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STRENGTHENING THE ROYAL DRUGS RESEARCH LABORATORY

DP/NEP/80/003

NEPAL

Technical report: Standards of ayurvedic crude drugs, volume I

Prepared for the Government of Nepal
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of S. R. Adhikary, R. Pradhan, R. K. Rajbhandary
G. Shrestha and B. B. Thapa, national experts

Backstopping officer: R.O.B. Wijesekera, Chemical Industries Branch

United Nations Industrial Development Organization

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Explanatory notes

Besides the common abbreviations, symbols and terms, the following have been used in this report:

BHP	British Herbal Pharmacopoeia
BPC	British Pharmaceutical Codex
IP	Indian Pharmacopoeia
JP	Japanese Pharmacopoeia
USNF	United States National Formulary

CONTENTS

INTRODUCTION

Within the context of the large-scale project "Strengthening the Royal Drugs Research Laboratory" (DP/NEP/80/003) for which the United Nations Industrial Development Organization is the executing agency on behalf of the United Nations Development Programme, a team of national experts undertook research with the aim of establishing standards for ayurvedic crude drugs, in compliance with one of the immediate objectives of the project, i.e. "to develop quality-control standards for ayurvedic drugs, particularly for those that are used in the primary health care".

The ayurvedic system of medicine is an ancient one. It has stood the test of time and has been serving people ever since its inception, in spite of the tremendous progress made by the allopathic system of medicine over recent years.

Plants constitute the main components of ayurvedic preparations and these are described by their common names in the ancient literature of ayurveda. In the absence of a sound scientific basis for the identification of plants, people engaged in the preparation of ayurvedic medicines may be receiving plant components of different types of plants having the same name at different places. This is the main reason which seems to be responsible for creating uncertainty about the efficacy of ayurvedic medicines. Hence, quite often, controversy arises regarding the constituents used for preparations by different people at different places as regards their authenticity and efficacy. In order to overcome this uncertainty, and at the same time to provide a modern scientific input to the ayurvedic system for the authentication of the proper drug to be used in the preparations, a programme to prepare standards for crude drugs has been launched by the Royal Drug Research Laboratory, Department of Medicinal Plants, in 1985. The present volume constitutes the result of the work of one year. The purpose of this research work will be considered achieved if its results will serve the ayurvedic community in selecting drugs of the right quality.

The methodology adopted for the selection of crude drugs and their subsequent analysis is briefly described in the following section.

There is a large number of preparations in the ayurvedic system. At the beginning of the research work, the plant materials used for the preparation of essential drugs of the ayurvedic system were selected. The Singh Durbar Vaidyakhana, a government-owned medical institution, prepared a list of 25 essential ayurvedic medicines for which 101 different medicinal plants are being used (see annex II). This volume contains the monographs of 20 of these plants. In each monograph the methods of identification are described, primarily based on macroscopic and microscopic techniques. A photograph of the drug should facilitate the comparison of whole drugs, and drawings of characteristic microscopic features are given for the microscopic identification of crude drugs, mainly in powdered form. Furthermore, total ash, acid-insoluble ash and moisture content of the samples are also indicated. If active constituents of a drug are known, e.g. of an alkaloid-bearing plant, they are also determined. However, as only few such determinations were carried out in the laboratory, definite limits cannot yet be established. Samples of the tested drugs were provided by the Singh Durbar Vaidyakhana. In some cases the samples were also purchased by the Royal Drug Research Laboratory on the local market.

For additional information on the drug, a selected bibliography is given at the end of each monograph, including literature consulted for the preparation of the monographs. Normally, books listed under the heading "General"

were used, particularly the British Herbal Pharmacopoeia. The textbooks on pharmacognosy consulted for the preparation of the monographs were: A Textbook of Pharmacognosy by T. C. Denston (fourth edition, 1944, Pitman), A Textbook of Pharmacognosy by T. E. Wallis (second edition, 1951, J. and A. Churchill), Textbook of Pharmacognosy by H. W. Yonken (sixth edition, 1950, Blakston), Pharmacognosy by G. E. Trease and W. C. Evans (eleventh edition, 1978, Bailiere Tindall) and Pharmacognosy of Indian Root and Rhizome Drugs by S. C. Datta and B. Mukherji (first edition, 1950, Ministry of Health, Government of India).

In annex I, the methodologies used in the microscopic examination and the determination of the analytical standards of a drug in the laboratory are described. Annexes II-IV contain selected ayurvedic preparations and lists of their constituents.

MONOGRAPHS

1. Aconitum spicatum (aconite)

It is the dried root of Aconitum spicatum Stapf (family Ranunculaceae). Roots are dried, entire or split longitudinally for quick drying.

Description

Macroscopical: Root perennial, paired, tuberous, conical, 3-9 cm long, 1-2.5 cm wide; external surface brown or blackish; longitudinally wrinkled; fracture short; transversely cut surface shows grey bark, stellate cambium, central pith; root hair straight or slightly curved (picture 1).

Microscopical: Powdered drug yellowish grey, fragments of cork; stone cells of various shapes (tabular, rectangular, elliptic) with lignified walls, 30-155 µ long and 30-60 µ wide parenchymatous cells with starch grains, simple, round, 6-15 µ in diameter with central hilum; vessels with reticulate and pitted thickening (figure 1).

Analytical standards

	Laboratory results (Percentage)
Loss on drying	10.41
Total ash	4.35
Acid-insoluble ash	0.84
Total alkaloid content	0.4

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British Pharmaceutical Codex 1973, pp. 7-8.

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Thin-layer chromatography

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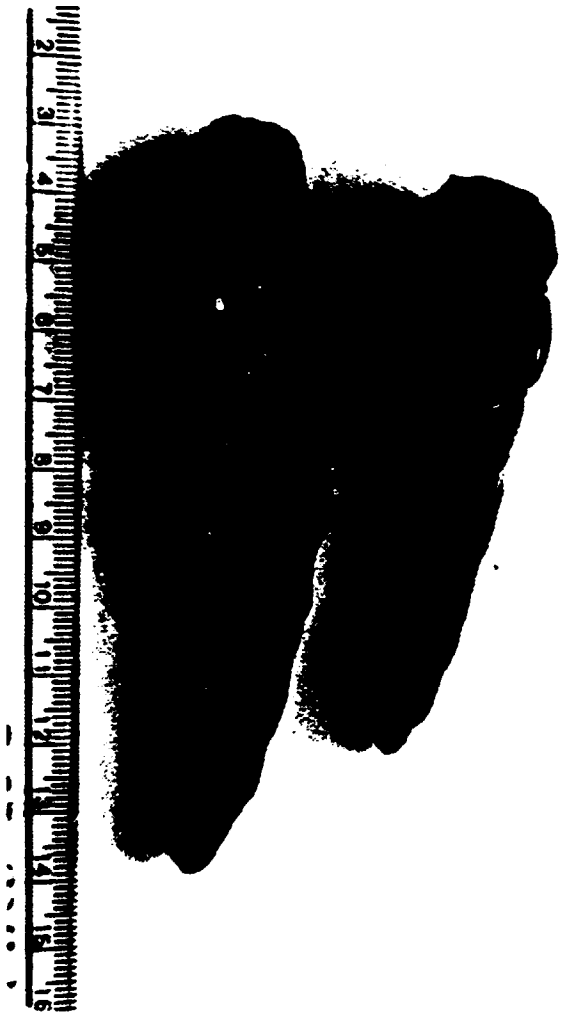
Chemistry

Dunstan and Anelrews. Isolation of bikhaconitine. J. Khim. Soc. 1905, 87, 1636.

Klasek, A., V. Simanek and F. Santavy. Alkaloids from Aconitum plant (1); Isolation of bikhaconitine, chasmaconitine, indaconitine and pseudoconitine from Aconitum ferox. Lloydia. 1972, 35, 55-60.



Picture 1. Aconitum spicatum Stapf. (root)

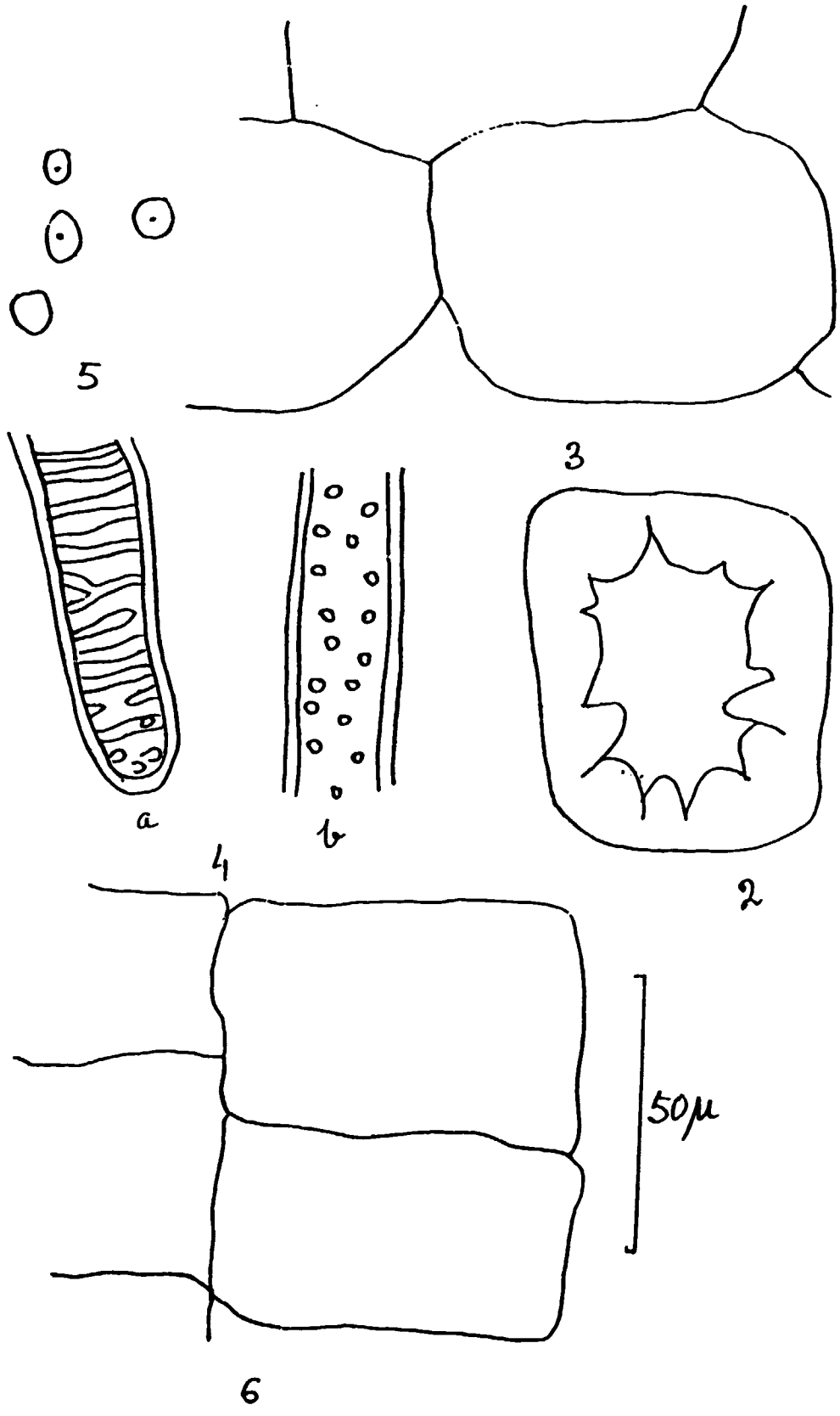


Figure 1. Aconitum spicatum root powder (microscopic)

Key: 2 Stone cell
3 Parenchymatous cells
4 Vessels:
a Reticulate
b Pitted
5 Starch grains
6 Cork

2. Acorus calamus (calamus)

It is the dried rhizome of Acorus calamus L. (family Araceae). The rhizome is collected in the autumn, trimmed and sometimes scrapped or peeled. It contains a bitter, aromatic volatile oil to the extent of 1.5-3.5 per cent. The drug also contains a bitter principle acorin, starch and tannin. The main constituents of the volatile oil are asaryl alcohol, eugenol and asarone.

Description

Macroscopical: Rhizome partly cylindrical, 3-10 cm long and 0.5-2 cm wide, pinkish brown in colour; on upper surface triangular leaf scars and hair-like fibres of fibro-vascular tissue, longitudinally furrowed; on lower surface many small root scars distributed in zig-zag manner; fracture short, white internally, stele at centre and cortex at periphery, stele and cortex separated by circle (picture 2).

Microscopical: Powdered drug yellowish white; fragments of oval-shaped parenchyma containing numerous spherical starch grains of 3-6 µm diameter; some parenchyma cells contain yellow oleoresin; vessels with reticulate, scalariform thickening, fragments of epidermal cells; thick-walled fibres; septed root hair rarely present (figure 2).

Analytical standards

	Laboratory results (Percentage)	Pharmacopoeial limits (BHP) (Percentage)
Loss on drying	9.80	-
Total ash	5.22	6.0
Acid-insoluble ash	0.70	1.0
Volatile oil content	2.06	-

Picture 2. Acorus calamus Linn. (rhizome)

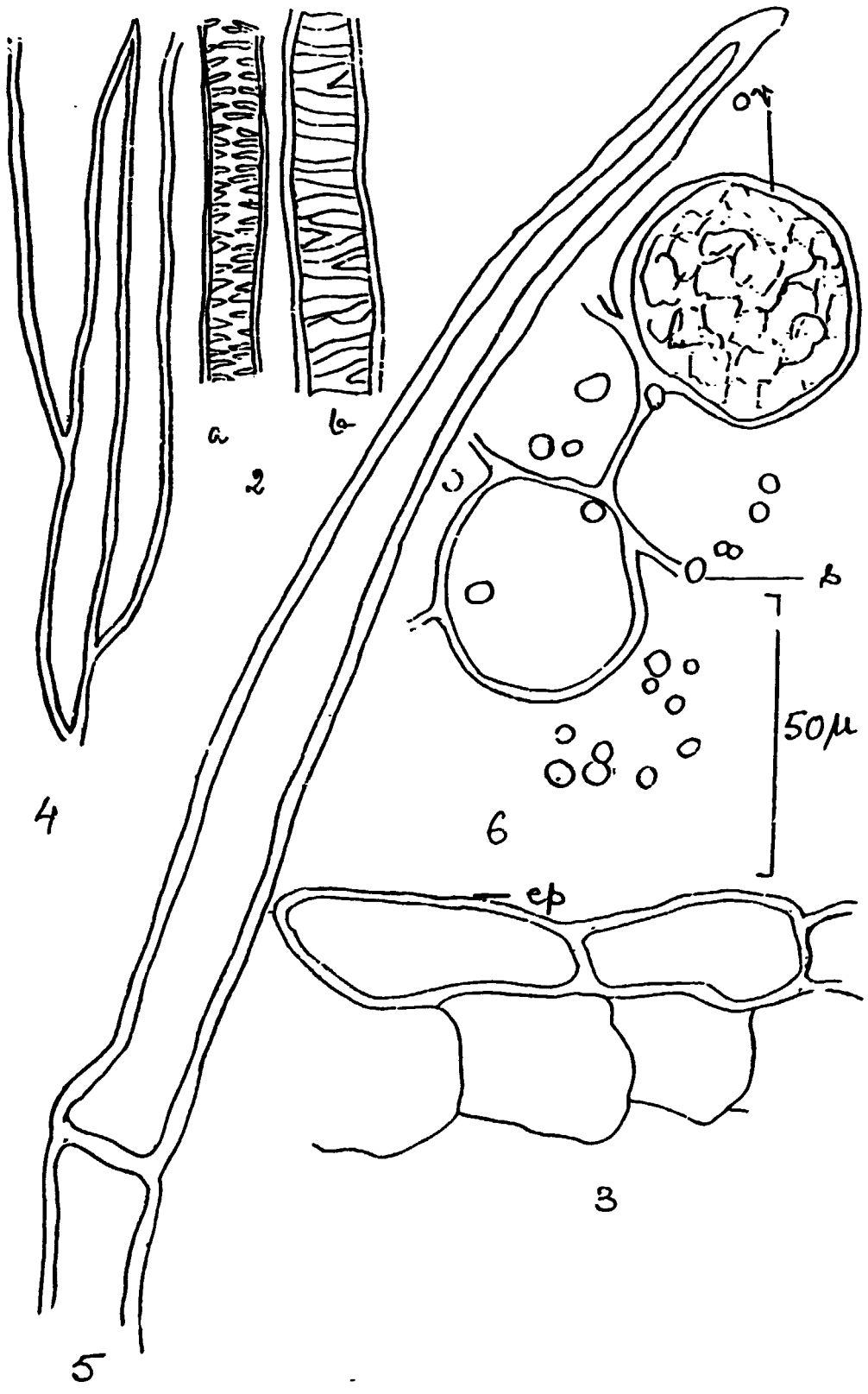


Figure 2. Acorus calamus rhizome powder (microscopic)

Key:
- 2 Vessels
  - a Scalariform
  - b Reticulate
- 3 Fragment of epidermal cell
  - ep Epidermal cell
- 4 Fibre
- 5 Septed hair
- 6 Parenchymatous cells or oleoresin
  - s Starch

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Chemistry

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M. Iguchi, A. Nishiyama, H. Kogama et al. Isolation and structures of three new sesquiterpenes. Tetrahed. Letters. 1968, 51, 5315-5318.

R. H. Dyer, G. E. Martin and P. C. Buscemi. Gas-liquid chromatographic determination of β-Asarone in wines and flavors. J. Assoc. Off. Anal. Chem. 1976, 59, 675-677.

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Pharmacology

American Federal Register 09, May 1968, 33, 6937. Carcinogenic properties of the oil of Acorus.

N. S. Dhalla and I. C. Bhattacharya. Further studies on neuropharmacologial actions of Acorus oil. Arch. Int. Pharmacodynther. 1968, 172 (2), 356-365. Biol. Abstr.1969, 50, 64308.

Other

Medicinal and Aromatic Plant Abstract. 1979, 1 (4), 34-42.

3. Amomum subulatum (greater cardamomum)

It is the dried fruit of Amomum subulatum Roxb. (family Zingiberaceae). It contains volatile oil which contains sabinene, 1,8-cineol, λ-terpinene, λ-terpineol, terpenyl acetate and bisabolene, λ-pinene, β-pinene, myrcene, limonene, γ-terpinene, P-cymene, terpinen-4-ol, S-terpineol and nerolidol.

Description

Macroscopical: Inferior, ovoid or oblong capsule, 1 to 2 cm long, 0.5 to 1.8 cm wide; plump, large fruit, three-sided, externally longitudinally striated, dark reddish-brown in colour, short beak at the apex, base rounded, remains of stalk; seeds brown, 4 mm long, 3 mm wide, irregularly angular (picture 3).

Microscopical: Powdered drug of brown colour, elongated brown cells of outer epidermis, fragments of thin-walled polygonal parenchyma of mesocarp, large-celled parenchyma containing small prisms of calcium oxalate and small oil globules, polyhedral masses of adherent starch granules, individual granules 3 μ in diameter, thin-walled brown palisade cells of hypodermis, fragments of annular vessels, dark brown thick-walled sclerenchyma (figure 3).

Analytical standards

	Laboratory results (Percentage)
Loss on drying	13.72
Total ash	3.79
Acid-insoluble ash	0.776
Oil content	2.043

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General

Martindale. The Extra Pharmacopoeia 28th ed., 1982, p. 670.

Wealth of India, 1948; Raw Materials. Vol. I, p. 69.

Chemistry

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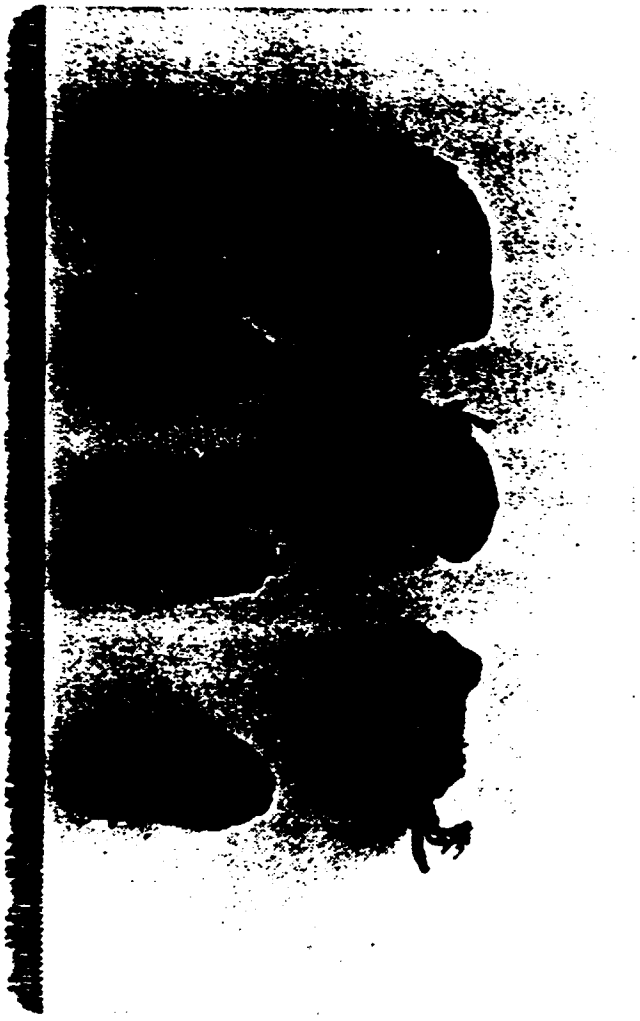
S. S. Nigam and R. M. Purohit. Perfumary and Essential Oil Record. 1960, 51, 121.



Picture 3. Amomum subulatum Roxb. (fruit)

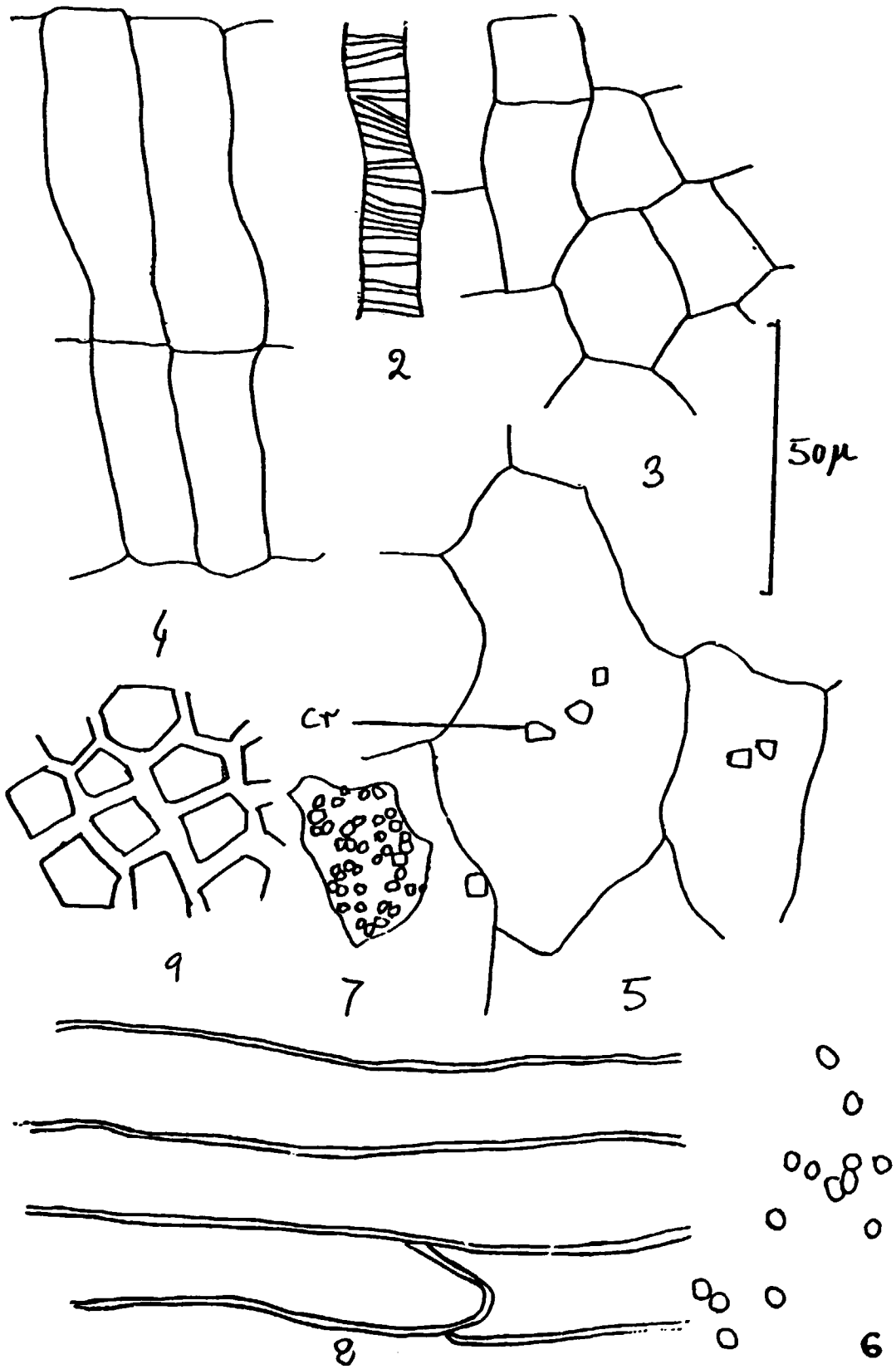


Figure 3. Amomum subulatum fruit powder (microscopic)

Key:
2 Annular vessel
3 Parenchyma of mesocarp
4 Palisade cells of hypodermis
5 Parenchyma cells
cr Calcium oxalate crystal
6 Oil globules
7 Adherent starch granules
8 Outer epidermis
9 Sclerenchyma

4. Cinnamomum tamala (cassia cinnamomum)

These are the dried leaves of Cinnamomum tamala (Buch. Ham.) Nees and Eberm. (family Lauraceae). It contains volatile oil which contains d-l-phellandrene and eugenol.

Description

Macroscopical: Leaves thin, yellowish; petioles short, about 1 cm long; lamina lanceolate, 8 to 18 cm long, 3 to 5 cm wide; apex acute, glabrous, entire margin, pinnate venation, three veins (picture 4).

Microscopical: Powdered drug light yellow; epidermal cells with striated walls, stomata animocytic (ranunculus), a single layer of palisade parenchyma, many layers of spongy parenchyma, fragments of annular vessels, spherical oil cells (figure 4).

Analytical standards

	Laboratory results (Percentage)
Loss on drying	10.86
Total ash	3.32
Acid-insoluble ash	0.64
Volatile oil	1.4

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General

Wealth of India, 1950; Raw Materials. Vol. II, pp. 178-179.

Picture 4. Cinnamomum tamala Nees and Eberm. (leaf)

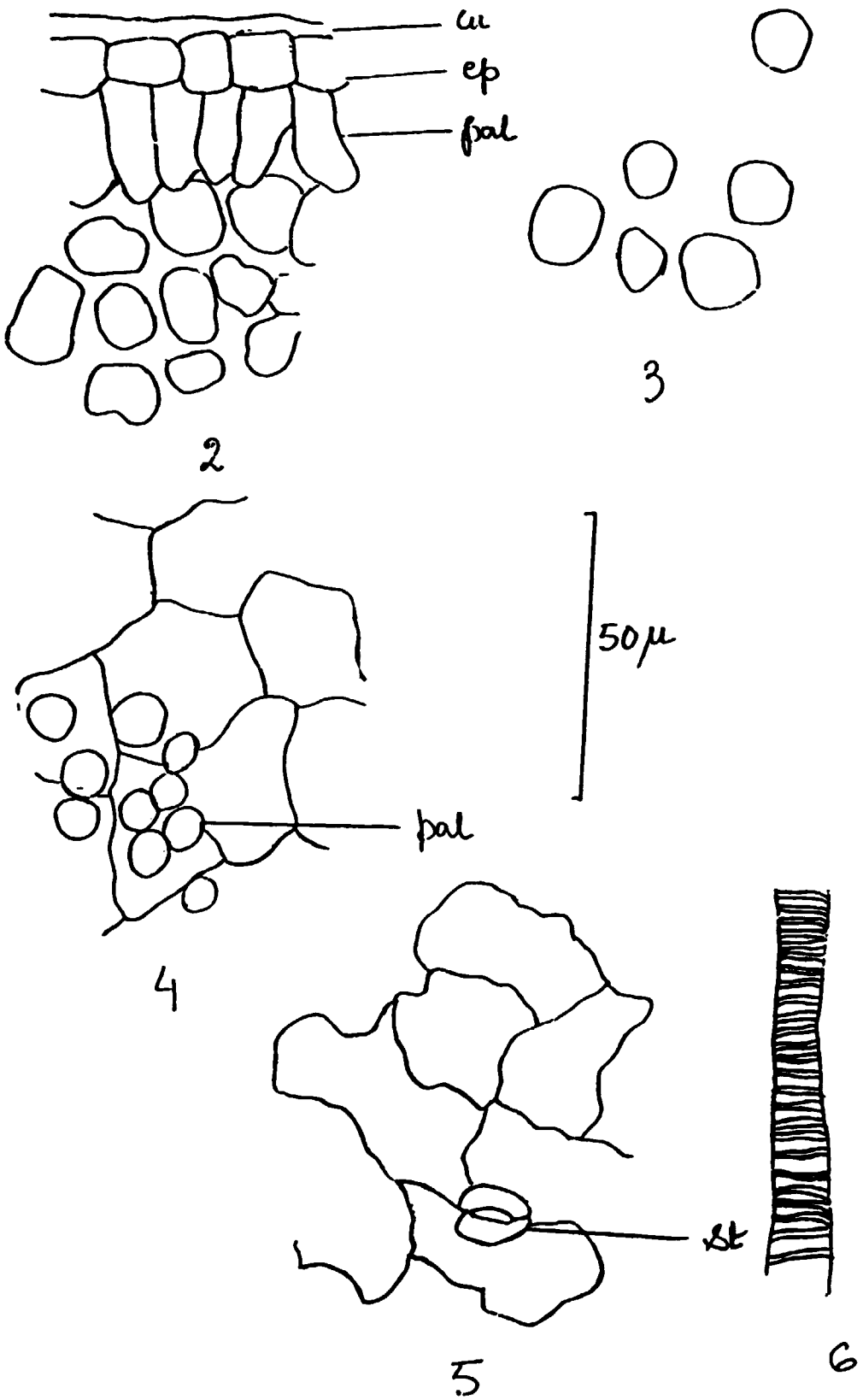

Figure 4. Cinnamomum tamala leaf powder (microscopic)

Key: 2 Fragment of transverse section of leaf
cu Cuticle
ep Epidermal
pal Palisade
3 Oil cells
4 and 5 Leaf surface
st Stomata
6 Annular vessel

5. Cinnamomum zeylanicum (true cinnamon)

It is the dried bark of Cinnamomum zeylanicum Nees (family Lauraceae). It contains not less than 1 per cent of volatile oil containing 60 to 75 per cent w/w of aldehydes calculated as cinnamic aldehyde (C_9H_8O) together with eugenol, phellandrene and other minor terpenes. The bark also contains tannins.

Description

Macroscopical: Single or double quills, about 1 cm wide; when flattened out, double quills are separated into parts after soaking in water; outer surface of pale brown colour, marked with small circular scars and longitudinal lines, 0.2 mm thick; inner surface brown and smooth, brittle, fracture short splintery; transversely cut surface shows outer layer pericyclic sclerenchyma, inner phloem (picture 5).

Microscopical: Powdered drug brown; sclereids thick-walled, rectangular, polygonal in shape; parenchyma containing acicular microcrystals of calcium oxalate and starch granules, simple or compound, diameter of individual granules 5-15 μ; spherical, thick-walled phloem fibres, spherical oil cells 20-30 μ in diameter (figure 5).

Analytical standards

	Laboratory results (Percentage)
Loss on drying	12.67
Total ash	2.35
Acid-insoluble ash	0.88
Volatile oil	0.2

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Indian Pharmacopoeia 1966, p. 192.

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Chemistry

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Picture 5. Cinnamomum zeylanicum Blume. (bark)

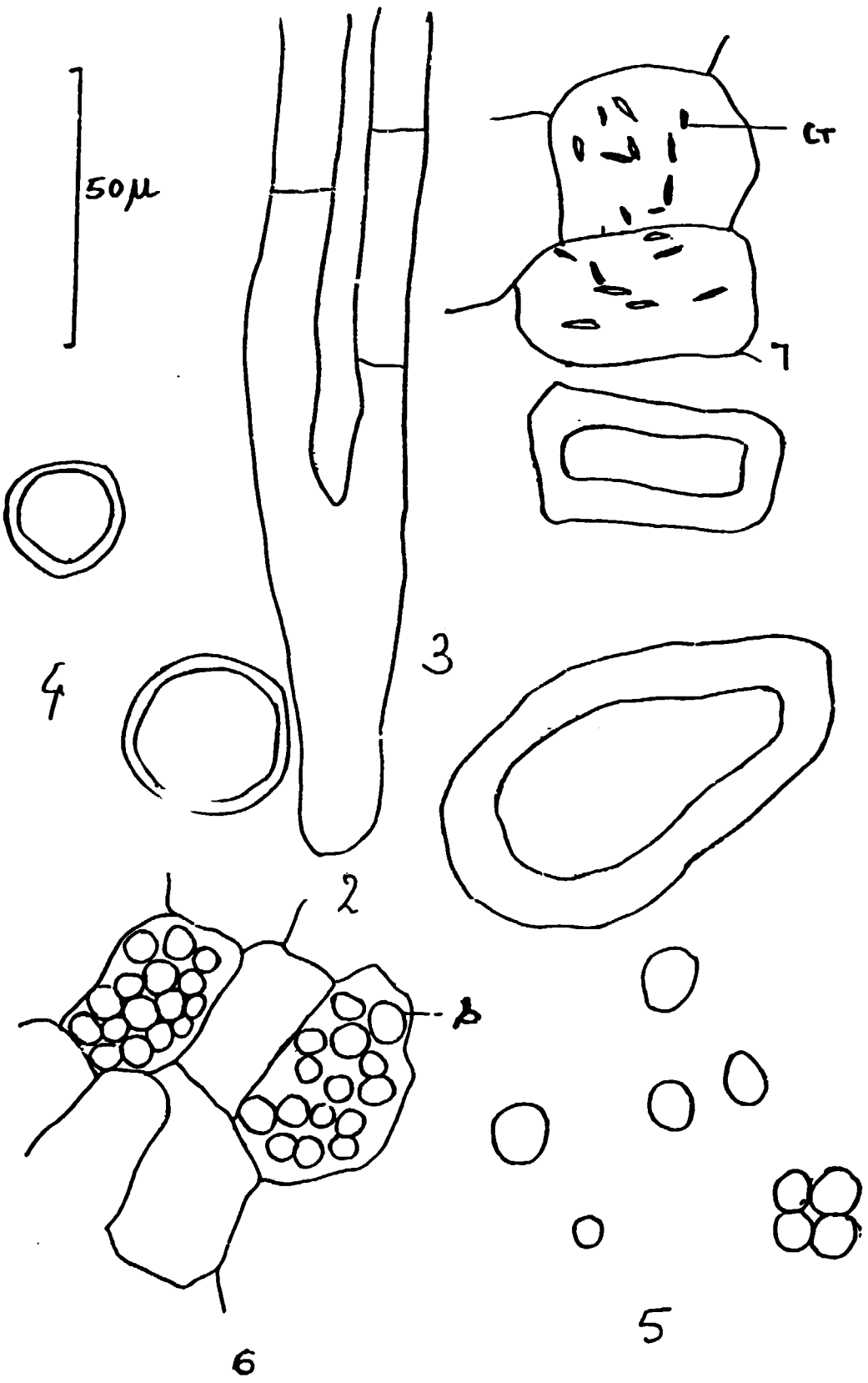

Figure 5. Cinnamomum zeylanicum bark powder (microscopic)

Key: 2 Phloem fibre
3 Sclerids
4 Oil cells
5 Starch grains
6 and 7 Fragments of parenchymatous cells
s Starch grains
cr Calcium oxalate crystal

6. Cuminum cyminum (cumin)

This is the dried fruit of Cuminum cyminum Linn. (family Umbelliferae).

Description

Macroscopical: Entire cremocarp, 3 to 5 mm long, 1 mm wide, greyish, slightly compressed laterally, usually pedicel attached, elongated ellipsoidal, seven yellowish longitudinal ridges (picture 6).

