Thai Herbal Pharmacopoeia 2019

Volume I

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กรมวิทยาศาสตร์การแพทย์
DEPARTMENT OF MEDICAL SCIENCES

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THAI HERBAL PHARMACOPOEIA 2019

VOLUME I

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PREFACE

This Thai Herbal Pharmacopoeia (THP) 2019 is published to celebrate the coronation of King Rama X. May 2019 (B.E. 2562) marks an auspicious moment in the history of the Kingdom of Thailand. The coronation certainly brought the greatest hope and joy to all the people of Thailand.

Throughout the history, the nation and the people of Thailand have benefited from the wholehearted love, remarkable leadership and restless work of their monarchs. From the Sukhothai to the Rattanakosin era, monarchy after monarchy, one thing that has never changed is the kings' devotion towards the welfare state of the kingdom and their people. A huge leap in health care development over the period of the current dynasty is among various proofs of the monarch's contributions to the Thai society. From a country where healthcare services and facilities were scarcely available, Thailand is currently working its way towards a medical hub of Asia. Though the development requires numerous factors, one quiet, yet crucial driving force behind the success is keen interest and support of Their Majesties. The establishment of Siriraj Hospital by King Rama V introduced the first hospital and medical school to the country, uplifting health education and services. During the reign of King Rama IX, a number of royal projects and activities were set forth with the aim of providing equal access to treatments and health care services to all Thai people, especially those in impoverished, remote areas.

Following the previous monarch's royal footsteps, King Rama X continues to engage in supporting the health care sector, including advancement in both modern and traditional medicines, as well as the integration of Thai herbal medicine into the mainstream health care.

When a Thai herbal drug is utilized, three substantial aspects that should be taken into account are the safety, efficacy and quality of the drug. In order to ensure that those aspects are met, in 1989, the Department of Medical Sciences, Ministry of Public Health established the THP, a publication setting forth quality standards for herbal drugs and herbal drug preparations marketed in the country. The choice of the plants included in the THP was limited to commercially available plants and to other plants which appear on the List of Medicines from Herbal Drugs under the Thai National List of Essential Medicines. The selection process was based on the critical evaluation of the documented therapeutic merit and the accessibility of each plant. The process has been applied to all publications in the series ever since. The first publication, THP Volume I, came into use in 1995 and was promulgated by the Ministry of Public Health as one of the national pharmacopoeiae. Up to the present, nine publications have been released (THP Volume I [1995], THP Volume II [2000], Supplement to THP [2004], THP Volume III [2009], Supplement to THP [2011], THP Volume IV [2014], THP 2016, THP 2017, and THP 2018). These publications specify standards for a total of 80 herbal drugs and herbal drug preparations. All publications, except THP 2016 and 2018, have been notified by the Minister of Public Health as official compendia. The current publication, THP 2019, contains 90 monographs on herbal drugs and herbal drug preparations, 80 monographs of which are from the published monographs of THP 2018.

The THP is one of the achievements of the Thai Pharmacopoeia Committee. The monographs on both herbal drugs and herbal drug preparations together with the appendices, as well as other necessary information in the Thai Herbal Pharmacopoeia 2019, were prepared by the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia in affiliation with other subcommittees, viz. the Subcommittee on the Pharmacognostic and Botanic Specifications for the Thai Herbal Monographs, the Subcommittee on the Physico-chemical Specifications and Safety for the Thai Herbal Monographs, the Subcommittee on Standards for Thai Herbal Drug Preparations, the Subcommittee on Drug Safety, the Subcommittee on General Specifications and Reagents, the Subcommittee on Standards and Analytical Methods, the Subcommittee on Drug Stability, and the Subcommittee on Editorial Style, under the supervision of the Thai Pharmacopoeia Committee. The Department of Medical Sciences and the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia wish to express their deep gratitude to the generous assistance and technical support from various contributors, government agencies, academic institutions and other organizations, particularly the Botanical Garden Organization, the Department of National Parks, Wildlife and Plant Conservation Research Office, the Government Pharmaceutical Organization, Chiang Mai University Faculty of Pharmacy, Chulalongkorn University Faculty of Pharmaceutical Sciences, Kasetsart University Faculty of Sciences, Khon Kaen University Faculty of Pharmaceutical Sciences, Mahasarakham University Faculty of Medicine, and Srinakharinwirot University Faculty of Pharmacy, and those individuals who have provided comments and advice and shared their time and expertise. This publication would never have been succeeded without their outpouring of support and contribution.

(Clin. Prof. Emeritus Piyasakol Sakolsatayadorn, M.D.)

Minister of Public Health

INTRODUCTION

In 1989, the Thai Pharmacopoeia Committee appointed the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia with the mission of establishing the Thai Herbal Pharmacopoeia, a companion publication to existing Thai Pharmacopoeia. The Subcommittee's responsibilities are:

1. selecting appropriate herbal drugs and herbal drug preparations based on public health and industrial demand for further consideration by the Thai Pharmacopoeia Committee;
2. establishing specifications for herbal drugs and herbal drug preparations selected by the Thai Pharmacopoeia Committee and compiling the corresponding monographs;
3. publishing the Thai Herbal Pharmacopoeia;
4. attending to all matters related to the preparation of the Thai Herbal Pharmacopoeia.

In 2010, the Thai Pharmacopoeia Committee appointed three specialized subcommittees to provide the existing subcommittee with data on specific fields in order to facilitate the work of the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia, as well as to accelerate the work process, making it possible to meet the goal of launching new editions of the Thai Herbal Pharmacopoeia regularly. The responsibilities of each of these Subcommittees are described as follows:

1. The Subcommittee on the Pharmacognostic and Botanic Specifications for Thai Herbal Monographs

This Subcommittee is responsible for:

1.1 producing drafts of the pharmacognostic and botanic specifications of the Thai herbal monographs, i.e. nomenclature, definitions, plant descriptions, macroscopical and microscopical descriptions, and other related information;

1.2 submitting the drafts to the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia for approval;

1.3 attending to all matters related to the preparation of pharmacognostic and botanic specifications.

2. The Subcommittee on the Physico-chemical Specifications and Safety for Thai Herbal Monographs

This Subcommittee is responsible for:

2.1 producing drafts of the physico-chemical specifications of the Thai herbal monograph, i.e. constituents, packaging and storage, identification, assay, ashes, extractives, and other related information;

2.2 producing draft information on the safety of the Thai herbal monographs, i.e. categories, contra-indications, warnings, precautions, additional information, dosage, and other related information;

2.3 submitting the drafts to the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia for approval;

2.4 attending to all matters related to the preparation of the physico-chemical and safety specifications.

3. The Subcommittee on Standards for Thai Herbal Drug Preparations

This Subcommittee is responsible for:

3.1 producing draft specifications for Thai herbal drug preparations preselected by the Thai Pharmacopoeia Committee and compiling these specifications in monographs in the Thai Herbal Pharmacopoeia;

3.2 submitting the drafts to the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia for approval;

3.3 attending to all matters related to establishing the specifications for Thai herbal drug preparations;

3.4 preparing appendices of the tests related to the Thai herbal monographs.

This publication is included in a series known as the Thai Herbal Pharmacopoeia. Despite the fact that the majority of monographs being on medicines of plant origin, due to their extensive use, the various terms described in the text, such as herbal drugs or materials, refer not only to plants but also to animals and minerals used for medicinal purposes. The pattern of the various monographs is relatively inconsistent due to the fact that they were compiled from various publications of the Thai Herbal Pharmacopoeia. For instance, the illustrations of thin-layer chromatograms may be found as colour drawings or colour photographs.

Any comments or suggestions from readers/users are welcomed by the Subcommittees in order to further refine the information in this publication. Such comments will be considered when the monographs are revised so that the most useful information is provided.

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[1]Effective from October 2002 (formerly Drug Analysis Division)

[2]Effective from October 2002 (formerly Thai Pharmacopoeia Section)

[3]Effective from April 2005 (formerly Thai Pharmacopoeia and Reference Substances)

[4]Effective from October 2007 (formerly Thai Pharmacopoeia Section)

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Nalinphat **Saktiyasunthorn** (deceased), B.Sc. in Pharm., M.Sc. in Pharm.
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Pranom **Dechwisissakul**, B.Sc., M.Sc. in Pharm., *Representative*
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Pairin **Thongkhoom**, B.Sc., M.Sc. in Pharm., *Representative*
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Director, Bureau of Drug and Narcotic (2014-)
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Thaweephol **Dechatiwongse Na Ayudhya**, B.Sc. in Pharm. (1989-)
Supatra **Im-erb**, B.Sc. in Pharm., M.Sc. (Pharm. Chem.) (1990-1991, 2009-)
Panida **Kanchanapee** (deceased), B.Sc. in Pharm. (1993-2000)
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Nantana **Sittichai**, B.Sc. in Pharm., M.S. (1990-2008)
Panit **Somhom**, B.Sc. in Pharm., M.Sc. in Pharm. (1991-1992)
Prapai **Wongsinkongman**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (1990-1991, 1993-1996)

This subcommittee is responsible for:

1.1 selecting the appropriate herbal drugs and herbal drug preparations based on public health and industrial demands for further consideration by the Thai Pharmacopoeia Committee;

1.2 establishing the specifications of herbal drugs and herbal drug preparations selected by the Thai Pharmacopoeia Committee and compiling the corresponding monographs;

1.3 publishing the Thai Herbal Pharmacopoeia;

1.4 attending to all matters related to the preparation of the Thai Herbal Pharmacopoeia.

2. SUBCOMMITTEE ON THE PHARMACOGNOSTIC AND BOTANIC SPECIFICATIONS FOR THAI HERBAL MONOGRAPHS (2010-2019)

Chairperson: Chayan **Picheansoonthon**, B.S. in Pharm., Ph.D., FRI (2010-)

Vice-chairperson: Thatree **Phadungcharoen**, B.Sc. in Pharm., M.Sc. in Pharm. (2010-2015)

Advisors: Chirayupin **Chandraprasong**, B.Sc., M.Sc., Hon. Ph.D., FRI (2010-2015)
Kongkanda **Chayamarit**, B.Sc., M.Sc., D.Sc. (2010-2015)

Members: Chief, Pharmacognosy Section, Medicinal Plant Research Institute, Department of Medical Sciences (2010-)
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Wilawan **Rattanathirakul**, B.Sc., M.Sc., *Representative*
Jaree **Bansiddhi**, B.Sc., M.Sc. (2010-)
Bhanubong **Bongcheewin**, B. Pharm., M.Sc., Ph.D. (2014-)
Kongkanda **Chayamarit**, B.Sc., M.Sc. D.Sc. (2015-)
Pranom **Dechwisissakul**, B.Sc., M.Sc. in Pharm. (2010-)

Jiranuch **Jamtaweekul**, B.Sc. in Pharm., M.Sc. in Pharm. (2010-2015, 2017-)
Ornusa **Khamsuk**, B.S., M.S., Ph.D. (2014-)
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Sawanee **Sathornviriyapong**, B.S. (Agriculture), M.S. (Horticulture), Ph.D. (2010-)

Secretaries: Sasiphimol **Boontavee**, Pharm. D. (2017-2018)
Kornvika **Charupant**, B.S. Pharm., M.Sc. in Pharm., Ph.D. (2010-)
Jiranuch **Jamtaweekul**, B.Sc. in Pharm., M.Sc. in Pharm. (2015-2017)
Sasiwimon **Patasema**, B. Pharm., M.Sc. in Pharm. (2015-)
Thanita **Patthamajinda**, B.S. in Pharm., M.A. MS in Regulatory Affairs and Health Policy (2010-2015, 2018-)

This subcommittee is responsible for:

2.1 producing drafts of the pharmacognostic and botanic specifications for Thai herbal monographs, i.e. nomenclature, definitions, plant descriptions, macroscopical and microscopical descriptions, and other related information;

2.2 submitting the drafts to the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia for approval;

2.3 attending to all matters related to the preparation of pharmacognostic and botanic specifications.

3. SUBCOMMITTEE ON THE PHYSICO-CHEMICAL SPECIFICATIONS AND SAFETY FOR THAI HERBAL MONOGRAPHS (2010-2019)

Chairperson: Khanit **Suwanborirux**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (2010-)

Vice-chairperson: Nantana **Sittichai**, B.Sc. in Pharm., M.S. (2010-2015)

Advisor: Yupadee **Payakkapan**, B.Sc. in Pharm., M.Sc. in Pharmaceutical Analysis (2010-2015)

Members: Chief, Herbal Quality Assurance Center, Medicinal Plant Research Institute, Department of Medical Sciences (2010-2013, 2015-)
Somchit **Niumsakul**, B.Sc., M.Sc.
Nawarat **Chadchen**, B. Pharm., M.Sc. in Pharm., *Representative*
Apirak **Sakpetch**, B.S. Pharm., *Representative*
Chitra **Chaiyawat**, B. Pharm. (2010-2014)
Veena **Nukoolkarn**, B.S. in Pharm., Ph.D. (2014-)
Yupadee **Payakkapan**, B.Sc. in Pharm., M.Sc. in Pharmaceutical Analysis (2015-)
Chada **Phisalapong**, B.Sc. in Pharm., M.Sc., Ph.D. (2010-)
Nantana **Sittichai**, B.Sc. in Pharm., M.S. (2015-)
Uthai **Sotanaphun**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (2014-)
Taweesak **Suntorntanasat**, B.Sc. in Pharm., M.Sc. in Pharm. (2010-)
Witchuda **Thanakijcharoenpath**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (2014-)
Prapai **Wongsinkongman**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (2011-)

Secretaries: Sasiphimol **Boontavee**, Pharm. D. (2017-)
Kornvika **Charupant**, B.S. Pharm., M.Sc. in Pharm., Ph.D. (2010-2014)
Sirichai **Krabesri**, B.Sc. in Pharm., M. Pharm., LL.B., B.L. (2014-)
Santi **Nimnoi**, B.S. in Pharm. (2015-)

This subcommittee is responsible for:

3.1 producing drafts of the physico-chemical specifications for Thai herbal monograph, i.e. constituents, packaging and storage, identification, assay, ashes, extractives, and other related information;

3.2 producing draft information on the safety for Thai herbal monographs, i.e. categories, contra-indications, warnings, precautions, additional information, dosage, and other related information;

3.3 submitting the drafts to the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia for approval;

3.4 attending to all matters related to the preparation of the physico-chemical and safety specifications.

4. THE SUBCOMMITTEE ON STANDARDS FOR THAI HERBAL DRUG PREPARATIONS (2010-2019)*

Chairperson: Yupadee **Payakkapan**, B.Sc. in Pharm., M.Sc. in Pharmaceutical Analysis (2010-)

Members: Kornvika **Charupant**, B.S. Pharm., M.Sc. in Pharm., Ph.D. (2015-)
Jiranuch **Jamtaweekul** B.Sc. in Pharm., M.SC. in Pharm. (2017-)
Piyaporn **Prayakprom**, B.Sc. in Pharm., Ph.D., (2017-)
Nidapan **Ruangrittinon**, B.Sc. in Pharm., M.Sc. in Pharm. (2010-)
Churairat **Rakwatin**, B.Sc. in Pharm. (2010-)
Nantana **Sittichai**, B.Sc. in Pharm., M.S. (2010-)
Prapai **Wongsinkongman**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (2010-)
Sasida **Yoosuk**, B.Sc. in Pharm., M.Sc. in Pharm. (2017-)

Secretaries: Sasiphimol **Boontavee**, Pharm. D. (2017-)
Sirichai **Krabesri**, B.Sc. in Pharm., M. Pharm., LL.B., B.L. (2010-)
Sarinee **Lenapun**, B.S. Pharm., M.Sc. in Pharm. (2010-2015)
Santi **Nimnoi**, B.S. in Pharm. (2015-)

This subcommittee is responsible for:

4.1 producing draft specifications for Thai herbal drug preparations preselected by the Thai Pharmacopoeia Committee and compiling these specifications in monographs in the Thai Herbal Pharmacopoeia;

4.2 submitting the drafts to the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia for approval;

4.3 attending to all matters related to establishing the specifications for Thai herbal drug preparations;

4.4 preparing appendices of the tests related to the Thai herbal monographs.

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*Effective from June 2017 (formerly The Ad Hoc Subcommittee on Standards of the Thai Herbal Drug Preparations)

5. THE SUBCOMMITTEE ON EDITORIAL STYLE (1980-2019)

Chairpersons:
Komol **Pengsritong** (deceased), M.D., M.S., Ph.D., Hon. D.Sc. in Pharm. (1980-1988)
Nadhirat **Sangkawibha** (deceased), M.D., M.P.H. (1989-1997)
Sumana **Vardhanabhuti** (deceased), B.Sc. in Pharm., M.Sc. in Pharm., M.P.H., Cert. in Immunol. (WHO) (1997-2010)
Boonchua **Dhorranintra**, M.D., Dr.med (magna cum laude) (Freiburg U.), FRCP(T) (2010-)

Advisors:
Prachaksvich **Lebnak**, M.D. (2000-2003)
Komol **Pengsritong** (deceased), M.D., M.S., Ph.D., Hon. D.Sc. in Pharm. (CU) (1988-1991)
Rachanee **Pinthaworn**, B.Sc. in Pharm. (2003-2005, 2009-2010)
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Suntana **Sutadarat**, B.Ed. (Hons.), M.A., Ph.D. (1997)
Prakorb **Tuchinda** (deceased), M.D., Hon. D.Sc. in Med. (MU) (1988-1991)
Sumana **Vardhanabhuti** (deceased), B.Sc. in Pharm., M.Sc. in Pharm., M.P.H., Cert. in Immunol. (WHO) (2010-2015)
M.L. Pranod **Xumsaeng** (deceased), Ph.G., B.Sc. in Pharm. (1991-1997)

Members:
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Secretaries: Manas **Attawish**, B.S. (Pharm.) (1997-2013)
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Wanida **Suchonwanit**, B.Sc. in Pharm. (1997-2000)

This subcommittee is responsible for:

5.1 designing the format and style for printing;

5.2 editing the text;

5.3 keeping conformity of the molecular formulae, chemical names, molecular weights, and expressions of the symbols of units throughout the text;

5.4 organizing the information compiled by the subcommittees into a pharmacopoeial form and completing the final draft of the Thai Pharmacopoeia;

5.5 attending to all matters related to editing the Pharmacopoeia.

6. WORKING GROUP ON PRINTING THE THAI HERBAL PHARMACOPOEIA (1989-1995)

Chairperson: Director, Drug Analysis Division, Department of Medical Sciences, Ministry of Public Health
Chongdee **Wongpinairat**, B.Sc. in Pharm., M.Sc., Ph.D.

Members: Chief, Herbal Quality Assurance Center, Medicinal Plant Research

Manas **Attawish**, B.S. (Pharm.)
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Nongluck **Ruangwises**, B.S. (Pharm.), M.S., Ph.D.
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***Contributors*:**

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Pranom **Dechwisissakul**, B.Sc., M.Sc. in Pharm.
Warunee **Jirawattanapong**, B.Sc. in Pharm.
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Vansiri **Rimsamut**, Cert.A.
Amporn **Ruangchan**, B.Sc. in Pharm., M.Sc.
Weena **Sathianpokkasap**, B.Sc. in Pharm.
Kamol **Sawasdimongkol**, B.Sc. in Pharm., M.S.
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Suntana **Sutadarat**, B.Ed. (Hons.), M.A., Ph.D.
Yenchit **Techadamrongsin**, B.S., B.S. Phar., Post. Cert.
Parkpoom **Tengamnuay**, B. Pharm., Ph.D.
Thawatchai **Thawonying** (deceased), B.Sc. in Pharm.

The following persons were engaged in the production of THP Volume II (1995-2000):

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Nuchattra **Chansuwanit**, B.Sc., M.S.
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Tathaporn **Maison**, B.Sc.
Narumole **Mongkolchaipak**, B. Pharm., M.Sc.
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Proramate **Sansongsak**, B.Sc. (Pharm.)
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Pairin **Thongkhoom**, B.Sc., M.Sc. in Pharm.
Rawat **Tiasakul**, B.Sc. (Pharm.)
Suppachai **Tiyaworanant**, B.Sc. (Pharm.), M.Sc. in Pharm.

The following persons were engaged in the production of Supplement to THP (2000-2004):
Nuchattra **Chansuwanit**, B.Sc., M.S.
Tanwarat **Kajsongkram**, B.S., M.S. (Chemistry)
Pichitra **Maekprayoon**, B.Sc.
Tathaporn **Maison**, B.Sc.
Jiranuch **Mingmuang**, B.Sc. in Pharm.
Piya **Mokkamul**, B.S. (Forestry)
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Thanawat **Thongchin**, B.S.
Pairin **Thongkhoom**, B.Sc., M.Sc. in Pharm.
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The following persons were engaged in the production of THP Volume III (2004-2009):
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Chalermchoke **Boonchit**, B.F.A.
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Supanee **Duangteraprecha**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D.
Pajaree **Inthachub**, B.Sc., M.Sc.
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Tanwarat **Kajsongkram**, B.S., M.S.
Supachai **Koonterm**, B.Sc.
Sirichai **Krabesri**, B.Sc. in Pharm., M. Pharm., LL.B., B.L.
Sumanee **Lertakanokkun**, B.Sc. (Pharm.)
Pichitra **Maekprayoon**, B.Sc.
Duangpen **Pattamadilok**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D.
Wittaya **Pongamornkul**, B.Sc., M.S.
Sununta **Srisopon**, B. Pharm., M. Pharm.
Thanawat **Thongchin**, B.S.
Pairin **Thongkhoom**, B.Sc., M.Sc. in Pharm.
Niran **Vipunngeun**, B.Sc., M.Sc.
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GENERAL NOTICES

GENERAL NOTICES

The information given in the general notices provides the basic guidelines for the interpretation and applications of the standards, tests, assays and other specifications of the Thai Herbal Pharmacopoeia.

In the text of the Thai Herbal Pharmacopoeia the word "Pharmacopoeia" means the Thai Herbal Pharmacopoeia. The official abbreviation for the Thai Herbal Pharmacopoeia is THP. An herbal material is not of the pharmacopoeial quality unless it complies with all the requirements of the relevant monograph. The statements under the headings: Description, Solubility, Constituents, Packaging and storage, Contra-indication, Warning, Precaution, and Additional information are not to be regarded as analytical requirements. However, the macroscopic and microscopic descriptions under each monograph are important means for the identification of the drug and its corresponding origin.

Unless otherwise specified, the rules of the General Notices of the Thai Pharmacopoeia (TP) apply to the Thai Herbal Pharmacopoeia.

Monograph Nomenclature

A Thai name is adopted as the main title of each pharmacopoeial substance. It is transcribed to English following the Royal Institute's official transliteration system[1] and printed with capital letters. Subsidiary titles, where applicable, are other Thai name(s), Latin genitives of plants, English common name(s), and English synonym(s).

In the text, English common names are usually mentioned in place of the main titles. When the English common names are not available, the English names derived from the Latin genitives of plants will be used instead. All titles (main and/or subsidiary) and names (synonyms as well as botanical names) are listed in the index.

Reference Substances

Where a test or an assay calls for the use of a Reference Substance, the ASEAN Reference Substance or other recognized reference substances may be used. The ASEAN Reference Substances are available from the Bureau of Drug and Narcotic, the Department of Medical Sciences, Nonthaburi, Thailand.

Authenticated Reference Specimens

For the botanical evaluation of the crude drug samples, the herbarium specimen numbers of the corresponding plants provided in the text are taken from the Department of Medical Sciences Herbarium (DMSC), the Department of Medical Sciences, Nonthaburi, Thailand, or other recognized herbaria such as the Bangkok Herbarium (BK), the Department of Agriculture, Bangkok, Thailand; the Forest Herbarium (BKF),

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[1] *Rules for Transcribing Foreign Words to Thai Script*: *English*, *French*, *German*, *Italian*, *Spanish*, *Russian*, *Japanese*, *Arabic*, *Malay* (The Royal Institute ed.), Bangkok: the Royal Institute, 1992.

the Department of National Parks, Wildlife and Plant Conservation, Bangkok, Thailand; the Herbarium of Queen Sirikit Botanic Garden (QSBG), Chiang Mai, Thailand. If not provided, the herbarium specimens could be compared to the existing named specimens at the above-mentioned herbaria.

For some plants non-native and not commercially cultivated in Thailand so that their herbarium specimens are not available at the above-mentioned herbaria, citation of the herbarium specimen numbers will be indicated under the Additional information of such monographs. If not indicated, it is suggested to investigate from other internationally-recognized herbaria.

The crude drug numbers (DMSc) are also cited. The reference crude drug specimens are authenticated by the Medicinal Plant Research Institute, the Department of Medical Sciences, Nonthaburi, Thailand.

Freshly and Recently Prepared

The direction that a preparation must be freshly prepared indicates that it must be made not more than 24 hours before it is issued for use. The direction that a preparation should be recently prepared indicates that deterioration is likely if the preparation is stored for longer than about 4 weeks at 15° to 25°.

Description

In addition to macroscopical and microscopical descriptions of crude drugs, the morphological and anatomical descriptions of plants are provided for the botanical identification of the samples. Colour photographs of the plants and crude drugs are also given.

Macroscopical descriptions in the monographs refer to features which can be seen by the unaided eyes or with the aid of a hand lens. Statements of the characteristic microscopical description of the whole drug are included in the monograph as a means for determining identity, quality, or purity. Most of the transverse sections of the plants are line drawn but some are photomicrographed and inserted to illustrate the authenticity of the cellular structures.

Identification

Thin-layer chromatography is used as one of the principal means of identification of herbal drugs. In some cases where isolated constituents of herbal drugs are available, chromatographically separated constituents are related to the known constituents used as markers[1]. For purposes of evaluation, an hR_f value is used in place of an R_f value in order to preclude the use of decimal fractions. The hR_f value is the R_f value multiplied by the factor 100, resulting in values of 0 to 100.

In the monograph, the hR_f values of known and unknown constituents are listed in the table, accompanied by the corresponding thin-layer chromatograms. The illustrations of thin-layer chromatograms are provided in colour photographs.

[1]Constituent(s) of a herbal material which is/are chemically defined and of interest for quality control purposes.

In cases where isolated constituents of herbal drugs are not readily available, a fingerprint of the separated constituents is obtained and the positions of major spots or bands in the chromatogram are described in relation to a non-constituent marker, in terms of their relative R_f values (RR_f). RR_f can be determined by the formula:

$$RR_f = a/b$$

where a = R_f value of a constituent of interest, and

b = R_f value of a non-constituent marker.

Due to variations in the levels of constituents in different samples of herbal drug, minor deviations from one chromatogram to another can be observed. A judgement by the analyst is needed as to the extent of deviation allowed before samples are considered incorrect or contaminated with foreign matter. Further investigations should be carried out in case of doubt.

Quantitative Determination

Unless otherwise specified, all quantitative determinations prescribed in the monographs are carried out on materials which have not been specially dried and calculations are made accordingly.

Arsenic and Heavy Metals

With regard to vegetable drugs, the toxic elements which may be present in sufficient quantity to pose potential risk vary from plant to plant. The amount of these elements depends on the location, the quality of the soil, or environmental pollution. Because of their toxic natures, arsenic and heavy metals are of major concern. Although not specifically required in the monograph, it is suggested that the maximum amounts of the toxic elements, based on the acceptable daily intake (ADI) values, in final dosage forms of plant materials be as follows:

Arsenic	4	ppm
Cadmium	0.3	ppm
Lead	10	ppm
Mercury	0.5	ppm

Microbial Contamination

Although not specifically required in the monographs, possible microbial contamination should be controlled to such an extent that the preparations derived from them meet the requirements as described in the “Limits for Microbial Contamination” (Appendix 10.5).

Strength(s) Available

Strength(s) available is provided only as a guide and is not necessarily comprehensive. For Solid dosage forms such as Capsules, the strength is usually given as the amount of herbal drugs, in powder form, in each unit. For herbal drugs intended for oral aqueous preparations such as Herbal Teas, the strength is usually given as the amount of herbal drugs, in powder form, in each unit dose.

Contra-indication

This section specifies those conditions in which the drug should NOT be used.

Warning and Precaution

Under the heading "Warning", the possible risks of certain hazards from the use of a herbal drug are to be observed and taken care of before prescribing or administering it to a patient. Caution and careful consideration on the risk-benefit ratio of the drug should therefore be contemplated on an individual basis prior to the decision to use it.

On the other hand, important notes to be observed and carefully followed during and after the administration of a drug are described under the heading "Precaution".

Where there is a clear risk, the important warnings and precautions are selected and included under the headings "Warning" and "Precaution" in some monographs. However, it should not be assumed that the omission of a warning or a precaution in any particular monograph means that warning or precaution may not be of clinical significance for a specific patient.

Additional Information

Any personal observation of a particular drug and other special relevant information concerned are to be categorized under the heading "Additional information". It is not regarded as analytical requirements.

Category and Dose

The statements given under "Category" are provided only for information on the drug's main pharmacological actions, which are presumably based on its use in traditional medicine. It should not be assumed that the substance has no other actions or uses. Information on doses is also related to its traditional use and is intended only for general guidance. The dose of a drug specified in this Pharmacopoeia is the usual dose for adults; some adjustments may be necessary for individual patients, including children, depending on their conditions. Unless otherwise stated, the information is given for internal use.

Remark It is to be noted that the actions and doses stated in the Pharmacopoeia do not imply any regulatory acceptance for the purpose of licensing.

Packaging and Storage

The substances and preparations described in the Pharmacopoeia are stored in such a way as to prevent contamination and, as far as possible, deterioration. Precautions that should be taken in relation to the effects of the atmosphere, moisture, heat, and light are indicated, where appropriate, in the monographs.

CONTAINERS

The container is the device that holds the substance, either in the form of the raw material or of the finished dosage form. The closure of the container, including the stopper, the cap, the attached dropper, etc., is considered as a part of the container.

The *immediate container* is the one which is in direct contact with the substance.

The container should be cleaned before use, and no extraneous matter should be introduced into it or into the substance placed in it. It must, likewise, not interact physically or chemically with the substance which it holds so as to alter the latter's quality, purity, or therapeutic potency to a level below its Pharmacopoeial requirements.

Well-closed container

A well-closed container must protect the contents from extraneous matter or from loss of the substance under ordinary or customary conditions of handling, shipment, storage, or sale.

Tightly closed container

A tightly closed container must protect the contents from contamination by extraneous matter or moisture, from loss of the substance, and from efflorescence, deliquescence, or evaporation under the ordinary or customary conditions of handling, shipment, storage, or sale, and shall be capable of tight reclosure. Where a tightly closed container is specified, it may be replaced by a hermetically closed container for a single-dose of the substance.

STORAGE

The following expressions are used in monographs under Packaging and storage with the meaning shown.

Protected from light means that the product is to be stored either in a light-resistant container or in a container enclosed in an outer cover that provides such protection or stored in a place from which all such light is excluded.

Protected from moisture means that the product is to be stored in a tightly closed container. Care is to be taken when the container is opened in a damp atmosphere. A low moisture content may be maintained, if necessary, by the use of a desiccant in the container provided that direct contact with the product is avoided.

STORAGE TEMPERATURES

When special conditions of storage are necessary, including limits of temperature, they are prescribed in the monograph. Where, in a monograph, the storage conditions are mentioned using the general expressions "at room temperature", "in a cold place", and the like, these terms are generally defined as follows.

Very cold temperature Any temperature above –10º but not higher than 8º. A *refrigerator* is a very cold place in which the temperature is maintained thermostatically between 2º and 8º.

Cool temperature Any temperature above 16º but not higher than 23º.

Room temperature Any temperature above 23º but not higher than 35º.

MONOGRAPHS

บอระเพ็ด (BORAPHET)

Tinosporae Crispae Caulis
Tinospora Crispa Stem

Category Antipyretic, bitter tonic, stomachic.

Tinospora Crispa Stem is the dried stem of *Tinospora crispa* (L.) Hook. f. & Thomson [*T. crispa* Diels, *T. rumphii* Boerl., *T. tuberculata* (Lam.) Beumée ex K. Heyne, *T. gibbericaulis* Hand. Mazz., *T. mastersii* Diels, *T. thorelii* Gagnep.] (Family Menispermaceae), Herbarium Specimen Number: DMSC 354, 355.

Constituents Tinospora Crispa Stem contains tinosporine, tinosporidine, picroretin, *N-trans*-feruloyl tyramine, *N-cis*-feruloyl tyramine, tinotuberide, borapetoside A, borapetol A, ceryl alcohol, *β*-sitosterol, stigmasterol, etc.

Description of the plant (Figs. 1a, 1b) Woody climber with tuberous roots; young stems smooth, older ones very prominently tuberculate with exceedingly bitter sap; aerial root filiform, very long. Leaves broadly ovate to orbicular, 5 to 14 cm long, 4 to 12 cm wide, apex acuminate, base cordate, palmately 5- to 7-nerved at the base; petiole 5 to 15 cm long. Inflorescence pseudoracemose, not coetaneous with the leaves. Male inflorescence very slender, a few in groups. Male flower small, on filiform pedicel; sepals pale green, 3 outer ones ovate, 3 inner ones obovate; petals 3; stamens 6. Female inflorescence similar to male one but shorter. Female flower with sepals and petals as in male; staminodes 6; carpels 3. Drupe orange, ellipsoid, up to 2 cm long.

Description Odour, indistinct; taste, intensely bitter.

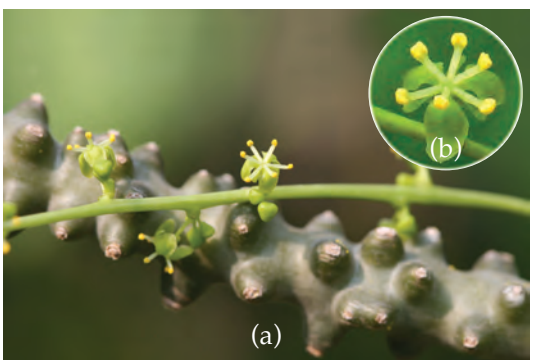
Macroscopical (Fig. 1a) Cylindrical, transverse or oblique pieces, 3 to 30 mm long, 3 to 18 mm in diameter; externally brown, longitudinally wrinkled and numerous warty lenticels; internally pale greyish yellow, exhibiting a bark from 1.5 to 2.5 mm in thickness, surface, radiate and a minute disintegrated pith.

Microscopical (Figs. 2a, 2b) Transverse and longitudinal sections of the stem show cork, several layers of rectangular brownish cells. Cortex, broad zone of parenchyma cells containing starch granules, groups of stone cells (sclereids) containing prismatic crystals, occur beneath cork layers; parenchyma cells containing prismatic crystals occur in the innermost part of cortex adjacent to bast fibres. Stele composed of phloem and xylem separated by cambium, occurring several bands from cortex to pith, with medullary ray between the bands. Phloem composed of thick-walled bast fibres and phloem tissue; cambium, several layers of rectangular cells; xylem composed of large size vessels, xylem fibres and xylem parenchyma containing prismatic crystals; annular, spiral, reticulate, pitted and bordered-pitted vessels, up to 160 μm in diameter; medullary rays, non-lignified parenchyma containing starch granules. Pith, parenchyma cells containing starch granules.

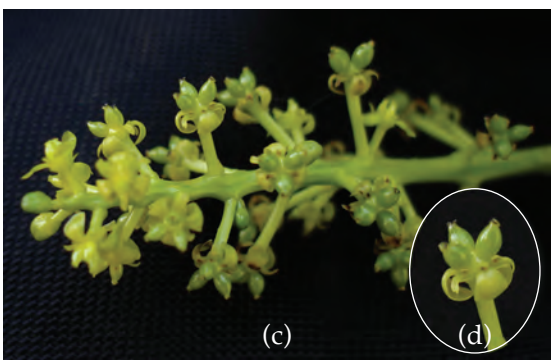
Tinospora Crispa Stem in powder possesses the diagnostic microscopical characters of the unground drug.

1

2



3



4

5

1 cm

Fig. 1a *Tinospora crispa* (L.) Hook. f. & Thomson
1. habit 2. stems and leaves 3. part of male inflorescences and part of stem (a), male flower (b) 4. female inflorescences (c), female flower (d) 5. crude drug

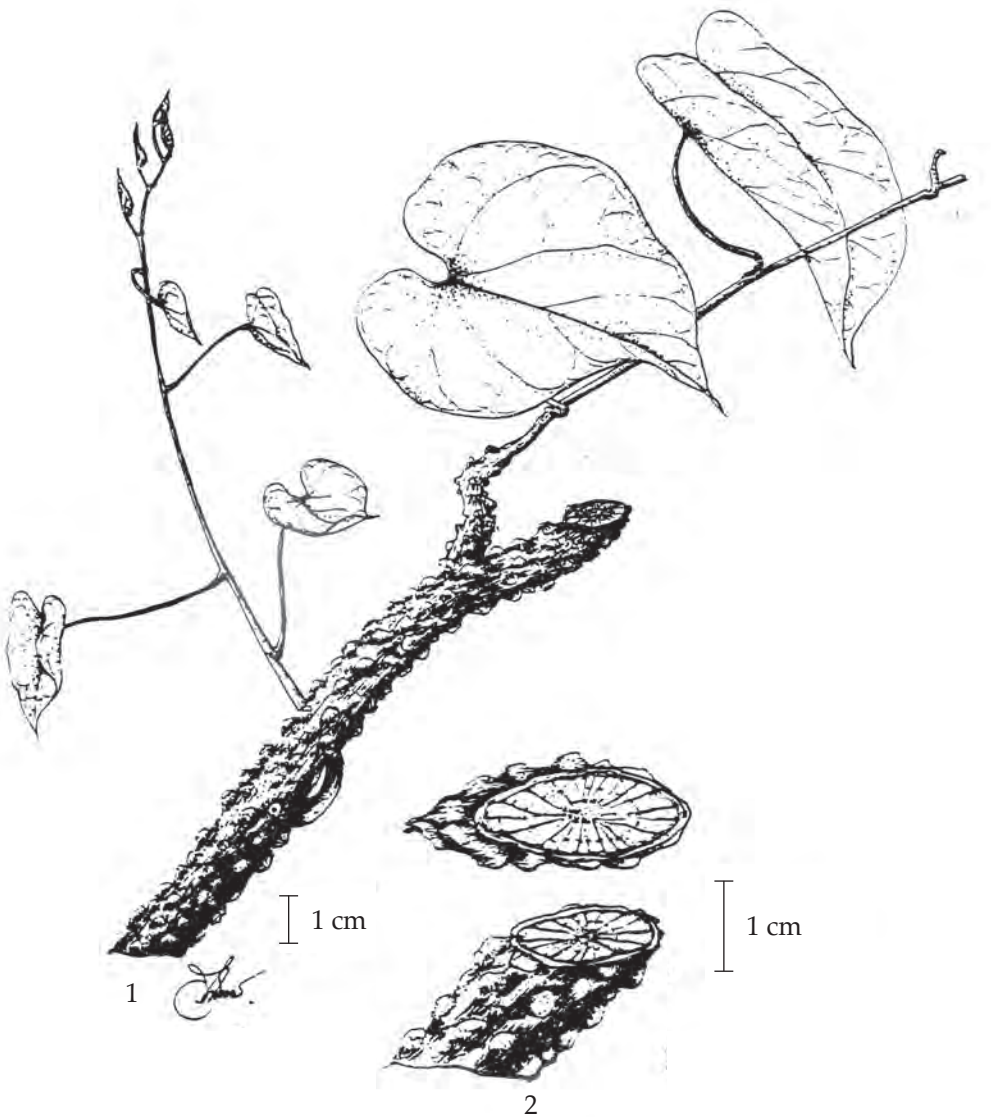


Fig. 1b *Tinospora crispa* (L.) Hook. f. & Thomson
1. branching stem 2. crude drug

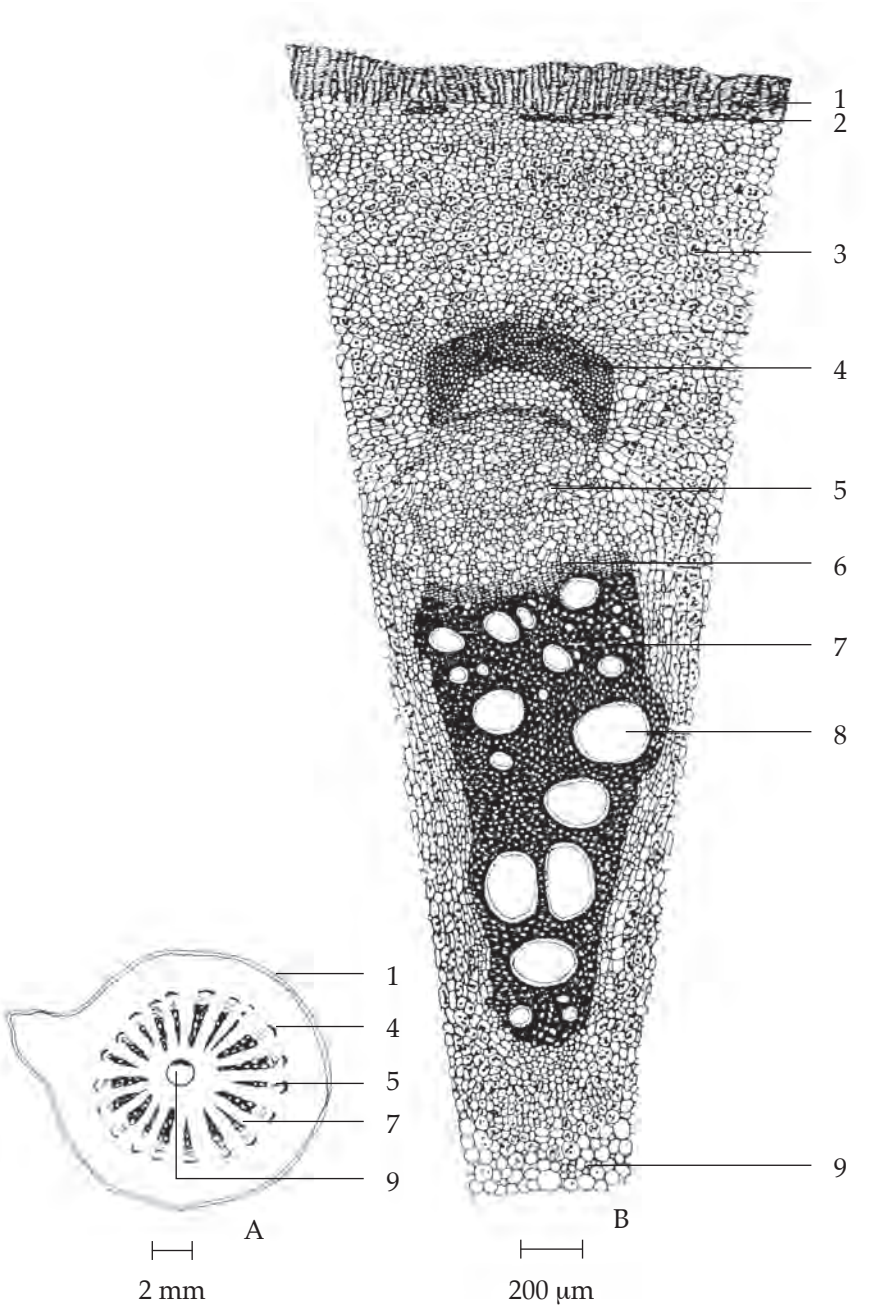


Fig. 2a Transverse Section of the Stem of *Tinospora crispa* (L.) Hook. f. & Thomson

A. Diagram

B. Part of Transverse Section

1. cork
2. sclereid
3. cortical parenchyma
4. fibre
5. phloem
6. cambium
7. xylem fibre
8. vessel
9. pith

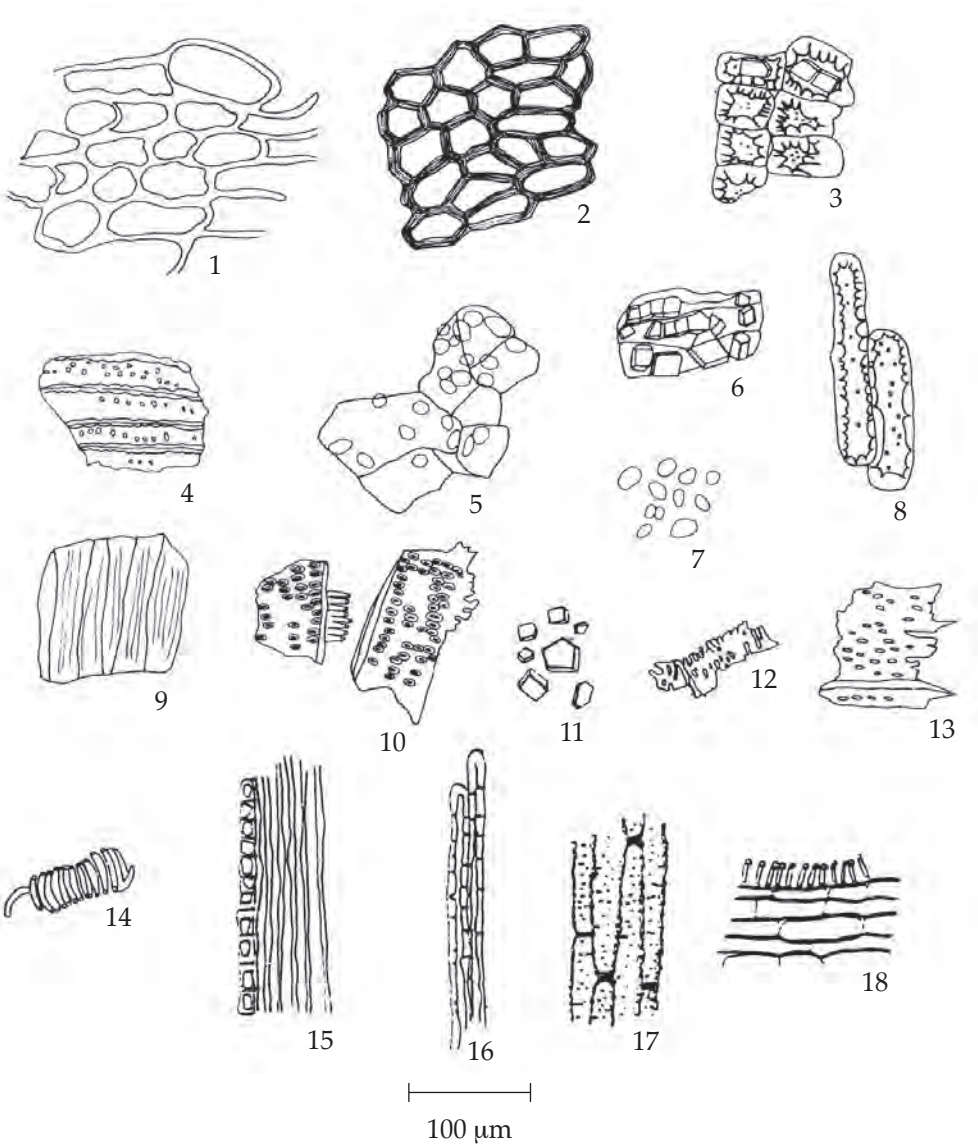


Fig. 2b Powdered Drug of the Stems of *Tinospora crispa* (L.) Hook. f. & Thomson

1. cortical parenchyma
2. cork in surface view
3. stone cells
4. xylem parenchyma
5. parenchyma cells with starch granules
6. parenchyma cells with prismatic crystals
7. starch granules
8. sclereids
9. phloem cells
10. bordered-pitted vessels
11. prismatic crystals
12. reticulate vessel
13. pitted vessel
14. spiral thickening
15. parenchyma cell containing calcium oxalate crystals adjacent to bast fibres
16. fragments of bast fibres with dentate wall
17. fragments of lignified parenchyma
18. fragments of annular vessel with parenchyma cells

Packaging and storage Tinospora Crispa Stem shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. To 500 mg of the sample, in powder, add 2 mL of *acetic anhydride*, warm on a water-bath for 2 minutes and filter. Slowly add 1 mL of *sulfuric acid* to the filtrate to form a layer: a brownish red ring forms at the zone of contact.

B. Shake vigorously 200 mg of the sample, in powder, with 10 mL of *water*: a long lasting foam is produced.

C. Add 10 mL of *methanol* to 1 g of the sample, in powder, warm on a water-bath for 10 minutes, shake intermittently, cool, and filter. To 1 mL of the filtrate, add a few drops of *acetic potassium iodobismuthate TS*: a brown precipitate forms.

D. **Test a** Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 75 volumes of *hexane*, 25 volumes of *ethyl acetate* and 1 volume of *glacial acetic acid* as the mobile phase and allowing the solvent front to ascend 12 cm above the line of application. Apply to the plate, 20 μL of the test solution prepared by warming 1 g of the sample, in powder, with 10 mL of *methanol* on a water-bath at 60° for 10 minutes, shaking, filtering, and evaporating to 2 mL. After removal of the plate, allow it to dry in air and examine under ultraviolet light (366 nm), marking the spots. Several spots of different colours are observed (Table 1); see also Fig. 3. Spray the plate with a 10 per cent w/v solution of *phosphomolybdic acid* in *ethanol*, and heat at 100° for 5 to 10 minutes. Several blue spots are observed (Table 1); see also Fig. 3.

Test b Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 75 volumes of *chloroform*, 20 volumes of *methanol* and 5 volumes of *strong ammonia solution* as the mobile phase and allowing the solvent front to ascend 12 cm above the line of application. Apply to the plate, 20 μL of the test solution prepared as described in *Test a*. After removal of the plate, allow it to dry in air and spray with *acetic potassium iodobismuthate TS*. Several spots of different colours are observed (Table 1); see also Fig. 3. Repeat the same procedure on another plate but spray with *iodoplatinate TS*. Several spots of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Stems of *Tinospora crispa* (L.) Hook. f. & Thomson

Spot	hR_f Value	Detection			
		Mobile Phase I		Mobile Phase II	
		UV 366	10 Per Cent W/V Solution of *Phosphomolybdic Acid* in *Ethanol*	*Acetic Potassium Iodobismuthate TS*	*Iodoplatinate TS*
1	1–3	light blue	dark blue	–	–
2	4–7	carmine red	–	–	–
3	9–12	moss green	–	–	–
4	12–17	light blue	–	–	–
5	14–16	–	–	orange	purple
6	20–24	light blue	–	–	–
7	25–29	carmine red	–	–	–
8	31–34	red	–	–	–
9	37–40	–	–	orange	purple
10	42–45	–	dark blue	–	–
11	45–50	red	–	–	–
12	49–51	–	–	orange	purple
13	51–55	carmine red	dark blue	–	–
14	55–58	–	dark blue	–	–
15	59–63	light blue	–	–	–
16	61–64	–	dark blue	–	–
17	86–90	–	dark blue	–	–
18	91–94	–	dark blue	–	–
19	92–96	–	–	–	orange
20	96–98	yellow	dark blue	moss green	moss green
21	98–99	–	–	yellow	yellow

Mobile phase I: 75 volumes of *hexane,* 25 volumes of *ethyl acetate* and 1 volume of *glacial acetic acid*

Mobile phase II: 75 volumes of *chloroform,* 20 volumes of *methanol* and 5 volumes of *strong ammonia solution*

Loss on drying Not more than 11.0 per cent w/w after drying 10 g at 105° for 5 hours (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 0.5 per cent w/w (Appendix 7.6).

Total ash Not more than 7.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 5.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 10.0 per cent w/w (Appendix 7.12).

Determination of bitterness Not less than 210 units per g when determined by the following method.

Standard preparation Transfer about 100 mg of *quinine hydrochloride*, accurately weighed, to a 100-mL volumetric flask, dissolve in safe drinking water, dilute to volume with the same solvent, and mix. Dilute this solution quantitatively with safe drinking water to obtain the solution containing 10 μg of *quinine hydrochloride* per mL. This solution is used as the stock solution of quinine hydrochloride (S_Q).

Prepare a serial dilution of S_Q in nine test-tubes according to the following table for the first series of testing.

No. of Tubes	1	2	3	4	5	6	7	8	9
mL of S_Q	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8
mL of *water*	5.8	5.6	5.4	5.2	5.0	4.8	4.6	4.4	4.2
μg of *quinine hydrochloride* in 10 mL of the solution (C)	42	44	46	48	50	52	54	56	58

Test preparation Transfer about 200 mg of the sample, in powder, accurately weighed, into a 100-mL conical flask, add 45 mL of safe drinking water, and reflux in a boiling water-bath for 1 hour with frequent shaking. Cool, filter and dilute the filtrate with safe drinking water to 50.0 mL. Pipette 1.0 mL of this solution into a 100-mL volumetric flask and dilute with safe drinking water to volume. This solution is used as the stock solution of the sample (S_T). Calculate its concentration and express it in μg per mL.

Prepare a serial dilution of S_T in 10 test-tubes according to the following table for the second series of testing.

No. of Tubes	1	2	3	4	5	6	7	8	9	10
mL of S_T (b)	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0
mL of *water*	9.0	8.0	7.0	6.0	5.0	4.0	3.0	2.0	1.0	–

Procedure After rinsing the mouth with safe drinking water, taste 10 mL of the dilution swirling it in the mouth mainly near the base of the tongue for 30 seconds. Unless otherwise specified, always begin with the lowest concentration of the serial dilution. If the bitter sensation is no longer felt, withdraw the solution and wait for 1 minute to ascertain that there is no delayed sensitivity. Then rinse with safe drinking water. The next highest concentration of dilution should not be tasted until at least 10 minutes have passed. The threshold bitter concentration is the lowest concentration of dilution at which a material still provokes a bitter sensation. After the first series of tests, rinse the mouth thoroughly with safe drinking water, until no bitter sensation remains and wait for at least 10 minutes before carrying out the second series of tes ts. In this series of tes ting and in order to save time, it is advisable to first ascertain whether the solution in tube no. 5 (containing 5 mL of S_T in 10 mL) gives a bitter sensation. If noted, find the threshold bitter concentration of the material by tasting the dilutions in tubes nos. 1 to 4. If the solution in tube no. 5 does not give a bitter sensation, find the threshold bitter concentration in the dilutions of tubes nos. 6 to 10. All solutions and safe drinking water for mouthwashing should be at 20° to 25°.

Calculation

$$\text{Bitterness} = \frac{2000 \times C}{a \times b} \quad \text{units/g},$$

where a = µg of sample contained in 1 mL of S_T,

b = mL of S_T contained in 10 mL of the solution of threshold bitter concentration, and

C = µg of *quinine hydrochloride* contained in 10 mL of the solution of threshold bitter concentration.

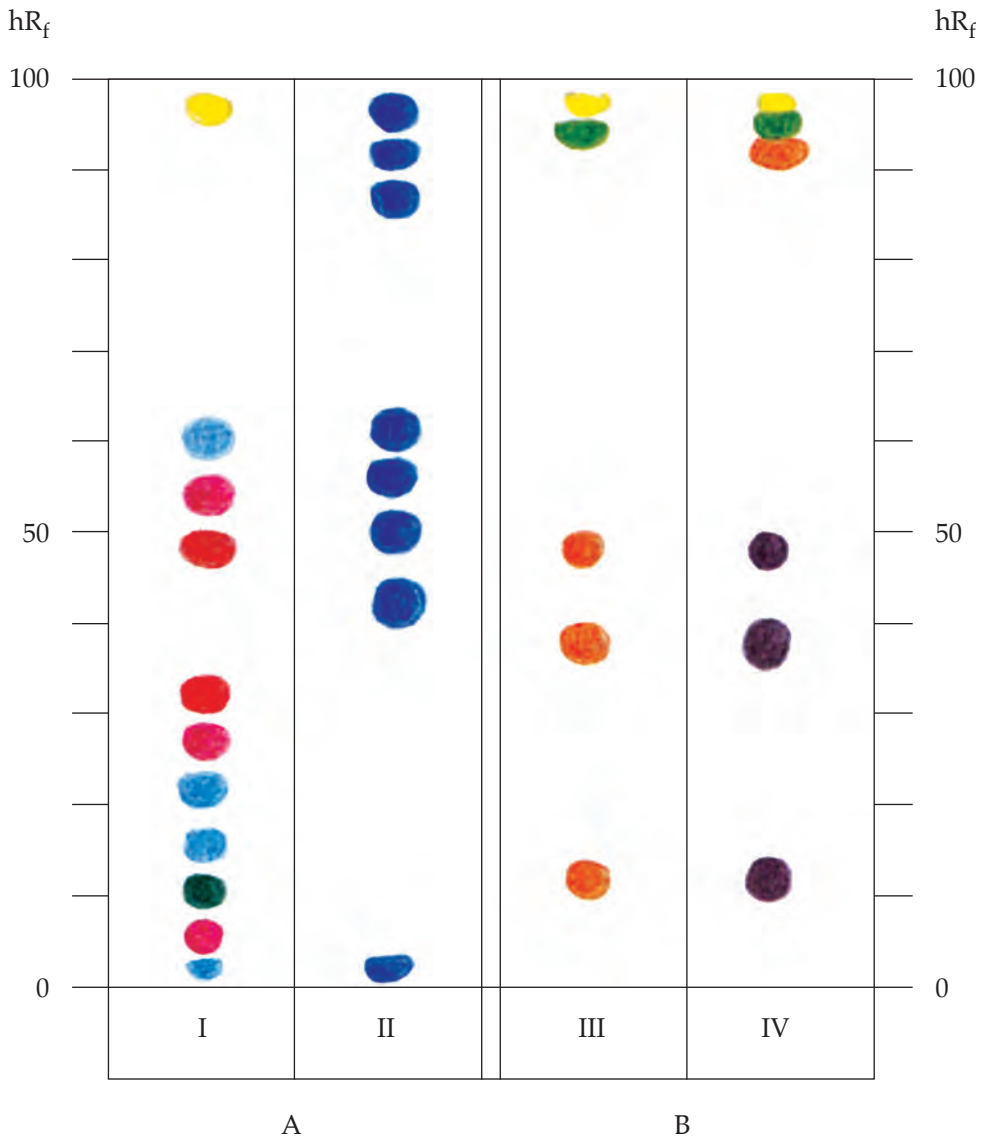


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Stems of *Tinospora crispa* (L.) Hook. f. & Thomson

A = use 75 volumes of *hexane*, 25 volumes of *ethyl acetate* and 1 volume of *glacial acetic acid* as the mobile phase.
B = use 75 volumes of *chloroform*, 20 volumes of *methanol* and 5 volumes of *strong ammonia solution* as the mobile phase.
I = detection under UV light (366 nm)
II = detection with a 10 per cent w/v solution of *phosphomolybdic acid* in *ethanol*
III = detection with *acetic potassium iodobismuthate TS*
IV = detection with *iodoplatinate TS*

บัวหลวง, เกสร (BUA LUANG, KESON)

บัว, เกสร (BUA, KESON)
Nelumbinis Stamen
Sacred Lotus Stamen

Synonyms Indian Lotus Stamen, Lotus Stamen

Category Cardiotonic, antipyretic.

Sacred Lotus Stamen is the dried stamen of *Nelumbo nucifera* Gaertn. (*Nelumbium speciosum* Willd.) (Family Nelumbonaceae), Herbarium Specimen Number: DMSC 5156, Crude Drug Number: DMSc 0891, 0892.

Constituents Sacred Lotus Stamen contains flavonoids and carotenoids as its major components. It also contains arbutin, *β*-sitosterol glucopyranoside, etc.

Description of the plant (Figs. 1a, 1b) Perennial aquatic herb with milky latex and stout creeping rhizomes. Leaves simple, alternate, arising above the water surface, circular, 10 to 100 cm in diameter, margin entire or slightly undulate, papery, greyish green below, green on the upper, peltate, veins radiate from its centre in all directions, become forked near the margin; petiole terete, stout, up to 1 m or more long, about 1 cm in diameter, smooth or prickly. Flower solitary, large and showy, on thick peduncle rising several centimetres above the leaves; flower bud ovate, acute, 5 to 8 cm long, flower hemispheric as anthesis, 8 to 25 cm in diameter; perianth with 4 or 5 outermost sepals, elliptic to ovate, 1.5 to 5 cm long, 0.8 to 3.5 cm wide, free, green or pinkish green, to white or pink with age, petal-like, incurved; petals 5 to numerous, elliptic, 4 to 15 cm long, 2 to 8 cm wide, obtuse, incurved, white to dark pink or reddish; stamens numerous, 2.2 to 4.5 cm long, anther linear, 1.5 to 2 cm long, up to 2 mm wide, golden yellow, with white clavate connective appendage up to 7 mm long at the apex, incurved; ovary apocarpous, 12 to 30 free carpels; receptacle expanded to cone-shape, flat upper surface, 3 to 5 cm long, about 2.5 cm wide with individual carpels sunken into it; style short. Fruit indehiscent nutlets, embedded in an accrescent spongy conical receptacle, 9 to 13 cm long, 4 to 7 cm wide; nutlet ovoid, 1.5 to 2 cm long; pericarp thick, hard, brownish or greyish black when dry, endocarp thin, whitish pulp. Seed 1.

Description Odour, slightly aromatic; taste, astringent.

Macroscopical (Fig. 1a) Sacred Lotus Stamen consists of anther, anther connective appendage and filament. Anther linear, twisted, longitudinally split, 1.2 to 1.5 cm long, about 1 mm in diameter, pale yellow to brownish yellow. Filament slender, slightly-curved, 1.5 to 1.8 cm long, pale yellow to brownish.

Microscopical (Figs. 2a, 2b) Transverse section of the filament shows an epidermal layer with papillae, secretory substances in a parenchyma layer adjacent to the epidermal layer, loose parenchyma cells, some of which contain secretory substances, air spaces, and a vascular bundle at the centre.

Transverse section of the anther reveals an epidermal layer with papillae, a fibrous layer, pollen grains in 4 pollen sacs. The contact region between filament and the 4 pollen sacs shows an epidermal layer, parenchyma cells, some of which contain secretory substances and a vascular bundle at the centre.

