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PHARMACOGNOSY OF SWIETENIA MAHAGONI BARK DRUG

MANISHA SANYAL (SARKAR) AND P. C. DATTA*

Botanical Lab of Pharmaco – anatomy, University College of Science, Calcutta – 700 019, India.

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ABSTRACT: *Swietenia mahagoni Jacq. (native to tropical America), a common avenue tree of India, yields a bark drug, used as antipyretic, bitter tonic, astringent, and occasionally as a substitute for Cinchona. The district characteristics of the species are : blackish brown colour; cracks and fissures with both clean cut and thick recurved edges; irregular wrinkles; splintery and fibrous fractures; bitter taste; compound sieve plates; mostly biseriate rays; abundant rhomboidal crystals; presence of tannin, saponin, lignin and absence of alkaloids.*

INTRODUCTION

Swietenia mahagoni Jacq. (*Meliaceae)* is a large tree that was introduced from Jamaica to India. The plant (True or Spanish Mahagony) is world famous as a timber yielder. The bark of this plant has certain physiological actions and medicinal uses. Moreover, it is sometimes used as a substitute of *Cinchona.* The other types of mahagony trees, mahagony e.g. Indian mahagony, bara mahagony are also interchangeable. Present attempt is to distinguish the bark drug from other mahagony bark drugs from therapeutic aspect and the specific pharmacognostic characters.

Related species and possible substitutes

Swietenia Jacq. Includes 7 – 8 valid species (Willis, 1973) of which *S. mahagoni* Jacq., *S. macrophylla* King and *S. humilis* Zucc. are the most common.

The species of *Swietenia* other than the *S. mahagoni* may substitute for the drug because they are very much alike in morphology. *S. macrophylla* is also popular called “bara mahagony” or Malay mahagony in Bengal (W. I. 1976). Moreover, it may be substituted by Indian mahagony (*Toona ciliate).*

Geographical distribution and vernacular names

Swietenia Jacq. (*Meliaceae)* is native to Tropical America, Central America and the West Indies and distributed in Jamaica, South Florida, Central America, Colombia, Venezuella and possibly Ecuador (W. I. 1976). Mahagony is the vernacular name used in West Indies (Benhall, 1946).

Therapeutic uses and actions of the bark

The bark serves as an antipyretic, bitter tonic and astringent or as a substitute of *Cinchona* (Burkill 1935, Benthall 1946, Howes 1953, Watt and Breyer – Brandwijk 1962, W. I. 1976).

Use of other parts of the plant

This tree yields perhaps the most famous timber in the world and is largely used for furniture and all purposes for which a hard wood of the best quality is needed (Benthall 1946, W. I. 1976). True mahagony timber is highly prized for decorative articles (W. I. 1976).

Reports on chemical constitution

The bark contains 15% tannin (Howes 1953, W. I. 1962) and no alkaloidal principles (Watt 1893, Burkill 1935, Howes 1953, W. I. 1962). The gum dissolves readily in water, forming a weak dark mucilage which freely reduces Fehling's solution, and is precipitated by acetate of lead and gelatinized by lead basic acetate and by ferric chloride but not by borax (Watt 1893, W. I. 1962). The seed on extraction with petroleum ether gives 50% of a yellow fixed oil with an unpleasant and bitter taste and fatty acids: palmitic, 9.48%, stearic, 18.44%, oleic, 56.01% and lenolenic, 16.07%. The seed contains a bitter substance ($C_{21}H_{30}O_7$; m.p. 127^o), mahagonin ($C_{27}H_{30}O_8$); 7 – deacetyl – 7 – oxogedunin ($C_{26}H_{30}O_6$); cyclomahagenol ($C_{31}H_{52}O_2$) and 6 – hydroxymethyl angolensate; melianone ($C_{30}H_{46}O_4$) in leaf. The wood contains 6% tannin and cycloencalenon (Howes 1953, W. I. 1962).

MATERIALS AND METHODS

Bark samples examined are: B 354, B 355 (both from South Calcutta), B 356 (from Serampore, West Bengal), B 357 (from South Calcutta), B 363 (from Serampore, West Bengal) all collected by Sanyal. Evaluation techniques followed (Jackson and Snowdon 1968, I. P. 1970, Rayner 1970, Trease and Evans 1972).