Microscopical: Powdered drug yellowish; epidermis of the pericarp showing polygonal cells with unstriated cuticle; cells of endosperm containing aleurone grains, fragments of pitted vessels; elongated cells of endocarp; mesocarp cells parenchymatous; vittae lined by epithelium (figure 6).

Analytical standards

	Laboratory results (Percentage)
Loss on drying	10.59
Total ash	7.59
Acid-insoluble ash	1.54
Volatile oil	2.4

Bibliography

General

Wealth of India, 1950; Raw Materials. Vol. II, pp. 396-398.

Picture 6. Cuminum cyminum Linn. (fruit)

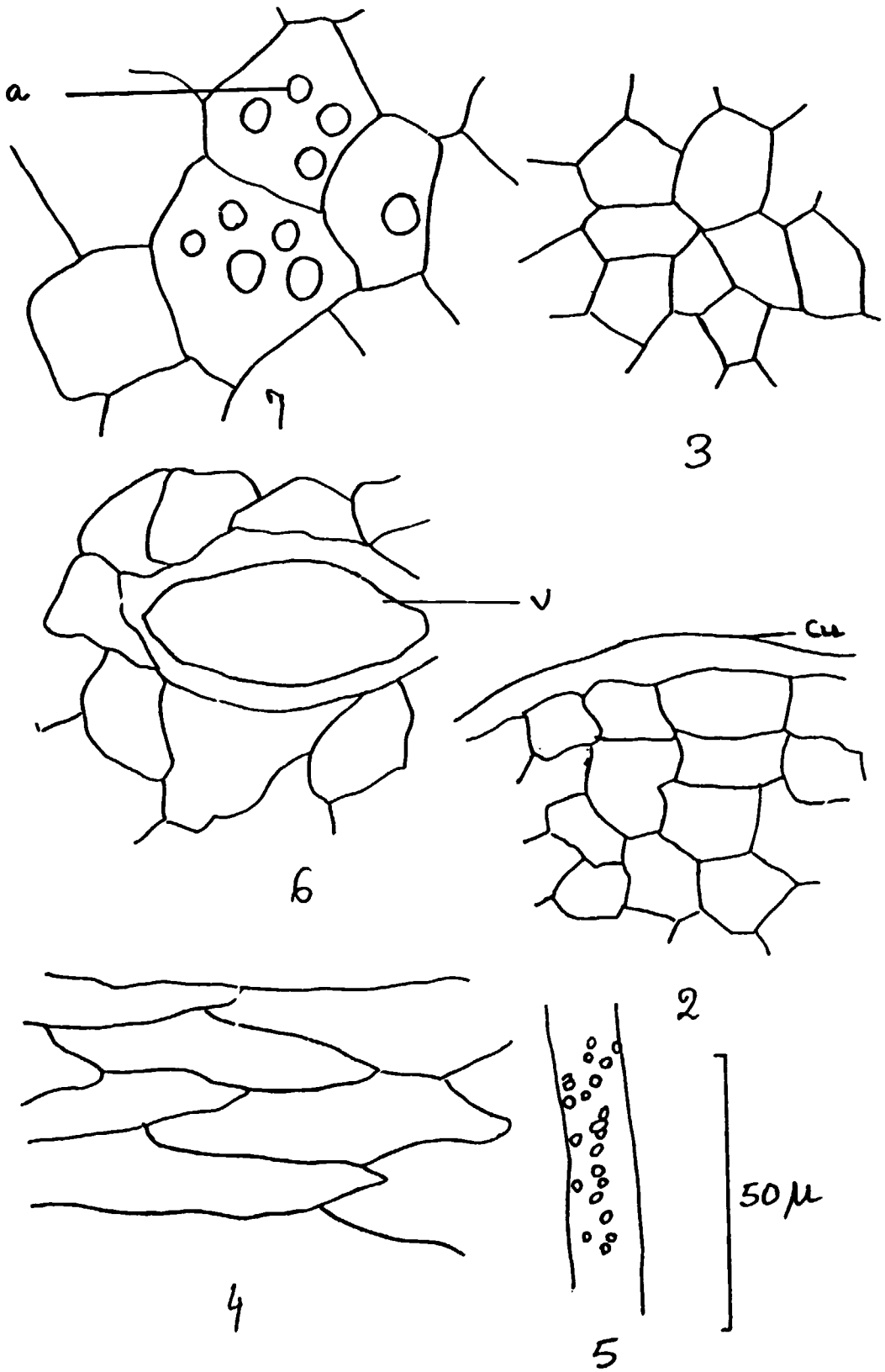

Figure 6. Cuminum cyminum fruit powder (microscopic)

Key: 2 Epidermis of pericarp
cu Cuticle
3 Parenchymatous mesocarp cell
4 Endocarp cells
5 Pitted vessel
6 Vittae lined by an epithelium
v Vittae
7 Cells of endosperm
a Aleurone grain

7. Datura metel (datura leaf)

These are the dried leaves of Datura metel L. (family Solanaceae). They contain not less than 0.20 per cent of total alkaloids of Datura, calculated as hyoscyamine.

Description

Macroscopical: Greyish-green shrivelled mass of leaves, petioles about one-third the length of the lamina, lamina ovate, usually unequal at the base, about 9 to 18 cm long and 3 to 9 cm wide; apex acute, lamina nearly glabrous, usually three or four coarse teeth with irregular serrated margin, four to five secondary veins on each side of midrib (picture 7).

Microscopical: Powdered drug greenish; epidermal cells with sinuous anticlinal walls and a smooth cuticle; trichomes conical, uniseriate, three to four celled, stomata anisocytic (cruciferous), diameter of stomata about 3.2 μ; single layer of palisade parenchyma; palisade ratio varies from five to seven; idoblast of the mesophyll (spongy parenchyma) containing aggregate crystals of calcium oxalate (16 to 27) of 4 μ diameter; fragments of annular vessels (figure 7).

Analytical standards

	Laboratory results (Percentage)	Pharmacopoeial limit (IP) (Percentage)
Loss on drying	7.67	-
Total ash	9.60	-
Acid-insoluble ash	1.55	4.0
Alkaloid content	0.257	0.2

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Picture 7. Datura metel Linn. (leaf)

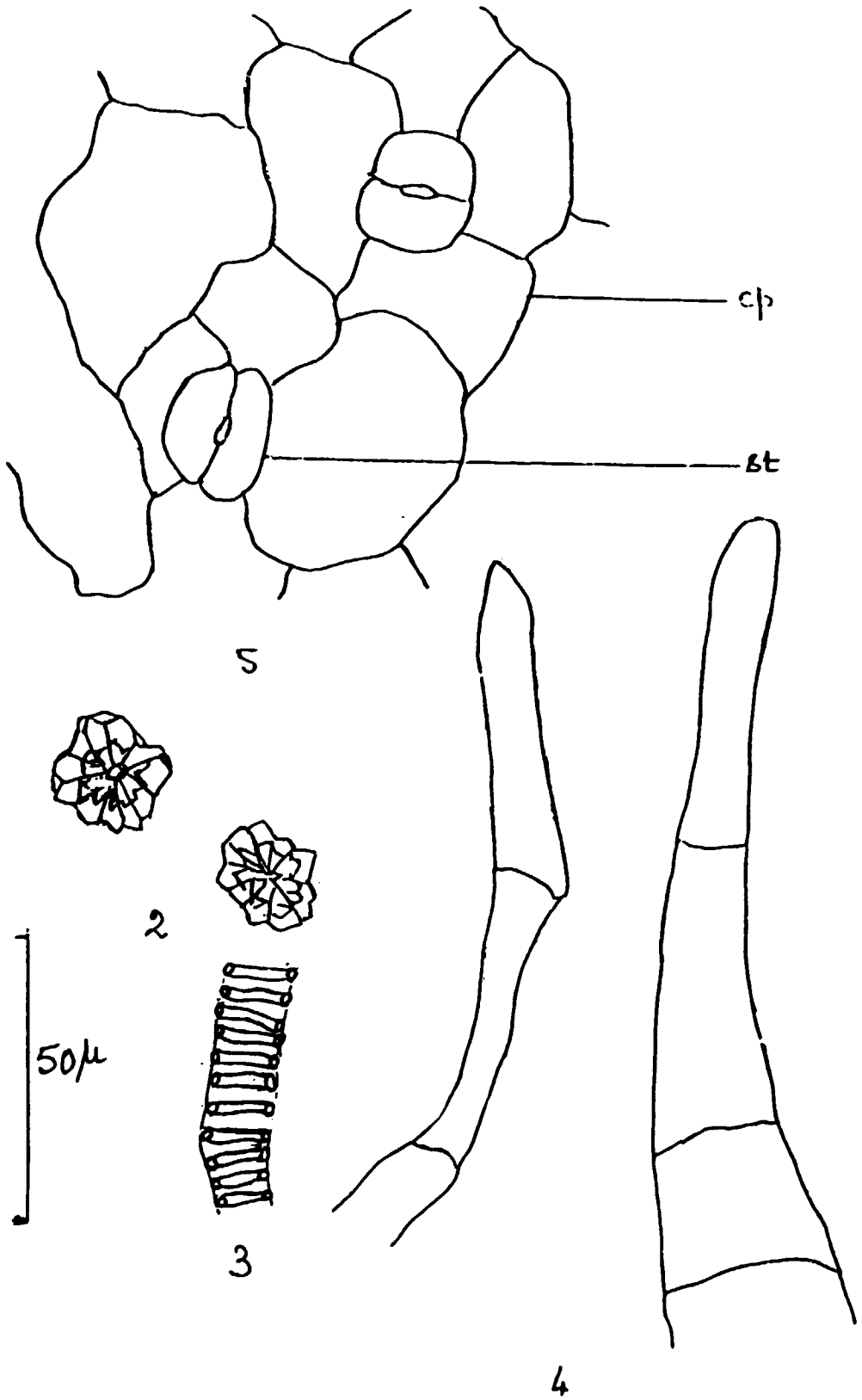

Figure 7. Datura metel leaf powder (microscopic)

Key: 2 Aggregate crystals of calcium oxalate
3 Annular vessel
4 Multicellular trichomes
5 Portion of leaf surface
ep Epidermal cells
st Anisocytic stomata

8. Datura metel (datura seed)

These are the dried seeds of Datura metel L. (family Solanaceae), containing alkaloids of the hyoscyamine group.

Description

Macroscopical: Light grey in colour, flattened, reniform in outline, concave edge acute, convex edge round, 4 to 5 mm long, 3 to 4 mm wide and 1 mm thick; testa followed by translucent endosperm encloses a curved embryo (picture 8).

Microscopical: Powdered drug grey; outer epidermis palisade layer polygonal, length of cell three to four times the width; inner epidermis shows sclerenchymatous layer with thickened walls; endosperm consists of polyhedral parenchyma containing fixed oil globules, embryo cells polyhedral, walls thinner than endosperm, group of tracheids (figure 8).

Analytical standards

	Laboratory results (Percentage)
Loss on drying	8.48
Total ash	5.54
Acid-insoluble ash	1.34
Alkaloid content	0.24

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General

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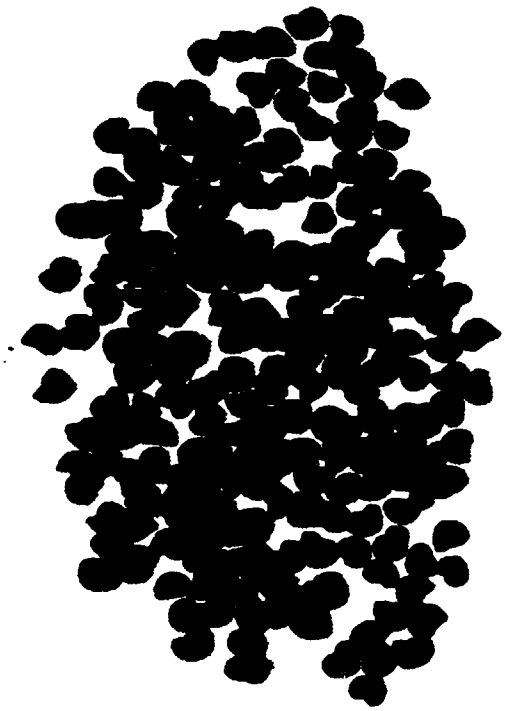

Picture 8. Datura metel Linn. (seed)

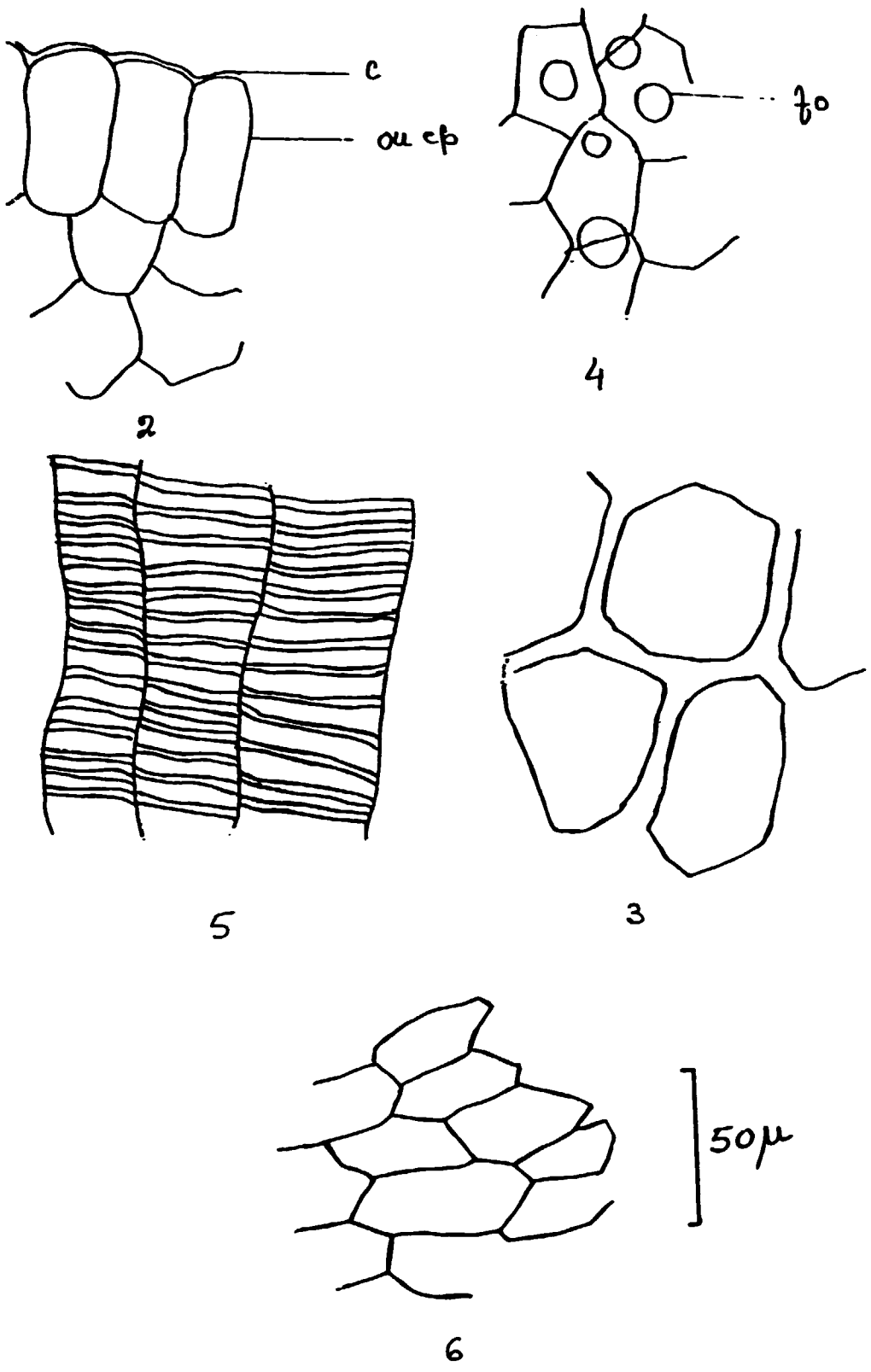

Figure 8. Datura metel seed powder (microscopic)

Key: 2 Epidermis
c Cuticle
ou ep Outer epidermis
3 Inner epidermis sclerenchymatous
4 Endospermic cells
fo Fixed oil
5 Group of tracheids
6 Embryo cells

9. Elettaria cardamomum (cardamom)

This is the dried fruit of Ellettaria cardamomum L. Maton. (family Zingiberaceae). The seeds contain volatile oil of not less than 4 per cent which contains cineol, terpineol, terpinene, limonene, sabinene, terpineol esters (as acetate and formate), λ-terpineol, p-cymene, β-pinene, nerol and linalyl acetate.

Description

Macroscopical: Ovoid or oblong capsule, 1 to 2 cm long, 0.5 to 1 cm wide, three-sided; externally longitudinally striated; pale buff or yellowish in colour; base round, short beak of the apex; three loculi with membraneous septa and axile placentation; seeds reddish brown, 3 mm long, 2 mm wide, irregularly angular, hard, covered externally by a colourless membraneous arillus (picture 9).

Microscopical: Powdered drug light yellow; elongated cells of outer epidermis; fragments of thin-walled polygonal parenchyma of mesocarp; dark brown, thick-walled sclerenchyma; large-celled parenchyma containing small prisms of calcium oxalate and small oil globules, polyhedral masses of adherent starch granules, individual granules about 3 μ in diameter, thin-walled palisade cells of hypodermis, few annular vessels (figure 9).

Analytical standards

	Laboratory result	Pharmacopoeial limit		
		JP	BPC	BHP
	(Percentage)	(Percentage)		
Loss on drying	15.34	-	-	-
Total ash	6.71	6.0	-	6.0
Acid-insoluble ash	2.46	4.0	-	3.5
Volatile oil content	4.8	3.33	4.0	4.0

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Chromatography

H. C. Nigam, I. C. Nigam, K. L. Handa and L. Levi, J. Pharm. Sci. 1965, 54, 799.

Picture 9. Elettaria cardamomum L. Maton. (fruit)

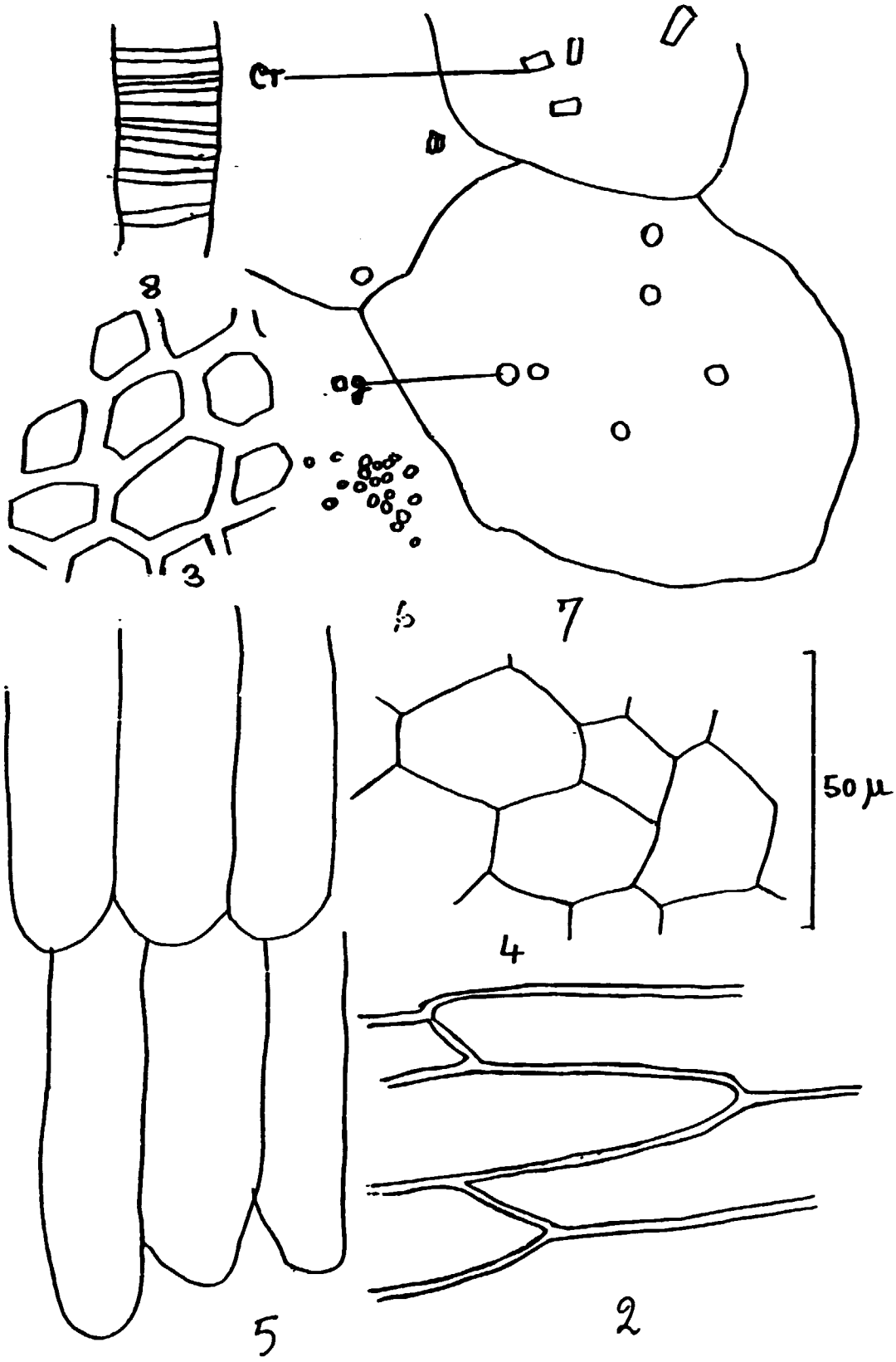

Figure 9. Elettaria cardamomum fruit powder (microscopic)

Key:
2 Outer epidermis
3 Sclerenchyma
4 Parenchyma of mesocarp
5 Palisade cells of hypodermis
6 Adherent starch granules
7 Parenchyma
cr Calcium oxalate
og Oil globule
8 Annular vessels

10. Embelia ribes

It is the dried fruit of Embelia ribes Burm. f. (family Myrsinaceae). It contains about 2.5 per cent of embeline.

Description

Macroscopical: Globular, 3 to 4 mm in diameter, surface warty or with longitudinal striation, grey or dirty red in colour; short pedicel often present; single seed covered with a membrane, globular, smooth, grey in colour (picture 10).

Microscopical: Powdered drug brownish; epidermis of pericarp polygonal, showing cells with unstriated cuticle; fragments of annular vessels; endocarp has a single row of palisade cells, stone cells, groups of stone cells (figure 10).

Analytical standards

	Laboratory results (Percentage)
Loss on drying	11.02
Total ash	2.76
Acid-insoluble ash	0.55

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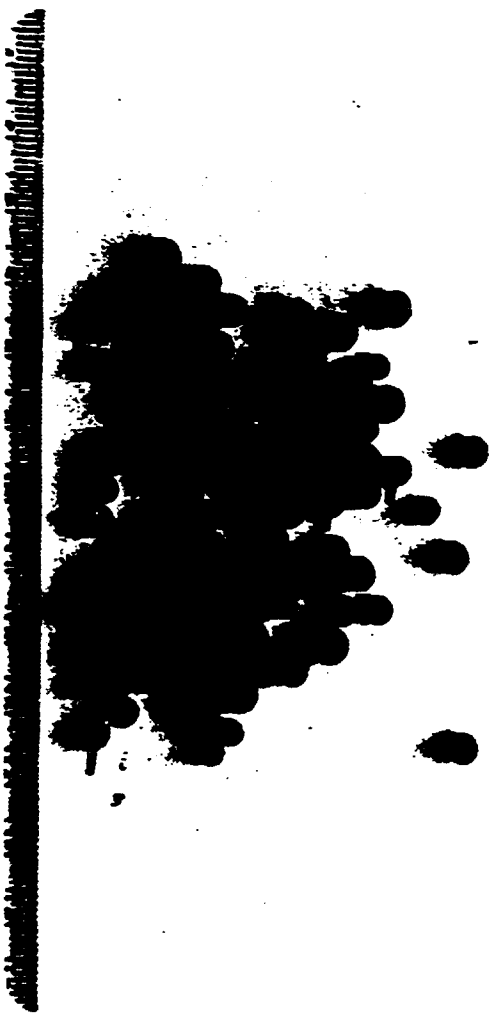


Picture 10. Embelia ribes Burm. f. (fruit)

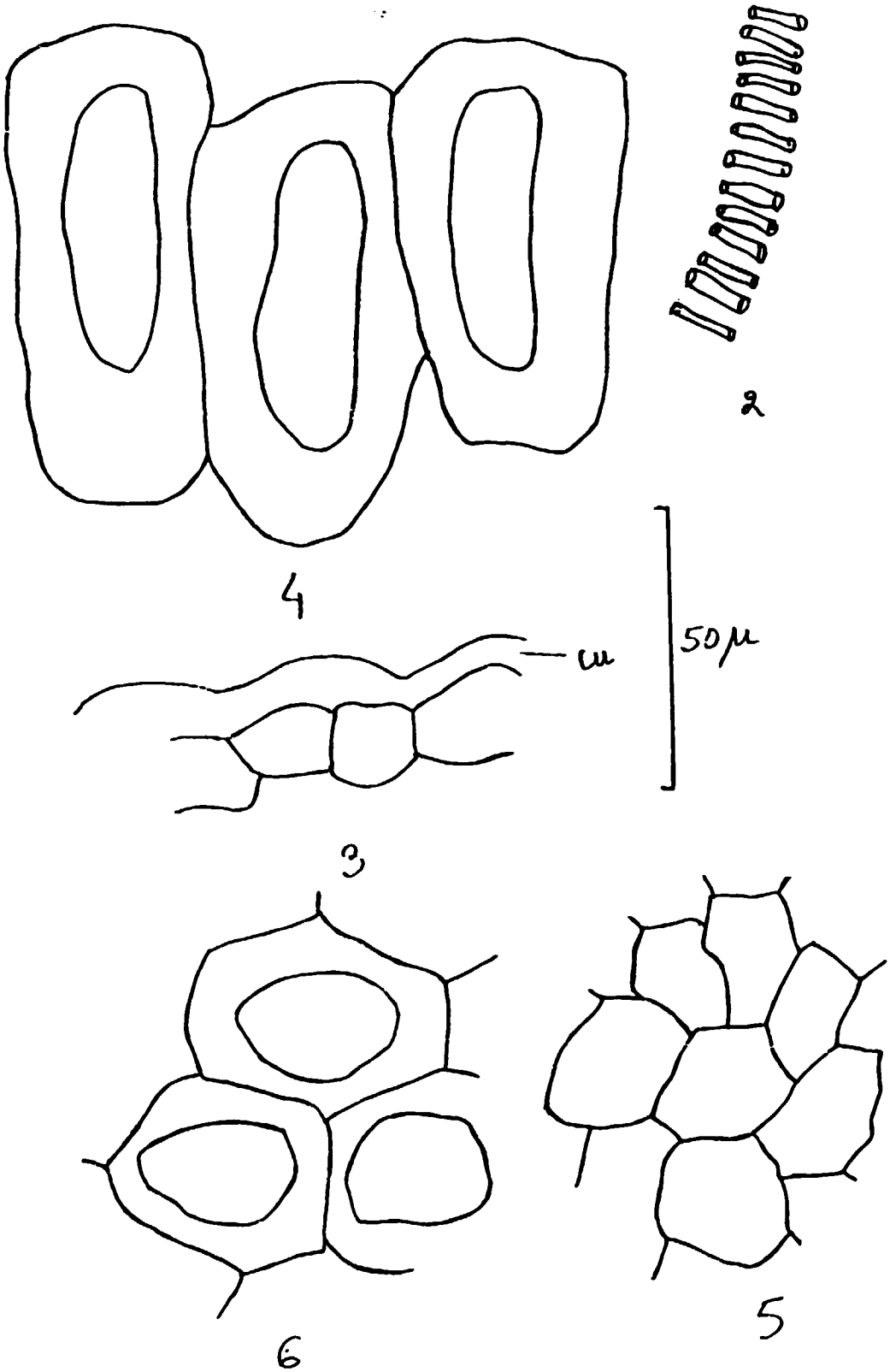


Figure 10. Embelia ribes fruit powder (microscopic)

Key: 2 Annular vessel
3 Epidermal cells
cu Cuticle
4 Palisade stone cells
5 Epidermis of pericarp
6 Groups of stone cells

11. Foeniculum vulgare (fennel)

It is the dried fruit of cultivated plants of Foeniculum vulgare Mill. (family Umbelliferae). It contains volatile oil, the main components of which are anethole and (+)-fenchone.

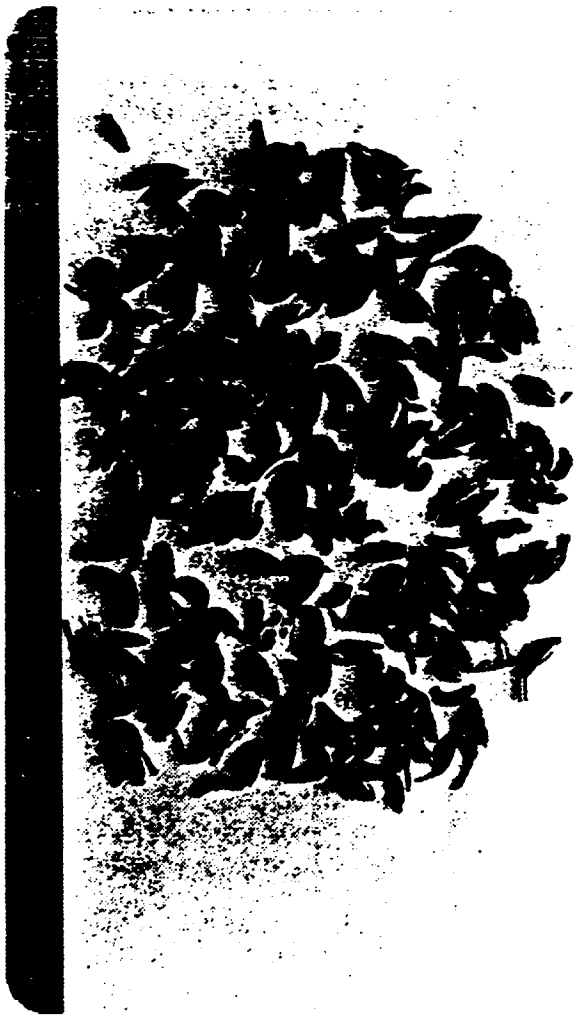
Description

Macroscopical: Fruits usually whole, cremocarps up to 8 mm long and 3 mm wide, greenish-yellow or brown, glabrous with pedicel attached, elliptic, oblong, crowned by bifid stylopodium at the apex, seven prominent greenish yellow or brown longitudinal ridges (picture 11).

Microscopical: Powdered drug greenish-yellow; epidermis of the pericarp composed of polygonal cells, with an unstriated cuticle; cells of endosperm containing fixed oil with rosettes of calcium oxalate, fragments of annular tracheid; cells of endocarp arranged parquetrily, absence of trichomes and starch; parenchyma of mesocarp two types: one with reticulate thickened and the other with ordinary polyhedral cells; brown vittae lined by an epithelium of small polygonal tabular cells (figure 11).

Analytical standards

	Laboratory results	Pharmacopoeial limit			
		BHP	BPC	JP	IP
	(Percentage)	(Percentage)			
Loss on drying	10.7	-	-	-	-
Total ash	7.49	11.0	-	10.0	-
Acid-insoluble ash	1.24	1.5	1.5	1.5	1.5
Volatile oil content	1.2	1.2	1.2	-	1.4



Picture 11. Foeniculum vulgare Mill. (fruit)

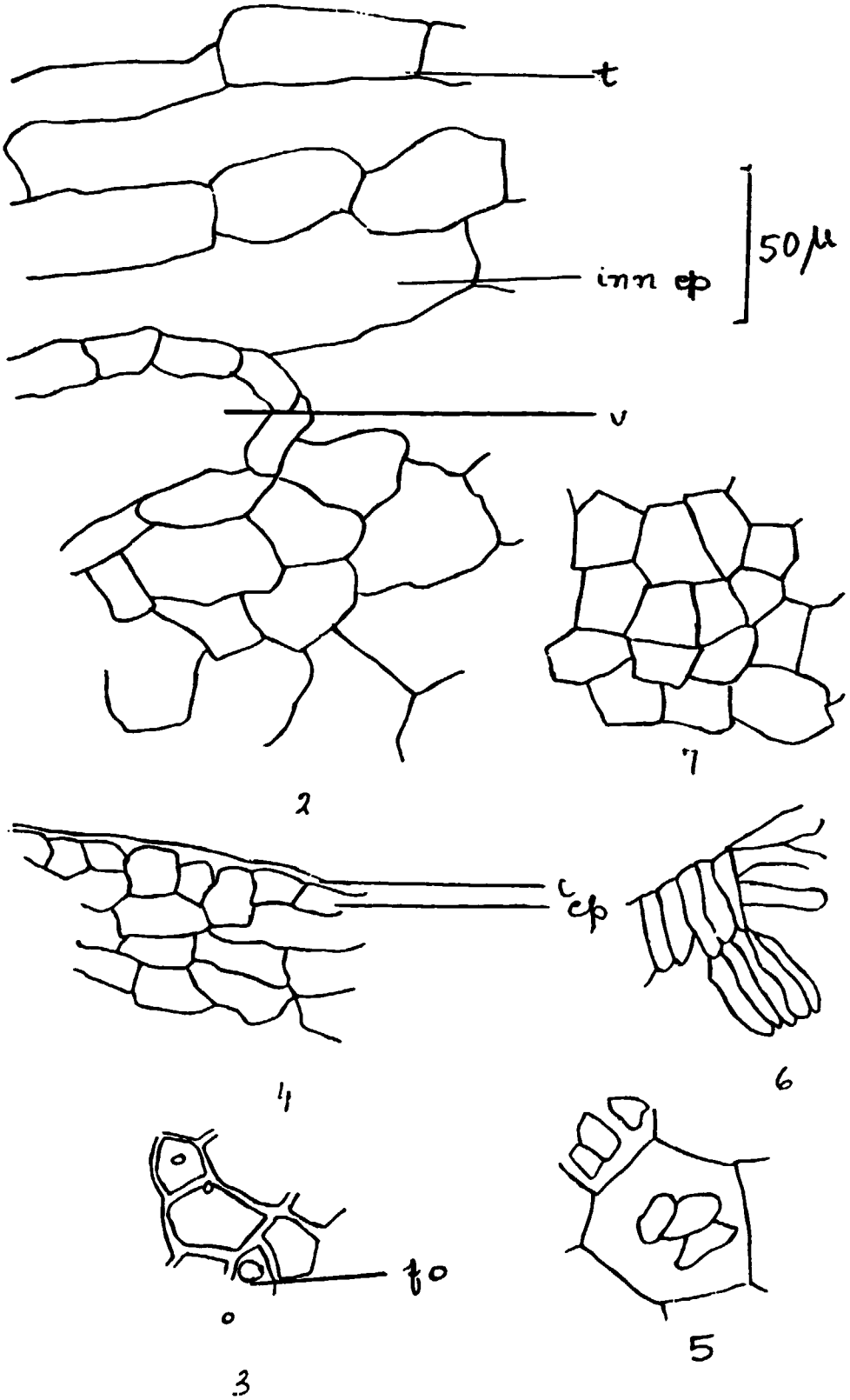


Figure 11. Foeniculum vulgare fruit powder (microscopic)

Key:
- 2 Portion of pericarp
  - t Testa
  - inn ep Inner epidermis of pericarp
  - v Vitta
- 3 Endospermic cells
  - fo Fixed oil
- 4 Outer portion of pericarp
  - c Cuticle
  - ep Epicarp
- 5 Reticulate parenchyma of mesocarp
- 6 Parquetrily arranged cells of endocarp
- 7 Polyhedral cells of mesocarp

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12. Glycyrrhiza glabra (liquorice)

This is the peeled or unpeeled root and stolon of Glycyrrhiza glabra L. (family Leguminosae). It contains about 7 per cent of glycyrrhizin, triterpenoid acids, flavonoid glycosides, glucose, sucrose and starch.

Description

Macroscopical: Rhizome 3-8 cm long, 0.5-2.0 cm wide, cylindrical, external surface when unpeeled longitudinally wrinkled, grey in colour; fracture coarsely fibrous, internal colour yellow, bark and wood radiate, pith in centre; transversely cut surface shows a distinct cambium line at a depth of about one third of the radius separating the yellowish bark from radiate yellow wood (picture 12).