Fig. 1a *Nelumbo nucifera* Gaertn.
1. habit (Buntharik, บุณฑริก) 2. flower (Buntharik, บุณฑริก) 3. habit (Pathum, ปทุม)
4. flower (Pathum, ปทุม) 5. stamens and receptacle 6. crude drug

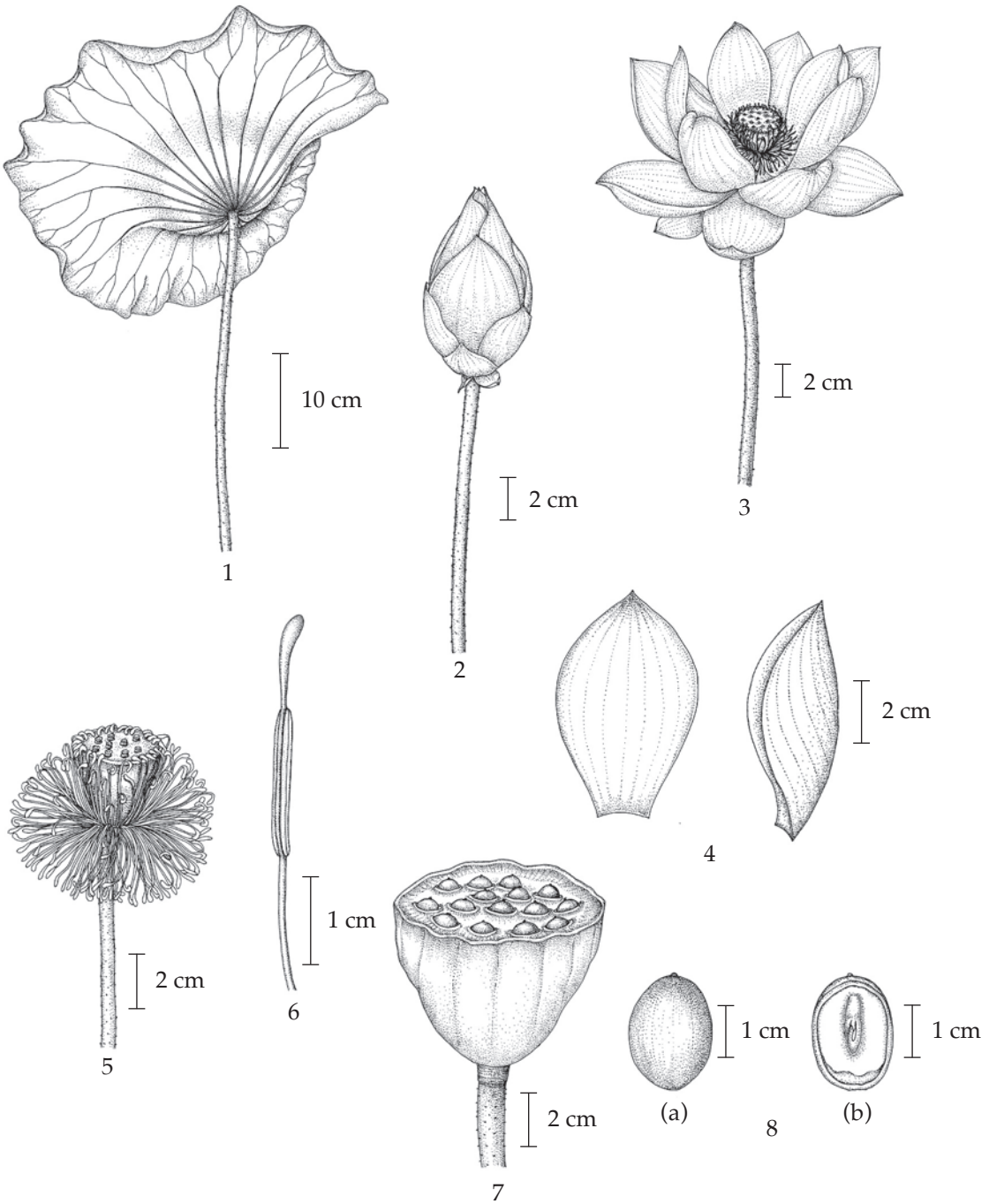


Fig. 1b *Nelumbo nucifera* Gaertn.
1. leaf 2. flower bud 3. flower 4. petal, in front and side views
5. central part of flower showing stamens and receptacle
6. stamen showing connective appendage, anther and part of filament
7. infructescence 8. nutlet (a), longitudinal section of nutlet showing embryo (b)

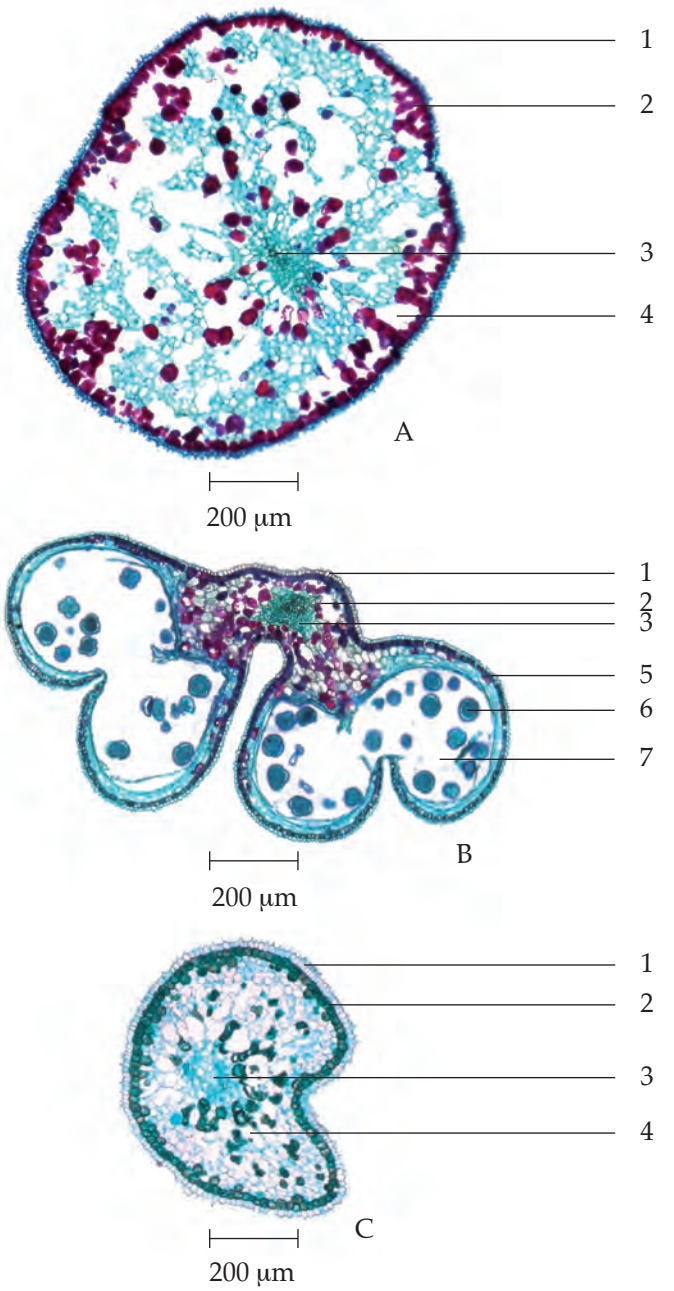


Fig. 2a Photomicrographs of Transverse Sections of the Stamen of *Nelumbo nucifera* Gaertn., Stained with Safranin-Fast Green

A. Appendage
B. Anther
C. Filament

1. epidermal layer with papillae
2. parenchyma cell with secretory substances
3. vascular bundle
4. air space
5. fibrous layer of pollen sac
6. pollen grain
7. pollen sac

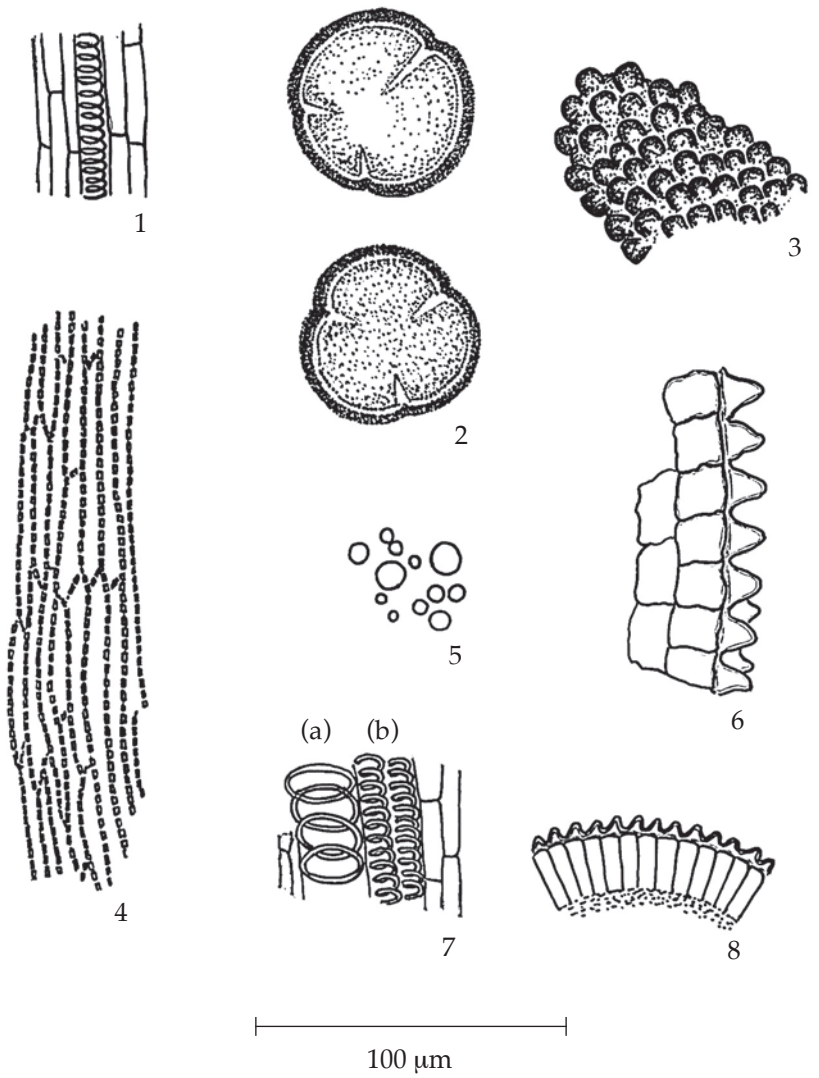


Fig. 2b Powdered Drug of the Stamens of *Nelumbo nucifera* Gaertn.

1. fragment of a filament in longitudinal view
2. pollen grains
3. papillae of epidermal layer in surface view
4. fibrous layer of pollen sac in surface view
5. oil globules
6. filament showing papillae of epidermal cells, and parenchyma cells in sectional view
7. annular vessel (a) and spiral vessels (b) in vascular bundle
8. fragment of pollen sac containing epidermal layer with papillae in sectional view

Transverse section through appendage of the stamen illustrates an epidermal layer with papillae, secretory substances in a parenchyma layer adjacent to the epidermal layer, loose parenchyma cells, some of which contain secretory substances, air spaces, and a vascular bundle at the centre.

Sacred Lotus Stamen in powder possesses the diagnostic microscopical characters of the unground drug.

Additional information

1. Sacred lotus cultivated in Thailand is classified into four types based on the form of the flower bud and the colour of the flower: Pathum (ปทุม), Buntharik (บุณฑริก), Sattabongkot (สัตตบงกช), and Sattabut (สัตตบุษย์). Only stamens of the first two types are used in Thai traditional medicine.
2. It is commonly used with other herbal drugs in Thai traditional herbal preparations.

Packaging and storage Sacred Lotus Stamen shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Sonicate 2.5 g of the sample, in *fine powder,* with 10 mL of *methanol* for 45 minutes, centrifuge and use a clear supernatant (solution 1). To 1 mL of solution 1, add 2 or 3 pieces of *magnesium ribbon*, shake well and mix with 4 drops of *hydrochloric acid*: a pink colour develops.

B. To 1 mL of solution 1, add 10 mg of *zinc powder* and 4 drops of *hydrochloric acid* and shake well: a reddish orange colour develops.

C. To 1 mL of solution 1, add 4 drops of *sulfuric acid* and shake well: a brown colour develops.

D. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 60 volumes of *ethyl acetate* and 40 volumes of *toluene* as the mobile phase. Apply to the plate as a band of 5 mm, 15 µL of the test solution prepared by sonicating 100 mg of the sample, in *fine powder*, with 10 mL of *methanol* for 15 minutes, filtering, and evaporating the filtrate to dryness. Dissolve the residue in 1.5 mL of *methanol*. After removal of the plate, allow it to dry in air and examine the plate under ultraviolet light (366 nm); two blue bands are observed. Spray the plate with *vanillin-sulfuric acid TS1* and heat at 120° for 5 minutes; several violet bands appear (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Stamens of *Nelumbo nucifera* Gaertn.

Band	hR_f Value	Detection	
		UV 366	*Vanillin-Sulfuric Acid TS1*
1	52–53	–	pale violet
2	61–62	–	pale violet
3	69–70	blue	violet
4	77–79	–	pale violet
5	84–85	light blue	violet

Loss on drying Not more than 12.0 per cent w/w after drying at 105° for 3 hours (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 1.0 per cent w/w (Appendix 7.6).

Total ash Not more than 6.0 per cent w/w (Appendix 7.7).

Water-soluble extractive Not less than 10.5 per cent w/w (Appendix 7.12).

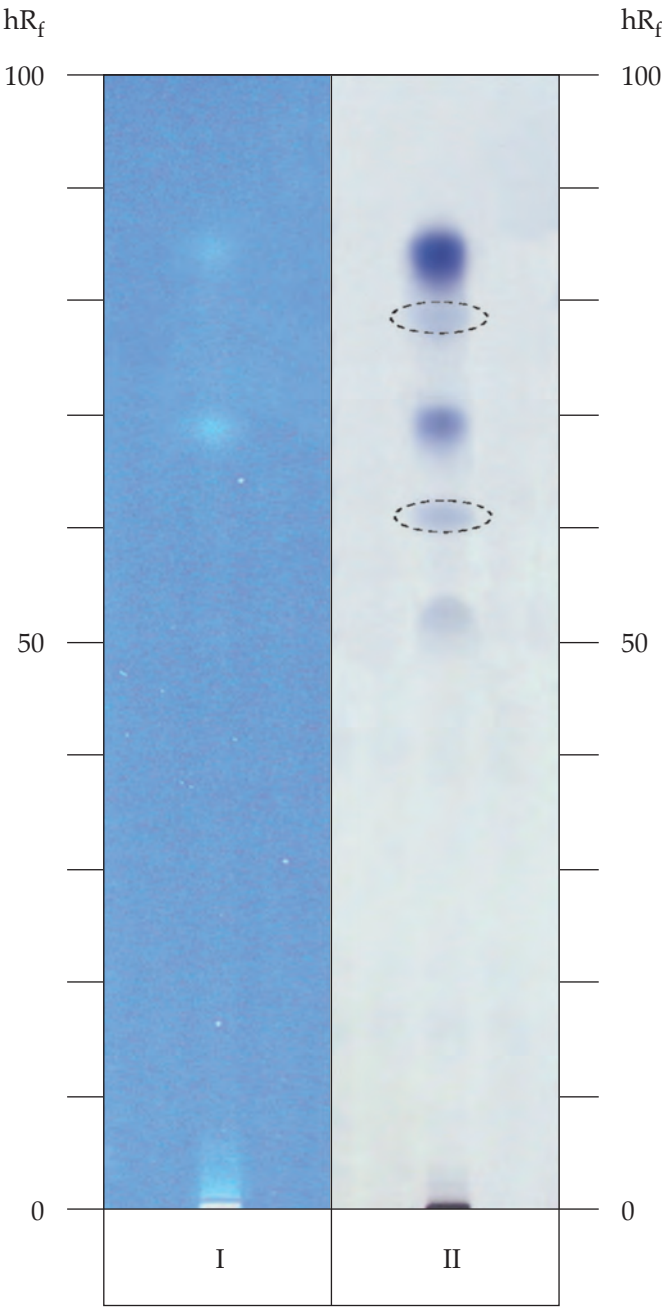


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Stamens of *Nelumbo nucifera* Gaertn.
I = detection under UV light (366 nm)
II = detection with *vanillin-sulfuric acid TS1*
⬭ = bands developed in some samples

บัวบก (BUABOK)

ผักหนอก (PHAK NOK)
Centellae Asiaticae Herba
Centella

Synonyms Asiatic Pennywort, Gotu Kola, Indian Pennywort, Indian Water Navelwort

Category Mild diuretic, anti-inflammatory, wound healing (topical).

Centella is the dried aerial part of *Centella asiatica* (L.) Urb. (*C. coriacea* Nannf., *Hydrocotyle asiatica* L., *H. lunata* Lam., *Trisanthus cochinchinensis* Lour.) (Family Umbelliferae), Herbarium Specimen Number: DMSC 1461, Crude Drug Number: DMSc 1261.

Constituents Centella contains triterpenoid saponins, including asiaticoside and madecassoside and their aglycones which are asiatic acid and madecassic acid, respectively. It also contains volatile oil, pectin, trace of alkaloids, etc.

Description of the plant (Figs. 1a, 1b) Slender trailing herb, rooting at nodes. Leaves simple, 1 to 6 in rosette at each node, orbicular to reniform, more or less cupped, glabrous and shiny above, paler beneath, 1 to 7 cm in diameter, apex rounded, base cordate, margin entire, crenate, or usually repand-dentate; petiole (1–)4 to 10(–50) cm long. Inflorescence in single umbel, bearing solitary or 2 to 5 together in the axils; peduncle shorter than petiole. Flowers usually 3, middle one sessile, lateral ones pedicellate; involucres 2, ovate; petals 5, minute, white or rose-tinged; ovary laterally flattened, style filiform. Fruit small, compressed, about 8 mm long, orbicular to ellipsoid, manifestly ribbed, slightly hairy when young.

Description Odour, characteristic; taste, slightly bitter-sweet.

Macroscopical (Fig. 1a) Aerial part, greenish brown, rough and brittle; stem thin, long, twisted; leaves rennate or cordate, brittle; petiole long.

Microscopical (Figs. 2a, 2b, 2c, 2d) Transverse section of the fresh leaf shows upper epidermis, a layer of rectangular cells, polygonal and straight-walled in surface view; stomata, anisocytic, some paracytic and rarely anomocytic. Palisade cells, a layer of large columnar cells. Spongy cells, parenchymatous, some containing calcium oxalate crystals in the forms of rosette aggregate or prism. Collenchyma, occurring beneath upper and lower epidermises in the midrib. Vascular bundles, xylem in the upper part and phloem in the lower part; vessels, annular, spiral, scalariform, or reticulate. Lower epidermis, a layer of rectangular cells, slightly wavy-walled in surface view; stomata, anisocytic, paracytic or anomocytic. Oil ducts, occurring beneath collenchyma in the middle of midrib.

Transverse sections of the fresh petiole and stolon show epidermal layer with cuticle. Collenchyma, present. Parenchyma containing chloroplastids, oil droplets, spreading circularly beneath collenchyma. Vascular bundles, collateral. The centre of petiole, hollow. Unicellular trichomes may also be found, but rare, in the section near the base of petiole.

Centella in powder possesses the diagnostic microscopical characters of the unground drug.

1

2

3

4

1 cm

5

Fig. 1a *Centella asiatica* (L.) Urb.
1. habit 2. leaves 3. flowers and fruits 4. inflorescence 5. leaves, flowers and fruits

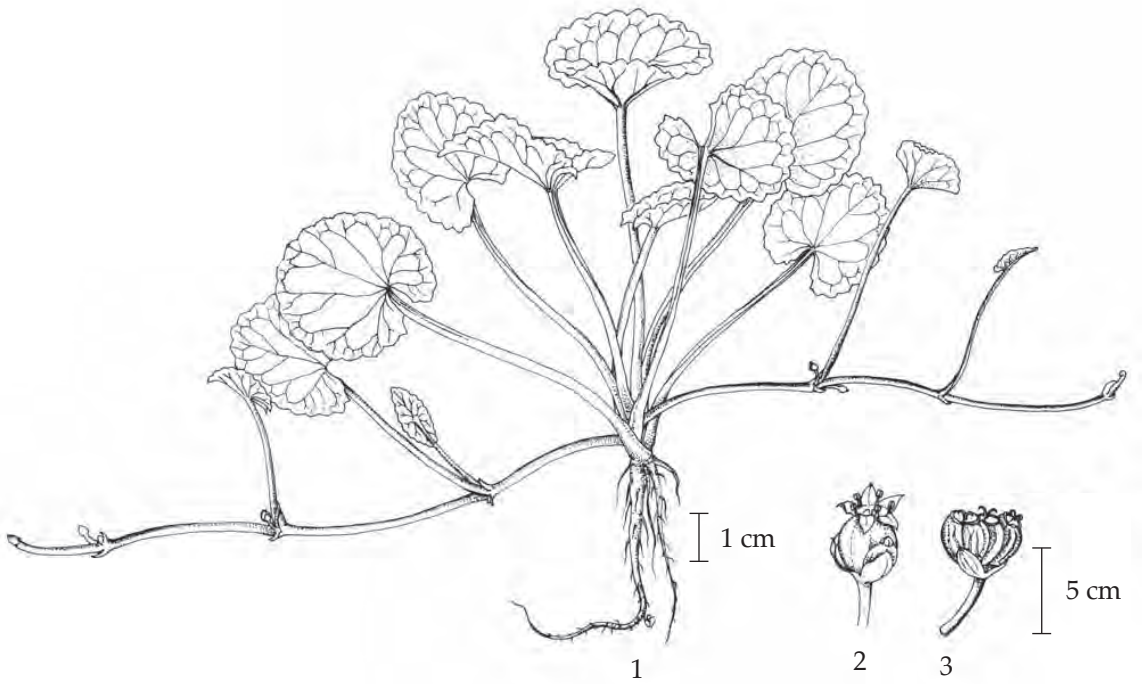
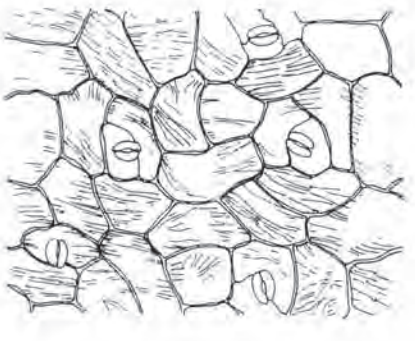
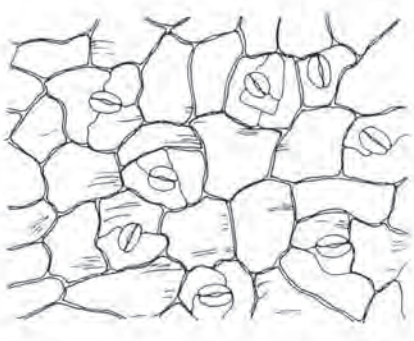


Fig. 1b *Centella asiatica* (L.) Urb.
1. habit 2. inflorescence 3. fruits

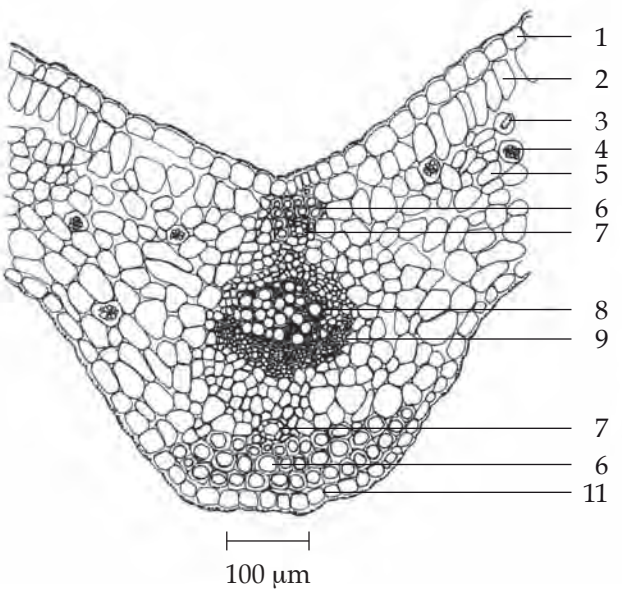


Upper Epidermis of the Lamina

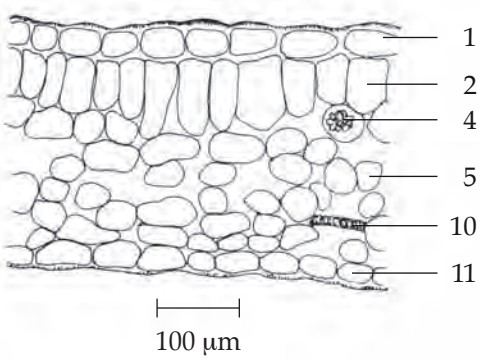


Lower Epidermis of the Lamina

Fig. 2a Epidermises of the Fresh Leaf of *Centella asiatica* (L.) Urb.



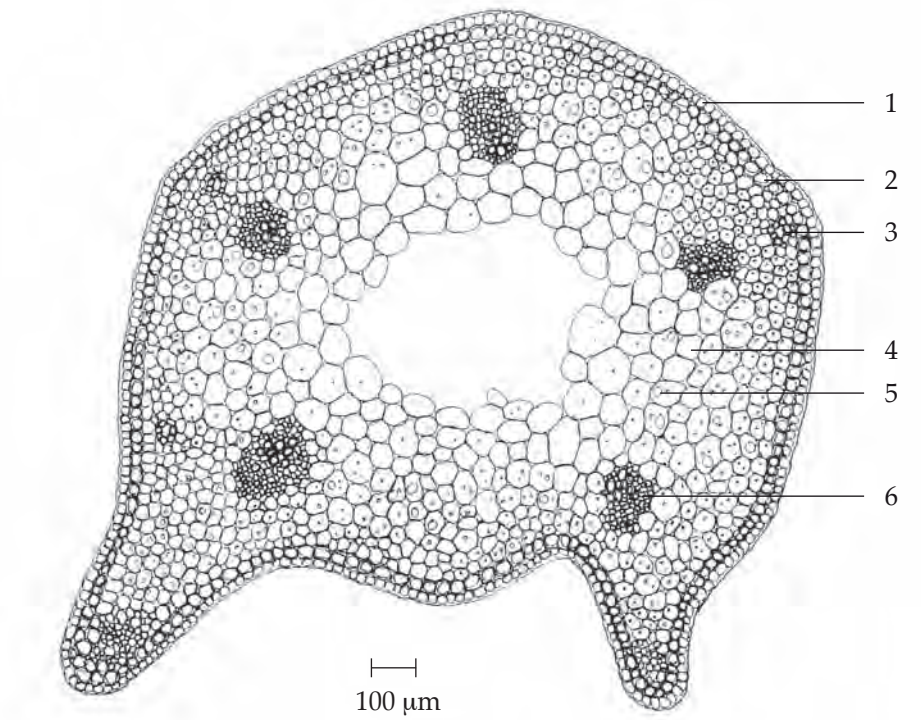
Transverse Section of the Midrib



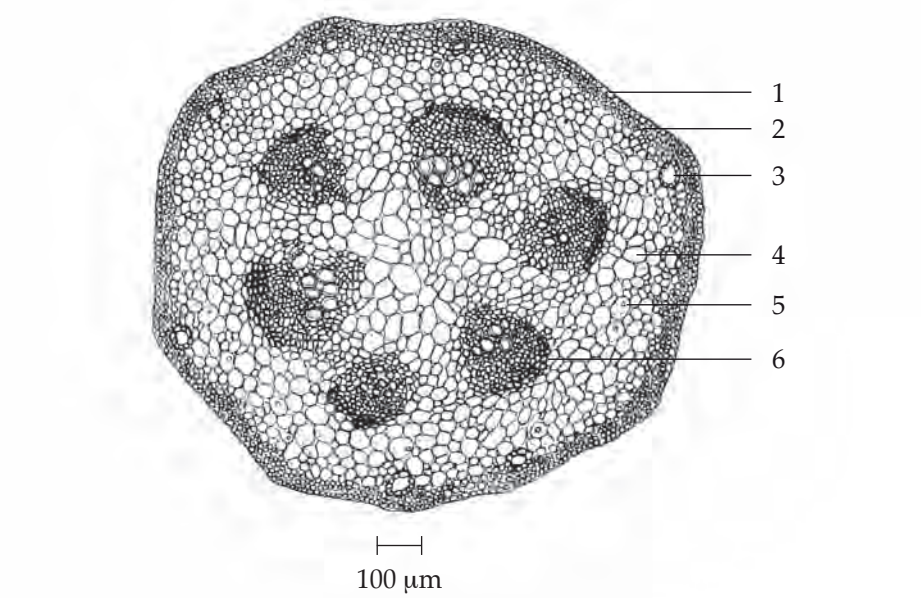
Transverse Section of the Lamina

Fig. 2b Transverse Sections of the Fresh Leaf of *Centella asiatica* (L.) Urb.

1. upper epidermis
2. palisade cell
3. prismatic crystal
4. rosette aggregate crystal
5. spongy cell
6. collenchyma
7. oil duct
8. xylem
9. phloem
10. vessel
11. lower epidermis



Transverse Section of the Petiole



Transverse Section of the Stolon

Fig. 2c Transverse Sections of the Fresh Petiole and Stolon of *Centella asiatica* (L.) Urb.

1. epidermis
2. collenchyma
3. oil duct
4. parenchyma
5. oil droplet
6. vascular bundle

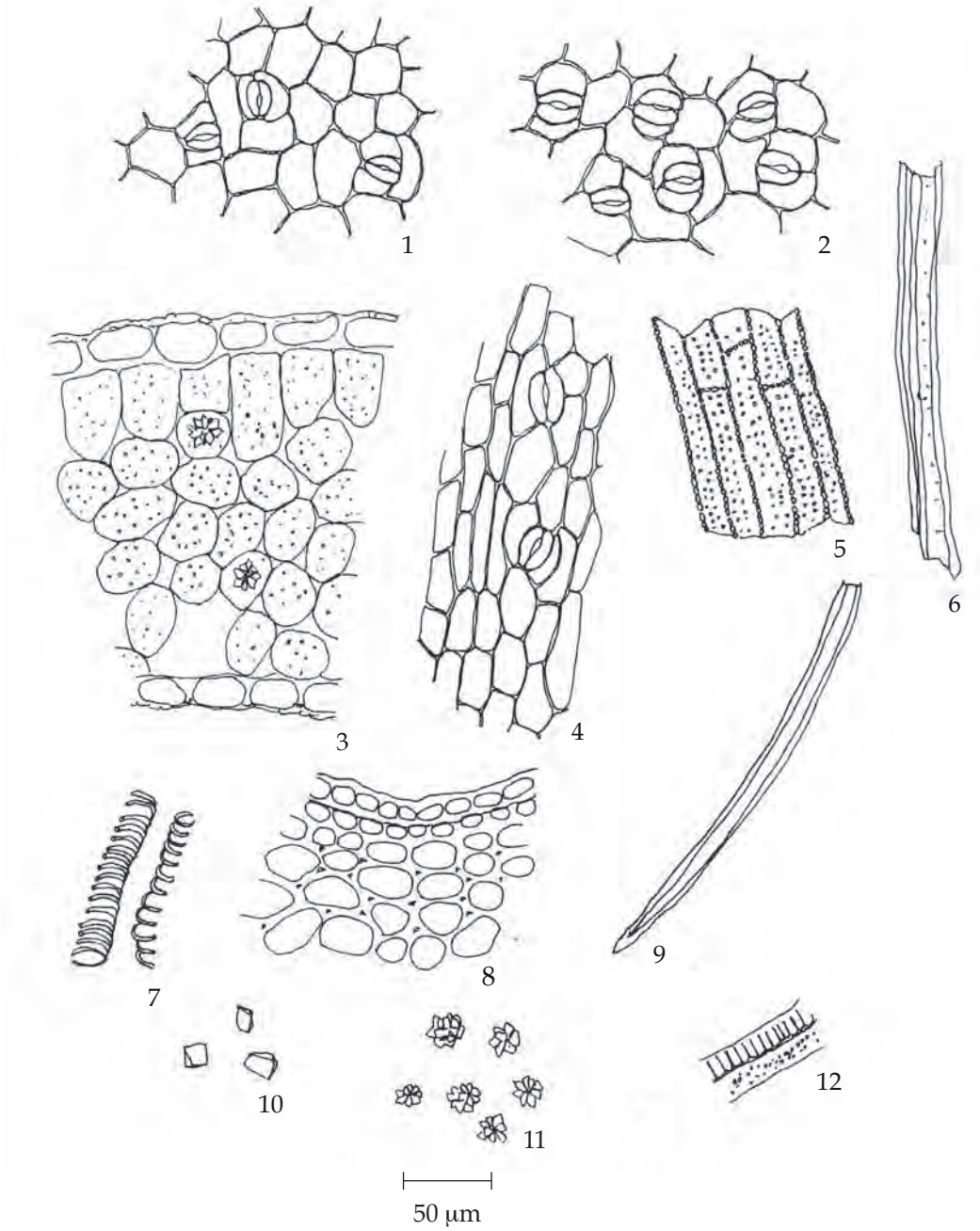


Fig. 2d Powdered Drug of the Aerial Parts of *Centella asiatica* (L.) Urb.

1. upper epidermis
2. lower epidermis
3. lamina in sectional view
4. epidermis with stomata from petiole
5. pitted vessels
6. fibres
7. spiral vessels
8. epidermis and collenchyma in sectional view
9. unicellular trichome
10. prismatic crystals
11. rosette aggregate crystals
12. scalariform and pitted vessels

Warning Excessive oral administration should be avoided during pregnancy and lactation.

Packaging and storage Centella shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Warm 500 mg of the sample, in powder, with 5 mL of *ethanol* for 5 minutes and filter (solution 1). To 2 mL of solution 1, add a few drops of *sulfuric acid*: a green colour develops.

B. Evaporate 2 mL of solution 1 to dryness and dissolve the residue in 2 mL of *acetic anhydride*. Add slowly 1 mL of *sulfuric acid* to form two layers: a green colour develops in the upper layer and a brownish red ring forms at the zone of contact.

C. Shake vigorously 500 mg of the sample, in powder, with 10 mL of *water*: a long lasting foam is produced.

D. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 15 volumes of *chloroform*, 7 volumes of *methanol* and 1 volume of *water* as the mobile phase. Apply separately to the plate, 5 µL each of the following solutions. Prepare solution (A) by refluxing 1 g of the sample, in powder, with 20 mL of *ethanol* for 10 minutes and filtering. Evaporate the filtrate under reduced pressure at 40° until dryness, and dissolve the residue in 4 mL of *ethanol*. For solution (B), dissolve 1 mg of *asiaticoside* in 2 mL of *ethanol*. For solution (C), dissolve 1 mg of *asiatic acid* in 2 mL of *ethanol*. After removal of the plate, allow it to dry in air. Spray the plate with *anisaldehyde TS* and heat at 105° for 5 minutes. The chromatogram obtained from solution (A) shows a purple spot (hR_f value 27 to 28) and a violet spot (hR_f value 72 to 74) corresponding to the asiaticoside and the asiatic acid spots from solutions (B) and (C), respectively. Several other spots of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Ethanolic Extract of the Aerial Parts of *Centella asiatica* (L.) Urb.

Spot	hR_f Value	Detection
		Anisaldehyde TS
1	2	green
2	5	green
3	8	green
4	16	green
5*	27–28	purple
6	33–34	violet
7	43	violet
8	63–64	violet
9	67	green
10**	72–74	violet
11	79–80	brown-violet
12	84	brown-green
13	87–88	violet-green
14	91–92	green

*asiaticoside
**asiatic acid

Loss on drying Not more than 14.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 7.0 per cent w/w (Appendix 7.6).

Total ash Not more than 17.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 15.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 24.0 per cent w/w (Appendix 7.12).

Dose 0.6 g three times a day.

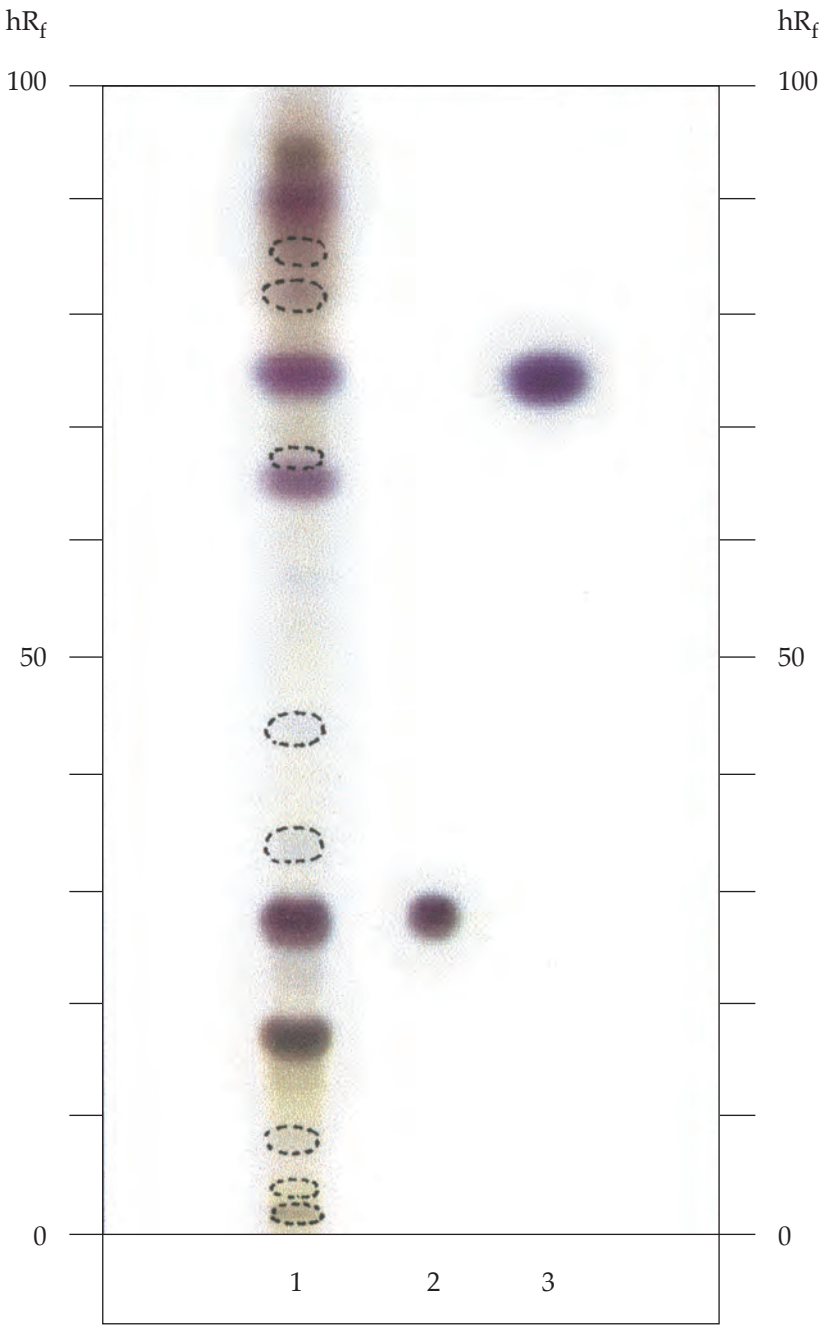


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Aerial Parts of *Centella asiatica* (L.) Urb., Detected with *Anisaldehyde TS*

1 = solution (A)
2 = solution (B)
3 = solution (C)
◌ = spots developed in some samples

สารสกัดแห้งบัวบก (BUABOK DRY EXTRACT)

Centella Dry Extract

Category Anti-inflammatory, wound healing (topical).

Centella Dry Extract is prepared from the powdered Centella by extraction with *ethanol*. It contains not less than 90.0 per cent and not more than 110.0 per cent of the labelled amounts of asiaticoside ($C_{48}H_{78}O_{19}$) and madecassoside ($C_{48}H_{78}O_{20}$); the labelled amounts of asiaticoside and madecassoside are not less than 3.0 per cent and 4.0 per cent, respectively, calculated on the dried basis.

Description Pale greenish yellow to brownish yellow powder, slightly hygroscopic.

Packaging and storage Centella Dry Extract shall be kept in tightly closed containers, protected from light, and stored in a cool and dry place.

Labelling The label on the container states (1) the amounts of asiaticoside and madecassoside; (2) the expiration date.

Identification

A. The chromatogram of the Assay preparation shows several peaks, two of which correspond to those of the Standard preparation, as obtained in the *Assay*.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 15 volumes of *chloroform*, 7 volumes of *methanol* and 1 volume of *water* as the mobile phase and allowing the solvent front to ascend 8 cm above the line of application. Apply separately to the plate as bands of 8 mm, 15 μL each of the following three solutions. For solution (A), dissolve 50 mg of the sample in 4 mL of *methanol*. Solution (B) contains 0.1 mg per mL of *asiaticoside* in *methanol* and solution (C) contains 0.1 mg per mL of *madecassoside* in *methanol*. After removal of the plate, allow it to dry in air. Spray the plate with *anisaldehyde TS* and heat at 105° for 5 minutes. The chromatogram obtained from solution (A) shows a greenish blue band and a violet band, corresponding to the asiaticoside and the madecassoside bands from solutions (B) and (C), respectively. Several other bands of different colours are observed.

Loss on drying Not more than 10.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Assay Carry out the determination as described in the "Liquid Chromatography" (Appendix 3.5).

Mobile phase A Use *acetonitrile*, containing 6.0 per cent v/v of *methyl* tert-*butyl ether* and 0.01 per cent v/v of *trifluoroacetic acid*. Make adjustments if necessary.

Mobile phase B Prepare a 0.01 per cent v/v solution of *trifluoroacetic acid*. Make adjustments if necessary.

Standard preparation Dissolve an accurately weighed quantity of *asiaticoside* and *madecassoside* in *methanol* to obtain a solution having known concentrations of about 100 μg of asiaticoside and 100 μg of madecassoside per mL.

Assay preparation Transfer an accurately weighed quantity of Centella Dry Extract, containing about 5 mg of asiaticoside, to a 50-mL volumetric flask. Dissolve and dilute with *methanol* to volume and mix. Centrifuge, if necessary. Pass a portion of the clear solution through a filter having a 0.45 μm or finer porosity.

Chromatographic system The chromatographic procedure may be carried out using (a) a stainless steel column (15 cm × 4.6 mm) packed with octadecylsilane chemically bonded to porous silica or ceramic microparticles (4 μm), polar end-capped (Synergi Hydro RP C_{18} or equivalent is suitable.), equipped with a similarly packed guard column, maintained at a temperature of 30°, (b) *Mobile phase* at a flow rate of 1.0 mL per minute (the retention time is about 60 minutes for the main asiaticoside peak.), and (c) an ultraviolet photometer set at 210 nm. The step gradient of mobile phases is as follows:

Time (Minutes)	*Mobile Phase A* (Per Cent V/V)	*Mobile Phase B* (Per Cent V/V)
0	17	83
10	17	83
45	19	81
70	19	81

To determine the suitability of the chromatographic system, chromatograph *Standard preparation*, and record the peak response as directed under *Procedure*: the relative standard deviation for replicate injections is not more than 2.0 per cent, the column efficiency determined from the asiaticoside peak is not less than 2000 theoretical plates, the symmetry factors for the madecassoside peak and for the asiaticoside peak are not more than 1.5, the relative retention times are about 0.6 for madecassoside and 1.0 for asiaticoside, and the resolution factors, *R*, between the madecassoside and its adjacent peaks and between the asiaticoside and its adjacent peaks are not less than 1.5.

Procedure Separately inject equal volumes (about 20 μL) of *Standard preparation* and *Assay preparation* into the chromatograph, record the chromatograms, and measure the responses for the madecassoside and asiaticoside peaks.

Calculation Calculate the contents of $C_{48}H_{78}O_{19}$ and $C_{48}H_{78}O_{20}$ in the portion of the Extract taken, using the declared contents of $C_{48}H_{78}O_{19}$ and $C_{48}H_{78}O_{20}$ in *asiaticoside* and *madecassoside*, respectively.

Other requirements Complies with the requirements described under “Extracts” (Appendix 1.16H).

ยาครีมบัวบก (BUABOK CREAM)

Centella Cream

Category Wound healing (topical).

Centella Cream is Centella Dry Extract in a suitable hydrophilic cream base. It contains not less than 90.0 per cent and not more than 110.0 per cent of the labelled amounts of asiaticoside ($C_{48}H_{78}O_{19}$) and madecassoside ($C_{48}H_{78}O_{20}$).

Strength available 7 per cent w/w of centella dry extract (about 0.2 per cent w/w of asiaticoside).

Dose *Topical*, to the wound, one to three times a day.

Contra-indication It is contra-indicated in patients hypersensitive to herbal drugs belonging to Family Umbelliferae.

Warning

1. Contact with eyes should be avoided.
2. It may cause allergic contact dermatitis.

Precaution Treatment with Centella Cream should be discontinued if there is no response after two weeks.

Packaging and storage Centella Cream shall be kept in collapsible tubes or in tightly closed containers, protected from light, and stored at a temperature not exceeding 30°.

Labelling The label on the container states (1) the amounts of asiaticoside and madecassoside; (2) the expiration date.

Identification

A. The chromatogram of the Assay preparation shows several peaks, two of which correspond to those of the Standard preparation as obtained in the *Assay*.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 15 volumes of *chloroform*, 7 volumes of *methanol* and 1 volume of *water* as the mobile phase and allowing the solvent front to ascend 8 cm above the line of application. Apply separately to the plate as bands of 8 mm, 15 μL each of the following three solutions. For solution (A), transfer 6 g of the sample to a 125-mL Erlenmeyer flask. Add 25.0 mL of *methanol*, shake well and sonicate for about 30 minutes. Transfer the solution to a 50-mL volumetric flask, dilute with *methanol* to volume and mix. Centrifuge the resulting solution at 13,684 × *g* (12,000 rpm) at –20° for 15 minutes. Pass a portion of the supernatant through a filter having a 0.45 μm or finer porosity. Solution (B) contains 0.1 mg per mL of *asiaticoside* in *methanol* and solution (C) contains 0.1 mg per mL of *madecassoside* in *methanol*. After removal of the plate, allow it to dry in air. Spray the plate with *anisaldehyde TS* and heat at 105° for 5 minutes. The chromatogram obtained from solution (A) shows a greenish blue band and a violet band corresponding to the asiaticoside and the madecassoside bands from solutions (B) and (C), respectively. Several other bands of different colours are observed.

Microbial limit Complies with the requirements for Category 1B in the "Limits for Microbial Contamination" (Appendix 10.5).

Assay Carry out the determination as described in the "Liquid Chromatography" (Appendix 3.5).

Mobile phase A, **Mobile phase B**, **Standard preparation**, **Chromatographic system**, and **Procedure** Proceed as directed in the Assay under *Centella Dry Extract.*

Assay preparation Transfer an accurately weighed quantity of Centella Cream, containing about 5 mg of asiaticoside, to a 125-mL Erlenmeyer flask. Add 25.0 mL of *methanol*, shake well and sonicate for about 30 minutes. Quantitatively transfer the solution to a 50-mL volumetric flask, dilute with *methanol* to volume and mix. Centrifuge the resulting solution at 13,684 × *g* (12,000 rpm) at –20° for 15 minutes. Pass a portion of the clear solution through a filter having a 0.45 μm or finer porosity.

Calculation Calculate the contents of $C_{48}H_{78}O_{19}$ and $C_{48}H_{78}O_{20}$ in the portion of the Cream taken, using the declared contents of $C_{48}H_{78}O_{19}$ and $C_{48}H_{78}O_{20}$ in *asiaticoside* and *madecassoside*, respectively.

Other requirements Complies with the requirements described under "Topical Preparations" (Appendix 1.16H).

บุนนาค (BUNNAK)

Mesuae Ferreae Flos
Ironwood Flower

Synonyms Ceylon Ironwood Flower, Cobra's Saffron Flower, Indian Rose Chestnut Flower

Category Cardiotonic, antipyretic.

Ironwood Flower is the dried blooming flower of *Mesua ferrea* L. (Family Clusiaceae), Herbarium Specimen Number: DMSC 5165, BKF 166239, Crude Drug Number: DMSc 0763.

Constituents Ironwood Flower contains 4-phenylcoumarins, biflavonoids, chromones, triterpenes, volatile oil, oleoresin, etc.

Description of the plant (Figs. 1a, 1b) Tree up to 30 m high, trunk upright, cylindrical, often buttressed at base, young twig slender, exuding aromatic white resin when wounded. Leaves simple, opposite, elliptic, oblong or lanceolate, 6 to 13 cm long, 1 to 4 cm wide, apex acute, base acute or obtuse, margin entire, blade leathery, midrib faint and depressed on both surfaces, lateral veins numerous, very fine, almost invisible, lower surface whitish glaucous; young leaves reddish to pinkish; petiole 0.4 to 1.2 cm long. Flower solitary or fascicled, fragrant, axillary; peduncle 0.8 to 2.3 cm long, slender; sepals 4, light green, orbicular, 1 to 1.5 cm long, arranged in 2 rows, outer pair small, inner pair larger, densely velvety puberulous outside, fleshy; petals 4, white or pinkish, obovate or obcordate, 1.5 to 4 cm long, base cuneate, margin curled, brown or purple striations, caducous; stamens numerous, anthers orange to golden yellow, linear, 0.4 to 1 cm long; ovary superior, ovoid, up to 5 mm long, 2-loculed, each locule 2-ovuled, style 1, about 1 cm long, stigma peltate. Fruit ovoid to ellipsoid, 2.5 to 3.5 cm long, with conical apex, striated; sepal enlarged up to 4 cm long, persistent, dark orange or purplish brown; pericarp tough. Seed(s) 1 to 4, up to 2.4 cm long, woody, smooth, glossy, brown, oily.

Description Odour, aromatic; taste, astringent.

Macroscopical (Fig. 1a) Complete dried flowers, broken flowers, fragments of sepals, petals and stamens are commonly found. Sepals dark brown; petals and stamens, light or golden brown.

Microscopical (Figs. 2a, 2b, 2c) Transverse section of the sepal shows rectangular cells of upper and lower epidermises, with unicellular trichomes. Mesophyll composed of polygonal parenchyma cells, some containing rosette aggregates of calcium oxalate, sclereids, resin ducts, small air spaces, and vascular bundles.

Transverse section of the petal shows rectangular cells of upper and lower epidermises. Mesophyll composed of loose polygonal parenchyma cells, resin ducts, air spaces, and vascular bundles.

Transverse section of the filament reveals a layer of epidermis with papillae, wavy parenchyma cells and a vascular bundle.

Transverse section of the anther shows 4 pollen sacs containing a layer of epidermis with papillae, a fibrous layer of pollen sac, pollen grains; at the centre comprising epidermis, parenchyma, resin ducts, and a vascular bundle.

1

2

3

4

1 cm

Fig. 1a *Mesua ferrea* L.
1. habit 2. flower 3. fruiting twig 4. crude drug

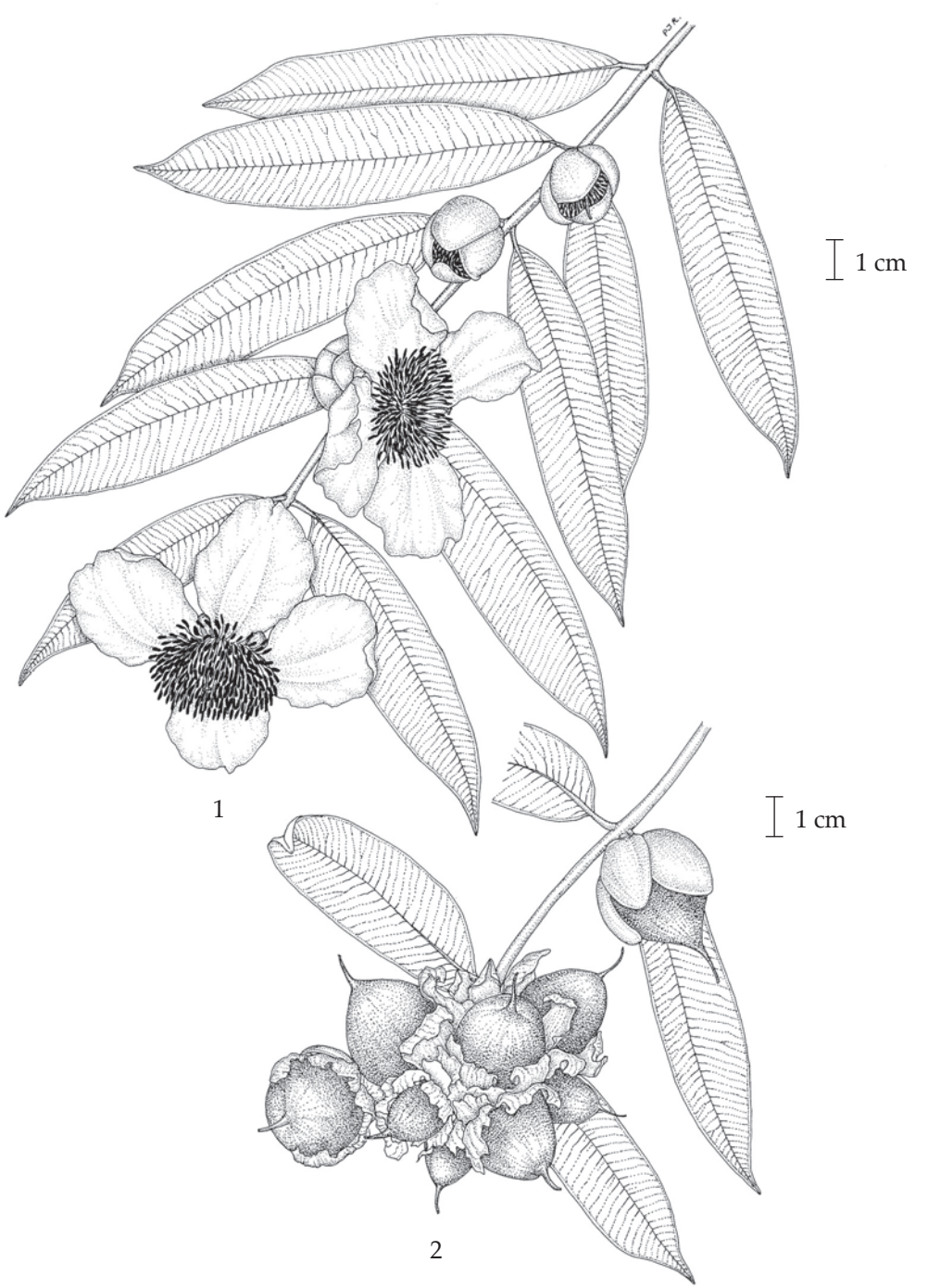


Fig. 1b *Mesua ferrea* L.
1. flowering twig 2. fruiting twig

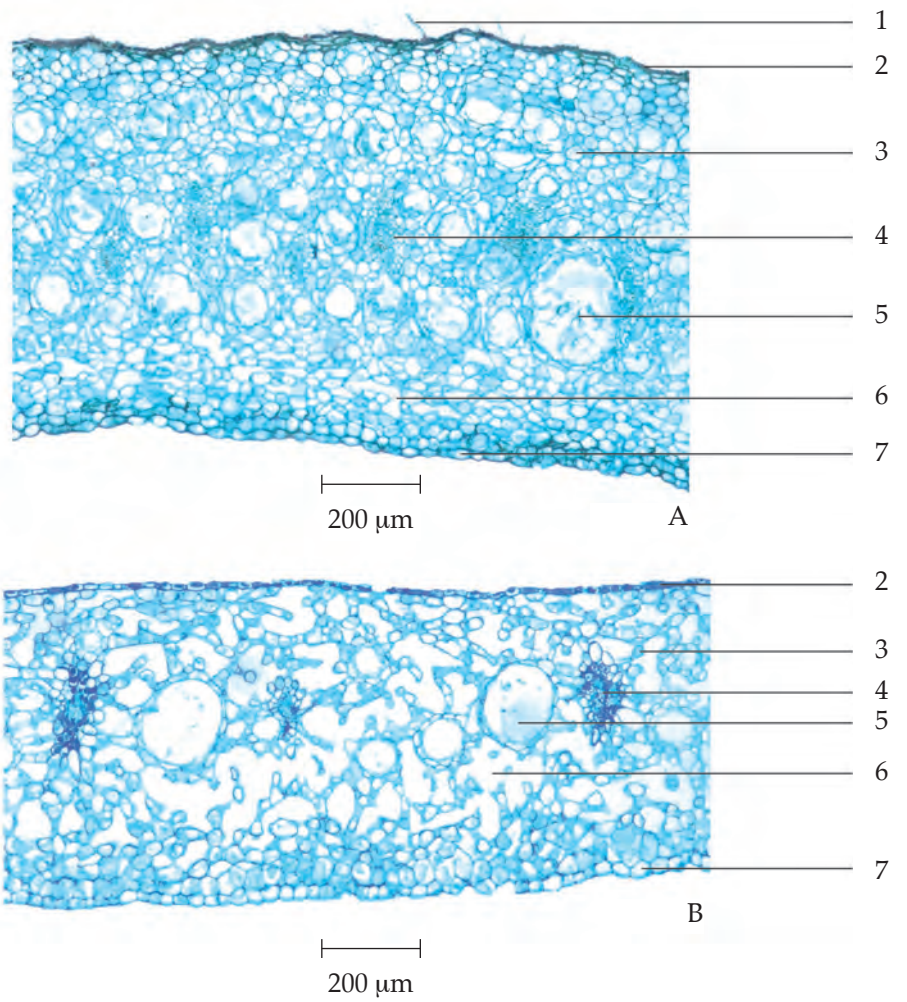


Fig. 2a Photomicrographs of Transverse Sections of the Flower of *Mesua ferrea* L., Stained with Safranin-Fast Green

A. Sepal
B. Petal

1. unicellular trichome
2. upper epidermis
3. parenchyma
4. vascular bundle
5. resin duct
6. air space
7. lower epidermis

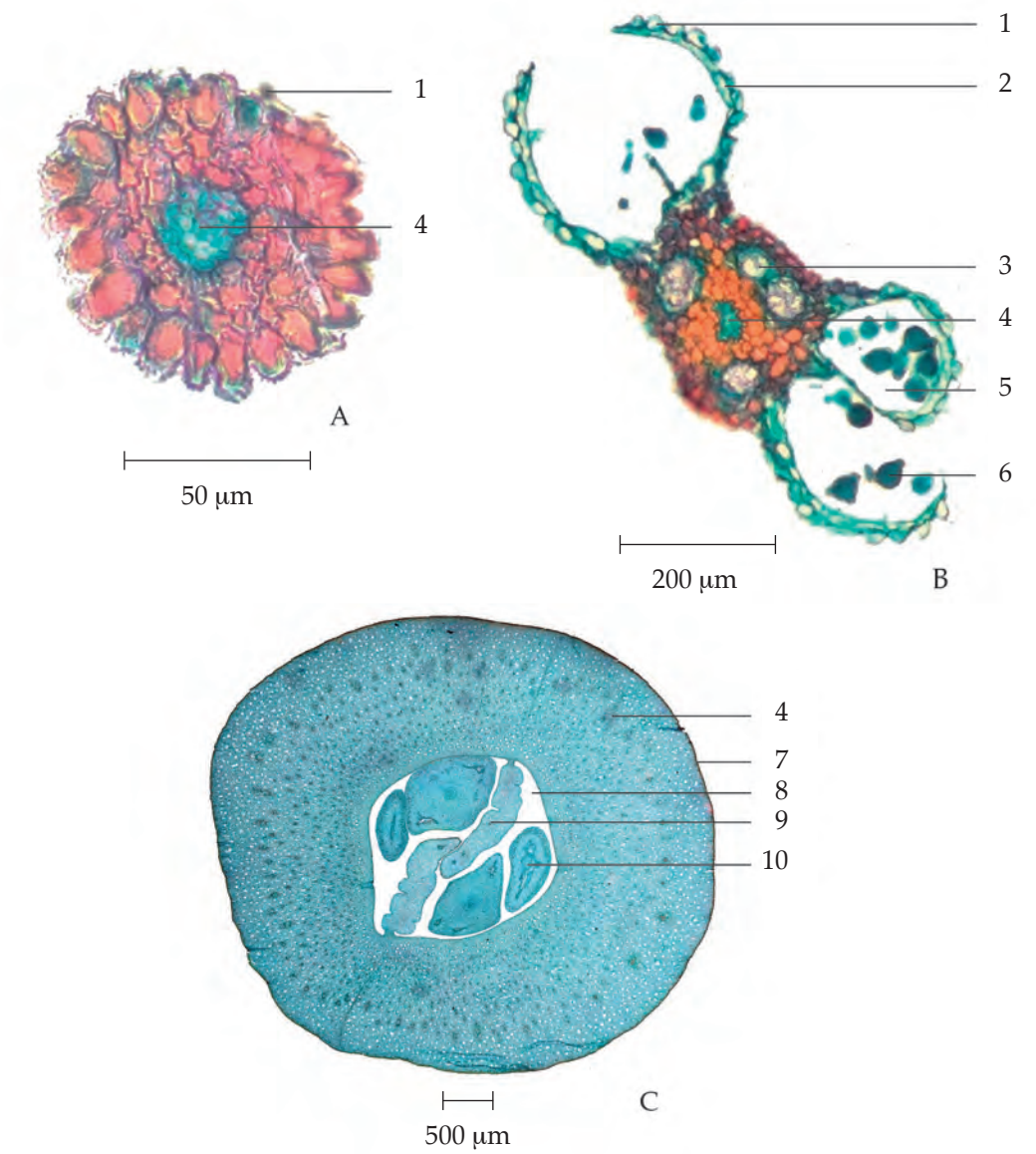


Fig. 2b Photomicrographs of Transverse Sections of the Flower of *Mesua ferrea* L., Stained with Safranin-Fast Green

A. Filament
B. Anther
C. Ovary

1. epidermal cell with papilla
2. fibrous layer of pollen sac
3. resin duct
4. vascular bundle
5. pollen sac
6. pollen grain
7. epidermis of ovary wall
8. locule
9. septum
10. ovule

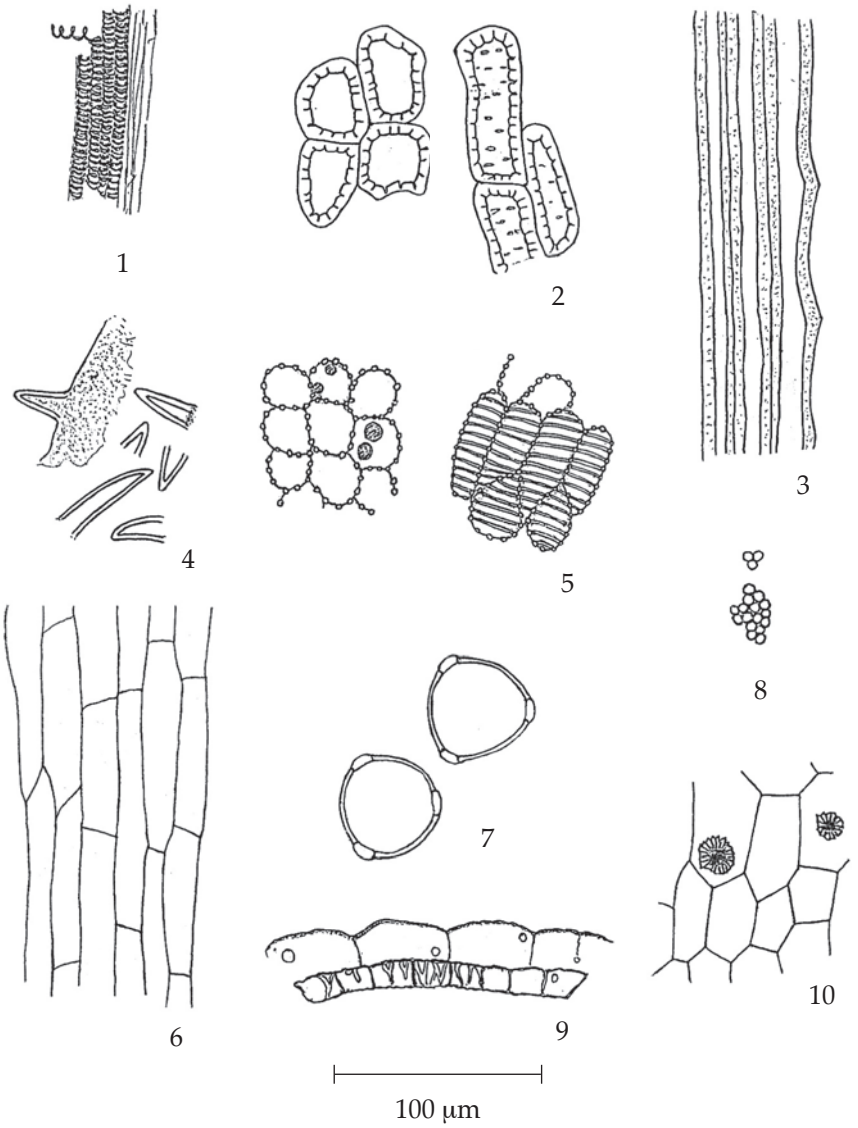


Fig. 2c Powdered Drug of the Flowers of *Mesua ferrea* L.

1. fragment of spiral vessels and fibres
2. sclereids
3. fibres
4. unicellular trichomes of sepal
5. fragments of fibrous layer of pollen sac in different views, some containing oil globules
6. fragment of filament showing elongated epidermal cells
7. pollen grains
8. starch grains
9. part of pollen sac in sectional view with epidermal layer and underlying fibrous layer
10. fragment of sepal showing parenchyma cells and rosette aggregates

Transverse section of the ovary shows ovary wall, 2 locules, septum, and ovules. The ovary wall composed of a layer of small epidermal cells, parenchyma cells and vascular bundles. The locules divided by a septum, each containing 2 ovules.

Ironwood Flower in powder possesses the diagnostic microscopical characters of the unground drug.

Additional information It is commonly used with other herbal drugs in Thai traditional herbal preparations.

Packaging and storage Ironwood Flower shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. To 5 g of the sample, in powder, add 20 mL of *ethanol*, sonicate for 1 hour and filter (solution 1). To 2 mL of solution 1, add 4 or 5 pieces of *magnesium ribbon,* shake well and mix with a few drops of *hydrochloric acid*: a pink colour develops.

B. To 2 mL of solution 1, add a few drops of a 2.5 per cent w/v solution of *iron(III) chloride* and shake well: a blue-green colour develops.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 80 volumes of *hexane* and 20 volumes of *ethyl acetate* as the mobile phase and allowing the solvent front to ascend 14 cm above the line of application. Apply to the plate as a band of 10 mm, 20 μL of the test solution prepared by macerating 1 g of the sample, in *fine powder*, with 10 mL of *hexane* for about 12 hours, shaking frequently, filtering and evaporating the filtrate to dryness. Dissolve the residue in 1 mL of *hexane*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching bands. Spray the plate with a 20 per cent v/v solution of *sulfuric acid* in *ethanol* and heat at 105° for 5 minutes; several bands of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Hexane Extract of the Flowers of *Mesua ferrea* L.

Band	hR_f Value	Detection	
		UV 254	20 Per Cent V/V Solution of *Sulfuric Acid* in *Ethanol*
1	14–16	quenching	pale brown
2	23–25	–	violet
3	27–31	strong quenching	brown
4	37–40	weak quenching	pale brown
5	41–43	–	purple
6	58–61	weak quenching	purple
7	70–71	weak quenching	–
8	74–79	weak quenching	–
9	80–81	–	pale purple
10	83–84	weak quenching	–
11	85–88	–	pale purple
12	89–92	–	purple

Loss on drying Not more than 11.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 1.5 per cent w/w (Appendix 7.6).

Total ash Not more than 5.0 per cent w/w (Appendix 7.7).

Ethanol (80 per cent)-soluble extractive Not less than 4.5 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 2.5 per cent w/w (Appendix 7.12).

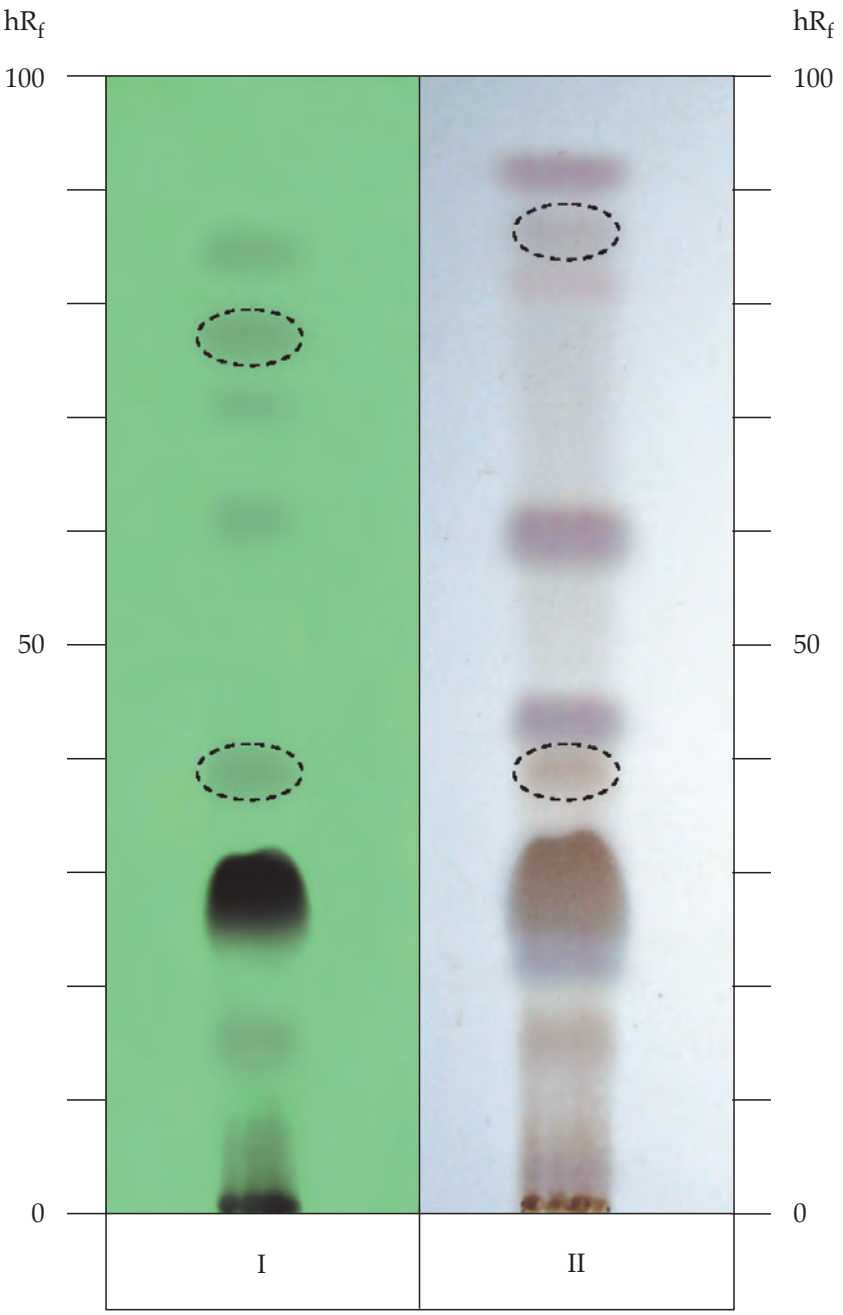


Fig. 3 Thin-Layer Chromatogram of Hexane Extract of the Flowers of *Mesua ferrea* L.
I = detection under UV light (254 nm)
II = detection with a 20 per cent v/v solution of *sulfuric acid* in *ethanol*
⬭ = bands developed in some samples

จันทน์แดง (CHAN DAENG)

รักตจันทน์ (RAKTACHAN), รัตจันทน์ (RATTACHAN)
Santali Rubri Lignum
Red Sandalwood

Synonyms Red Sanders, Red Saunders, Rubywood, Saunders Wood

Category Antipyretic, anti-inflammatory, cardiotonic.