Drug evaluation

a. *Organoleptic evaluation*

Outer surface (Fig. 1) rugged; blackish brown before and snuff brown after scraping with a scapel; corky warts present; inner surface (Fig. 2) snuff brown; striations fine. Fracture splintery and fibrous; odour bitter.

b. *Microscopic evaluation*

Cork cells (Fig. 3) hexagonal to rectangular (Fig. 4), the remnants of shed off portion of old bark and rhytidome present. Phelloderm cells contain crystals andstarch grains. Cortex cells thin-walled parenchymatous; starch grains almost in all cells, simple, round to oval; hilum indistinct. Crystals almost evenly distributed in bark, right – square prisms predominant, rosettes occasional. Sieve tubes (Fig.6) with compound sieve plates; phloem fibres with irregular transactional outline (Fig. 5), in compact bundles, thick – walled, with simple pits, a band of radially compressed cells containing a reddish orange substance and numerous crystals. Phloem rays mostly biseriate and occasionally uniseriate (Fig. 6), contain starch grains and crystals (prisms and rosettes).

Powder reddish snuff brown; very bitter; chalk absent; saponin and tannin present; volatile oil and anthraquinone absent.

Broken pieces of fibres abundant (Fig. 7), also attached to phloem parenchyma cells and crushed cells containing a reddish orange content; cork cells (Fig. 8) and phellodermcells (Fig. 9); abundant starch grains and crystal in parenchymatous cells

(Fig. 10) and isolated, both prism and rosette (Fig. 11) common.

Cork 28 – 40 cells and 720 – 1080 µ in depth; phelloderm 7 – 9 cells in extent. Prismatic crystals 4 – 28 µ long and 4 – 24 µ broad; rosette crystals 16 – 24 µ in diameter. Cortex 8 – 10 cells in breadth. Secondary phloem 1680 – 1800 µ in depth. Sieve elements 160 – 252 µ long, 20 – 30 µ broad, phloem fibres 1080 – 1320 µ long, 12 – 20 µ high. Uniseriate ray width near cambium 16 – 20 µ and biseriate ray width near cambium 32 – 48 µ. Upright cells 20 - 40 µ high, 25 – 35 µ wide; procumbent cells 16 – 32 µ high and 40 – 50 µ wide radial length. Ray abundance towards cambium 7 – 12 / mm.

Histochemistry

a) Colour changes of histological zones by chemical reagents are: presence of lignin in phloem fibres and thick-walled phelloderm (aniline sulphate with H_2SO_4, phloroglucinol-HCl, chlor – zinc – iodine) cellulose in cortex, pheloderm and fibres (iodine soln.). Suberin in cork cells, a few phelloderm and crushed cells of seco. Phloem (Sudan III, strong KOH + H_2SO_4), starch in all cells, protein maximum in thick – walled cells (Lugol's and Millon's reagent), calcium oxalate, sterol in some cells of phellogen (Liebermann – Burchard test).

b) Tests on extractives – Powdered bark was extracted successively with the following solvents of increasing polarity and then each extract fraction was variously tested. *Sterol* was in extracts of pet, ether. Ether, benzene, chloroform, ethyl alcohol; *tannin* in that of ethyl alcohol and water; *oil* in that of pet. Ether, ether, benzene; *protein* and saponin in that of water.

III. Physical evaluation

A. *Fluoresecence behaviour*

Various fluorescence behaviour of the entire bark, powder and extracts with different solvents under UV light and its comparison with colour under day light are shown in Table I.

