C H A P T E R - XI

Pharmacognosy of stem-bark of ZANTHOXYLUM RHETSA DC.

The dried barks of Zanthoxylum americanum Mill. and Z.Clavaherculis Lenne. (Rutaceae) are commercially known in America as northern and southern prickly ash bark respectively. There, they are used as domestic remedy for the treatment of rheumatic affections, toothache and colic (Claus, 1956). In India Z. rhetsa DC., is reported to grow in the area adjoining the Coromandal coast and the Konkan southwards (Hooker, 1885). Its roots and bark are reputed in Goa as 'purgative of kidneys'. They are claimed to remove 'kapha' and to cure asthma, bronchitis, heart diseases and toothache (Kirtikar and Basu, 1933). The plant is prescribed in diarrhoea and dyspepsia. Its antibacterial activity has also been reported (Joshi and Magar, 1953).

Recently, the chemical and pharmacological investigations of the bark of Zanthoxylum rhetsa have been reported. Mehta, Mehta and Rana (1960) isolated lupeole, an unidentified white crystalline alkaloid from the Karwar variety of the bark. Previously, Chatterji and Mitra (1960), isolated lupeole and four alkaloids from the same bark but obtained from a different source. Patel and Desai (1960) 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.

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M O R P H O L O G Y

The bark which consists of flat or slightly recurved pieces measuring about 7 cm. long, 5 cm. wide and 10 mm. thick. The outer surface has a thick, yellowish cork which makes about half of the total thickness of the bark. The inner rough surface shows prominent longitudinal striations (Plate XIX,1B).

The cork shows irregular rounded cone-like outgrowths externally (Plate XIX, 1A). The sharp pointed apex of such cones are the remains of the spines which get detached automatically. Sides of the cork give laminated appearance.

Fracture of the bark is fibrous, Taste at first is acrid and then persistently bitter to some extent.

H I S T O L O G Y

Young stem :

The young stem on its outer side has an epidermis with thick cuticle, which is followed by 1 - 3 layers of cork, 1 - 2 lavered phellogen and 3 - 4 layer of phelloderm. Cortex is parenchymatous, 20 - 25 cell thick with many, scattered roundish to oval oil cells (Plate XIX 2A). Pericyclic fibres are present all

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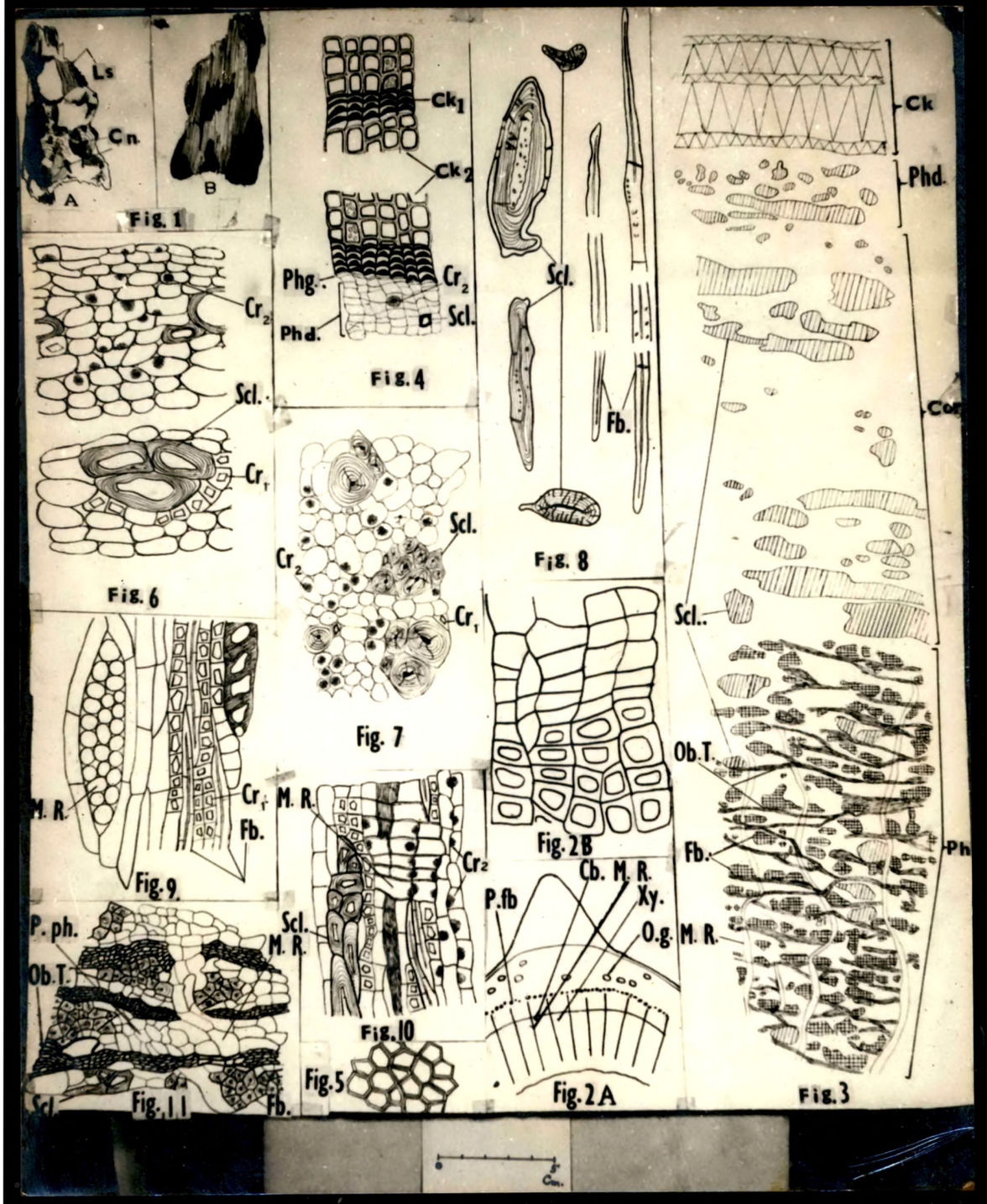
around the vascular cylinder, in the form of small lignified groups. Cambium is 3-4 layered. Uni- to multiseriate medullary rays traverse the vascular tissues. A number of endarch primary xylem groups are present on the innerside of xylem and around the periphery of pith. The pith which is hollow and parenchymatous, shows pits in in the peripheral cells.