Red Sandalwood is the dried heartwood of *Pterocarpus santalinus* L. f. (Family Fabaceae), Herbarium Specimen Number: BKF 170463, Crude Drug Number: DMSc 0933.

Constituents Red Sandalwood contains red pigments consisting mainly of santalin A and santalin B. It also contains isoflavones, a small amount of volatile oil, triterpenes, sterols, etc.

Description of the plant (Figs. 1a, 1b) Tree up to 15 m high, deciduous; bark deeply cracked into vertical and horizontal rectangular plates, blackish brown. Leaves mostly trifoliate, rarely 4 or 5, alternate, 10 to 18 cm long; petiole swollen at base; leaflet broadly elliptic to ovate, 7 to 10 cm long, 3.5 to 5.5 cm wide, apex round or deeply notched, base round or slightly cordate, margin entire, blade leathery, shiny. Inflorescence axillary or terminal, raceme or panicle; bract and bracteole small, often caducous. Flower yellowish, 1.6 to 2 cm long; petals 5, papilionaceous; stamens 10, subdiadelphous; ovary superior, shortly stalked, 2-ovuled. Fruit samara, flat, obliquely rounded, broadly hardened winged around margin, beaked, 3.5 to 5 cm in diameter. Seeds 2, smooth, reddish brown.

Description Odour, aromatic; taste, slightly astringent.

Macroscopical (Fig. 1a) Irregular pieces of woody segment, dense, hard and heavy, but readily split. Dark red to blackish red. Transversely cut surface showing ring zones. Longitudinally cut surface showing alternating dark and light zones.

Microscopical (Figs. 2a, 2b, 2c, 2d, 2e) Transverse section of the heartwood shows vessel, xylem parenchyma, xylem ray, and fibre. Vessel, large, thick-walled, scattered, solitary or small cluster, some containing red resin. Xylem parenchyma, oval, thick-walled, band paratracheal. Xylem ray, mostly 1 row. Fibre, thick-walled.

Tangential and radial longitudinal sections of the heartwood show vessel, xylem parenchyma, xylem ray, and fibre. Vessel, large, with bordered-pitted and simple perforation plate, some of which contain red resin. Axial parenchyma, rectangular, thick-walled, some of which contain prismatic crystals of calcium oxalate. Xylem ray; in tangential longitudinal view, mostly uniseriate, oval; in radial longitudinal view, rectangular, perpendicular to other adjacent cells. Fibre, thick-walled, simple pitted.

Red Sandalwood in powder possesses the diagnostic microscopical characters of the unground drug.

Storage Red Sandalwood shall be stored in a dry place, protected from light.

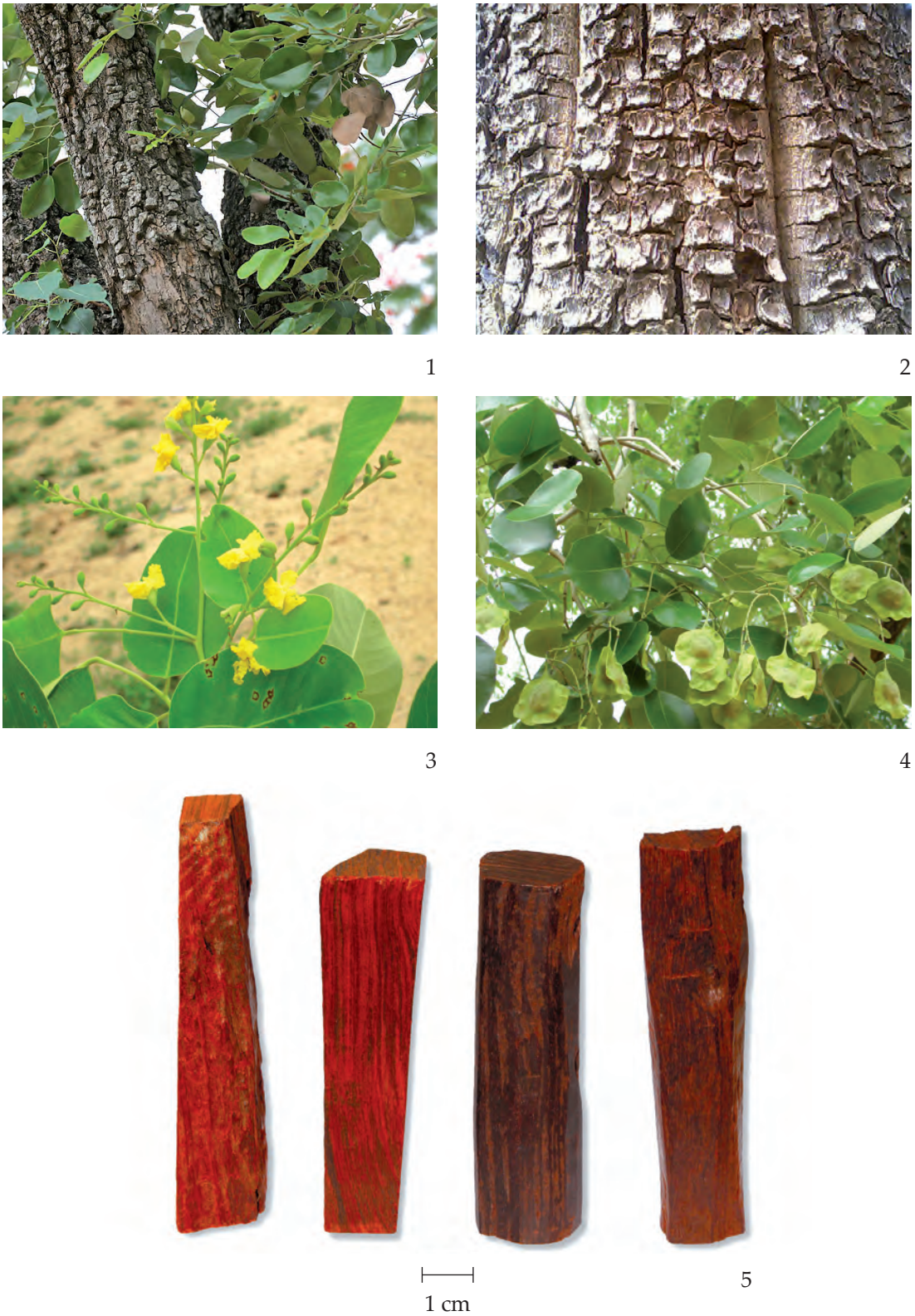


Fig. 1a *Pterocarpus santalinus* L. f.
1. part of stem and twig 2. bark 3. inflorescence 4. infructescence 5. crude drug

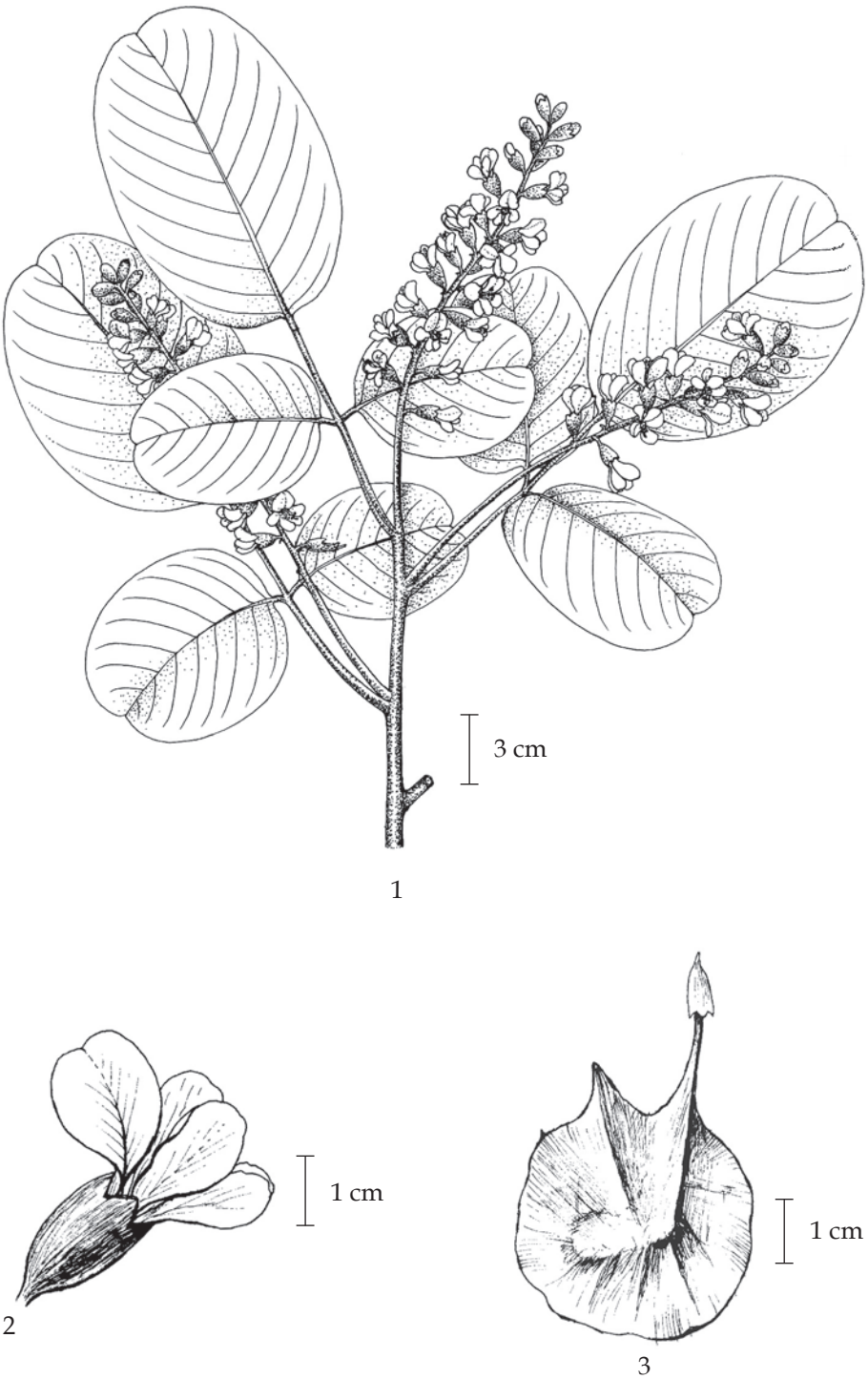


Fig. 1b *Pterocarpus santalinus* L. f.
1. flowering twig 2. flower 3. fruit

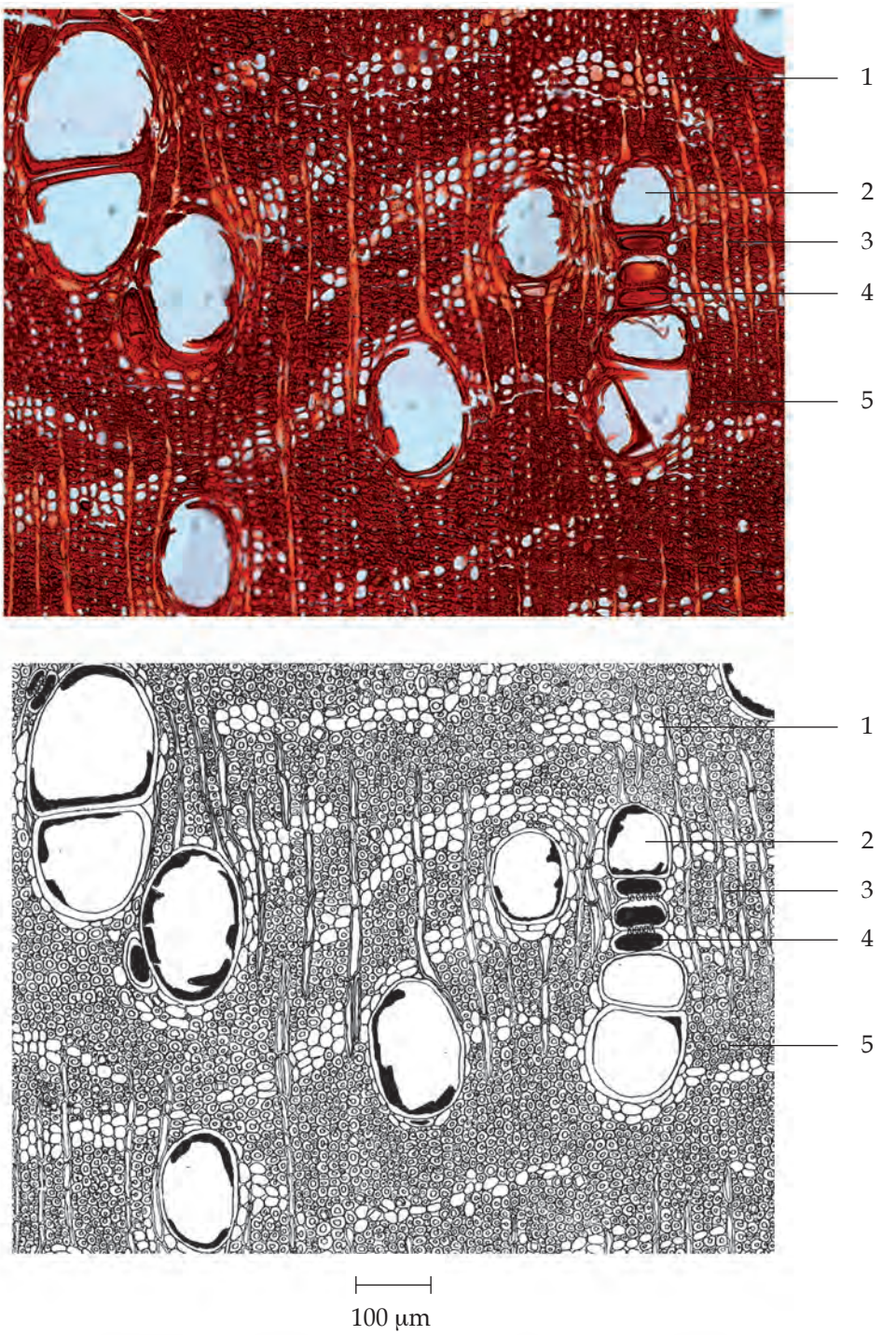


Fig. 2a Photomicrograph and Line Drawing of Transverse Section of the Heartwood of *Pterocarpus santalinus* L. f.

1. xylem parenchyma
2. vessel
3. xylem ray
4. red resin in vessel
5. fibre

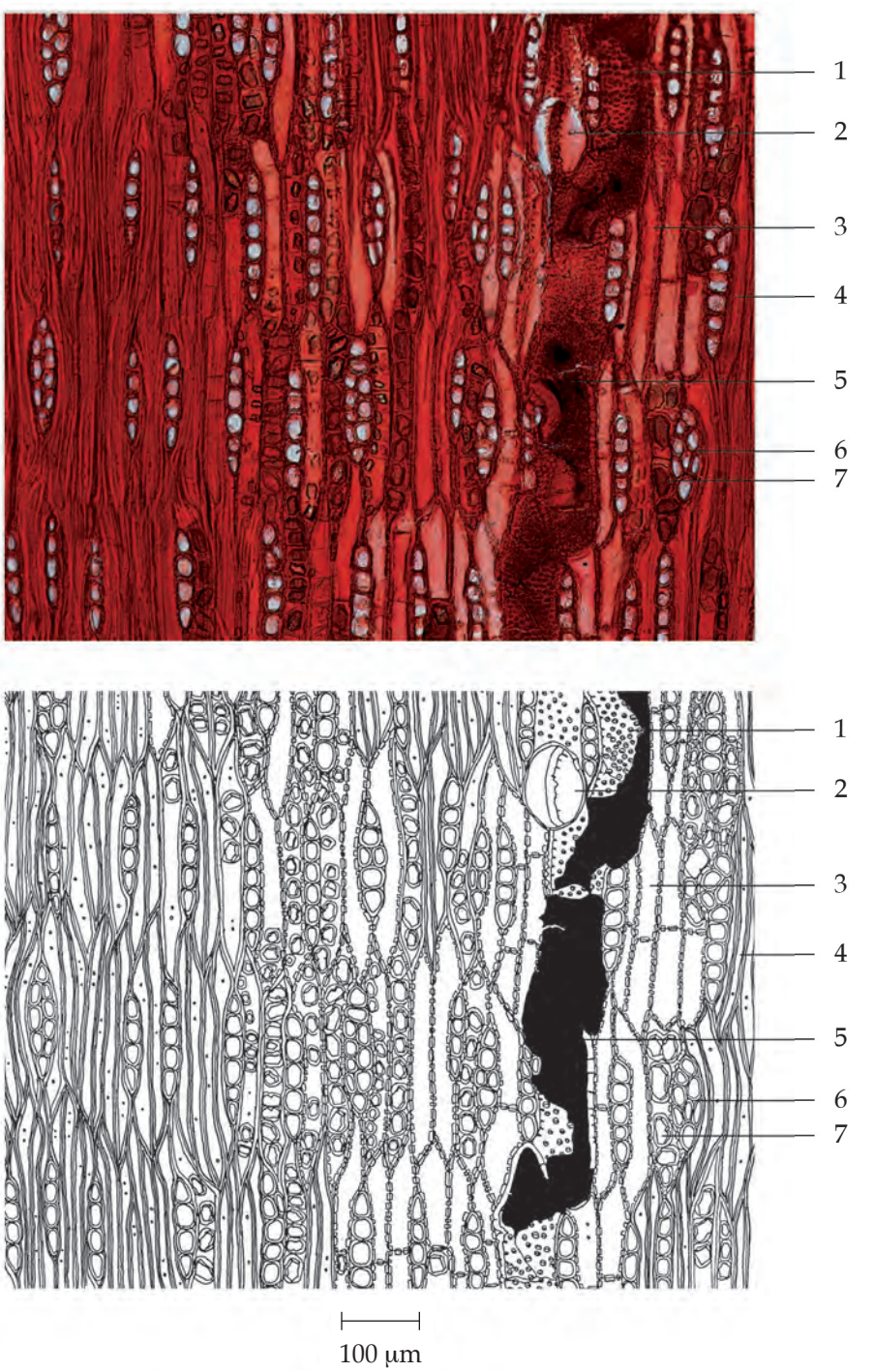


Fig. 2b Photomicrograph and Line Drawing of Tangential Longitudinal Section of the Heartwood of *Pterocarpus santalinus* L. f.

1. bordered-pitted vessel
2. simple perforation
3. xylem parenchyma
4. fibre
5. red resin in vessel
6. xylem ray
7. prismatic crystal of calcium oxalate in xylem parenchyma

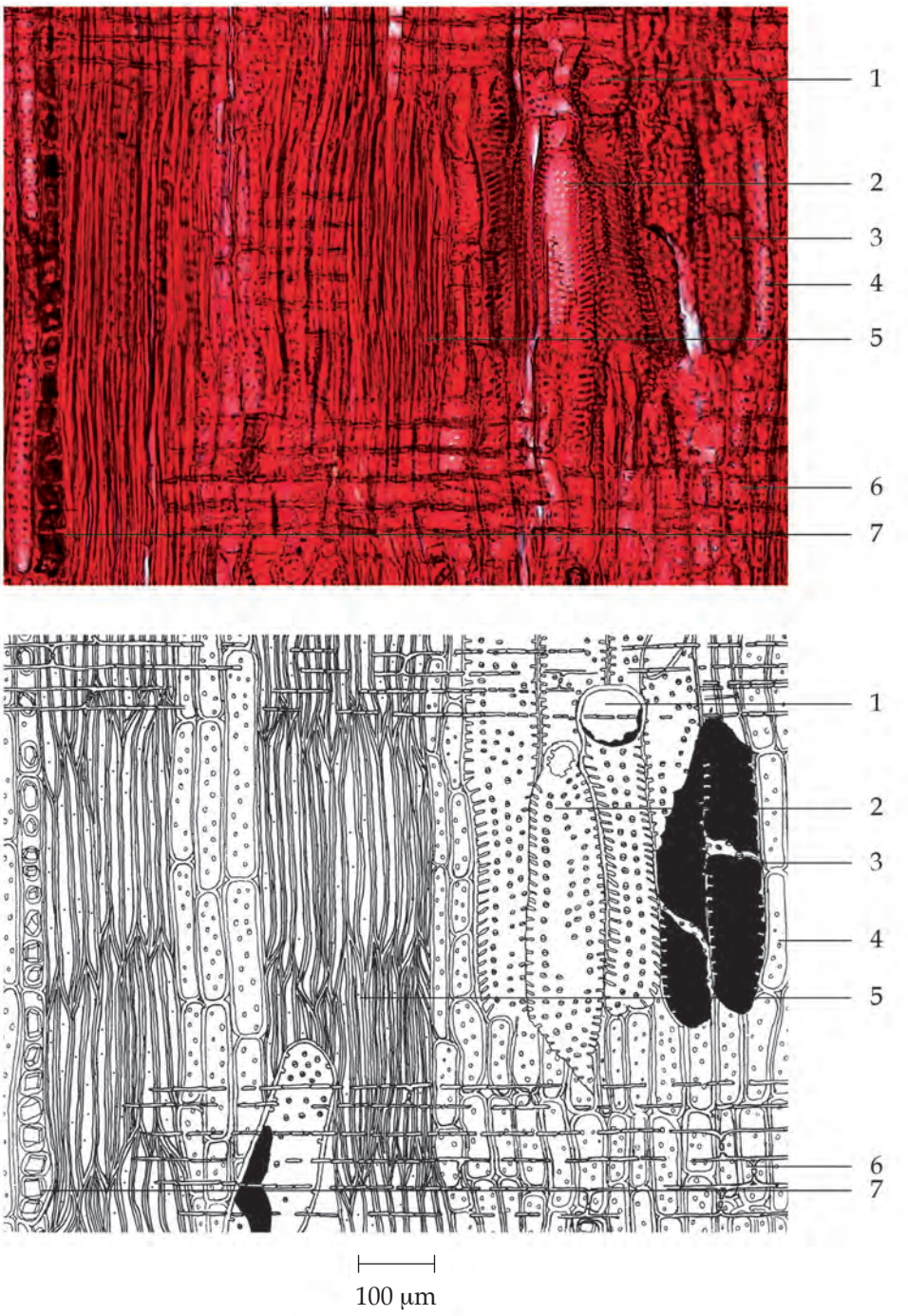


Fig. 2c Photomicrograph and Line Drawing of Radial Longitudinal Section of the Heartwood of *Pterocarpus santalinus* L. f.

1. simple perforation
2. bordered-pitted vessel
3. red resin in vessel
4. xylem parenchyma
5. fibre
6. xylem ray, perpendicular to xylem parenchyma
7. prismatic crystal of calcium oxalate in xylem parenchyma

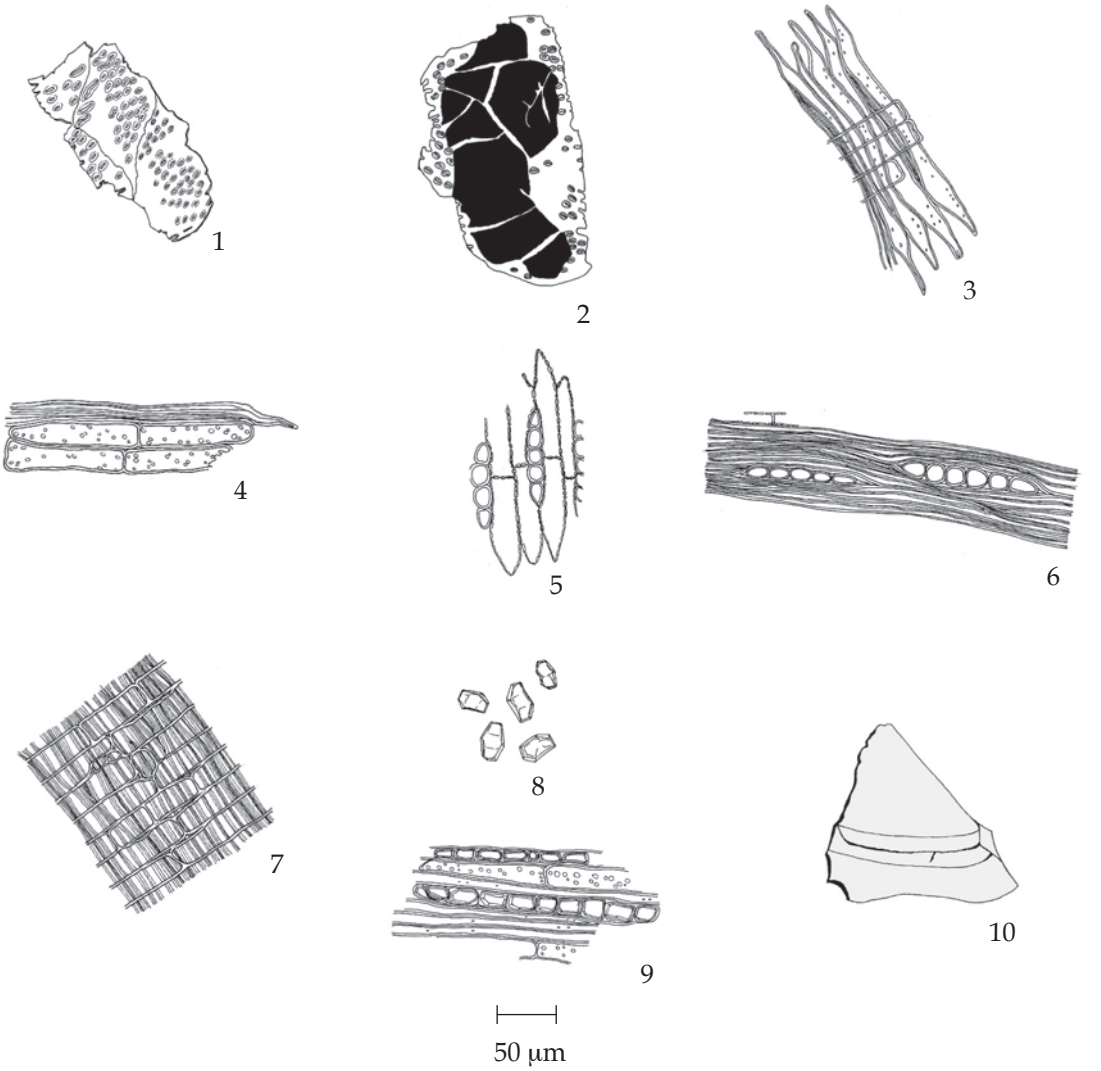


Fig. 2d Line Drawings of Powdered Drug of the Heartwood of *Pterocarpus santalinus* L. f.

1. fragment of bordered-pitted vessel
2. fragment of vessel with red resin
3. group of fibres perpendicular to xylem ray
4. xylem parenchyma and fibres
5. xylem parenchyma and xylem rays in tangential longitudinal view
6. xylem rays and fibres in tangential longitudinal view
7. xylem ray and fibres in radial longitudinal view
8. prismatic crystals of calcium oxalate
9. fibres and prismatic crystals of calcium oxalate in xylem parenchyma
10. fragment of red resinous substance

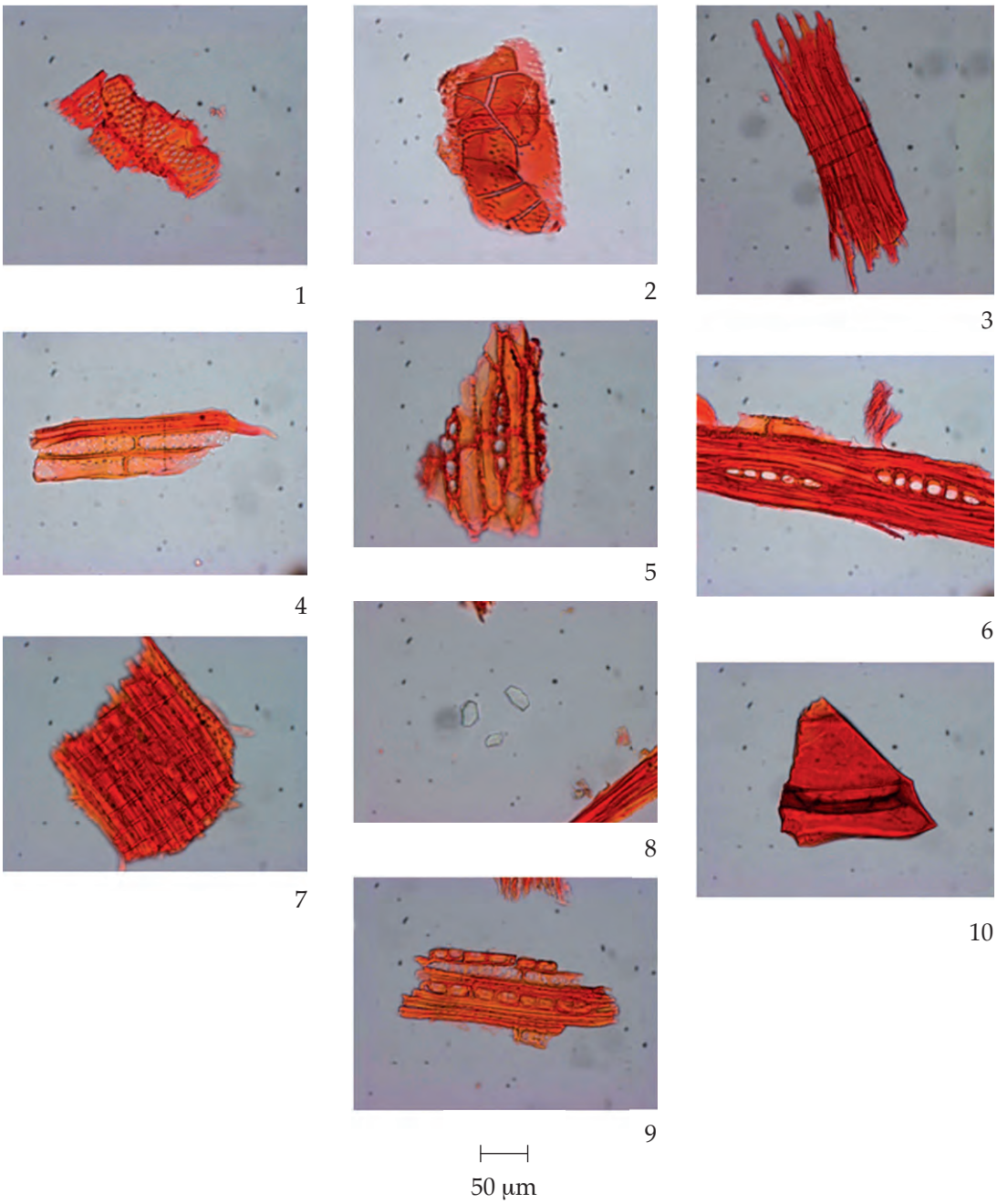


Fig. 2e Photomicrographs of Powdered Drug of the Heartwood of *Pterocarpus santalinus* L. f.

1. fragment of bordered-pitted vessel
2. fragment of vessel with red resin
3. group of fibres perpendicular to xylem ray
4. xylem parenchyma and fibres
5. xylem parenchyma and xylem rays in tangential longitudinal view
6. xylem rays and fibres in tangential longitudinal view
7. xylem ray and fibres in radial longitudinal view
8. prismatic crystals of calcium oxalate
9. fibres and prismatic crystals of calcium oxalate in xylem parenchyma
10. fragment of red resinous substance

Identification

A. Reflux 1.2 g of the sample, in powder, with 30 mL of *methanol* for 30 minutes and filter (solution 1). Evaporate 2 mL of solution 1 to dryness. Dissolve the residue in 1 mL of *acetic anhydride*, slowly add a few drops of *sulfuric acid* and mix: a deep brownish red colour develops.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 80 volumes of *hexane* and 20 volumes of *ethyl acetate* as the mobile phase. Apply to the plate, 5 µL of the test solution prepared by evaporating about 20 mL of solution 1 to dryness and dissolving the residue in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; several blue fluorescent spots are observed. Spray the plate with *anisaldehyde TS* and heat at 110° for 10 minutes; several spots of different colours appear (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Heartwood of *Pterocarpus santalinus* L. f.

Spot	hR_f Value	Detection		
		UV 254	UV 366	*Anisaldehyde TS*
1	7–9	–	light blue	violet
2	11–14	quenching	–	–
3	14–18	–	light blue	violet
4	20–24	quenching	–	brownish purple
5	25–29	–	light blue	–
6	32–35	–	blue	–
7	48–53	quenching	light blue	brownish purple
8	62–68	–	intense blue	–
9	69–72	–	–	pale violet
10	75–79	–	light blue	–
11	79–82	–	–	violet
12	83–87	–	light blue	–
13	87–90	–	–	pale violet
14	95–98	–	–	pale violet
15	98–99	–	–	violet

Loss on drying Not more than 8.0 per cent w/w after drying at 105° for 5 hours (Appendix 4.15).

Foreign matter Not more than 0.5 per cent w/w (Appendix 7.2).

Total ash Not more than 1.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 12.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 1.0 per cent w/w (Appendix 7.12).

Dose 3 to 5 g a day.

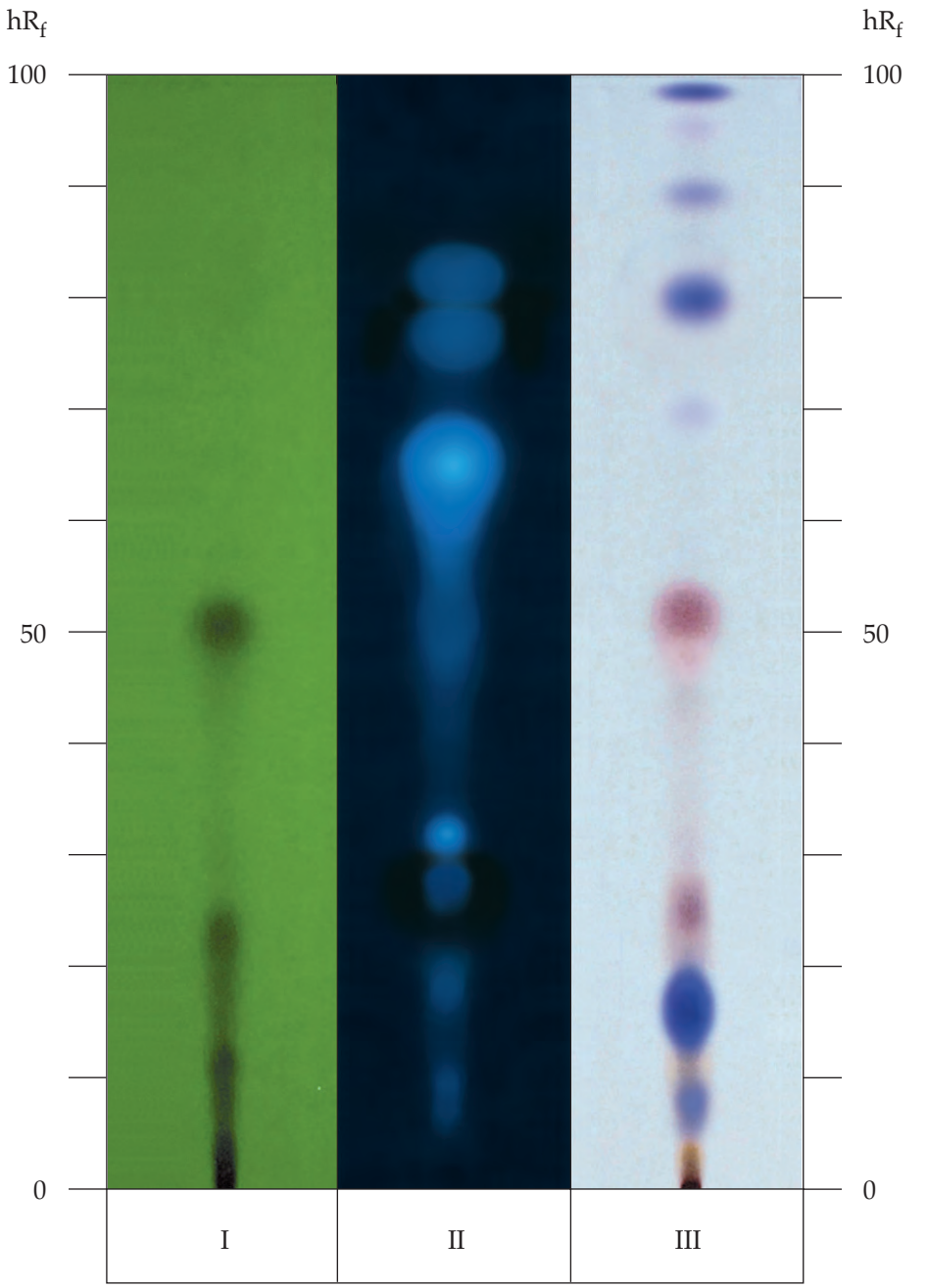


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Heartwood of *Pterocarpus santalinus* L. f.

I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *anisaldehyde TS*

จันทน์ขาว (CHAN KHAO)

จันทน์หิมาลัย (CHAN HIMALAI), แก่นจันทน์ (KAEN CHAN), แก่นจันทน์เทศ (KAEN CHAN THET)
Santali Albi Lignum
Sandalwood

Synonyms White Sandalwood, Yellow Sandalwood

Category Cardiotonic, stomachic, nervotonic.

Sandalwood is the dried heartwood of *Santalum album* L. (*S. album* Rumph., *S. ovata* R. Br., *S. ovatum* Miq., *S. myrtifolium* L., *Sirium myrtifolium* L.) (Family Santalaceae), Herbarium Specimen Number: DMSC 5178, BKF 168153, Crude Drug Number: DMSc 0935.

Constituents Sandalwood contains volatile oil, of which α- and β-santalol are major components. The volatile oil also contains santenone, santalone, α-terpineol, etc.

Description of the plant (Figs. 1a, 1b) Hemiparasitic tree up to 20 m high, glabrous; bark rough, cracked, dark grey or brownish black. Leaves simple, opposite or sub-opposite, elliptic-lanceolate or ovate, coriaceous, 4 to 11 cm long, 1.5 to 3.5 cm wide, apex acute or shortly acuminate, base obtuse, attenuate, margin undulate; petiole slender, about 1 cm long. Inflorescence paniculate, terminal or axillary, pedunculate; peduncle slender, tortuous. Flowers 9 to 15, receptacular, pedicellate; pedicel slender, angular, 1 to 3 mm long; perianth tube campanulate, 4- to 5-lobed, deltoid, 1.5 to 3.5 mm long, 1 to 1.5 mm wide, reflexed, whitish, turning reddish then crimson; stamens 4 or 5, opposite to perianth lobes, filament narrow, slightly dilated at the base, covered with white hair-tuft; ovary semi-inferior, style angular, stigma 3-lobed; nectary concave, deeply 5-lobed, protruding between the perianth segments, brownish, turning reddish then crimson. Fruit drupe, globose or subglobose, about 1 cm in diameter, green, turning red then purplish black, juicy when ripe; exocarp smooth; endocarp ribbed. Seed 1, globose or obovoid.

Description Odour, aromatic, strongly aromatic when burning; taste, slightly bitter.

Macroscopical (Fig. 1a) Cylindrical woody segment, varying in size and diameter, some somewhat curved. Externally pale yellow or yellowish brown, fine and smooth, some with nodal scars or longitudinal cracks. Texture compact, uneasily broken; transversely cut surface brownish yellow, showing annual rings; longitudinally cut surface shows straight grains.

Microscopical (Figs. 2a, 2b, 2c, 2d) Transverse section of the heartwood shows vessel, xylem parenchyma, xylem ray, and fibre. Vessel, single, large, thick-walled, and scattered. Xylem parenchyma, round, thick-walled, apotracheal, and some of which contain prismatic crystals of calcium oxalate. Xylem ray, 1 to 3 rows, some of which contain red or brownish oleoresin. Fibre, thick-walled.

Tangential and radial longitudinal sections of the heartwood show vessel, xylem parenchyma, fibre, fibre-tracheid and xylem ray. Vessel, large, with bordered-pitted and simple perforation plate. Xylem parenchyma, thick-walled, some of which contain prismatic crystals of calcium oxalate. Fibre, thick-walled, simple pitted. Fibre-tracheid, thick-walled, bordered-pitted with tapering ends. Xylem ray; in tangential longitudinal view, mostly multiseriate, oval, some of which contain red or brownish oleoresin; in radial longitudinal view, rectangular, perpendicular to other adjacent cells.

1

2

3

4

5

Fig. 1a *Santalum album* L.
1. habit 2. stem 3. flowering twig 4. fruiting twig 5. crude drug

Fig. 1b *Santalum album* L.
1. flowering twig 2. flower 3. fruit

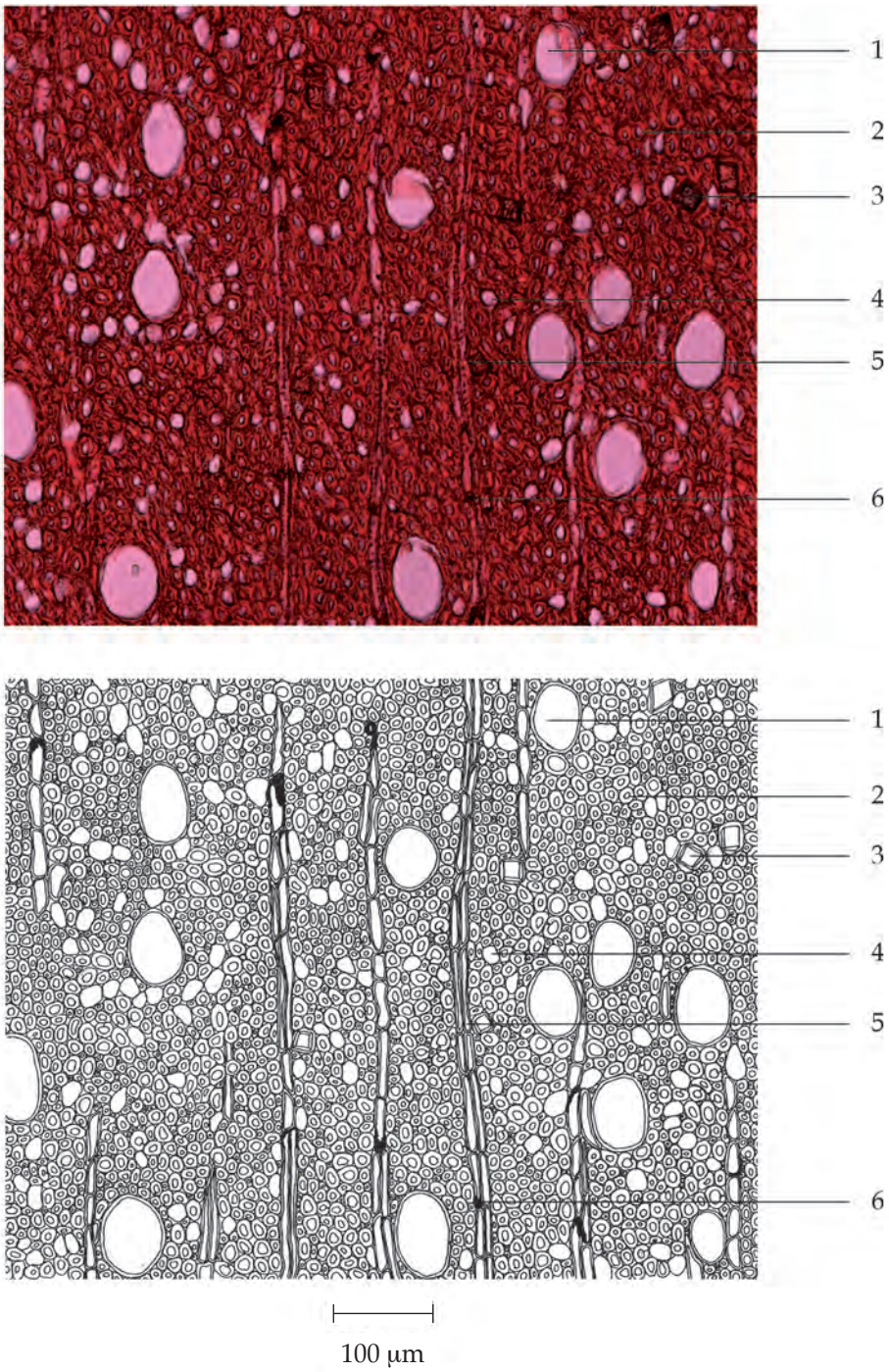


Fig. 2a Photomicrograph and Line Drawing of Transverse Section of the Heartwood of *Santalum album* L.

1. vessel
2. fibre
3. prismatic crystal of calcium oxalate
4. xylem parenchyma
5. xylem ray
6. oleoresin in xylem ray

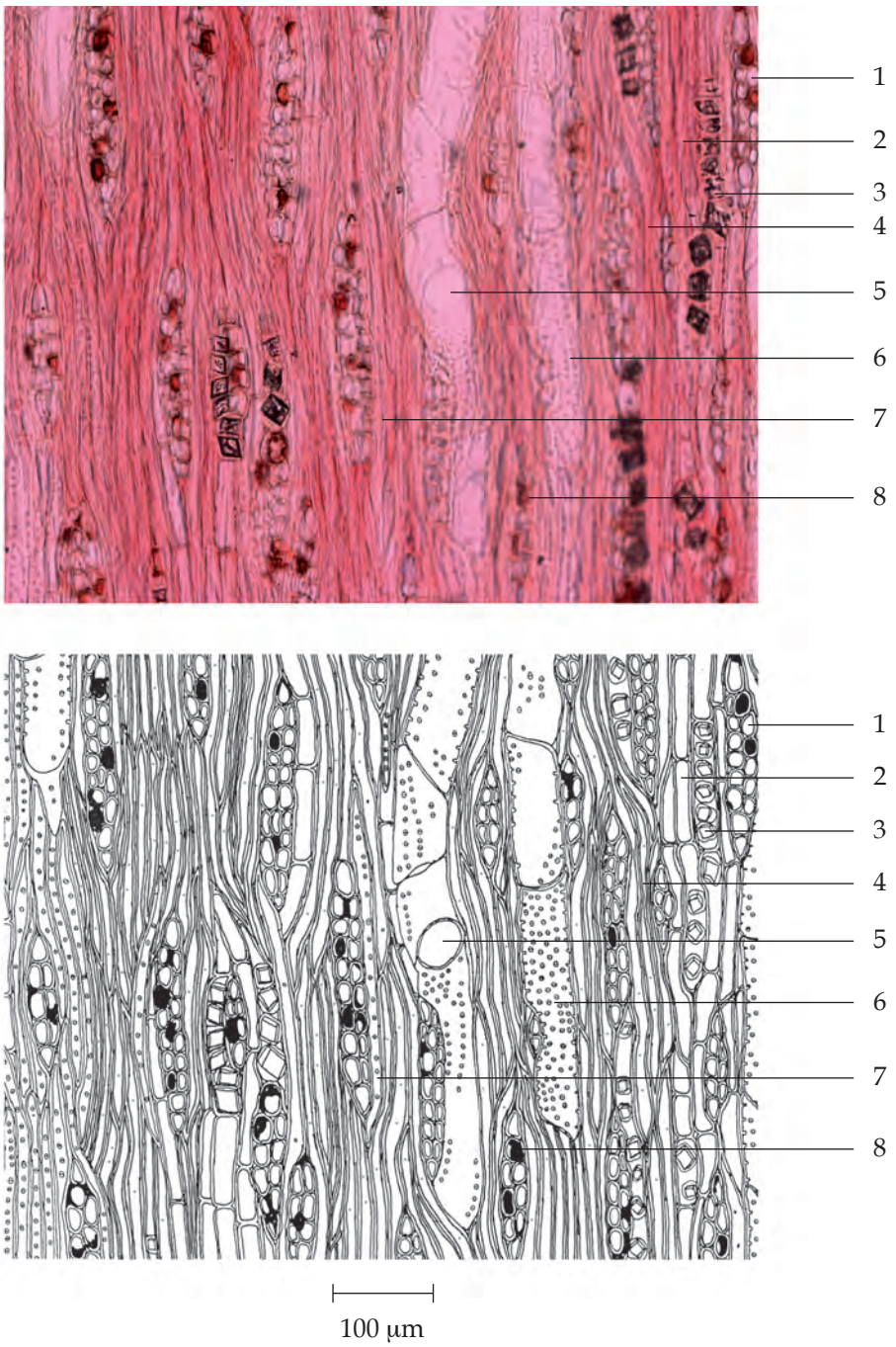


Fig. 2b Photomicrograph and Line Drawing of Tangential Longitudinal Section of the Heartwood of *Santalum album* L.

1. xylem ray
2. xylem parenchyma
3. prismatic crystal of calcium oxalate
4. fibre
5. simple perforation plate
6. bordered-pitted vessel
7. fibre-tracheid
8. oleoresin in xylem ray

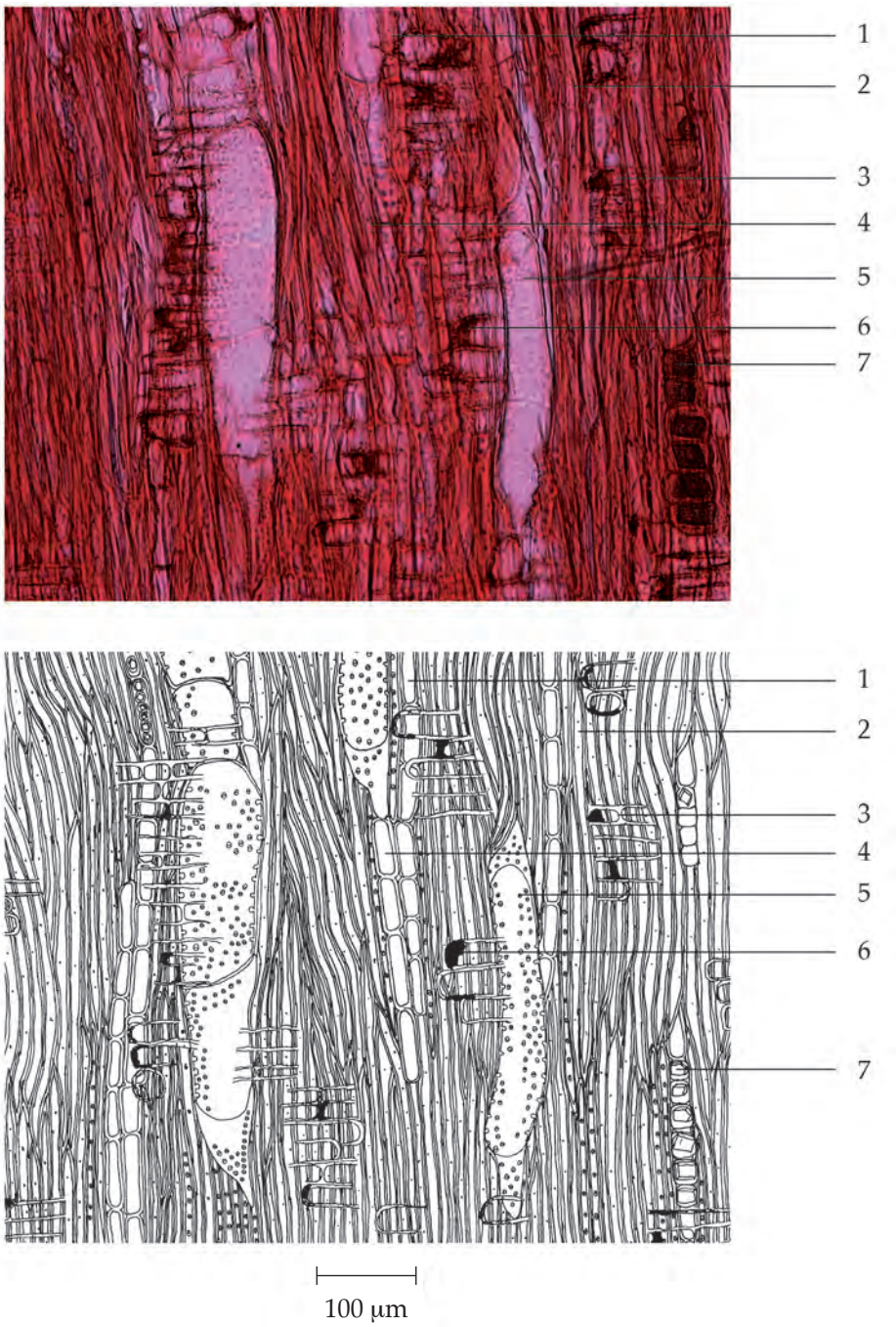


Fig. 2c Photomicrograph and Line Drawing of Radial Longitudinal Section of the Heartwood of *Santalum album* L.

1. fibre-tracheid
2. fibre
3. xylem ray
4. xylem parenchyma
5. bordered-pitted vessel
6. oleoresin in xylem
7. prismatic crystal of calcium oxalate

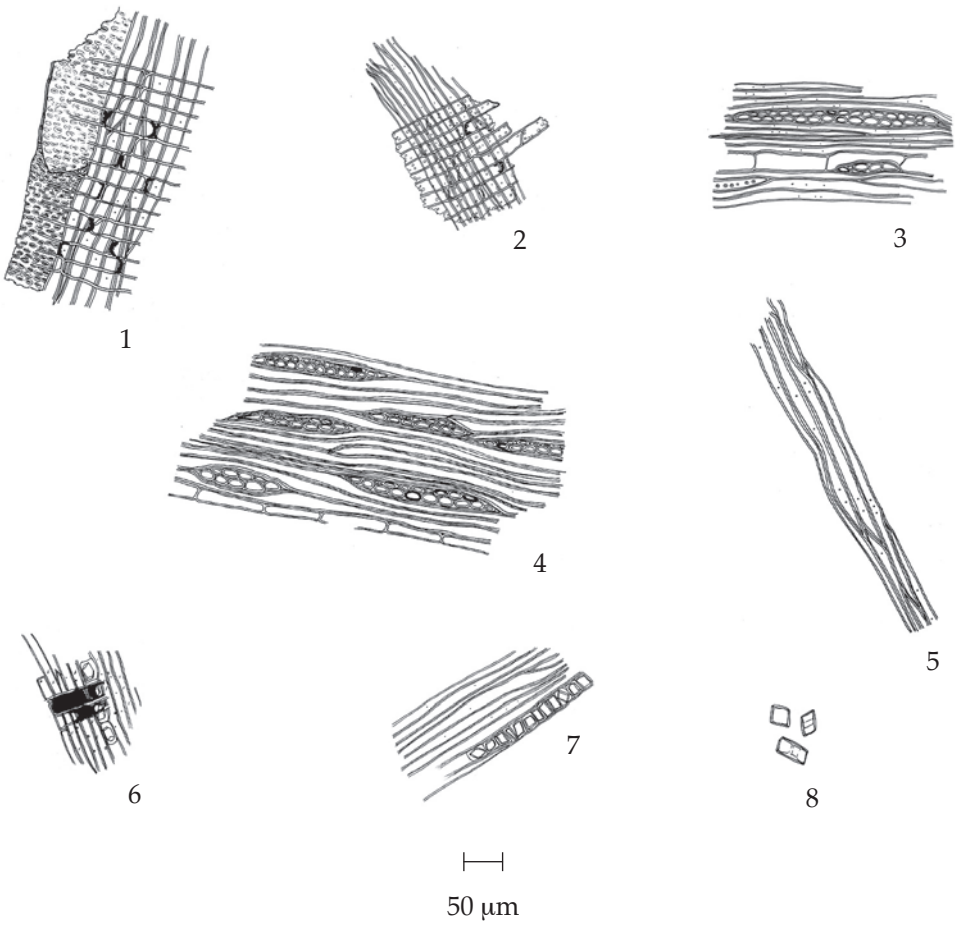


Fig. 2d Powdered Drug of the Heartwood of *Santalum album* L.

1. xylem in radial longitudinal view showing elongated vessel, fibres and xylem ray, some of which contain oleoresin
2. xylem ray, some of which contain oleoresin and fibres in radial longitudinal view
3. xylem in tangential longitudinal view showing fibres, parenchyma and xylem rays
4. xylem in tangential longitudinal view showing xylem rays and fibres
5. fibres
6. fibres associated with parenchyma containing oleoresin and prismatic crystals of calcium oxalate
7. fibres associated with xylem parenchyma containing prismatic crystals of calcium oxalate
8. prismatic crystals of calcium oxalate

Sandalwood in powder possesses the diagnostic microscopical characters of the unground drug.

Storage Sandalwood shall be stored in a cool and dry place, protected from light.

Identification

A. Reflux 1 g of the sample, in powder, with 20 mL of *methanol* for 15 minutes and filter (solution 1). Evaporate 2 mL of solution 1 to dryness. Dissolve the residue in 2 mL of *acetic anhydride*, and then slowly add 1 mL of *sulfuric acid* to form two layers: a brown colour forms at the zone of contact and the upper layer is green.

B. To 2 mL of solution 1, add a few drops of *iron(III) chloride TS*: a green colour is produced.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 90 volumes of *toluene* and 10 volumes of *ethyl acetate* as the mobile phase. Apply to the plate, 5 μL of the test solution prepared by refluxing 1 g of sample, in powder, with 30 mL of *dichloromethane* for 30 minutes and filtering. Evaporate the filtrate to dryness and dissolve the residue in 1 mL of *toluene*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; one intense blue fluorescent spot is observed. Spray the plate with *anisaldehyde TS* and heat at 110° for 10 minutes; several spots of different colours appear (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Dichloromethane Extract of the Heartwood of *Santalum album* L.

Spot	hR_f Value	Detection		
		UV 254	UV 366	*Anisaldehyde TS*
1	15–22	–	–	violet
2	25–30	–	–	orange
3	32–38	–	–	violet
4	40–45	–	–	brown
5	45–48	–	–	pale violet
6	50–52	–	intense blue	–
7	58–64	–	–	brown
8	65–68	quenching	–	–
9	69–73	–	–	brown
10	73–76	–	–	pink
11	85–88	–	–	pale brown
12	94–97	weak quenching	–	violet

Water Not more than 9.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 0.5 per cent w/w (Appendix 7.2).

Total ash Not more than 1.5 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 3.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 3.0 per cent w/w (Appendix 7.12).

Volatile oil Not less than 1.0 per cent v/w (Appendix 7.3H). Use 30 g, in *coarse powder*, freshly prepared and accurately weighed. Use 300 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube.

Dose 2 to 6 g a day.

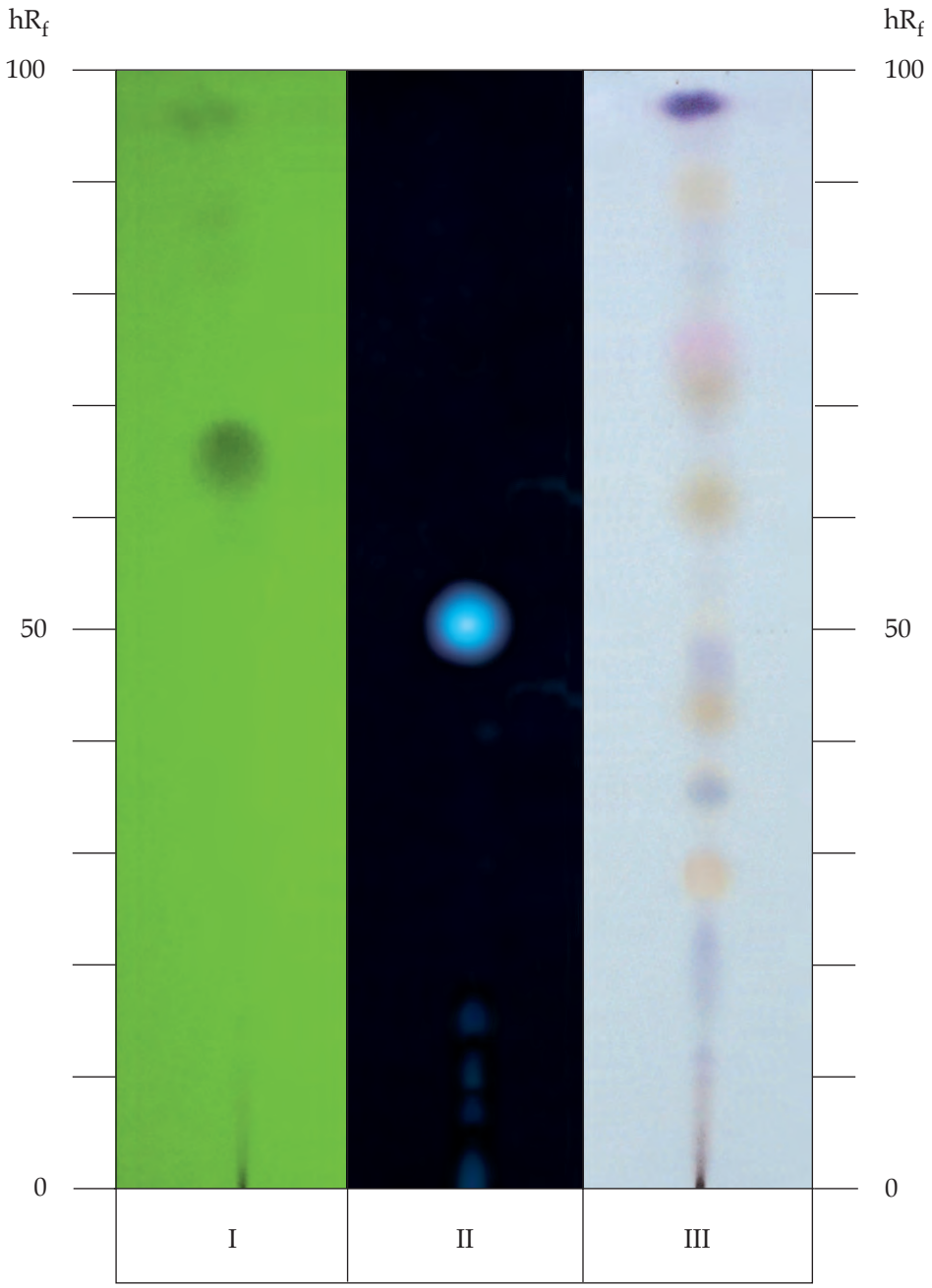


Fig. 3 Thin-Layer Chromatogram of Dichloromethane Extract of the Heartwood of *Santalum album* L.
I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *anisaldehyde TS*

ช้าพลู, ใบ (CHAPHLU, BAI)

ชะพลู, ใบ (CHAPHLU, BAI), ผักอีเลิด, ใบ (PHAK I LOET, BAI), พลูลิง, ใบ (PHLULING, BAI), ปูลิง, ใบ (PULING, BAI)
Piperis Sarmentosi Folium
Piper Sarmentosum Leaf

Category Carminative.

Piper Sarmentosum Leaf is the dried leaf of *Piper sarmentosum* Roxb. (Family Piperaceae), Herbarium Specimen Number: DMSC 2714, BKF 160077, Crude Drug Number: DMSc 0686.

Constituents Piper Sarmentosum Leaf contains phenylpropanoids.

Description of the plant (Figs. 1a, 1b) Herb erect or creeping, often stoloniferous, swollen node. Leaves simple, alternate, stipulate; suborbicular ovate, or ovate-oblong, 7 to 15 cm long, 5 to 10 cm wide, surface glabrous or short hairs, apex acute to shortly acuminate, base cordate to obliquely obtuse or rounded, margin entire, slightly undulate, veins palmately 5- to 7-nerved, prominent on lower surface; petiole 2 to 5 cm long. Inflorescence leaf-opposed dense spike, generally unisexual. Male spike white, 1.5 to 3 cm long; peduncle 0.5 to 1.5 cm long; stamens 2 to 3, filament very short, anther subglobose. Female spike whitish, 2 to 5 cm long; peduncle 0.5 to 1.5 cm long; stigmas 3 to 4. Fruit drupe, obovoid, dark green when ripe. Seeds small.

Description Odour, characteristic; taste, slightly pungent.

Macroscopical (Fig. 1a) A mixture of entire and broken leaves. Entire leaf, ovate or obovate-oblong, 3.5 to 13 cm long, 2.5 to 7 cm wide; apex, acuminate; base, cordate or obtuse or obliquely obtuse; upper surface green to greenish brown, lower surface green to greyish green, lighter colour; petiole brown, 1 to 6 cm long.