Microscopical: Powdered drug yellow; large number of thick-walled fibres, rows of rectangular cells each containing a monoclinic prism of calcium oxalate; fragments of xylem vessels with bordered pores and few reticulate simple, oval and rounded starch grains of about 10 μ in diameter, fragments of tabular cork cells, parenchyma with starch granules (figure 12).

Analytical standards

For unpeeled samples of Glycyrrhiza glabra

	Laboratory results	Pharmacopoeial limit				
		IP	BPC	BHP	USNF	JP
	(Percentage)	(Percentage)				
Total ash	4.23	10.0	-	10.0	-	7.0
Acid-insoluble ash	1.25	2.5	2.0	2.0	2.5	2.0
Loss on drying	10.37	-	-	-	-	12.0

Picture 12. Glycyrrhiza glabra Linn. (root)

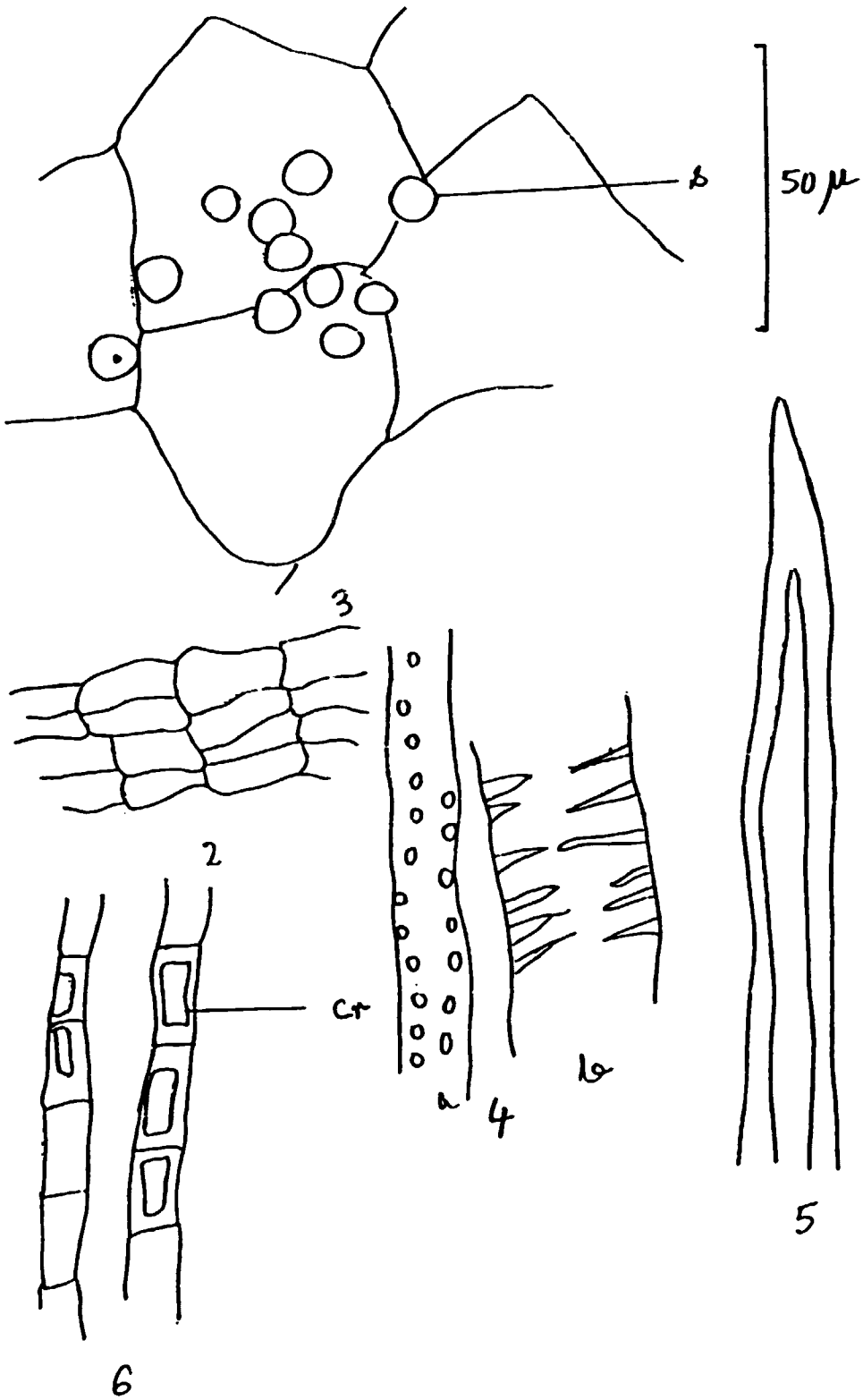

Figure 12. Glycyrrhiza glabra root powder (microscopic)

Key:
- 2 Cork cell
- 3 Fragment of parenchymatous cells
  - s Starch grains
- 4 Vessels
  - a Pitted
  - b Reticulate
- 5 Fibre
- 6 Rows of rectangular cells
  - cr Monoclinic crystals of calcium oxalate

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13. Picrorhiza scrophulariaeflora (picrorhiza)

These are the dried roots and rhizome of Picrorhiza scrophulariaeflora Pennell (family Scrophulariaceae), cut into small pieces and freed from attached rootlets.

Description

Macroscopical: Rhizome cylindrical, 3-7 cm long and 0.5-0.8 cm wide, greyish brown in colour; on younger part of rhizome closely set scale leaves, on the older part scars of scale leaves; on the underside scattered circular scars of roots; fracture short, thin brown cork, grey bark, five vascular bundles, central grey pith; loose roots, dark grey, longitudinally wrinkled, 3-5 cm long, 1 cm in diameter, straight or slightly curved (picture 13).

Microscopical: Powdered drug greyish brown; tangentially elongated thin-walled cork cells, polygonal or hexagonal parenchymatous cells of the cortex, more or less rounded pith, thick-walled cells, xylem vessels with spiral, reticulate and pitted wall thickenings (figure 13).

Analytical standards

	Laboratory results			
	A	B	C	D
	(Percentage)			
Loss on drying	7.24	9.94	9.28	11.59
Total ash	2.73	2.56	2.60	2.57
Acid-insoluble ash	0.21	0.20	0.20	0.19

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Picture 13. Picrorhiza scrophulariaeflora Pennell (rhizome)

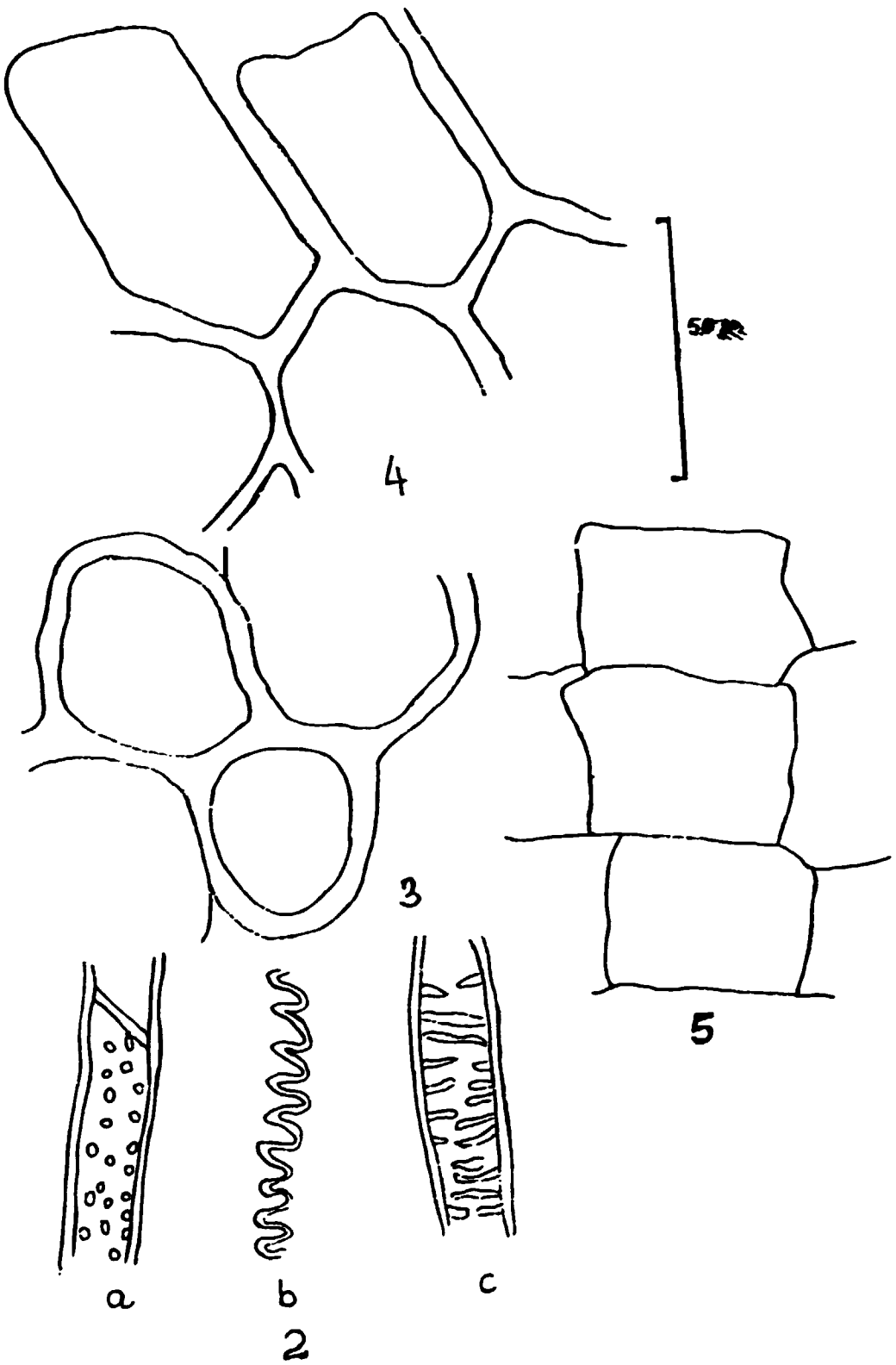

Figure 13. Picrorhiza scrophulariaeflora rhizome powder (microscopic)

Key: 2 Vessels
a Pitted
b Spiral
c Reticulate
3 Pith cells
4 Parenchymatous cells
5 Cork cells

14. Piper longum (long pepper)

It is the dried fruit of Piper L. (family Piperaceae). It contains volatile oil consisting of monocyclic sesquiterpenes, zingiberene, n-nonadecane, n-heptadecane etc. It also contains alkaloids, piperlongumine and piperlonguminine.

Description

Macroscopical: Cylindrical, greyish brown, 20 to 50 mm long, 4 to 8 mm wide; surface honey-combly wrinkled, pedicel attached; usually transverse section of the fruit shows thin, dark pericarp, within which is the yellowish mesocarp (picture 14).

Microscopical: Powdered drug brownish grey; epidermal cell tabular; hypodermis with thin-walled parenchyma; rectangular or polygonal stone cells in hypodermis; inner pericarp sclerenchymatous; starch grains oval or round up to 9 μ in diameter; oil globules about 15 μ in diameter (figure 14).

Analytical standards

	Laboratory results (Percentage)
Loss on drying	14.17
Ash content	4.18
Acid-insoluble ash	1.24
Volatile oil	0.6

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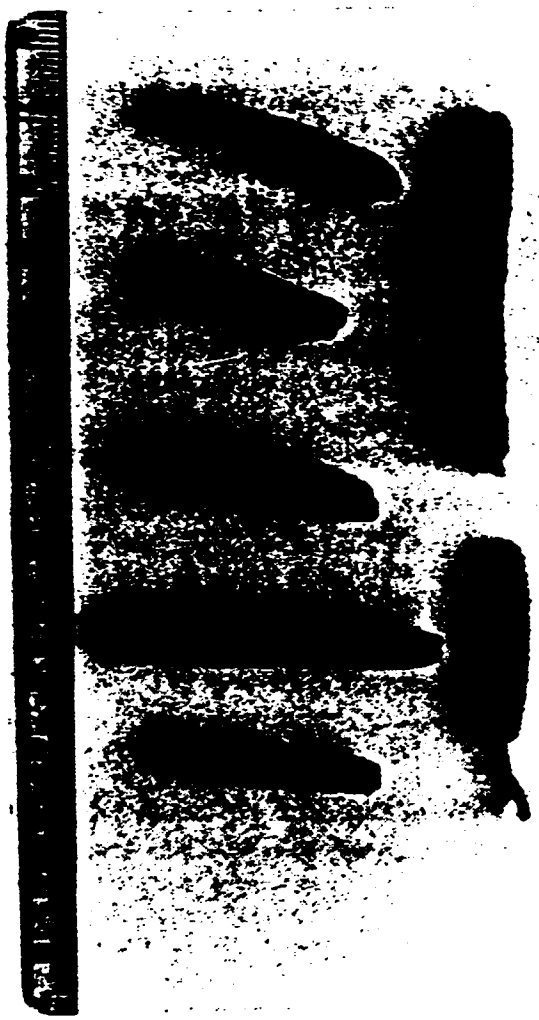

Picture 14. Piper longum Linn. (fruit)

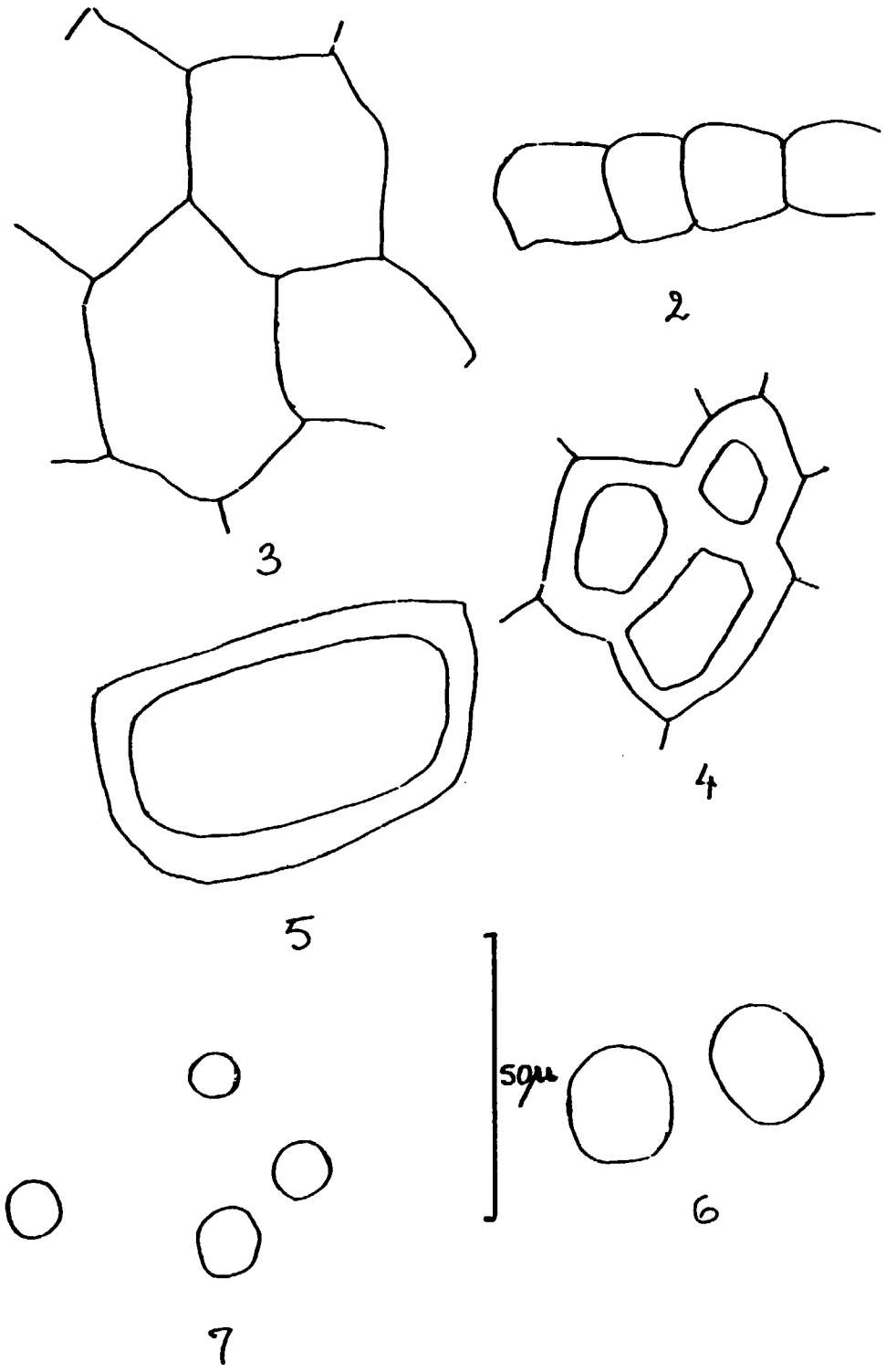

Figure 14. Piper longum fruit powder (microscopic)

Key: 2 Epidermal cells
3 Parenchyma
4 Sclerenchymatous cells
5 Stone cell
6 Oil globules
7 Starch grains

15. Piper nigrum (pepper)

This is the dried fruit of Piper nigrum Linn. (family Piperaceae). It contains a pungent resin, chavicine, with piperine, piperidine and volatile oil.

Description

Macroscopical: Spherical, greyish-brown to black, 4 to 5 mm in diameter; surface deeply reticulately wrinkled, vertical section of the fruit shows a thin, narrow, dark pericarp, within which is the whitish kernel of the single seed to which the pericarp adheres (picture 15).

Microscopical: Powdered drug yellowish; epidermal cells tabular; hypodermis with thin-walled parenchyma; rectangular or polygonal stone cells in hypodermis; inner pericarp sclerenchymatous of a single layer of brown lignified beaker-shaped cells; starch grains oval or round up to 6 μ in diameter; oil globules about 30 μ in diameter (figure 15).

Analytical standards

	Laboratory results (Percentage)
Loss on drying	12.34
Total ash content	3.95
Acid-insoluble ash	1.14
Volatile oil content	1.0

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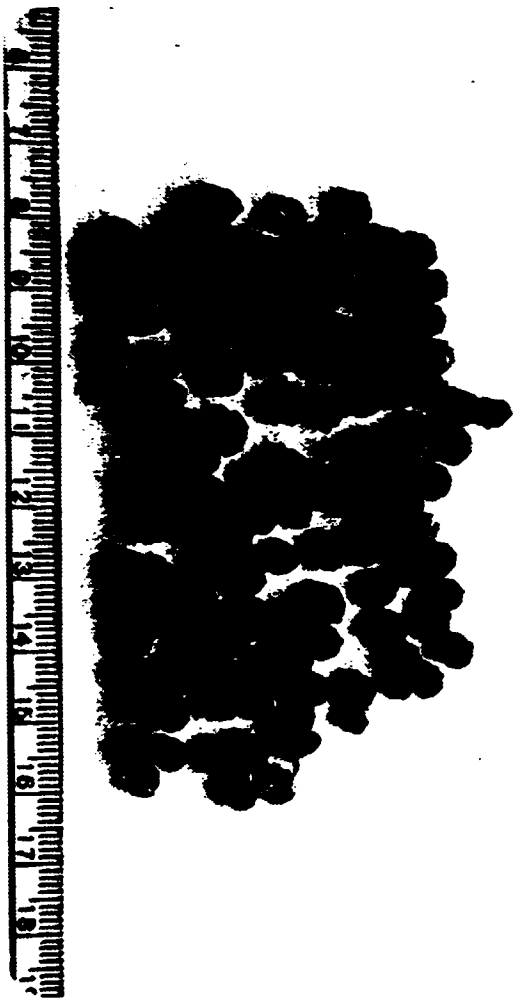

Picture 15. Piper nigrum Linn. (fruit)

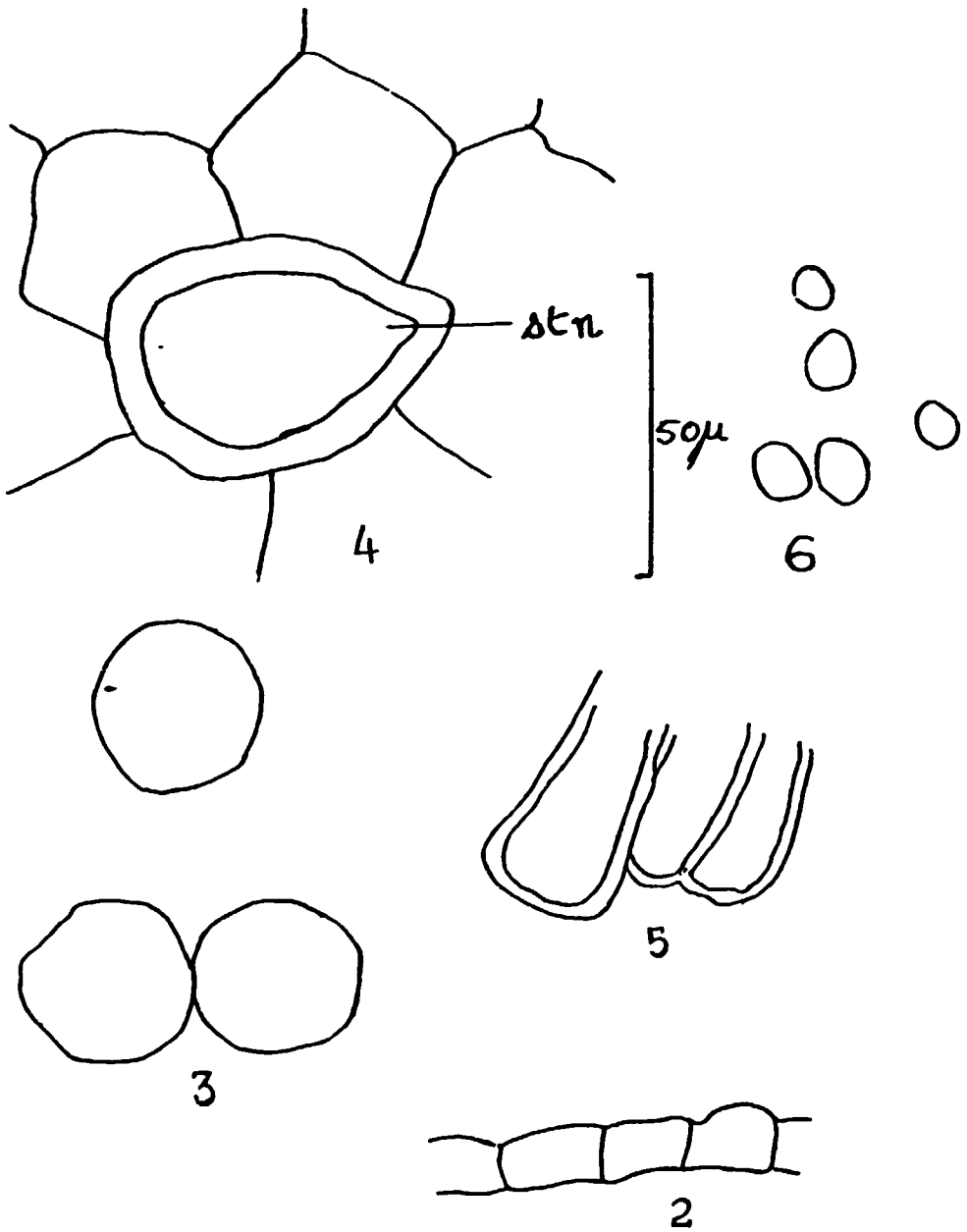

Figure 15. Piper nigrum fruit powder (microscopic)

Key: 2 Epidermal cells
3 Oil globules
4 Fragments of parenchymatous cells
stn Stone cells
5 Beaker-shaped cells
6 Starch grains

16. Swertia chirata (chiraita)

This is the dried plant of Swertia chirata Buch. Ham. (family Gentianaceae), collected when in flower and dried. It contains bitter principle.

Description

Macroscopical: Root about 10 mm in diameter, yellowish brown; stem about 5 mm in diameter, greyish brown in colour, glabrous, lower part cylindrical and upper part quadrangular, longitudinal section shows thin, yellowish wood with thick, yellowish pith which is easily separable; leaves opposite, sessile, ovate, lanceolate, entire, acuminate, glabrous; flowers panicled, small, green (picture 16).

Microscopical: Powdered drug dark brown; vessels with bordered pits, reticulate, spiral thickening, fragments of epidermal cells of stem with parenchyma, dorsiventral leaf; upper epidermis with straight anticlinal walls; lower epidermis with wavy anticlinal walls; stomata anomocytic and anisocytic; pollen 25 μ in diameter, spherical, three pores (figure 16).

Analytical standards

	Laboratory results (Percentage)	Pharmacopoeial limit IP (Percentage)	Pharmacopoeial limit BHP (Percentage)
Loss on drying	7.80	-	-
Total ash	4.22	-	-
Acid-insoluble ash	0.60	1.0	1.0
Bitter principle	1.00	1.3	-

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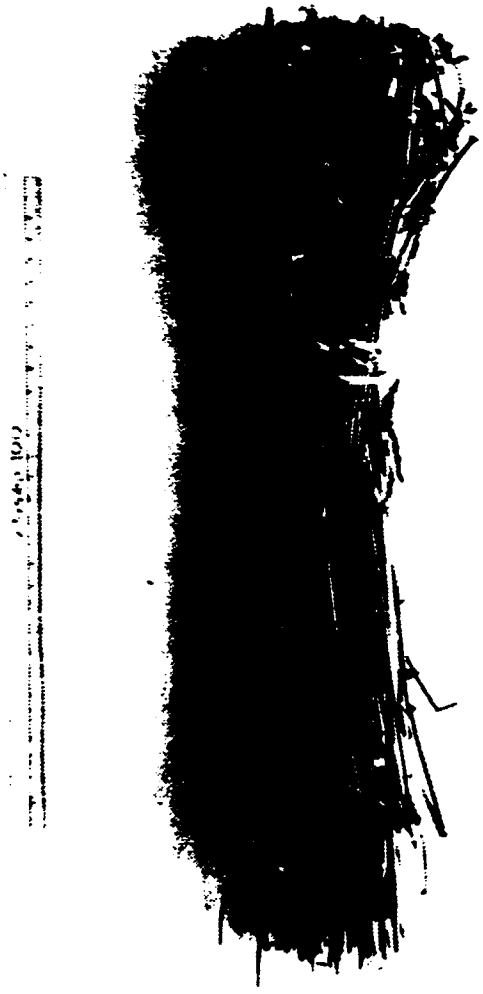

Picture 16. Swertia chirata Hamilt. (plant)

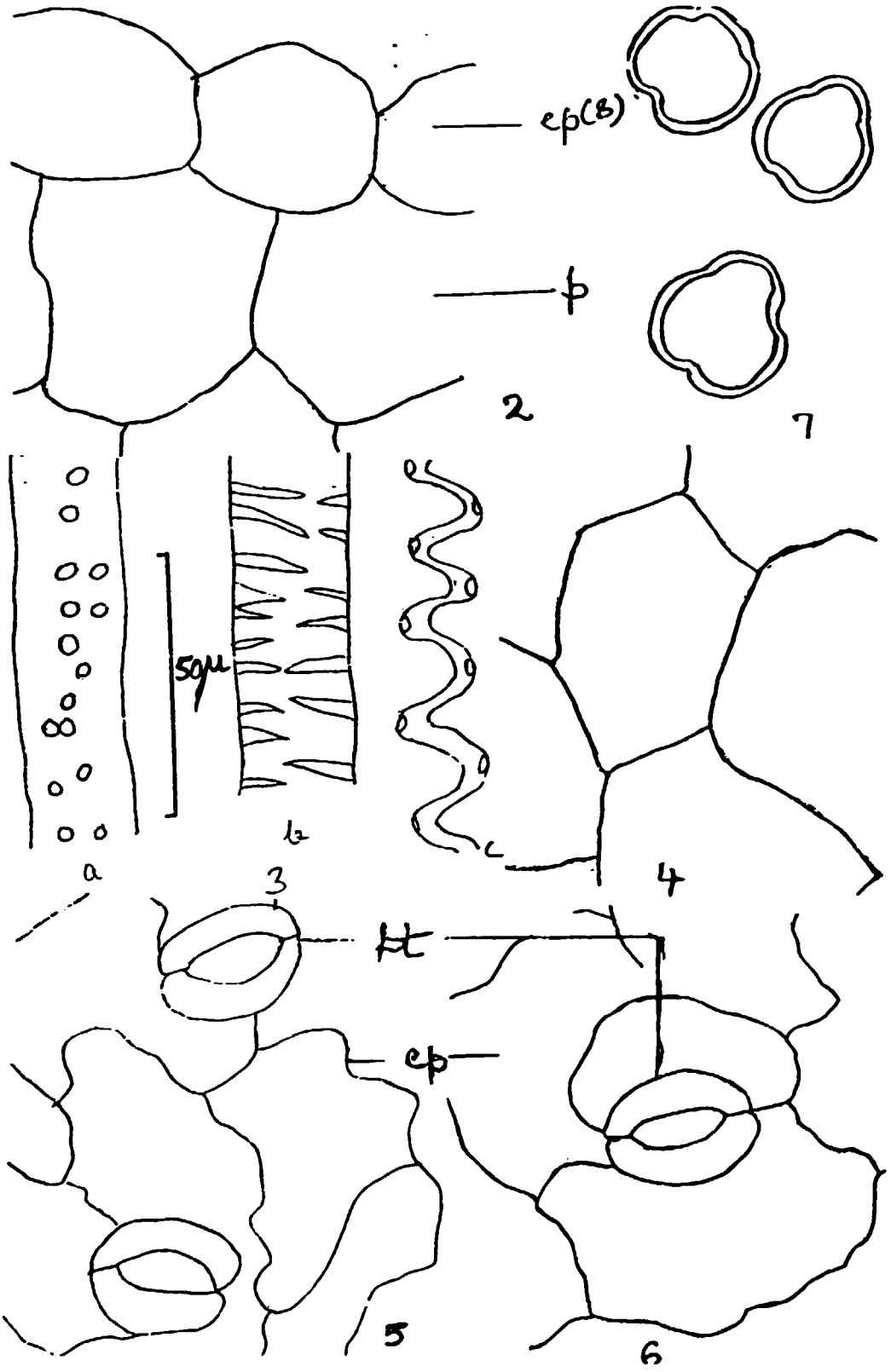

Figure 16. Swertia chirata plant powder (microscopic)

Key:
- 2 Stem
  - ep Epidermal cell
  - p Parenchyma
- 3 Vessels
  - a Pitted
  - b Reticulate
  - c Spiral
- 4 Upper epidermal cell of leaf
- 5 Fragment of lower leaf showing anomocytic stomata
- 6 Fragment of lower epidermis showing anisocytic stomata
  - ep Epidermal cell
  - st Stomata
- 7 Pollen

17. Terminalia belerica (bastard myrobolan)

This is the dried fruit of Terminalia belerica C. B. Clarke (family Combretaceae).

Description

Macroscopical: Fruit ovoid to round with projecting lower end, 30–40 mm long and 15–20 mm in diameter, grey to brown externally, hard; when broken, yellow internal surface with projecting threads showing vascular system; endocarp hard in the centre (picture 17).

Microscopical: Powdered drug yellow; presence of sclerotic cells, single or groups; pitted vessels; xylem fibres; fragments of xylem parenchyma with pits; oval parenchymatous cells containing starch grains, simple and compound grains, oval or round up to 6 µ in diameter; hairs unicellular; numerous rosette aggregate crystals of calcium oxalate up to 30 µ in diameter (figure 17).

Analytical standards

	Laboratory results (Percentage)
Loss on drying	9.76
Ash content	4.55
Acid-insoluble ash	1.07
Tannin content	13.0

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Chemistry

Awasthi K. Lekha and Bhola Nath. Chemical examination of Termenalia belerica. J. Indian Chem. Soc. 1968, 45 (10), 913–917.

Picture 17. Terminalia belerica Roxb. (fruit)

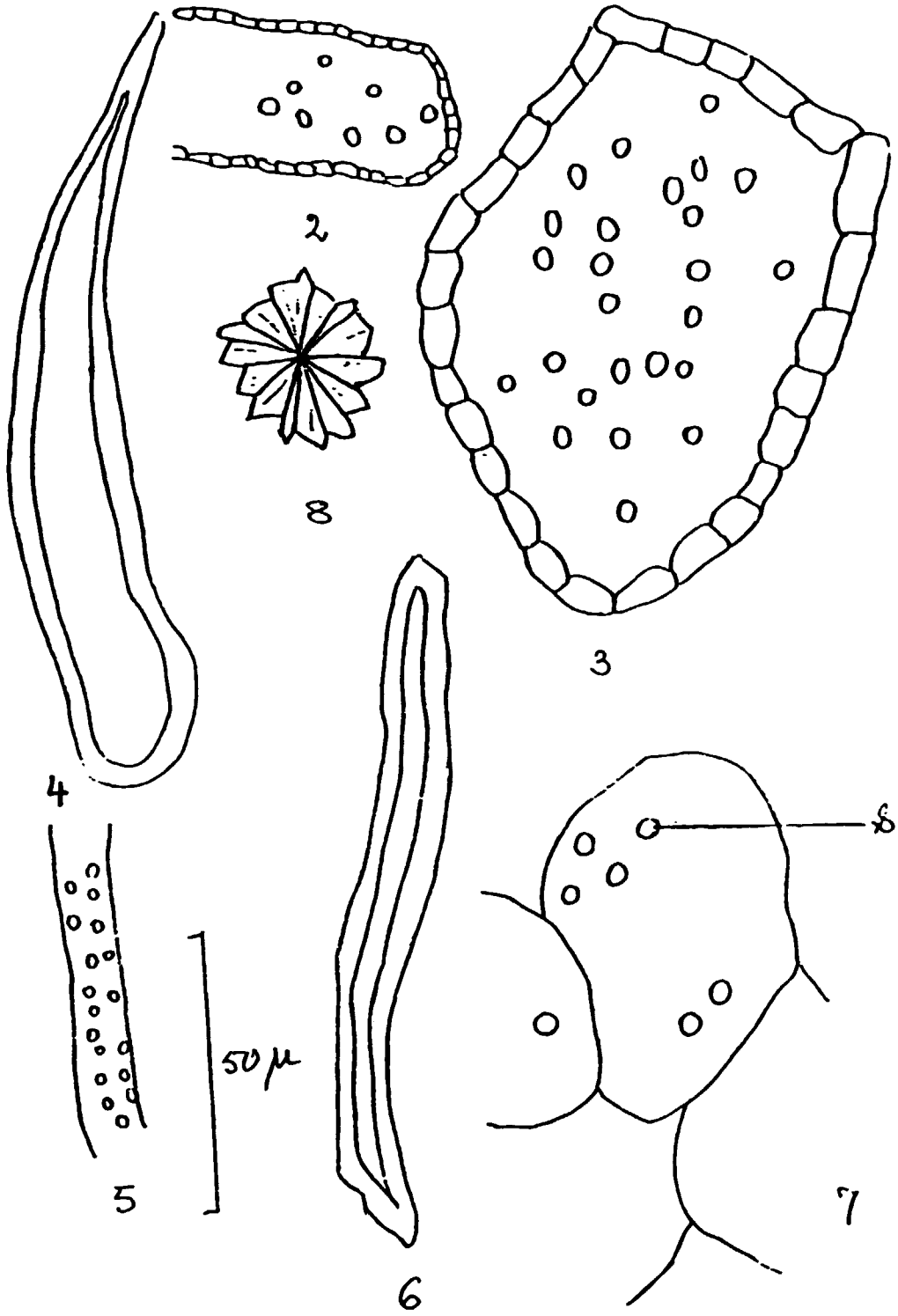

Figure 17. Terminalia belerica fruit powder (microscopic)

Key:
2 Xylem parenchyma
3 Sclerotic cells
4 Unicellular hair
5 Pitted vessels
6 Xylem fibre
7 Fragment of parenchymatous cells starch
s Starch
8 Calcium oxalate crystal

18. Terminalia chebula (chebulic myrobolan)

This is the dried fruit of Terminalia chebula Retz. (family Combretaceae).

Description

Macroscopical: Fruit ovoid, 25-35 mm in length, 15-20 mm in diameter, grey to brown externally, six prominent grey to brown longitudinal ridges; surface rough, hard; when broken, yellow internal surface, hard endocarp on the centre (picture 18).