TABLE – I

Colour changes by UV fluorescence

	Material taken	Colour in day light	Colour in UV light
1	Entire dry bark		
	a. Upper surface	Blackish brown	Dark brown vinaceous
	b. Lower surface	Sepia	Purple slate
2	Dry powder as such	Light brick	Greenish grey
3	Dry powder rubbed on filter paper	Cinnamon	Olivaceous
4	Different extracts (1 gm powder in each of the following 10 ml solvents of increasing polarity were macerated and after 24 hours these		

	were filtered and examined under ordinary and UV light)		
	a) Petroleum ether	Reddish brick	Light greenish grey
	b) Ether	Light brick	Very light greenish grey
	c) Benzene	Faint straw	Sulphur yellow
	d) Chloroform	Light brick	Light greenish grey
	e) Acetone	Light brick	- do -
	f) Alcohol	Dark rust	Citrine green
	g) Water		
	i. pH 5	Light scarlet	Dirty rust
	ii. pH 7	Dark scarlet	Dirty green
	iii. pH 9	Blood colour	Dark purplish grey

B. Extractive values

The powdered bark extracted with solvents of increasing polarity were dried and the following results were obtained; ether 0.3; pet, ether / benzene / acetone 0.5; chloroform 0.7; ethanol 3.5; water 4.1.

C. Ash values

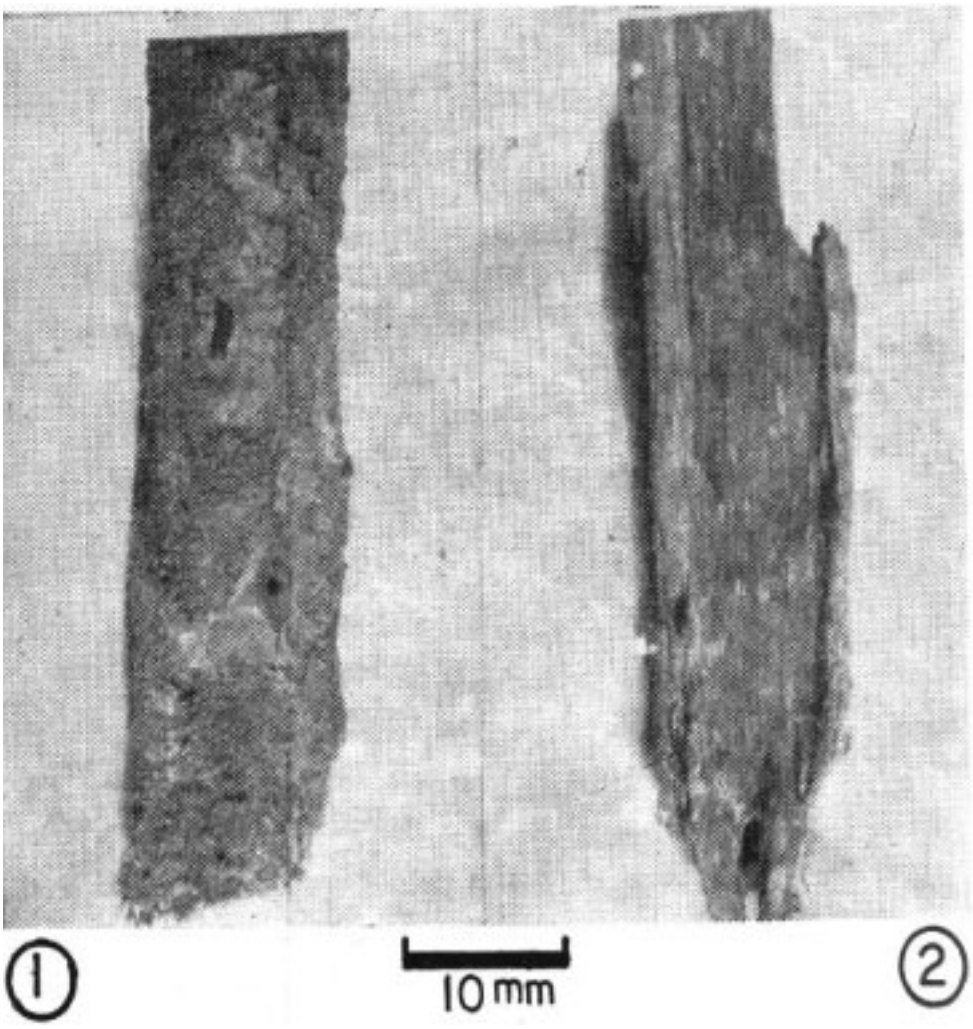
Total ash determined of powdered bark = 22%, total sulphated ash = 14.5%; total water – soluble ash = 1.4%; total acid – insoluble ash = 0.6%.