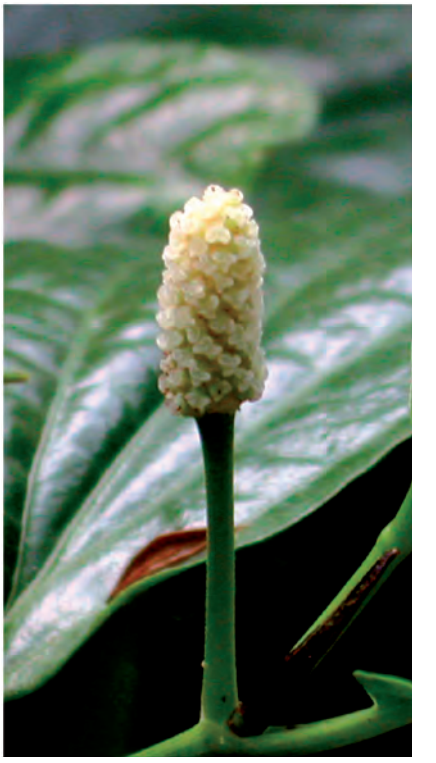
Microscopical (Figs. 2a, 2b, 2c) Transverse section of the leaf shows upper epidermis, a single layer of cuticularized rectangular cells, polygonal in surface view, with few unicellular trichomes and pearl glands. Mesophyll, a single layer of palisade parenchyma and several layers of round spongy parenchyma with scattered small vascular bundles. Lower epidermis, a single layer of rectangular cells, polygonal and irregular shape in surface view; stomata, mostly anomocytic. Hypodermis, 1 to 2 layers of cells under upper and lower epidermises of midrib and nearby area, and leaf margin.

Transverse section through the midrib of lamina shows several layers of collenchyma underneath the epidermis, parenchyma and collateral vascular bundles. Trichomes, 1 to 3 cells, uniseriate nonglandular, abundant at lower epidermis.

Piper Sarmentosum Leaf in powder possesses the diagnostic microscopical characters of the unground drug.

Packaging and storage Piper Sarmentosum Leaf shall be kept in well-closed containers, protected from light, and stored in a dry place.

1



2

3

4

Fig. 1a *Piper sarmentosum* Roxb.
1. habit 2. inflorescence 3. infructescence 4. crude drug

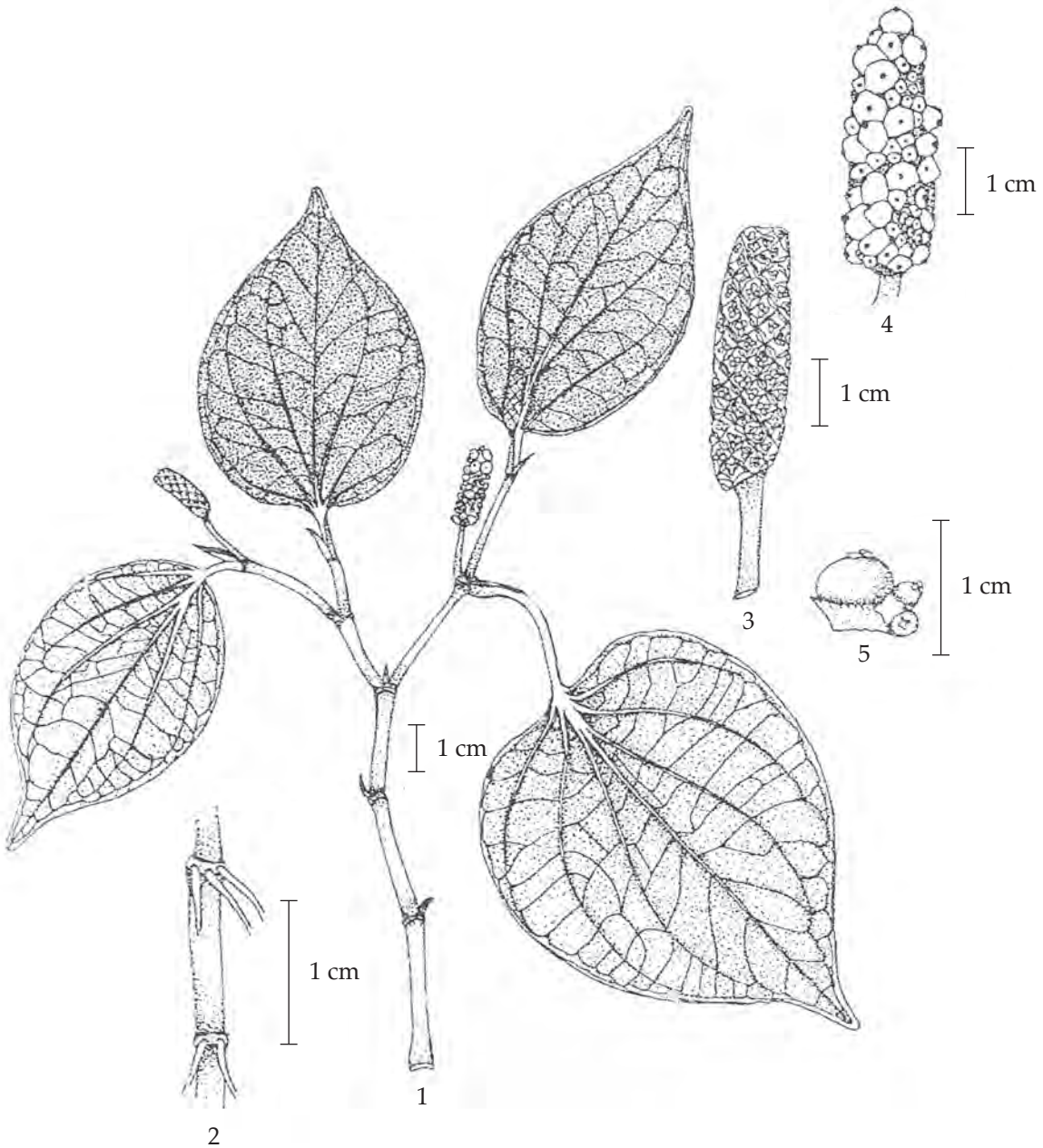
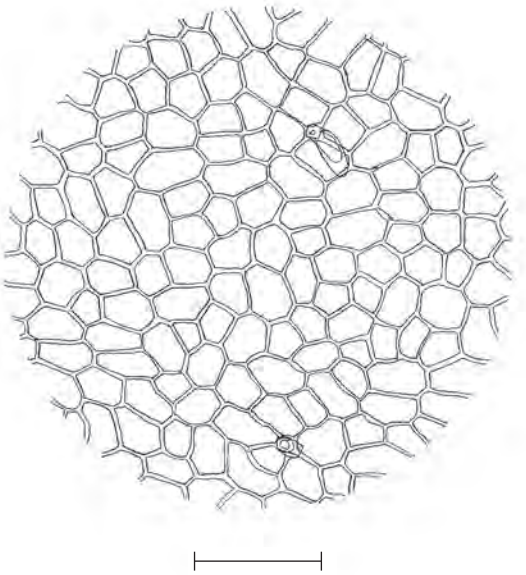
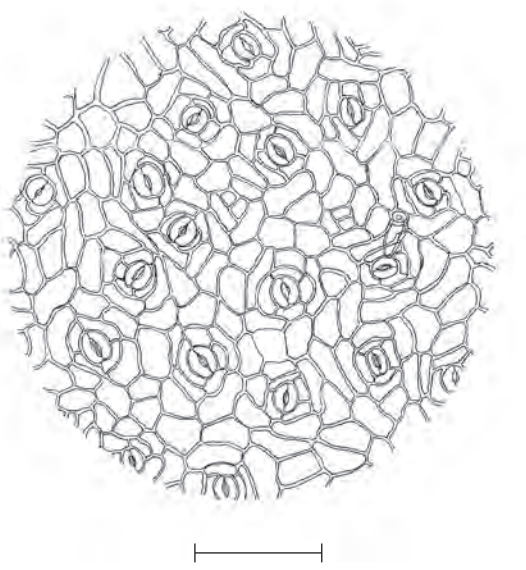


Fig. 1b *Piper sarmentosum* Roxb.
1. twig 2. stem with adventitious roots 3. inflorescence
4. infructescence 5. drupes



100 μm

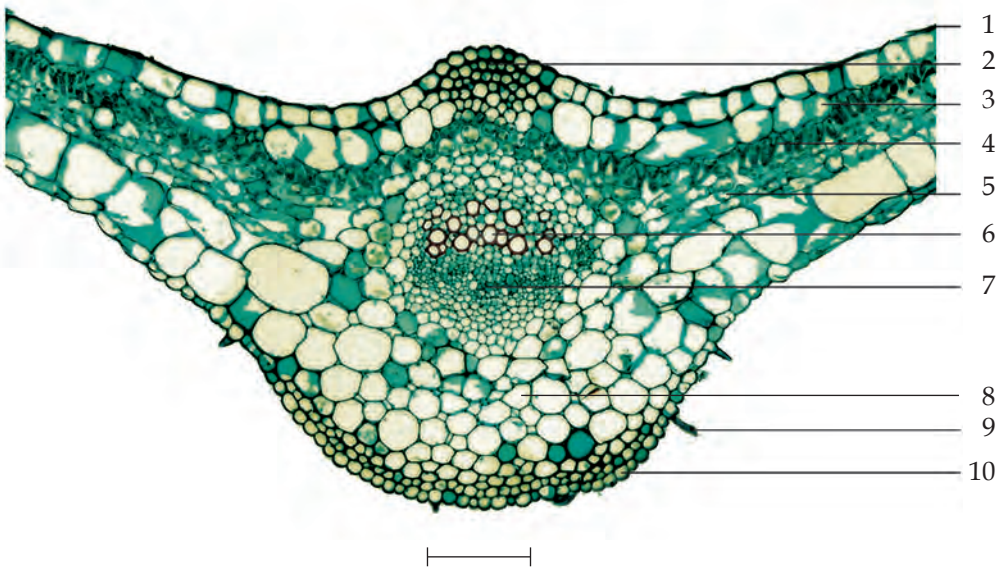
Upper Epidermis of the Lamina



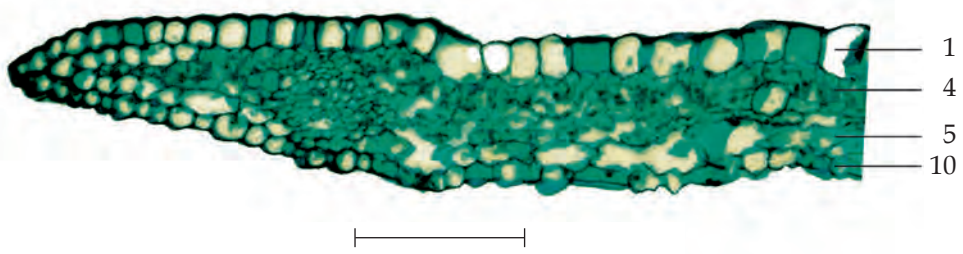
100 μm

Lower Epidermis of the Lamina

Fig. 2a Epidermises of the Leaf of *Piper sarmentosum* Roxb.



Transverse Section of the Midrib



Transverse Section of the Margin

Fig. 2b Photomicrographs of Transverse Sections of the Leaf of *Piper sarmentosum* Roxb. Stained with Safranin-Fast Green

1. upper epidermis
2. collenchymatous tissue
3. hypodermis
4. palisade cell
5. spongy cell
6. xylem tissue
7. phloem tissue
8. parenchyma in midrib
9. trichome
10. lower epidermis

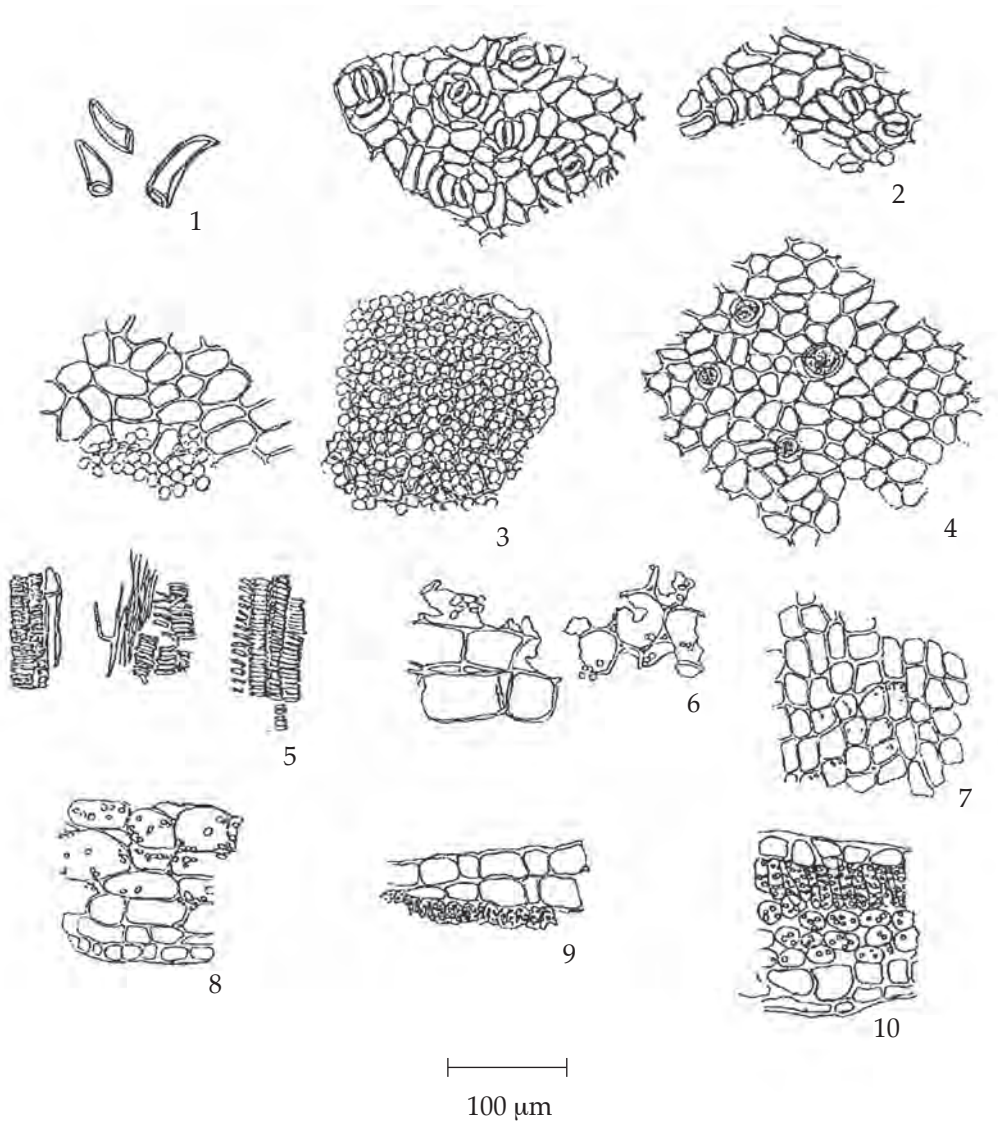


Fig. 2c Powdered Drug of the Leaves of *Piper sarmentosum* Roxb.

1. unicellular trichomes
2. lower epidermis consisting of mostly anomocytic stomata in surface view
3. upper epidermis and underlying palisade cells in surface view
4. upper epidermis with pearl glands in surface view
5. fibres and reticulate, spiral and scalariform vessels
6. parenchyma cells with starch grains
7. epidermal cells in surface view
8. lower epidermis with parenchyma cells
9. upper epidermis underlying hypodermis and palisade cells with chloroplast
10. leaf blade in transverse view

Identification

A. Macerate 500 mg of the sample, in *coarse powder*, with 25 mL of *ethanol* for 24 hours, filter, and evaporate the filtrate to dryness. Dissolve the residue in 10 mL of *dilute sulfuric acid* and filter (solution 1). To 2 mL of solution 1, add a few drops of *mercuric-potassium iodide TS*: a white precipitate is produced.

B. To 2 mL of solution 1, add a few drops of *modified Dragendorff TS1*: an orange precipitate is produced.

C. Boil 500 mg of the sample, in *coarse powder*, with 10 mL of *water* in a water-bath for 10 minutes and filter. To 2 mL of the filtrate, add 1 or 2 drops of a 1 per cent w/v solution of *iron(III) chloride*: a greenish grey precipitate develops.

D. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 3 volumes of *ethyl acetate* and 1 volume of *toluene* as the mobile phase. Apply to the plate, 10 μL of the test solution prepared by macerating 500 mg of the sample, in *coarse powder*, with 25 mL of *ethanol* for 24 hours, filtering, and evaporating the filtrate to dryness. Dissolve the residue in 1 mL of *ethanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; several fluorescent spots of different colours are observed. Spray the plate with *modified Dragendorff TS1*; several spots of different colours appear (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Ethanolic Extract of the Leaves of *Piper sarmentosum* Roxb.

Spot	hR_f Value	Detection		
		UV 254	UV 366	*Modified Dragendorff TS1*
1	7–9	quenching	red	–
2	12–14	quenching	intense red	greyish blue
3	14–16	quenching	red	greyish blue
4	21–23	quenching	purple	orange
5	25–27	–	red	–
6	30–32	quenching	–	orange
7	33–35	weak quenching	–	–
8	37–39	–	red	–
9	41–43	–	light purple	–
10	46–48	weak quenching	green	–
11	57–59	weak quenching	–	–
12	60–62	–	intense blue	–
13	68–70	weak quenching	red	–
14	71–73	weak quenching	–	–
15	78–80	weak quenching	red	–
16	88–90	quenching	red	–
17	92–94	quenching	red	greyish blue
18	95–97	quenching	red	–

Loss on drying Not more than 10.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Acid-insoluble ash Not more than 7.0 per cent w/w (Appendix 7.6).

Total ash Not more than 20.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 7.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 20.0 per cent w/w (Appendix 7.12).

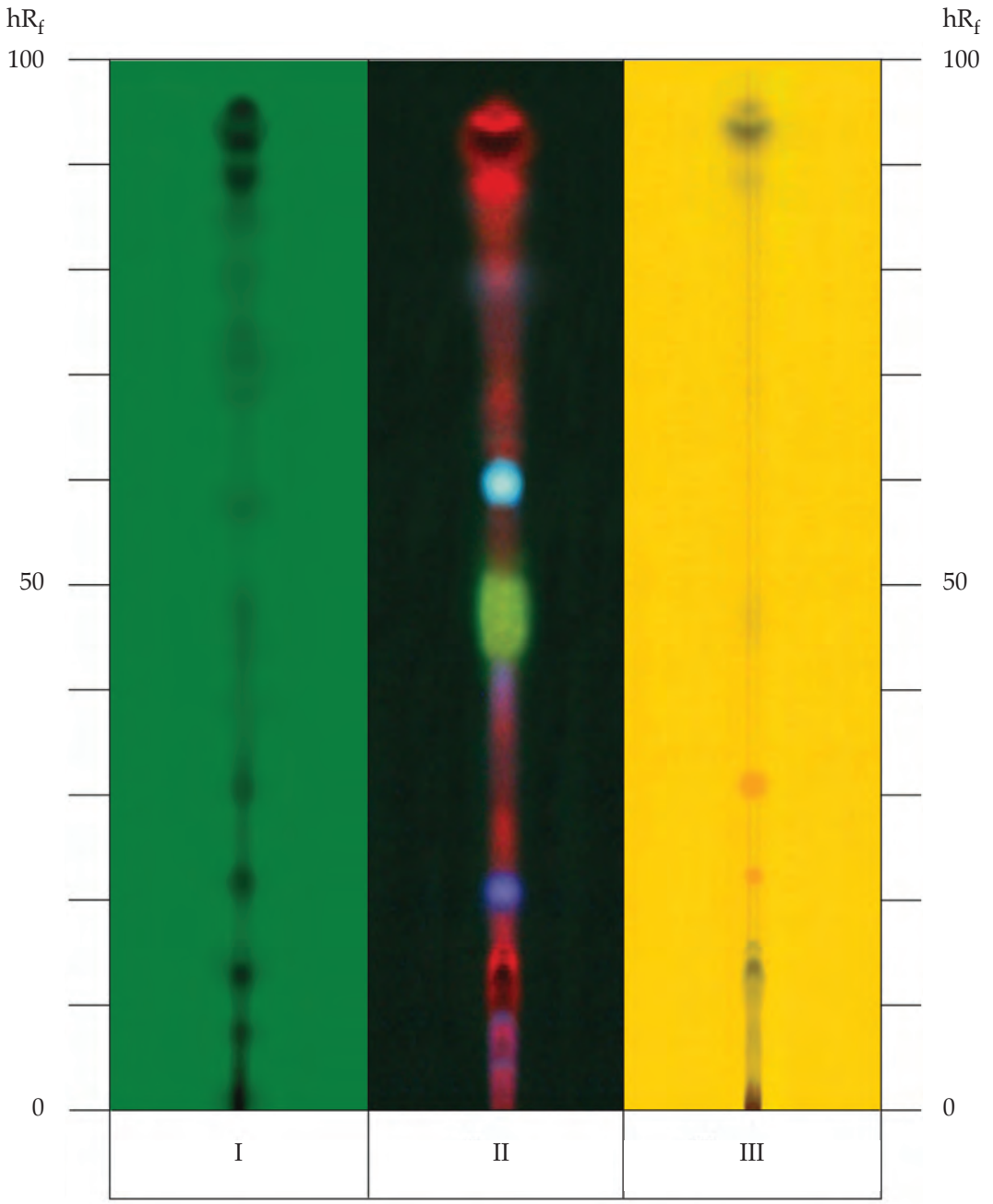


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Leaves of *Piper sarmentosum* Roxb.

I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *modified Dragendorff TS1*

ชุมเห็ดไทย (CHUMHET THAI)

ชุมเห็ดเขาควาย (CHUMHET KHAO KHWAI), ชุมเห็ดเล็ก (CHUMHET LEK), ชุมเห็ดนา (CHUMHET NA)
Sennae Torae Semen
Cassia Seed

Category Laxative, diuretic.

Cassia Seed is the dried mature seed of *Senna tora* (L.) Roxb. (*Cassia tora* L.) (Family Leguminosae), Herbarium Specimen Number: DMSC 1514, Crude Drug Number: DMSc 427.

Constituents Cassia Seed contains anthraquinone aglycones (e.g., emodin, aloe-emodin, chrysophanol, physcione, rhein) and their glycosides. It also contains toralactone, sterols, mucilage, etc.

Description of the plant (Figs. 1a, 1b) Herb or undershrub up to 1 m high, nearly glabrous. Leaves with 2 to 4 pairs of leaflets; petiole 1 to 4 cm long; rhachis 2 to 3 cm long with a subulate, about 2 mm long, gland between the two lower pairs of leaflets; stipule setaceous, 1 to 1.5 cm long, more or less caducous, leaflets increasing in size distally with a short petiolule, membranous, obovate, apex broadly rounded, base cuneate-rounded, 2 to 5 cm long, 1.5 to 2 cm wide. Inflorescence axillary, raceme, short, 1- or few-flowered; bract linear-acute, 2 to 3 mm long; pedicel 4 to 10 mm (enlarging in fruit); sepals 5, subequal, ovate, about 5 mm long, 2 to 4 mm wide; petals 5, yellow, unequal, obovate, short-clawed with rounded apex, up to 1 cm long, about 6 mm wide; stamens 7 to 10, 3 large, 4 medium, 3 staminodial or absent, rarely perfect, filament 1.5 to 2 mm long, anther 1.5 to 2.5 mm long, opening by apical pores, reduced stamens absent; ovary densely pubescent, style glabrous with truncate apex (stigma). Fruit terete, more or less falcate, 10 to 15 cm long, about 5 mm wide. Seeds 20 to 30, glossy, brown rhomboidal, 3 to 6 mm long, 2 to 3 mm wide.

Description Odour, foetid; taste, slightly bitter.

Macroscopical (Fig. 1a) Hard rhomboid-prismatic, 3 to 6 mm long, 2 to 3 mm wide, with a beak at one end. Externally greenish brown or yellowish brown, smooth and glossy, with pale brown bands occurring on both sides. The hilum and micropyle are located on the beak side.

Microscopical (Figs. 2a, 2b) Transverse and longitudinal sections of the seed reveal seed coat, cotyledon and embryo. Seed coat, covered with a thick cuticle layer, following by a layer of sclerified palisade cells, a layer of lagenosclereids and several layers of thick-walled parenchyma. Endosperm, non-lignified, thick-walled cells, mostly with empty protoplasm. Cotyledons, two layers of dense, cylindrical, parenchymatous palisade cells and spheroidal spongy cells. Embryo, mostly with parenchyma cells. Crystals, rosette aggregate and prismatic, may be seen in thick-walled parenchyma, embryo and cotyledons.

Cassia Seed in powder possesses the diagnostic microscopical characters of the unground drug.

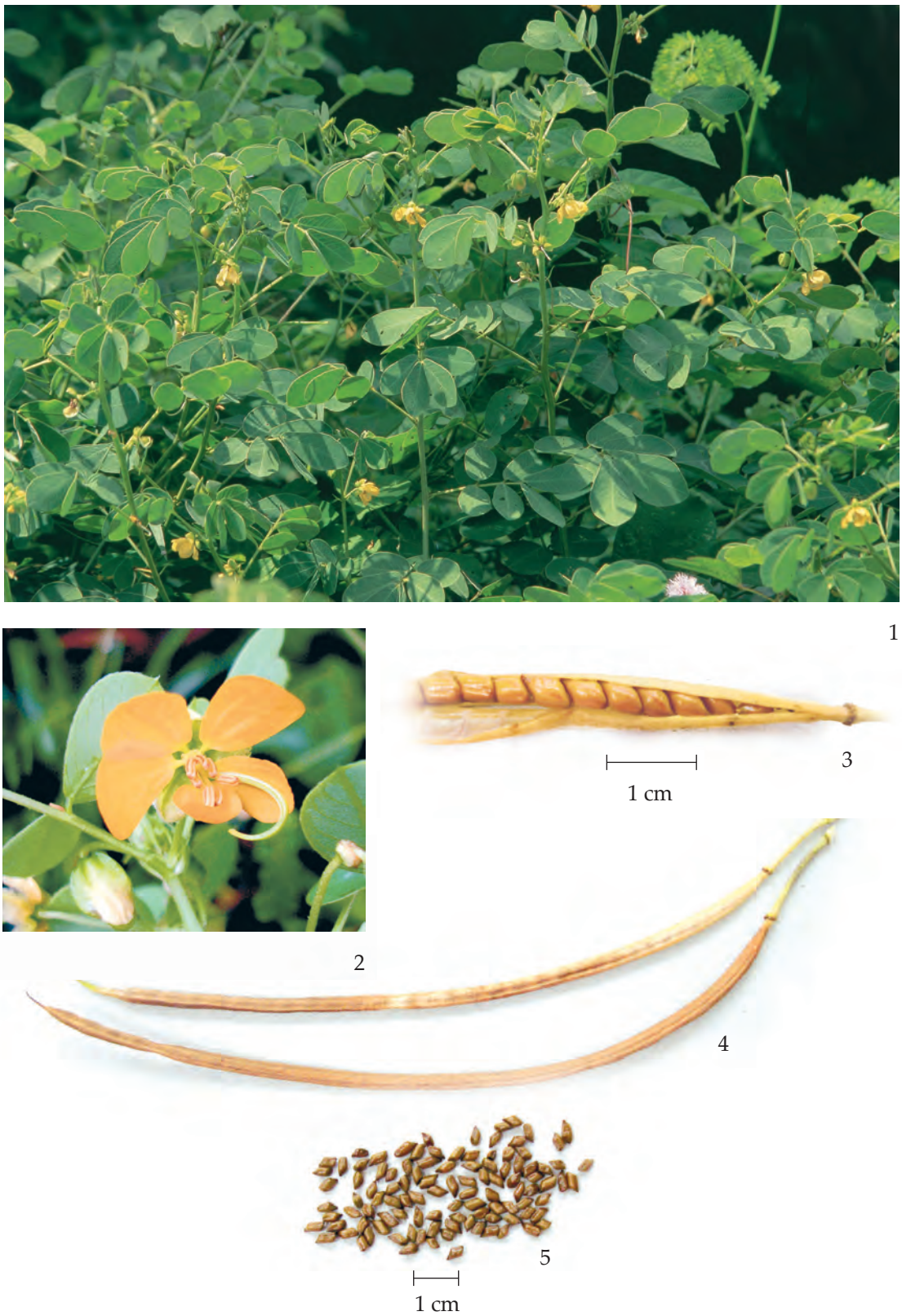


Fig. 1a *Senna tora* (L.) Roxb.
1. habit 2. flowering twig 3. young pod 4. mature pods 5. crude drug

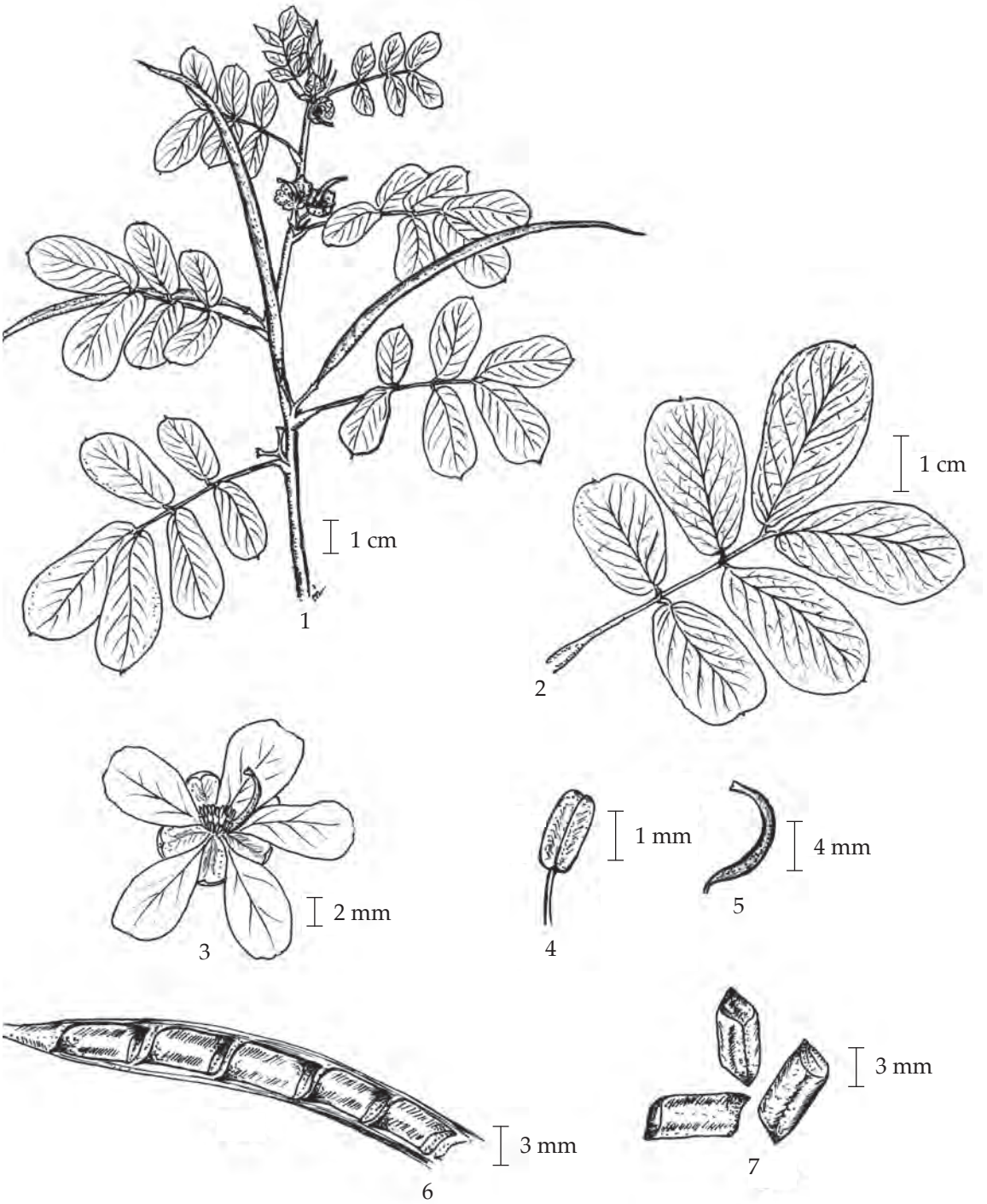


Fig. 1b *Senna tora* (L.) Roxb.
1. flowering top showing leaves and pods 2. compound leaf 3. flower 4. stamen 5. pistil 6. part of pod showing seeds 7. seeds

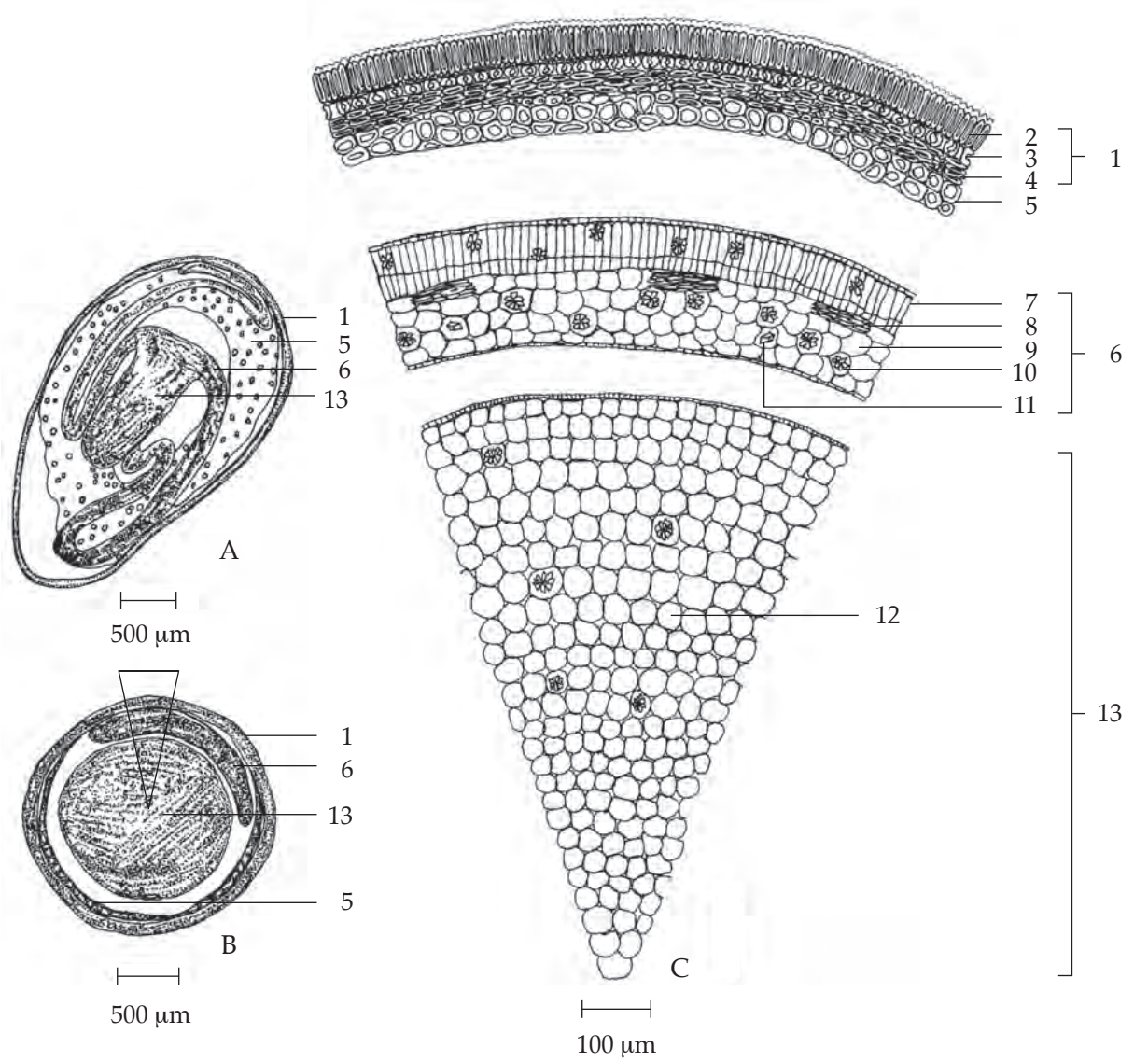


Fig. 2a Section of the Seed of *Senna tora* (L.) Roxb.

A. Diagram of Longitudinal Section
B. Diagram of Transverse Section
C. Sectional View of Transverse Section

1. seed coat covered with a cuticle layer
2. sclerified palisade cell
3. lagenosclereid
4. thick-walled parenchyma
5. thick-walled endosperm
6. cotyledon
7. palisade cell
8. vascular tissue
9. spongy cell
10. rosette aggregate crystal
11. prismatic crystal
12. parenchyma cell
13. embryo axis

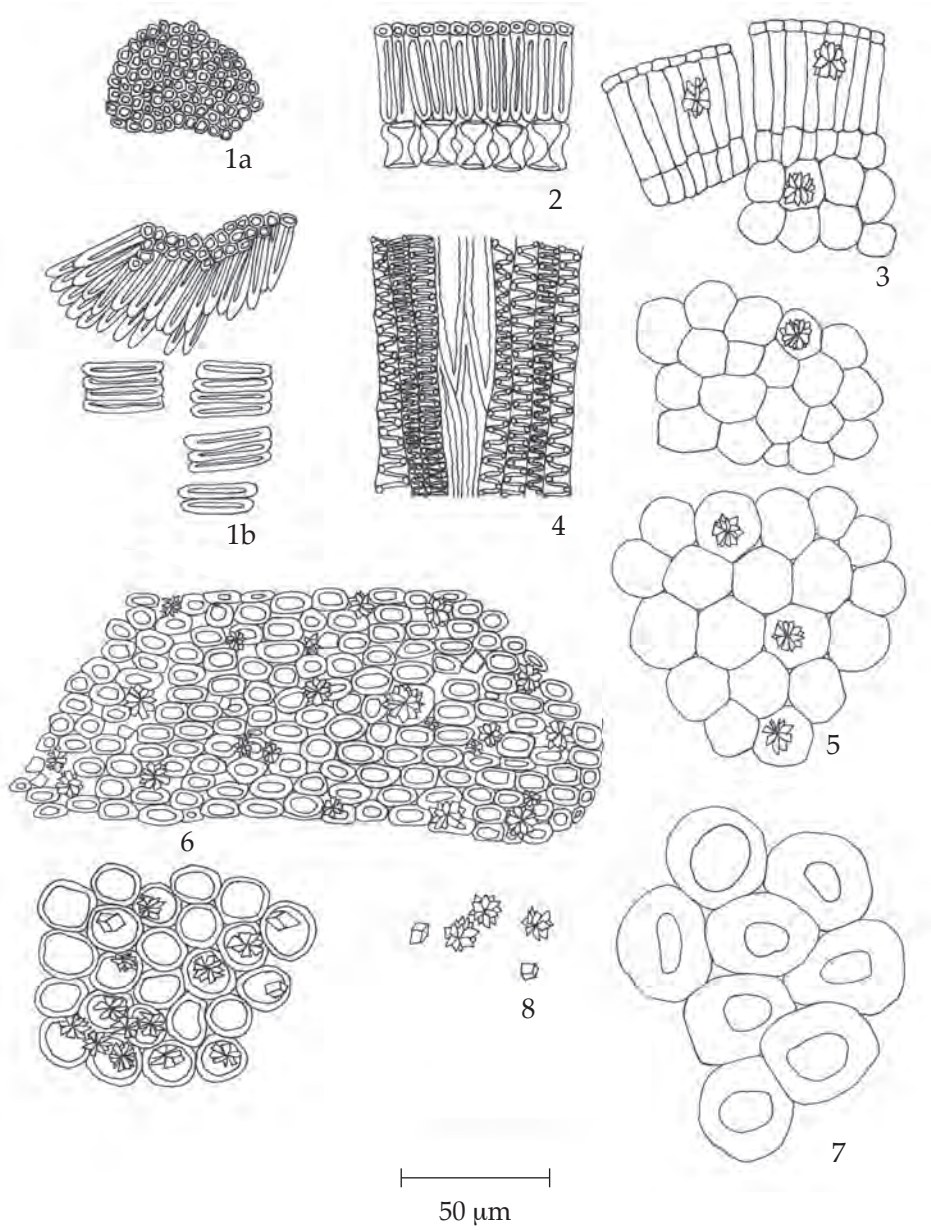


Fig. 2b Powdered Drug of the Seeds of *Senna tora* (L.) Roxb.

1. sclerified palisade cells in surface (1a) and tangential longitudinal (1b) views of seed coat
2. sclerified palisade cells with a covering cuticle layer and underlying langenosclerids
3. cotyledon in sectional view showing epidermal layer, palisade cells, spongy cells, and rosette aggregate crystals
4. vascular tissue in longitudinal view showing spiral vessels and fibres
5. parenchyma cells with rosette aggregate crystals
6. thick-walled parenchyma with scattering rosette aggregate and prismatic crystals
7. thick-walled endosperm cells
8. rosette aggregate and prismatic crystals

Warning

1. It should be used with caution in children, pregnant women or patients with inflammatory bowel disease.

2. It may cause drowsiness and/or mild abdominal discomfort such as colic or cramps. Excessive doses may produce nephritis.

3. Prolonged use should be avoided since it may result in diarrhea with excessive loss of water and electrolytes, particularly potassium.

Additional information Traditionally, it must be stir-fried[1] before use.

Packaging and storage Cassia Seed shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. To 100 mg of the sample, in *coarse powder*, add 25 mL of 2 M *hydrochloric acid*, heat on a water-bath for 15 minutes, and immediately filter through a plug of cotton wool. Allow the filtrate to cool and shake with 20 mL of *ether*. Separate the ether layer and shake with 10 mL of *ammonia TS*: the aqueous layer becomes pink-red.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 75 volumes of n-*hexane*, 25 volumes of *ethyl acetate* and 1 volume of *glacial acetic acid* as the mobile phase. Apply separately to the plate, 10 μL each of the following two solutions. Prepare solution (A) by refluxing 10 g of the defatted sample[2], in *coarse powder*, with 100 mL of *chloroform* for 1 hour. Filter the chloroform extract, evaporate the filtrate on a water-bath to dryness and dissolve the residue in 1 mL of *methanol*. For solution (B), dissolve 5 mg of *emodin* in 5 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. The chromatogram obtained from solution (A) shows a quenching spot (hR_f value 41 to 47) corresponding to the emodin spot from solution (B). Expose the plate to ammonia vapour; the spot due to emodin is reddish purple. Several other spots of different colours are also observed (Table 1); see also Fig. 3.

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[1]Place the clean crude drug in a pan or wok, and stir with gentle heat until slightly scented.

[2]Defat the sample by either extracting in a Soxhlet apparatus for 2 hours with *petroleum ether* (*boiling range, 40° to 60°*) or standing overnight with the petroleum ether without heating.

Table 1 hR_f Values of Components in Chloroform Extract of the Seeds of *Senna tora* (L.) Roxb.

Spot	hR_f Value	Detection	
		UV 254	Ammonia Vapour
1	19–25	quenching	violet
2	25–29	quenching	yellowish brown
3	32–38	quenching	reddish purple
4*	41–47	quenching	reddish purple
5	50–55	quenching	reddish purple
6	75–80	quenching	reddish purple
7	81–85	quenching	reddish purple

*emodin

Loss on drying Not more than 12.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 0.2 per cent w/w (Appendix 7.6).

Total ash Not more than 6.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 8.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 20.0 per cent w/w (Appendix 7.12).

Dose Stir-fried seeds, 10 to 13 g a day.

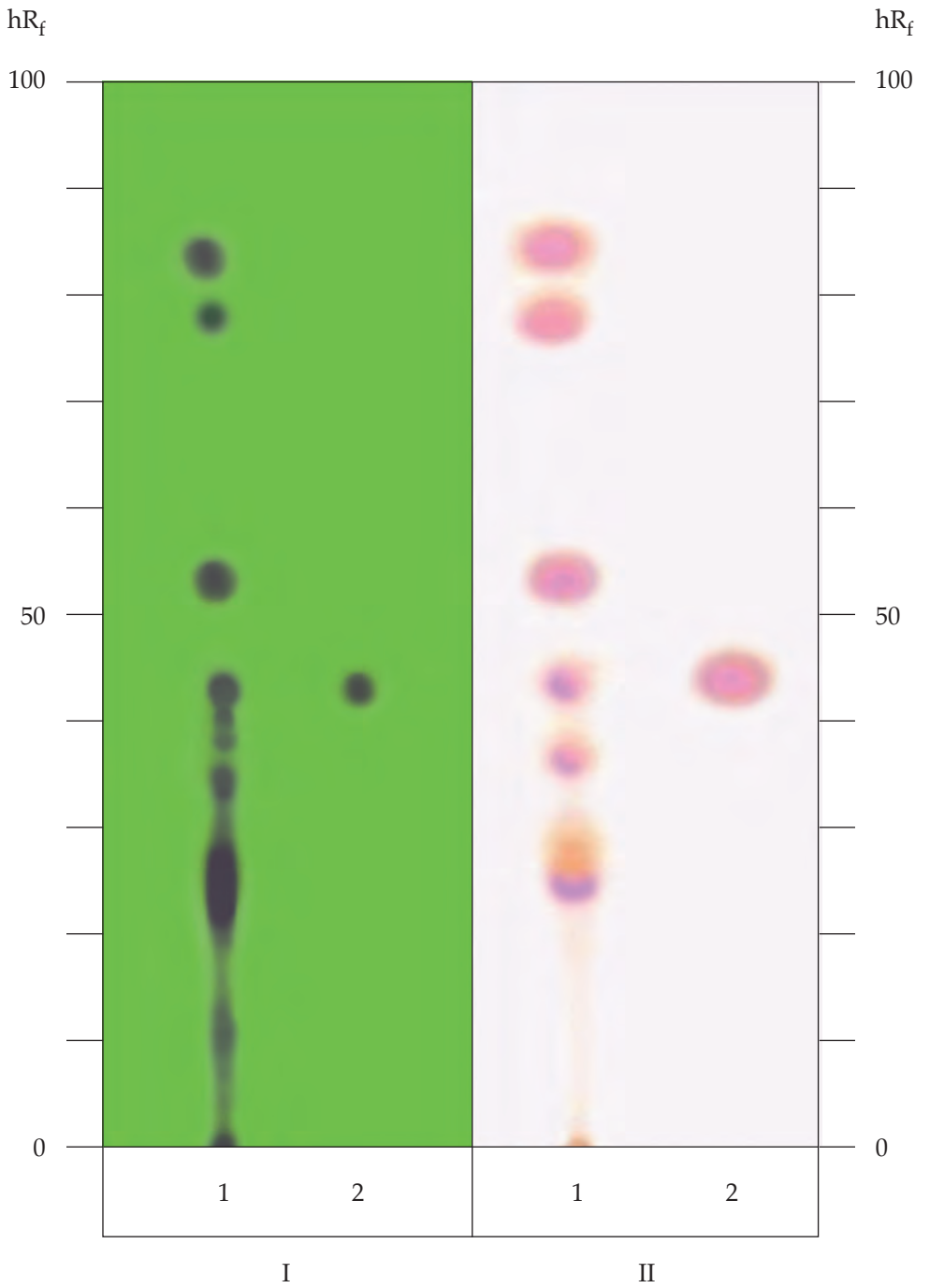


Fig. 3 Thin-Layer Chromatogram of Chloroform Extract of the Seeds of *Senna tora* (L.) Roxb.

1 = solution (A)
2 = solution (B)
I = detection under UV light (254 nm)
II = detection with ammonia vapour

ชุมเห็ดเทศ (CHUMHET THET)

Sennae Alatae Folium
Senna Alata Leaf

Synonym Ringworm Senna Leaf

Category Laxative, antifungal (ringworm).

Senna Alata Leaf is the dried leaflets of *Senna alata* (L.) Roxb. [*Cassia alata* L., *Herpetica alata* (L.) Raf., *Cassia bracteata* L. f.] (Family Leguminosae), Herbarium Specimen Number: DMSC 323, Crude Drug Number: DMSc 1052.

Constituents Senna Alata Leaf contains anthraquinone aglycones (e.g., rhein, emodin, aloe-emodin, chrysophanol, and isochrysophanol), glycosides of rhein, of aloe-emodin and of physcione. It also contains kaempferol, β-sitosterol, sennosides A, B, C, and D, etc.

Description of the plant (Figs. 1a, 1b) Shrub 1 to 5 m high with pubescent, horizontally spread branches. Leaves compound, leaflets 8 to 20 pairs; petiole robust 2 cm; rachis 30 to 60 cm; stipule auriculate, persistent, deltoid, 6 to 8 mm long; leaflet oblong-elliptic, rounded at both ends, 5 to 15 cm long, 3 to 7 cm wide, glabrous; petiolule robust, 2 to 3 mm. Inflorescence axillary, raceme, dense, robust, 20 to 50 cm long, 3 to 4 cm wide; bract caducous, 2 to 3 cm long, 1 to 2 cm wide; pedicel very short, 2 to 4 mm, sepal unequal, oblong, 10 to 20 mm long, 6 to 7 mm wide; petal bright yellow, ovate-orbicular to spathulate, short clawed, 2 cm long, 1 to 1.5 cm wide; stamens 9 to 10, 2 largest with thick filaments, 4 mm long and anthers 12 to 13 mm long, 4 stamens with filaments 2 mm long and anthers 4 to 5 mm long, opening by apical pores, 3 to 4 stamens reduced; ovary and style glabrous, stigma small. Fruit thick, flattened, winged, glabrous, septate, 10 to 15 cm long, 1.5 to 2 cm wide; wing 5 mm. Seeds about 50, flattened, slightly quadrangular, 7 to 10 mm long, 5 to 8 mm wide.

Description Odour, slightly aromatic; taste, slightly bitter.

Macroscopical (Fig. 1a) Senna Alata Leaf occurs as a mixture of entire and broken, greenish brown to brown leaflets and frequently rachillae of the compound leaf. Leaflets, 5 to 15 cm long, 3 to 7 cm wide, oblong to obovate, minutely mucronate at the apex, base oblique, margin entire, pinnate reticulate venation, rigidly subcoriaceous, obscurely downy beneath.

Microscopical (Figs. 2a, 2b) Transverse section of the leaflet shows epidermal cells with cuticle, slightly sinuous walls at both sides. Papillae, epidermal appendages, blurred and rarely seen at the upper, whereas clearly and densely at the lower. Covering trichomes with thickened and slightly warty walls, unicellular, occasionally found on the lamina, but more frequently found at the lower surface of the midrib. Stomata, paracytic at both epidermides. Palisade cells, columnar, beneath upper epidermis. Spongy cells, parenchymatous. Vascular bundles, xylem in the upper part and phloem in the lower part, surrounded by fibres with a crystal sheath containing calcium oxalate prisms. Vessels, lignified spiral and scalariform in the vein and more reticulate, pitted and bordered-pitted in the midrib. Collenchyma, found beneath upper and lower epidermises in the midrib.

Fig. 1a *Senna alata* (L.) Roxb.
1. habit 2. inflorescence 3. flower 4. fruit 5. crude drug

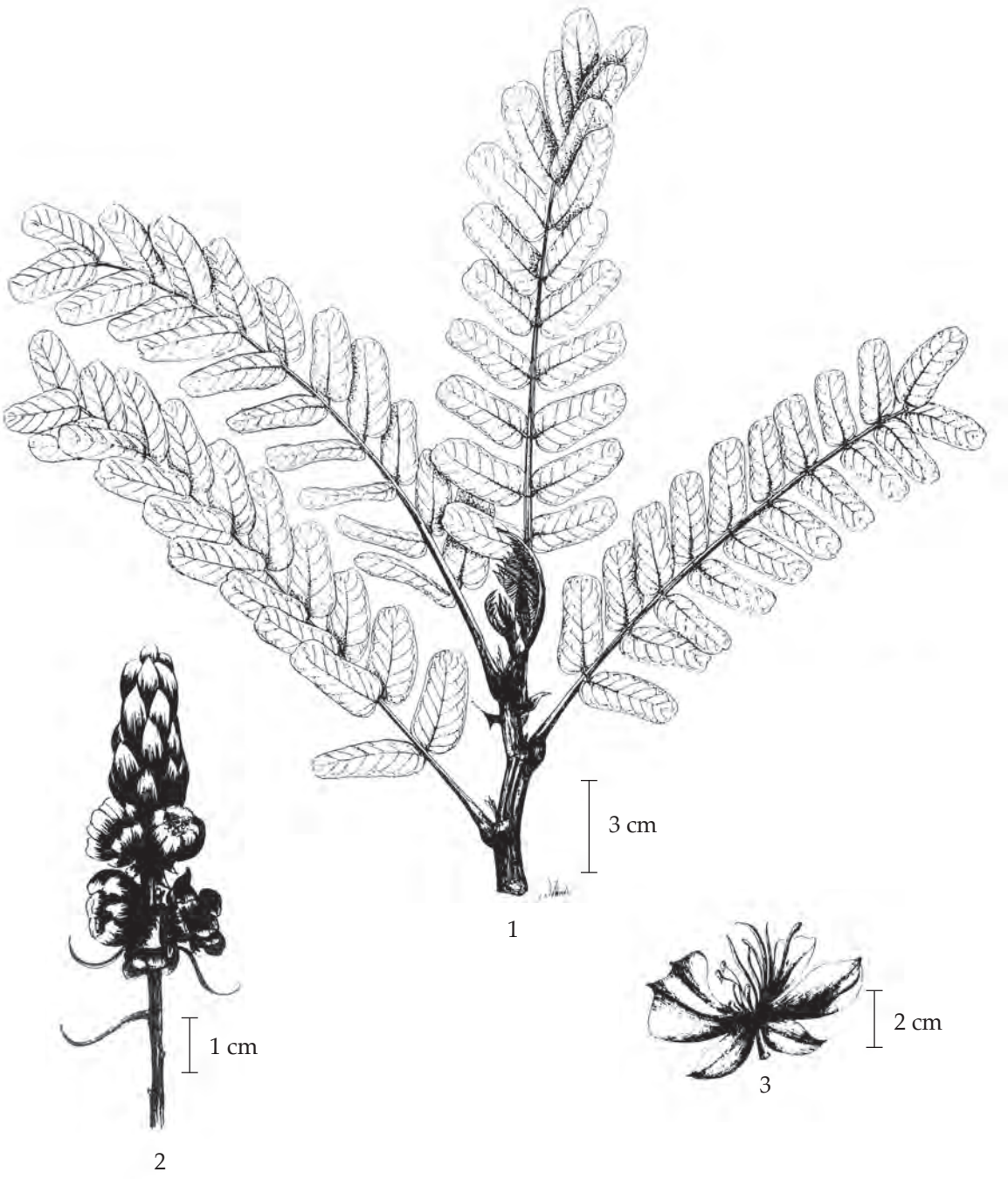


Fig. 1b *Senna alata* (L.) Roxb.
1. twig 2. inflorescence 3. flower

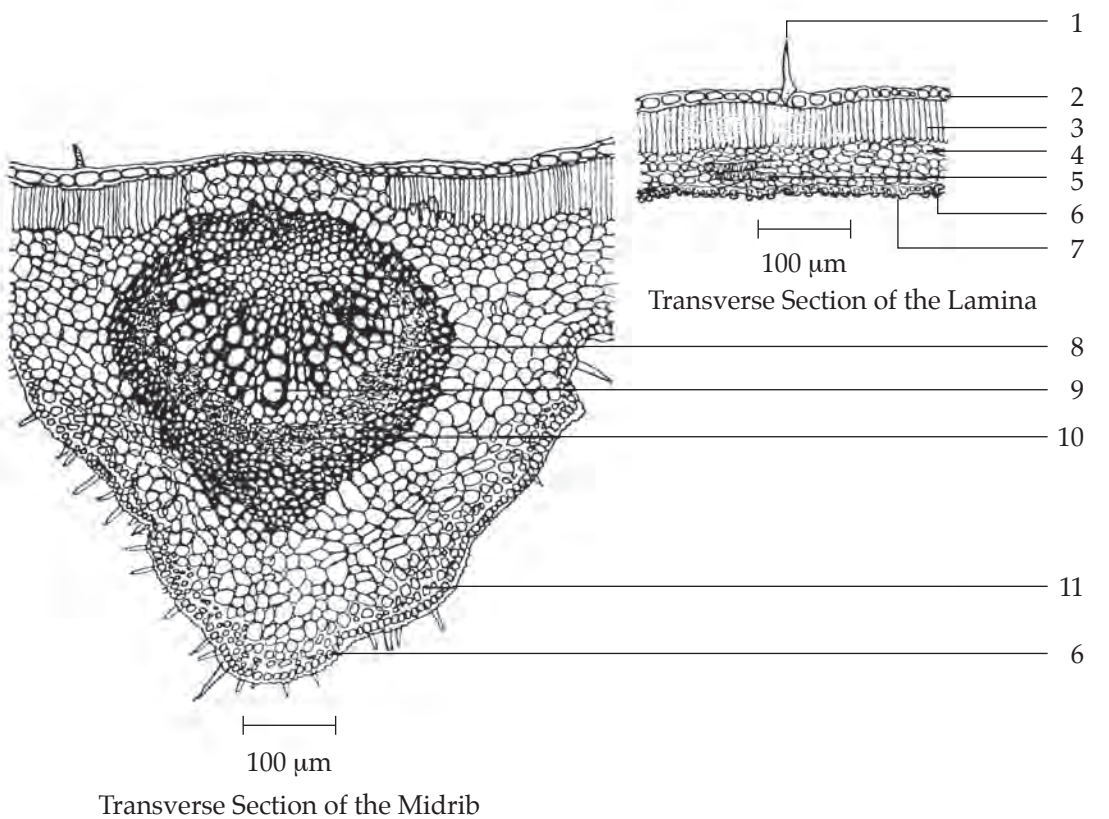


Fig. 2a Transverse Sections of the Leaf of *Senna alata* (L.) Roxb.

1. unicellular trichome
2. upper epidermis
3. palisade cell
4. spongy cell
5. vascular bundle
6. lower epidermis
7. papilla
8. crystal sheath fibre
9. xylem
10. phloem
11. collenchyma

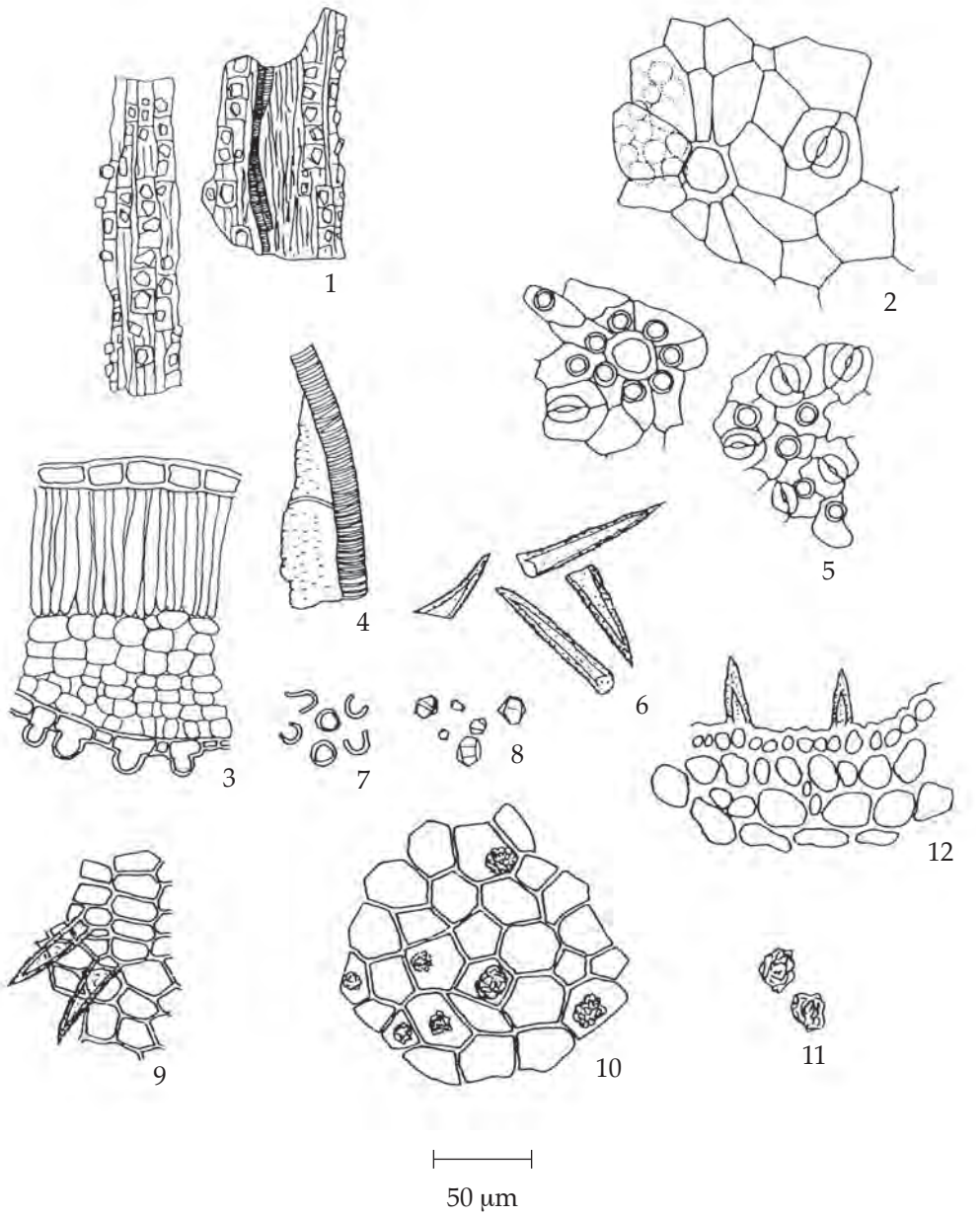


Fig. 2b Powdered Drug of the Leaves of *Senna alata* (L.) Roxb.

1. bundle of crystal sheath fibres
2. upper epidermis with stoma, cicatrix and underlying palisade cells
3. lamina in sectional view showing papillae
4. spiral and pitted vessels
5. lower epidermis with stoma, cicatrix and papillae
6. unicellular trichomes
7. fragments of papillae
8. prismatic crystals
9. epidermis with unicellular trichomes
10. parenchyma with cluster crystals
11. cluster crystals of calcium oxalate
12. collenchyma and epidermis with unicellular trichomes from midrib

Senna Alata Leaf in powder possesses the diagnostic microscopical characters of the unground drug.

Warning

1. It should be used with caution in children, or in patients with inflammatory bowel disease.
2. It may cause mild abdominal discomfort such as colic or cramps. Excessive doses may produce nephritis.
3. Prolonged use should be avoided since it may result in diarrhoea with excessive loss of water and electrolytes, particularly potassium.

Packaging and storage Senna Alata Leaf shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. To 100 mg of the sample, in powder, add 25 mL of 2 M *hydrochloric acid,* heat on a water-bath for 15 minutes, and immediately filter through a plug of cotton wool. Allow the filtrate to cool and shake with 20 mL of *ether*. Separate the ether layer and shake with 10 mL of *ammonia TS*: the aqueous layer becomes red.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 75 volumes of *petroleum ether (boiling range, 40° to 60°)*, 25 volumes of *ethyl acetate* and 1 volume of *anhydrous formic acid* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply separately to the plate, 5 μL each of the following three solutions. Prepare solution (A) by refluxing 100 mg of the sample, in powder, with two 50-mL portions of *chloroform* on a water-bath for 15 minutes. Combine the chloroform extracts and evaporate to dryness. Dissolve the residue in 0.5 mL of *chloroform*. For solution (B), add 25 mL of 2 M *hydrochloric acid* to the marc obtained after the reflux and proceed as in the test for Identification A, beginning with "heat on a water-bath ..." to obtain the ether layer. Evaporate the ether layer to dryness. Dissolve the residue in 0.5 mL of *ether*. For solution (C) dissolve 1 mg of *rhein* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (366 nm), locating the spots. The chromatogram obtained with solutions (A) and (B) correspond in hR_f value and colour to that of rhein as shown in Table 1 or as of solution (C) (Table 1); see also Fig. 3. Expose the plate to ammonia vapour; the spots due to rhein are red. Other spots of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in the Extract of the Leaves of *Senna alata* (L.) Roxb.

Solution	Spot	hR_f Value	Detection	
			UV 366	Ammonia Vapour
A	1	4–8	–	pale green
	2	25–28	–	yellow
	3	29–32	–	yellow
	4*	34–38	orange	red
	5	53–58	–	pale green
	6	60–64	–	pale green
	7	74–77	–	pale green
	8	78–80	–	pale green
B	1	2–4	–	pale brown
	2	25–28	–	yellow
	3*	34–38	orange	red

*rhein

Loss on drying Not more than 11.0 per cent w/w after drying at 105° for 5 hours (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w of stems and other foreign matter (Appendix 7.2).

Acid-insoluble ash Not more than 1.0 per cent w/w (Appendix 7.6).

Total ash Not more than 9.0 per cent w/w (Appendix 7.7).

Ethanol (50 per cent)-soluble extractive Not less than 21.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 18.0 per cent w/w (Appendix 7.12).

Hydroxyanthracene derivatives content Not less than 1.0 per cent w/w of hydroxyanthracene derivatives, calculated as rhein-8-glucoside on the dried basis, when determined by the following method.

Accurately weigh about 150 mg of Senna Alata Leaf, in *No. 150 powder*, and place in a 100-mL round-bottomed flask. Add 30.0 mL of *water*, mix, weigh, and place in a water-bath. Heat under a reflux condenser for 15 minutes. Allow to cool, weigh and adjust to the original weight with *water*. Centrifuge and transfer 20.0 mL of the supernatant liquid to a 150-mL separator. Add 0.1 mL of 2 M *hydrochloric acid* and shake with three 15-mL portions of *chloroform*. Allow to separate and discard the chloroform layer. Add 100 mg of *sodium hydrogencarbonate* and shake for 3 minutes. Centrifuge and transfer 10.0 mL of the supernatant liquid to a 100-mL round-bottomed flask with a ground glass neck. Add 20 mL of a 10.5 per cent w/v solution of *iron(III) chloride* and mix. Heat for 20 minutes under a reflux condenser in a water-bath with water level above that of the liquid in the flask, add 1 mL of *hydrochloric acid* and heat for a further 20 minutes with frequent shaking, to dissolve the precipitate. Cool, transfer the mixture to a separator and shake with three 25-mL portions

of *ether* previously used to rinse the flask. Combine the ether layers and wash with two 15-mL portions of *water*. Transfer the ether layers to a 100-mL volumetric flask and dilute with *ether* to volume. Evaporate 25.0 mL carefully to dryness at low temperature and dissolve the residue in 10.0 mL of a 0.5 per cent w/v solution of *magnesium acetate* in *methanol*. Measure the absorbance of this solution at the maximum at about 515 nm (Appendix 2.2), using the magnesium acetate solution as the blank.