Prickles originate from few cells of the phellogen. As observed in a young stem small strips of the phellogen become more active and give rise to many layers of thick walled lignified cells which after complete development turn into a sharp pointed structure. The rest of the phellogen acts normally to give rise to two layers of cork cells on its outer side (Plate XIX, 2A and 2B).

Cells of the cortex, phloem and xylem vessels are filled with sphaero-crystalline masses. Parenchymatous cells of cortex, medullary rays and pith contain abundant starch grains.

Bark :

Cork is the outermost tissue whose cells are stratified (Plate XIX, 3). 7-25 bands of smaller cells alternate with an equal number of bands formed of large cells. Smaller cells 2 - 7 in a band are brick-shaped. The bigger cells, 7 - 15 in a band are cubical


Ls
Cn
A
B
Fig. 1
Ck1
Ck2
Phg.
Cr2
Phd.
Scl.
Fig. 4
Cr2
Scl.
Cr1
Fig. 6
Scl.
Cr2
Cr1
Fig. 7
Scl.
Fb.
Fig. 8
Ck
Phd.
Cor
Scl.
Ob.T.
Fb.
Ph
M. R.
Fig. 3
M. R.
Cr1
Fb.
Fig. 9
M. R.
Cr2
Fig. 10
Cb. M. R.
Xy.
P.fb
O.g.
Fig. 2B
P. ph.
Ob.T.
Scl.
M. R.
Fig. 11
Fig. 5
Fig. 2A
5 Cm.

P L A T E - XIX

(Figs. 1 - 11 : Zanthoxylum rhetsa DC.)

Fig. 1 - Stem-bark. x 1

A - dorsal view; B - ventral view.

Fig. 2 - 2A - T.s. young stem (diagrammatic). x 30

2B - T.s. Phellogen, cork and phelloderm at a spine. x 780

Fig. 3 - T.s. bark (diagrammatic). x 80.

Fig. 4 - T.s. periderm showing small and big cork cells. x 285.

Fig. 5 - Cork cells in surface view. x 285.

Fig. 6 - T.s. cortex. x 285.

Fig. 7 - L.S. cortex. x 285.

Fig. 8 - Sclereids and fibres from macerated material. x 285.

Fig. 9 - T. l. s. passing through phloem region. x 285.

Fig.10 - L.s. passing through phloem region. x 285.

Fig.11 - T.s. passing through phloem region. x 285.

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

Cb. - cambium; Ck. - cork; Ck_1 - small cells of cork; Ck_2 - large cells of cork; Cn. - cone; Cor. - cortex; Cr_1 - calcium oxalate crystal; Cr_2 - sphaero-crystalline mass; Fb. - fibre; Ls. - laminated sides of cork; M.R. - medullary ray; Ob.T. - obliterated tissue; O.g. - oil cell; Ph. - phloem; Phd. - phelloderm; Phg. - phellogen; P.fb. - pericyclic fibre; P.Ph. - phloem parenchyma; Scl. - sclereid; Xy. - xylem.

