The plant is a perennial undershrub, and thus, young tuberous roots and older roots have distinct and different macroscopic and microscopic characters.

Generally in commerce, young tuberous roots are used and it would be desirable to mention age, season of collection of the drug and percentage of active constituents in the I.P. monograph. Further, the correction as regards presence of calcicum oxalate crystals and a detailed revised monograph in view of the above work may be prepared.

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We express our thanks to the Director, Central Drugs Laboratory, Calcutta, for the supply of the material. We also thank Dr. R. P. Patel, Principal, L. M. College of Pharmacy, for granting us facilities in carrying out this work.

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Botanical Identity of 'Konkan' (Mysore) Variety of *Capparis moonii* Fruits

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By a comparison of the authentic samples of the fruits and entire plants of 'Khandala' and 'Konkan' varieties of *Capparis moonii* Wight, it has been found that the botanical identity of 'Konkan' variety is *Capparis horrida* Linn. and not *C. moonii*.

THE fruits of *Capparis moonii* Wight are recommended in the treatment of pulmonary tuberculosis[1]. Sheth and Murty[2] distinguished the two varieties of *C. moonii*, viz. the 'Khandala' and the 'Konkan' varieties by the morphological characters of the plants and fruits, and considered the fruits of the latter variety to be more effective. Shah and Sukkawala[3] have studied the pharmacognosy of *C. moonii* ('Khandala' variety). Bundeally and Bellare[4] found that only the fruits of the 'Konkan' variety possessed tuberculostatic property. Recently[5], *l*-stachydrine, rutin and β-sitosterol have been isolated from the 'Konkan' variety.

Authentic samples of the fruits of the two varieties were obtained and it was found that the diameter of the fruits of the 'Konkan' variety is less (1·0-1·5 in.) than that of the fruits of the 'Khandala' variety (2·0-4·0 in.). This and the other morphological characters[2] of the plants show wide differences between the two varieties. This led to the suspicion that the two varieties may not belong to the same species (*C. moonii* Wight). Further investigations of entire authentic plants and fruits of both the varieties confirmed that the fruits of the 'Konkan' variety are obtained from *C. horrida* Linn., a distinct species, and not from *C. moonii* Wight.

Thus, all the properties and chemical constituents of the 'Konkan' variety should be attributed to *C. horrida* Linn. Distinguishing pharmacognostic characters of the fruits of *C. moonii* Wight and *C. horrida* Linn. will be published elsewhere.

The authors wish to express their thanks to Shri A. V. Modi of Unichem Laboratories, Bombay, for the supply of authentic fruits of 'Konkan' variety and to Prof. N. K. Patel of M.G. Science Institute, Ahmedabad, for his suggestions and also for lending us the herbarium sheets of the two species.

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