Calculate the percentage content of rhein-8-glucoside from the expression:

$$A \times 0.4283 / w,$$

where A = the absorbance of the substance being examined at 515 nm, and

w = the weight in g of the substance being examined.

Dose 3 to 6 g once a day at bedtime.

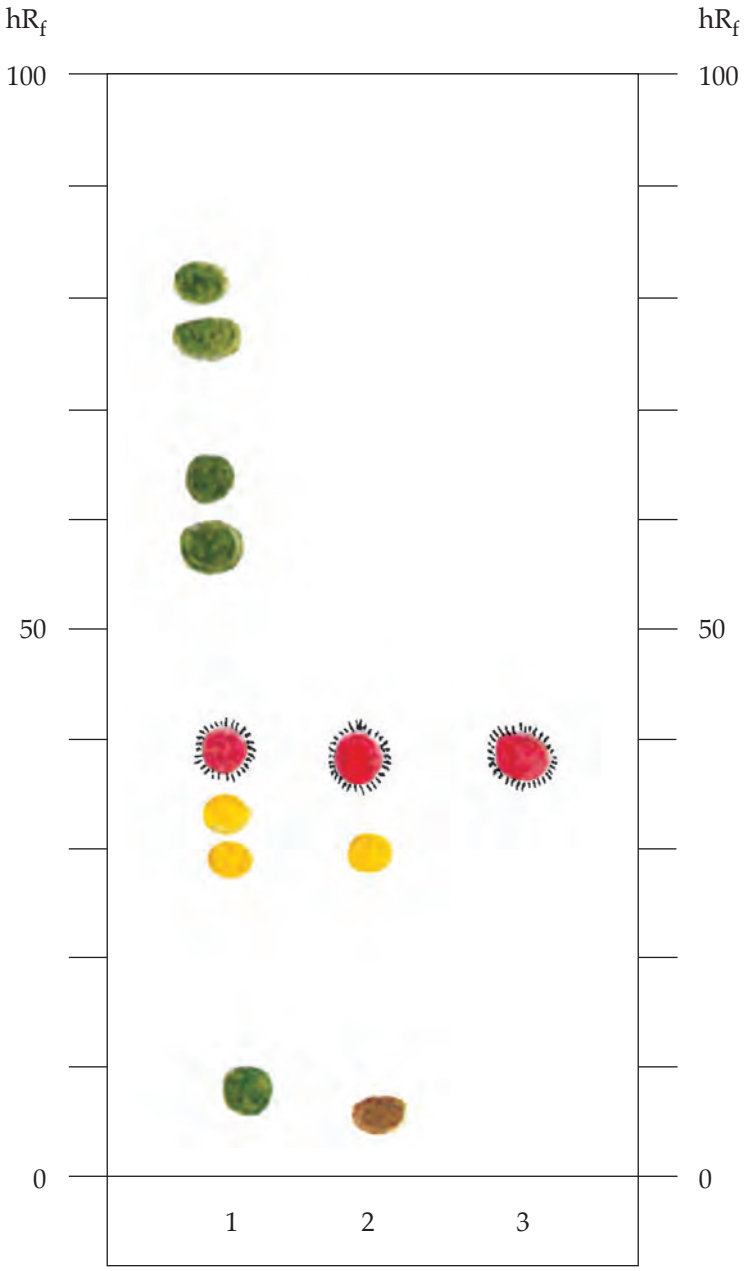


Fig. 3 Thin-Layer Chromatogram of the Extracts of the Leaves of *Senna alata* (L.) Roxb.

1 = solution (A)
2 = solution (B)
3 = solution (C)
= detection under UV light (366 nm)
= detection with ammonia vapour

ยาแคปซูลชุมเห็ดเทศ (CHUMHET THET CAPSULES)

Senna Alata Capsules

Category Laxative.

Senna Alata Capsules contain an amount of powdered Senna Alata Leaf equivalent to not less than 90.0 per cent and not more than 110.0 per cent of the labelled amount of hydroxyanthracene derivatives, calculated as rhein-8-glucoside.

Strength available 500 mg (powder).

Dose Six to twelve capsules once a day at bedtime.

Contra-indication It is contra-indicated in patients with symptoms of gastro-intestinal obstruction or abdominal pain with unknown etiology.

Warning

1. It should be used with caution in children, or in patients with inflammatory bowel disease.
2. It may cause mild abdominal discomfort such as colic or cramps. Excessive doses may produce nephritis.
3. Prolonged use should be avoided since it may result in diarrhea with excessive loss of water and electrolytes, particularly potassium.

Packaging and storage Senna Alata Capsules shall be kept in well-closed containers, protected from light, and stored at a temperature not exceeding 30°.

Labelling The label on the container states (1) the equivalent amount of hydroxyanthracene derivatives, calculated as rhein-8-glucoside; (2) the expiration date.

Identification

A. The capsule contents exhibit diagnostic structures of the powdered drug described under *Senna Alata Leaf*.

B. The capsule contents comply with the tests for Identification A and B described under *Senna Alata Leaf*.

Loss on drying Of the capsule contents, not more than 11.0 per cent w/w after drying at 105° for 5 hours (Appendix 4.15).

Microbial limit Comply with the requirements for Category 4 in the "Limits for Microbial Contamination" (Appendix 10.5).

Assay Weigh and mix the contents of not less than 20 capsules of Senna Alata Capsules. Grind to *fine powder* and transfer about 150 mg, accurately weighed, to a 100-mL round-bottomed flask. Add 30.0 mL of *water*, mix, weigh, and place in a water-bath. Heat under a reflux condenser for 15 minutes. Allow to cool, weigh and adjust to the original weight with *water*. Centrifuge and transfer 20.0 mL of the supernatant liquid to a 150-mL separator. Add 0.1 mL of 2 M *hydrochloric acid* and shake with three 15-mL portions of *chloroform*. Allow to separate and discard the chloroform layer. Add 100 mg of *sodium hydrogencarbonate* and shake for 3 minutes. Centrifuge and transfer 10.0 mL of the supernatant liquid to a 100-mL round-bottomed flask. Add 20 mL of a 10.5 per cent w/v solution of *iron(III) chloride* and mix. Heat for 20 minutes under a reflux condenser in a water-bath with its water level above that of the liquid in the flask, add 1 mL of *hydrochloric acid* and heat for a further 20 minutes with

frequent shaking, to dissolve the precipitate. Cool, transfer the mixture to a separator and shake with three 25-mL portions of *ether* previously used to rinse the flask. Combine the ether layers and wash with two 15-mL portions of *water*. Transfer the ether layers to a 100-mL volumetric flask and dilute with *ether* to volume. Evaporate 25.0 mL carefully to dryness at a low temperature and dissolve the residue in 10.0 mL of a 0.5 per cent w/v solution of *magnesium acetate* in *methanol*. Measure the absorbance of this solution at the maximum at about 515 nm (Appendix 2.2), using the magnesium acetate solution as the blank. Calculate the quantity, in mg, of rhein-8-glucoside in the portion of the Capsules taken by the formula:

$$(446.37/284.22)\ (1200A/440),$$

in which 446.37 and 284.22 are the molecular weights of rhein-8-glucoside and rhein, respectively, A is the absorbance of the solution at 515 nm and 440 is the specific absorbance.

Other requirements Comply with the requirements described under "Capsules" (Appendix 1.16H).

ยาชงชุมเห็ดเทศ (YA CHONG CHUMHET THET)

Senna Alata Tea

Category Laxative.

Senna Alata Tea contains an amount of powdered Senna Alata Leaf equivalent to not less than 90.0 per cent and not more than 110.0 per cent of the labelled content of hydroxyanthracene derivatives, calculated as rhein-8-glucoside.

Strength available 3 g (powder), supplied in a sachet.

Dose One or two sachets, prepared as an infusion by soaking each with 120 mL of boiling water for 10 minutes, once a day at bedtime.

Warning It should be used with caution in children.

Packaging and storage Senna Alata Tea shall be kept in well-closed containers, protected from light.

Labelling The label on the container states (1) the equivalent amount of hydroxyanthracene derivatives, calculated as rhein-8-glucoside; (2) the expiration date.

Identification

A. The tea contents exhibit diagnostic structures of the powdered drug described under *Senna Alata Leaf.*

B. The tea contents comply with the tests for Identification A and B described under *Senna Alata Leaf.*

Loss on drying Of the tea contents, not more than 11.0 per cent w/w after drying at 105° for 5 hours (Appendix 4.15).

Microbial limit Complies with the requirements for Category 2 in the "Limits for Microbial Contamination" (Appendix 10.5).

Assay Grind the contents of not less than 20 sachets of Senna Alata Tea to *fine powder*. Transfer about 150 mg, accurately weighed, to a 100-mL round-bottomed flask. Add 30.0 mL of *water*, mix, weigh, and place in a water-bath. Heat under a reflux condenser for 15 minutes. Allow to cool, weigh and adjust to the original weight with *water*. Centrifuge and transfer 20.0 mL of the supernatant liquid to a 150-mL separator. Add 0.1 mL of 2 M *hydrochloric acid* and shake with three 15-mL portions of *chloroform*. Allow to separate and discard each chloroform layer. Add 100 mg of *sodium hydrogencarbonate* and shake for 3 minutes. Centrifuge and transfer 10.0 mL of the supernatant liquid to a 100-mL round-bottomed flask. Add 20 mL of a 10.5 per cent w/v solution of *iron(III) chloride* and mix. Heat for 20 minutes under a reflux condenser in a water-bath with its water level above that of the liquid in the flask, add 1 mL of *hydrochloric acid* and heat for a further 20 minutes with frequent shaking, to dissolve the precipitate. Cool, transfer the mixture to a separator and shake with three 25-mL portions of *ether* previously used to rinse the flask. Combine the ether layers and wash with two 15-mL portions of *water*. Transfer the ether layers to a 100-mL volumetric flask and dilute with *ether* to volume. Evaporate 25.0 mL carefully to dryness at a low temperature and dissolve the residue in 10.0 mL of a 0.5 per cent w/v solution of *magnesium acetate* in *methanol*. Measure the absorbance of this solution at the maximum at about 515 nm (Appendix 2.2),

using the magnesium acetate solution as the blank. Calculate the quantity, in mg, of rhein-8-glucoside in the sample taken by the formula:

$$(446.37/284.22)\,(1200A/440),$$

in which 446.37 and 284.22 are the molecular weights of rhein-8-glucoside and rhein, respectively, A is the absorbance of the solution at 515 nm and 440 is the specific absorbance.

Other requirements Complies with the requirements described under "Herbal Teas" (Appendix 1.16H).

ดีปลี (DI PLI)

ดีปลีเชือก (DI PLI CHUEAK)
Piperis Retrofracti Fructus
Java Long Pepper

Category Carminative, expectorant, stomachic, anti-emetic, oxytocic.

Java Long Pepper is the dried red mature infructescence of *Piper retrofractum* Vahl (*P. chaba* Hunter) (Family Piperaceae), Herbarium Specimen Number: DMSC 48, 75, 456, 467.

Constituents Java Long Pepper contains piperine, piperlongumine, pyridine alkaloids, sesamin, volatile oil, etc.

Description of the plant (Figs. 1a, 1b) Climber, glabrous, rather fleshy, with the aid of adventitious roots, rarely creeping; stem much branched, stout, cylindrical, thickened above nodes. Leaves simple, alternate, 3 to 20 cm long, 2 to 13 cm wide, lower ones ovate or lanceolate with cordate base, upper ones oblong-oval to oblong with obtuse, cordate or cuneate base, unequal, all tapering or acuminate, entire, glabrous, reticulate venation sunk above and raised beneath; petioles of lower leaves 1.5 to 3 cm long, of the upper ones 0.5 to 1.5 cm long; stipule 1 to 1.5 cm long, membranous, lanceolate, obtuse, enclosing the bud but soon falling off. Inflorescence spike, erect or patent; peduncle 0.7 to 2 cm long; bract broadly oval-ovate, 1.5 to 2 mm long; flower unisexual, bisexual; male spike 2.5 to 8.5 cm long, stamens 2, rarely 3, very short; female spike 1.7 to 3 cm long, stigmata 2 to 3, short, obtuse, persistent. Infructescence cylindro-conic; berry connate and adnate to stalk of bract, broadly rounded, bright red. Seed 2 to 2.5 mm in diameter.

Description Odour, aromatic; taste, pungent.

Macroscopical (Fig. 1a) Condensed infructescence, reddish brown, subcylindrical, about 2.5 to 7.5 cm long and 5.0 to 8.0 mm in diameter, rather rough surface with persistent stigmata.

Microscopical (Figs. 2a, 2b, 2c) Transverse section of the fruit shows epicarp composed of a layer of epidermal cells of which the outer tangential wall thick, glandular trichomes and cuticle. Mesocarp composed of 3 to 4 layers of collenchyma of hypodermis in which stone cells scattered followed by zone of thin-walled parenchyma, some of which containing brownish substance, oil droplets and starch grains and a few layers of large oil cells. Endocarp composed of a single layer of sclerenchyma. Zone of ground parenchyma scattered with vascular bundles around the cavity at the centre of the fruit. Spermoderm composed of outer thick-walled epidermis, collapse parenchyma of middle epidermis and inner thin-walled epidermis. Perisperm, elongated reserve parenchyma cells containing numerous angular starch grains and rod-shaped crystals. Embryo embedded in the endosperm.

Java Long Pepper in powder possesses the diagnostic microscopical characters of the unground drug.

1

2

3

4

5

Fig. 1a *Piper retrofractum* Vahl
1. habit 2. flowering twig 3. different stages of infructescences
4. red mature infructescence 5. crude drug

Fig. 1b *Piper retrofractum* Vahl

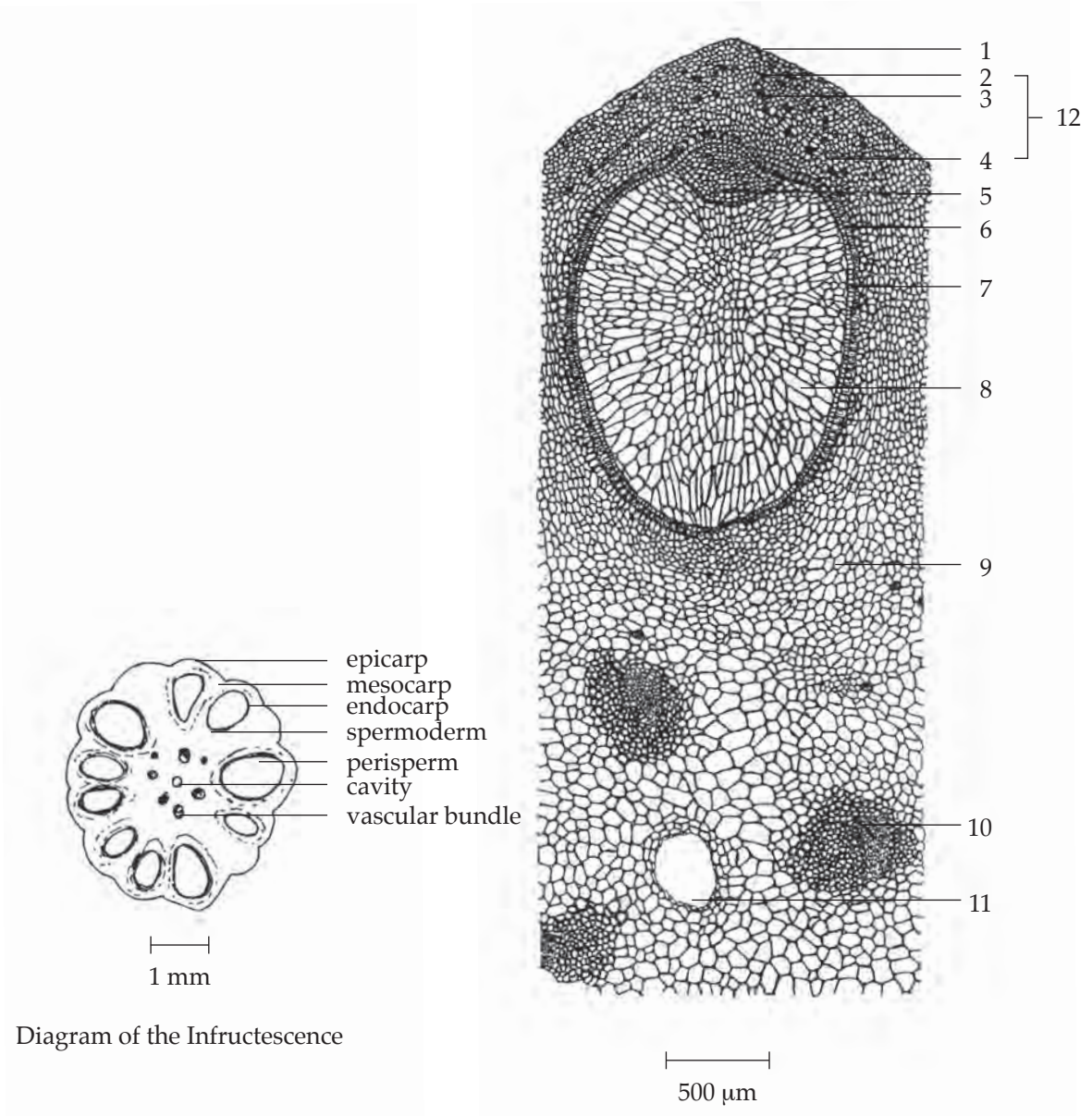


Diagram of the Infructescence

Fig. 2a Transverse Section of the Fruit of *Piper retrofractum* Vahl

1. epicarp
2. thick-walled parenchyma
3. sclereid
4. oil cell
5. embryo
6. sclerenchyma of endocarp
7. spermoderm
8. perisperm
9. ground parenchyma
10. vascular bundle
11. cavity
12. mesocarp

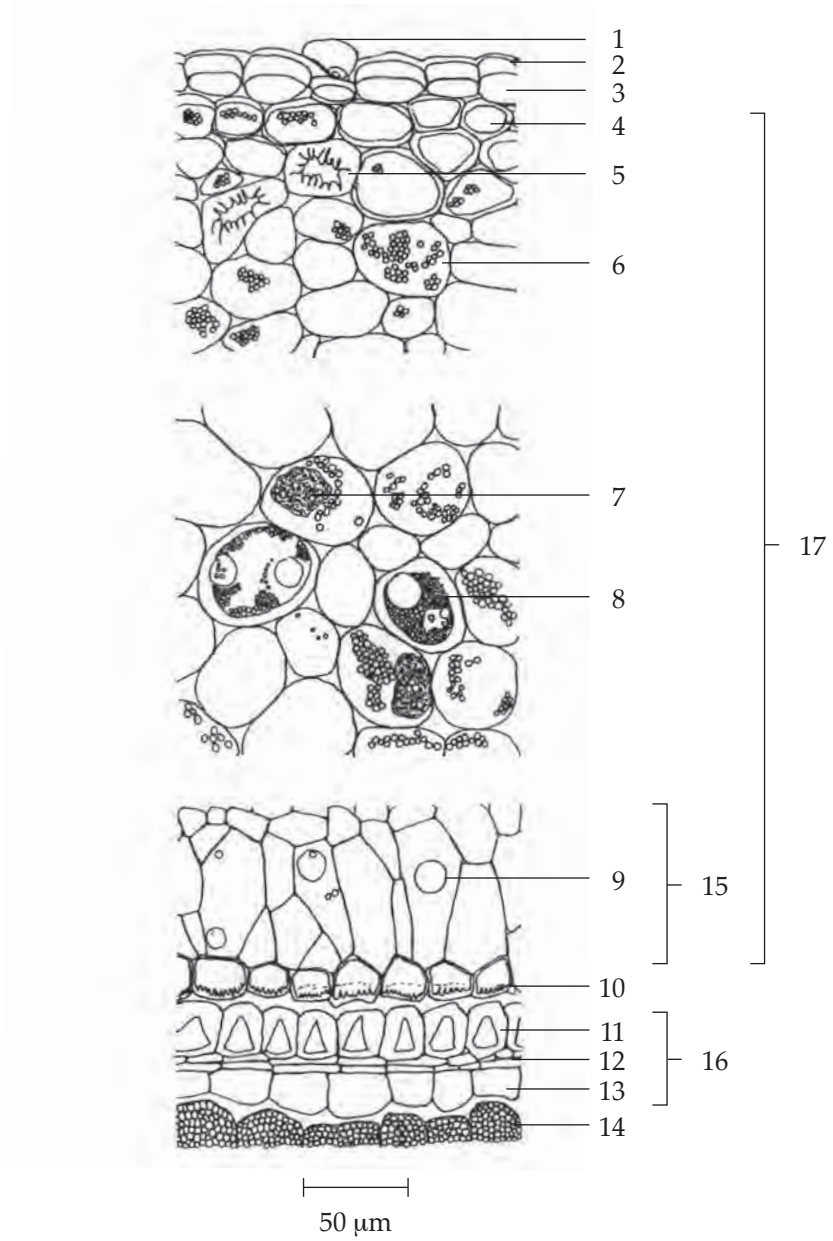


Fig. 2b Transverse Sections of Epicarp, Mesocarp, Endocarp, and Spermoderm of the Fruit of *Piper retrofractum* Vahl

1. glandular trichome
2. cuticle
3. epidermis
4. thick-walled parenchyma
5. sclereid
6. parenchyma containing starch grains
7. brownish substance
8. oil cell
9. oil droplet
10. sclerenchyma of endocarp
11. outer epidermis of spermoderm
12. middle epidermis of spermoderm
13. inner epidermis of spermoderm
14. perisperm
15. layer of large oil cells
16. spermoderm
17. mesocarp

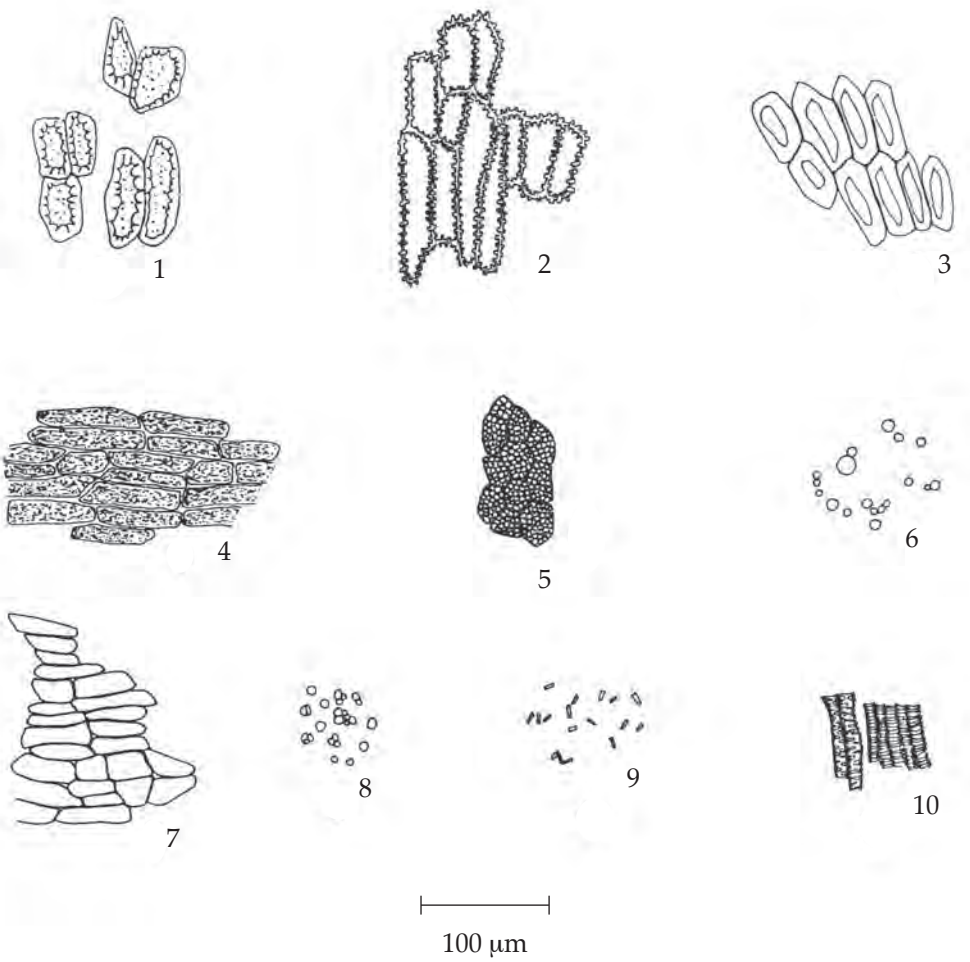


Fig. 2c Powdered Drug of the Fruits of *Piper retrofractum* Vahl

1. sclereids of mesocarp
2. sclerenchymatous endocarp
3. outer epidermis of spermoderm
4. inner epidermis of spermoderm
5. perisperm containing starch grains
6. oil globules
7. parenchyma
8. starch grains
9. rod-shaped crystals
10. vessels

Packaging and storage Java Long Pepper shall be kept in well-closed containers, preferably of metal or glass, protected from light and stored in a cool and dry place.

Identification

A. Reflux 1 g of the sample, in powder, with 25 mL of *ethanol* for 10 minutes and filter (solution 1). To 2 mL of solution 1, add a few drops of *ninhydrin TS* and warm in a water-bath for a few minutes: a purple colour is produced.

B. Evaporate 2 mL of solution 1 to dryness. Dissolve the residue in 2 mL of *acetic anhydride*, and then slowly add 1 mL of *sulfuric acid* to form two layers: a brown ring develops at the zone of contact.

C. Evaporate 2 mL of solution 1 to almost dryness and add a few drops of Marquis'reagent, prepared by adding a few drops of *formaldehyde solution* to 6 mL of *sulfuric acid*: a brownish red colour is produced.

D. To 100 mg of the sample, in powder, add 1 mL of *sulfuric acid*: a deep red colour is produced at first, turning to reddish brown and brown.

E. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 7 volumes of n-*hexane* and 3 volumes of *ethyl acetate* as the mobile phase and allowing the solvent front to ascend 12 cm above the line of application. Apply separately to the plate, 5 μL each of the following two solutions. Prepare solution (A) by macerating 500 mg of the sample, in powder, with 25 mL of *chloroform* for 15 minutes and filtering. Evaporate the filtrate to dryness and dissolve the residue in 2 mL of *chloroform*. For solution (B), dissolve 2 mg of *piperine* in 1 mL of *chloroform*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. The chromatogram obtained from solution (A) shows a quenching spot (hR_f value 20 to 22) corresponding to the piperine spot from solution (B), and several spots of higher hR_f values. Spray the plate with *modified Dragendorff TS2*; the spot due to piperine is orange and one orange spot is observed (Table 1); see also Fig. 3.

Repeat the same procedure on another plate but spray with *anisaldehyde TS*. The chromatogram obtained from solution (A) shows a green spot (hR_f value 20 to 22) corresponding to the piperine spot from solution (B), and several other spots of different colours are also observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Chloroform Extract of the Fruits of *Piper retrofractum* Vahl

Spot	hR_f Value	Detection		
		UV 254	*Modified Dragendorff TS2*	*Anisaldehyde TS*
1	5–6	–	–	pale violet
2*	20–22	quenching	orange	green
3	25–27	quenching	pale orange	green
4	31–33	quenching	–	violet
5	36–38	quenching	–	violet
6	43–44	quenching	–	purple
7	50–51	quenching	–	–
8	58–59	–	–	pale violet
9	60–61	quenching	–	–
10	64–66	–	–	violet
11	66–69	quenching	–	–
12	74–77	quenching	–	blue
13	91–95	–	–	violet

*piperine

Water Not more than 13.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Acid-insoluble ash Not more than 0.4 per cent w/w (Appendix 7.6).

Total ash Not more than 7.5 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 10.0 per cent w/w (Appendix 7.12).

Volatile oil Not less than 1.0 per cent v/w (Appendix 7.3H). Use 25 g, in *fine powder,* freshly prepared and accurately weighed. Use 250 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube.

Alkaloids content Not less than 2.5 per cent w/w of alkaloids, calculated as piperine, when determined by the following method. (**Note** Use light-resistant glassware to reduce photodegradation of piperine in solution.)

Standard piperine solution Dissolve about 10 mg of *piperine*, accurately weighed, in sufficient *1,2-dichloroethane* to produce 100.0 mL.

Standard piperine curve Transfer into six 100-mL volumetric flasks, 1, 2, 3, 4, 5, and 6 mL, respectively, of *Standard piperine solution,* dilute to volume with *1,2-dichloroethane,* and mix. Measure the absorbances of the standard solutions relative to the blank at 342 nm (Appendix 2.2). Plot the readings and draw the curve of best fit.

Procedure Place about 500 mg of Java Long Pepper, in *fine powder* and accurately weighed, in a soxhlet apparatus. Add a sufficient quantity of *1,2-dichloroethane* and extract, until complete extraction of the alkaloids is effected (Appendix 7.4). Transfer the dichloroethane extract to a 100-mL volumetric flask and dilute with *1,2-dichloroethane* to volume. Transfer 2.0 mL of this solution to a 100-mL volumetric flask and dilute with *1,2-dichloroethane* to volume. Measure the absorbance of the resulting solution, at the maximun at about 342 nm (Appendix 2.2). By reference to the standard curve, calculate the content of alkaloids as piperine in the sample.

Dose 200 to 500 mg three times a day.

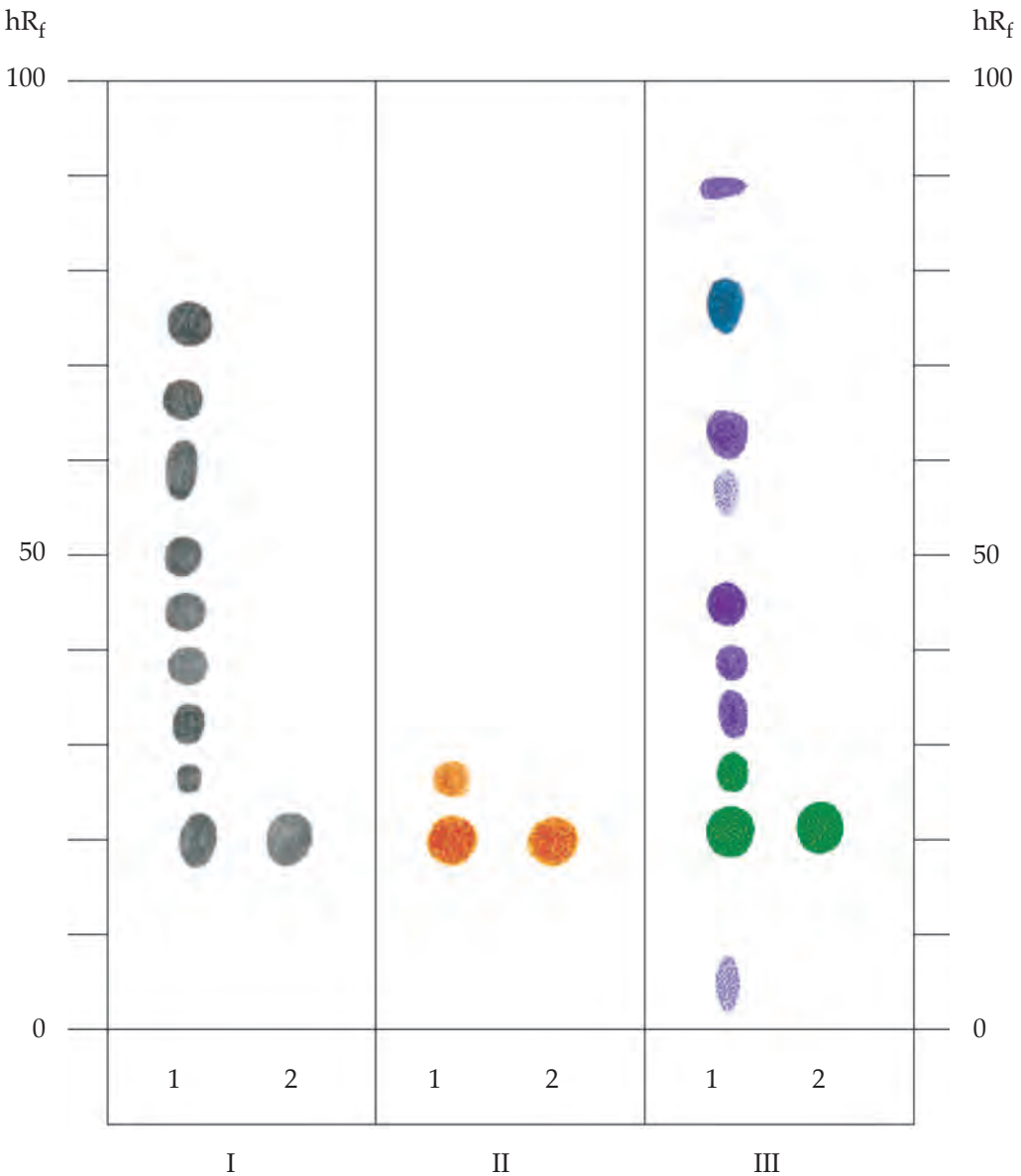


Fig. 3 Thin-Layer Chromatogram of Chloroform Extract of the Fruits of *Piper retrofractum* Vahl

1 = solution (A)
2 = solution (B)
I = detection under UV light (254 nm)
II = detection with *modified Dragendorff TS2*
III = detection with *anisaldehyde TS*

ฟ้าทะลาย (FA THALAI)

ฟ้าทะลายโจร (FA THALAI CHON), น้ำลายพังพอน (NAMLAI PANGPON), สามสิบดี (SAM SIP DI)
Andrographitis Herba
Andrographis Herb

Category Antidiarrheal, antipyretic, anti-inflammatory in laryngitis.

Andrographis Herb is the dried aerial part of *Andrographis paniculata* (Burm. f.) Nees (*Justicia paniculata* Burm. f.) (Family Acanthaceae), Herbarium Specimen Number: DMSC 821, 854, Crude Drug Number: DMSc 0407.

Constituents Andrographis Herb contains a large quantity of bitter diterpenoid lactones which mainly are andrographolide, neoandrographolide, 14-deoxy-11,12-didehydroandrographolide (dehydroandrographolide), dideoxyandrographolide (andrograpanin), etc. and their glycosides. It also contains β-sitosterol-D-glucoside, flavonoids, etc.

Description of the plant (Figs. 1a, 1b) Annual herb up to 1 m high, erect; stem acutely quadrangular. Leaves simple, opposite, lanceolate, 2 to 12 cm long, 1 to 3 cm wide, acute, glabrous, entire-slightly undulate, upper ones often bracteiform; petiole short. Inflorescence patent, terminal and axillary, in panicle, 10 to 30 cm long; bract small, pedicel short. Flower: calyx 5-partite, small, linear; corolla tube narrow, about 6 mm long, limb not shorter than the tube, bilabiate, upper lip oblong, white with a yellowish top, lower lip broadly cuneate, trifid, white with violet marking; stamens 2, inserted in the throat and far exserted, anther basally bearded; ovary superior, 2-celled, style far exserted. Fruit capsule, erect, linear-oblong, 1 to 2 cm long, 2 to 5 mm wide, compressed, longitudinally furrowed on the broad faces, thinly glandular-hairy. Seed small, subquadrate.

Description Odour, slight and specific; taste, extremely bitter.

Macroscopical (Fig. 1a) Dried herb occurs as a mixture of broken, crisp, mainly dark green lanceolate leaf and quadrangularly stem; capsule fruit and small flower occasionally found.

Microscopical (Figs. 2a, 2b, 2c, 2d) Surface and transverse sections of the leaf through lamina and midrib region show the following characters: upper epidermis, a layer of cells; stomata absent; covering trichomes, glandular, unicellular and multicellular present; cicatrices rarely seen; lithocysts, fairly large, 27 μm × 96 μm to 30 μm × 210 μm in size and 49 μm thick. Palisade cells, columnar. Collenchyma occurs in the midrib, beneath upper and lower epidermises. Spongy cells, parenchymatous. Vascular bundles, composed of lignified xylem in the upper part and phloem in the lower part. Vessels, spiral, scalariform and reticulate. Lower epidermis, a layer of wavy-walled cells; stomata, diacytic; covering trichomes and lithocysts present.

Transverse section of the stem shows the following characters: epidermis, a layer of cells; stomata, diacytic; covering trichomes and lithocysts present. Collenchyma, densely found at the corners of stem. Parenchyma, containing chlorophyll. Endodermis, a layer of thick-walled cells. Vessels, spiral, scalariform and pitted. Pith, large parenchyma cells.

Fig. 1a *Andrographis paniculata* (Burm. f.) Nees
1. flowering and fruiting plant 2. different views of flowers (a–d)
3. fruits in different stages (e), dehiscent fruit showing seeds (f) 4. crude drug

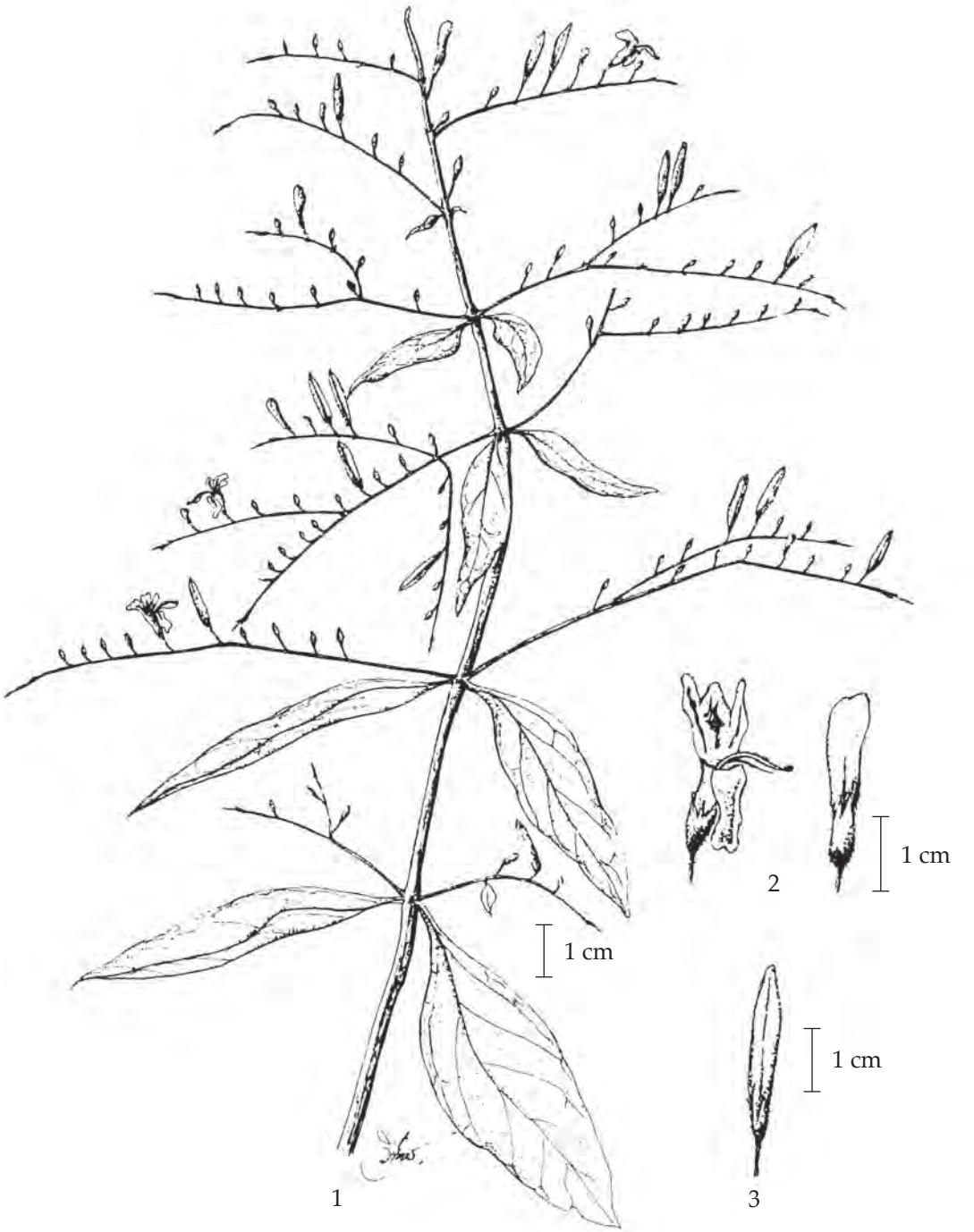
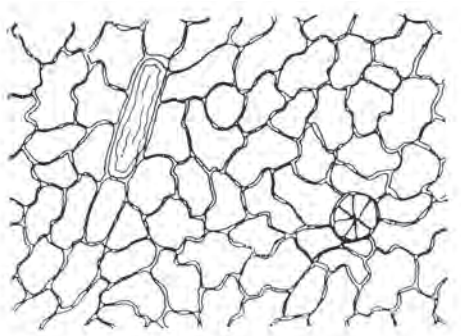
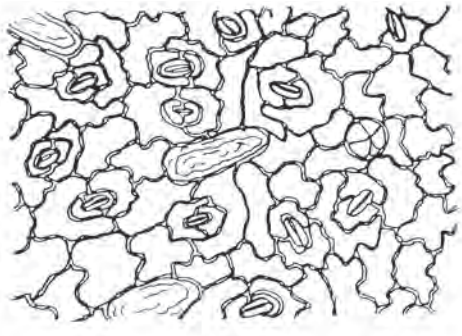


Fig. 1b *Andrographis paniculata* (Burm. f.) Nees
1. aerial part 2. flower 3. capsule

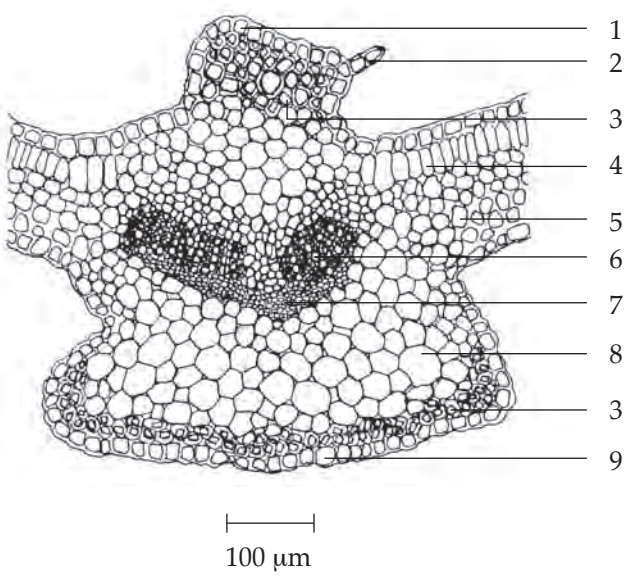


Upper Epidermis of the Lamina

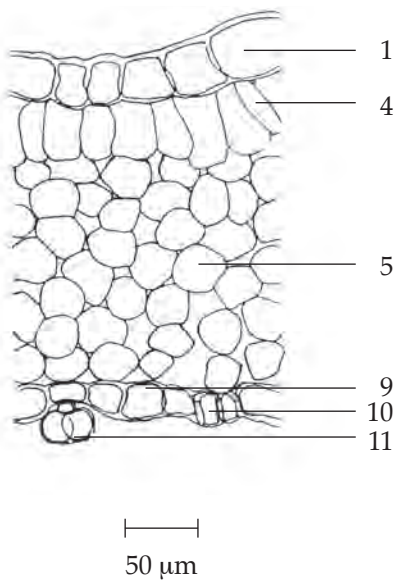


Lower Epidermis of the Lamina

Fig. 2a Epidermises of the Leaf of *Andrographis paniculata* (Burm. f.) Nees



Transverse Section of the Midrib



Transverse Section of the Lamina

Fig. 2b Transverse Sections of the Leaf of *Andrographis paniculata* (Burm. f.) Nees

1. upper epidermis
2. multicellular trichome
3. collenchyma
4. palisade cell
5. spongy cell
6. xylem
7. phloem
8. parenchyma
9. lower epidermis
10. stoma
11. glandular trichome

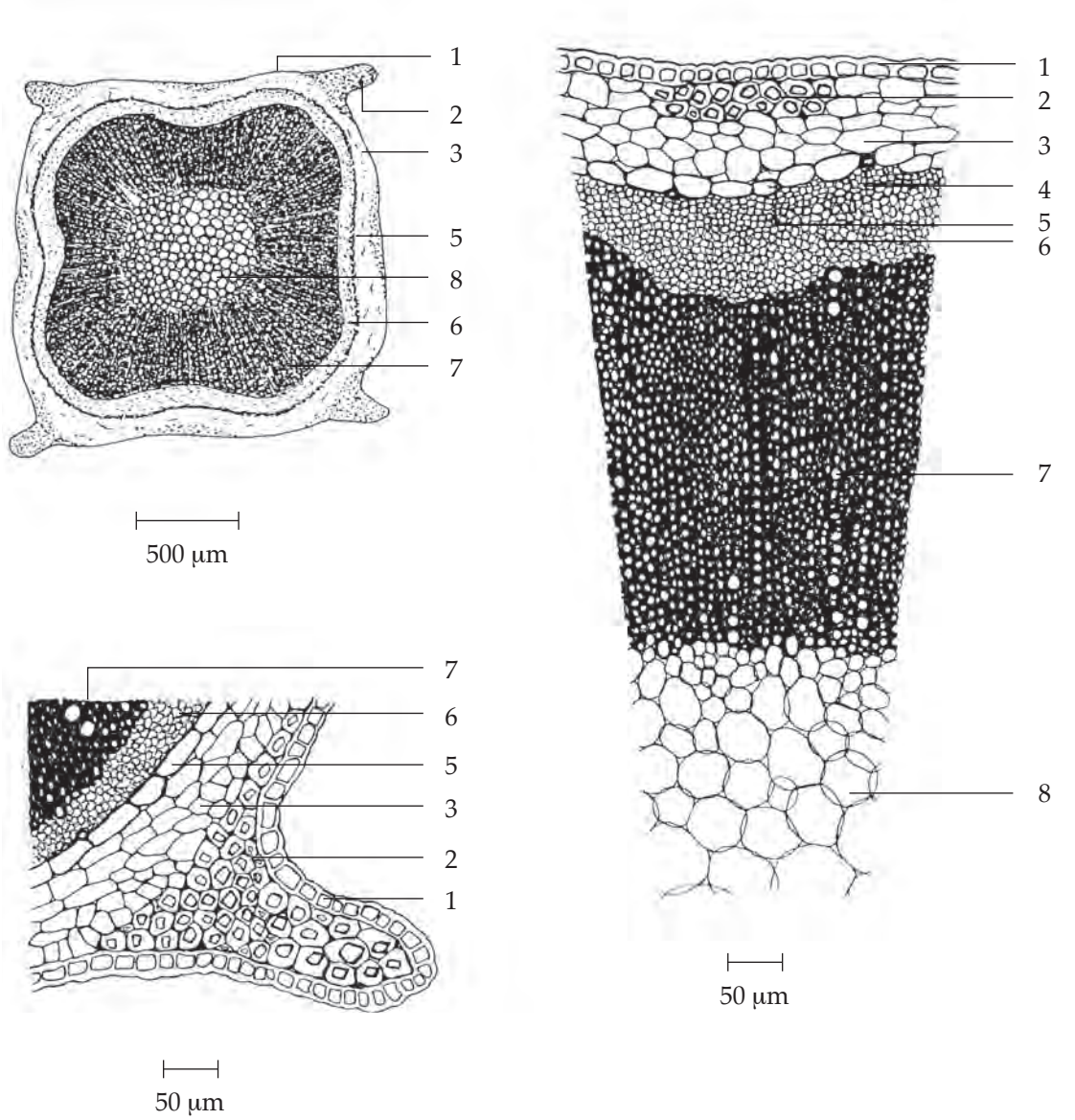


Fig. 2c Transverse Section of the Stem of *Andrographis paniculata* (Burm. f.) Nees

1. epidermis
2. collenchyma
3. cortical parenchyma
4. fibre
5. endodermis
6. phloem
7. xylem
8. pith parenchyma

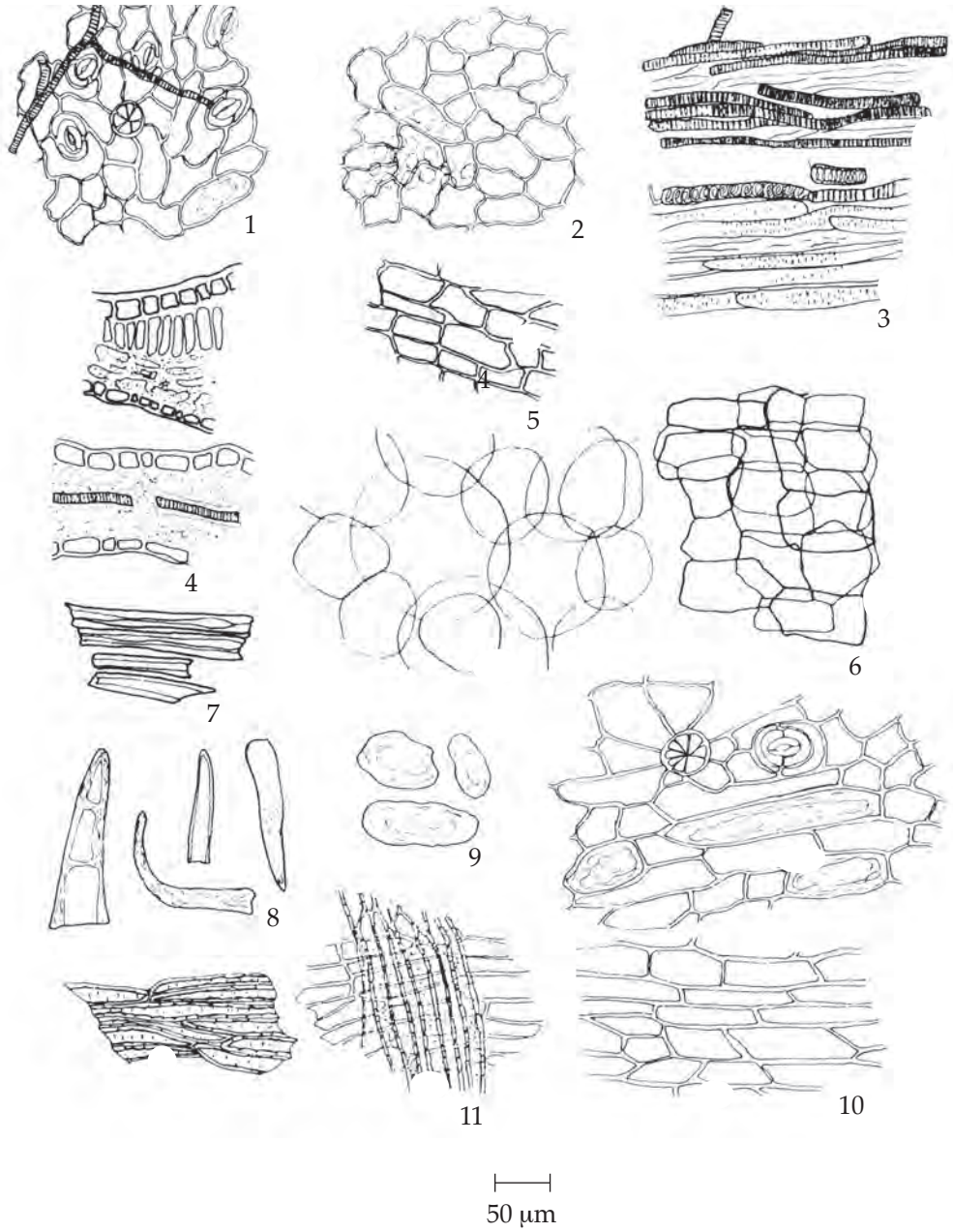


Fig. 2d Powdered Drug of the Leaves and Stems of *Andrographis paniculata* (Burm. f.) Nees

1. lower epidermis showing stomata lithocyst, glandular trichome
2. upper epidermis showing lithocyst, underlying palisade
3. spiral, scalariform and reticulate vessels
4. sectional views of lamina
5. midrib epidermis
6. transverse and longitudinal sections of parenchyma
7. fibre bundle
8. covering trichomes
9. cystolith
10. stem epidermis
11. layer of fibres in fruit wall

Andrographis Herb in powder possesses the diagnostic microscopical characters of the unground drug.

Packaging and storage Andrographis Herb shall be kept in well-closed containers, protected from light, and stored in a dry place. It should be used within 1 year and air-dried every 2 to 3 months.

Identification

A. To about 1 g of the sample, in powder, add 20 mL of *ethanol*, boil in a water-bath and filter. To the filtrate, add 300 mg of *decolorizing charcoal*, stir and filter (solution 1). To 1 mL of solution 1, add 2 drops of a 2 per cent w/v solution of *3,5-dinitrobenzoic acid* in *methanol* and 2 drops of a 5.7 per cent w/v solution of *potassium hydroxide* in *methanol*: a purplish red colour develops.

B. To 1 mL of solution 1, add several drops of a 6.5 per cent w/v solution of *potassium hydroxide* in *ethanol* until it shows a red colour. Set aside for 10 to 15 minutes: the colour is changed to yellow.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 85 volumes of *chloroform* and 15 volumes of *absolute ethanol* as the mobile phase. Apply separately to the plate, 5 μL each of the following solutions. Prepare solution (A) by boiling 1 g of the sample, in powder, with 20 mL of *ethanol* on a water-bath for 5 minutes, adding 300 mg of *decolorizing charcoal*, stirring, and filtering. Evaporate the filtrate under reduced pressure to dryness, and dissolve the residue in 1 mL of warm *ethanol (80 per cent)*. For solution (B), dissolve 2 mg of *andrographolide* in 1 mL of *ethanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. The chromatogram obtained with solution (A) shows a quenching spot (hR_f values 52 to 56) corresponding to the andrographolide spots from solution (B) and other four spots of different hR_f values (Table 1); see also Fig. 3. Spray the plate with a 2 per cent w/v solution of *3,5-dinitrobenzoic acid* in *methanol* and then with an excess of a 5.7 per cent w/v solution of *potassium hydroxide* in *methanol*; the spot due to andrographolide is dark violet. Two dark violet spots due to the spot numbers 4 and 9 in Table 1 and other violet and dark violet spots are also observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Ethanolic Extract of the Aerial Parts of *Andrographis paniculata* (Burm. f.) Nees

Spot	hR_f Value	Detection	
		UV 254	*3,5-Dinitrobenzoic Acid/ Potassium Hydroxide* in *Methanol*
1	1–5	–	dark violet
2	11–15	quenching	violet
3	18–22	quenching	violet
4*	28–32	–	dark violet
5	49–51	–	violet
6**	52–56	quenching	dark violet
7	57–59	quenching	violet
8	66–68	–	violet
9***	69–71	quenching	dark violet

*neoandrographolide

**andrographolide

*** dehydroandrographolide

Loss on drying Not more than 11.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 2.0 per cent w/w (Appendix 7.6).

Ethanol (85 per cent)-soluble extractive Not less than 13.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 18.0 per cent w/w (Appendix 7.12).

Total lactones content Not less than 6.0 per cent w/w of total lactones, calculated as andrographolide, when determined by the following method.

Procedure Place about 1 g of Andrographis Herb in *fine powder*, accurately weighed, in a 100-mL round-bottomed flask, add 50 mL of *ethanol (85 per cent)*, reflux in a water-bath for 2 hours, and filter. Wash the marc with sufficient amount of *ethanol (85 per cent)* until the last washing is almost colourless. Combine the washings and the filtrate and allow to cool. Add 1 mL of *basic lead acetate TS*, set aside for 15 minutes, filter, and wash the precipitate with *ethanol* until the last washing is no longer green. Combine the washings and the filtrate, add dropwise with swirling 1 mL of a 25 per cent w/v solution of *sodium sulfate* and mix well. Set aside for 1 hour, add 500 mg of *decolorizing charcoal*, and reflux in a water-bath for 10 minutes. Filter through the Büchner funnel containing 500 mg of *decolorizing charcoal* and wash with three 2-mL portions of hot *ethanol*. Combine the washings and the filtrate, add 20 mL of *distilled water*, allow to cool, and neutralize with 0.1 M *sodium hydroxide*, using *phenolphthalein TS* as indicator. Add 5.0 mL of 0.1 M *sodium hydroxide VS*, reflux in a water-bath for 30 minutes, allow to cool, and titrate with 0.05 M *hydrochloric acid VS*.

Perform a blank determination (Residual Titrations, Appendix 6.17). Each mL of 0.1 M *sodium hydroxide VS* is equivalent to 35.05 mg of total lactones calculated as andrographolide ($C_{20}H_{30}O_5$).

Andrographolide content Not less than 1.0 per cent w/w of andrographolide ($C_{20}H_{30}O_5$). Carry out the determination as described in the "Liquid Chromatography" (Appendix 3.5).

Mobile phase Prepare a mixture of 52 volumes of *distilled water* and 48 volumes of *methanol*. Make adjustments if necessary.

Standard preparations Dissolve an accurately weighed quantity of *andrographolide* in sufficient *methanol* and dilute with *Mobile phase* to obtain a stock solution having a known concentration of about 200 μg per mL. Dilute this solution quantitatively, and stepwise with *Mobile phase* to obtain six solutions having known concentrations of 20, 40, 60, 80, 100, and 140 μg per mL.

Sample preparation Reflux about 400 mg of Andrographis Herb, in *fine powder*, accurately weighed, with 50 mL of a mixture of equal volumes of *dichloromethane* and *methanol* in a water-bath for 30 minutes. Filter and evaporate the filtrate at 50° under reduced pressure to dryness. Dissolve the residue in sufficient *methanol*, transfer quantitatively to a 100-mL volumetric flask, dilute with *Mobile phase* to volume, and mix. Filter through a nylon membrane having a 0.45-μm porosity.

Chromatographic system The chromatographic procedure may be carried out using (a) a stainless steel column (15 cm × 3.9 mm) packed with octadecylsilane chemically bonded to porous silica or ceramic microparticles (5 μm), (b) a guard column (20 mm × 3.9 mm) packed with octadecylsilane chemically bonded to porous silica or ceramic microparticles (5 μm), (c) *Mobile phase* at a flow rate of about 1 mL per minute, and (d) an ultraviolet photometer set at 224 nm.

To determine the suitability of the chromatopraphic system, chromatograph *Standard preparation* having a known concentration of 60 μg per mL and record the peak responses as directed under *Procedure* and *Calculation*: the symmetry factor for the andrographolide peak is not more than 2.0 and the relative standard deviation for replicate injections is not more than 2.0 per cent.

Procedure and **Calculation** Separately inject about 20 μL each of *Standard preparations* into the chromatograph, record the chromatograms and measure the responses for the major peaks. Plot the readings and draw the standard curve of best fit. Inject about 20 μL of *Sample preparation* into the chromatograph, record the chromatogram and measure the response for the major peak. By reference to the standard curve, calculate the content of andrographolide ($C_{20}H_{30}O_5$) in the Andrographis Herb taken.

Dose 0.5 to 2 g four times a day after meals and at bedtime.

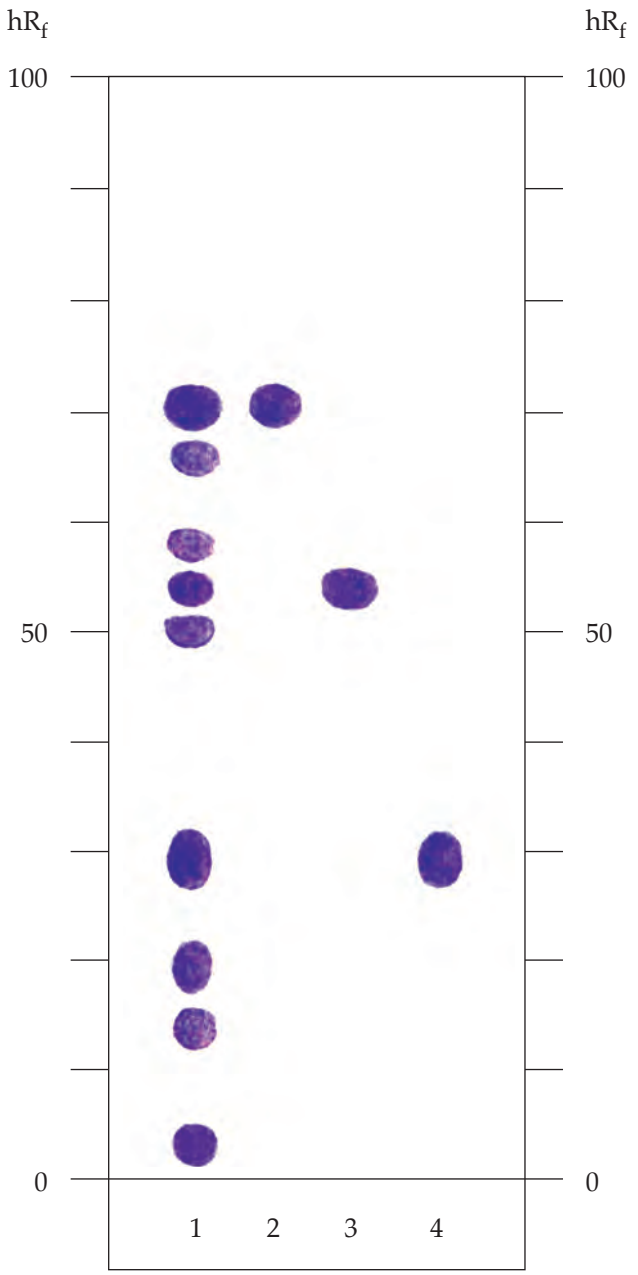


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Aerial Parts of *Andrographis paniculata* (Burm. f.) Nees, Detected with *3,5-Dinitrobenzoic Acid/Potassium Hydroxide* in *Methanol*

1 = solution (A)
2 = a 0.4 per cent w/v solution of dehydroandrographolide in *ethanol*
3 = solution (B)
4 = a 0.2 per cent w/v solution of neoandrographolide in *ethanol*

ยาแคปซูลฟ้าทะลาย (FA THALAI CAPSULES)

Andrographis Capsules

Category Antidiarrheal, antipyretic, anti-inflammatory in laryngitis.

Andrographis Capsules contain an amount of powdered Andrographis Herb equivalent to not less than 80.0 per cent and not more than 120.0 per cent of the labelled amount of total lactones, calculated as andrographolide ($C_{20}H_{30}O_5$).

Strengths available 250, 300, 350, and 500 mg (powder).

Dose Antidiarrheal: 0.5 to 2 g four times a day after meals and at bedtime.
Laryngitis: 0.75 to 1.5 g four times a day after meals and at bedtime.

Contra-indication It is contra-indicated in pregnant and nursing women and in patients with known allergy to plants of the Acanthaceae family.

Warning

1. It should not be used for more than 2 days as antidiarrheal and for more than 7 days as anti-inflammatory in laryngitis.
2. Concomitant use with anticoagulants, antiplatelets and antihypertensives should be avoided.

Additional information Animal studies show that andrographolide may increase a risk for carcinogenicity. Risk-benefit should be therefore considered when consuming. However, clinical data is not available at present.

Packaging and storage Andrographis Capsules shall be kept in well-closed containers, protected from light, and stored in a dry place and at a temperature not exceeding 30°.

Labelling The label on the container states (1) the equivalent amount of total lactones, calculated as andrographolide; (2) the amount of andrographolide in mg per capsule; (3) the expiration date.

Identification

A. The capsule contents exhibit diagnostic structures of the powdered drug described under *Andrographis Herb*.

B. The capsule contents comply with the tests for Identification A, B and C described under *Andrographis Herb*.

Loss on drying Of the capsule contents, not more than 11.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Microbial limit Comply with the requirements for Category 4 in the "Limits for Microbial Contamination" (Appendix 10.5).

Andrographolide content Not less than 1.0 per cent w/w of andrographolide ($C_{20}H_{30}O_5$). Carry out the determination as described in the "Liquid Chromatography" (Appendix 3.5).

Mobile phase Prepare a mixture of 52 volumes of *distilled water* and 48 volumes of *methanol*. Make adjustments if necessary.

Standard preparations Dissolve an accurately weighed quantity of *andrographolide* in sufficient *methanol* and dilute with *Mobile phase* to obtain a stock solution having a known concentration of about 200 μg per mL. Dilute this solution quantitatively, and stepwise with *Mobile phase* to obtain six solutions having known concentrations of 20, 40, 60, 80, 100, and 140 μg per mL.

Sample preparation Remove, as completely as possible, the contents of not less than 20 Andrographis Capsules, and grind to *fine powder*. Transfer about 400 mg, accurately weighed, to a 100-mL round-bottomed flask. Add 50 mL of a mixture of equal volumes of *dichloromethane* and *methanol*, reflux in a water-bath for 30 minutes, and filter. Evaporate the filtrate at 50° under reduced pressure to dryness and dissolve the residue in sufficient *methanol*. Transfer quantitatively to a 100-mL volumetric flask, dilute with *Mobile phase* to volume and mix. Filter through a nylon membrane having a 0.45-μm porosity.

Chromatographic system The chromatographic procedure may be carried out using (a) a stainless steel column (15 cm × 3.9 mm) packed with octadecylsilane chemically bonded to porous silica or ceramic microparticles (5 μm), (b) a guard column (20 mm × 3.9 mm) packed with octadecylsilane chemically bonded to porous silica or ceramic microparticles (5 μm), (c) *Mobile phase* at a flow rate of about 1 mL per minute, and (d) an ultraviolet photometer set at 224 nm.

To determine the suitability of the chromatographic system, chromatograph *Standard preparation* having a known concentration of 60 μg per mL and record the peak responses as directed under *Procedure* and *Calculation*: the symmetry factor for the andrographolide peak is not more than 2.0 and the relative standard deviation for replicate injections is not more than 2.0 per cent.