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or slightly elongated radially (Plate XIX,4). Cork cells appear polygonal in surface view (Plate XIX,5). Bigger cells measure 22-31 μ tangentially and 23.5-34 μ radially, while the smaller cells measure 10-19 μ radially. The cork cells in general are suberised and lignified and show big oval pits on their walls. The phellogen has 1-2 layers of distinct thin-walled brick-shaped cells (Plate XIX, 4). Phelloderm and cortex are not clearly demarcated; they together form a very wide parenchymatous zone (Plate XIX,3). Phelloderm consists of isodiametric cells. Outermost layers are radially arranged and are in a compact manner (Plate, XIX, 4). Tangentially elongated cells of the cortex show intercellular spaces (Plate XIX, 6). Isolated sclereid cells or numerous small or large groups of sclereids strengthen the phelloderm and the cortex (Plate XIX 3,4 & 6). The sclereids are generally tangentially elongated; isodiametric ones are rare. They have a small lumen and thick lignified wall. The latter shows well-marked striations and pit-canals which are occasionally branched (Plate XIX, 8). In longitudinal section a sclereid shows 3-4 clefts (Plate XIX, 6). Groups of scereids are surrounded by small thin-walled parenchyma, each one of which contains a small crystal of calcium oxalate (Plate XIX,6 & 7). 1-2 sphaero-crystalline masses may also occur abundantly in a parenchyma cell adhering to the cell walls (Plate XIX 4, 6 & 7). They may measure 6.6-15.5 μ in diameter. Pericycle is obscure.

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Phloem is smaller in size as compared to the outer tissues (Plate XIX, 3). It consists of sieve tubes, parenchyma, medullary rays, fibres and sclereids. Throughout this tissue, large bands of ceratenchyma occur (Plate XIX, 3, 9, 10 & 11). This mostly consists of collapsed sieve tubes and some parenchyma; a few sieve tubes can however be observed after warming the section with 2% KOH solution. The ceratenchyma appears slightly lignified. Groups of phloem fibres and sclereids occur throughout phloem (Plate XIX, 3). Fibres have small lumen, tapering ends and thick walls. They are lignified and stratified and show a few simple pits. In transverse section 1-2 cleft-like pits are observed. Majority of the phloem fibres are septate (Plate XIX, 8). They occur in groups which are surrounded by a sheath of thin-walled small parenchyma cells, each containing a crystal of calcium oxalate measuring 15.5-24.4 μ (Plate XIX 9 & 10).

Sclereids occur as a few groups in phloem (Plate XIX 3, 10 & 11) and show the same characters as those of the cortex.

Phloem is traversed by medullary rays. Tangential sections show the maximum heights of medullary rays as 11-12 cells and width as 2-3 cells (Plate XIX, 9). These cells are radially elongated and thin-walled. Parts of the rays may get crushed along with the adjoining phloem tissue to form bands of ceratenchyma (Plate XIX, 3)

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Cells of the phloem parenchyma are big, thin-walled and isodiametric. They also show the same sphaero-crystalline masses as in case of phelloderm and cortex (Plate XIX, 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 that the sphaero-crystalline masses are of hesperidin (Trease, 1957).

T A B L E - 25

MEASUREMENTS OF BARK ELEMENTS

Elements	Length	Width
Phloem fibres	564-780-964-1162-1444 μ	200-289-377 μ
Sclereids	32-164-226-304-360 μ	32-44-71-89-119 μ

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S U M M A R Y

Bark consists of flat of slightly recurved pieces.

Young stem develops a subepidermal phellogen which at places gives out many layers of lignified cells on its outer side; the latter develops a sharp pointed structure.

Bark on its outer side shows a stratified cork. It is formed of about 7-25 bands of small cells alternating with an equal number of bands of large cells. Phelloderm and cortex together form a wide parenchymatous zone and contains numerous small and large groups of sclereids. Sclereids are surrounded by small parenchyma cells each containing a calcium oxalate crystal. Sphaero-crystalline masses of hesperidin are also found throughout the parenchymatous zone.

Bands of ceratenchyma are common inthe phloem zone. Groups of phloem fibres as well as a few sclereids are of common occurrence in this zone. Such groups are also surrounded by cells containing oxalate crystals. A few sphaero-crystalline masses are also found in this zone. 11-12 cells long and 2-3 cells wide medullary rays traverse the phloem.