Microscopical: Powdered drug yellow; sclerotic cells present, pitted vessels, xylem fibres; parenchymatous cells containing starch grains, simple, oval or round up to 6 µ in diameter; hairs unicellular; fragments of xylem parenchyma with pits; rosette aggregate crystal of calcium oxalate up to 30 µ in diameter (figure 18).

Analytical standards

	Laboratory results (Percentage)
Loss on drying	12.99
Total ash	2.37
Acid-insoluble ash	0.36
Tannin content	28.0

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Picture 18. Terminalia chebula Retz. (fruit)

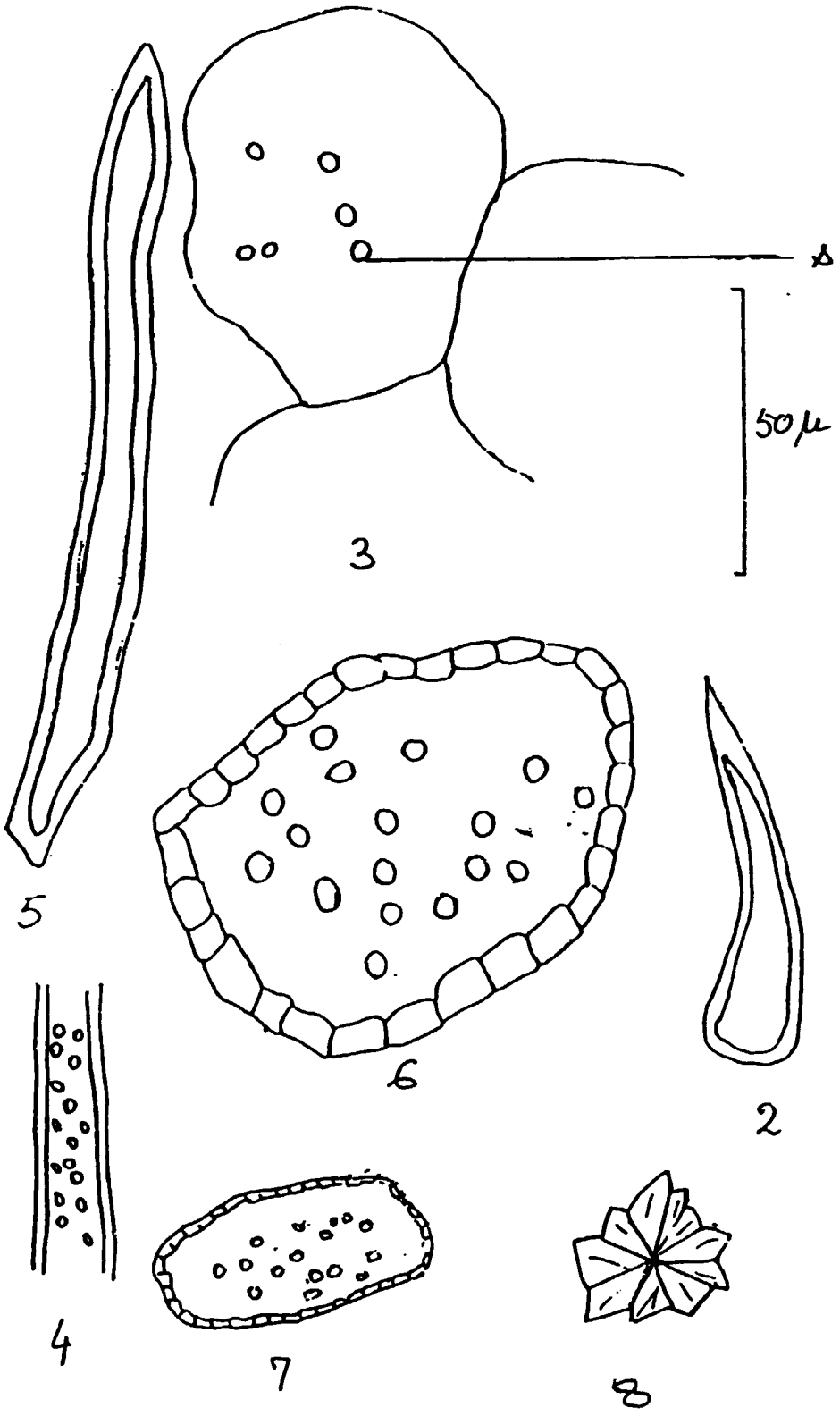

Figure 18. Terminalia chebula fruit powder (microscopic)

Key:
2 Unicellular hair
3 Fragment of parenchymatous cells
s Starch
4 Pitted vessel
5 Xylem fibre
6 Sclerotic cells
7 Xylem parenchyma
8 Calcium oxalate crystal

19. Valeriana jatamansi (valerian)

This is the dried rhizome and roots of Valeriana jatamansi Jones Syn. V. wallichii DC (family Valerianaceae). It has a characteristic odour resembling that of valeric acid and camphor, and a sweet taste with spicy bitter after-taste. It contains odourless crystalline principle (methyl 2-pyrrolyl ketone), alkaloids, valepotriates and about 1 per cent of volatile oil.

Description

Macroscopical: Rhizome 2-4 cm long, 0.5-2 cm wide, cylindrical, often slightly curved; external surface with transverse groove (leaf scar); greyish brown; some rhizome bearing cylindrical root; fracture short, yellow, internally pale brown, thin cortex, dark cambium line, ring of inconspicuous vascular bundle and large pith (picture 19).

Microscopical: Powdered drug greyish brown; presence of starch grains of 6-16 μ diameter, spherical, plano-convex elliptic, simple as well as compound, usually with central hilum; fragments of vessels with scalariform and pitted thickenings, fragments of cortical parenchyma; occasional presence of root hair; fragments of cork (figure 19).

Analytical standards

	Laboratory results				Pharmacopoeial limit (IP)
	A	B	C	D	
	(Percentage)				(Percentage)
Loss on drying	9.88	10.96	13.58	10.20	-
Total ash	5.64	4.40	6.29	4.7	12.0
Acid-insoluble ash	0.30	0.23	0.39	0.28	-

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Picture 19. Valeriana jatamansi Jones
syn. V. wallichii DC (rhizome)

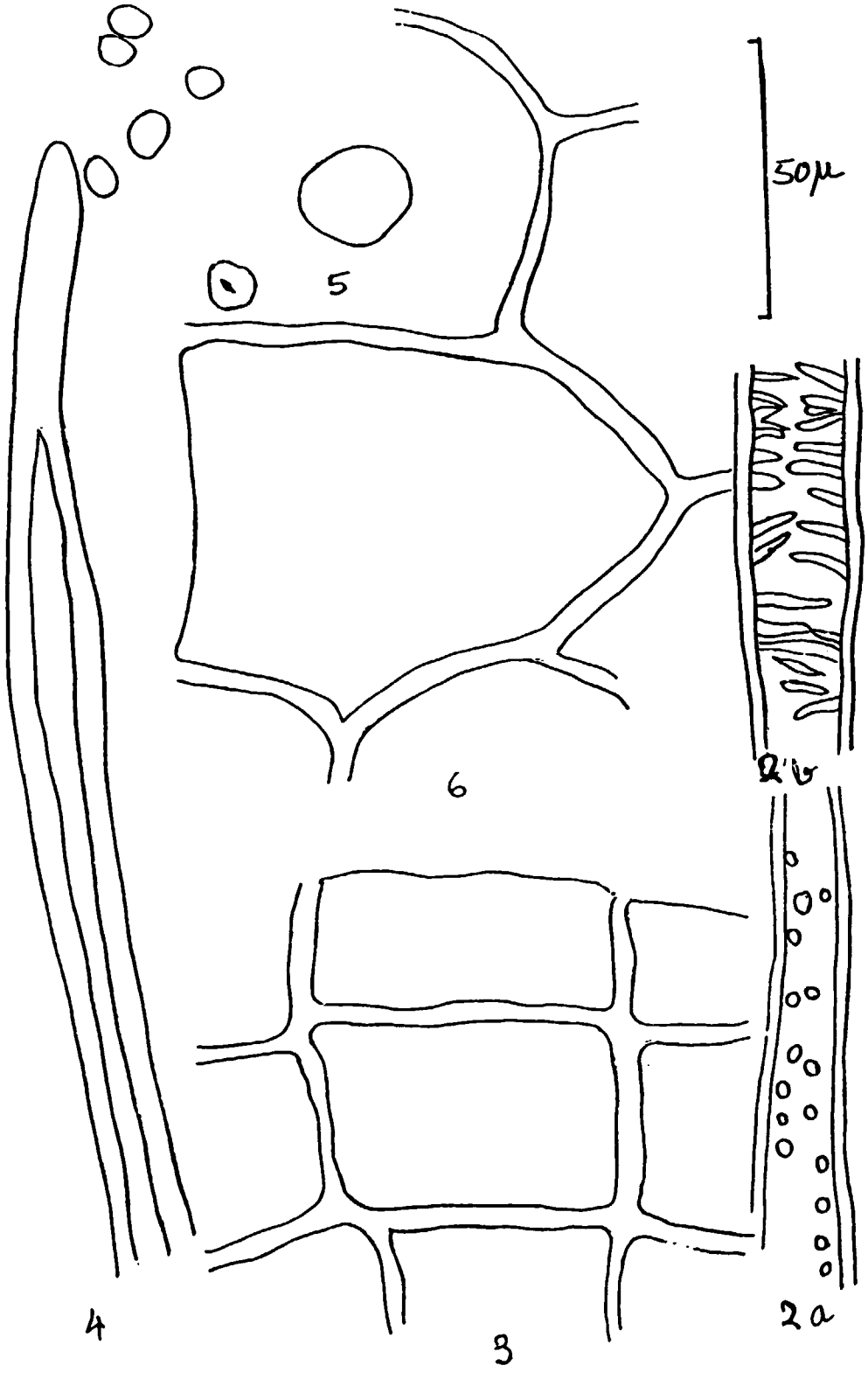

Figure 19. Valeriana jatamansi rhizome powder (microscopic)

Key: 2 Vessels
a Pitted
b Scalariform
3 Cork
4 Hair
5 Starch grains
6 Cortical parenchyma

20. Zingiber officinale (ginger)

This is the dried and bleached rhizome of Zingiber officinale Rosc. (family Zingiberaceae). It contains volatile oil. The volatile oil contains camphene, phellandrene, zingiberene, zingiberol, eucalyptol, citral, borneol, linalool, methylheptenone and nonyl alcohol, together with esters of acetic and caprylic acid, a yellow oil gingerol which is a mixture of phenols and to which the drug owes its odour, a resin and shogaol.

Description

Macroscopical: Underground rhizomes, branched, known as hands, 3 to 6.5 cm long, 1 to 2 cm high and 0.5 to 1 cm thick; branches, known as fingers, arising from upper surface of rhizome; externally brown colour, but appearance whitish due to calcium sulphate or carbonate dust; leaf traces on external surface which are easily removable by scraping; fracture short with projecting fibres; internally light yellow, transversely cut surface shows scattered vascular bundles (picture 20).

Microscopical: Powdered drug light yellow; thin-walled cells of ground tissue containing abundant starch grains, single, spheroidal and ellipsoidal, diameter 10-30 μ; long, thin-walled unlignified fibres, annular, reticulate vessels, subspherical oleo-resin cells with thick walls and yellow content (figure 20).

Analytical standards

	Laboratory results (Percentage)	Pharmacopoeial limit (Percentage)			
		BP	IP	BHP	JP
Total ash	5.95	6.0	6.0	6.0	6.0
Acid-insoluble ash	1.28	-	-	-	-
Volatile oil content	0.8	-	-	-	-
Water-soluble extractive	11.15	10.0	10.0	-	-
Loss on drying	12.94	-	-	-	-

Picture 20. Zingiber officinale Rosc. (rhizome)

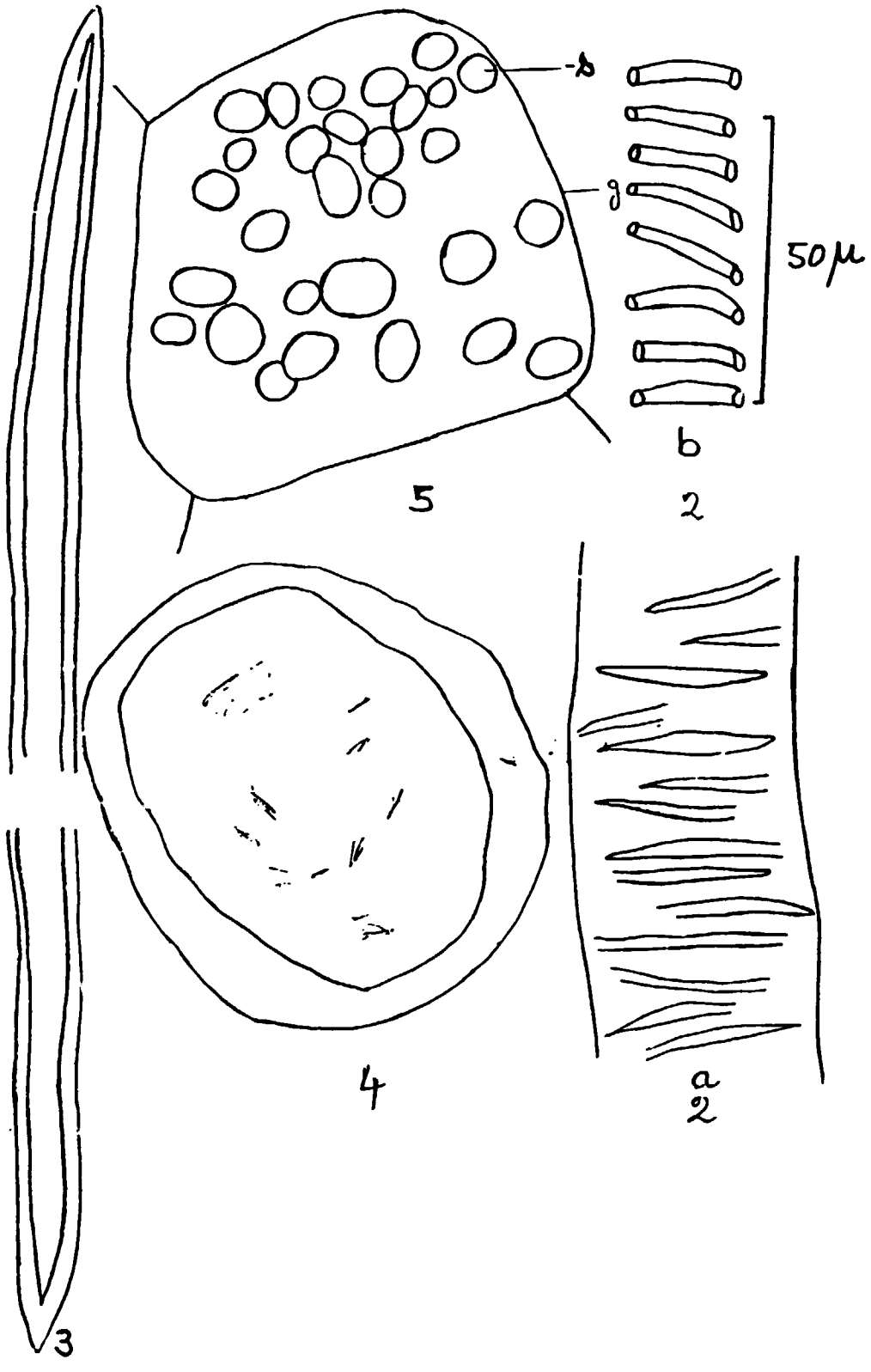

Figure 20. Zingiber officinale rhizome powder (microscopic)

Key: 2 Vessels
a Reticulate
b Annular
3 Fibre
4 Oleo-resin
5 Ground tissue cell
g Ground tissue
s Starch

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Annex I

METHODOLOGY

A. Microscopic examination of powdered drugs

Small pieces of the dried drug were ground in a mortar with pestle. The powder was then sieved to be fine enough for microscopic examination. Several drops of a mounting medium, i.e. a chloral-hydrate solution and water were placed in the centre of a clean slide and a small amount of the powdered drug was sprinkled on that fluid. A cleaned cover-slip, held with forceps, was then carefully placed on the slide starting at one edge, where it made contact with the mounting medium first. To prevent drying of the aqueous chloral-hydrate solution during observation, a small amount of glycerol was usually added. The prepared slide was observed first under low magnification, then under high magnification for details of structure. For the preparation of detailed drawings, the microscope was fitted with a camera lucida. To take exact measurements, the microscope was fitted with a calibrated micrometer eyepiece.

B. Determination of ash

An accurately weighed amount of the ground drug (usually about 2 g) was distributed in a fine, even layer on the bottom of a tared platinum or silica crucible. The heat was gradually increased, not exceeding dull red, until the sample was free from carbon. Then it was cooled and weighed. If a carbon-free ash could not be obtained in that way, the charred mass was exhaustively extracted with hot water. The residue was collected on an ashless filter paper, the residue and the filter paper were incinerated, and the filtrate was added and evaporated to dryness. The combined mass was ignited at a low temperature. The percentage of ash was calculated with reference to the air-dried drug.

C. Determination of acid-insoluble ash

The ash, obtained in the determination of ash, was boiled for five minutes with 25 ml of dilute hydrochloric acid (10% w/v). The insoluble matter was collected on an ashless filter paper, washed with hot water, ignited and weighed. The percentage of acid-insoluble ash was calculated with reference to the air-dried drug.

D. Determination of volatile oil

The drug was coarsely powdered and an accurately weighed amount of it (as shown in the table) was put, together with 250 ml of water, into the one-litre distilling flask A (as shown in the figure). A few pieces of porous earthenware were added, and the distilling flask was then connected to the still-head. Before attaching the condenser, the graduated receiver R was filled with water until it overflowed at P. Tap T serves as outlet. The condenser was attached. The contents of the flask was heated and stirred by frequent agitation until ebullition commenced. The distillation was continued at such a rate by which the lower end of the condenser was kept cool. The flask was rotated occasionally to wash down any material that adhered to its sides. The distillation was continued for four to five hours, after which the apparatus was allowed to cool for 10 minutes. Tap T was opened to let out the water and to bring the oil into the graduated part of the receiver where the volume of oil was measured. The distillation was continued for another hour and the volume of oil was read again, after letting the apparatus cool off as before. Distillations were repeated until successive readings of the volatile oil content

did not differ. The measured yield of volatile oil was taken to be the content of volatile oil in the drug.

Table. Weight of the coarsely powdered drug to be used for the determination of volatile oil

Drug	Weight of powder (g)
Acorus calamus	15
Amomum subulatum	15
Cinnamomum tamala	15
Cinnamomum zeylanicum	50
Cuminum cyminum	15
Elettaria cardamomum	10
Foeniculum vulgare	20
Piper longum	30
Piper nigrum	30
Zingiber officinale	40

E. Determination of alkaloid content

An accurately weighed quantity (about 10 g) of the powdered drug (mesh No. 60) was put into a flask and a mixture of ether and alcohol (4:1) was added. The mixture was well shaken and set aside (10 minutes). Ammonia solution (1.5 ml of 10% w/w) mixed with water (2 ml) was added and shaken frequently during one hour. The mixture was transferred to a small percolator, plugged with cotton wool. When the liquid ceased to flow and the powder was firmly packed, percolation was continued, first with a further 25 ml of the ether-alcohol mixture, and then with further amounts of ether until complete extraction of the alkaloid was effected.

The percolate was transferred to separator No. 1, 0.5N hydrochloric acid (20 ml) was added and the mixture was shaken. The layers were allowed to separate and the lower layer was drained off. The extraction was continued by adding successively each time 10 ml of a mixture of 0.1N hydrochloric acid and alcohol (3:1), until complete extraction of the alkaloid was effected.

The mixed acid solution was then washed with chloroform (10 ml) and the chloroform layer was transferred into separator No. 2 containing 0.1N hydrochloric acid (20 ml). It was shaken and allowed to separate, and the chloroform layer was discarded. Extraction of the liquid in separator No. 1 was repeated with two further quantities of 5 ml chloroform each. The chloroform layer was transferred to separator No. 2 and was washed with the same aqueous acid as before.

The acid from the first and second separators were then combined and made distinctly alkaline with dilute ammonia solution. The mixture was then shaken with successive quantities of chloroform until complete extraction of the alkaloid was effected. The combined chloroform extract was washed with water (3 ml). Most of the chloroform was removed by distillation over a water-bath, and the remainder of the chloroform was transferred to a shallow open dish. The final traces of chloroform were completely removed and ethyl alcohol (2 ml) was added to the residue, and the solvent was evaporated to dryness. The

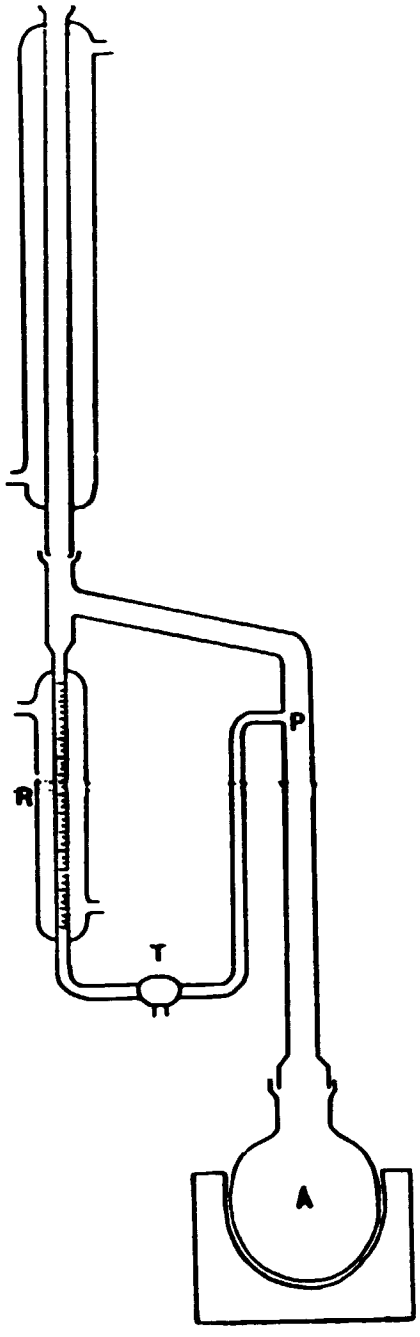

Figure. Volatile oil determination apparatus

residue was then dried at 105 °C and was weighed at intervals of one hour until two successive weighings did not differ by more than 1 mg. The residue was then dissolved in 0.02N sulphuric acid (20 ml) and was titrated with 0.02N sodium hydroxide using methyl red as indicator. Each ml of 0.02N sulhuric acid is equivalent to 0.005787 g of alkaloid calculated as hyoscyamine.

F. Loss on drying

Two grams of the sample were weighed in a tared silica crucible and dried in an air-oven at 110 °C till constant weight was obtained. The difference in the two weighings gives the loss on drying.

G. Water-soluble extractive

The coarsely powdered, air-dried drug (5 g) was macerated for 24 hours in chloroform water (100 ml) in a glass flask closed with a stopper with occasional shaking during the first six hours and then standing for another 18 hours. It was filtered and 25 ml of the filtrate was evaporated to dryness in a tared petridish. The dish was then dried to constant weight at 105 °C. The percentage of water-soluble extractive was calculated with reference to the air-dried drug.

H. Determination of tannin

The coarsely powdered sample (5 g) was boiled with 400 ml of water for 30 minutes, cooled and transferred to a 500 ml volumetric flask. The volume was made up with water. The infusion was then filtered and to 10 ml of the filtrate, 25 ml of indigo-carmine solution (prepared by dissolving 6 g of indigo carmine in water containing 50 ml of sulphuric acid and volume made up to 1 litre) and about 750 ml water were added. A potassium-permanganate solution (1.33 g per litre) was added to it slowly from a burette while stirring slowly, until the solution became light green. Then the potassium-permanganate solution was added dropwise until the colour changed to bright yellow or faint pink at the rim. The volume of potassium permanganate used was designated as x.

To further 100 ml of the filtered infusion, gelatin solution (50 ml), acid sodium-chloride solution (100 ml) and powdered kaolin (10 g) was added. (The gelatin solution was prepared by soaking 25 g of gelatin in a saturated sodium-chloride solution for one hour, and heating it to dissolve the gelatin. Subsequently it was cooled and then diluted with a saturated sodium-chloride solution to give 1 litre. The acid sodium-chloride solution was prepared by acidifying 975 ml of saturated sodium-chloride solution with 25 ml of sulphuric acid.)

The mixture was shaken for several minutes in a closed flask, allowed to settle, and decanted through a filter paper. Twenty-five ml of the filtrate was mixed with 25 ml of indigo-carmine solution and about 750 ml of water, and titrated with potassium permanganate as before. The volume of permanganate consumed was designated as y. Y-x gives the volume of potassium permanganate required to oxidize tannin. The potassium-permanganate solution was immediately standardized against 0.1N oxalic acid. Each ml of 0.1N potassium-permanganate solution is equivalent to 0.0042 g of tannin calculated as gallotannic acid.

Annex II

LIST OF MEDICINAL PLANTS USED IN AYURVEDIC PREPARATIONS

1. Abies spectabilis (Talispatra, तालिस पत्र)
2. Acacia catachu (Khayar, खयर)
3. Aconitum heterophyllum (Atis, अतिस)
*4. Aconitum spicatum (Bish,Batsanavbikh; बिष,बत्सनाभ)
5. Aconitum sp. (Sudcha Batsanav, शुद्ध बत्सनाभ)
*6. Acorus calamus (Bojho, घोकटो)
7. Achatoda vasica (Asuro,Vasa; अडुसो,बासा)
8. Aegle marmelos,seed (Bel, बेलको बोउ)
9. Aegle marmelos, fruit (Bel, बेलको फल)
10. Aegle marmelos, leaf (Bel, बेलको पात)
11. Allium sativum (Lashun, लसुन)
12. Aloe succotrina (Musawar, मुसाखर)
*13. Amomum subulatum (Alaichi, अलैंची)
14. Anium graveolens (Ajamoda, अजमोडा)
15. Areca catachu (Dakshin supari, दक्षिण सुपारी)
16. Asparagus racemosus (Satawari, सतावरी)
17. Azadirachta indica, leaf (Neem, निमको पात)
18. Bacopa monniera (Brahmi, ब्राह्मी)
19. Baliospermum montanum (Danti, दन्ती)
20. Bambusa arundinacia (Bamshalochan, वंशलोचन)
21. Berberis aristata (Rasanjan, रसांजन)
22. Butea monosperma (Palasbij, पलाशबीज)
23. Cedrus deodara (Deodaru, देवदार)
24. Cannabis sativa (Suddha bhang, शुद्ध भांग)
25. Cinnamomum camphora (Kapur, कपुर)
*26. Cinnamomum tamala (Tejpat, तेजपात)

*27. Cinnamomum zeylanicum (Dalchini, दालचीनी)

28. Coriandrum sativum (Dhania, धनिया)

29. Croton tiglium (Jamalgota, जमालगोटा)

30. Cubeba officinale (Kankol, कंकोल)

31. Commiphora mukul (Gugul, गुग्गुल)

*32. Cuminum cyminum (Jeera, जीरा)

33. Curculigo orchioides (Musali, मूसली)

34. Curcuma longa (Haledo, Besar; हलेदो, बेसार)

35. Curcuma zedoaria (Kachur, कचूर)

36. Cyperus rotundus (Mothe, मोथे)

37. Cyperus scariosus (Nagarmothe, नागर मोथे)

*38. Datura metel, leaf (Daturapatra, धतूरापत्र)

*39. Datura metel, seed (Daturabij, धतूरा बीज)

40. Desmodium gangeticum (Salparni, शालपर्णी)

41. Desmotrichum fimbriatum (Jivanti, जीवन्ती)

42. Eclipta prostrata (Bhrigraj, भृंगराज)

*43. Elettaria cardamomum (Sukmel, सुकमेल)

*44. Embelia ribes (Bayubidang, वायु विडंग)

45. Ephedra gerardiana (Somlata, सोम लता)

*46. Foeniculum vulgare (Deshi soph, देशी सौफ)

*47. Glycyrrhiza glabra (Jethimadhu, जेठी मधु)

48. Gmelina arborea (Khamari, खमारी)

49. Guizotia abyssinica (Krishna jira, कृष्ण जीरा)

50. Holarrhina antidysenterica (Indrajau, इन्द्र जौ)

51. Holarrhina antidysenterica (Indrajau ko bokra, (इन्द्र जौ को बोकरा)

52. Ichnocarpus frutescens (Sariba, सरीवा)

53. Jasminum auriculatum (Juhiko pat, जुही को पात)

54. Leucas cephalotes (Dron pushpa, द्रोण पुष्प)

55. Mimosa pudica (Lazzawati, लज्जावती)

56. Nannifera indica (Ampko khoya, आंपको खोया)

57. Myristica fragrans (Jaiphal, जायफल)

58. Myristica malabarica (Jaipatri, जावपत्री)

59. Nardostachys jatamansi (Jatamasi, जटामसी)

60. Nigella sativa (Kugralo, कुंथेलो)

61. Nymphaea stellata (Neelkamal, नीलकमल)

62. Ochrocarpus longifolius (Nagkeshar, नागकेशर)

63. Ocimum americanum (Krishnaparni, कृष्णा पर्णी)

64. Ocimum sanctum (Tulsi, तुलसी)

65. Operculina turpethum (Nisoth, निशोथ)

66. Oroxylum indicum (Totelo, टटेलो)

67. Papaver somniferum (Aphim, अफीम)

68. Phyllanthus emblica (Amla, आमला)

*69. Picrorhiza scrophulariaeflora (Kutki, कुटकी)

70. Piper chaba (Chavo, (चावो)

71. Piper longum, root (Piplamul, (पिप्पलामूल)

*72. Piper longum, fruit (Pipla, पिप्पली)

*73. Piper nigrum (Marich, मरीच)

74. Plumbago zeylanica (Chitu, चीतु)

75. Premna integrifolia (Ginari, गनीयर)

76. Prunus cerasoides (Paiyun, पैयूं)

77. Pueraria tuberosa (Badarikand, बदरीकन्द)

78. Pongamia pinnata (Karanj, करंज)

79. Rauwolfia serpentina (Sarpgandha, सर्पगंधा)

80. Rubia cordifolia (Majitho, मजेठो)
81. Saussurea lappa (Kut, कुट)
82. Scinbapnus officinalis (Gajpipala, गज पिपला)
83. Solanum indicum (Bihi, भिंडे)
84. Solanum xanthocarpum (Kantakari, कंटकारी)
85. Stephania hernandiifolia (Patha, पाथ)
86. Strychnus nux-vomica (Kuchila, कुचीला)
*87. Swertia chirata (Chiraito, चिरायतो)
88. Symplocos paniculata (Lodh, लोध)
89. Syzygium aromaticum (Lwang, ल्वांग)
*90. Terminalia chebula (Harro, हर्रो)
*91. Terminalia belerica (Barro, बर्रो)
92. Tinospora cordifolia (Gurjo, गुर्जो)
93. Trachyspermum ammi (Jwano, ज्वानो)
94. Tribulus terrestris (Gokhur, गोखुर)
95. Trichosanthes dioica (Parwalko pat, परवलको पात)
96. Vetiveria zizanioides (Ushir, उसीर)
97. Valeriana hardwickii (Tagar, तगर)
98. Vanda roxburghii (Tagar, Rasna, तगर, रास्ना)
99. Woodfordia fruticosa (Dhaiyaroko phul, धाइयोको फूल)
*100. Valeriana jatamansi (Sugandhawal, सुगंधवाल)
*101. Zingiber officinale (Sutho, सुंठो)

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*These plants are described in the present report.