Procedure and **Calculation** Separately inject about 20 μL each of *Standard preparations* into the chromatograph, record the chromatograms and measure the responses for the major peaks. Plot the readings and draw the standard curve of best fit. Inject about 20 μL of *Sample preparation* into the chromatograph, record the chromatogram and measure the response for the major peak. By reference to the standard curve, calculate the content of andrographolide ($C_{20}H_{30}O_5$) in the portion of the Capsules taken.

Assay Grind the contents of not less than 20 Andrographis Capsules to *fine powder*. Transfer about 1 g, accurately weighed, to a 100-mL round-bottomed flask. Add 50 mL of *ethanol (85 per cent)*, reflux in a water-bath for 2 hours and filter. Wash the marc with sufficient amount of *ethanol (85 per cent)* until the last washing is almost colourless. Combine the washings and the filtrate and allow to cool. Add 1 mL of *basic lead acetate TS*, set aside for 15 minutes, filter, and wash the precipitate with *ethanol* until the last washing is no longer green. Combine the washings and the filtrate, add dropwise with swirling 1 mL of a 25 per cent w/v solution of *sodium sulfate* and mix well. Set aside for 1 hour, add 500 mg of *decolorizing charcoal*, and reflux in a water-bath for 10 minutes. Filter through the Büchner funnel containing 500 mg of *decolorizing charcoal* and wash with three 2-mL portions of hot *ethanol*. Combine the washings and the filtrate, add 20 mL of *distilled water*, allow to cool, and neutralize with 0.1 M *sodium hydroxide*, using *phenolphthalein TS* as indicator. Add 5.0 mL of 0.1 M *sodium hydroxide VS*, reflux in a water-bath for 30 minutes, allow to cool, and titrate with 0.05 M *hydrochloric acid VS*. Perform a blank determination (Residual Titrations, Appendix 6.17). Each mL of 0.1 M *sodium hydroxide VS* is equivalent to 35.05 mg of total lactones calculated as andrographolide ($C_{20}H_{30}O_5$).

Other requirements Comply with the requirements described under “Capsules” (Appendix 1.16H).

หอม (HOM)

หอมบัว (HOM BUA), หอมแกง (HOM KAENG), หอมเล็ก (HOM LEK)
Allii Ascalonici Bulbus
Shallot

Category Carminative, expectorant.

Shallot is the air-dried bulb of *Allium ascalonicum* L. (*Allium cepa* var. *ascalonicum* Backer) (Family Amaryllidaceae), Herbarium Specimen Number: DMSC 5172, BKF 156785, Crude Drug Number: DMSc 1143.
(**Note** The samples used are air-dried in the well-ventilated shade until the outermost bulb scales become dried.)

Constituents Shallot contains volatile oil comprising sulfur-containing organic compounds (e.g., diallyl disulfide, dipropyl disulfide, dipropyl trisulfide, methyl propyl trisulfide), flavonoids and their glycosides, saponins, etc.

Description of the plant (Figs. 1a, 1b) Biennial herb 20 to 50 cm high; subterranean bulbs ovoid, 1.5 to 5 cm long, 1 to 4 cm wide, often consisting of 1 to 3 bulblet(s), usually reddish purple. Leaves simple, alternate, basally clustered, blade terete or cylindrical, 10 to 40 cm long, 0.3 to 1 cm wide, apex acuminate, sheathing at base, shiny green. Inflorescence terminal, scapose, umbel-like, globose, subtended by a few membranous spathe-like bracts; peduncle 30 to 45 cm long; pedicel 1.5 to 2 cm long. Flower bisexual, small; tepals 6, white to greenish white, pink or purple, ovate-lanceolate or oblong-lanceolate, 4 to 9 mm long; stamens 6, biseriate, inner filaments dilated at base; ovary superior, consisting of 3 connated carpels, 3-loculed, ovules numerous in each locule, style 1, filiform. Fruit locucidal capsule, 3-lobed. Seed flat, black.

Description Odour, acrid and characteristic; taste, acrid.

Macroscopical (Fig. 1a) Ovoid bulbs, 1.5 to 5 cm long, 1 to 4 cm wide, often consisting of 1 to 3 bulblet(s), reddish purple.

Microscopical (Figs. 2a, 2b, 2c) Transverse section of the bulb shows upper and lower epidermis layers, mesophyll and vascular bundles. Upper and lower epidermises, small rectangular cells, some of which containing purple pigment. Mesophyll composed of parenchyma cells, some of which contain rod-shaped crystals and oil globules. Vascular bundles, in mesophyll layers, circularly arranged; vessels, annular, spiral and reticulate.

Shallot in powder possesses the diagnostic microscopical characters of the unground drug. Typical rod-shaped crystals in some parenchyma cells and small unbranched vessels are characteristic.

Additional information

1. It is usually harvested after one crop of cultivation (70 to 110 days) to obtain its bulbs although it is a biennial herb.
2. Traditionally, inhaling the vapour or soaking the head with warm water containing the freshly crushed bulbs could alleviate nasal congestion from common cold.

1

2

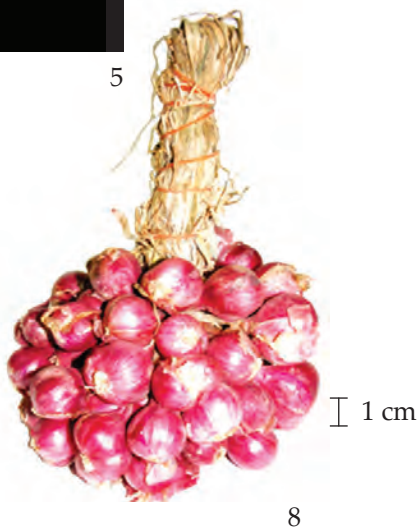
3

4

5

6

7



8

Fig. 1a *Allium ascalonicum* L.
1. cultivated plants 2. habit 3. inflorescence 4. flowers (in different stages)
5. flower (top view) 6. and 7. flower (side view) 8. crude drug

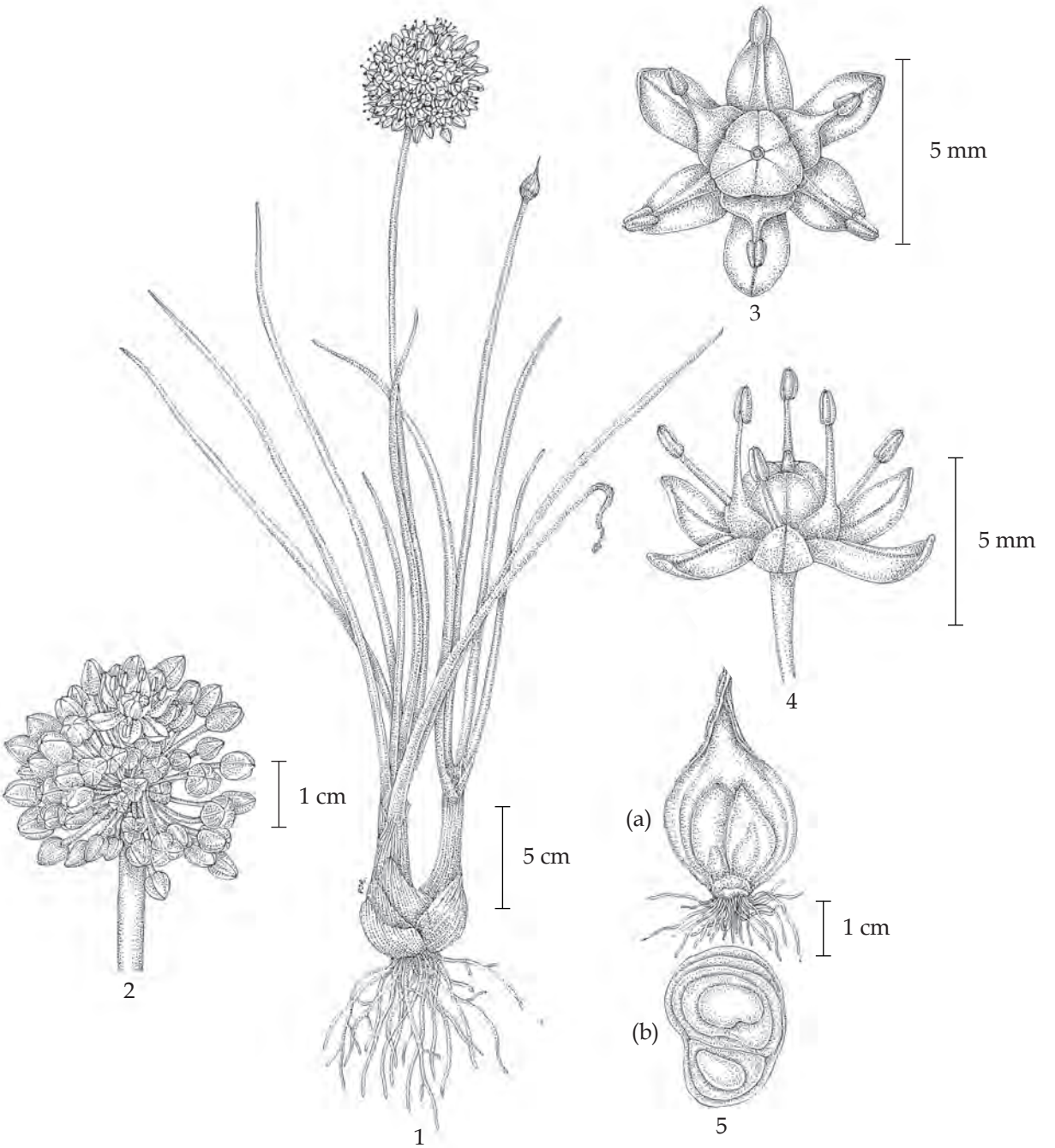


Fig. 1b *Allium ascalonicum* L.
1. habit showing bulbs, leaves and inflorescences 2. inflorescence 3. flower (top view)
4. flowers (side view) 5. bulbs in longitudinal view (a) and sectional view (b)

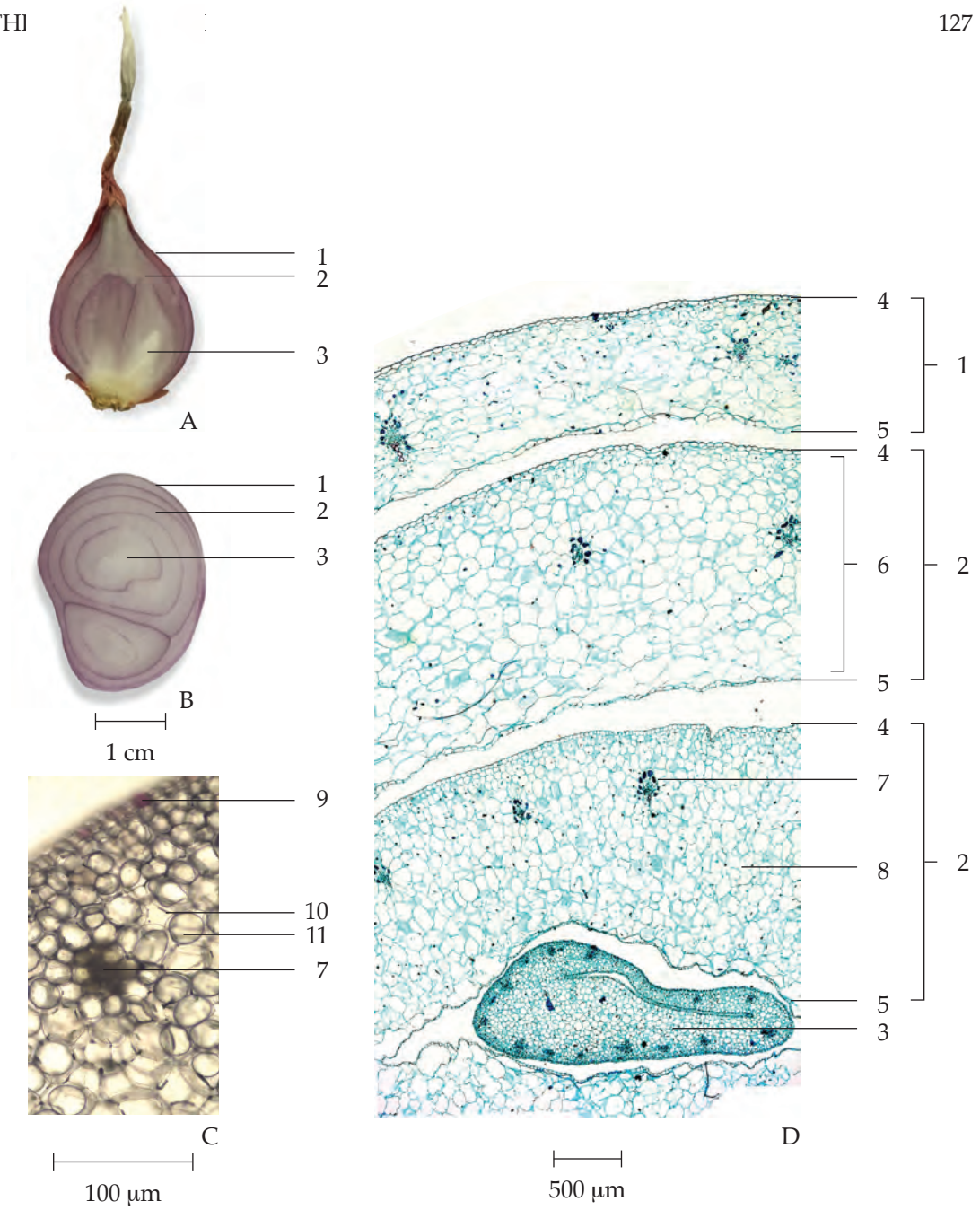


Fig. 2a Sections of the Bulb of *Allium ascalonicum* L.
A. Longitudinal Section
B. Transverse Section
C. Photomicrograph of Transverse Section of the Outer Scale Leaf
D. Photomicrograph of Transverse Section of Part of the Bulb, Stained with Safranin-Fast Green

1. outer scale leaf
2. inner scale leaf
3. young shoot
4. lower epidermis
5. upper epidermis
6. mesophyll
7. vascular bundle
8. parenchyma
9. purple pigment
10. rod-shaped crystal
11. oil globule

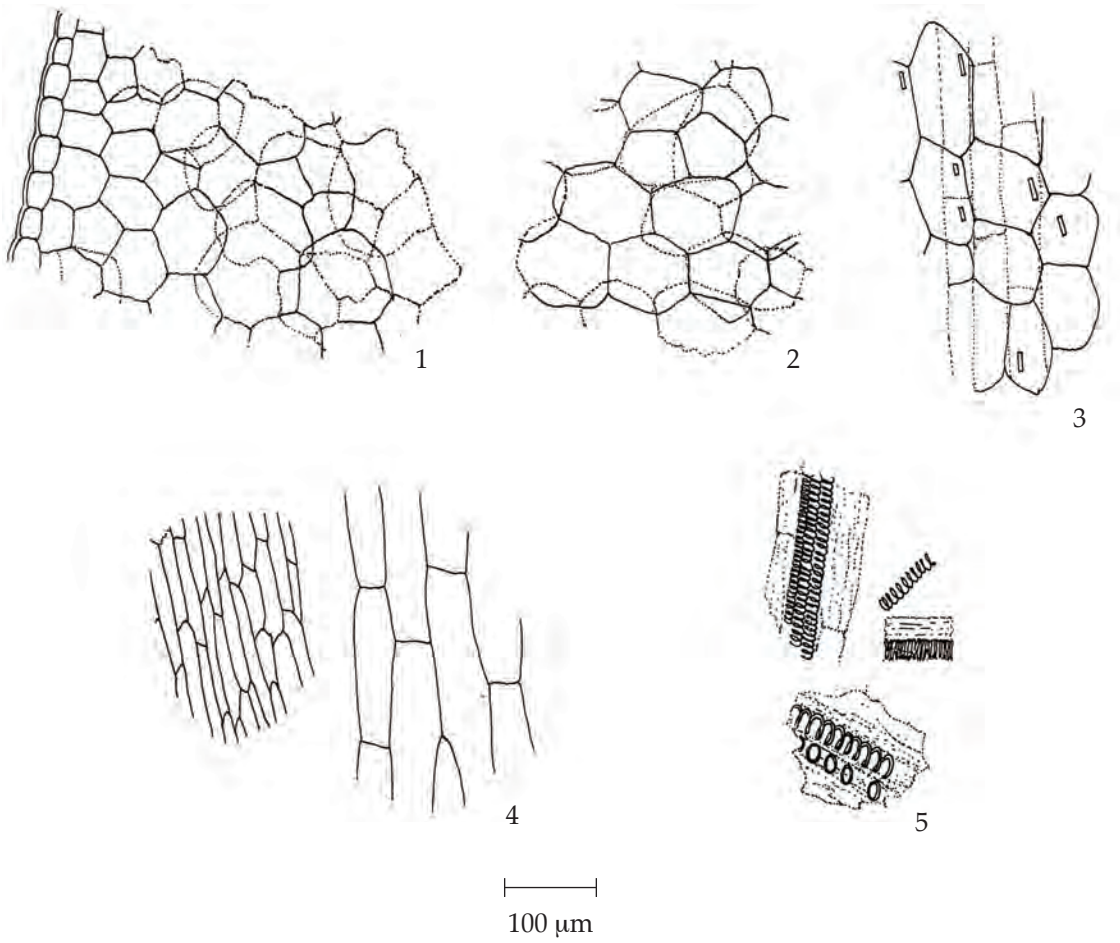


Fig. 2b Line Drawings of Powdered Drug of the Dried Bulbs of *Allium ascalonicum* L.

1. epidermis associated with parenchyma in sectional view
2. parenchyma
3. parenchyma, some containing rod-shaped crystals
4. epidermis in surface view
5. annular, spiral and reticulate vessels

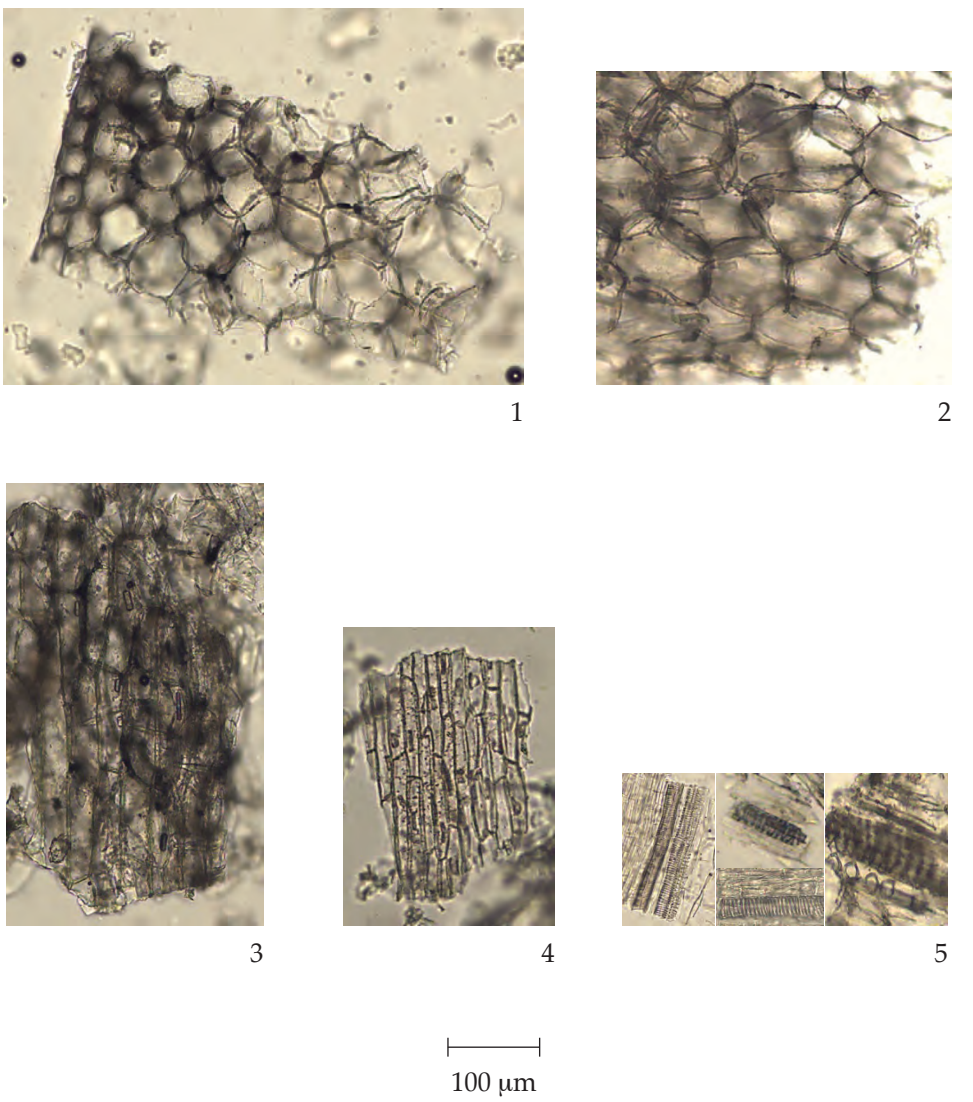


Fig. 2c Photomicrographs of Powdered Drug of the Dried Bulbs of *Allium ascalonicum* L.

1. epidermis associated with parenchyma in sectional view
2. parenchyma
3. parenchyma, some containing rod-shaped crystals
4. epidermis in surface view
5. annular, spiral and reticulate vessels

Packaging and storage Shallot shall be stored in a well-ventilated, dry place, protected from light; under these conditions it may be stored for 6 months after harvesting.

Identification

A. Shake 2 g of the crushed, peeled sample with 25 mL of *methanol* for 5 minutes and filter. Dilute 0.5 mL of the filtrate to 2 mL with *methanol*, add 2 drops of *ninhydrin TS* and immerse in a water-bath for a few minutes: a violet-blue colour appears.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 30 volumes of *1-butanol*, 10 volumes of *water*, 10 volumes of *1-propanol*, and 10 volumes of *glacial acetic acid* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply to the plate, 4 μL of the test solution prepared by refluxing 30 g of the crushed, peeled sample, with 50 mL of *ethanol* on a water-bath for 30 minutes. Cool, filter, evaporate the filtrate to dryness, and dissolve the residue in 1.0 mL of *ethanol*. After removal of the plate, allow it to dry in air. Spray the plate with *ethanolic ninhydrin TS* and heat at 110° for 10 minutes. Several spots of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Ethanolic Extract of the Bulbs of *Allium ascalonicum* L.

Spot	hR_f Value	Detection
		Ethanolic Ninhydrin TS
1	5–8	orange
2	9–11	orange
3	18–20	pink
4	21–26	pink
5	26–29	pale yellow
6	32–36	reddish brown
7	36–40	reddish brown
8	44–49	reddish brown
9	50–53	reddish brown

Water Not more than 87.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Total ash Not more than 1.0 per cent w/w (Appendix 7.7).

Dose 15 to 30 g as a decoction.

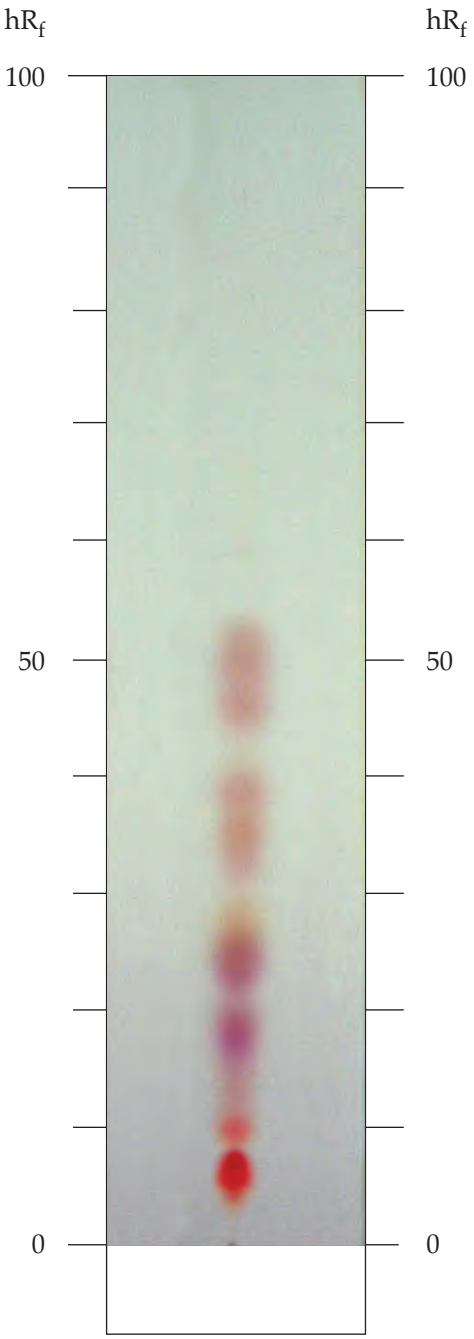


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Bulbs of *Allium ascalonicum* L., Detected with *Ethanolic Ninhydrin TS*

กะเพราแดง (KAPHRAO DAENG)

Ocimi Tenuiflori Folium
Holy Basil Leaf, Ocimum Tenuiflorum Leaf

Category Pharmaceutic aid (flavouring agent), carminative.

Holy Basil Leaf is the dried leaf of the red variety of *Ocimum tenuiflorum* L. [*O. sanctum* L., *O. monochorum* L., *O. album* Blanco, *O. flexuosum* Blanco, *O. nelsonii* Zippelius ex Spanoghe, *O. virgatum* Blanco, *O. brachiatum* Hasskarl, *Moschosma tenuiflorum* (L.) Heynh.] (Family Labiatae), Herbarium Specimen Number: DMSC 43, 418, Crude Drug Number: DMSc 0273.

Constituents Holy Basil Leaf contains up to about 1.7 per cent of volatile oil, of which methyl eugenol, caryophyllene and methyl chavicol are its major components. It also contains β-carotene, sterols, fatty acids, etc.

Description of the plant (Figs. 1a, 1b) Herb 30 to 60 cm high, erect, aromatic, much branched, twigs usually purplish, subquadrangular, clothed with soft spreading hairs, often woody at the base. Leaves simple, opposite, elliptic-oblong or elliptic, 3 to 6 cm long, 1 to 2.5 cm wide, apex acute or obtuse, base acute or obtuse, margin entire or serrate, membranous, pubescent on both surfaces, lower surface more hairy on midrib; petiole, 1 to 3 cm long, slender, hairy. Flower in terminal raceme of verticillasters, 8 to 10 cm long; bract 2 to 3 mm long, broadly ovate with acuminate apex, ciliated; pedicel 3 to 4.5 mm, slender, pubescent. Flower: calyx tubular-bilabiate, about 2.5 mm (in fruit 3 to 3.5 mm) long, glabrous inside (pubescent outside), the upper lip broadly obovate, flat, the lower lip 4-toothed, the 2 central with long slender awns which project beyond the upper lip and are much curved upwards; corolla purplish, tubular-bilabiate, the upper lip 4 of almost equal lobes, pubescent on the back, lower lip, the longest lobe and ascending; stamens 4, epipetalous, exserted, filaments slender, the upper pair with a small bearded basal appendage. Fruit small, 4-seeded nutlets. Seed ovoid, brown, nearly smooth, about 1.2 mm long.

Description Odour, aromatic; taste, slightly pungent.

Macroscopical (Fig. 1a) Leaves, wrinkled and broken; entire leaves, elliptic-oblong, 2 to 5 cm long and 1 to 3 cm wide; petiole 1 to 3 cm long, greenish brown.

Microscopical (Figs. 2a, 2b) Transverse section of the leaf shows upper epidermis, a single layer of rectangular cells containing reddish purple matters. Mesophyll consisting of a single layer of palisade parenchyma and several layers of more or less rounded spongy parenchyma, rich in chloroplastids. Through this region, scattered the small vascular bundles. Lower epidermis, a single layer of rectangular cells, no colouring matters, non-glandular and glandular trichomes occur as outgrowths from lower epidermis more abundant than upper epidermis. The non-glandular trichomes are uniseriate, 1 to 7 cells, some of the cells are more or less collapsed. The glandular trichomes have a 1-celled stalk and 2- to 4-celled glandular head. Transverse section through the midrib of the lamina shows the 2 or 3 layers of angular collenchyma underneath the epidermis, parenchyma and collateral vascular bundles. In surface view, the epidermides of upper and lower surfaces are wavy-walled polygonal cells with diacytic stomata.

1

2

3

4

1 cm

Fig. 1a *Ocimum tenuiflorum* L.
1. habit 2. leaves and inflorescences (a), flower (b)
3. part of infructescence 4. crude drug

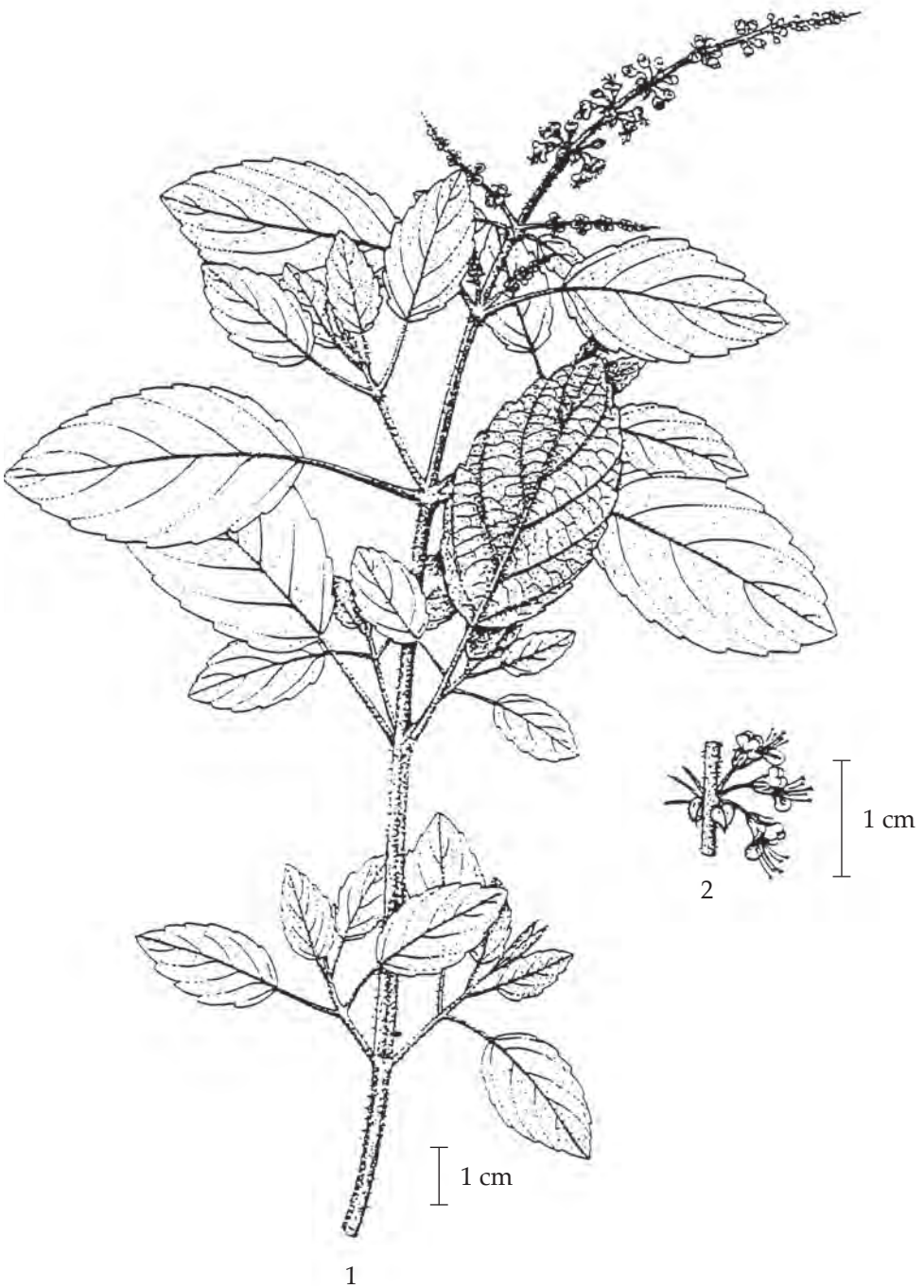


Fig. 1b *Ocimum tenuiflorum* L.
1. twig 2. inflorescence

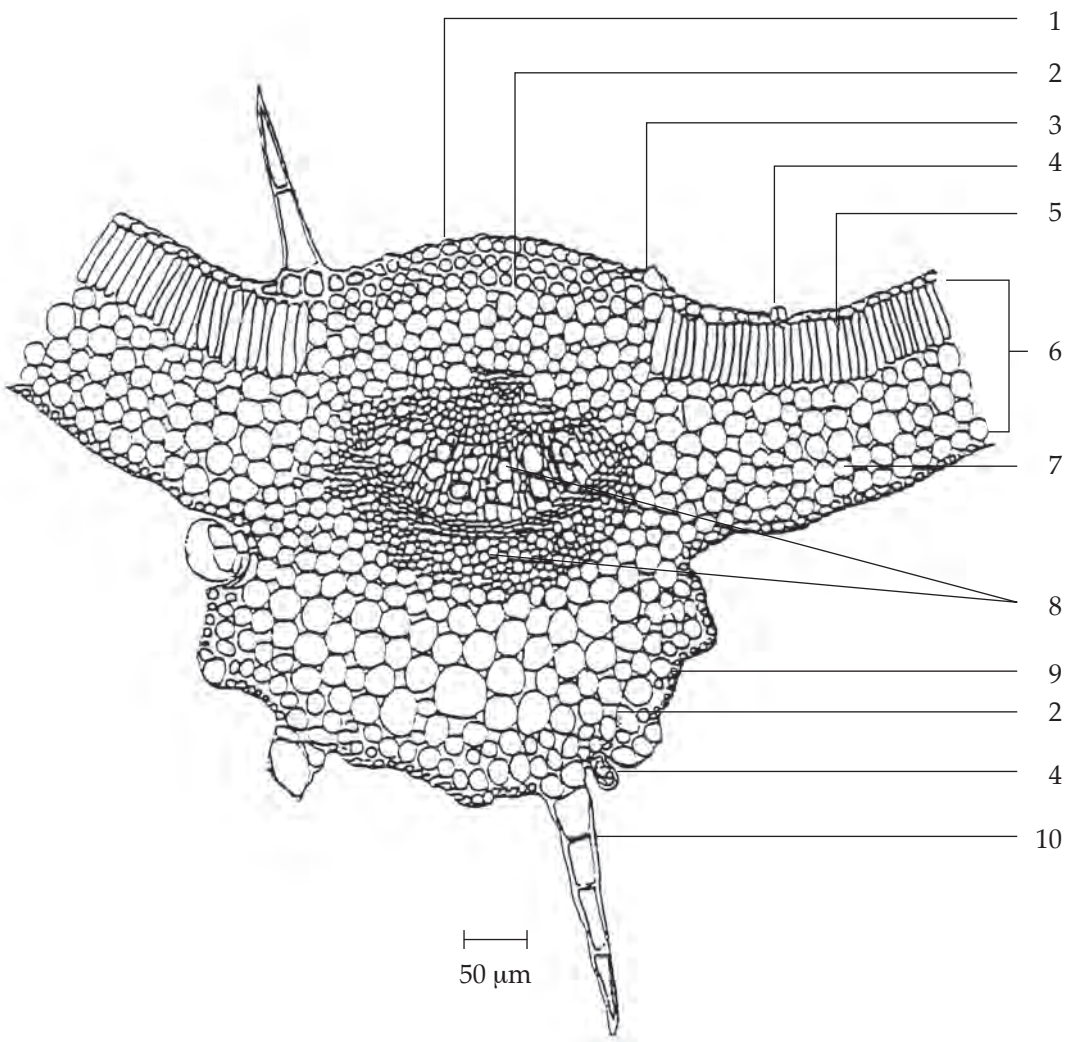


Fig. 2a Transverse Section of the Leaf of *Ocimum tenuiflorum* L.

1. upper epidermis
2. collenchyma
3. unicellular trichome
4. glandular trichomes
5. palisade parenchyma
6. mesophyll
7. spongy parenchyma
8. vascular bundles
9. lower epidermis
10. uniseriate multicellular trichome

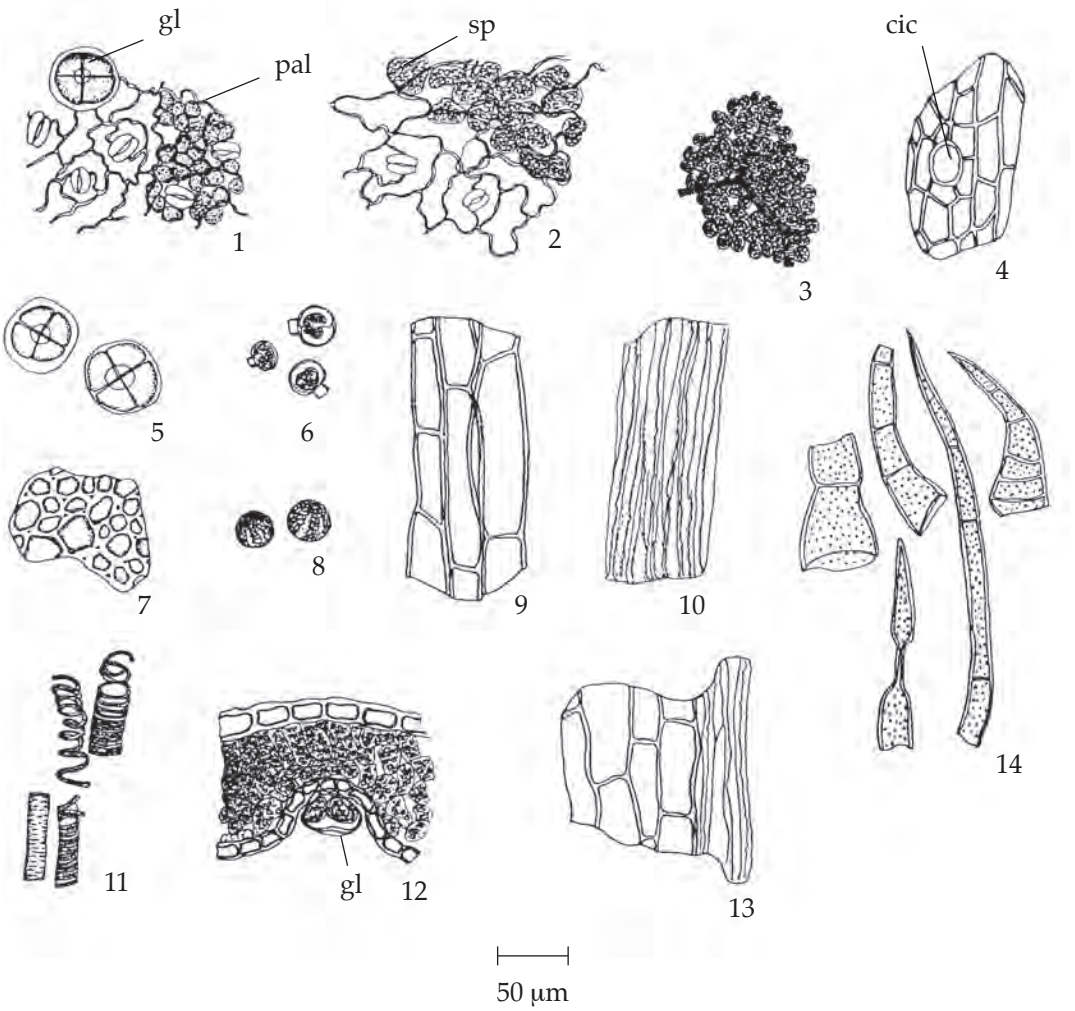


Fig. 2b Powdered Drug of the Leaves of *Ocimum tenuiflorum* L.

1. upper epidermis in surface view with diacytic stomata, glandular trichome and underlying palisade cells
2. lower epidermis with diacytic stomata and underlying spongy cells
3. spongy cells and veinlets
4. epidermis of the petiole in surface view, showing cicatrix
5. 4-celled head glandular trichomes
6. 2-celled head glandular trichomes
7. collenchyma from the petiole
8. pollen grains (rare)
9. parenchyma from stem in longitudinal view (rare)
10. group of lignified fibres
11. group of vessels
12. transverse section of lamina
13. parenchyma and fibres from the petiole
14. part of uniseriate multicellular trichomes showing collapsed cell

(gl = glandular trichome; pal = palisade cell; sp = spongy cells; cic = cicatrix)

Holy Basil Leaf in powder possesses the diagnostic microscopical characters of the unground drug.

Packaging and storage Holy Basil Leaf shall be kept in well-closed containers, preferably of metal or glass, protected from light and stored in a cool and dry place.

Identification

A. To 500 mg of the sample, in powder, add 2 mL of *acetic anhydride*, warm on a water-bath for about 2 minutes, shake, and filter. Slowly add 1 mL of *sulfuric acid* to the filtrate to form a layer: a brownish red ring forms at the zone of contact.

B. Add 10 mL of *water* to 500 mg of the sample, in powder, heat for 2 minutes and filter. To 2 mL of the filtrate, add 1 drop of a 5 per cent w/v solution of *iron(III) chloride*: a green precipitate is produced.

C. Add 10 mL of *water* to 500 mg of the sample, in powder, boil for 2 minutes and filter. To 3 mL of the filtrate, add 1 drop of *potassium cupri-tartrate TS* and warm: a brick-red precipitate is produced.

D. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 75 volumes of *chloroform* and 25 volumes of *benzene* as the mobile phase. Apply to the plate, 10 μL of the test solution, prepared by shaking 100 mg of the sample, in powder, with 2 mL of *dichloromethane* for about 15 minutes and filtering. Evaporate the filtrate on a water-bath to dryness and dissolve the residue in 0.5 mL of *toluene*. After removal of the plate, allow it to dry in air and spray with a 10 per cent w/v solution of *phosphomolybdic acid* in *ethanol*. Heat at 105° to 110° for 5 to 10 minutes. Several spots of different colours are observed (Table 1); see also Fig. 3.

Repeat the same procedure on another plate. After removal of the plate, allow it to dry in air. Spray the plate with *anisaldehyde TS*; several spots of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Dichloromethane Extract of the Leaves of *Ocimum tenuiflorum* L.

Spot	hR_f Value	Detection	
		10 Per Cent W/V Solution of *Phosphomolybdic Acid* in *Ethanol*	*Anisaldehyde TS*
1	5–10	blue	violet
2	15–22	green	–
3	23–28	blue	pink
4	29–32	–	blue
5	33–35	green	blue
6	36–38	–	blue
7	39–45	–	green
8	50–55	blue	pink
9	56–65	blue	pale blue
10	66–70	–	green
11	75–80	blue	pink

Water Not more than 14.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Acid-insoluble ash Not more than 2.0 per cent w/w (Appendix 7.6).

Sulfated ash Not more than 20.0 per cent w/w (Appendix 5.3).

Ethanol-soluble extractive Not less than 5.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 20.0 per cent w/w (Appendix 7.12).

Chloroform-soluble extractive Not less than 5.0 per cent w/w (Appendix 7.12H).

Volatile oil Not less than 1.0 per cent v/w (Appendix 7.3H). Use 50 g of hand-crushed leaves, accurately weighed. Use 1000 mL of *water* as the distillation liquid and a 2.5-L round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube.

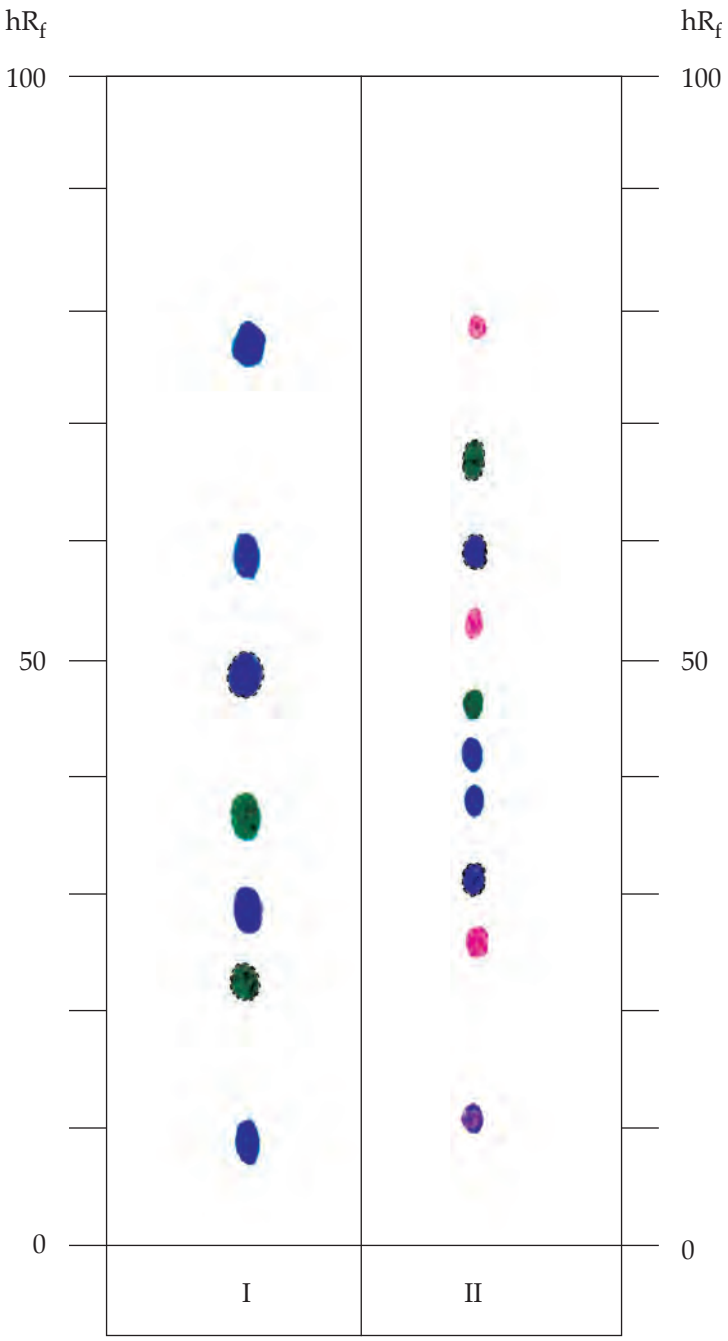


Fig. 3 Thin-Layer Chromatogram of Dichloromethane Extract of the Leaves of *Ocimum tenuiflorum* L.

I = detection with a 10 per cent w/v solution of *phosphomolybdic acid* in *ethanol*

II = detection with *anisaldehyde TS*

◌ = spots developed in some samples

ขมิ้นชัน (KHAMIN CHAN)

Curcumae Longae Rhizoma, Curcumae Domesticae Rhizoma
Turmeric

Synonyms Curcuma, Indian Saffron, Yellow Root

Category Stomachic, carminative, pharmaceutic aid (colouring agent), astringent.

Turmeric is the dried rhizome of *Curcuma longa* L. (*C. domestica* Valeton) (Family Zingiberaceae), Herbarium Specimen Number: DMSC 31, 1410, 1458, Crude Drug Number: DMSc 0012.

Constituents Turmeric contains yellow volatile oil, of which turmerone and zingiberene are its major components, and curcuminoids, of which curcumin, desmethoxycurcumin, and bisdesmethoxycurcumin are its major components.

Description of the plant (Figs. 1a, 1b) Perennial herb with a thick, ellipsoid-ovate rhizome, orange inside, giving rise to short blunt daughter rhizomes called fingers; leafy shoots up to 1 m tall, bearing 6 to 10 leaves. Leaves simple, glabrous, lamina, elliptic, oblong-elliptic or lanceolate, 30 to 45 cm long, 10 to 15 cm wide, apex acuminate, base narrow; petiole as long as lamina (rather abruptly broadened to leaf sheath, forming a pseudostem). Inflorescence scape from the apex of the rhizome; peduncle 15 cm long or more; spike 10 to 15 cm long, 5 to 7 cm in diameter; bract, white or white with green, 5 to 6 cm long, each subtending flowers; bracteole thin, pale green and tinged with pink, elliptic to ovate, up to 3.5 cm long. Flowers as long as the bracts; calyx whitish tubular, unilateral split, unequally toothed; corolla white, tubular at base, upper half cup-shaped with 3 unequal lobes inserted on edge of cup lip; lateral staminode petaloid, oblong, folder under the dorsal petal, staminode and lip creamy-white with yellow median band, filament united to another about the middle of the pollen sac, spurred at base; ovary trilocular. Fruit capsule, globose to ellipsoid. Seed arillate.

Description

Macroscopical (Fig. 1a) Dried rhizome occurs as an ovate, oblong or pear-shaped of round turmeric; cylindrical and often short-branched of long turmeric; the round about half as broad as long, the long 2 to 5 cm long and 1 to 2 cm thick; externally yellowish to yellowish brown, with root scars and annulations, the latter from the scars of leaf bases; fracture horny; internally orange-yellow to orange, waxy, showing a cortex separated from a central cylinder (about twice as broad as cortex) by a distinct endodermis; in both cortex and central cylinder, scattered bundles are seen.

Microscopical (Figs. 2a, 2b) Transverse section of the rhizome shows epidermis consisting of a layer of rectangular cells; covering trichomes, unicellular, up to 280 μm long. Hypodermis composed of 3 to 6 layers in the mature rhizome, but absent in the younger. Cork, 4 to 6 layers of rectangular cells. Cortex composed of thin-walled parenchyma cells containing numerous starch grains, yellowish oil droplets and yellow colouring matter occasionally seen; starch grains, simple, flattened, rounded to oval or irregular in outline, very faint transverse striations could be seen in some granules. Endodermis, a layer of thin-walled cells. Stele, thin-walled parenchyma cells containing numerous starch grains, yellowish oil droplets and yellow colouring matter. Fibrovascular bundles, non-lignified walled cells, scattered in cortex and stele; vessels, spiral, scalariform and reticulate.

Turmeric in powder possesses the diagnostic microscopical characters of the unground drug.

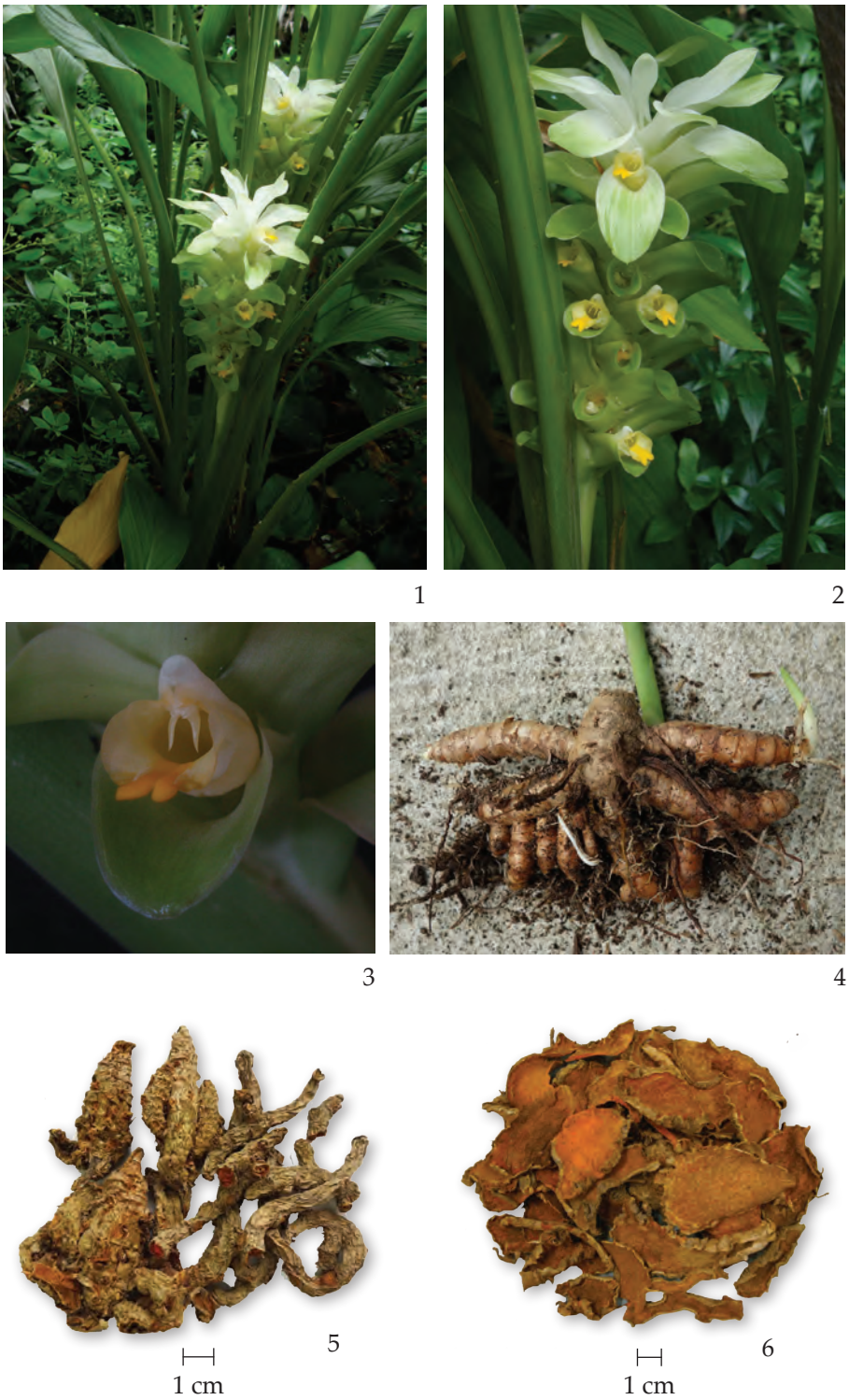


Fig. 1a *Curcuma longa* L.
1. habit 2. inflorescence 3. flower 4. rhizome 5. and 6. crude drug

Fig. 1b *Curcuma longa* L.
1. habit 2. inflorescence 3. rhizome

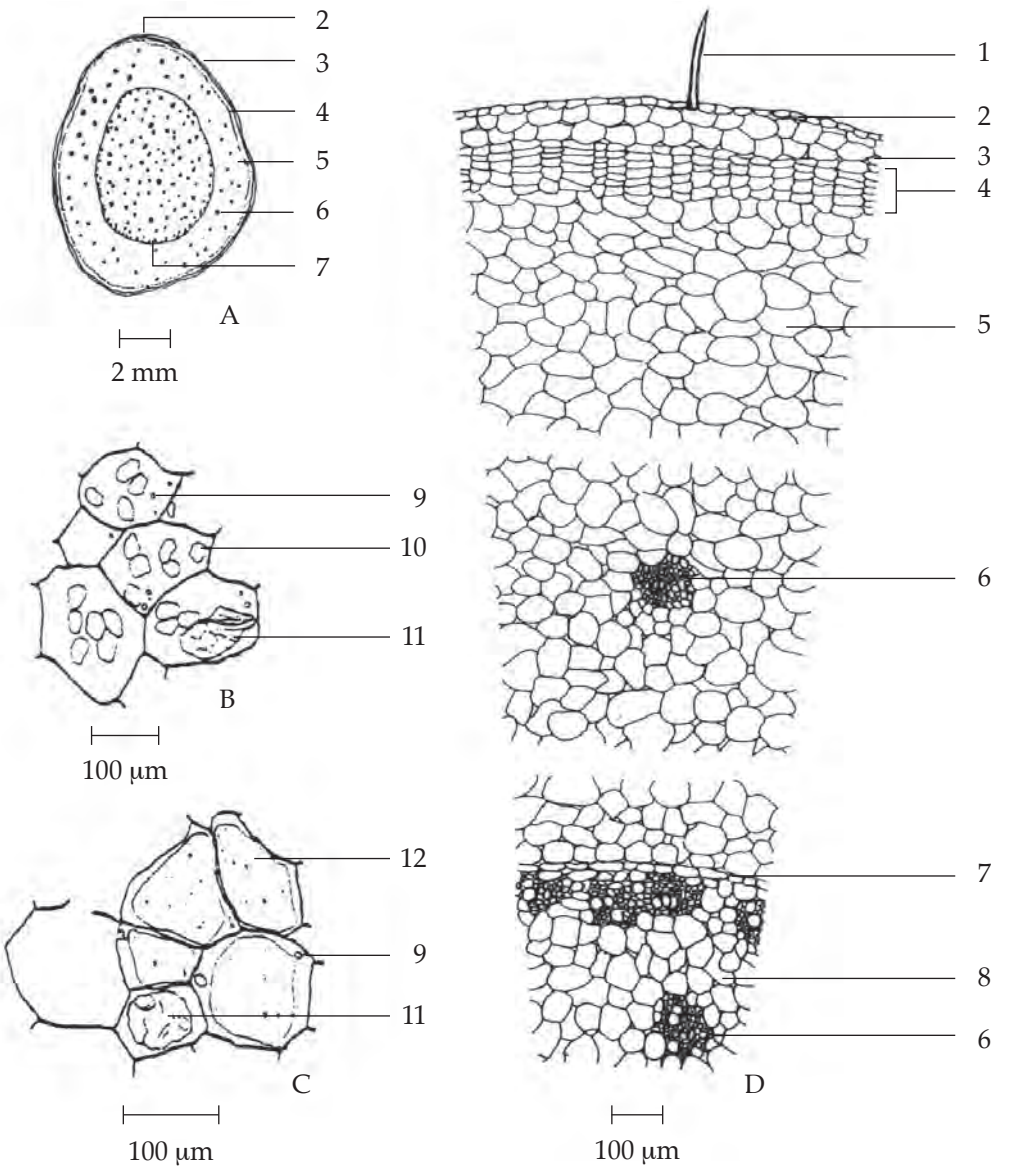
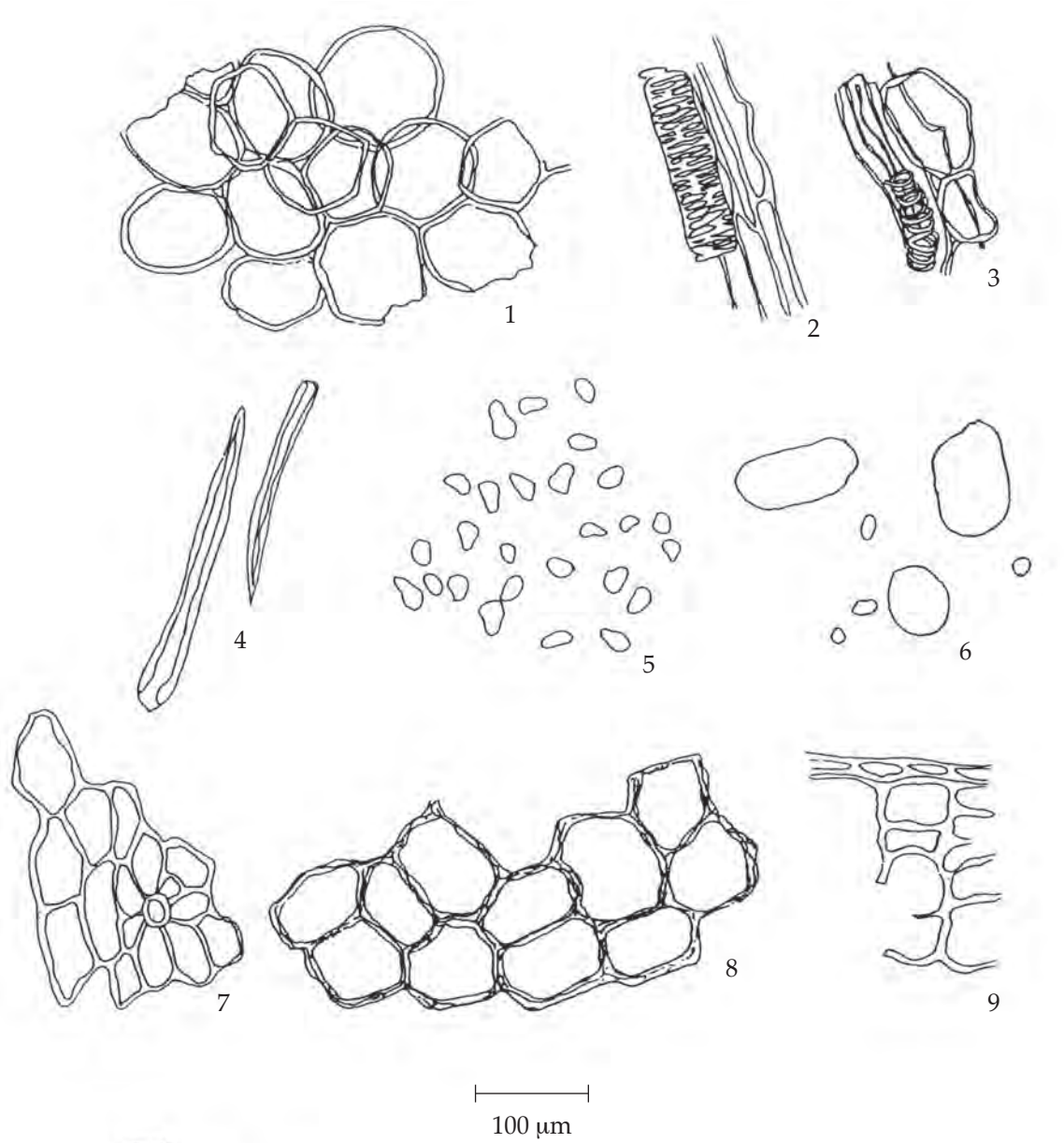


Fig. 2a Transverse Section of the Rhizome of *Curcuma longa* L.

A. Diagram
B. Parenchyma of Untreated Rhizome
C. Parenchyma of Steam-Treated Rhizome
D. Part of Transverse Section

1. unicellular covering trichome
2. epidermis
3. hypodermis
4. cork layers
5. cortical parenchyma containing starch granules
6. vascular bundles
7. endodermis
8. stele parenchyma containing starch granules
9. oil droplet
10. starch granule
11. orange-yellow colouring matter
12. yellow gelatinized starch mass



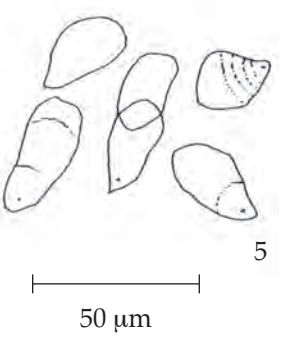


Fig. 2b Powdered Drug of the Rhizomes of *Curcuma longa* L.

1. parenchyma
2. reticulate vessel
3. spiral vessel
4. unicellular trichomes
5. starch granules
6. altered starch grains
7. epidermis in surface view
8. cork in surface view
9. epidermis and hypodermis in sectional view

Packaging and storage Turmeric shall be kept in well-closed containers, preferably of metal or glass, protected from light and stored in a cool and dry place.

Identification

A. Extract 10 mg of the sample, in powder, with 2 mL of *acetic anhydride*, add a few drops of *sulfuric acid* and observe under ultraviolet light (366 nm): the solution shows blood-red colour.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 49 volumes of *benzene*, 49 volumes of *chloroform* and 2 volumes of *ethanol* as the mobile phase and allowing the solvent front to ascend 17 cm above the line of application. Apply separately to the plate, 5 μL each of the following two solutions. Prepare solution (A) by placing 1 g of the sample, in powder, in a stoppered test-tube, adding 3 mL of *methanol* and shaking for a few minutes. Set aside for 1 hour and filter. For solution (B) dissolve 1 mg of *curcumin* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (366 nm), locating the spots. The chromatogram obtained with solution (A) shows a yellow-brown spot (hR_f value 28 to 34) corresponding to the curcumin spot from solution (B). Other two yellow-brown spots correspond in hR_f values to the spot numbers 2 and 3. Several spots of higher and lower hR_f values are observed (Table 1); see also Fig. 3. Spray the plate with a 10 per cent w/v solution of *phosphomolybdic acid* in *ethanol* and heat at 105° for 5 minutes; the spot due to curcumin is orange-brown. The spots due to those of numbers 2, 3, 10, 14 and 15 in Table 1 are orange, orange-brown, blue, blue, and blue, respectively. Other spots of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Rhizomes of *Curcuma longa* L.

Spot	hR_f Value	Detection	
		UV 366	10 Per Cent W/V Solution of *Phosphomolybdic Acid* in *Ethanol*
1	5–8	light brown	brown
2	11–15	yellow-brown	orange
3	17–20	yellow-brown	orange-brown
4	21–24	blue-green	blue
5	28–34	yellow-brown	orange-brown
6	35–38	blue-green	blue
7	39–42	yellow	pale yellow
8	44–46	–	blue
9	48–51	–	blue
10	52–53	–	blue
11	57–60	–	blue
12	62–66	–	blue
13	71–74	–	blue
14	80–85	–	blue
15	87–90	–	blue

2 = bisdesmethoxycurcumin
3 = desmethoxycurcumin
5 = *curcumin*
10 = curcumol
14 = *dl*-turmerone
15 = ar-curcumene (ar = aromatic)

Water Not more than 10.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 1.0 per cent w/w (Appendix 7.6).

Total ash Not more than 8.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 10.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 9.0 per cent w/w (Appendix 7.12).

Volatile oil Not less than 6.0 per cent v/w (Appendix 7.3H). Use 10 g, in *fine powder*, accurately weighed. Use 100 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube. Calculate the content of volatile oil with reference to the anhydrous substance.

Curcuminoids content Not less than 5.0 per cent w/w of curcuminoids, calculated as curcumin, when determined by the following method.

Standard curcumin solution Dissolve about 2 mg of Curcumin RS, accurately weighed, in sufficient *methanol* to produce 5.0 mL.

Standard curcumin curve Transfer into five 10-mL volumetric flasks, 20, 40, 50, 60, and 80 µL, respectively, of *Standard curcumin solution*, dilute to volume with *methanol*, and mix. Measure the absorbances of the standard solutions relative to the blank at 420 nm (Appendix 2.2). Plot the readings and draw the curve of best fit.