Distribution from allied species and possible substitutes

Distinguishing features of True (*S. mahagoni)* or Spanish mahagony, Bara Mahagony *(S. marcrophylla)* and Indian mahagony *(Toona ciliate)* are represented below.

The True mahagony bark (T M) differed from others by snuff black colour after scraping with a scalpel (dark or reddish brown in others); snuff brown inner surface, dirty brown in Bara mahagony (BM) and reddish brown in Indian mahagony (IM); rhytidome scaling off (present in others). Cortical cells (shed off in IM); compound sieve plates (simple in BM; compound in IM) broadest of all; extractive values (highest of all); total ash 22% sulphated ash 14.5% (much higher in others), uniseriate rays 72 – 180/µm high (not more than 72/um in others).

True mahagony bark can be distinguished from *Cinchona* bark by the following characters : (1) Absence of idioblasts (containing micro – crystals) and secretion cells in the cortex (present in *Cinchona* bark; (2) presence of oblique sieve plate (transverse in *Cinchona)*; (3) absence of striations on the transverse wall of phloem fibres and funnel shaped pits (a prominent feature of *Cinchona* bark).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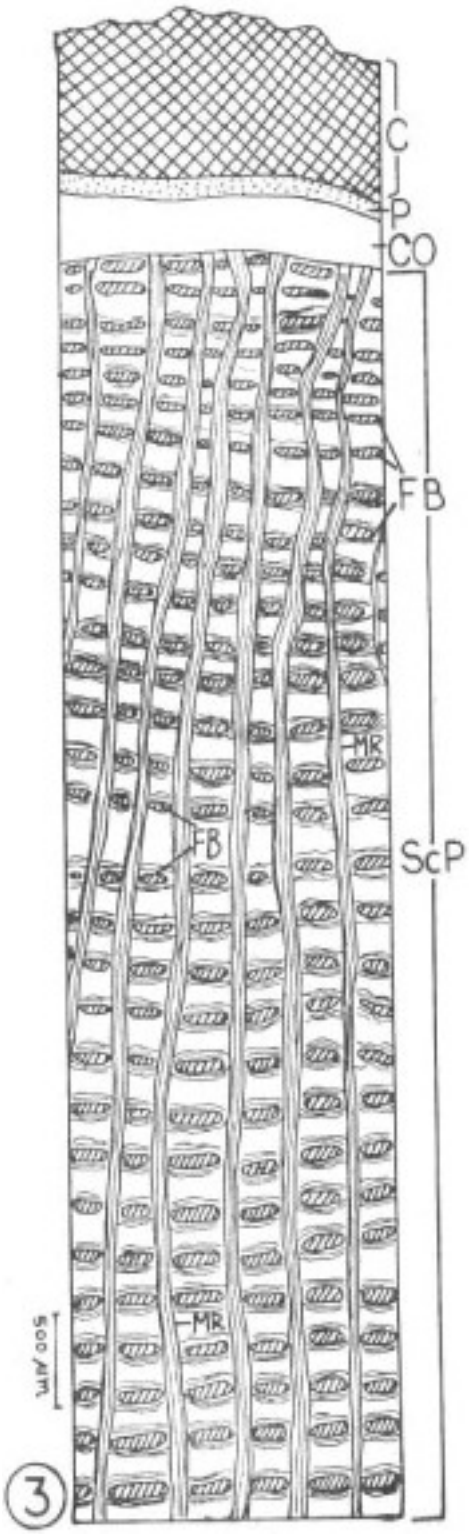