Annex III

LIST OF SELECTED AYURVEDIC PREPARATIONS AND THEIR COMPOSITION

Preparation and medicinal plant	Other constituents
1. Tribhuvan kirti mishran (त्रिभुवन कीर्ति मिश्रण)	
Aconitum spicatum	Borax
Datura metel (leaf)	Juice of Citrus sp.
Leucas cephalotes	Sulphuretim hydrargyri (hingul)
Ocimum sanctum	Yellow arseriicum sulphidus (godanti)
Piper longum (fruit)	
Piper longum (root)	
Piper nigrum	
Zingiber officinale	
2. Soot shekhar mishran (सूत शेखर मिश्रण)	
Aconitum sp.	Ash of copper (tamra bhasma)
Aconitum spicatum	Borax
Aegle marmelos (seed)	Calcium ash (shankha bhasma)
Allium sativum	Cow's urine
Ammomum subulatum	Mercury
Cinnamomum tamala	Milk
Curcuma zedoaria	Sulphur
Datura metel (seed)	
Ochrocarpus longifolius	
Piper longum	
Piper nigrum	
Zingiber officinale	
3. Shankhavati (शंखवटी)	
Aconitum spicatum	Calcium ash (shankha bhasma)
Piper longum	Ferula narthex excude (hing)
Piper nigrum	Five salts (pancha lawan)
Zingiber officinale	Juice of Citrus sp.
	Mercury
	Sulphur

Annex III (continued)

Preparation and medicinal plant	Other constituents
4. Krimimudgar vati (कृमि मुद्गर वटी)	
Allium sativum	Cow's urine
Apium graveolens	Mercury
Butea monosperma	Milk
Embelia ribes	Sulphur
Strychnus nux-vomica	
5. Gangadhar vati (गंगाधर वटी)	
Aegle marmalos	Sodium chloride (red variety) (sidhe nun)
Cyperus rotundus	
Holarrhina antidysenterica	Resin of Salmalia malabarica (simalko khoto)
Holarrhina antidysenterica (bark)	
Magnifera indica (seed)	
Mimosa pudica	
Stephania hernandiifolia	
Symplocos paniculata	
Valeriana jatamansi	
Zingiber officinale	
6. Karpur ras (कर्पूर रस)	
Cinnamomum camphora	Juice of Citrus sp.
Cyperus scariosus	Sulphuratum hydraegyri (hingul)
Holarrhena antidysenterica	
Myristica fragrans	
Papaver somniferum	
7. Kutjaghan vati (कुटजघन वटी)	
Aconitum heterophylum	Ghee
Cyperus sceriasus	
Embelia ribes	
Holarrhena antidysenterica	
8. Shetopaladi vati (सेतोपलादि वटी)	
Bambusa arundinacia	Sugar (mishri)
Cinnamomum zeylanicum	
Elettaria cardamomum	
Piper longum	

Annex III (continued)

Preparation and medicinal plant	Other constituents
9. Shringaravra mishran (शृंगाराभ्र मिश्रण)	
Abies spectabilis	Ghee
Adhatoda vasica	Mercury
Allium sativum	Mica (abrakh)
Amomum subulatum	Milk
Cinnamomum camphora	Sulphur
Cinnamomum zeylanicum	
Ephedra gerardiana	
Myristica fragrans	
Myristica malabarica	
Nardostachys jatamansi	
Ochrocarpus longifolius	
Phyllanthus emblica	
Piper nigrum	
Piper longum	
Saussurea lappa	
Scinbapnus officinalis	
Solanum xanthocarpum	
Syzygium aromaticum	
Terminalia belerica	
Terminalia chebula	
Valeriana jatamansi	
Woodfordia fructicosa (flower)	
Zingiber officinale	
10. Chadraprabhavati (चन्द्र प्रभावटी)	
Aconitum heterophyllum	Iron oxide (mandur bhasma)
Acorus calamus	Shilajeet
Baliospermum montanum	Sodium chloride (black) (bire nun)
Berberis aristata	Sodium chloride (red) (sidhe nun)
Cedrus deodara	Sugar (mishri)
Cinnamomum camphora	
Cinnamomum zeylanicum	
Commiphora mukul	
Cinnamomum tamala	
Curcuma longa	
Cyperus rotundus	

Annex III (continued)

Preparation and medicinal plant	Other constituents
Operculina turpenthum	
Piper longum	
Plumbago zeylanica	
Swertia chirata	
Tinospora cordifolia	
11. Rajpravartini vati (रजप्रवर्तीनी वटी)	
Aloe succotrina	Borax
Eclipta prostrata	Ferula narthex excude (hing)
	Ferry sulphas (hirakashi)
	Ghee
12. Yogaraj guggul (योगराज गुग्गुल)	
Cedrus deodara	Sodium chloride (red)
Cinnamomum tamala	(sidhe nun)
Cinnamomum zeylanicum	Yavakhyat
Coriandrum sativum	
Cuminum cyminum	
Cyperus rotundus	
Elettaria cardmomum	
Embelia ribes	
Foeniculum vulgare	
Guizotia abyssinica	
Phyllanthus emblica	
Piper chaba	
Piper longum	
Piper longum (root)	
Piper nigrum	
Plantago zeylanica	
Saussurea lappa	
Terminalia belerica	
Terminalia chebula	
Trachyspermum ammi	
Vanda roxburghii	
Vetiveria zizaniodes	
Zingiber officinale	
13. Lakashyachakrika (लाक्षाचक्रिका)	
	Coccus lacca excudate (kacho laha)
	Talc (khari churna)

Annex III (continued)

Preparation and medicinal plant	Other constituents
14. Shilavati (शिलावटी)	
Berberis aristata	Iron oxide (mandur bhasma)
Eclipta prc ata	Milk
Phyllanthus emblica	Shilajeet
Terminalia belerica	
Terminalia chebula	
15. Khadiradivati (खदिरा-दि वटी)	
Acacia catachu	
Areca catachu	
Cinnamomum camphora	
Cubeba officinale	
Myristica fragrans	
16. Lashunadivati (लशुनादिवटी)	
Allium sativum	Ferula nerthex excude (hing)
Cuminum cyminum	Sodium chloride (red)
Guizotia abyssinica	(sidhe nun)
Piper longum	Sulphur
Piper nigrum	
Zingiber officinale	
17. Haritakyadi vati (हरितक्यादिवटी)	
Croton tiglium	
Terminalia chebula	
18. Sharpagandhadhan vati (सर्पगंधाघन वटी)	
Cannabis sativa	
Nardostachys jatamansi	
Piper longum (root)	
Rauvolfia serpentina	
Trachyspermum ammi	

Annex III (continued)

Preparation and medicinal plant	Other constituents
19. Ghandhak rasayan (गंधक रसायन)	
Aegle marmalos	Ghee
Asparagus racemosus	Milk
Bacopa monniera	Patali
Cinnamomum tamala	
Cinnamomum zeylanicum	
Curculigo orchioides	
Cyperus rotundus	
Desmodium gangeticum	
Eclipta prostrata	
Elettaria cardamomum	
Gmelina arborea	
Ochrocarpus longifolious	
Ocimum amercanum	
Oroxylum indicum	
Phyllanthus emblica	
Piper longum	
Piper nigrum	
Premna integrifolia	
Pueraria tuberosa	
Solanum indicum	
Solanum zanthocarpum	
Terminalia belerica	
Tinospora cordifolia	
Tribulus terieseris	
Zingiber officinale (undried)	
Zingiber officinale (dried)	
20. Shadibindu tel (षाडबिन्दु तेल)	
Cinnamomum zeylanicum	Casia fistula oil
Desmotrichum fimbriatum	Eclipta prostrata juice
Embelia ribes	goat milk
Foeniculum vulgare	Sesamum indicum oil
Glycyrrhiza glabra	Sodium chloride (red) (sidhe nun)
Valeriana hardwickii	
Vanda roxburghii	
Zingiber officinale	

Annex III (continued)

Preparation and medicinal plant	Other constituents
21. Karnavindu tel (कर्ण विन्दु तेल)	
Acorus calamus	Aegle marmelos leaf juice
Allium sativum	Datura metel leaf juice
Curcuma longa	Sesamum indicum oil
22. Netravindu (नेत्र विन्दु)	
Berberis aristata	Alum
	Copper sulphate
	Yanchita
23. Panchagoon malaham (पंच गुण मलहम)	
Azadirachta indica	Beeswax
Cinnamomum camphora	Canarium strictum excude
Commiphora mukul	Eucalyptus oil
Phyllanthus emblica	Kejoput oil
Terminalia belerica	Pinus ruxburghii resin
Terminalia chebula	Salmalia malabarica excude
	Sesamum indicum oil
	Turpentine oil
24. Jatyadi malaham (जात्यादि मलहम)	
Azadirachta indica	Bees wax
Berberis aristata	Copper sulphate
Curcuma longa	Sesamum indicum oil
Ichnocarpus frutescens	
Jasminum auriculatum	
Nigella sativa	
Nymphaea stellate	
Picrorrhiza scrophulariaeflora	
Pongamia pinnata (seed)	
Prunus cerasoides	
Rubia cordifolia	
Saussurea lappa	
Symplocos paniculata	
Terminalia chebula	
Trichosantes dioica	

Annex III (continued)

Preparation and medicinal plant	Other constituents
25. Pratishyayaharvati (प्रतिश्यायहर वटी)	
Glycyrrhiza glabra	Ammonium chloride (nausader)
Piper nigrum	Burnt caramel (chaku)
Zingiber officinale	Gum (goond)

Annex IV

TWENTY MEDICINAL PLANTS AS CONSTITUENTS OF THE PREPARATIONS DESCRIBED IN ANNEX III

	Medicinal plant	Constituent of preparation No. a/
1.	*Aconitum spicatum*	1, 2, 3
2.	*Acorus calamus*	10, 21
3.	*Amomum subulatum*	2, 9
4.	*Cinnamum tamala*	2, 10, 12, 19
5.	*Cinnamum zeylanicum*	8, 9, 10, 12, 19, 20
6.	*Cuminum cyminum*	12, 16
7.	*Datura metel* (leaf)	1
8.	*Datura metel* (seed)	2
9.	*Ellettaria cardamomum*	8, 12, 19
10.	*Embelia ribes*	4, 7, 12, 20
11.	*Foeniculum vulgare*	12, 20
12.	*Glycyrrhiza glabra*	20, 25
13.	*Picrorhiza scrophulariaeflora*	24
14.	*Piper nigrum*	1, 2, 3, 9, 12, 16, 19, 25
15.	*Piper longum* (pipla)	1, 2, 3, 8, 9, 10, 12, 16, 18, 19
16.	*Swertia chirata*	10
17.	*Terminalia belerica*	9, 12, 14, 19, 23
18.	*Terminalia chebula*	9, 12, 14, 17, 19, 23, 24
19.	*Valeriana jatamansi*	5, 9
20.	*Zingiber officinale*	1, 2, 3, 5, 9, 12, 16, 19, 20, 25

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a/ The serial number of the preparation is that given in annex III.

RESTRICTED

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7 November 1988
ORIGINAL: ENGLISH

17325 (2of2)

STRENGTHENING THE ROYAL DRUGS RESEARCH LABORATORY

DP/NEP/80/003

NEPAL

Technical report: Standards of ayurvedic crude drugs, volume II

Prepared for the Government of Nepal
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of S. R. Adhikary, R. Pradhan, R. K. Rajbhandary, G. Shrestha and B. B. Thapa, national experts

Backstopping officer: R.O.B. Wijesekera, Chemical Industries Branch

United Nations Industrial Development Organization

Vienna

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Explanatory notes

Besides the common abbreviations, symbols and terms, the following have been used in this report:

BHP	British Herbal Pharmacopoeia
BPC	British Pharmaceutical Codex
IP	Indian Pharmacopoeia
JP	Japanese Pharmacopoeia
USNF	United States National Formulary

CONTENTS

Volume I

Annexes

Volume II

INTRODUCTION

Within the context of the large-scale project "Stengthening the Royal Drugs Research Laboratory" (DP/NEP/80/003) for which the United Nations Industrial Development Organization is the executing agency on behalf of the United Nations Development Programme, a team of national experts undertook research with the aim of establishing standards for ayurvedic crude drugs, in compliance with one of the immediate objectives of the project, i.e. "to develop quality-control standards for ayurvedic drugs, particularly for those that are used in the primary health care".

Standards of ayurvedic crude drugs, volume II, contains monographs of 20 medicinal plants, and is a continuation of volume I in this series. The information included in this volume follows the pattern of volume I, with one additional information, namely the indication of the places within Nepal where representative herbarium samples are being collected. This does not preclude, however, that the plants cannot be found at other places in the country.

Regarding the analytical results given in this volume, it should be noted that active constituents like alkaloids, volatile oil etc., and undesired substances like total ash and acid-insoluble ash, mostly meet the specified requirements, but that in some instances the volatile-oil content was found to be significantly low in comparison to the pharmacopoeial limit, presumably due to the age of the samples received from Singh Durbar Vaidyakhana.

A detailed description of the methods used in the analysis of the drugs is contained in volume I.

MONOGRAPHS

21. Aegle marmelos (bael fruit)

This is the dried fruit of Aegle marmelos Correa (family Rutaceae).

Description

Macroscopical: In transverse slices, outer epicarp hard, woody rind about 2 mm thick, smooth externally, reddish brown in colour, 10–15 seeds embedded in a reddish pulp, hard (picture 21).

Microscopical: Powdered drug light brown, unicellular hair, endospermic cells polyhedral, fragments of annular and pitted vessels, groups of stone cells, cells of pulp round and thick-walled, elongated cells of endocarp, epidermis of pericarp, parenchymatous mesocarp (figure 21).

Analytical standards

	Laboratory results (Percentage)	Pharmacopoeial limit (IP) (Percentage)
Total ash	3.31	3.5
Acid-insoluble ash	0.55	0.25

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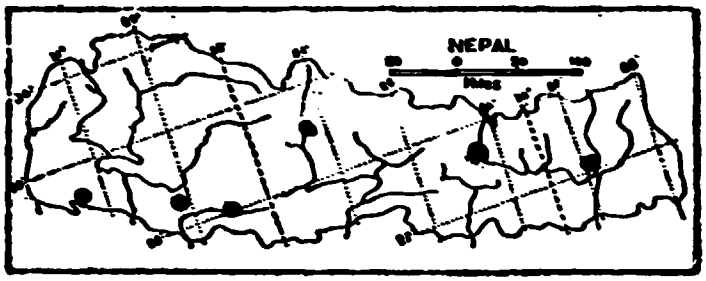
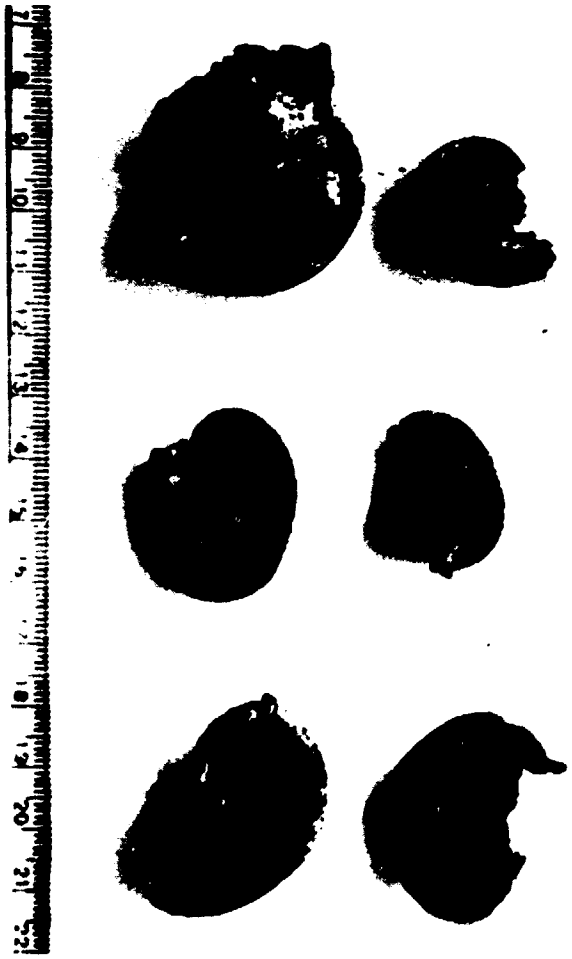


Distribution in Nepal



Picture 21. Aegle marmelos Correa (fruit)

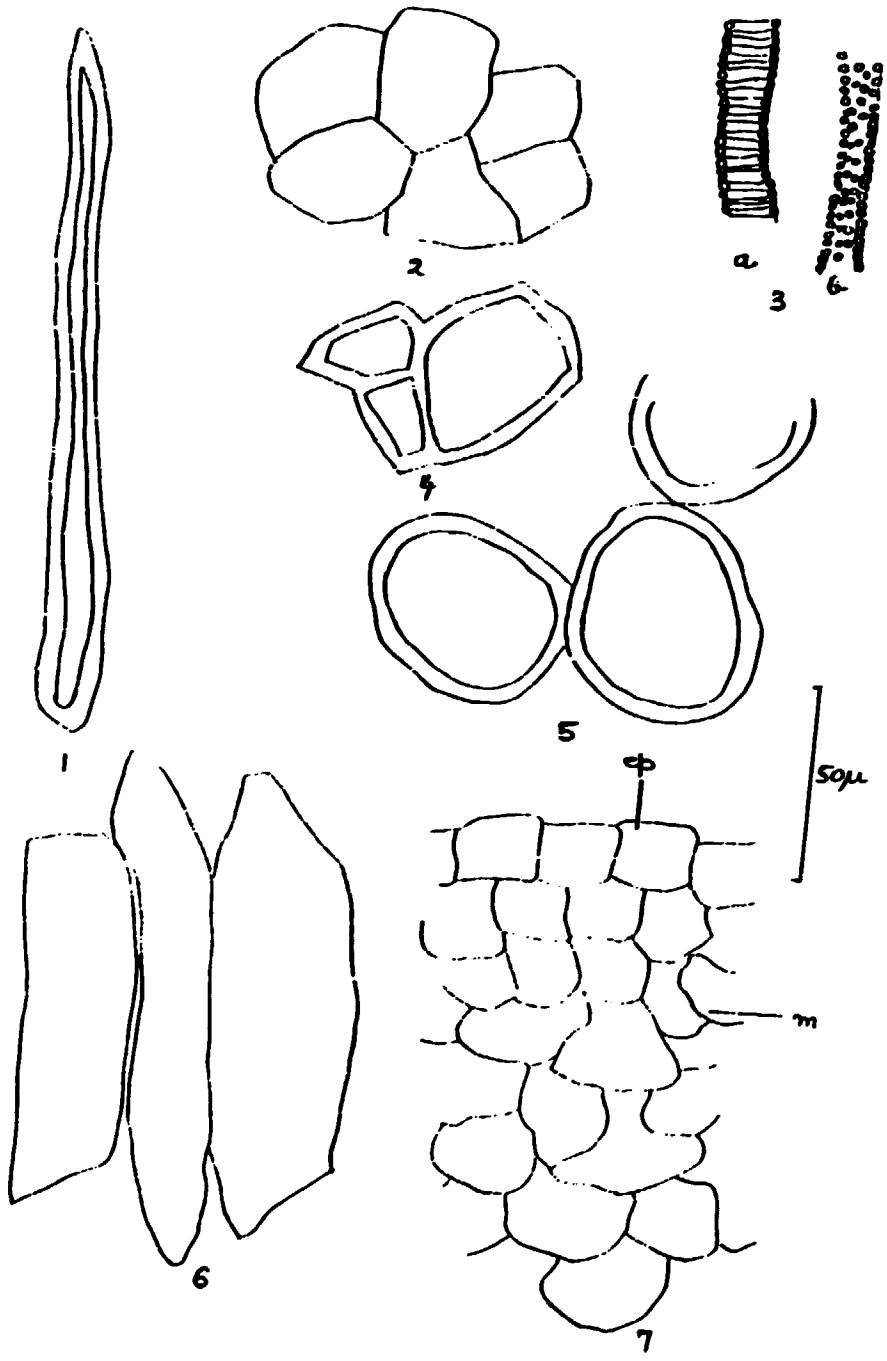


Figure 21. Aegle marmelos fruit powder (microscopic)

Key:
1 Unicellular hair
2 Endospermic cells
3 Vessels
a Annular
b Pitted
4 Stone cells
5 Cells of pulp
6 Endocarpic cells
7 Portion of pericarp
ep Epidermis
m Mesocarp

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Pharmacology

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22. Butea monosperma (bastard teak)

This is the dried seed of Butea monosperma (Lam.) Kuntze, syn. B. frondosa Koenig ex Roxb. (family Leguminosae).

Description

Macroscopical: Reddish brown in colour, convex on both sides, nearly reniform in outline, one edge is convex, the other edge nearly plain, 2-2.5 cm long, 1.5-2 cm wide, about 2 mm thick; testa with yellowish endosperm encloses an embryo (picture 22).

Microscopical: Powdered drug whitish, outer epidermis rectangular in section, thick-walled cells, hexagonal in surface view; endosperm consists of polyhedral parenchyma containing aleurone grains; embryo cells polyhedral, without aleurone grains (figure 22).

Analytical standards

	Laboratory results (Percentage)
Total ash	5.28
Acid-insoluble ash	1.22

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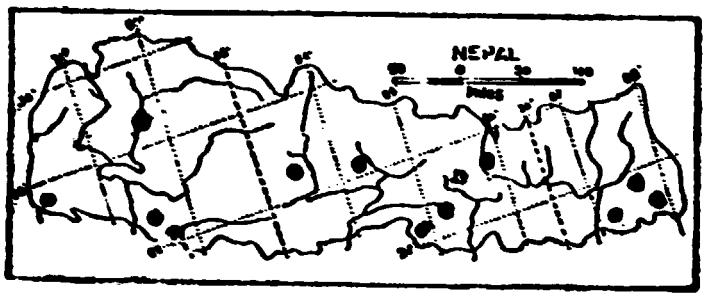

Distribution in Nepal

Picture 22. Butea monosperma (Lam.) Kuntze (seed)

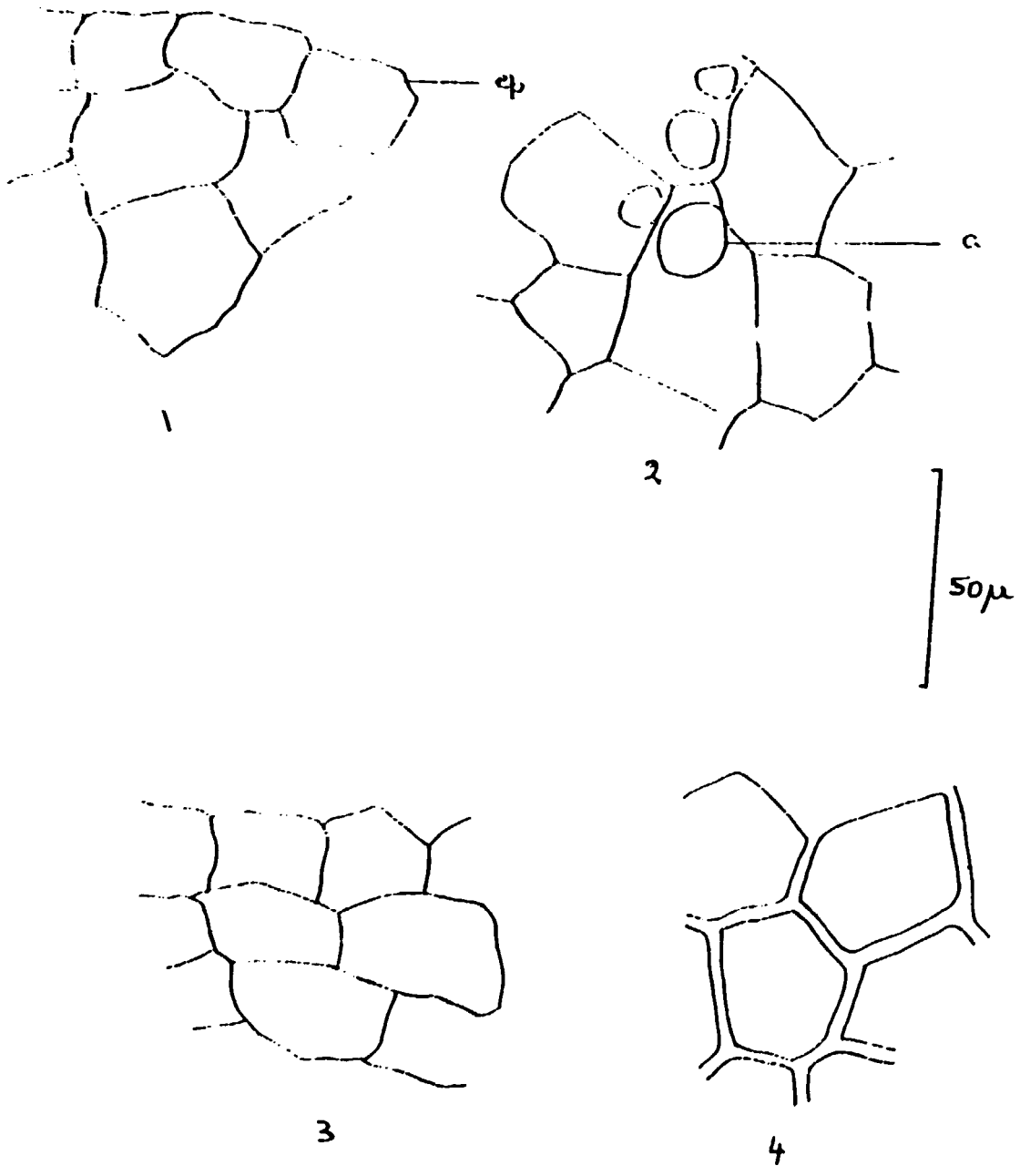

Figure 22. Butea monosperma seed powder (microscopic)

Key: 1 Portion of perisperm
ep epidermis
2 Cells of endosperm
a aleurone grains
3 Embryo cells
4 Epidermal cells in surface view

Chemistry

Chandra, S., Jawahar Lal and M. Sabir. Modified method for isolation of palasonin - the anthelmintic principle of Butea frondosa seeds. Indian J. Pharm. Sci. 1978, 40, 97-98.

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23. Carum Carvi (caraway)

This is the dried fruit of Carum carvi L. (family Umbelliferae).

Description

Macroscopical: Fruit cremocarps, 4-8 mm long, about 1 mm wide, pedicel absent, brownish grey, oblong, laterally compressed and slightly curved, tapering towards both ends; surface glabrous, five narrow primary longitudinal ridges (picture 23).

Microscopical: Powdered drug brownish-grey in colour; fragments of epidermal cells in surface view; annular vessels, fibres of vascular tissue; pitted sclerenchyma; thick-walled parenchymatous cells of endosperm containing aleurone grains (figure 23).

Analytical standards

	Laboratory results (Percentage)	Pharmacopoeial limit (Percentage)			
		IP	BP	BHP	USNF
Total ash	7.30	1.5	-	8.0	-
Acid-insoluble ash	0.29	2.0	1.5	1.5	1.5
Volatile oil	0.97	3.5	3.5 to 6.0	2.5	-

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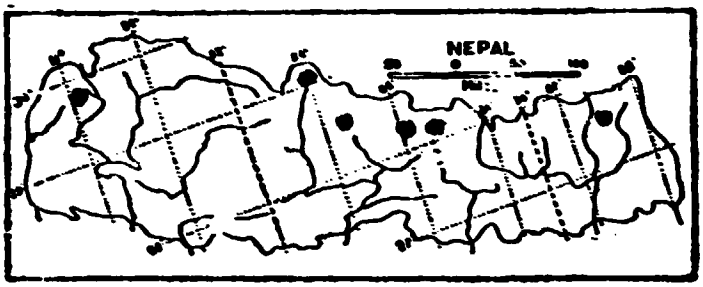

Distribution in Nepal

Picture 23. Carum carvi L. (fruit)

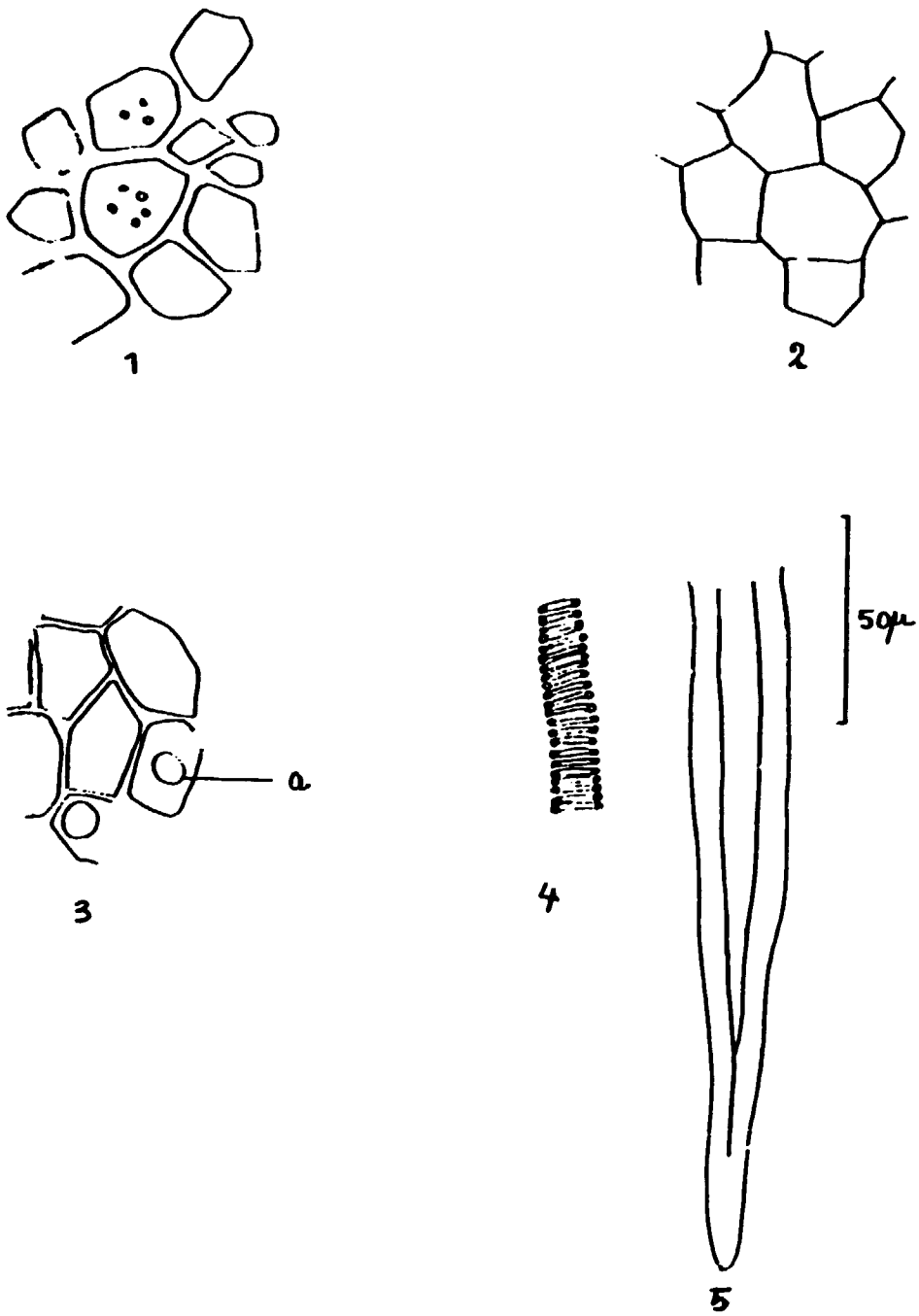

Figure 23. Carum carvi fruit powder (microscopic)

Key: 1 Pitted sclerenchyma
2 Epidermal cells in surface view
3 Cells of endosperm
a aleurone grains
4 Annular vessels
5 Fibre

United States National Formulary XV, p. 1216.

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Ibragimov, G. G. and D. D. Vasilev. Antifungal activity of essential oils. Azerb.- Med. zh. 1985, 62 (4), 44-48.

24. Cedrus Deodara (Himalayan cedar)

This is the dried bark of Cedrus deodara (Roxb. ex D. Don) G. Don (family Araucariaceae).

Description

Macroscopical: Flat; outer surface grey and brown, rugged, about 0.5 cm thick; inner surface smooth, outside grey, inside brown; fracture short, fracture surface shows three layers (picture 24).

Microscopical: Powdered drug brown, sclerids thick-walled polygonal in shape; presence of parenchymatous cells containing monoclinic calcium oxalate crystals; phloem fibres; fragments of cork in radial rows, rectangular in shape (figure 24).

Analytical standards

	Laboratory results (Percentage)
Total ash	0.53
Acid-insoluble ash	0.16
Volatile oil	negligible

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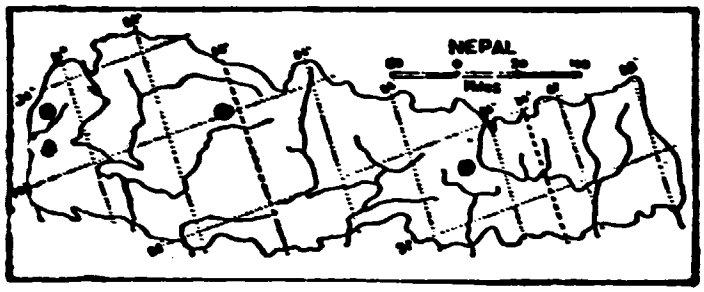
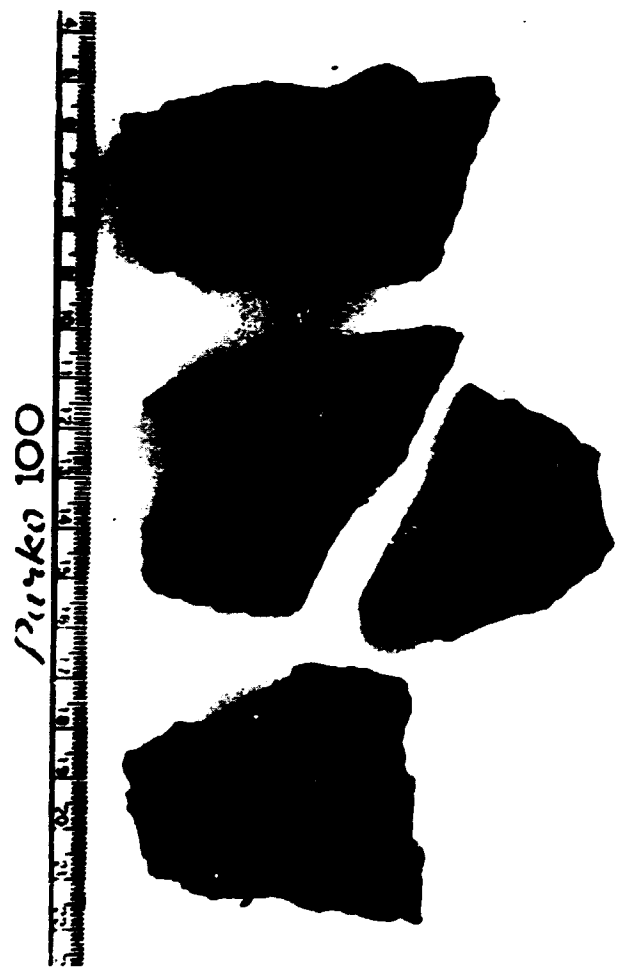


Distribution in Nepal



Picture 24. Cedrus deodara (Roxb. ex D. Don) G. Don (bark)

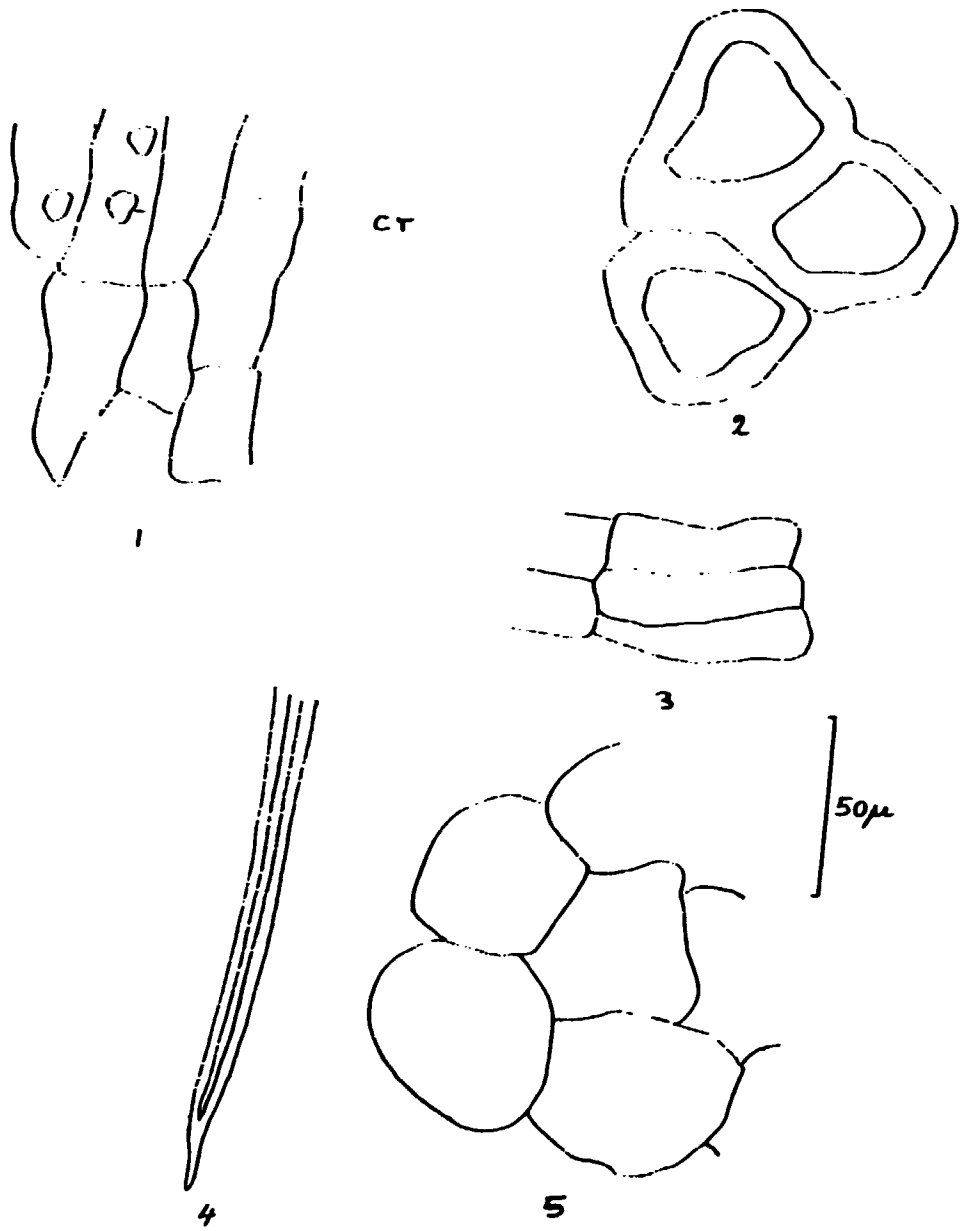


Figure 24. Cedrus deodara bark powder (microscopic)

Key: 1 and 5 Parenchymatous cells
cr Calcium oxalate crystal
2 Stone cells
3 Cork
4 Fibre

Pharmacology

Puri, V. M. et al. Spasmolytic constituents of Cedrus deodara. II. Isolation and evaluation of allohimachalol and three new sesquiterpene alcohols. Indian J. Exp. Biol. 1975, 13 (4), 369-370.

Kar, K. et al. Spasmolytic constituents of Cedrus deodara. Pharmacological evaluation of himachalol. J. Pharm. Sci. 1975, 64 (2), 258-262.

25. Coriandrum sativum (coriander)

This is the dried fruit of Coriandrum sativum L. (family Umbelliferae).

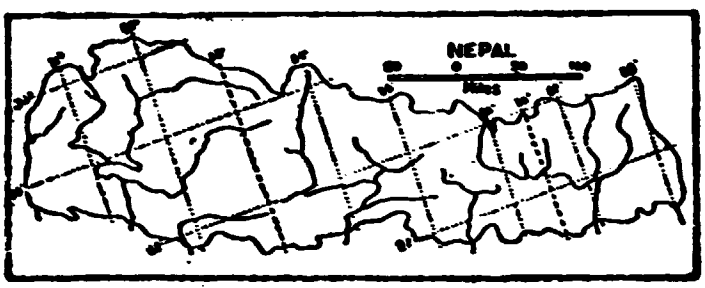
Description

Macroscopical: Cremocarp, ovoid, 3-8 mm in diameter, 10 ridges, yellowish brown, apex with a small stylopod, glabrous; usually with the pedicel attached, yellowish grey; transversely cut surface showing sclerenchyma in continuous band (picture 25).