Procedure Transfer about 300 mg of Turmeric, in *fine powder* and accurately weighed, into a 10-mL volumetric flask, add *tetrahydrofuran* to volume and mix. Set aside at room temperature for 24 hours with frequent shaking. Dilute 1.0 mL of the clear supernatant liquid with *methanol* to produce 25.0 mL. Transfer 1.0 mL of this solution into a 50-mL volumetric flask, dilute to volume with *methanol* and mix well. Measure the absorbance of the resulting solution at the maximum at about 420 nm (Appendix 2.2). By reference to the standard curve, calculate the content of as curcumin in the sample.

Dose 0.5 to 1 g four times a day after meals and at bedtime.

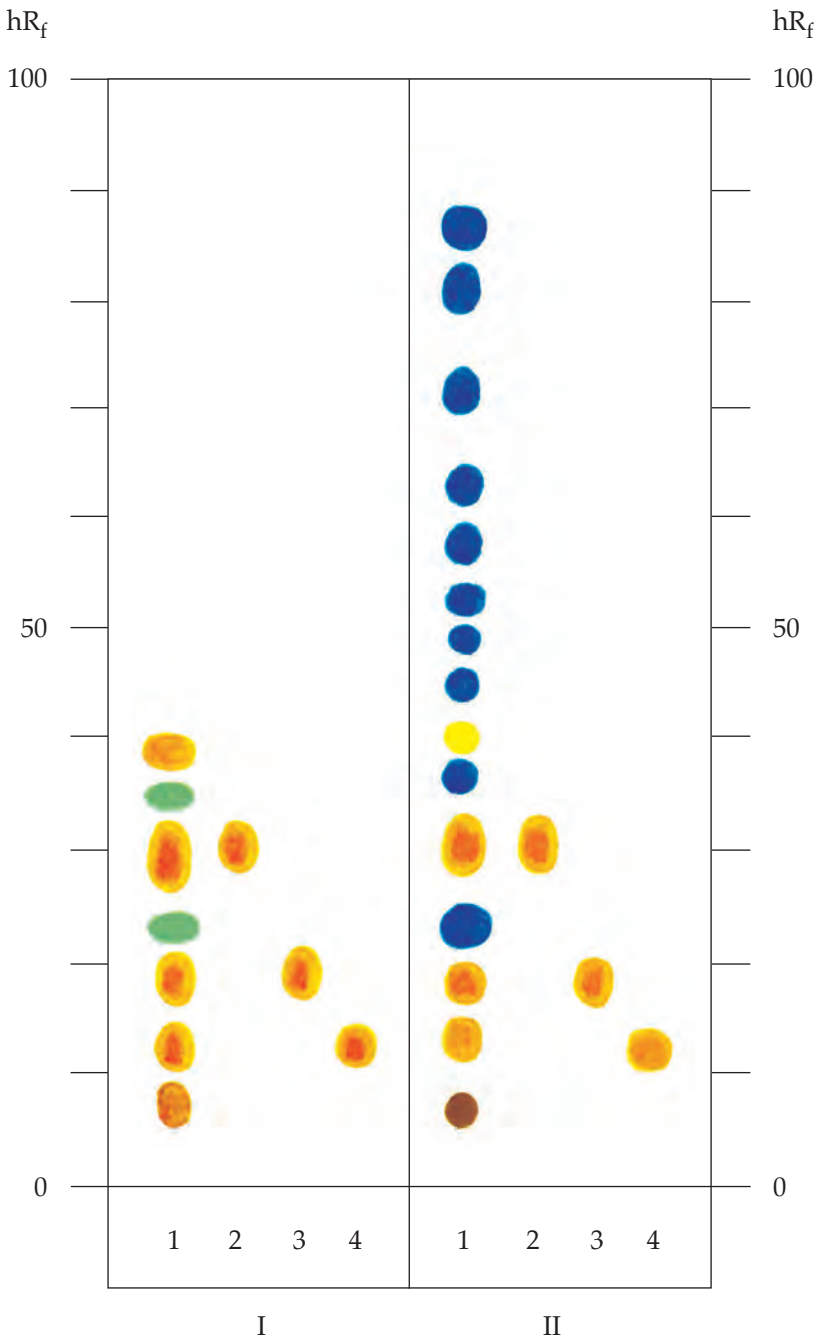


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Rhizomes of *Curcuma longa* L.

1 = solution (A)
2 = solution (B)
3 = a 0.1 per cent w/v solution of desmethoxycurcumin in *methanol*
4 = a 0.1 per cent w/v solution of bisdesmethoxycurcumin in *methanol*
I = detection under UV light (366 nm)
II = detection with a 10 per cent w/v solution of *phosphomolybdic acid* in *ethanol*

ยาแคปซูลขมิ้นชัน (KHAMIN CHAN CAPSULES)

Turmeric Capsules

Category Stomachic, carminative.

Turmeric Capsules contain an amount of powdered Turmeric equivalent to not less than 80.0 per cent of the labelled amount of volatile oil and not less than 90.0 per cent of the labelled amount of curcuminoids, calculated as curcumin ($C_{21}H_{20}O_6$).

Strength available 250 mg (powder).

Dose Two to four capsules four times a day after meals and at bedtime.

Warning

1. Long-term use is not recommended in pregnant or nursing women.
2. Use in patients with bile duct obstruction is not recommended, except under medical supervision.
3. Caution should be exercised when it is to be used concomitantly with anticoagulants and antiplatelets.

Packaging and storage Turmeric Capsules shall be kept in tightly closed containers, protected from light, and stored in a dry place and at a temperature not exceeding 30°.

Labelling The label on the container states (1) the equivalent amount of volatile oil and curcuminoids as curcumin; (2) the expiration date.

Identification

A. The capsule contents exhibit diagnostic structures of the powdered drug described under *Turmeric*.

B. The capsule contents comply with the tests for Identification A and B described under *Turmeric*.

Water Of the capsule contents, not more than 10.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Microbial limit Comply with the requirements for Category 4 in the "Limits for Microbial Contamination" (Appendix 10.5).

Dissolution Carry out the test as described in the "Dissolution Test for Herbal Drug Preparations" (Appendix 4.24H).

Dissolution medium: 0.8 per cent w/v solution of *sodium lauryl sulfate* in 0.05 M *hydrochloric acid*; 900 mL. Prepare and use within 12 hours.

Apparatus 1: 100 rpm.

Time: 60 minutes.

Determine the amount of curcuminoids dissolved, calculated as curcumin ($C_{21}H_{20}O_6$), using the following method.

Standard curcumin solution Dissolve an accurately weighed quantity of *curcumin* in *methanol*. Dilute quantitatively with *methanol* to obtain a solution having a known concentration of about 400 μg of curcumin per mL.

Standard curcumin curve Transfer into six 10-mL volumetric flasks, 10, 20, 40, 50, 60, and 80 μL of *Standard curcumin solution*, dilute to volume with *methanol*, and mix. Measure the absorbances of the standard solutions at the maximum at about 420 nm, using *methanol* as the blank (Appendix 2.2). Plot the readings and draw the curve of best fit.

Test solution Withdraw a 15-mL aliquot and filter. Combine 5.0 mL of the filtered solutions of the six individual capsules withdrawn as the pooled sample and dilute to 50.0 mL with *methanol*. Transfer 10.0 mL of this solution into a 50-mL volumetric flask, dilute to volume with *methanol* and mix well.

Procedure and **Calculation** Measure the absorbance of *Test solution* at the maximum at about 420 nm, using *methanol* as the blank (Appendix 2.2). By reference to the Standard curcumin curve, calculate the average content of curcuminoids as curcumin ($C_{21}H_{20}O_6$) dissolved.

Tolerances Not less than 75 per cent of the labelled amount of curcuminoids as curcumin is dissolved in 60 minutes.

Assay

FOR VOLATILE OIL Grind the contents of not less than 20 Turmeric Capsules to *fine powder*. Transfer about 10 g, accurately weighed, to a 500-mL round-bottomed flask. Use 100 mL of *water* as the distillation liquid and distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube (Appendix 7.3H). Calculate the content of volatile oil, in mL, in the portion of the Capsules taken with reference to the anhydrous substance.

FOR CURCUMINOIDS Carry out the determination as described in the "Ultraviolet and Visible Spectrophotometry" (Appendix 2.2).

Standard curcumin solution Dissolve an accurately weighed quantity of *curcumin* in *methanol*. Dilute quantitatively with *methanol* to obtain a solution having a known concentration of about 400 μg of curcumin per mL.

Standard curcumin curve Transfer into five 10-mL volumetric flasks, 20, 40, 50, 60, and 80 μL of *Standard curcumin solution*, dilute to volume with *methanol*, and mix. Measure the absorbances of the standard solutions at the maximum at about 420 nm, using *methanol* as the blank. Plot the readings and draw the curve of best fit.

Assay preparation Weigh and mix the contents of not less than 20 Turmeric Capsules. Transfer about 400 mg, accurately weighed, to a stoppered centrifuge tube. Add 10.0 mL of *tetrahydrofuran* and mix. Set aside at room temperature for 24 hours with frequent shaking. Dilute 1.0 mL of the clear supernatant liquid with *methanol* to produce 25.0 mL. Transfer 1.0 mL of this solution into a 50-mL volumetric flask, dilute to volume with *methanol* and mix well.

Procedure and **Calculation** Measure the absorbance of *Assay preparation* at the maximum at about 420 nm, using *methanol* as the blank. By reference to the Standard curcumin curve, calculate the content of curcuminoids as curcumin ($C_{21}H_{20}O_6$) in the portion of the Capsules taken.

Other requirements Comply with the requirements described under "Capsules" (Appendix 1.16H).

สารสกัดแห้งขมิ้นชัน (KHAMIN CHAN DRY EXTRACT)

Turmeric Dry Extract

Category Relief pain in knee osteoarthritis, stomachic.

Turmeric Dry Extract is prepared from the powdered Turmeric by extraction with *ethanol*. It contains not less than 90.0 per cent and not more than 110.0 per cent of the labelled amount of curcuminoids; the labelled amount of curcuminoids is not less than 80.0 per cent, calculated as curcumin ($C_{21}H_{20}O_6$) and on the dried basis. It may contain other added substances.

Description Yellow to brownish orange powder; slightly hygroscopic.

Packaging and storage Turmeric Dry Extract shall be kept in tightly closed containers, protected from light, and stored in a cool and dry place.

Labelling The label on the container states (1) the equivatent amount of curcuminoids as curcumin; (2) the expiration date.

Identification Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 96 volumes of *chloroform*, 4 volumes of *methanol* and 1 volume of *formic acid* as the mobile phase. Apply separately to the plate as bands of 10 mm, 10 μL each of the following two solutions. For solution (A), dissolve 100 mg of the sample in 50 mL of *acetone*. Solution (B) contains 200 μg per mL of *curcuminoids* in *acetone*. After removal of the plate, allow it to dry in air and examine under daylight. Three yellow bands are observed. Examine under ultraviolet light (366 nm). The chromatogram obtained from solution (A) shows three bluish green bands corresponding to the bisdesmethoxycurcumin, desmethoxycurcumin and curcumin bands from solution (B), in the order of increasing hR_f values.

Loss on drying Not more than 7.0 per cent w/w after drying at 105° for 2 hours (Appendix 4.15). Use 1.0 g.

Assay Carry out the determination as described in the "Ultraviolet and Visible Spectrophotometry" (Appendix 2.2).

Standard curcumin solution Dissolve an accurately weighed quantity of Curcumin RS in *methanol*. Dilute quantitatively and stepwise with *methanol* to obtain a solution having a known concentration of about 16 μg of curcumin per mL.

Standard curcumin curve Transfer into five 25-mL volumetric flasks, 1.0, 2.0, 3.0, 4.0, and 5.0 mL of *Standard curcumin solution*, dilute to volume with *methanol*, and mix. Measure the absorbances of the standard solutions at the maximum at about 420 nm, using *methanol* as the blank (Appendix 2.2). Plot the readings and draw the curve of best fit: the curve shows the correlation coefficient of not less than 0.995.

Assay preparation Transfer about 60 mg of Turmeric Dry Extract, accurately weighed, to a 100-mL volumetric flask, add 75 mL of *methanol* and sonicate for 15 minutes. Dilute to volume with *methanol* and mix. Pipette 2 mL of the solution into a 50-mL volumetric flask, dilute to volume with *methanol* and mix. Dilute 3.0 mL of the resulting solution with *methanol* to produce 25.0 mL and mix. Prepare three replicate samples for each analysis: the relative standard deviation is not more than 2.0 per cent.

Procedure and **Calculation** Measure the absorbance of *Assay preparation* at the maximum at about 420 nm, using *methanol* as the blank (Appendix 2.2). By reference to the Standard curcumin curve, calculate the content of curcuminoids as curcumin ($C_{21}H_{20}O_6$) in the portion of the Extracts taken.

Other requirements Complies with the requirements described under “Extracts” (Appendix 1.16H).

ยาแคปซูลสารสกัดแห้งขมิ้นชัน (KHAMIN CHAN DRY EXTRACT CAPSULES)

Turmeric Dry Extract Capsules

Category Relief pain in knee osteoarthritis.

Turmeric Dry Extract Capsules contain an amount of Turmeric Dry Extract equivalent to not less than 90.0 per cent and not more than 110.0 per cent of the labelled amount of curcuminoids, calculated as curcumin ($C_{21}H_{20}O_6$) and on the dried basis.

Strength available 250 mg (equivalent to curcuminoids).

Dose Two capsules three times a day after meals.

Warning

1. Long-term use is not recommended in pregnant or nursing women.
2. Use in patients with bile duct obstruction is not recommended, except under medical supervision.
3. Caution should be exercised when it is to be used concomitantly with anticoagulants and antiplatelets.

Packaging and storage Turmeric Dry Extract Capsules shall be kept in tightly closed containers, protected from light, and stored in a dry place and at a temperature not exceeding 30°.

Labelling The label on the container states (1) the equivalent amount of curcuminoids as curcumin; (2) the expiration date.

Identification The capsule contents comply with the tests for Identification described under *Turmeric Dry Extract*.

Loss on drying Of the capsule contents, not more than 7.0 per cent w/w after drying at 105° for 2 hours (Appendix 4.15). Use 1.0 g.

Microbial limit Comply with the requirements for Category 1A in the "Limits for Microbial Contamination" (Appendix 10.5).

Assay Carry out the determination as described in the "Ultraviolet and Visible Spectrophotometry" (Appendix 2.2).

Standard curcumin solution Dissolve an accurately weighed quantity of Curcumin RS in *methanol*. Dilute quantitatively and stepwise with *methanol* to obtain a solution having a known concentration of about 30 μg of curcumin per mL.

Standard curcumin curve Transfer into five 50-mL volumetric flasks, 2.0, 3.0, 4.0, 5.0 and 6.0 mL of *Standard curcumin solution,* dilute to volume with *methanol*, and mix. Measure the absorbances of the standard solutions at the maximum at about 420 nm, using *methanol* as the blank (Appendix 2.2). Plot the readings and draw the curve of best fit: the curve shows the correlation coefficient of not less than 0.995.

Assay preparation Weigh and mix the contents of not less than 20 Turmeric Dry Extract Capsules. Transfer an accurately weighed portion of the capsule contents, containing about 50 mg of curcuminoids, to a 100-mL volumetric flask, add 70 mL of *methanol* and sonicate for 15 minutes. Adjust to volume with *methanol*. Dilute quantitatively with *methanol* to obtain a solution containing 2.5 mg of curcumin per mL. Prepare three replicate samples for each analysis: the relative standard deviation is not more than 2.0 per cent.

Procedure and **Calculation** Measure the absorbance of *Assay preparation* at the maximum at about 420 nm, using *methanol* as the blank. By reference to the Standard curcumin curve, calculate the content of curcuminoids as curcumin, $C_{21}H_{20}O_6$, in the portion of the Capsules taken.

Other requirements Comply with the requirements described under "Capsules" (Appendix 1.16H).

ขมิ้นเครือ (KHAMIN KHRUEA)

Arcangelisiae Flavae Caulis
Arcangelisia Flava Stem

Category Stomachic, antidiarrheal, antibacterial.

Arcangelisia Flava Stem is the dried stem of *Arcangelisia flava* (L.) Merr. (Family Menispermaceae), Herbarium Specimen Number: DMSC 857, Crude Drug Number: DMSc 426.

Constituents Arcangelisia Flava Stem contains berberine as the major alkaloidal component. It also contains other isoquinoline alkaloids (e.g., columbamine, palmatine, jatrorrhizine), diterpenoids, etc.

Description of the plant (Figs. 1a, 1b) Large climber, woody, glabrous, dioecious; stem up to 5 cm in diameter, wood yellow, exuding yellow sap when cut, bearing prominent cup-like, petiole-scars. Leaves usually ovate, elliptic-ovate or broadly ovate, 10 to 25 cm long, 5.5 to 19 cm wide, base usually rounded, truncate or slightly cordate, apex abruptly acuminate, palmately 5-nerved at the base and with 1 to 3 pairs of lateral nerves, usually arising from above halfway along the midrib, both surfaces usually with a rather obscure reticulum, coriaceous; petiole 4 to 20 cm long, swollen at both ends, geniculate at base. Inflorescence axillary or cauliflorus paniculate, slender, 10 to 50 cm long, lateral branches spicate to subspicate, 1 to 5 cm long. Male flower sessile or subsessile, subtended by an ovate bracteole, about 2 mm long, strongly thickened at the base; outer sepals 3 to 4, less than 1 mm long; inner sepals 2 whorls of 3, larger, elliptic, ovate or narrowly obovate, 1.5 to 2.5 mm long; synandrium 0.5 to 1 mm long with a globose cluster of 9 to 12 anthers. Female flower main sepals 6, narrowly oblong with the apex becoming reflexed, 2.5 to 4 mm long; staminodes minute, scale-like; carpels 3, 1.5 mm long; stigma broad, sessile, papillose. Infructescence cauliflorous, usually branched, 5 to 45 cm long, with thickened axis and branches, 3 to 6 mm in diameter, the fruits plus carpophores borne on the lateral branches, 1 to 3 borne together on a club-shaped, unbranched carpophore swollen at the apex, up to 4 cm. Fruit drupe, yellow, laterally slightly compressed, transversely subovoid, 2.2 to 3 cm long, 2.5 to 3.3 cm (long axis), 2 to 2.5 cm thick, drying finely rugulose, glabrous; endocarp woody. Seeds broadly ellipsoid, with ruminate endosperm, cotyledons much folded.

Description Odourless; taste, bitter.

Macroscopical (Fig. 1a) Cylindrical, segmented or oblique pieces; externally brownish, rather smooth; sectional view golden yellow to yellowish when fresh and brownish yellow when dried, porous, with several successive concentric and distinctly radiate zones.

Microscopical (Figs. 2a, 2b) Transverse section of the stem shows several layers of rectangular, brownish cork cells and layers of lignified thick-walled, yellowish rectangular sclerenchymatous cells. Cortex, dark brown band of ovate parenchyma cells. Anomalous vascular tissues, several layers of tissue bands with distinct rays, each layer separated by layers of sclereids; phloem tissues, with groups of thick-walled sclereids and fibres in the outermost region; xylem tissues, simple pitted and bordered-pitted vessels, xylem fibres and rectangular or oblique or elongated xylem parenchyma containing prisms and starch grains. Pith, parenchyma cells containing prisms and starch grains.

1

2

3

4

5

6

5 cm

Fig. 1a *Arcangelisia flava* (L.) Merr.
1. habit 2. flowering twig 3. inflorescence 4. infructescence 5. stem 6. crude drug

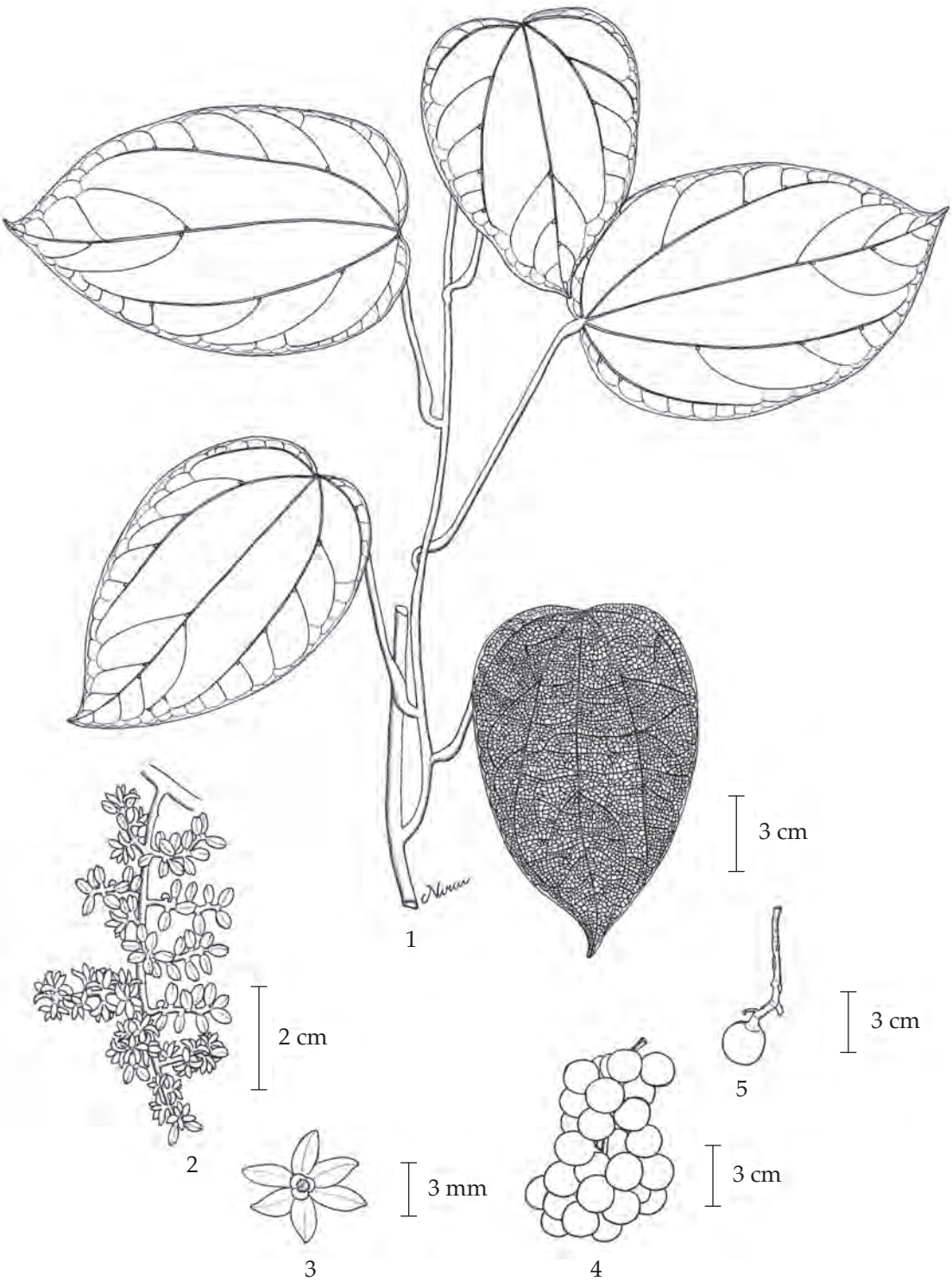


Fig. 1b *Arcangelisia flava* (L.) Merr.
1. part of vine showing leaves 2. female inflorescence
3. female flower 4. infructescence 5. fruit

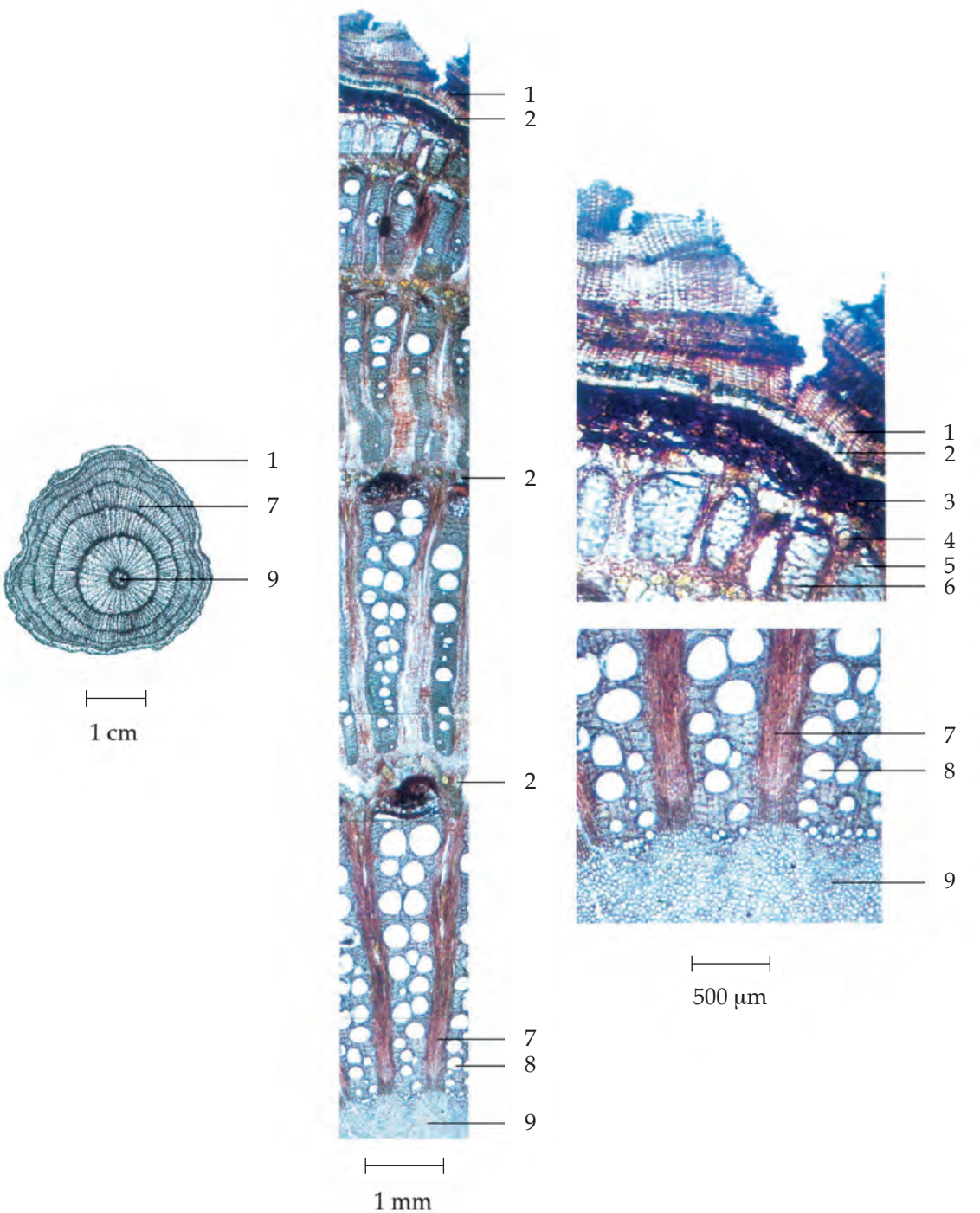


Fig. 2a Transverse Sections of the Stem of *Arcangelisia flava* (L.) Merr.

1. cork
2. sclereid
3. cortical parenchyma
4. xylem sclereid
5. xylem fibre
6. vascular tissue
7. xylem ray
8. vessel
9. pith

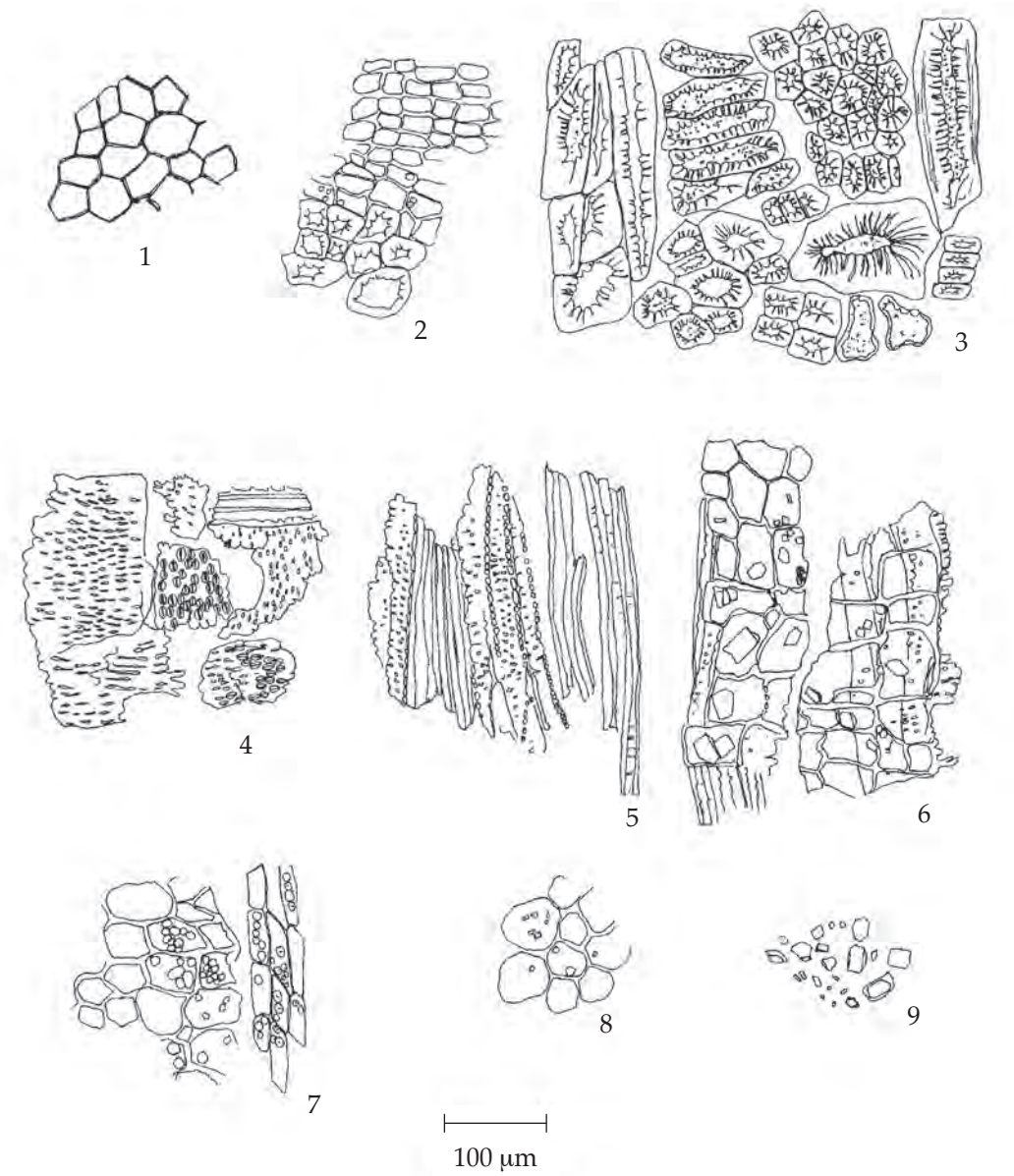


Fig. 2b Powdered Drug of the Stems of *Arcangelisia flava* (L.) Merr.

1. cork cells in surface view
2. cork cells in sectional view associated with sclereids
3. sclereids
4. simple pitted and bordered-pitted vessels
5. xylem fibres associated with pitted vessels
6. xylem ray in radial longitudinal section containing prismatic crystals
7. xylem parenchyma containing prismatic crystals and starch grains
8. pith parenchyma containing prismatic crystals and starch grains
9. prismatic crystals

Arcangelisia Flava Stem in powder possesses the diagnostic microscopical characters of the unground drug.

Packaging and storage Arcangelisia Flava Stem shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Reflux 1 g of the sample, in *fine powder*, with 25 mL of *methanol* in a water-bath for 10 minutes, and filter (solution 1). Examine 2 mL of solution 1 under ultraviolet light (366 nm): a yellow fluorescence is observed.

B. To 2 mL of solution 1, add 0.5 mL of *nitric acid* and mix well: an orange colour develops.

C. Evaporate 2 mL of solution 1 to dryness, dissolve the residue in 2 mL of *ether*, add 0.5 mL of *hydrogen peroxide TS* (*10 volumes*), and mix. Carefully add 1 mL of *hydrochloric acid* to form a layer: a red ring forms at the zone of contact.

D. Evaporate 2 mL of solution 1 to dryness. Add a few drops of *modified Dragendorff TS2* to the residue: an orange precipitate is produced.

E. Evaporate 5 mL of solution 1 to dryness. Dissolve the residue in 2 mL of 1.5 M *sulfuric acid*, add a few drops of 0.02 M *potassium permanganate*, and warm on a water-bath: the colour of potassium permanganate is decolorized.

F. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 70 volumes of *1-butanol*, 20 volumes of *water* and 10 volumes of *glacial acetic acid* as the mobile phase and allowing the solvent front to ascend 12 cm above the line of application. Apply separately to the plate, 5 μL each of the following three solutions. Prepare solution (A) by refluxing 500 mg of the sample, in *fine powder*, with 20 mL of *methanol* for 5 minutes. Filter and evaporate the filtrate under reduced pressure to 5 mL. For solution (B), dissolve 1 mg of *berberine chloride* in 1 mL of *water*. For solution (C), dissolve 1 mg of *palmatine iodide* in 1 mL of *water*. After removal of the plate, allow it to dry in air and examine under daylight, locating the spots. The chromatogram obtained from solution (A) shows two yellow spots (hR_f values 52 to 54 and 44 to 47) corresponding to the berberine chloride spot from solution (B) and the palmatine iodide spot from solution (C), respectively. Subsequently examine the plate under ultraviolet light (254 nm), marking the quenching spots. The chromatogram obtained from solution (A) shows two quenching spots corresponding to the berberine chloride spot from solution (B) and the palmatine iodide spot from solution (C) and other three quenching spots of lower hR_f values. Examine the plate under ultraviolet light (366 nm); the spots due to berberine chloride and palmatine iodide show yellow fluorescences. Other several blue and one yellow spots are also observed. Spray the plate with a 10 per cent w/v solution of *phosphomolybdic acid* in *ethanol* and heat at 105° for 5 minutes; the spots corresponding to berberine chloride and palmatine iodide are brown. Other several blue spots are also observed (Table 1); see also Fig. 3.

Repeat the same procedure on another plate but spray with *modified Dragendorff TS*; the spots due to berberine chloride and palmatine iodide are orange (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Stems of *Arcangelisia flava* (L.) Merr.

Spot	hR_f Value	Detection				
		Daylight	UV 254	UV 366	10 Per Cent W/V Solution of *Phospho-molybdic Acid* in *Ethanol*	*Modified Dragendorff TS*
1	4–5	–	–	blue	–	–
2	7–8	–	quenching	blue	–	–
3	12–14	–	–	blue	–	–
4	14–15	–	quenching	blue	blue	–
5	19	–	–	–	blue	–
6	25–28	–	–	blue	–	–
7	32–34	–	quenching	blue	blue	–
8*	44–47	yellow	quenching	yellow	brown	orange
9**	52–54	yellow	quenching	yellow	brown	orange
10	57	–	–	blue	–	–
11	62–64	–	–	yellow	–	–
12	66–67	–	–	–	blue	–
13	82	–	–	–	blue	–
14	88	–	–	blue	–	–
15	96–97	–	–	–	dark blue	–
16	98	–	–	–	dark blue	–

*palmatine iodide

**berberine chloride

Loss on drying Not more than 10.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Acid-insoluble ash Not more than 0.5 per cent w/w (Appendix 7.6).

Total ash Not more than 3.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 4.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 4.0 per cent w/w (Appendix 7.12).

Chloroform-soluble extractive Not less than 1.0 per cent w/w (Appendix 7.12H).

Berberine content Not less than 2.0 per cent w/w, calculated on the dried basis, when determined by the following method.

Standard berberine chloride stock solution Transfer about 40 mg of *berberine chloride*, previously dried at 110° for 4 hours and accurately weighed, to a 50-mL volumetric flask, dissolve in 30 mL of *methanol*, dilute to volume with a mixture of 1 volume of *hydrochloric acid* and 100 volumes of *methanol*, and mix.

Standard berberine chloride solution Dilute *Standard berberine chloride stock solution* quantitatively and stepwise with a mixture of 1 volume of *hydrochloric acid* and 100 volumes of *methanol* to obtain solutions having known concentrations of 80, 160, 240, 320, and 400 μg per mL, respectively.

Standard berberine chloride curve Place 2.5 mL of each standard solution in separate aluminium oxide minicolumns (about 15 × 1 cm), pretreated by filling the minicolumns with 2.5 g of *neutral aluminium oxide* using wet method and washing with about 15 mL of *ethanol*. Elute each column with 15 mL of *ethanol* in portions, combine the eluates in a 25-mL volumetric flask and dilute to volume with *ethanol*. Pipette 10 mL of each solution into separate 25-mL volumetric flasks and dilute to volume with 0.5 M *sulfuric acid*. Measure the absorbances of the solutions obtained at the maximum at about 345 nm, using 0.5 M *sulfuric acid* as the blank (Appendix 2.2). Plot the readings and draw the curve of best fit.

Procedure Place 500 mg of Arcangelisia Flava Stem, in *fine powder* and accurately weighed, in a soxhlet extractor of appropriate size. Add 25 mL of a mixture of 1 volume of *hydrochloric acid* and 100 volumes of *methanol*, extract to colourless and allow to cool. Quantitatively transfer the extract to a 50-mL volumetric flask and dilute to volume with a mixture of 1 volume of *hydrochloric acid* and 100 volumes of *methanol*. Transfer 2.5 mL of this solution to an aluminium oxide minicolumn, and proceed as directed under *Standard berberine chloride curve*, beginning with “pretreated by...”. Read the absorbance of the resulting solution, and by reference to the Standard berberine chloride curve, calculate the content of berberine in the Arcangelisia Flava Stem taken using 407.85 and 336.37 as the molecular weights of berberine chloride and berberine, respectively.

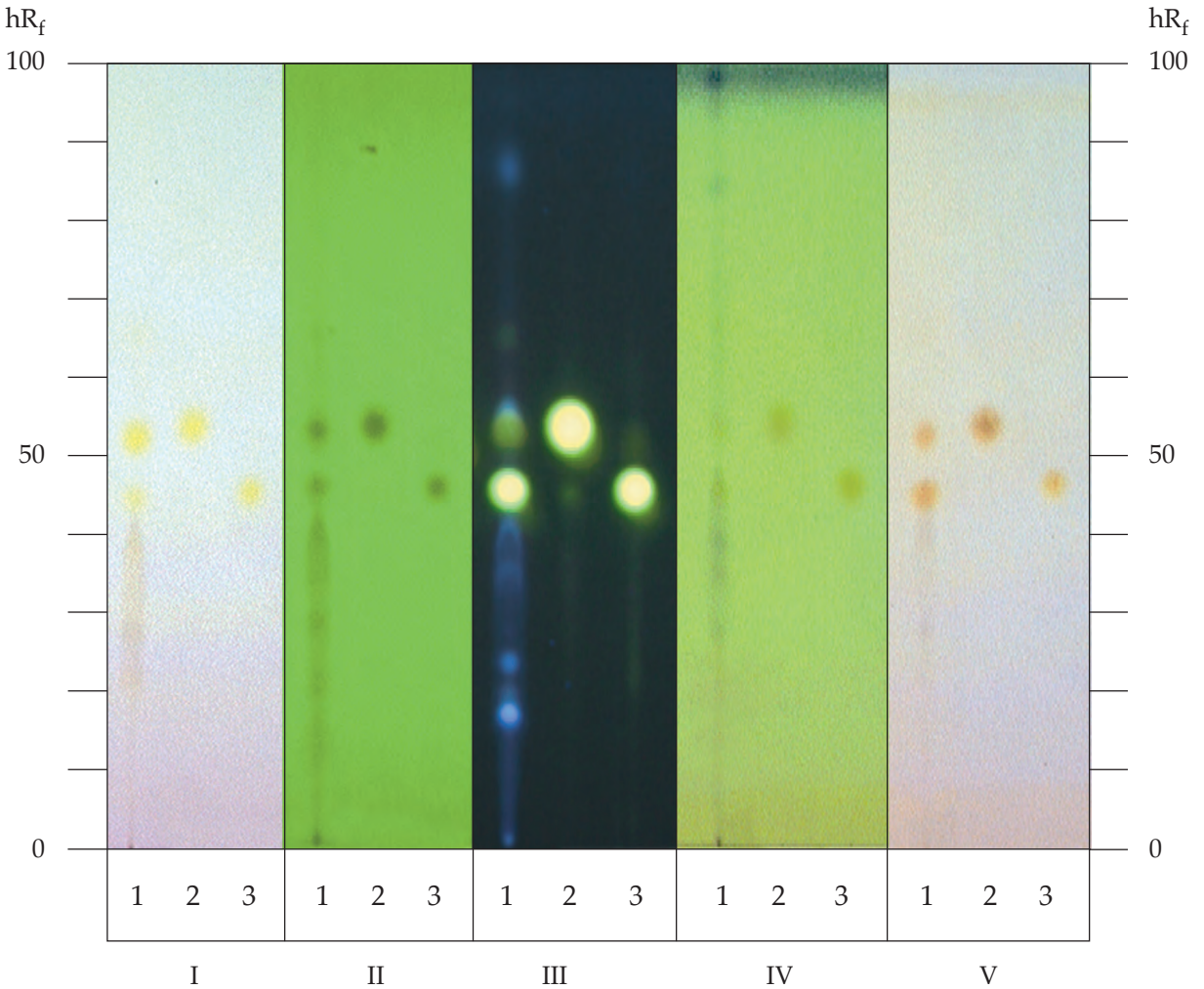


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Stems of *Arcangelisia flava* (L.) Merr.

1 = solution (A)
2 = solution (B)
3 = solution (C)
I = detection under daylight
II = detection under UV light (254 nm)
III = detection under UV light (366 nm)
IV = detection with a 10 per cent w/v solution of *phosphomolybdic acid* in *ethanol*
V = detection with *modified Dragendorff TS*

ขมิ้นอ้อย (KHAMIN OI)

ขมิ้นหัวขึ้น (KHAMIN HUA KHUEN), ขมิ้นขึ้น (KHAMIN KHUEN)

Category Stomachic, antidiarrheal, emmenagogue.

Khamin Oi is the dried rhizome of *Curcuma* sp. "Khamin Oi" (Family Zingiberaceae), Crude Drug Number: DMSc 0271.

Constituents Khamin Oi contains curcuminoids, of which curcumin, desmethoxycurcumin, and bisdesmethoxycurcumin are its major components. It also contains volatile oil, etc.

Description of the plant (Figs. 1a, 1b) Perennial herb; rhizome well-developed, mostly above ground, obconical to oblong-ovoid, branched, orange-yellow or pale yellow within, aromatic; leafy shoots up to 2 m high, bearing 4 to 9 leaves. Leaves simple, oblong-lanceolate, up to 90 cm long, up to 25 cm wide, apex acuminate, glabrous or pubescent, base acute decurrent; petioles long, narrowly winged. Inflorescence scape from the rhizome, appearing before the leaves; peduncle 5 to 15 cm long; spike cylindric, usually gradually widened to the apex, 10 to 18 cm long, 6 to 8 cm in diameter; primary bracts numerous, lower ones halfway connate, free part obliquely erect, 3 to 8 cm long, bracts usually increasing in length to the apex of spike, those of the lower bracts pale green or whitish, coma bract free and spreading, usually red-purple or violet; bracteoles hairy. Flower pale yellow; calyx hairy, tubular, white or white with red teeth; corolla about 4 cm long, tube white or yellowish, lobes ovate or oblong, white with pink; labellum orbicular or obovate, bilobed, yellow or white with yellow median field; petaloid staminodes oblong-obovate, pale yellow; ovary inferior, trilocular. Fruit capsule, ovoid, trigonous. Seeds oblong, arillate.

Description Odour, characteristic and aromatic; taste, slightly bitter and pungent.

Macroscopical (Fig. 1a) Dried slices of primary rhizomes and branched annulate tubers vary in size, shape and thickness; somewhat crooked, orange-yellowish brown to greyish brown; enclosed or nearly enclosed with outer cork layer, covered with coarse trichomes. Pseudoendodermal rings are seen in horizontal and oblique slices.

Microscopical (Figs. 2a, 2b, 2c) Transverse section of the fresh rhizome shows epidermis, composed of a layer of rectangular cells; covering trichomes, unicellular and uniseriate multicellular. Storied cork, several layers of rectangular cork cells. Cortex, composed of broad zone of thin-walled parenchyma cells, filled with numerous starch grains, some of which containing brownish yellow oleoresin or yellowish oil droplets. Pseudoendodermis, a circular layer of compressed rectangular cells, enclosing a broad zone of parenchyma cells similar to those in cortex. Vascular bundles, not yielding the *reaction* with *phloroglucinol TS*, scattering densely underneath endodermis; vessels, spiral, scalariform and reticulate.

Khamin Oi in powder possesses the diagnostic microscopical characters of the unground drug.

Contra-indication It is contra-indicated in pregnant women.

1

2

3

4

1 cm

5

Fig. 1a *Curcuma* sp. "Khamin Oi"
1. and 2. habit 3. inflorescence 4. fresh rhizomes 5. crude drug

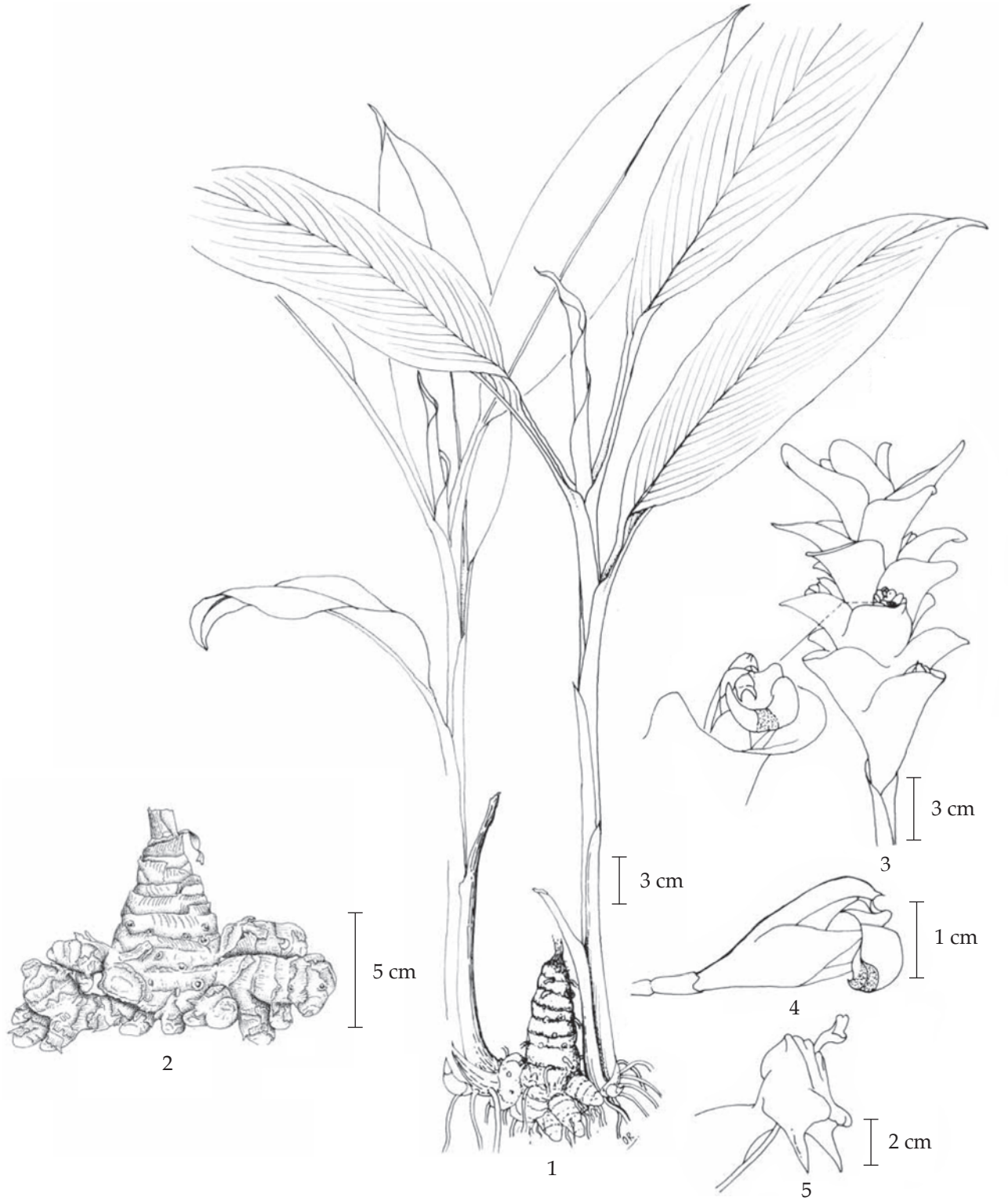


Fig. 1b *Curcuma* sp. "Khamin Oi"
1. habit 2. rhizome 3. scapose inflorescence (with the end of primary bract and single floret enlarged) 4. single floret 5. stamen with anther and spur, and stigma

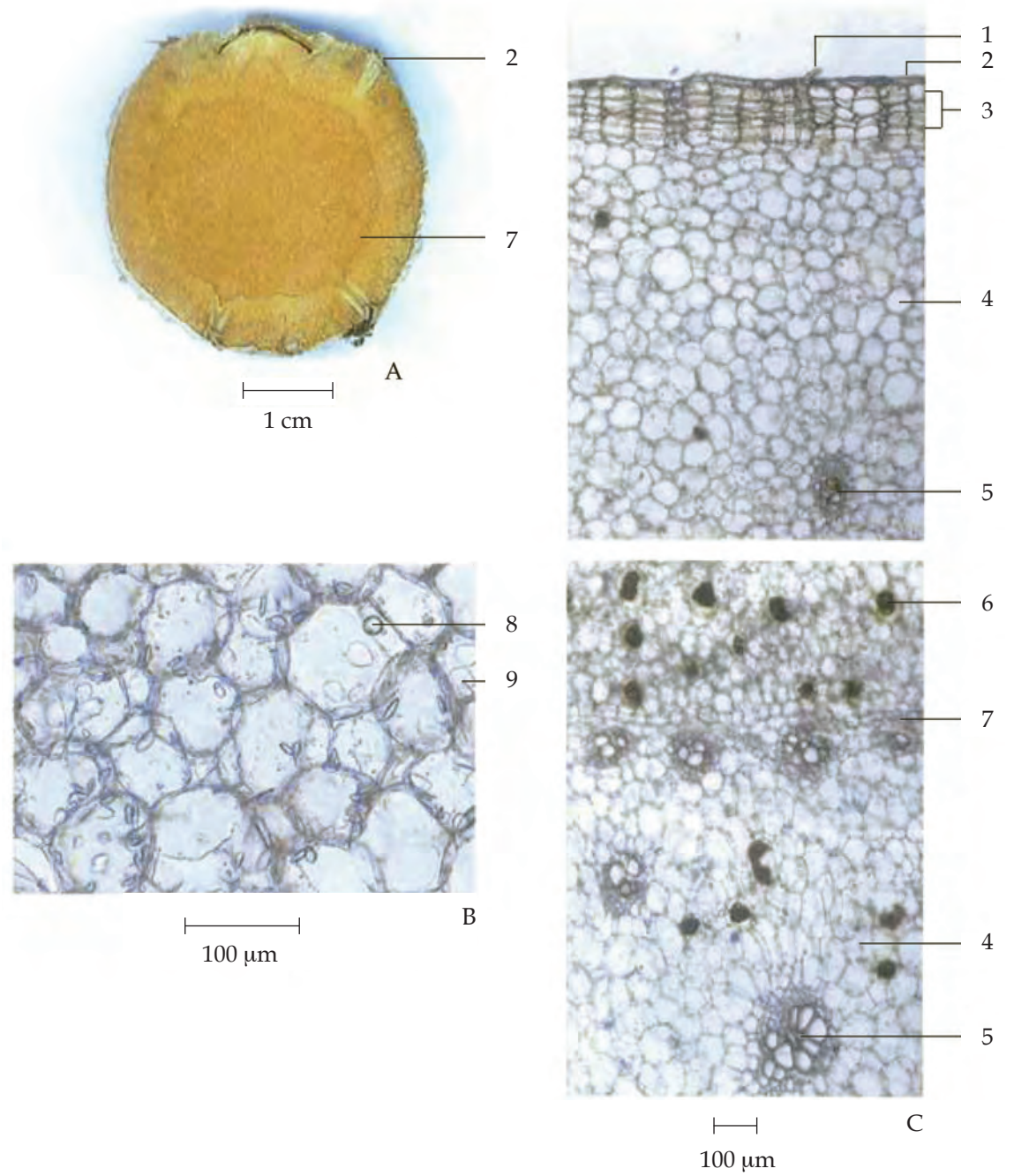


Fig. 2a Photomicrographs of Transverse Sections of the Rhizome of *Curcuma* sp. "Khamin Oi"
A. Transverse Section of the Rhizome
B. Cortical Parenchyma
C. Part of Sectional View

1. trichome
2. epidermis
3. cork layers
4. parenchyma
5. vascular bundle
6. orange-yellow colouring matter
7. pseudoendodermis
8. oil droplet
9. starch grain

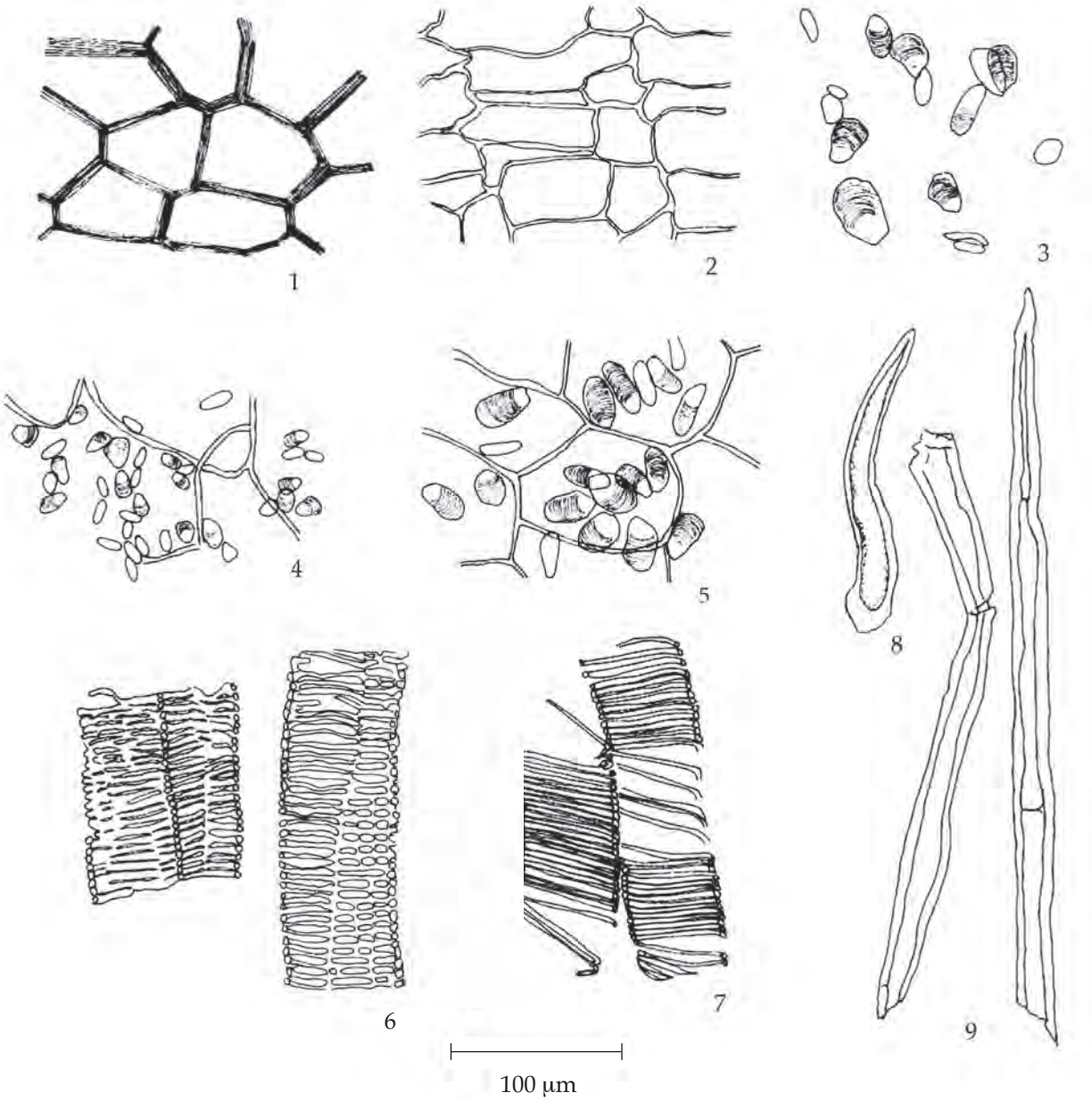


Fig. 2b Line Drawings of Powdered Drug of the Rhizomes of *Curcuma* sp. "Khamin Oi"

1. cork cells in surface view
2. cork cells in sectional view
3. starch grains
4. parenchyma cells containing small starch grains
5. parenchyma cells containing large starch grains
6. scalariform vessels
7. spiral vessels
8. unicellular trichome
9. fragments of uniseriate multicellular trichomes

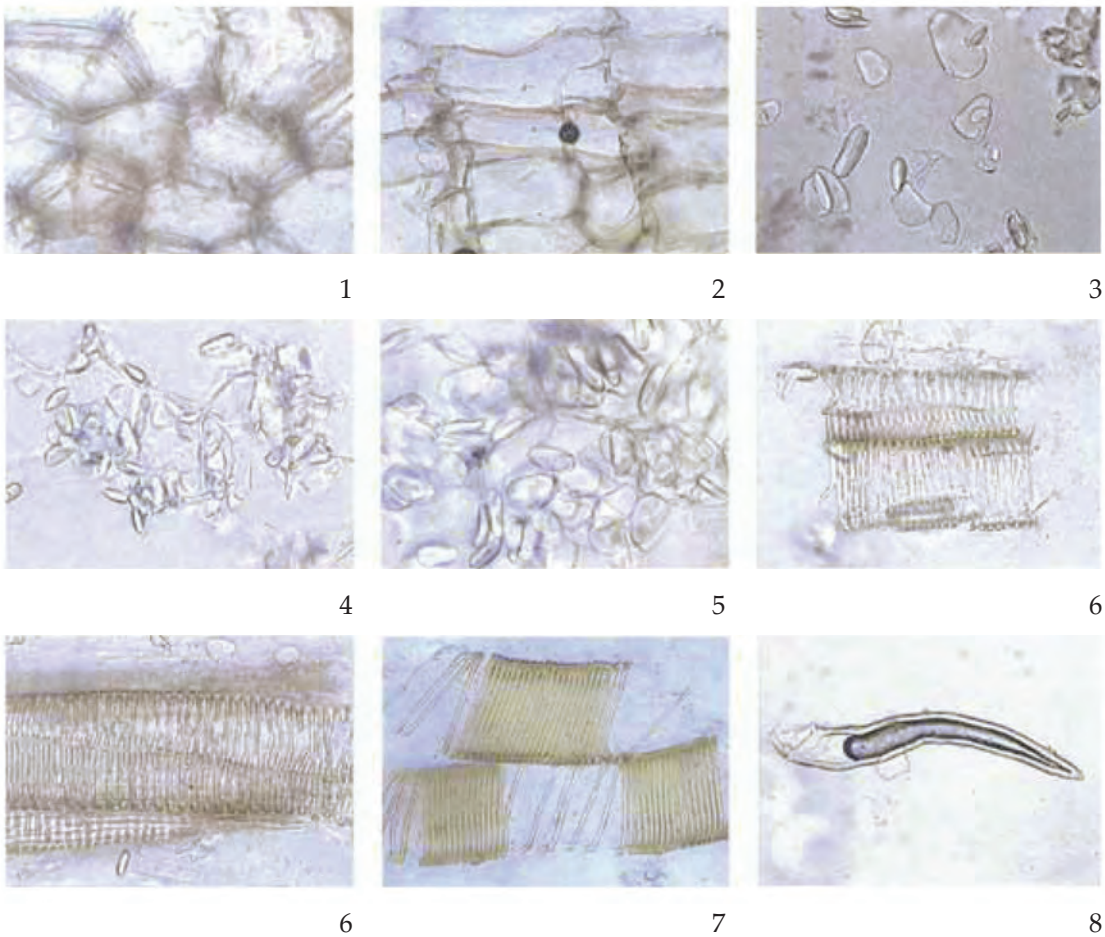


Fig. 2c Photomicrographs of Powdered Drug of the Rhizomes of *Curcuma* sp. "Khamin Oi"

1. cork cells in surface view
2. cork cells in sectional view
3. starch grains
4. parenchyma cells containing small starch grains
5. parenchyma cells containing large starch grains
6. scalariform vessels
7. spiral vessels
8. unicellular trichome

Packaging and storage Khamin Oi shall be kept in well-closed containers, preferably of metal or glass, protected from light and stored in a cool and dry place.

Identification

A. Extract 10 mg of the sample, in powder, with 2 mL of *acetic anhydride*, add a few drops of *sulfuric acid* and observe under ultraviolet light (366 nm): the solution shows blood-red colour.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 49 volumes of *toluene*, 49 volumes of *chloroform* and 2 volumes of *absolute ethanol* as the mobile phase and allowing the solvent front to ascend 17 cm above the line of application. Apply separately to the plate, 5 μL each of the following two solutions. Prepare solution (A) by placing 1 g of the sample, in powder, in a stoppered test-tube, adding 3 mL of *methanol* and shaking for a few minutes. Set aside for 1 hour and filter. For solution (B), dissolve 1 mg of *curcumin* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air, and examine under ultraviolet light (366 nm), locating the spots. The chromatogram obtained from solution (A) shows several spots of different colours. Two orange-brown spots (hR_f values 24 to 26 and 12 to 15) and one yellow spot (hR_f value 6 to 8) correspond to the spots of curcumin and its derivatives from solution (B). Spray the plate with a 10 per cent w/v solution of *phosphomolybdic acid* in *ethanol* and heat at 105° for about 10 minutes; the spots due to curcumin and its derivatives are brown. Other spots are blue (Table 1); see also Fig. 3.

Repeat the same procedure on another plate but spray with *vanillin-sulfuric acid TS* and heat at 105° for about 10 minutes. The chromatogram obtained from solution (A) shows three orange-brown spots corresponding to the spots of curcumin and its derivatives from solution (B). Other spots are purple and violet (Table l); see also Fig. 3.

Table 1 hR_f Values of Component in Metanolic Extract of the Rhizomes of *Curcuma* sp. "Khamin Oi"

Spot	hR_f Value	Detection		
		UV 366	10 Per Cent W/V Solution of *Phosphomolybdic Acid* in *Ethanol*	*Vanillin-Sulfuric Acid TS*
1	4–6	orange-blue	blue	purple
2*	6–8	yellow	brown	orange-brown
3	8–10	–	blue	purple
4*	12–15	orange-brown	brown	orange-brown
5	15–18	blue-green	blue	violet
6	18–19	–	blue	violet
7*	24–26	orange-brown	brown	orange-brown
8	26–28	blue-green	blue	purple
9	32–35	–	blue	violet
10	35–38	–	blue	violet
11	41–44	–	blue	violet
12	44–46	–	blue	violet
13	44–51	blue-green	–	–
14	52–54	–	blue	violet
15	56–59	–	blue	violet
16	65–69	–	blue	purple
17	72–78	–	blue	violet

*curcumin and its derivatives

Water Not more than 11.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Acid-insoluble ash Not more than 6.0 per cent w/w (Appendix 7.6).

Sulfated ash Not more than 14.0 per cent w/w (Appendix 5.3).

Volatile oil Not less than 4.0 per cent v/w (Appendix 7.3H). Use 10 g, in *fine powder*, accurately weighed. Use 100 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube. Calculate the content of volatile oil with reference to the anhydrous substance.

Dose 4.5 to 9 g.