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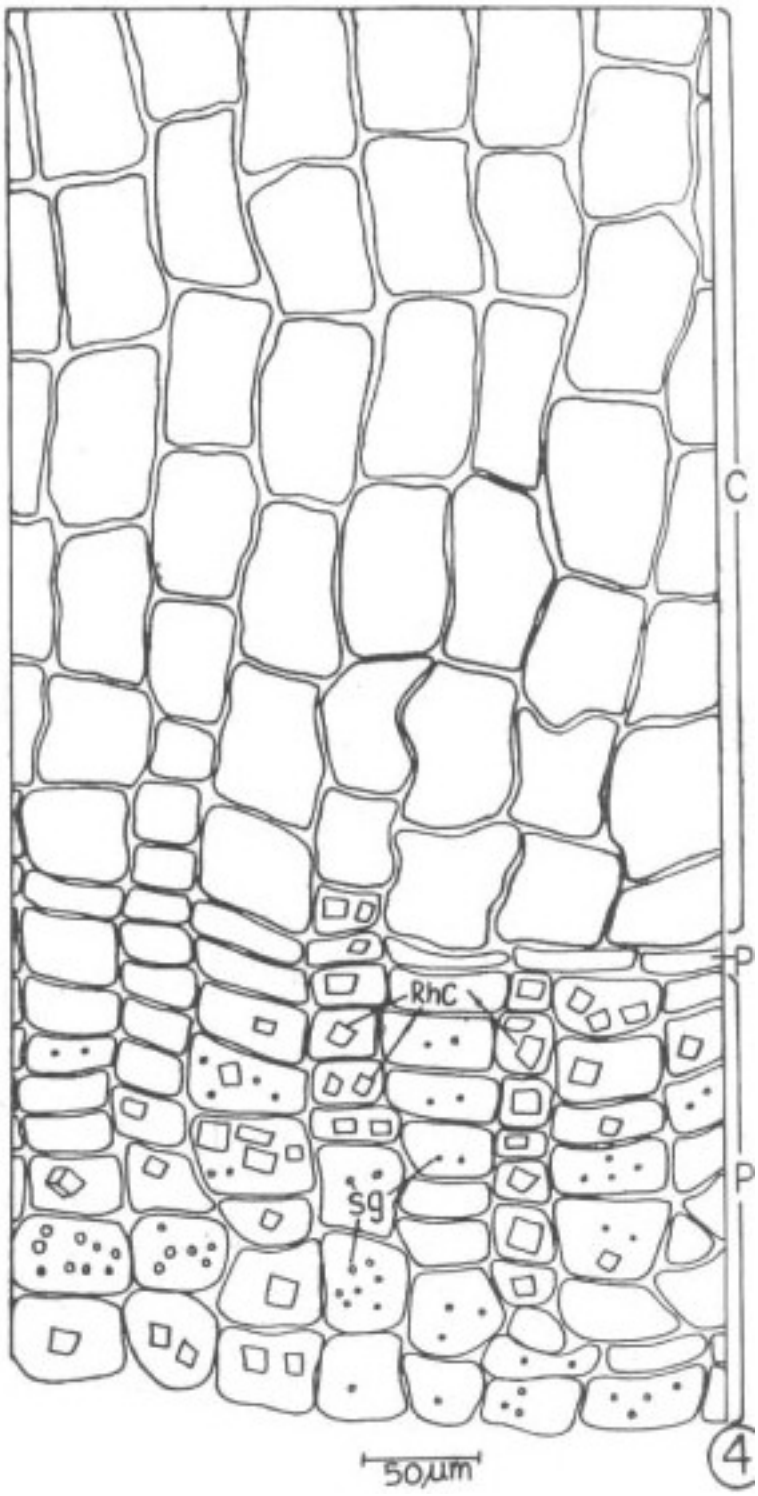
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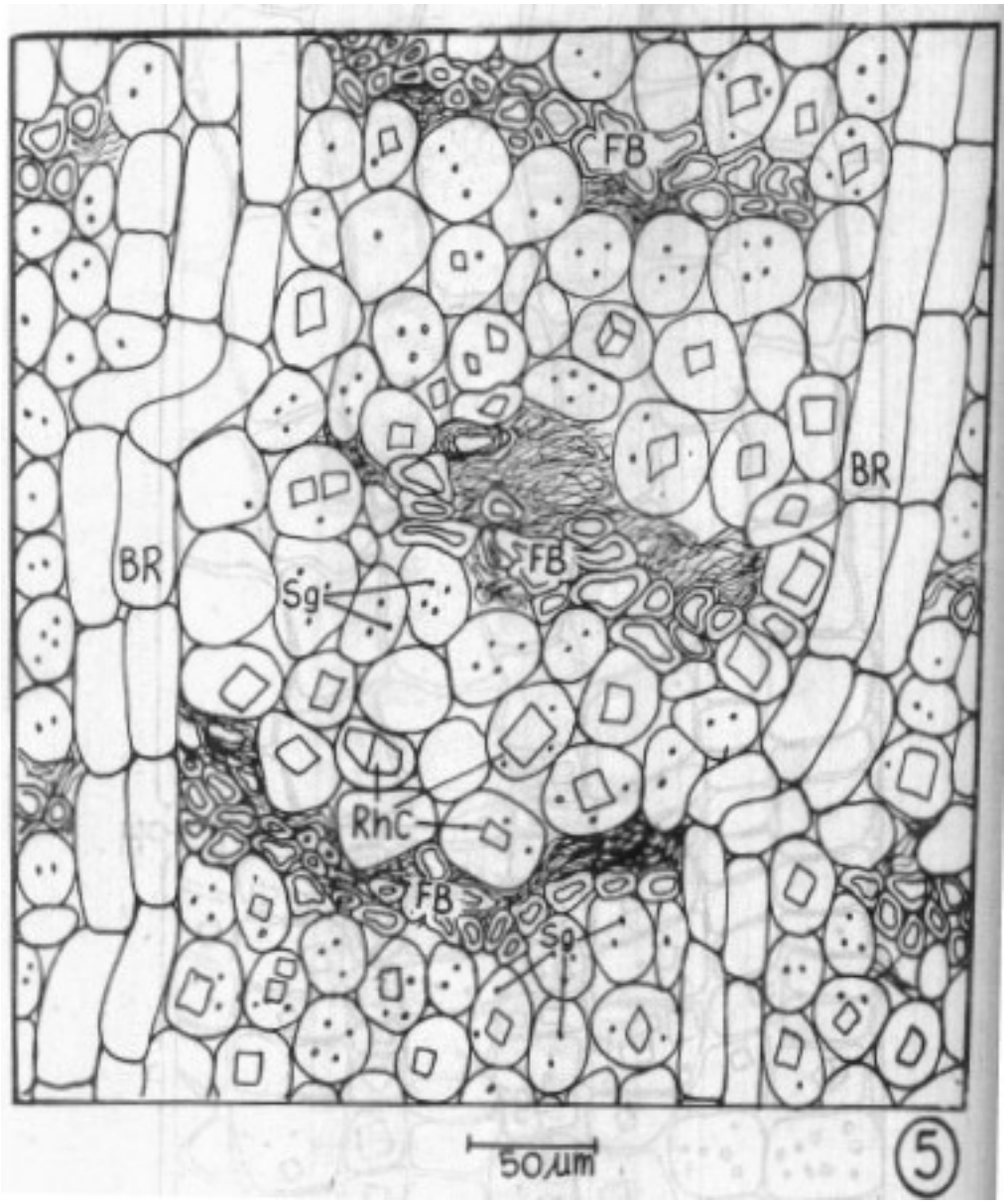
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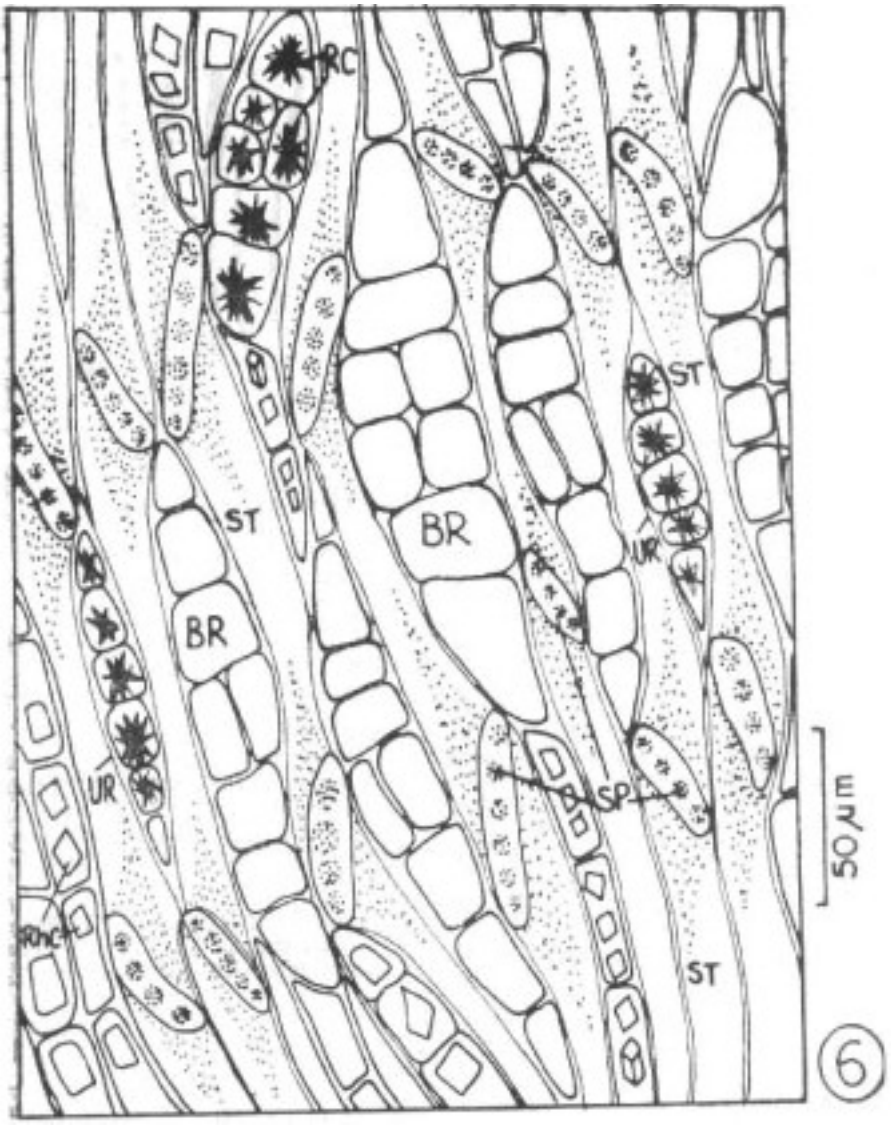
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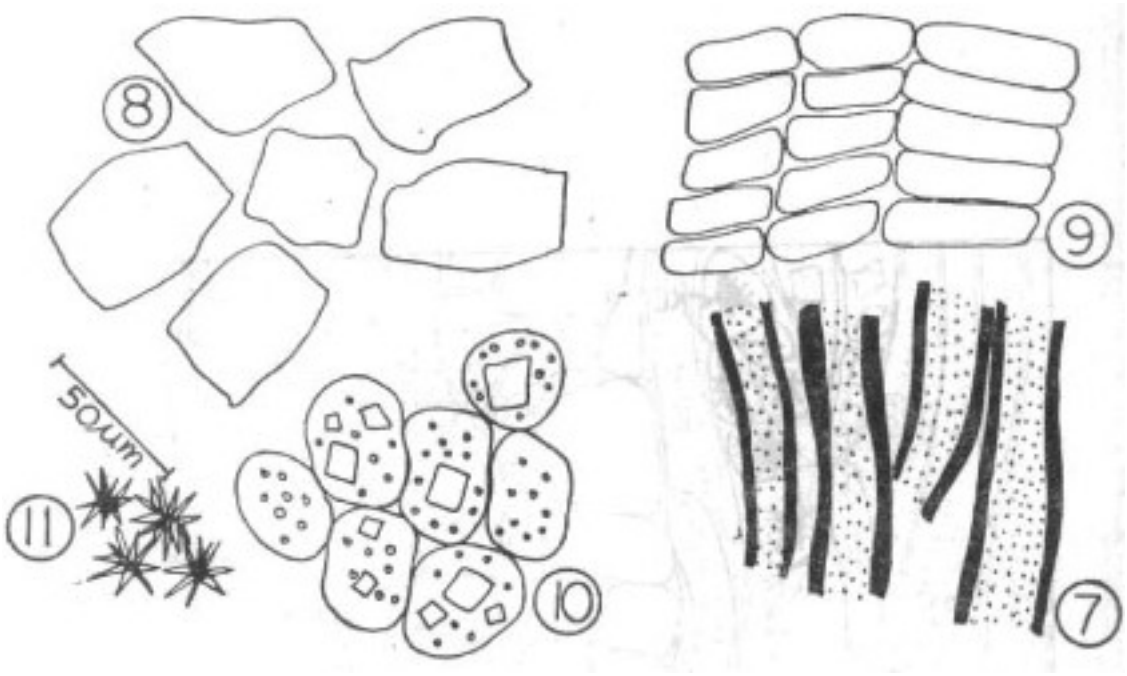