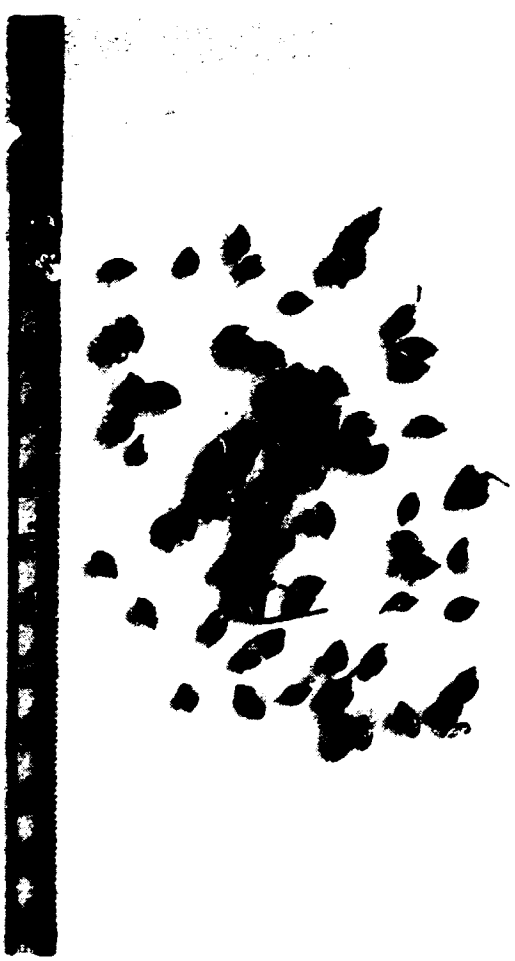
Microscopical: Powdered drug yellowish grey, epidermal cell thin-walled, rectangular in shape; mesocarp differentiated into three zones: outer zone parenchymatous, middle zone with longitudinal cells and inner zone with thick-walled hexagonal sclerids; endosperm parenchymatous, cells consist of aleurone grains, 3-6 μ in diameter, minute rosette calcium-oxalate crystals (figure 25).

Analytical standards

	Laboratory results	Pharmacopoeial limit	
		IP	BP
	(Percentage)	(Percentage)	
Total ash	5.81	-	-
Acid-insoluble ash	1.04	1.5	1.5
Volatile oil	0.17	0.3	0.3



Distribution in Nepal
This drug is being cultivated.



Picture 25. Coriandrum sativum L. (fruit)

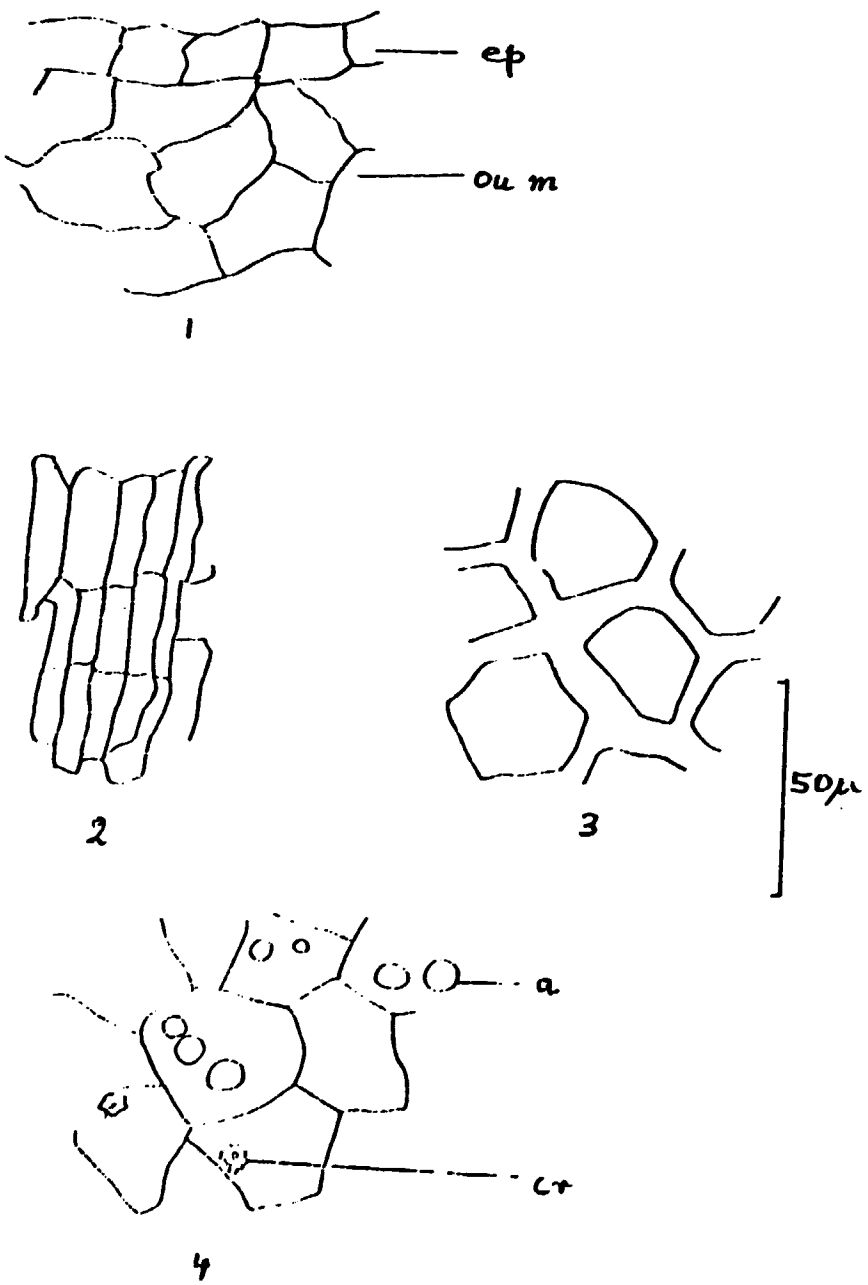


Figure 25. Coriandrum sativum fruit powder (microscopic)

Key: 1 Portion of pericarp
ep Epidermis
ou m Outer zone of mesocarp
2 Middle zone of mesocarp
3 Inner zone of mesocarp
4 Endosperm cells
a Aleurone grains
cr Calcium oxalate crystal

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26. Curcuma longa (turmeric)

This is the dried rhizome of Curcuma longa L., syn. C. domestica Valeton (family Zingiberaceae).

Description

Macroscopical: Rhizome ovate, cylindrical, branched, 4-7 cm long, 1-2 cm wide; externally yellowish, root scars, longitudinally wrinkled; internal colour orange, waxy; central cylinder four times wide to the cortex (picture 26).

Microscopical: Powdered drug yellow; fragments of cork tissue - hexagonal in surface view, brick-shaped parenchymatous in section view; starch glue ball similar in shape to parenchymatous cells; vessel fragment reticulate, fragments of parenchymatous cells, thin-walled; starch grains very rare, about 30 µ long and 15 µ wide, varying in shape (triangular, lens-shaped) (figure 26).

Analytical standards

	Laboratory results	Pharmacopoeial limit	
		IP	BPC
	(Percentage)	(Percentage)	
Total ash	7.33	9	9
Acid-insoluble ash	6.47	-	1
Volatile oil	1.61	4.0	4-5

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Analysis

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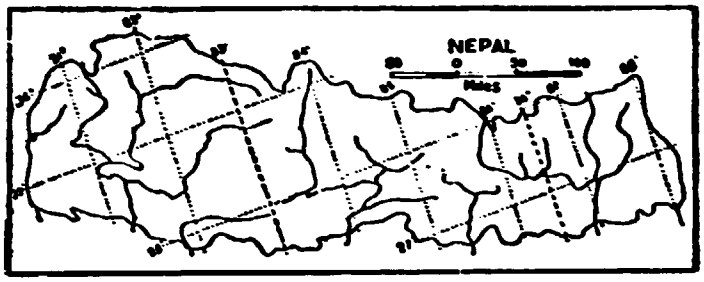

Distribution in Nepal
This drug is being cultivated.

Picture 26. Curcuma longa L. (rhizome)

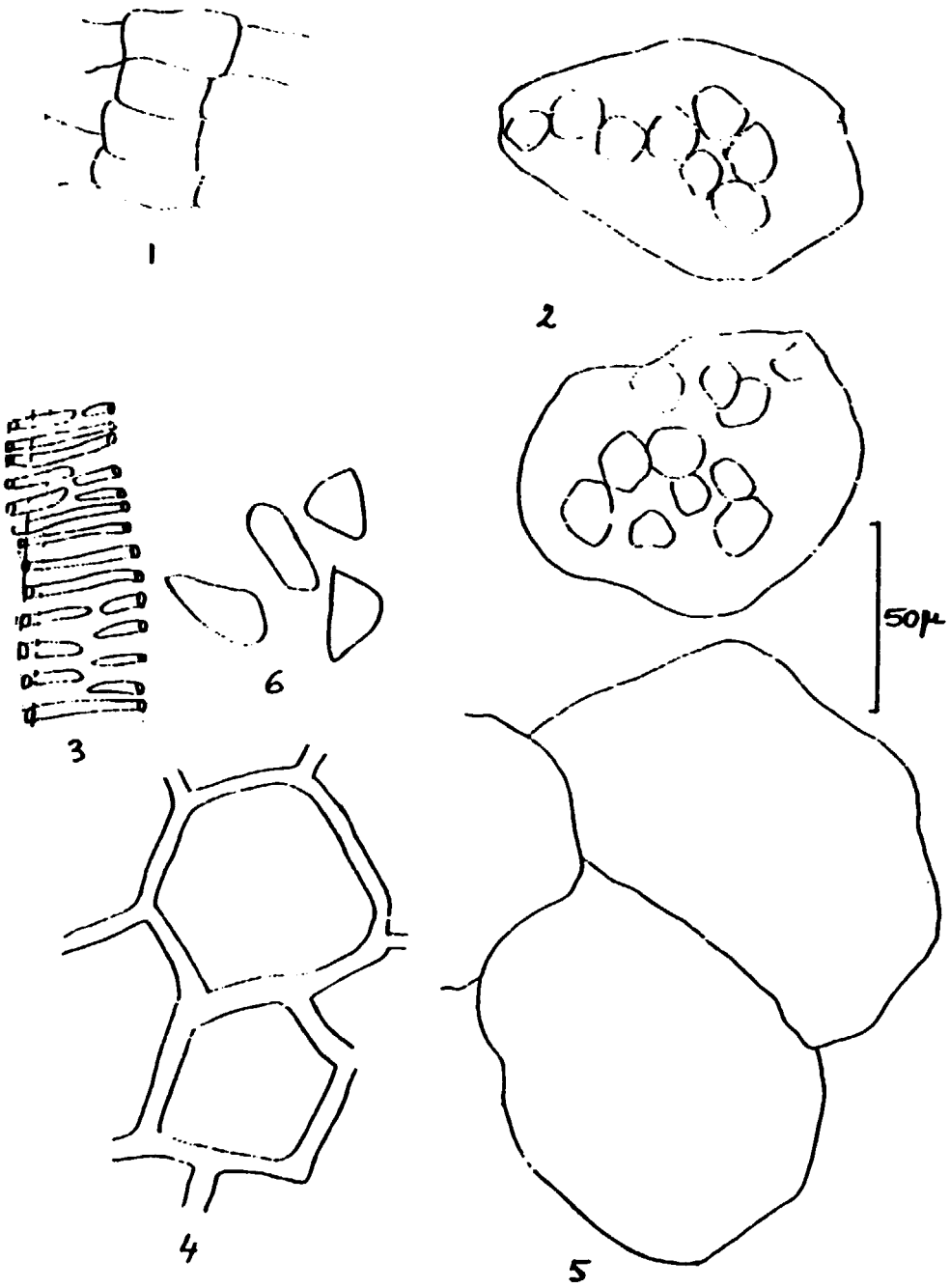

Figure 26. Curcuma longa rhizome (microscopic)

Key: 1 Cork cells in section
2 Starch glue balls
3 Reticulate vessel
4 Cork cells in surface view
5 Parenchymatous cells
6 Starch grains

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Other

Med. and Aromat. Plants Abstr. 1986, 8 (4), 386-396.

27. Curcuma zedoaria (zedoary)

This is the dried rhizome of Curcuma zedoaria Rosc. (family Zingiberaceae).

Description

Macroscopical: In transverse slices, externally grey, internally off-white, central cylinder four times wide to the cortex (picture 27).

Microscopical: Powdered drug off-white; fragments of thick-walled cork tissues; parenchymatous cells thin-walled, containing plenty of starch grains of varying shape (lens-shaped, triangular) 15-30 µm long, 3-15 µm wide; annular vessels (figure 27).

Analytical standards

	Laboratory results (Percentage)
Total ash	8.83
Acid-insoluble ash	1.08
Volatile oil	1.55

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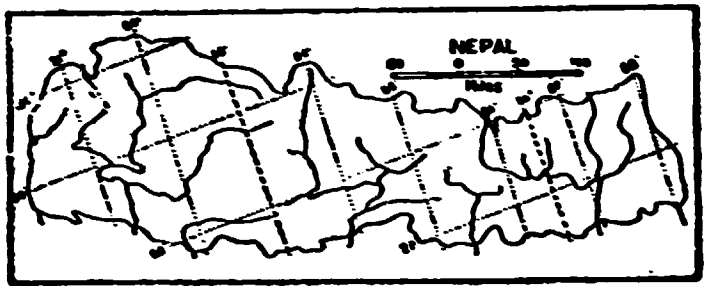
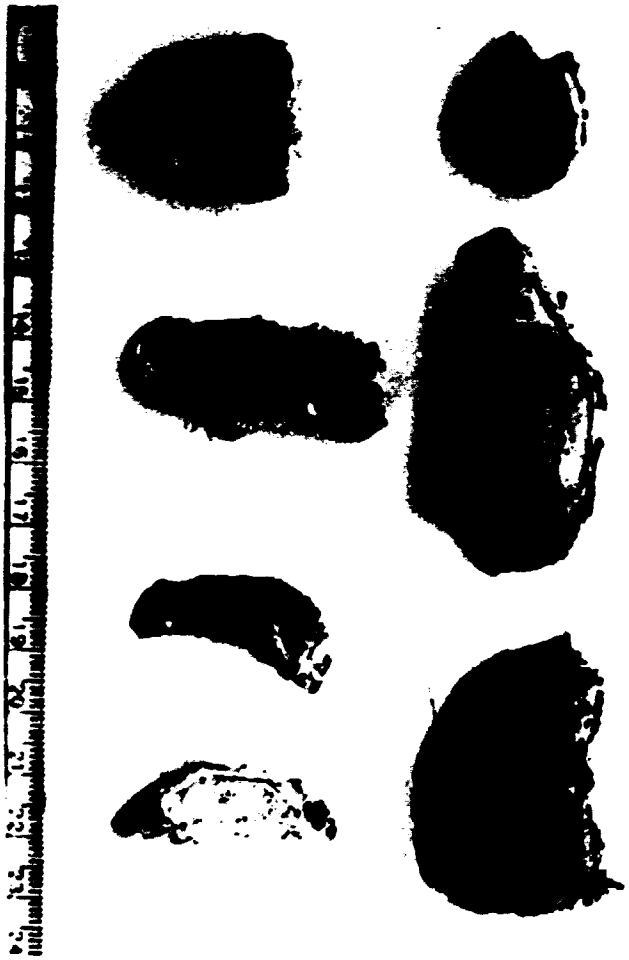
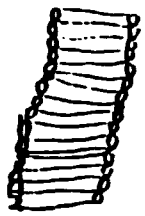


Distribution in Nepal
This drug is being cultivated.



Picture 27. Curcuma zedoaria Rosc. (rhizome)



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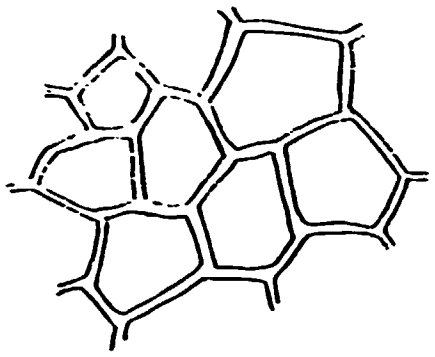
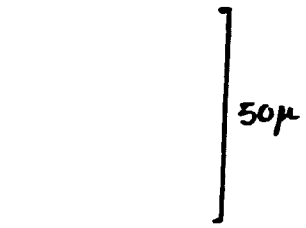


2

3



4

Figure 27. Curcuma zedoaria rhizome powder (microscopic)

Key: 1 Annular vessel
2 Cork tissues
3 Parenchymatous cells
s Starch grain
4 Starch grains

Chemistry

Gupta, S. K., A. B. Banerjee and B. Achari. Isolation of ethyl p-methoxycinnamate, the major antifungal principle of Curcuma zedoaria. Lloydia 1976, 39 (4), 218-222.

Pharmacology

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Other

Med. and Aromat. Plants Abstr. 1987, 9, 249-253.

28 Eclipta prostrata

This is the dried plant of Eclipta prostrata Roxb., syn. E. alba (L) Hassk.; E. erecta L.; Verbesina alba L.; V. erecta L. (family Compositae).

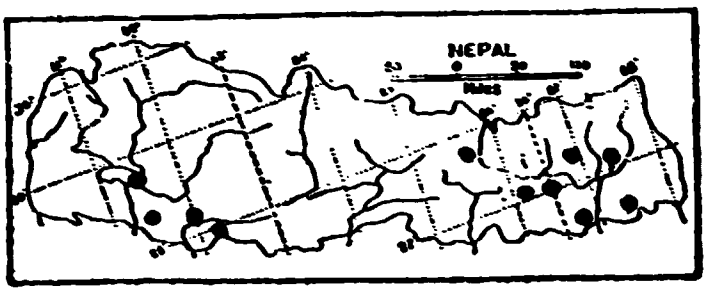
Description

Macroscopical: Annual herb; erect prostrate, branched; stem cylindrical, 2 mm in diameter, smooth, deep brown, solid, off-white internally; leaves opposite, sessile, oblong, lanceolate, acute, 2-4 cm long, 0.5-1 cm wide. (pictures 28A and B).

Microscopical: Powdered drug grey; fragment of transverse section of leaf with upper epidermis, palisade parenchyma, spongy parenchyma and lower epidermis, septed hair, three to four layers of rectangular cork cells, annular and pitted vessels, fragments of leaf surface with anomocytic stomata and palisade cells (figure 28).

Analytical standards

	Laboratory results (Percentage)
Total ash	15.34
Acid-insoluble ash	4.09



Distribution in Nepal

Picture 28 A. Eclipta prostrata Roxb. (whole plant)

Picture 28 B. Eclipta prostrata Roxb. (Herbarium)

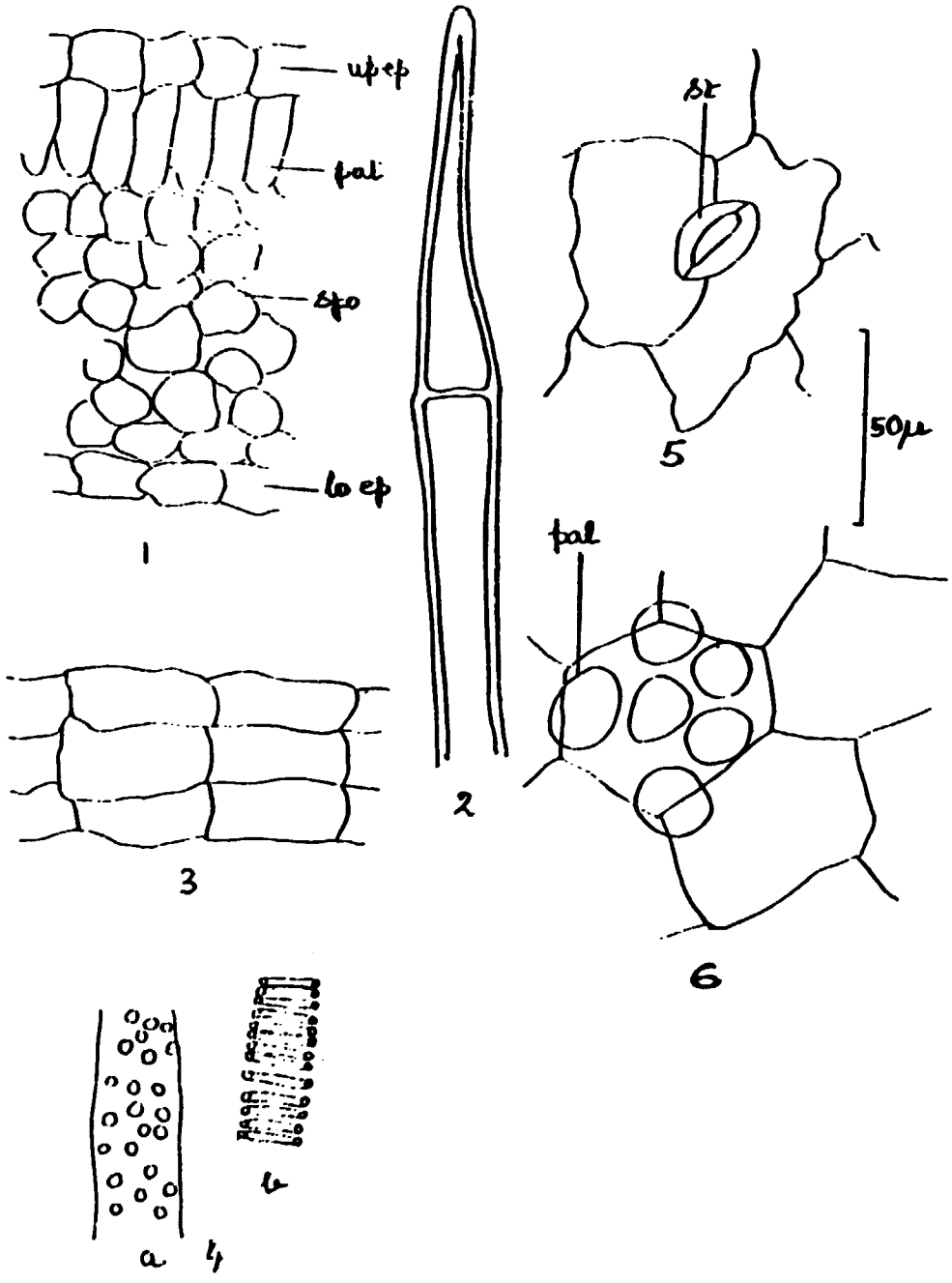


Figure 28. Eclipta prostrata whole plant (microscopic)

Key:
1 Fragment of transverse section of leaf
up ep Upper epidermis
pal Palisade parenchyma
spo Spongy parenchyma
lo ep Lower epidermis
2 Septed hair
3 Cork cells
4 Vessels
a Pitted
b Annular
5 Lower leaf surface
st Stomata
6 Upper leaf surface
pal Palisade parenchyma

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29. Holarrhena pubescens

This is the dried seed of Holarrhena pubescens (Buch-Ham) Wall. ex G. Don. (family Apocynaceae), syn. H. antidysenterica Wall.

Description

Macroscopical: Light yellow in colour; linear oblong, one side convex other concave, 1-1.5 cm long, 0.2 cm wide; testa followed by translucent endosperm, surface smooth (picture 29).

Microscopical: Powdered drug yellowish white; epidermal cell tabular in section, polygonal in surface view; endosperm consists of polyhedral parenchyma containing fixed oil and aleurone grains, elongated embryo cells (figure 29).

Analytical standards

	Laboratory results (Percentage)
Total ash	7.30
Acid-insoluble ash	0.29

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General

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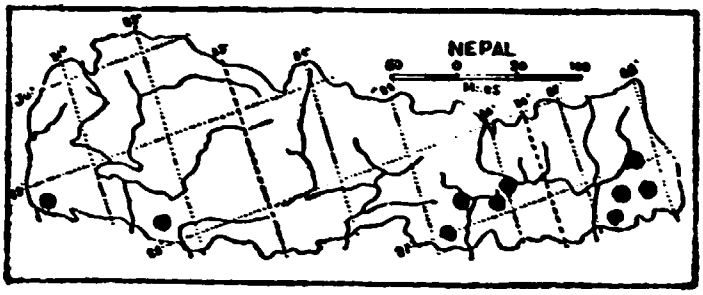

Distribution in Nepal

Picture 29. Holarrhena pubescens (Buch-Ham) Wall. ex G. Don.

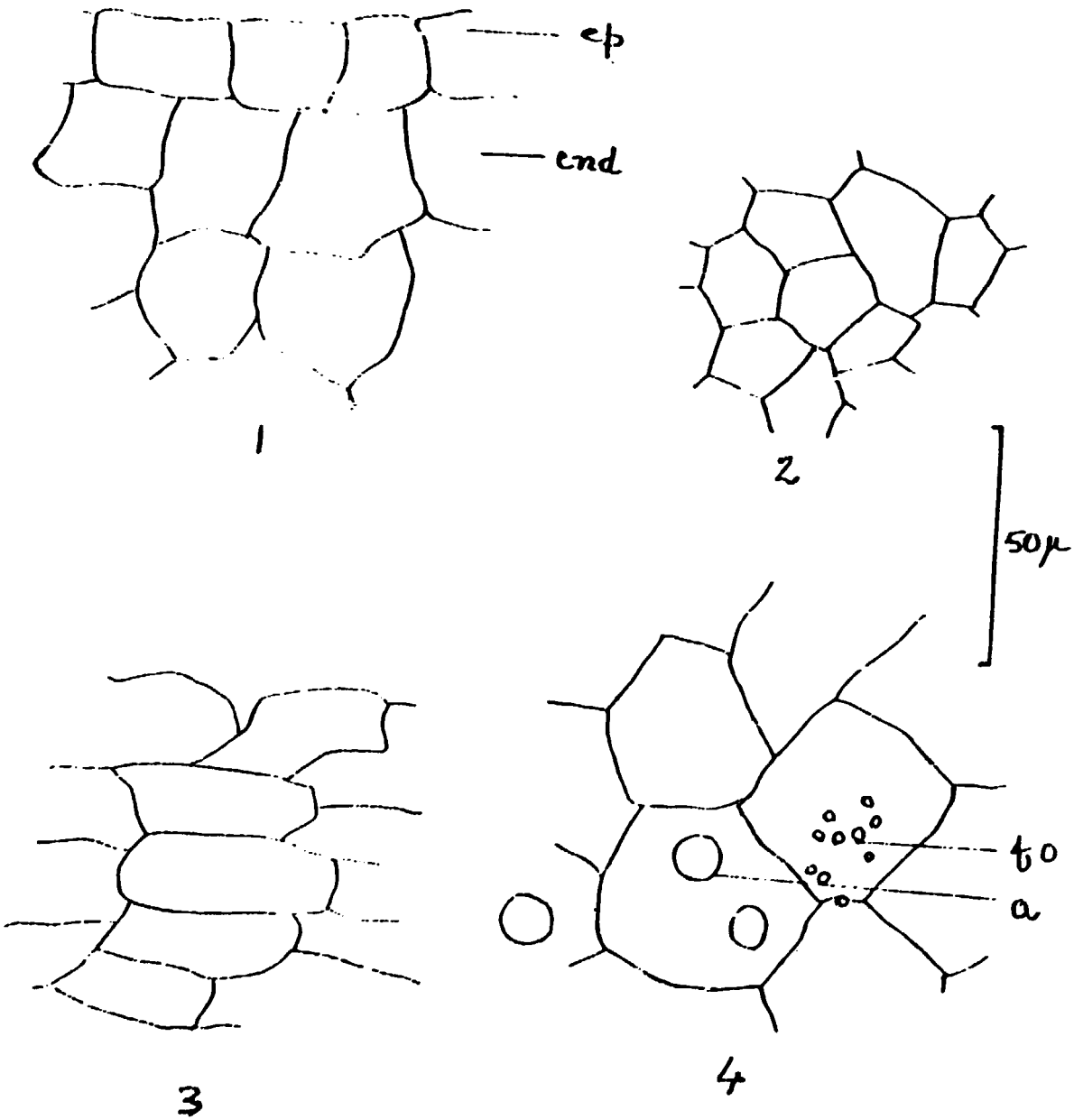

Figure 29. Holarrhena pubescens seed powder (microscopic)

Key: 1 Portion of perisperm
ep Epidermis
end Endosperm
2 Epidermal cell in surface view
3 Embryo cells
4 Endospermic cells
a Aleurone grain
fo Fixed oil

Chemistry

Chaturvedi, G. N., K. P. Singh and J. P. Gupta. Phytochemistry and pharmacology of Holarrhena antidysenterica, Med. Gaz. 1981, pp. 179-184.

Irani, R. J. Chemistry of Kurchi seeds. IV. Isolation of galactose from the picric acid hydrolysis of the glycoalkaloid. Curr. Sci. 1946, 15, 229-230.

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Thanki, R. J. and K. A. Thakar: Amino acid composition of the seeds of the plant Caesalpinia crista and Holarrhena antidysenterica. J. Instn. Chem. (India) 1980, 52 (Pt. 5) 209-210.

Other

Med. and Aromat. Plants Abstr. 1982, 4 (4), 351-359.

30. Mahonia napaulensis

This is the dried bark of Mahonia napaulensis DC (family Berberidaceae); syn. Berberis nepalensis (DC) Spreng, B. miccia Buch-Ham. ex G. Don.

Description

Macroscopical: Mostly flat, some curved; outer surface pale yellow, rugged, about 10 cm long, 2.5 cm wide, 0.2 cm thick, grey, smooth, fracture splintery (picture 30).

Microscopical: Powdered drug of brown colour; thick-walled, polygonal stone cells, prismatic crystals of calcium oxalate in parenchymatous cells; thick-walled phloem fibre; cork cells polygonal or hexagonal in surface view; spheroidal oil cells 12-20 m in diameter (figure 30).

Analytical standards

	Laboratory results (Percentage)
Total ash	7.22
Acid-insoluble ash	0.57
Alkaloid content	0.56-1.4

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General

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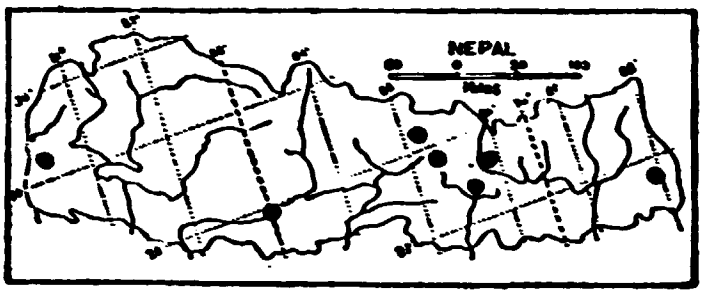
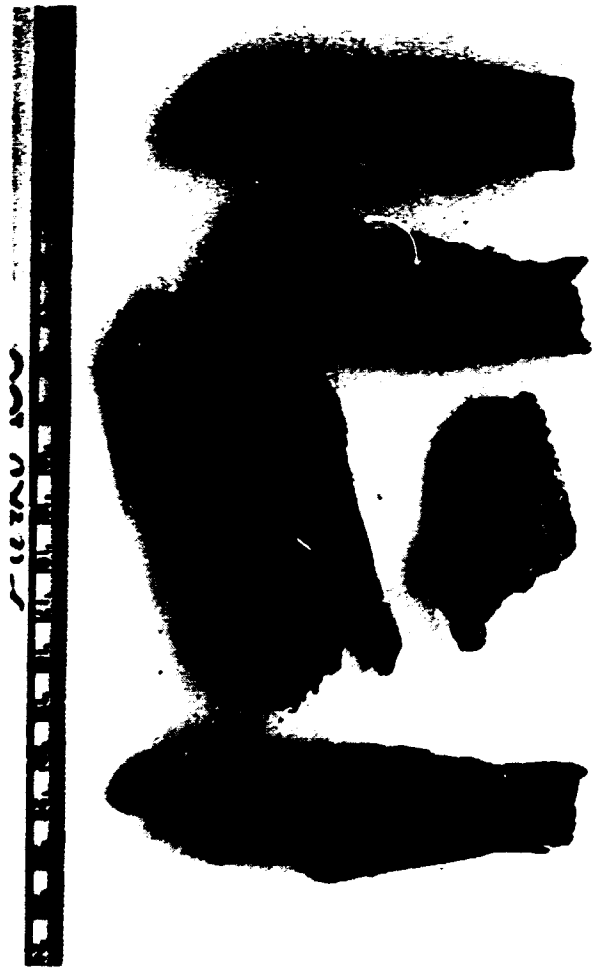


Distribution in Nepal



Picture 30. Mahonia napaulensis DC (bark)

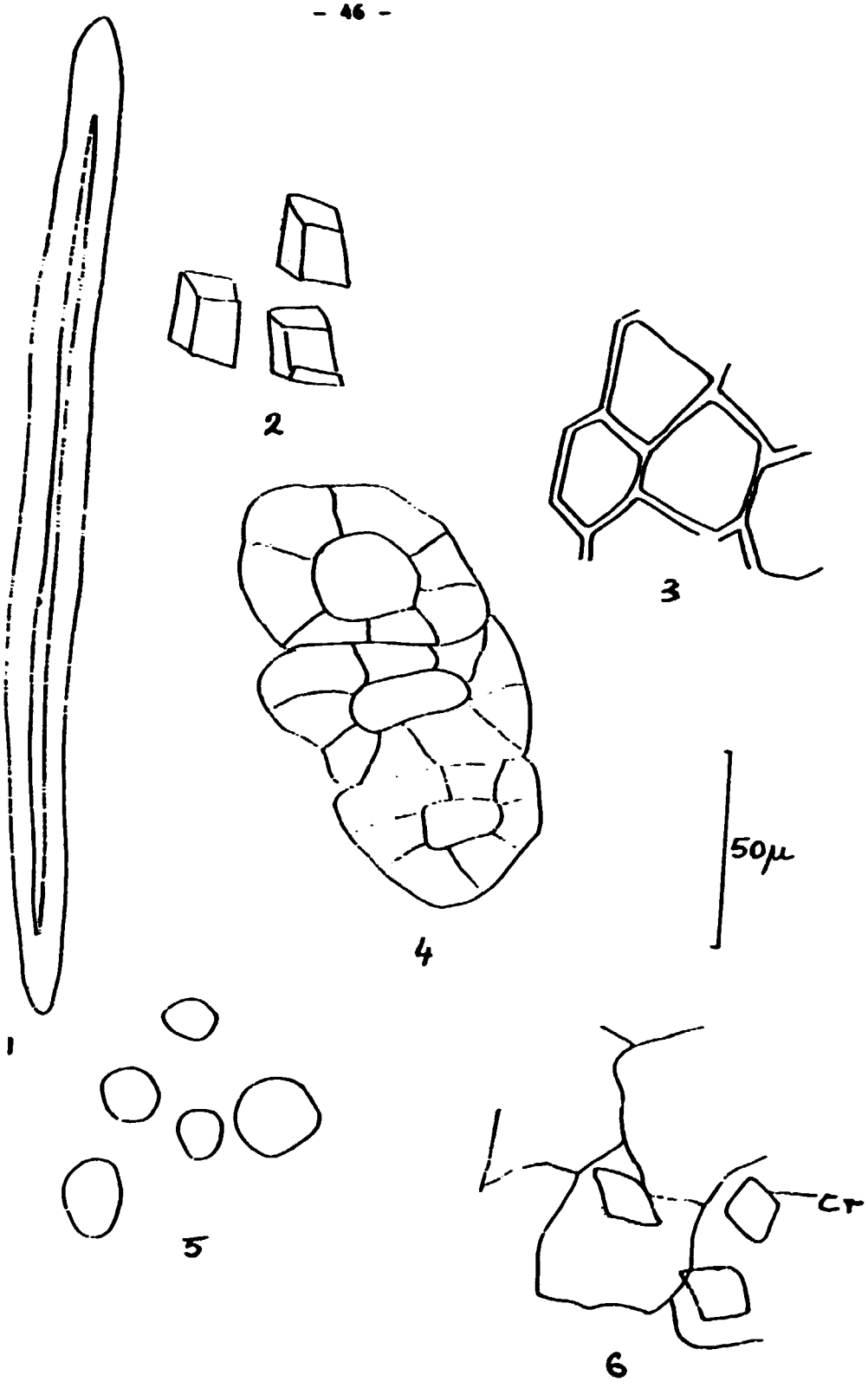


Figure 30. Mahonia napaulensis bark powder (microscopic)

Key:
1 Fibre
2 Calcium oxalate crystals
3 Cork cells
4 Stone cells
5 Oil cells
6 Parenchymatous cells
cr Calcium oxalate crystal

Chemistry

Chattarjee, R. Origin and function of the alkaloids in Mahonia nepalensis DC. J. Am. Pharm. Assoc. 1944, 33, 205-210.

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Govindachari, T. R. et al. Alkaloids of Mahonia nepalensis. Proc. Indian Acad. Sci. 1958, 47A, 41-48.

31. Myristica fragrans (nutmeg)

This is the dried kernel of the seed of Myristica fragrans Houtt. (family Myristicaceae).

Description

Macroscopical: Kernels subglobular to ovoid, 2.5 cm long and 2 cm wide; yellowish brown in colour, surface showing network of reticulate grooves and lines, circular depression at the one end (picture 31).

Microscopical: Powdered drug brown; perisperm cells polyhedral with brown content; endosperm cells polyhedral, containing single aleurone grain in each cell; aleurone grain about 20 µm in diameter, abundant starch grains, simple and compound, spherical, simple grains 6-12 µm in diameter (figure 31).

Analytical standards

	Laboratory results (Percentage)	Pharmacopoeial limit (Percentage)		
		IP	BPC	BHP
Total ash	1.80	3.0	3.0	3.0
Acid-insoluble ash	0.21	0.5	-	0.2
Volatile oil	7.76	5.0	4.0	5.0

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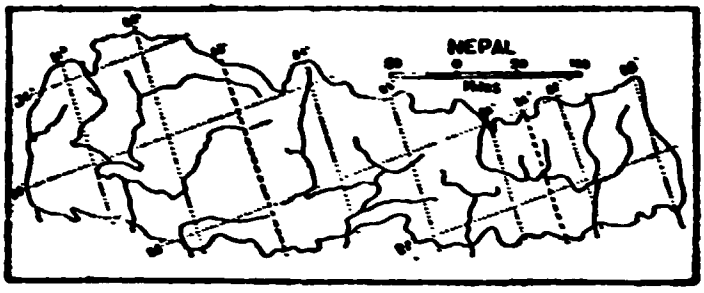

Distribution in Nepal
This drug is being imported.

Picture 31. *Myristica fragrans* Houtt. (seed)

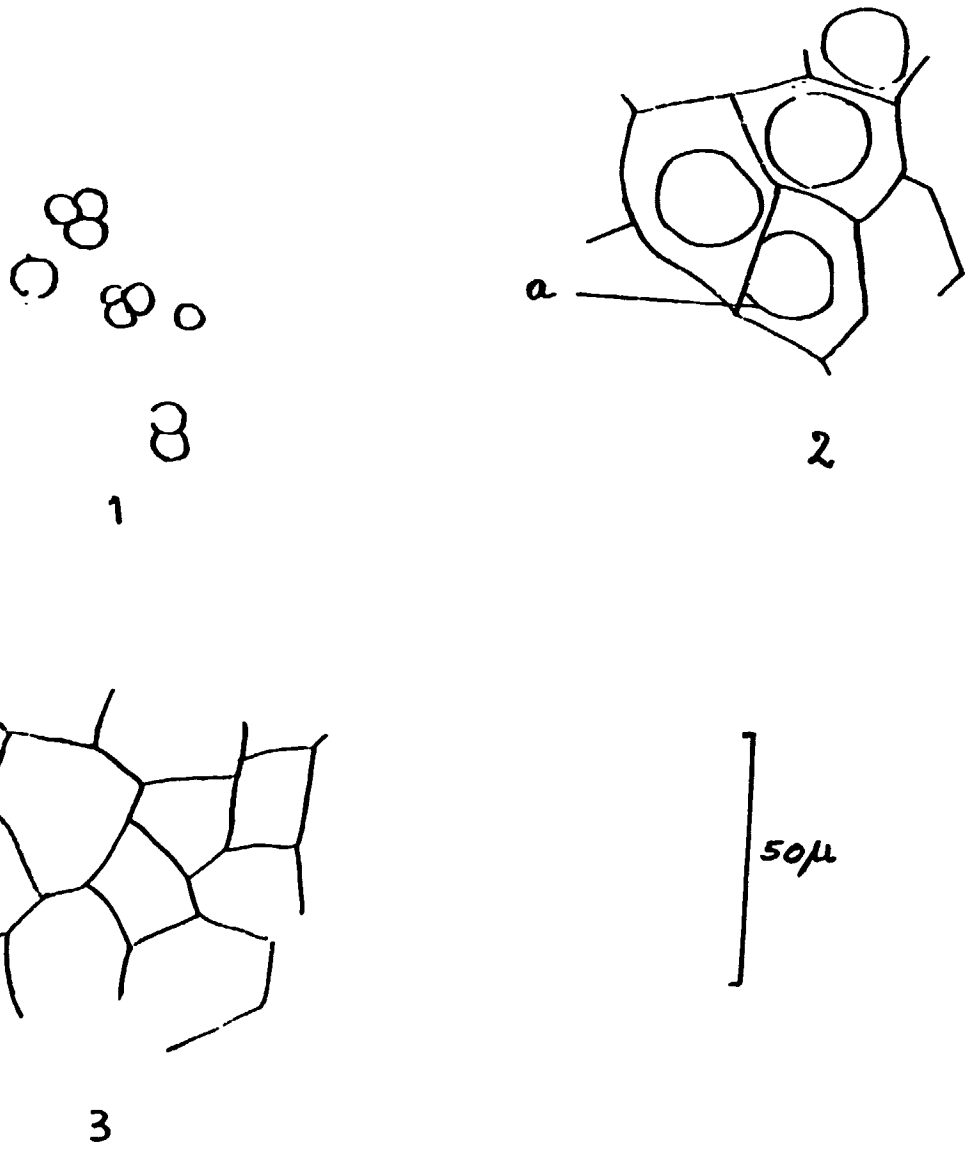

Figure 31. Myristica fragrans seed powder (microscopic)

Key: 1 Starch grains
2 Endospermic cells
a Aleurone grains
3 Perisperm cells

Chemistry

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Pharmacology

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Kalbhen, D. A. Nutmeg as a narcotic: Chemistry and pharmacology of nutmeg (M. fragrans). Angew. Chem. Inst. Ed. Engl. 1971, 10, 370-374.

Truitt Jr., E. B. The pharmacology of myristicin and nutmeg. U.S. Public Health Serv. Publ. 1967, No. 1645, 215-222.

Weil, A. T. Nutmeg as a narcotic. Econ. Botany. 1965, 19 (3), 194-217.

32. Nardostachys grandiflora (spikenard)

These are dried roots and rhizomes of Nardostachys grandiflora DC, syn. N. jatamansi DC (family Valerianaceae).

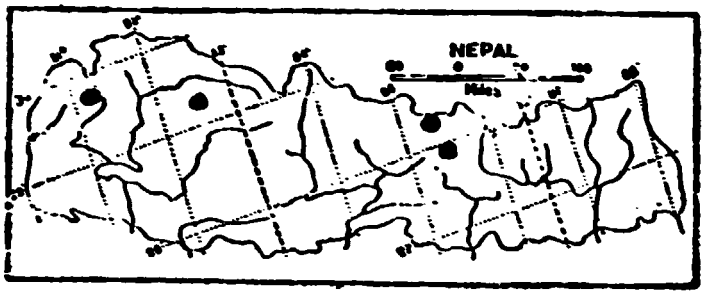
Description

Macroscopical: Rhizome about 8 mm thick, dark grey in colour, covered by a bundle of fine, reddish brown roots, about 20 cm long and 0.5 mm wide, inside whitish (picture 32).

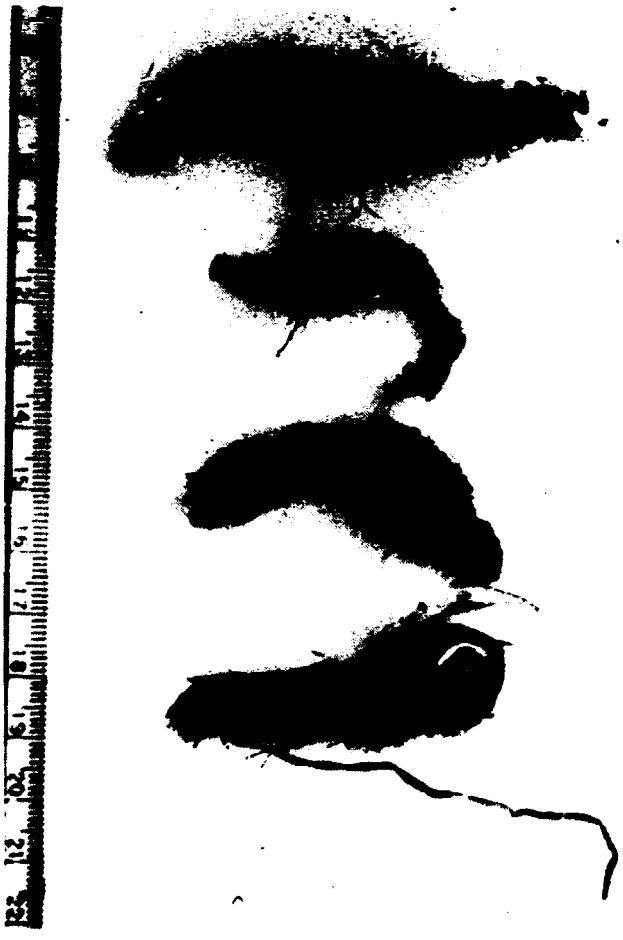
Microscopical: Powdered drug grey; thin-walled parenchymatous cells of various shapes; resinous matter; fragments of annular vessels; thick-walled fibres; group of brownish cork cells; oil globules (figure 32).

Analytical standards

	Laboratory results (Percentage)	Pharmacopoeial limit IP (Percentage)
Total ash	5.96	9.0
Acid-insoluble ash	3.14	5.0
Volatile oil	1.24	0.10



Distribution in Nepal



Picture 32. Nardostachys grandiflora DC (root and rhizome)

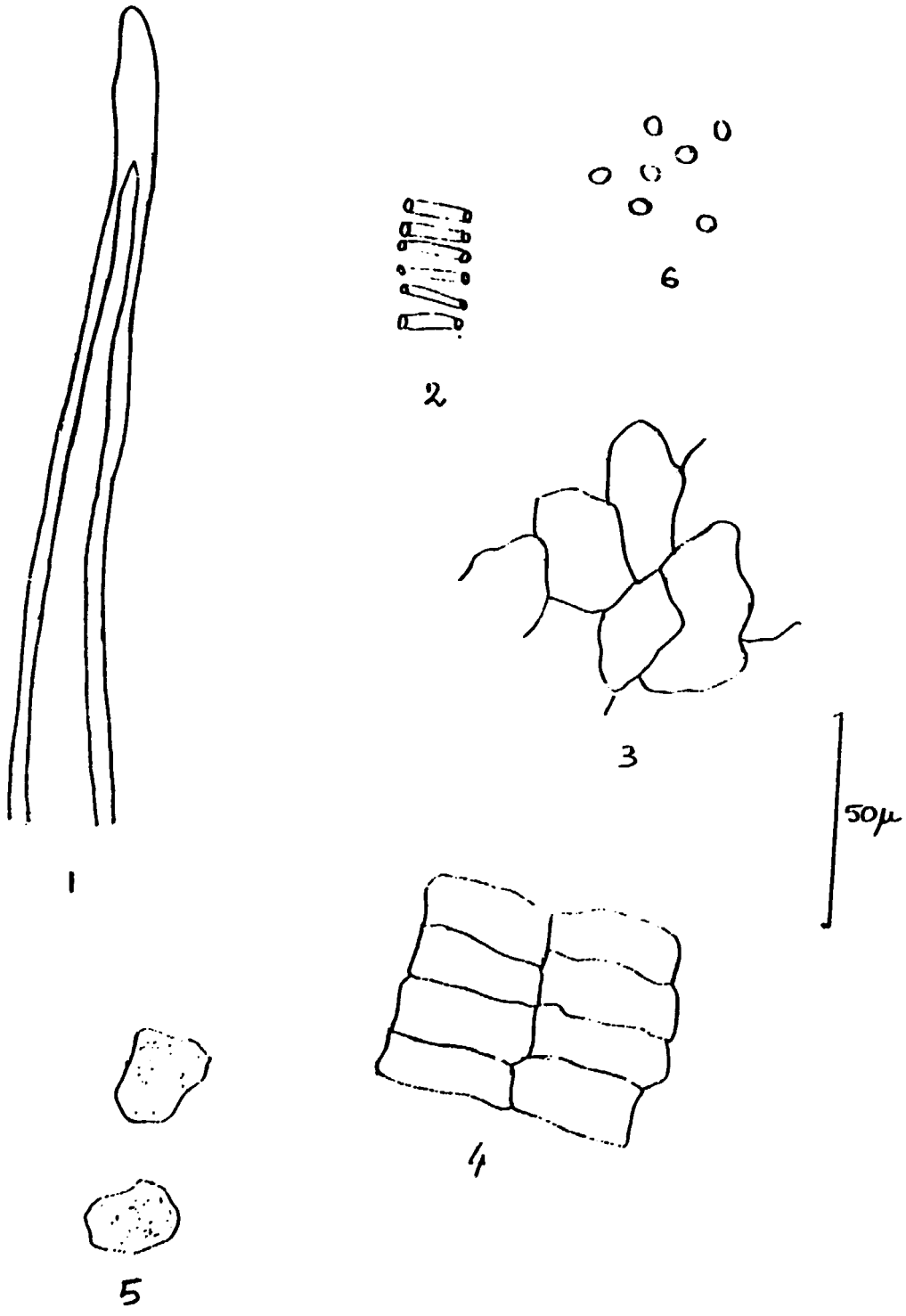


Figure 32. Hardostachys grandiflora root and rhizome powder (microscopic)

Key: 1 Fibre
2 Annular vessel
3 Parenchymatous cells
4 Cork cells
5 Resinous matter
6 Oil globules

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Chemistry

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33. Phyllanthus emblica (emblic myrobalan)

This is the dried fruit of Phyllanthus emblica L. syn. Emblica officinalis Gaertn. (family Euphorbiaceae).

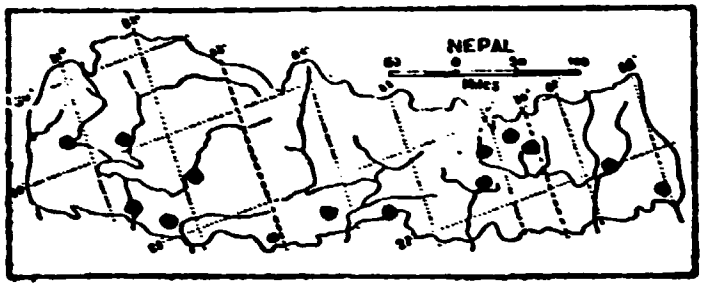
Description

Macroscopical: In pieces; wrinkled, externally grey, internally light grey; thick, single, brown seed, with five longitudinal ridges, other parts smooth (picture 33).

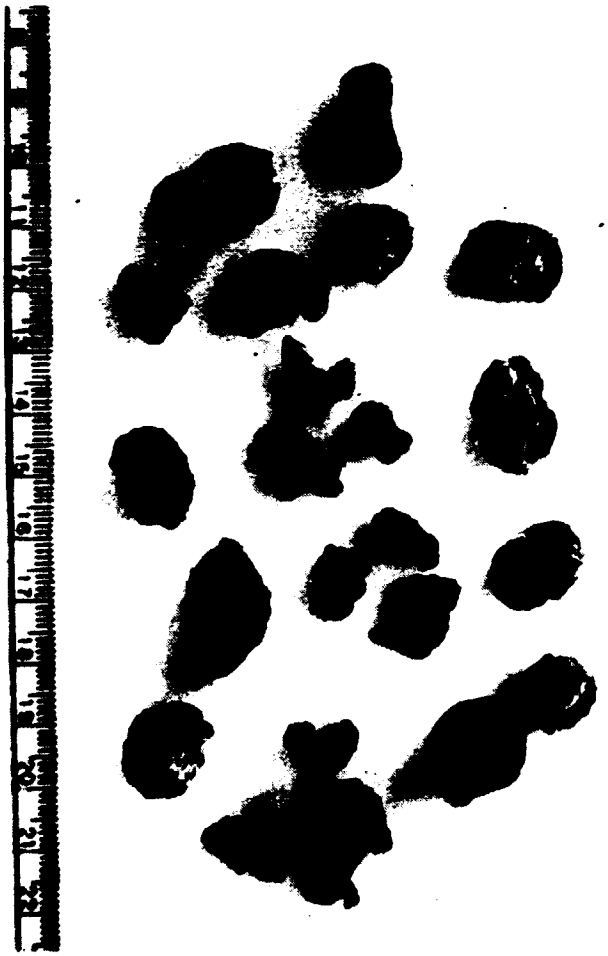
Microscopical: Powdered drug of greyish colour; epidermis of pericarp showing polygonal cells; cells of endosperm containing aleurone grains; fragment of annular vessel; transverse section of pericarp with rectangular cells of epicarp and parenchymatous mesocarp; thick-walled fibre; stone cells of rectangular and polygonal shape (figure 33).

Analytical standards

	Laboratory results (Percentage)
Total ash	3.41
Acid-insoluble ash	0.96
Tannin	10.15



Distribution in Nepal



Picture 33. Phyllanthus emblica L. (fruit)

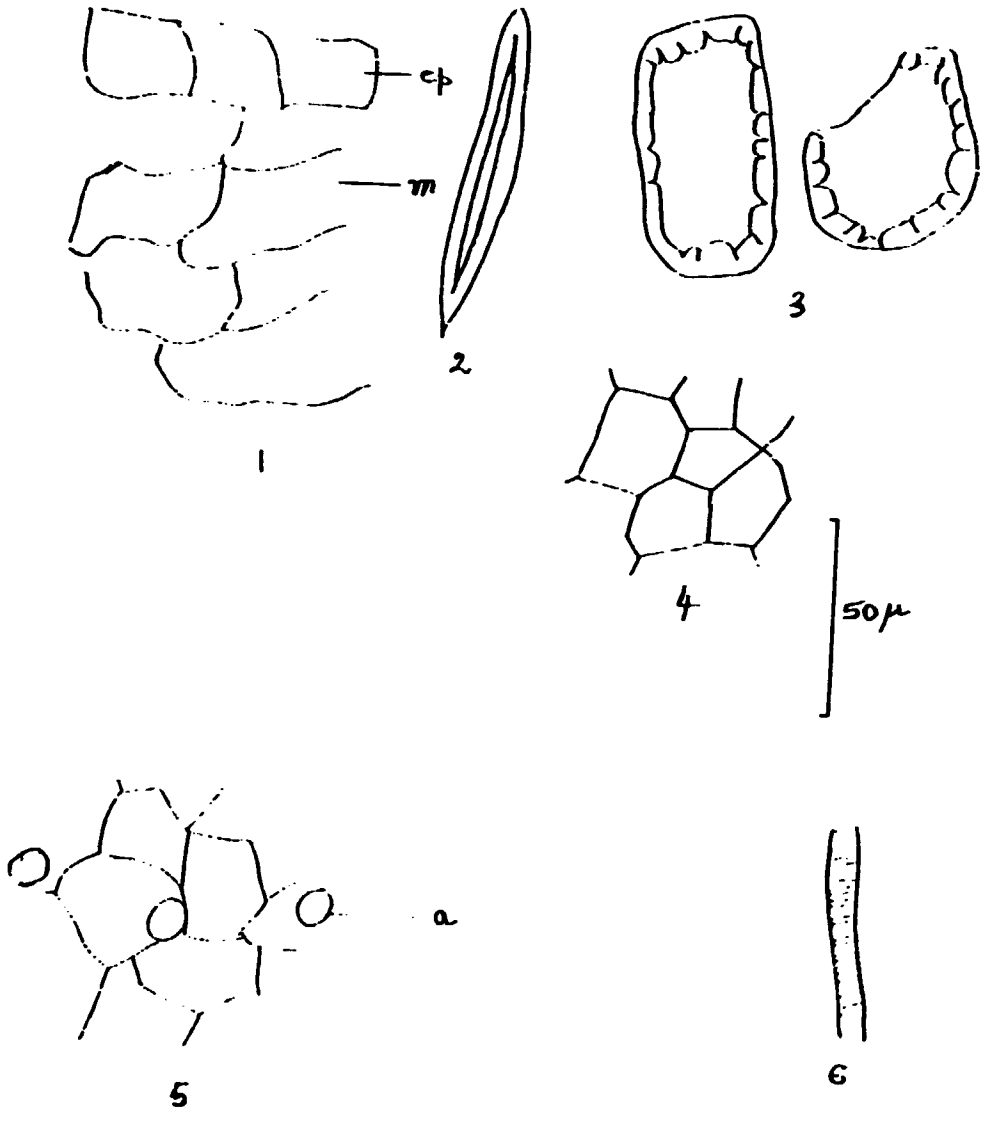


Figure 33. Phyllanthus emblica fruit powder (microscopic)

Key: 1 Transverse section of pericarp
ep Epidermis
m Mesocarp
2 Fibre
3 Stone cells
4 Surface view of epidermis
5 Cells of endosperm
a Aleurone grain
6 Annular vessel

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34. Piper longum (long pepper)

This is the dried plant of Piper longum L. (family Piperaceae).

Description

Macroscopical: Roots adventitious, cylindrical, up to 12 cm long, 0.5 cm wide, straight or curved, externally yellowish grey, fracture short, internal colour yellowish, xylem plates radiating from the centre; stem about 5 cm thick, cylindrical, straight, external surface yellowish grey to grey, internal colour yellowish, hollow (pictures 34 A and B).

Microscopical: Powdered drug brownish grey; fragment of thick cork tissue in surface view hexagonal, three to four layers of cells in section, brick shaped; cortical cells collenchymatous and parenchymatous; parenchymatous cells thin-walled with starch content and occasionally resinous content; starch grains, 3-6 μ in diameter, with central hilum; stone cells of different shapes in row, with oval, lignified walls; vessels elongated and annular or broad and pitted (figure 34).

Analytical standards

	Laboratory results (Percentage)
Total ash	6.92
Acid-insoluble ash	1.01

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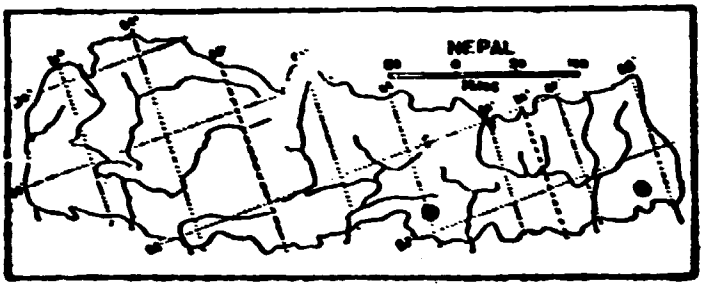
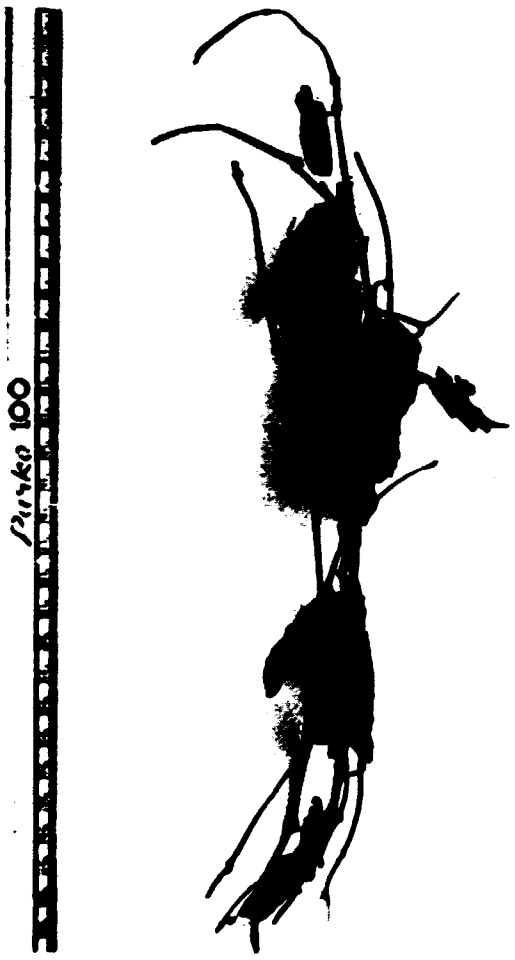
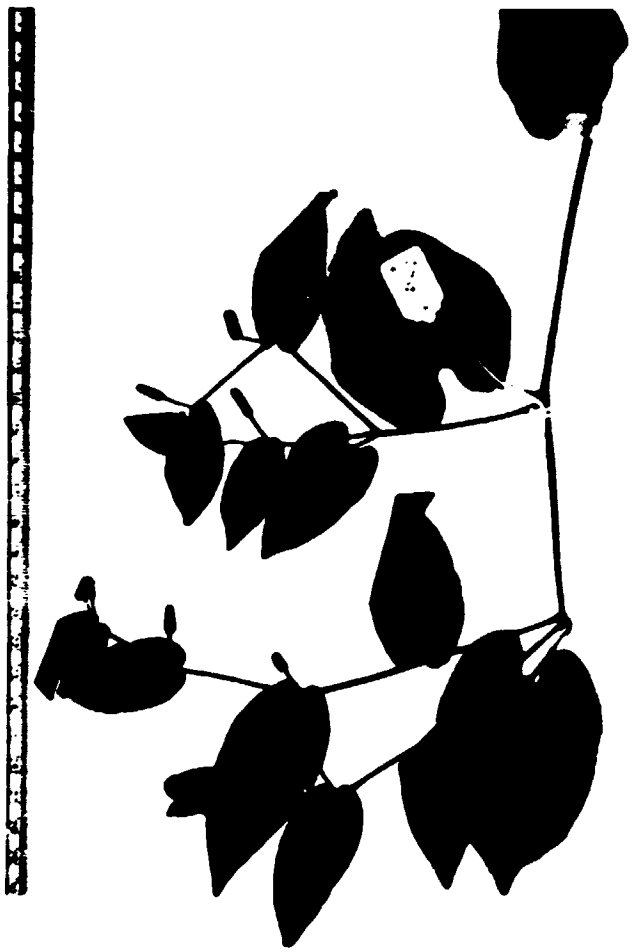


Distribution in Nepal



Picture 34 A. Piper longum L. (whole plant)



Picture 34 B. Piper longum L. (Herbarium)

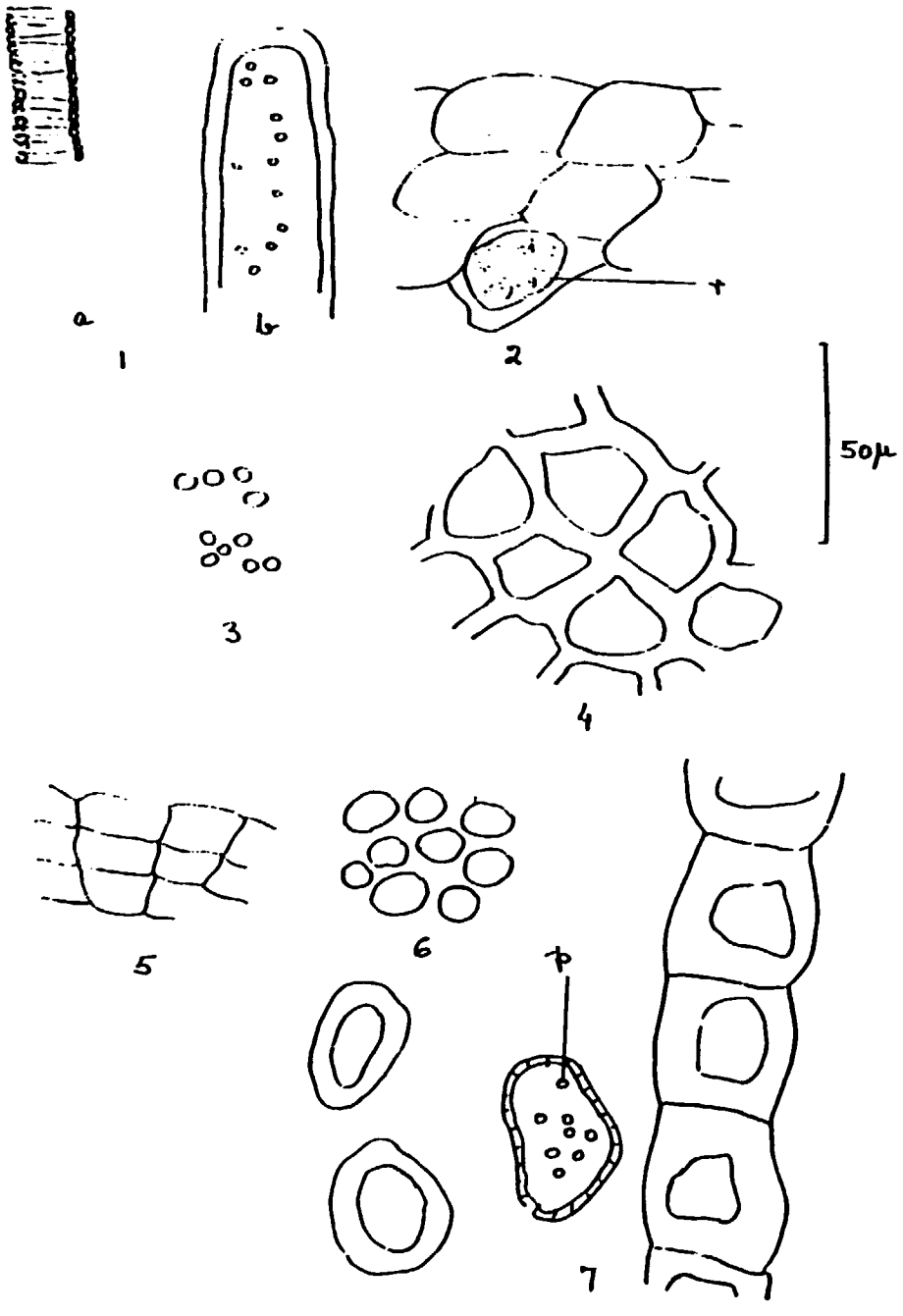


Figure 34. Piper longum whole plant powder (microscopic)

Key: 1 Vessel
a Annular
b Pitted
2 Parenchymatous cells
r Resinous content
3 Starch grains
4 Cork tissue in surface view
5 Cork tissue in section
6 Collenchymatous cells
7 Stone cells

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35. Plectranthus mollis

This is the dried plant of Plectranthus mollis (Ait.) Spreng. (family Labiatae).

Description

Macroscopical: Root minute, grey; stem 4 mm in diameter, grey, quadrangular, glabrous, longitudinally striated; leaves petiolate, opposite, ovate, cordate, acute, crenate; flower lax, flowered cymes in racemes; fruit subglobose, smooth, grey; seed oval, smooth, brown, grey (pictures 35 A and B).

Microscopical: Powdered drug brownish grey; fragments of epidermal cells with anomocytic stomata; trichomes: conical, uniserate, one- or two-celled, other cells enlarged at base; vessels with annular, spiral and pitted thickening; epidermal cells tabular in section; endosperm consisting of polyhedral parenchyma containing brown masses; presence of aleurone grains; polygonal parenchyma, palisade parenchyma, spongy parenchyma; upper epidermal cells without stomata; rectangular stone cells; thick-walled sclerenchyma (figure 35).

Analytical standards

	Laboratory results (Percentage)
Total ash	5.29
Acid-insoluble ash	0.64
Volatile oil	negligible

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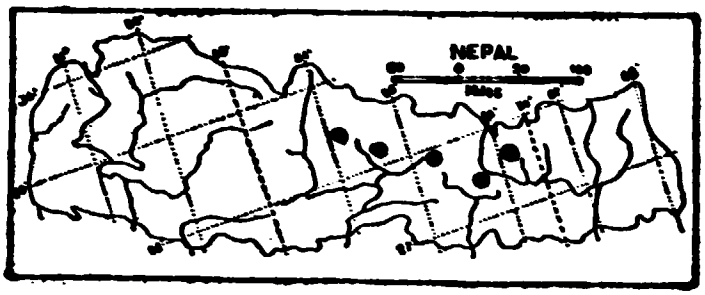
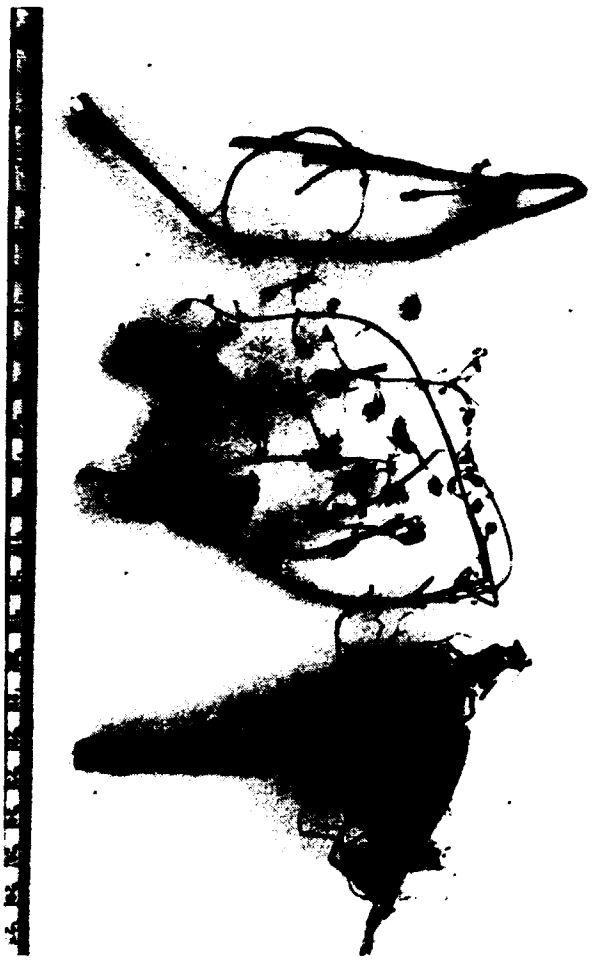
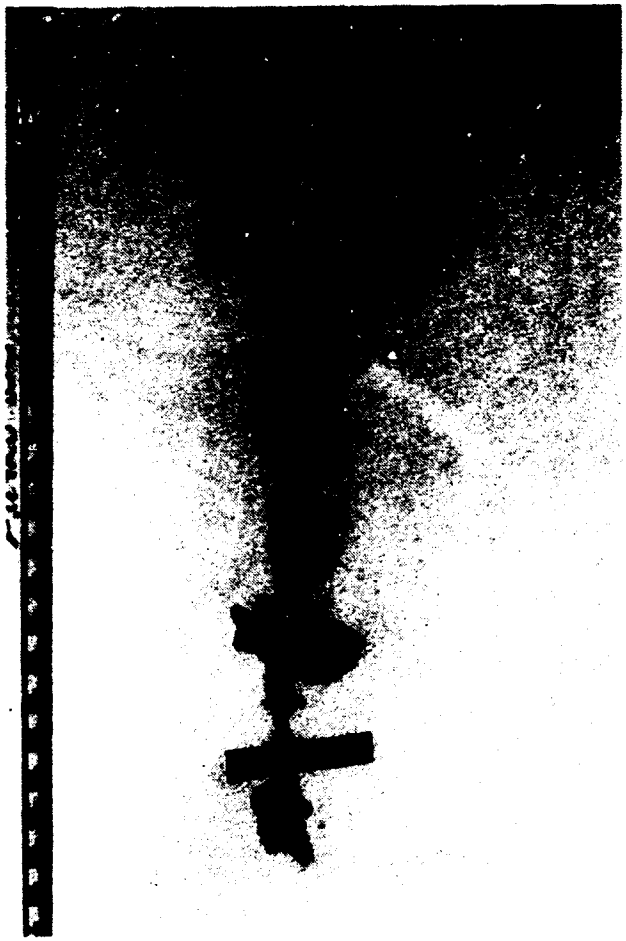


Distribution in Nepal



Picture 35 A. Plectranthus mollis (Ait.) Spreng. (whole plant)



Picture 35 B. Plectranthus mollis (Herbarium)

Note: Plectranthus mollis is called Sugandhawal in Nepali language and should not be confused with Valeriana jatamansi which has the same vernacular name.