EXPLANATION OF FIGURES

Figs. 1 – 2 : Macromorphology of *Swietenia mahagony* stem bark. 1, Outer surface of the bark showing rugged surface having cork warts and wrinkles. 2, Inner surface of the bark with fine striations.

Figs. 3 – 4 : Sectional views of *Swietenia mahagony* stem bark. 3, Diagrammatic representation of transaction; 4, Transection showing a portion of periderm with indistinct phelloderm.

Figs. 5 – 11 : Tissues in sections and powders of *Swietenia mahagony* stem bark. 5, Transection of a portion of secondary phloem showing biseriate rays and fibre bundles attached with crushed cells with deposits; 6, Tangential longitudinal section (near cambium) showing compound sieve plates, uni – and biseraite rays; 7, Broken fibre pieces in powder; 8, Cork cells in powder; 9, Phelloderm cells in stacks in powder; 10, Parenchyma cells with starch grains and rhomboidal crystals in powder; 11, Rosette crystals in powder.

(Abbreviations used: BR, biseriate ray; C, Cork; CO, Cortex; FB, fibre bundle; P, Phelloderm; PH, phellogen; RhC, rhomboidal crystal; RC, rosette crystal; ScP, secondary phloem; Sg, starch grain; ST, sieve tube; UR, uniseriate ray).

REFERENCES

BENTHALL, A. P. The Trees of Calcutta and its neighbourhood. 101 – 111. Published by Thacker, Spink & Co. (1983) Ltd., Calcutta (1946).

BURKILL, I. H. A dictionary of the Economic Products of Malay Peninusula, **2,** 2111. The Crown Agents for the Colonies, London (1935).

CROMWELL, B. T. *The Alkaloids: IV Reagents.* In : Modern Method of Plant Analysis, Paech, K. and Tracey, M. V. (eds.) Vol. **4 :** 373 – 4. Springer – Verlag – Berlin, Heidelberg (1955).

HOWES, F. N. Vegetable Tannin Materials, 287. Butterworth's Scientific Publications, London (1953).

JACKSON, B. P. and SNOWDON, D. W. Powdered Vegetable Drugs. Churchill Ltd., London (1968).

I. P. 1970. Pharmacopoeia of India, 2nd ed., Govt. of India, Ministry of Health, Delhi (1966).

JOHANSEN, D. A. Plant Microtechnique. McGraw Hill Book Company, New York (1940).

RAYNER, R. W. A Mycological Colour Chart. Commonwealth Mycological Institute. Kew Surrey and British Mycological Society, (1970).

TREASE, G. E. and EVANS, W. C. Pharmacognosy, 10th ed. Bailliere Tindall, London (1972).

WATT. G. A. Dictionary of the Economic Products of India. Vol. VI, Part III. Published under the authority of the Govt. of India, Department of Revenue and Agriculture (1933).

WATT. J. M. and BREYER – BRANDWIJK, M. C. The Medicinal and Poisonous Plants of Southern and Eastern Africa, Second Edition. E & S Livingston Ltd., Edinburgh and London (1962).

W. I. The Wealth of India. Vol. X : Sp – W, 84 – 87. CSIR, New Delhi (1976).

WILLIS, J. C. A Dictionary of Flowering Plants and Ferns. pp. 110. 8th ed., London, Cambridge University Press (1973).

YOUNGKEN, H. W. Pharmaceutical Botany, 7th ed. The Blakistan Company, Toronto (1951).