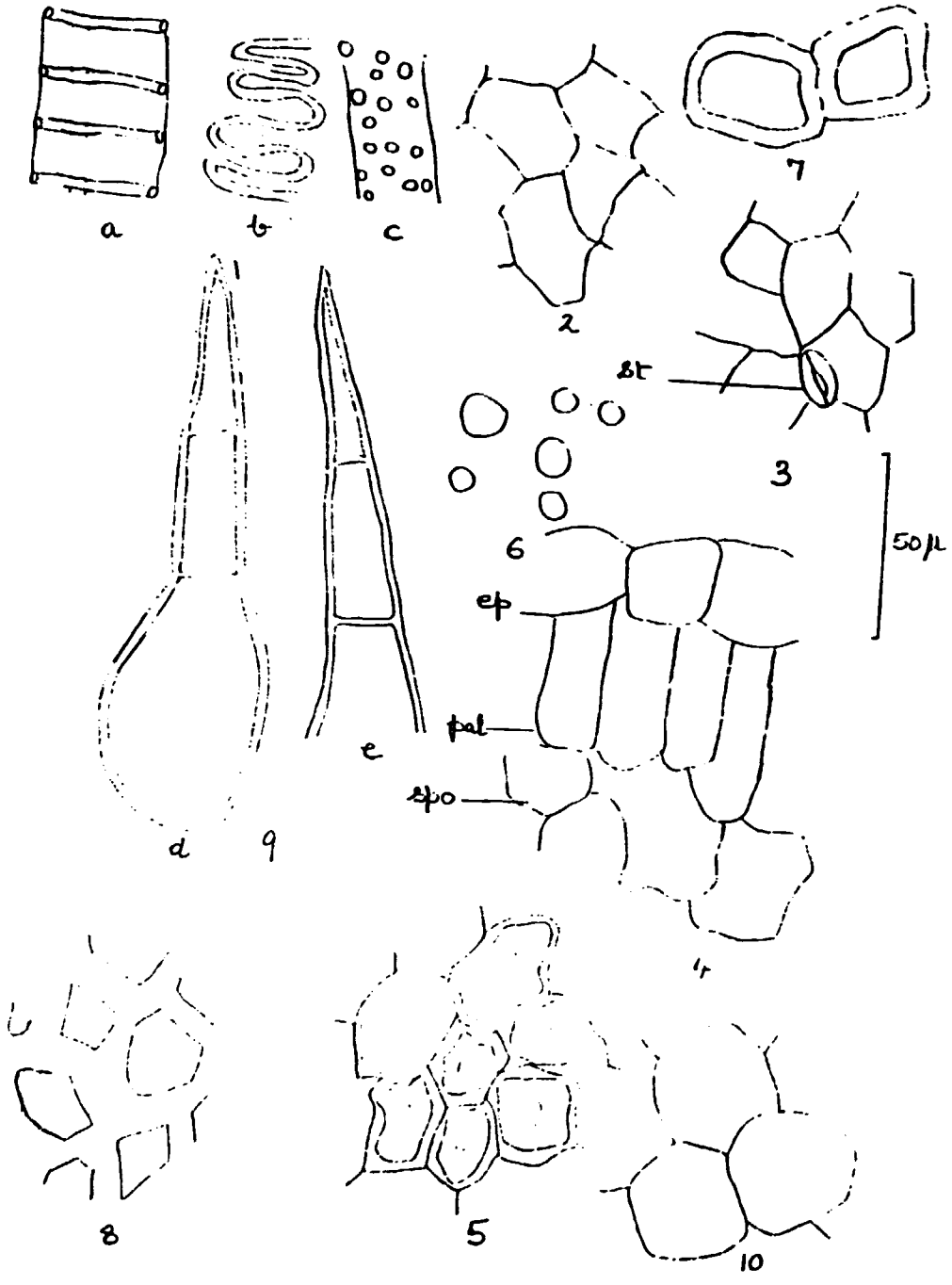


Figure 35. Plectranthus mollis whole plant powder (microscopic)

Key: 1 Vessels
a Annular
b Spiral
c Pitted
2 Fragment of upper leaf surface
3 Fragment of lower leaf surface
st Stomata
4 Fragment of transverse section of leaf
ep Epidermal cells
pal Palisade cells
spo Spongy parenchyma
5 Endospermic cells
6 Aleurone grains
7 Stone cells
8 Sclerenchymatous cells
9 Trichomes
d base enlarge trichome
e uniserrate, mulitecellular trichome
10 Parenchymatous cells

36. Rauwolfia serpentina (rauwolfia)

This is the dried root of Rauwolfia serpentina Benth. ex Kurz. Syn. (Rauvolfia serpentina (L.) Benth. ex Kurz.) (family Apocynaceae). It contains not less than 0.15 per cent of reserpine (rescinamine group of alkaloids), calculated as reserpine.

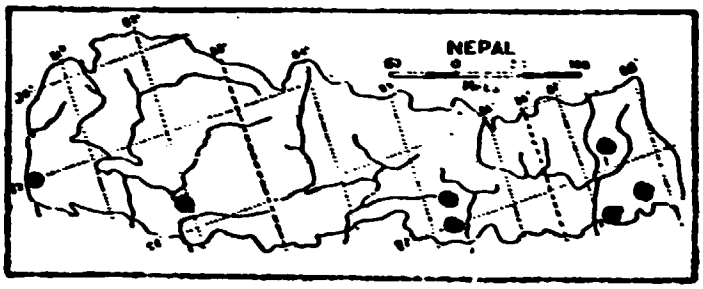
Description

Macroscopical: Pieces are 4-10 cm long and 0.5-1.5 cm wide, cylindrical, rarely branched, usually without rootlets; outer surface yellowish with longitudinal ridges; fracture short, smooth transversely cut surface showing a large yellow, radiate, dense xylem, covering about three quarters of the diameter (picture 36).

Microscopical: Powdered drug of yellowish colour; two types of cork cells, large and small, in alternating bands, arranged radially; abundance of starch, starch grains mostly rounded with a few irregular ones, 9-15 in diameter, some showing hilum at centre; parenchyma filled with starch grains, some pitted parenchyma with prismatic crystals of calcium oxalate; tracheids with numerous bordered pits and pitted thickenings; xylem fibres, few thick-walled (figure 36).

Analytical standards

	Laboratory results	Pharmacopoeial limit	
		IP	USP
	(Percentage)	(Percentage)	
Total ash	4.53	8	-
Acid-insoluble ash	0.45	2	2
Total alkaloid	1.67	0.15	0.15



Distribution in Nepal

Picture 36. Rauwolfia serpentina Benth. ex Kurz. (root)

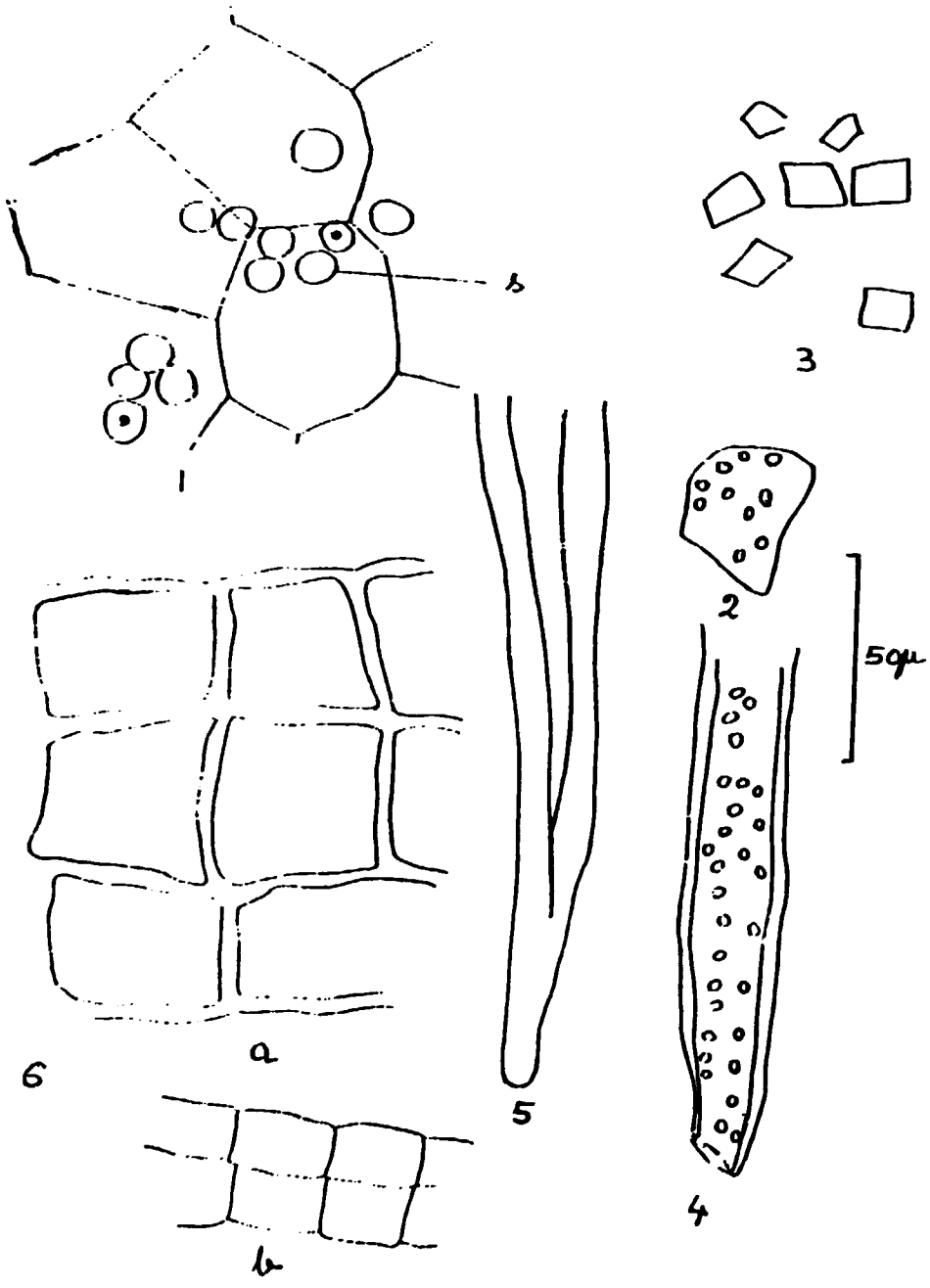


Figure 36. Rauwolfia serpentina root powder (microscopic)

Key: 1 Parenchymatous cells
s Starch grains
2 Pitted parenchyma
3 Calcium oxalate crystals
4 Tracheids
5 Fibre
6 Cork cells
a Large
b Small

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37. Rhododendron anthopogon

This is the dried plant of Rhododendron anthopogon D. Don (family Ericaceae).

Description

Macroscopical: Stem woody, upright, cylindrical, brown, smooth, whorled, solid; leaves 2.5 cm long, 0.8 cm wide, reticulate, entire, acute, linear, lanceolate, smooth; petiole short, 0.5 cm long, whorled (pictures 37 A and B).

Microscopical: Powdered drug light grey, undulate scales; upper epidermal cells without stomata; microspheroidal crystals; paracytic stomata on lower surface; two types of trichomes, unicellular or glandular; fragments of cork, in surface view thick-walled polygonal shape and in section tabular; polygonal parenchyma with cell content; vessels with annular thickening (figure 37).

Analytical standards

	Laboratory results (Percentage)
Total ash	2.15
Acid-insoluble ash	0.62
Volatile oil	0.53

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General

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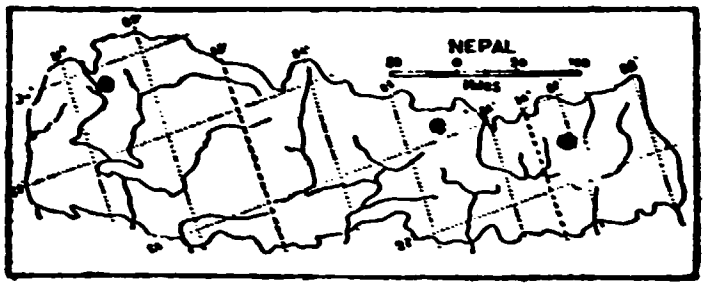
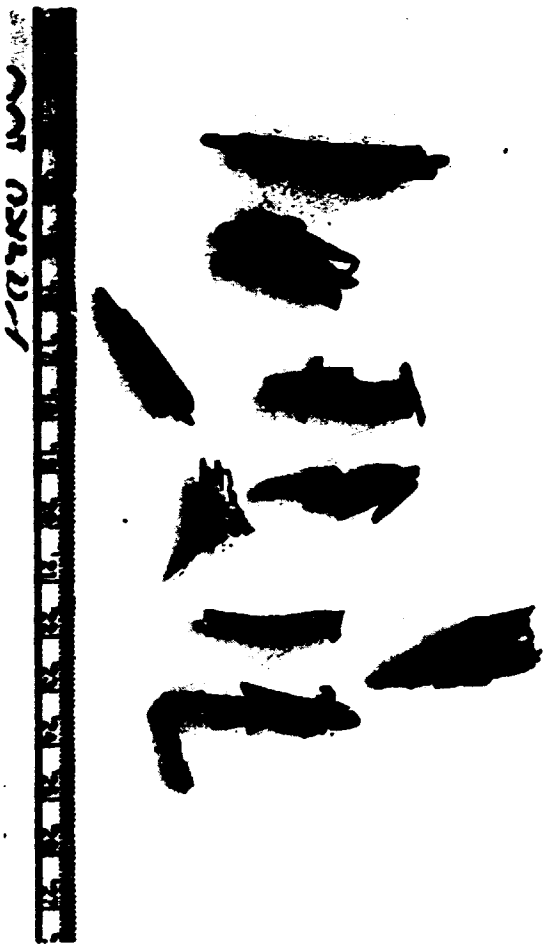


Distribution in Nepal



Picture 37 A. Rhododendron anthopogon D. Don (whole plant)

Picture 37 B. Rhododendron anthopogon (Herbarium)

Note: Talispatra (तालीसपत्र), used by Singh Durbar Vaidyakhana, is identified as Rhododendron anthopogon and should not be confused with Abies webbiana which has the same vernacular name.

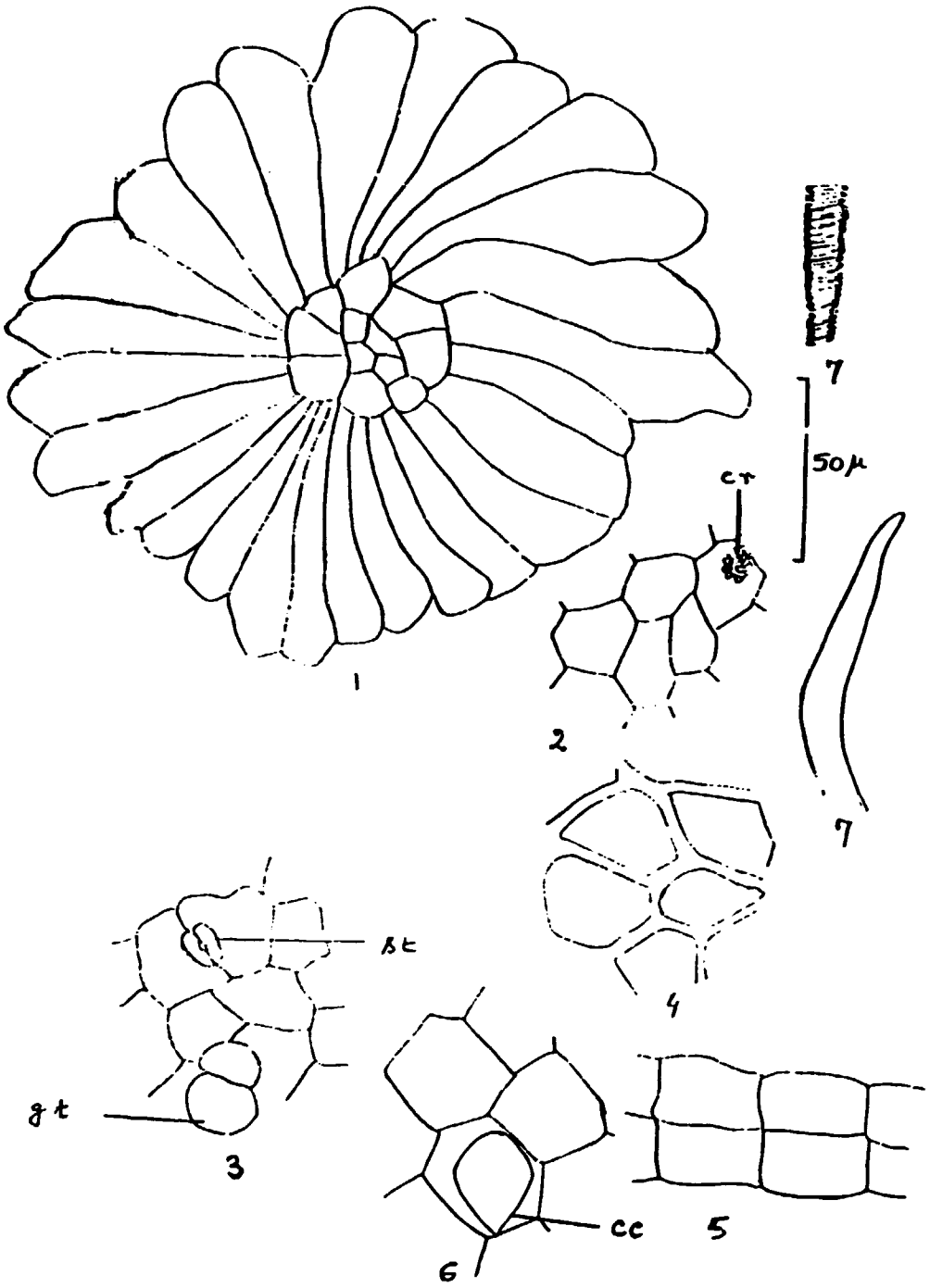


Figure 37. Rhododendron anthopogon whole plant powder (microscopic)

Key: 1 Undulate scale
2 Upper leaf surface
cr Crystals
3 Lower leaf surface
gt Glandular trichome
st Stomata
4 Cork cells in surface view
5 Cork cells in section
6 Parenchymatous cells
cc Cell vessel
7 Annular vessel

Chemistry

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38. Saussurea lappa (costus)

This is the dried root of Saussurea lappa C.B. Clarke (family Compositae).

Description

Macroscopical: Root stout, conical, about 12 cm long and 2.5 cm wide; external surface rough, grey, curved root hair; internally brown, central cylinder three times broad to the cortex (picture 38).

Microscopical: Powdered drug brownish grey; fragments of cork; fragments of thick-walled sclerenchymatous cells; nearly oval parenchymatous cells; vessels with reticulate thickening (figure 38).

Analytical standards

	Laboratory results (Percentage)	Pharmacopoeial limit JP (Percentage)
Total ash	3.66	4.0
Acid-insoluble ash	0.25	-

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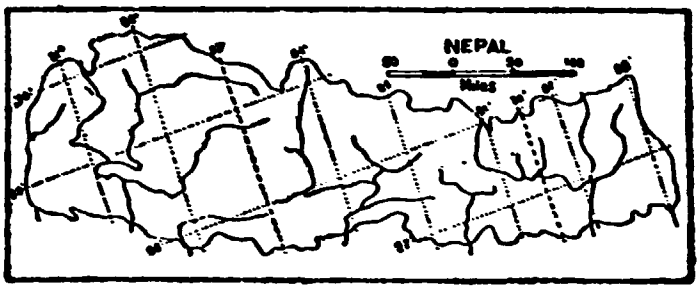

Distribution in Nepal
This drug is being cultivated and imported.

Picture 38. *Saussurea lappa* C.B. Clarke (root).

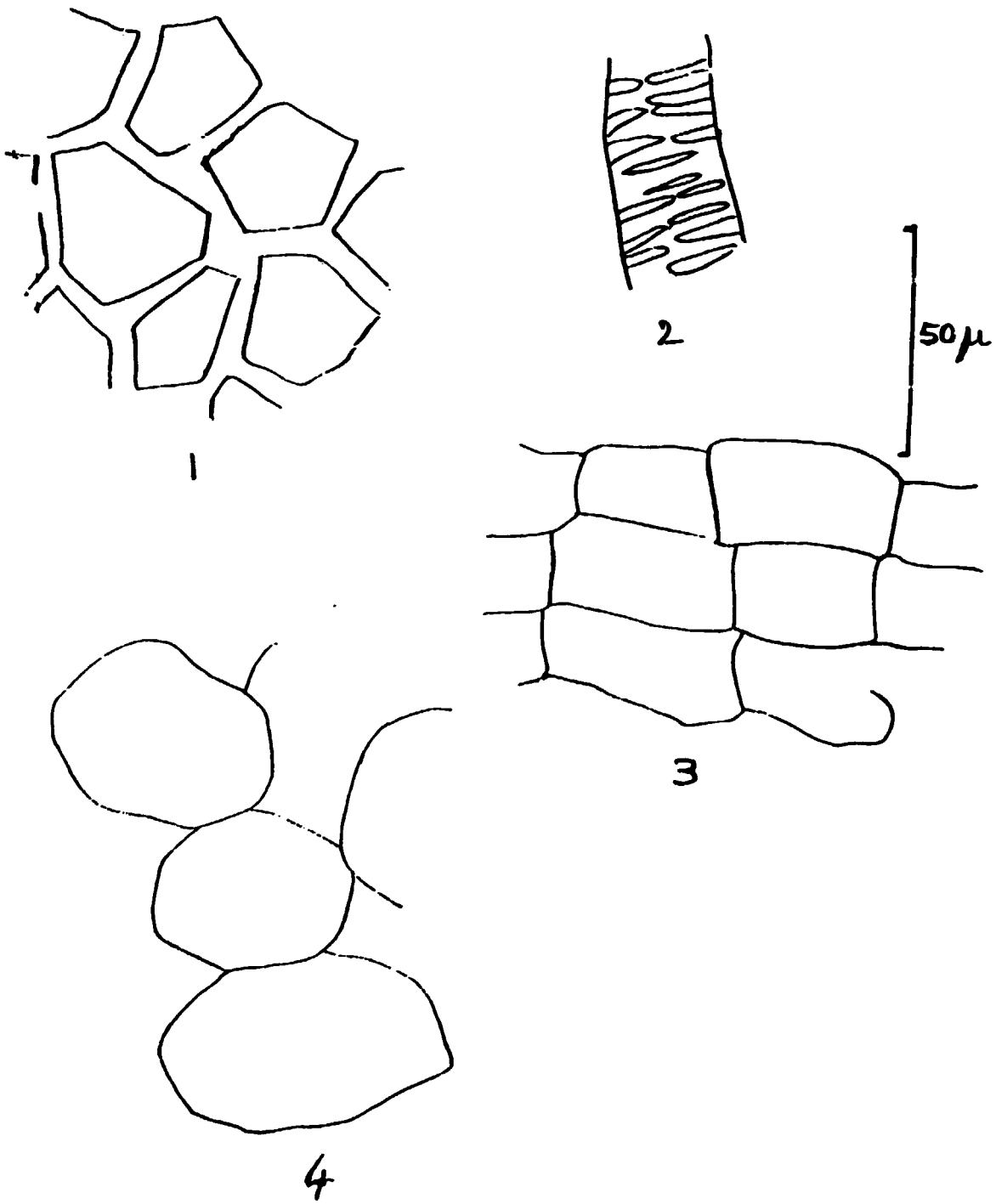

Figure 38. Saussurea lappa root powder (microscopic)

Key: 1 Sclerenchymatous cells
2 Reticulate vessel
3 Cork cells
4 Parenchymatous cells

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Chemistry

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39. Solanum nigrum (black nightshade)

This is the dried fruit of Solanum nigrum L. (family Solanaceae).

Description

Macroscopical: Berry, 6-10 mm in diameter, globuse, red or yellow, smooth; with many discoid seeds of about 1.5 mm diameter, yellow, smooth (picture 39).

Microscopical: Powdered drug yellowish; epicarp cells subrectangular; mesocarp cells polygonal; fragments of annular and pitted vessels; endosperm cells polyhedral, containing aleurone grains; endocarp with thin, wavy walls (figure 39).

Analytical standards

	Laboratory results (Percentage)
Total ash	4.08
Acid-insoluble ash	0.57

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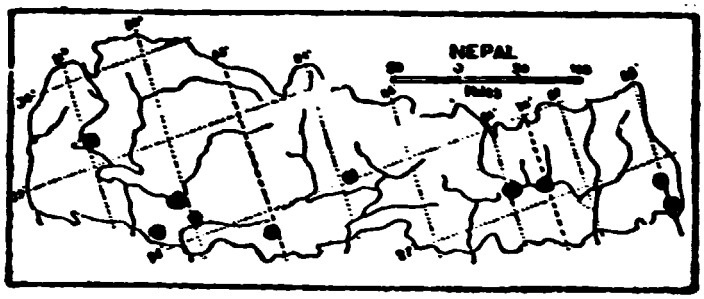
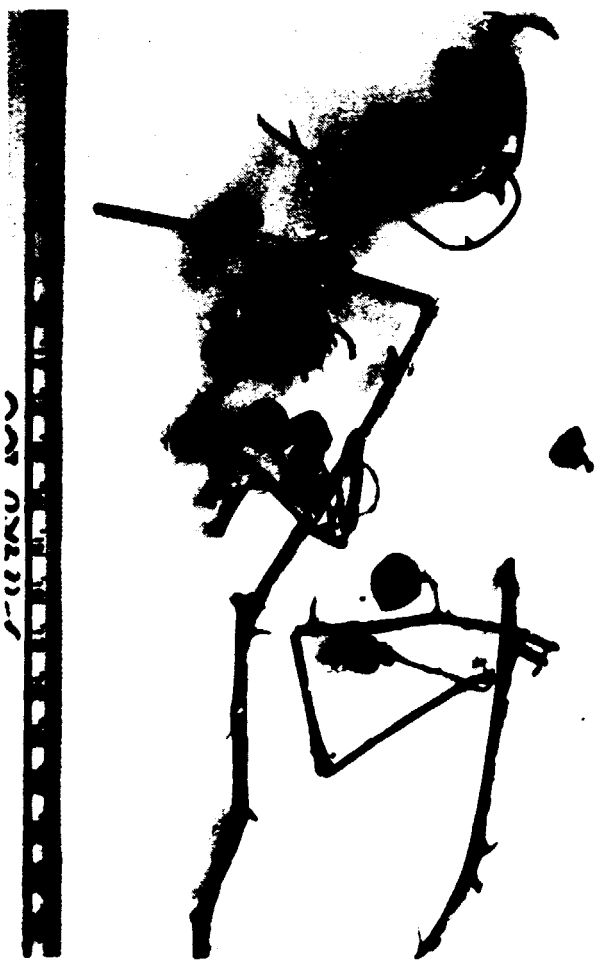


Distribution in Nepal



Picture 39. Solanum nigrum L. (fruit)

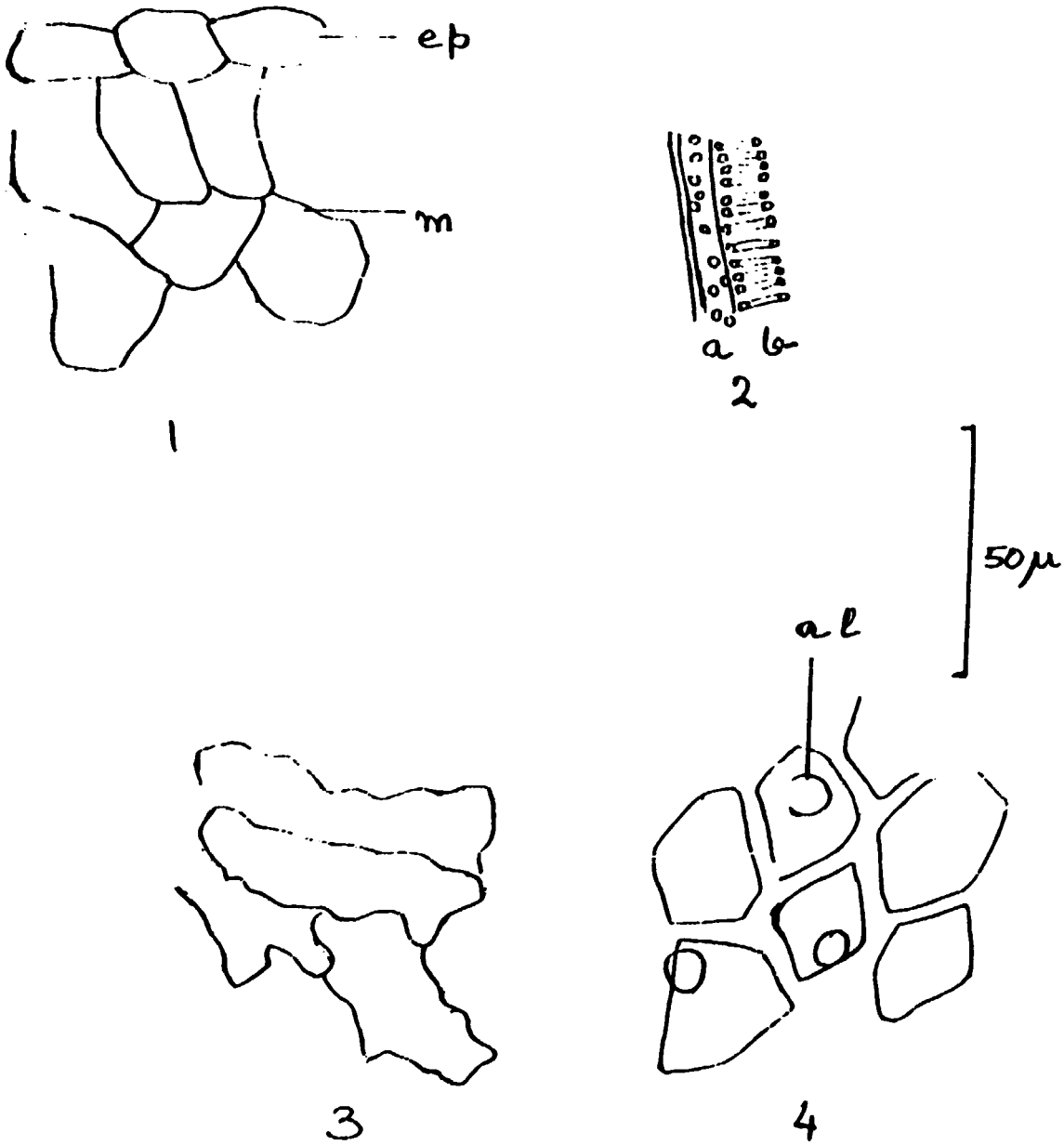


Figure 39. Solanum nigrum fruit powder (microscopic)

Key: 1 Transverse section of pericarp
ep Epidermis
m Mesocarp
2 Vessels
a Pitted
b Annular
3 Endocarp
4 Endosperm
al Aleurone grain

Analysis

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40. Tabernaemontana divaricata

This is the dried plant of Tabernaemontana divaricata (L) R. Br. ex Roem. et Schult. (family Apocynaceae); syn.: T. coronaria (Jacg.) Aitom.; Ervatamia divaricate (L) Burkill; Nerium divaricatum L.; N. coronarium Jacg.

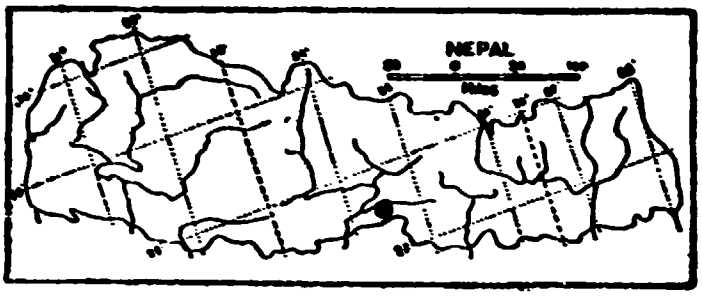
Description

Macroscopical: Stem about 4 mm in diameter; upper part light grey, quadrangular, glabrous, longitudinally striated; leaves with short petiole, opposite in pairs, ovate, lanceolate, entire, acuminate, glabrous; flowers in terminal cymes, white, corolla tube swollen at the middle (pictures 40 A and B).

Microscopical: Powdered drug greenish; fragments of tabular cork cells; stone cells of various shape, tabular, rectangular, with lignified walls; parenchymatous cells with starch grains, simple, round about 10 μ in diameter; vessels with annular thickening; thick-walled sclerenchymatous cells; upper epidermal cells without stomata, paracytic stomata on lower surface; oil globules 3-9 μ in diameter (figure 40).

Analytical standards

	Laboratory results (Percentage)
Total ash	5.25
Acid-insoluble ash	0.63
Volatile oil	0.12



Distribution in Nepal

Picture 40 A. Tabernaemontana divaricata (L) R. Br. ex Roem. et Schult. (whole plant)

Picture 40 B. Tabernaemontana divaricata (Herbarium)

Note: Tagar (तगर), used by Singha Durbar Vaidyakhana, is identified as Tabernaemontana divaricata and should not be confused with Valeriana hardwikii ( ).

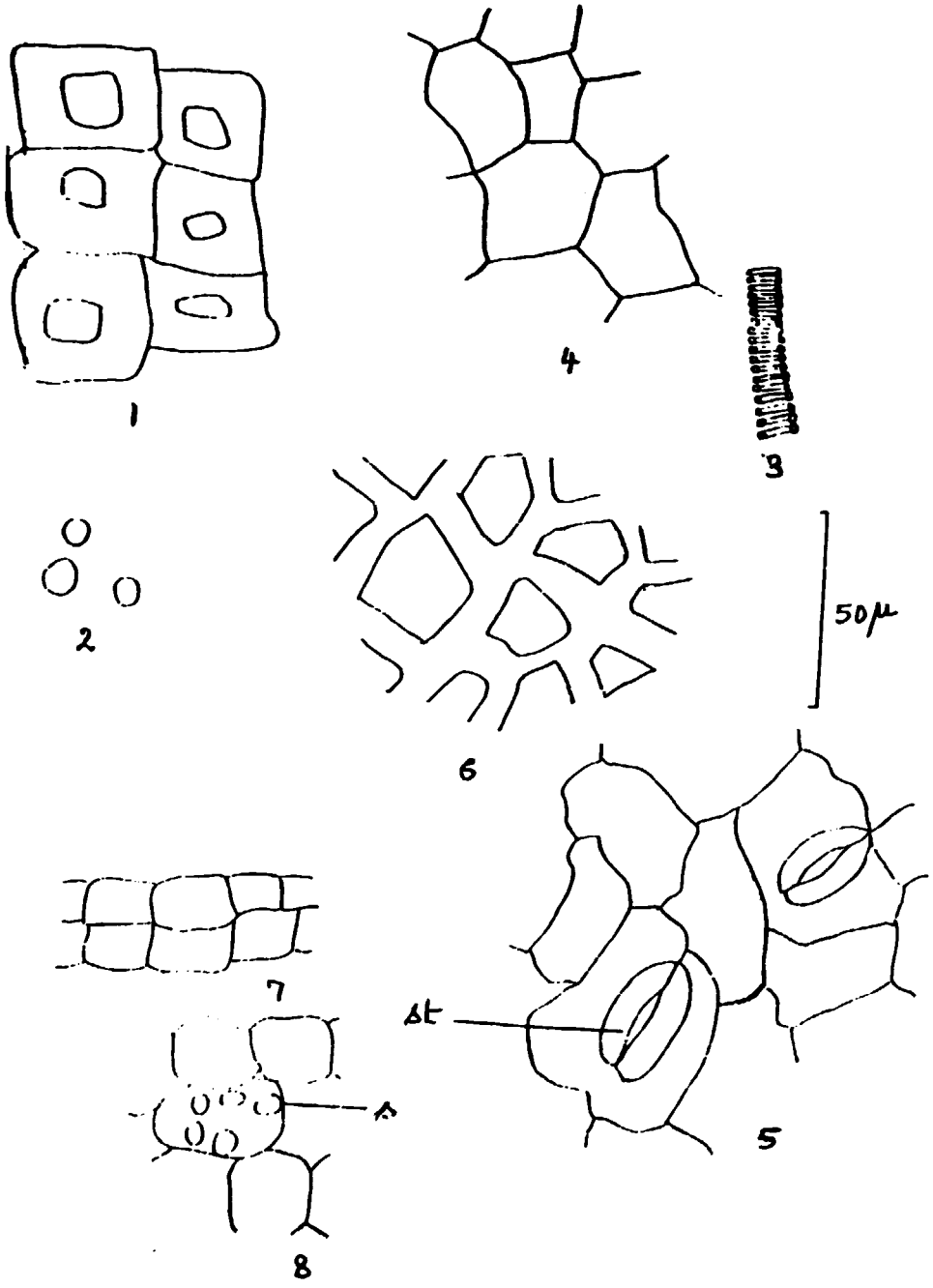


Figure 40. Tabernaemontana divaricata whole plant powder (microscopic)

Key: 1 Stone cells
2 Oil globules
3 Annular vessel
4 Upper epidermis
5 Lower epidermis
st Stomata
6 Sclerenchymatous cells
7 Cork cells
8 Parenchymatous cells
s Starch grains

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