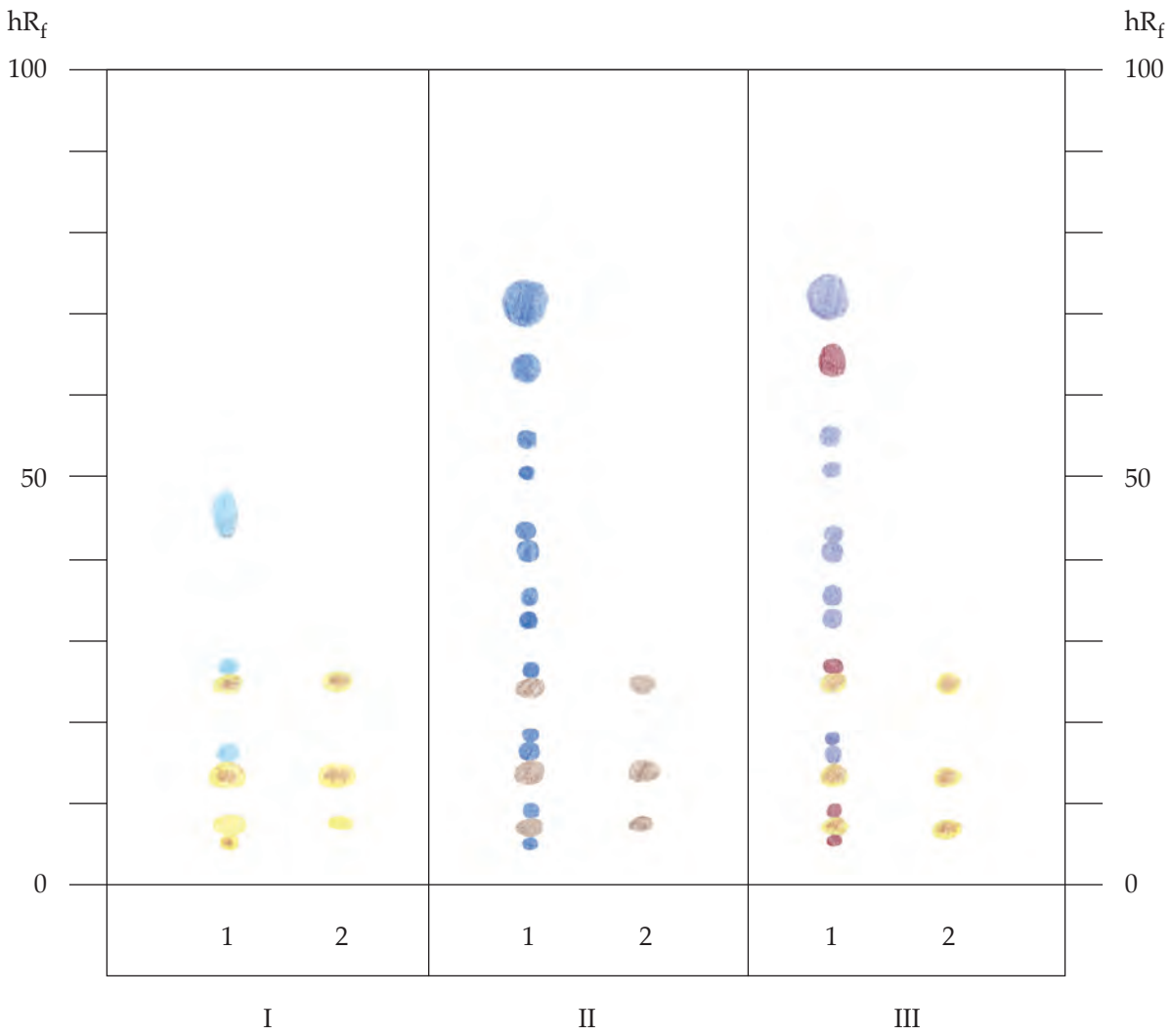


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Rhizomes of *Curcuma* sp. "Khamin Oi"

1 = solution (A)
2 = solution (B)
I = detection under UV light (366 nm)
II = detection with a 10 per cent w/v solution of *phosphomolybdic acid* in *ethanol*
III = detection with *vanillin-sulfuric acid TS*

คนทา (KHON THA)

กะลันทา (KALANTHA), โกทา (KOTHA), สีฟันคนทา (SI FAN KHON THA)
Harrisoniae Perforatae Radix
Harrisonia Perforata Root

Category Antipyretic, antidiarrheal.

Harrisonia Perforata Root is the dried root of *Harrisonia perforata* (Blanco) Merr. (*Paliurus perforatus* Blanco) (Family Rutaceae), Herbarium Specimen Number: DMSC 5218, Crude Drug Number: DMSc 1080.

Constituents Harrisonia Perforata Root contains limonoids (e.g., harperfolide, harrisonin, obacunone) and chromones (e.g., harperamone). It also contains coumarins, sterols, etc.

Description of the plant (Figs. 1a, 1b) Erect or straggling shrub, up to 5 m high, rarely small tree; thorn conical, straight or slightly curved, woody cylindrical-shaped in old stem. Leaves spirally arranged, imparipinnate, with 1 to 7 pairs of leaflets, up to 20 cm long; petiole reddish, 0.5 to 4.5 cm long; rachis narrowly winged; leaflet subsessile, lanceolate or ovate-oblong, 1 to 5 cm long, 0.5 to 2 cm wide, apex acute or obtuse, base acute or obtuse, unequal-sided, margin crenate-serrate, glabrous, sometimes pubescent on nerves. Inflorescence cymose, 8- to 20-flowered, in upper leaf axils and end of twigs, 12 to 20 cm long, rarely solitary flower; peduncle 7 to 11 cm long. Flower purplish red outside, creamy white inside, pubescent; pedicel 3 to 4 mm long, pubescent; calyx small, 4- or 5-lobed, lobe broadly triangular, apex obtuse, pubescent outside; petals 4 to 5, oblong-obovate or lanceolate, 5 to 9 mm long, 2 to 4 mm wide, apex acute, pubescent on both surfaces; stamens 8 or 10, filament 6 to 8 mm long, whitish, glabrous or pubescent, attached to edge of cup-shaped disc; ovary superior, 0.5 to 1 mm long, 4- or 5-loculed, ovule 1 per locule, style 5 to 8 mm long, pubescent, stigma knob-like. Fruit berry, subglobose, 4 to 9 mm long, 1 to 1.5 cm wide, slightly lobed, glabrous, endocarp hard, with 3 to 5 seeds.

Description Odourless; taste, bitter.

Macroscopical (Fig. 1a) Obliquely, longitudinally or transversely sliced roots, varied in shape and size; bark 1 to 3 mm thick, greyish brown to brownish, with scattered irregular scars; wood pale yellow with dark brown rings in the centre.

Microscopical (Figs. 2a, 2b, 2c, 2d) Transverse section of the root shows periderm, cortex, phloem, vascular cambium, and xylem. Periderm, several layers of small rectangular cork cells. Cortex, various sizes and shapes of thin-walled parenchyma cells, fibres, and round- or oval-shaped lysigenous intercellular spaces, some containing yellow or brown substance; with starch grains, yellow or brown substance, and rosette aggregate crystals scattered throughout parenchyma tissue. Phloem, converse V-shaped broad zones of small thin-walled parenchyma cells, some containing starch grains, groups of fibres, phloem rays, and round- or oval-shaped lysigenous intercellular spaces, some containing yellow or brown substance. Vascular cambium, several layers of small thin-walled rectangular cells. Xylem, bordered-pitted vessels (some of which contain tylose), xylem parenchyma, fibres, and xylem rays, some containing starch grains.

Radial and tangential longitudinal sections of the woody part of the root show bordered-pitted vessels, bundles of fibres and medullary rays.

1

2

4

3

5

6

Fig. 1a *Harrisonia perforata* (Blanco) Merr.
1. habit 2. stem showing woody thorns 3. flowering twig 4. flower
5. fruits 6. crude drug

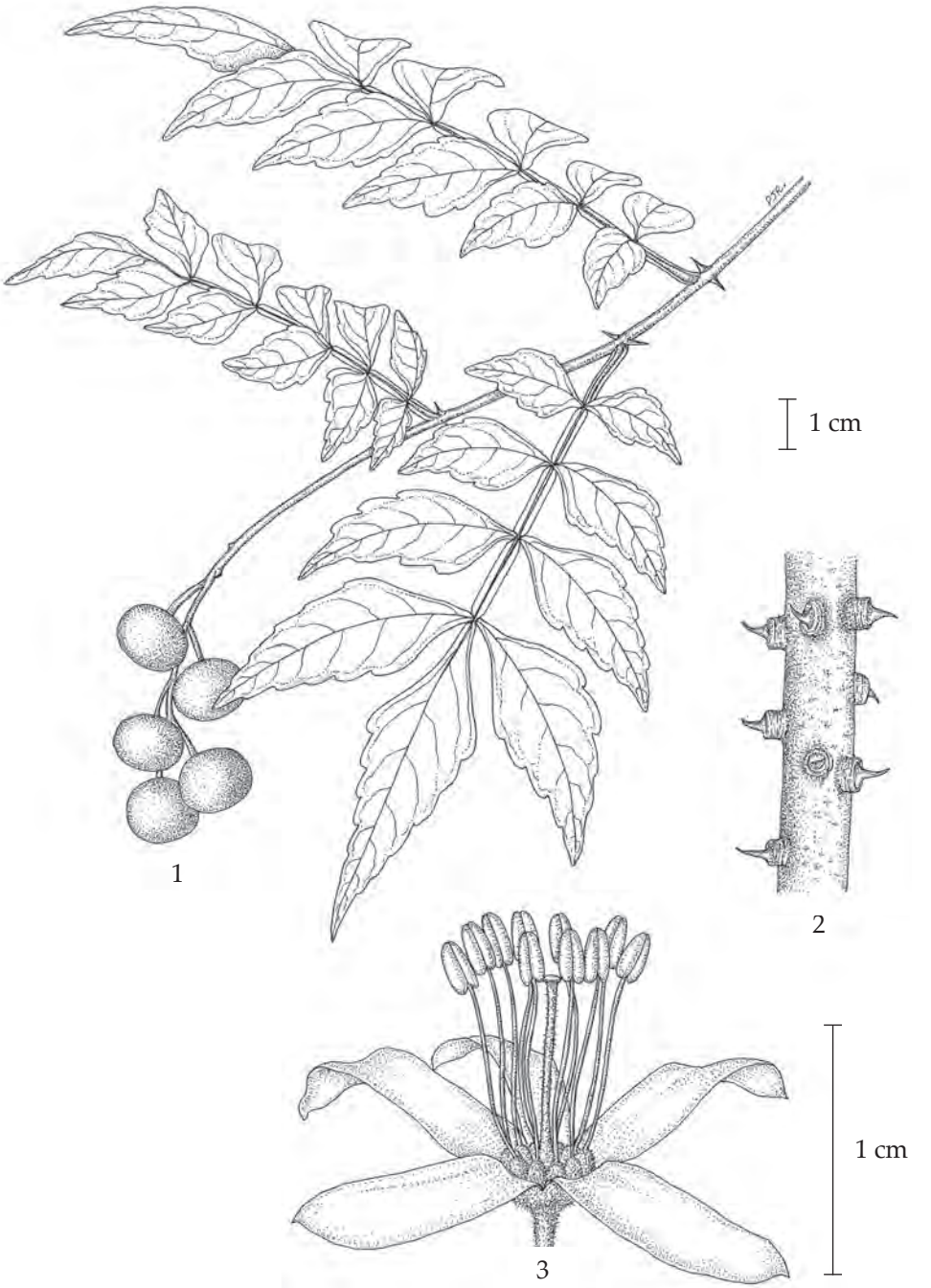


Fig. 1b *Harrisonia perforata* (Blanco) Merr.
1. fruiting twig showing leaves 2. stem showing thorns 3. flower

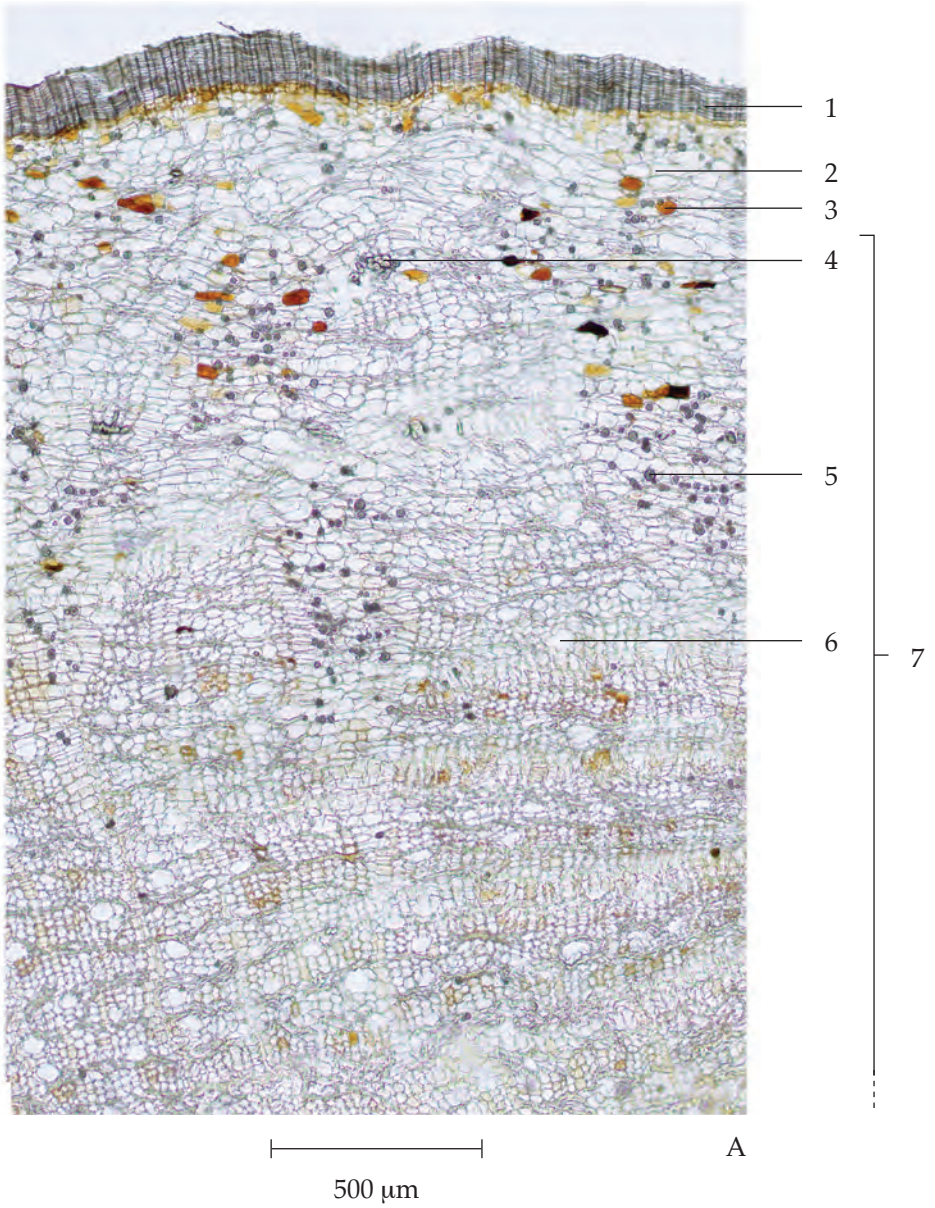


Fig. 2a Photomicrographs of Transverse Section of the Root of *Harrisonia perforata* (Blanco) Merr.

A. Bark

1. cork
2. parenchyma
3. brown substance
4. phloem fibre
5. rosette aggregate crystal
6. lysigenous intercellular space
7. phloem tissue

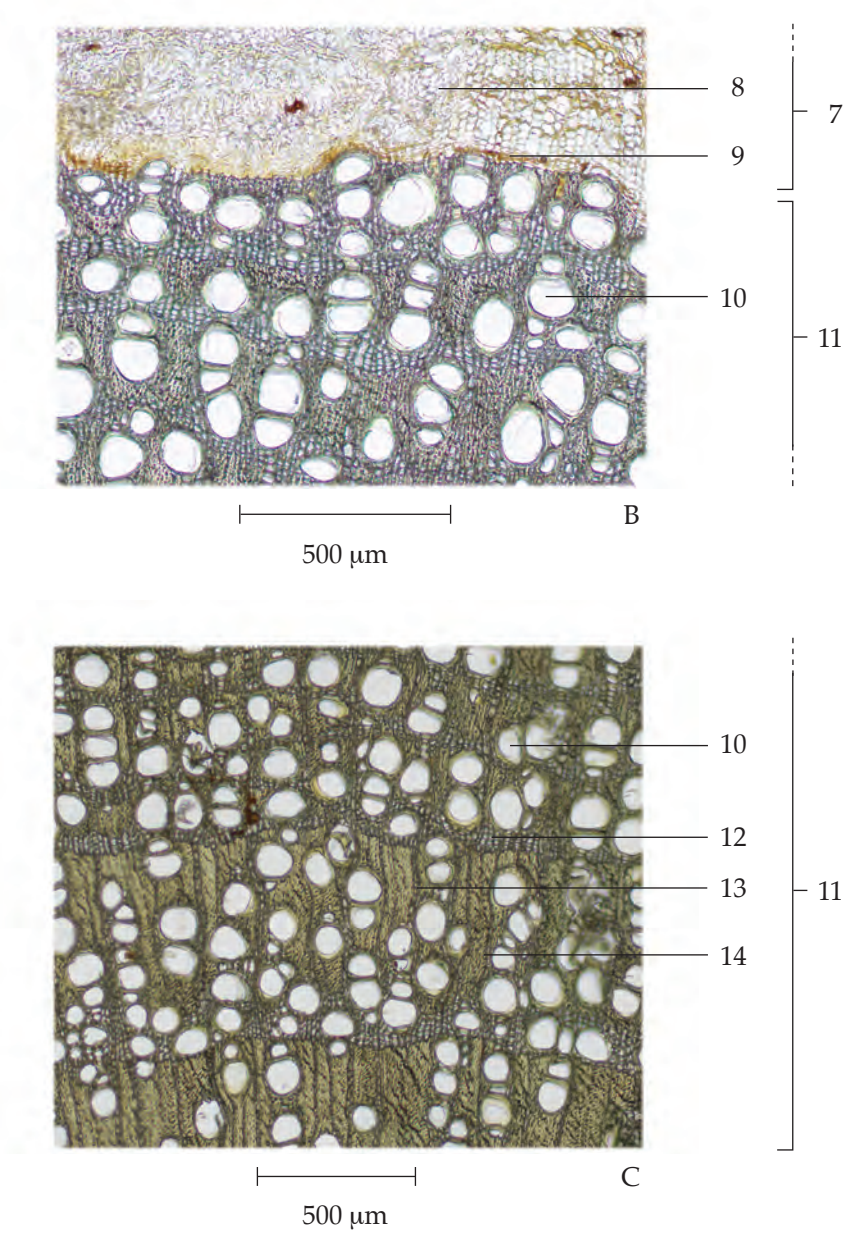


Fig. 2a Photomicrographs of Transverse Section of the Root of *Harrisonia perforata* (Blanco) Merr. (continued)

B. Part of Vascular Tissue
C. Wood

7. phloem tissue
8. phloem ray
9. vascular cambium
10. vessel
11. xylem tissue
12. xylem parenchyma
13. xylem ray
14. xylem fibre

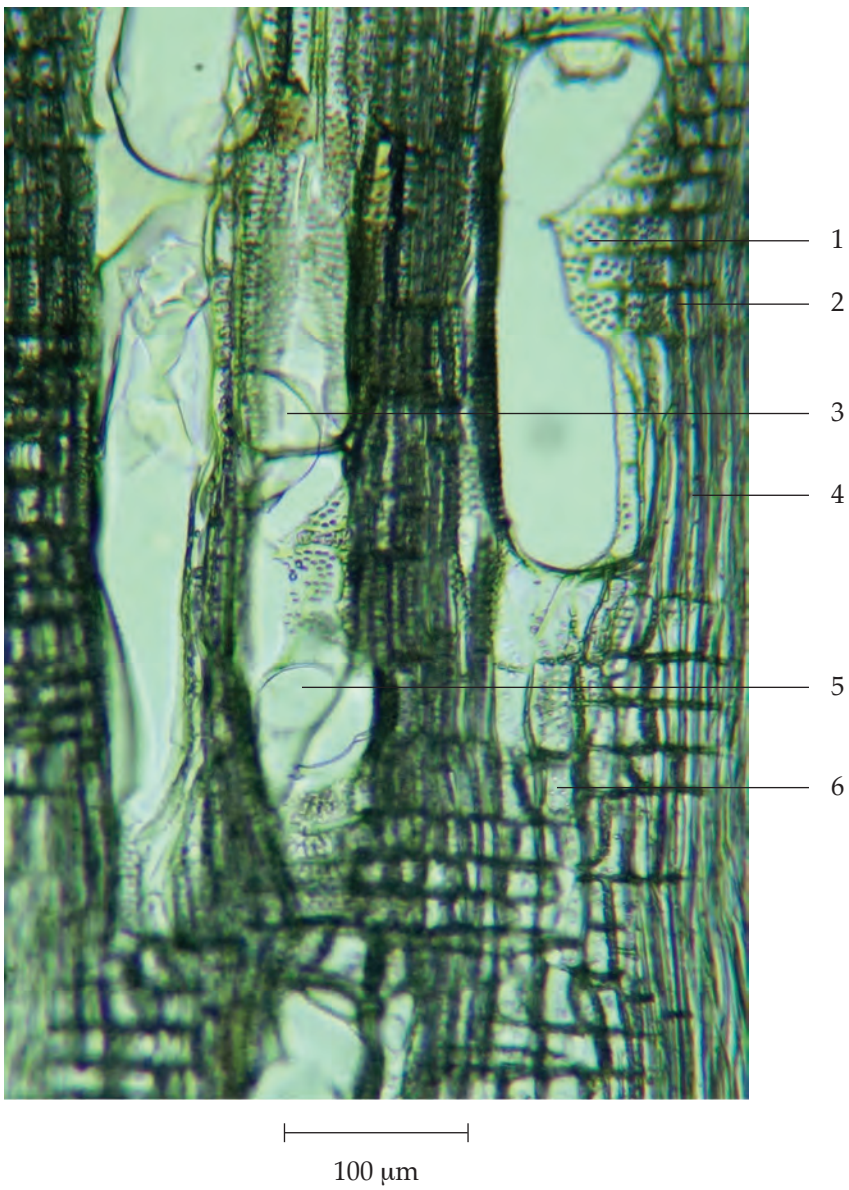


Fig. 2b Photomicrograph of Radial Longitudinal Section of the Woody Part of the Root of *Harrisonia perforata* (Blanco) Merr.

1. bordered-pitted vessel
2. xylem ray
3. tylose
4. fibre
5. perforation plate
6. axial parenchyma

Fig. 2c Photomicrograph of Tangential Longitudinal Section of the Woody Part of the Root of *Harrisonia perforata* (Blanco) Merr.

1. bordered-pitted vessel
2. axial parenchyma
3. xylem ray
4. fibre
5. brown substance

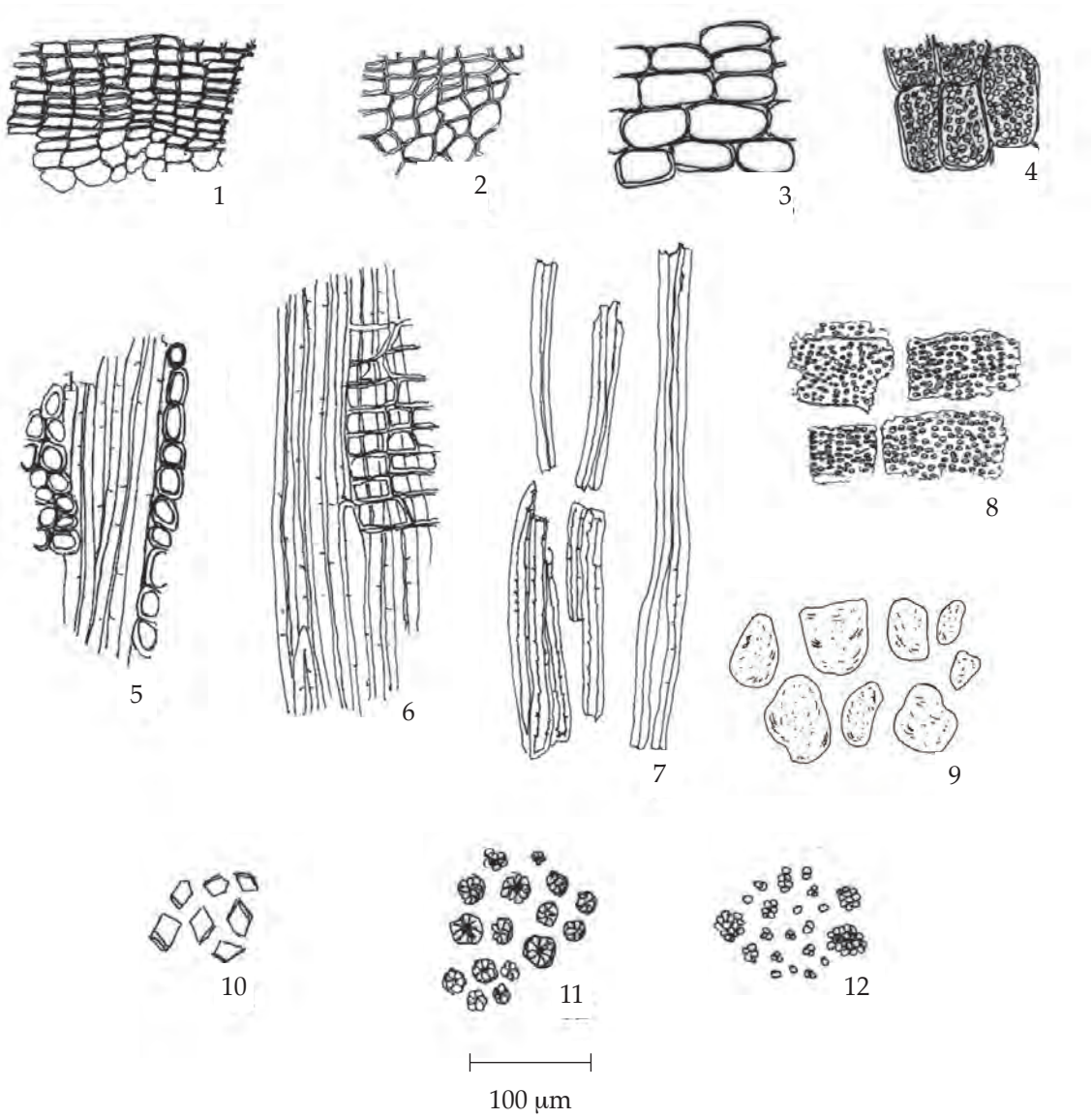


Fig. 2d Powdered Drug of the Roots of *Harrisonia perforata* (Blanco) Merr.

1. cork and parenchyma in sectional view
2. cork in surface view
3. parenchyma
4. parenchyma containing starch grains
5. fibres associated with xylem ray in tangential longitudinal view
6. fibres associated with xylem ray in radial longitudinal view
7. fibres
8. bordered-pitted vessels
9. brown substance
10. prismatic crystals
11. rosette aggregate crystals
12. starch grains

Harrisonia Perforata Root in powder possesses the diagnostic microscopical characters of the unground drug. Parenchyma tissue with starch grains, fibres associated with medullary rays, brown substance, and rosette aggregate crystals can be seen in abundance. Cork in various views and bordered-pitted vessels may also be observed.

Additional information In Thai herbal markets, the adulteration of harrisonia perforata root with stems, branches, etc. may be found.

Packaging and storage Harrisonia Perforata Root shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Macerate 100 mg of the sample, in *fine powder*, with 4 mL of *ethanol* for 5 minutes and filter. To 2 mL of the filtrate, add 2 or 3 pieces of *magnesium ribbon*, shake well and mix with a few drops of *hydrochloric acid*: a yellow-orange colour develops.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 95 volumes of *chloroform*, 5 volumes of *methanol* and 0.5 volume of *formic acid* as the mobile phase and allowing the solvent front to ascend 8 cm above the line of application. Apply to the plate as a band of 8 mm, 10 μL of the test solution prepared by macerating 500 mg of the sample, in *fine powder*, with 4 mL of *methanol* for 15 minutes and filtering. After removal of the plate, allow it to dry in air and examine the plate under ultraviolet light (254 nm), marking the quenching bands. Examine the plate under ultraviolet light (366 nm) through the cut-off filter; several fluorescent bands of different colours are observed. Heat the plate at 80° for 10 minutes and then spray with *natural products (NP) TS* while the plate is still warm. Subsequently spray the plate with *polyethyleneglycol (PEG) TS* and observe the colours of the bands under ultraviolet light (366 nm) through the cut-off filter within 5 to 15 minutes. Several fluorescent bands of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Roots of *Harrisonia perforata* (Blanco) Merr.

Band	hR_f Value	Detection		
		UV 254	UV 366	*NP/PEG TS* and UV 366
1	10–14	quenching	–	–
2	17–19	weak quenching	blue	light blue
3	20–21	weak quenching	blue	light greenish yellow
4	26–28	weak quenching	–	light greenish yellow
5	28–31	–	blue	light blue
6	32–34	weak quenching	–	light greenish yellow
7	46–49	–	blue	–
8	52–55	–	blue	blue
9	56–60	quenching	bright blue	blue
10	69–71	–	blue	–
11	72–76	quenching	–	greenish yellow

Loss on drying Not more than 9.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Total ash Not more than 4.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 2.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 3.0 per cent w/w (Appendix 7.12).

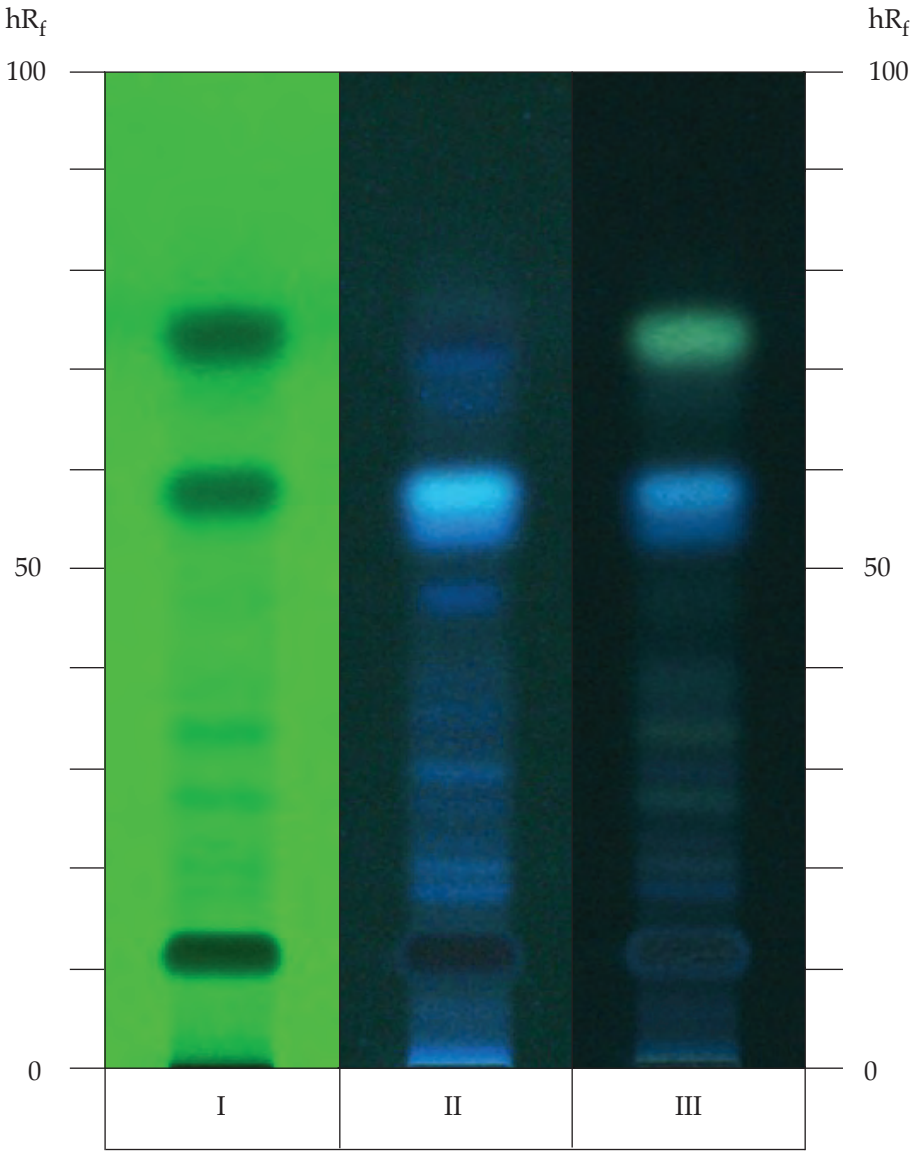


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Roots of *Harrisonia perforata* (Blanco) Merr.

I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection under UV light (366 nm) after spraying with *NP/PEG TS*

ขิง (KHING)

Zingiberis Officinalis Rhizoma
Ginger

Category Carminative, antiflatulent.

Ginger is the dried rhizome of *Zingiber officinale* Roscoe (*Amomum zingiber* L.) (Family Zingiberaceae), Herbarium Specimen Number: BKF 193777, Crude Drug Number: DMSc 1145.

Constituents Ginger contains oleoresin predominantly consisting of gingerols, shogaols and volatile oil. Its volatile oil comprises zingiberene, borneol, geraneol, etc. It also contains fatty acids, starch, etc.

Description of the plant (Figs. 1a, 1b) Perennial herb; pseudostem up to 2 m high, leafy; subterraneous rhizome branched, thick, fleshy, yellowish inside, strongly aromatic. Leaves simple, alternate, sessile, lanceolate or linear-lanceolate, 10 to 30 cm long, 1.5 to 3 cm wide, apex acute or acuminate, base obtuse, sheathing; ligule membranous, 2 to 4 mm long, bilobed. Inflorescence arising from rhizome, spike elliptic to oblong, 4 to 9 cm long, 2 to 3 cm wide; peduncle erect, up to 25 cm long, with 5 to 9 green sheaths; bract imbricate, free, green, incurved, globose, obrhombic or obovate, 2 to 3 cm long, 2 to 2.5 cm wide, apex obtuse, glabrous on both sides, cream to creamy yellow on margin and tip, sharp apex tip; bracteole elliptic-oblong, cirrated, 2.5 to 2.8 cm long, 1 to 1.5 cm wide, apex obtuse or teethed, glabrous; corolla tube 3-lobed, 2.2 to 2.5 cm long, glabrous, white, dorsal lobe 1.7 to 1.8 cm long, about 8 mm wide, lateral lobes 1.6 to 1.7 cm long, 4 to 5 mm wide; labellum conspicuously 3-lobed, midlobe rounded or obovate, about 1.6 cm long, 1.3 to 1.4 cm wide, apex truncate or emarginate, dark red with yellow blotches at base, side lobes about 7 mm long, 5 to 6 mm wide, apex acute, dark red with scattered creamy dots; anther about 1 cm long, about 3 mm wide, filament about 3 mm long, flattened, appendage 7 to 9 mm long, apex acute, dark red; stylode unequal, 7 to 8 mm long; ovary inferior, glabrous, 3-loculed, each locule with several ovules. Fruit capsule, oblong. Seeds numerous, blackish, arillate.

Description Odour, characteristic and aromatic; taste, pungent and aromatic.

Macroscopical (Fig. 1a) Unpeeled, horizontal, irregularly branched and vary in size. Externally light brown with longitudinal wrinkles and distinct annulated nodes; branched parts usually with remains of scale leaves, apex with stem scars or buds. Texture compact, fibrous; fracture yellowish to brownish.

Microscopical (Figs. 2a, 2b) Transverse section of the rhizome shows epidermis, storied cork, cortex, pseudoendodermis, and vascular bundles. Epidermis, a layer of thin-walled rectangular cells. Storied cork, layers of thin-walled, suberinized rectangular cells. Cortex, thin-walled parenchyma cells containing numerous starch grains and/or oil globules, some of which containing yellow oleoresin. Pseudoendodermis, a layer of small thin-walled rectangular cells. Vascular bundles, scattered in cortex, containing xylem and phloem tissues; vessels, mostly scalariform and reticulate.

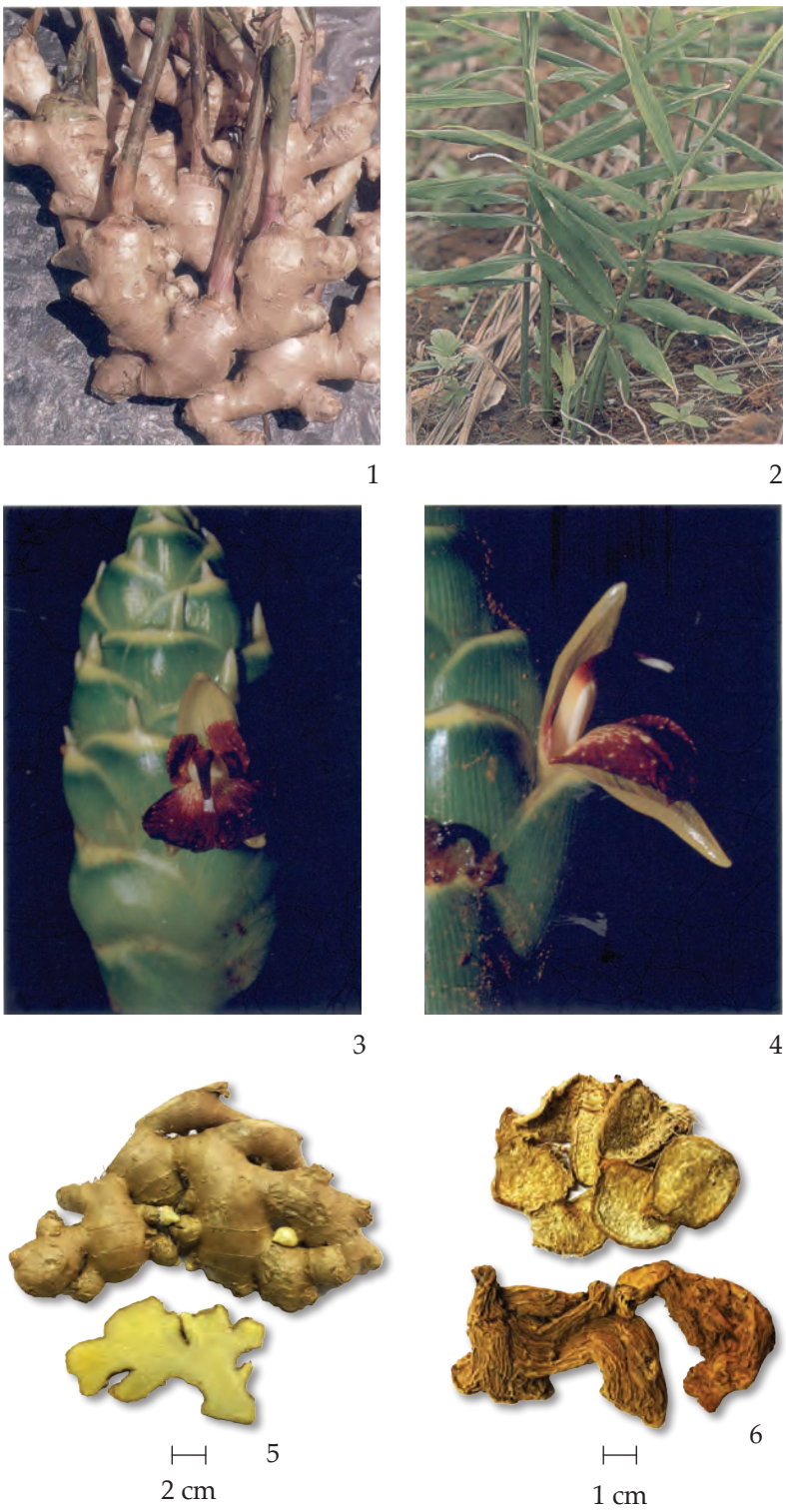


Fig. 1a *Zingiber officinale* Roscoe
1. rhizomes, showing lower part of pseudostems and young spike
2. pseudostems and leaf blades 3. spike with flowers, one in full bloom (front view)
4. flower (oblique view) 5. mature rhizome 6. crude drug

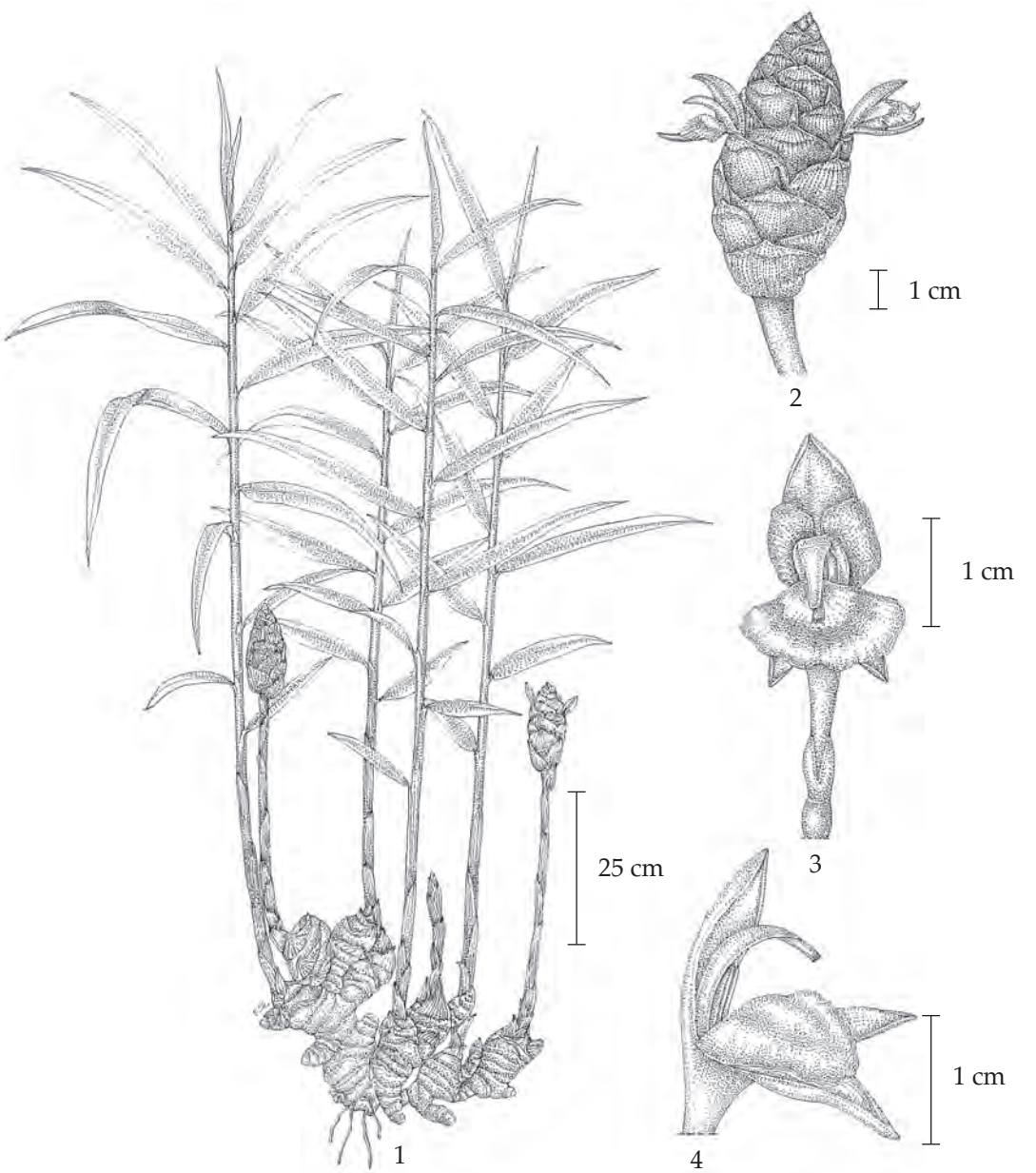


Fig. 1b *Zingiber officinale* Roscoe
1. habit showing rhizomes, pseudostems, leaves, and spike 2. inflorescence (spike)
3. flower (front view) 4. flower (oblique view)

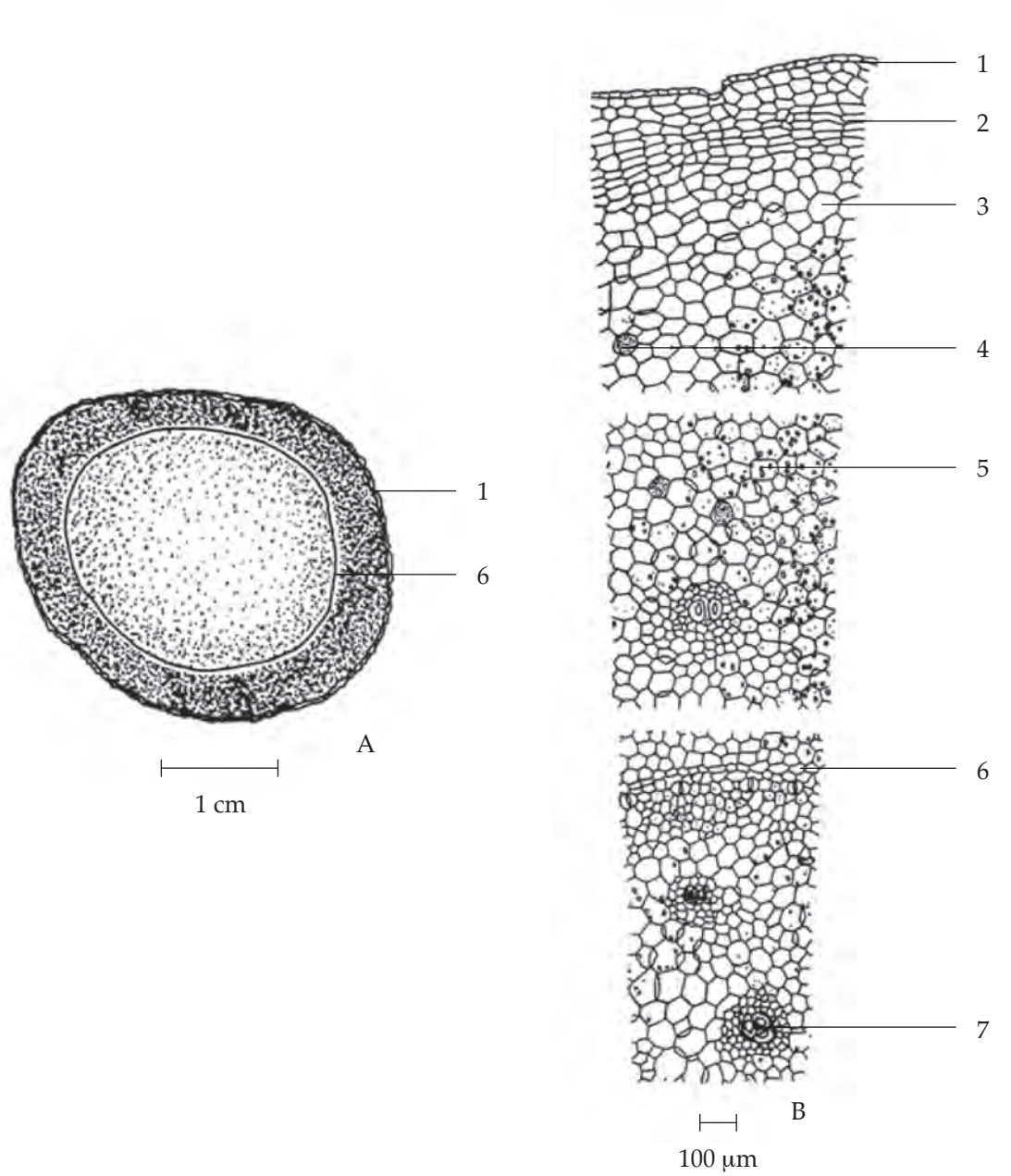


Fig. 2a Transverse Section of the Rhizome of *Zingiber officinale* Roscoe

A. Diagram

B. Part of Sectional View

1. epidermis
2. storied cork
3. parenchyma
4. parenchyma containing yellow oleoresin
5. parenchyma containing starch grains and oil globules
6. pseudoendodermis
7. vascular bundle

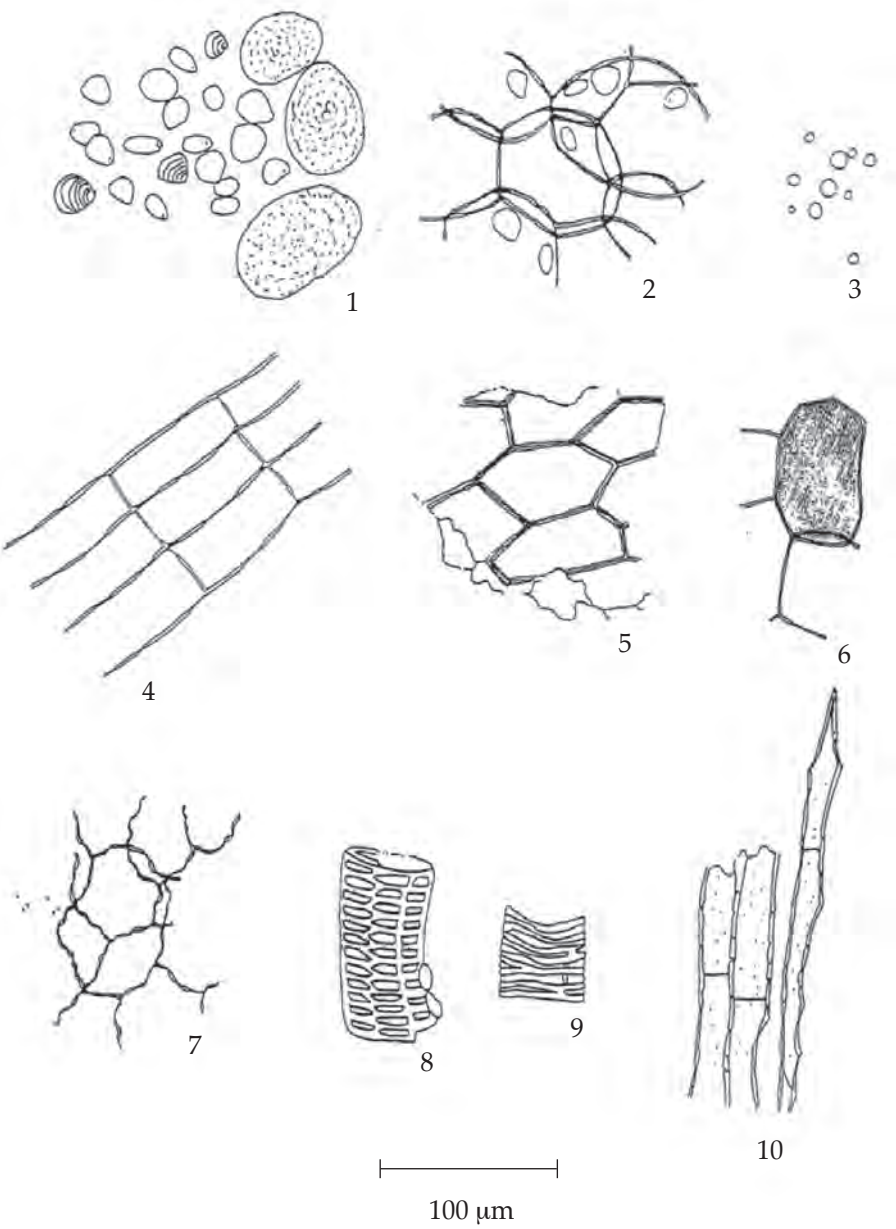


Fig. 2b Powdered Drug of the Rhizomes of *Zingiber officinale* Roscoe

1. starch grains and altered starch
2. parenchyma containing starch grains
3. oil globules
4. storied cork in sectional view
5. storied cork adjacent with parenchyma in surface view
6. parenchyma containing yellow oleoresin
7. parenchyma
8. scalariform vessel
9. reticulate vessel
10. septate fibres

Ginger in powder possesses the diagnostic microscopical characters of the unground drug. Layers of thin-walled cells of storied cork, parenchyma containing starch grains, and/or altered starch, and/or yellow oleoresin are characteristic.

Warning

1. It should not be used in children under 6 years of age and in pregnant women.
2. It should not be used in patients with bile duct obstruction except under medical supervision.
3. Concomitant use with anticoagulants and antiplatelets should be used with caution.

Additional information Ginger containing not less than 2 per cent v/w of volatile oil can be administered orally as an anti-emetic.

Packaging and storage Ginger shall be kept in well-closed containers, preferably of metal or glass, protected from light and stored in a cool and dry place.

Identification

A. Dissolve 50 mg of the residue obtained from *Ethanol-soluble extractive* in 25 mL of *water* and extract this solution with two 15-mL portions of *ether*. Combine the ether extracts and evaporate to dryness. To the residue, add 5 mL of a 75 per cent v/v solution of *sulfuric acid*, and 5 mg of *vanillin* and then mix well. Allow to stand for 15 minutes and add 5 mL of *water*: a bright blue colour develops.

B. To 1 g of the sample, in powder, add 5 mL of a 50 per cent v/v solution of *glacial acetic acid*. Shake vigorously for 15 minutes and filter. To the filtrate, add a few drops of *ammonium oxalate TS*: a slight turbidity is produced.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 40 volumes of *hexane* and 60 volumes of *ether* as the mobile phase. Apply separately to the plate as bands of 15 mm, 20 μL each of the following two solutions. Prepare solution (A) by shaking 1 g of the sample, in powder, with 5 mL of *methanol* for 15 minutes and filtering. For solution (B), dissolve 10 μL of *citral* and 10 mg of *resorcinol*, as the reference compounds[1], in 10 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching bands. The chromatogram obtained from solution (A) shows three quenching bands. Two quenching bands are between the bands due to resorcinol (hR_f value 30 to 33) and citral isomers (hR_f values 70 to 72 and 73 to 75) in the chromatogram obtained from solution (B) and one quenching band is below the resorcinol band. Examine the plate under ultraviolet light (366 nm) through the cut-off filter; one blue and several green-blue fluorescent bands are observed. Spray the plate with *vanillin-sulfuric acid TS2* and heat at 105° for 10 minutes. The chromatogram obtained from solution (A) shows one violet-grey, one brown-yellow and two violet bands below the red band due to resorcinol in the chromatogram obtained from solution (B). It also shows one dark violet band above the two violet bands due to citral isomers in the chromatogram obtained from solution (B) and two violet-grey and two violet bands between the bands due to resorcinol and citral isomers (Table 1); see also Fig. 3.

[1]Citral and Resorcinol are not marker compounds for Ginger. They are used as the reference compounds for the purpose of TLC identification.

Table 1 hR_f Values of Components in Methanolic Extract of the Rhizomes of *Zingiber officinale* Roscoe

Band	hR_f Values	Detection		
		UV 254	UV 366	*Vanillin-Sulfuric Acid TS2*
1	4–5	–	–	violet-grey
2	13–15	–	blue	brown-yellow
3	20–22	weak quenching	green-blue	violet
4	23–25	–	green-blue	violet
5	35–37	–	green-blue	–
6	42–43	–	–	pale violet
7	44–46	–	green-blue	–
8	47–49	–	–	pale violet
9	53–55	quenching	green-blue	violet-grey
10	57–58	quenching	–	violet-grey
11	90–92	–	–	dark violet

Water Not more than 11.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 1.0 per cent w/w (Appendix 7.6).

Total ash Not more than 10.0 per cent w/w (Appendix 7.7).

Water-soluble ash Not less than 3.0 per cent w/w (Appendix 7.11).

Ethanol-soluble extractive Not less than 5.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 13.0 per cent w/w (Appendix 7.12).

Volatile oil Not less than 0.8 per cent v/w, calculated on the anhydrous basis (Appendix 7.3H). Use 50 g, in *coarse powder,* freshly prepared and accurately weighed. Use 200 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube.

Dose 2 to 4 g a day.

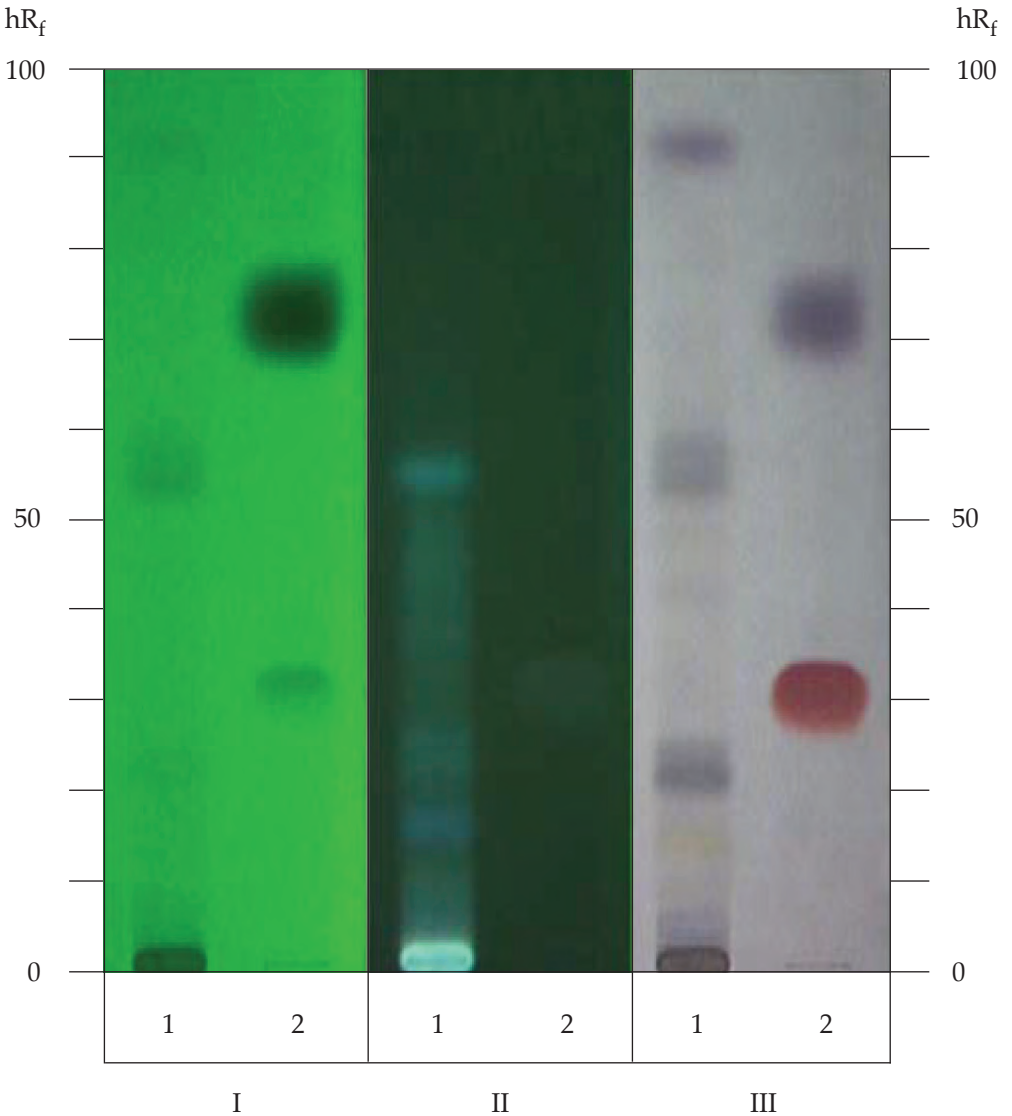


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Rhizomes of *Zingiber officinale* Roscoe

1 = solution (A)
2 = solution (B)
I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *vanillin-sulfuric acid TS2*

ยาแคปซูลขิง (KHING CAPSULES)

Ginger Capsules

Category Carminative, antiflatulent, anti-emetic.

Ginger Capsules contain an amount of powdered Ginger equivalent to not less than 90.0 per cent and not more than 110.0 per cent of the labelled amount of gingerols, gingerdiones and shogaols, and not less than 90.0 per cent of the labelled amount of volatile oil, calculated on the anhydrous basis.

Strengths available 250 and 500 mg (powder).

Dose Carminative, antiflatulent: 2 to 4 g a day.

Prophylaxis of nausea and vomiting associated with motion sickness: 1 to 2 g at least 30 minutes to 1 hour before travelling or as needed.

Prevention of postoperative nausea and vomiting: 1 g at 1 hour before operation.

Warning

1. It is not recommended in children under 6 years of age.
2. It may cause gastro-intestinal disturbances and irritation in mouth and throat.
3. Caution should be exercised when it is to be used concomitantly with anticoagulants and antiplatelets.
4. It should not be used in patients with bile duct obstruction except under medical supervision.

Packaging and storage Ginger Capsules shall be kept in tightly closed containers, protected from light**,** and stored in a dry place and at a temperature not exceeding 30°.

Labelling The label on the container states (1) the amounts of gingerols, gingerdiones and shogaols; (2) the amount of volatile oil; (3) the expiration date; (4) "If you are pregnant or nursing, consult a qualified health care professional before using".

Identification

A. The capsule contents exhibit diagnostic structures of the powdered drug described under *Ginger*.

B. The retention times of the major peaks in the chromatogram of the Assay preparation correspond to that of the Standard preparation, as obtained in the Assay.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 2 volumes of n-*hexane* and 3 volumes of *diethyl ether* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply separately to the plate, as bands of 5 mm, 10 μL of solution (A) and 5 μL each of solutions (B) and (C). For solution (A), shake a quantity of the capsule contents, containing 20 mg of 6-gingerol and 10 mg of 6-shogaol, with 10 mL of *methanol* and sonicate for 5 minutes and filter. Solution (B) contains 2 mg per mL of *6-gingerol* in *methanol* and solution (C) contains 1 mg per mL of *6-shogaol* in *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching bands. Spray the plate with *vanillin-sulfuric acid TS* and heat 105° for 10 minutes. The chromatogram obtained from solution (A) shows two violet bands corresponding to the 6-gingerol and 6-shogaol bands from solutions (B) and (C), respectively. Several other bands of different colours are observed.

Water Of the capsule contents, not more than 11.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Microbial limit Comply with the requirements for Category 4 in the "Limits for Microbial Contamination" (Appendix 10.5).

Assay

FOR VOLATILE OIL Remove the contents of not less than 20 Ginger Capsules, mix and transfer about 20 g, accurately weighed, to a 500-mL round-bottomed flask. Use 250 mL of *water* as the distillation liquid and distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube (Appendix 7.3H). Calculate the content of volatile oil, in mL, in the portion of the Capsules taken with reference to anhydrous substance.

FOR GINGEROLS, GINGERDIONES AND SHOGAOLS Carry out the determination as described in the "Liquid Chromatography" (Appendix 3.5).

Mobile phase A Prepare a mixture of 55 volumes of *acetonitrile*, 44 volumes of *phosphoric acid* (1 in 1000), and 1 volume of *methanol*.

Mobile phase B Use *acetonitrile*.

System suitability solution Reconstitute the content of 1 vial of Ginger Constituent Mixture RS containing 80 μg of 6-gingerol and 150 μg of 6-shogaol in 1 mL of *Standard preparation*.

Standard preparation Dissolve an accurately weighed quantity of Capsaicin RS in *methanol* to obtain a solution having a known concentration of about 100 μg per mL of capsaicin.

Assay preparation Weigh and mix the contents of not less than 20 Ginger Capsules. Transfer about 2 g of the powdered ginger, accurately weighed, to a glass-stoppered conical flask. Add 50 mL of *ethanol*, insert a stopper into the flask, macerate for 24 hours, shaking frequently during the first 8 hours, and then allowing to stand for 16 hours. Filter.

Chromatographic procedure The chromatographic procedure may be carried out using (a) a stainless steel column (25 cm × 4.6 mm) packed with octadecylsilane chemically bonded to porous silica or ceramic microparticles (5 μm), (b) *Mobile phase A* at a flow rate of 1.0 mL per minute for not less than seven times the retention time of capsaicin (the retention time is about 10 minutes for capsaicin.), and (c) an ultraviolet photometer set at 282 nm. After each chromatographic run, wash the column as follows.

Time (Minutes)	*Mobile Phase A* (Per Cent V/V)	*Mobile Phase B* (Per Cent V/V)
0	100	0
2	0	100
12	0	100
14	100	0
35	100	0

To determine the suitability of the chromatographic system, chromatograph *Standard preparation* and record the peak response as directed under *Procedure*: the relative standard deviation for replicate injections is not more than 2.5 per cent. Chromatograph *System suitability solution* and record the peak response as directed under *Procedure*: the relative retention times are about 0.8 for 6-gingerol, 1.0 for capsaicin and 1.9 for 6-shogaol. The resolution factor, *R*, between the 6-gingerol and the capsaicin peaks is not less than 3.0 and the resolution factor, *R*, between the capsaicin and the 6-shogaol peaks is not less than 10.0. The symmetry factors for 6-gingerol, 6-shogaol and capsaicin peaks are not more than 2.0.

Procedure Separately inject equal volumes (about 25 μL) of *Standard preparation* and *Assay preparation* into the chromatograph, record the chromatograms, and measure the responses for the major peaks.

Calculation Calculate the percentage of the labelled amount of gingerols, gingerdiones, and shogaols in the portion of the Capsules taken by the expression:

$$(r_U/r_S) \times C \times (V/D) \times (W/L) \times 100,$$

in which r_U is the sum of the peak responses for gingerols, gingerdiones, and shogaols from *Assay preparation*, r_S is the peak response of capsaicin from *Standard preparation*, *C* is the concentration, in mg per mL, of Capsaicin RS in *Standard preparation*, *V* is the final volume, in mL, of *Assay preparation*, *D* is the weight, in mg, of the portion of capsules taken, *W* is the average weight, in mg, of the capsule content, and *L* is the labelled amount, in mg per capsule, of gingerols, gingerdiones, and shogaols.

(**Note** Calculate the sum of the peak responses due to gingerols and gingerdiones occurring at about the following retention times relative to 1.0 for capsaicin: 0.8 for 6-gingerol, 1.5 for 8-gingerol A, 2.2 for 8-gingerol B, 2.5 for 6-gingerdiol, 2.6 for 6-gingerdione, 3.4 for 10-gingerol, and 5.2 for 8-gingerdione and calculate the sum of the peak responses due to shogaols, occurring at about the following retention times, relative to 1.0 for capsaicin: 1.9 for 6-shogaol, 4.2 for 8-shogaol, and 5.8 for 10-shogaol.)

Other requirements Comply with the requirements described under “Capsules” (Appendix 1.16H).

ยาชงขิง (YA CHONG KHING)

Ginger Tea

Category Carminative, antiflatulent, anti-emetic.

Ginger Tea contains an amount of powdered Ginger equivalent to not less than 90.0 per cent and not more than 110.0 per cent of the labelled amount of gingerols, gingerdiones and shogaols, and not less than 90.0 per cent of the labelled amount of volatile oil, calculated on the anhydrous basis.

Strengths available 1, 2 and 3 g (powder), supplied in a sachet.

Dose Carminative, antiflatulent, antidyspepsia: one sachet, containing 1 to 3 g of powdered ginger, prepared as an infusion by soaking each with 150 mL of boiling water for 10 minutes, twice a day.

Prophylaxis of nausea and vomiting associated with motion sickness: one sachet, containing 1 to 2 g of powdered ginger, prepared as an infusion by soaking each with 150 mL of boiling water for 10 minutes, at least 30 minutes to 1 hour before travelling or as needed.

Prevention of postoperative nausea and vomiting: one sachet, containing 1 g of powdered ginger, prepared as an infusion by soaking each with 150 mL of boiling water for 10 minutes, at least 1 hour before operation.

Warning

1. It is not recommended in children under 6 years of age.
2. It may cause gastro-intestinal disturbances and irritation in mouth and throat.
3. Caution should be exercised when it is to be used concomitantly with anticoagulants and antiplatelets.
4. It should not be used in patients with bile duct obstruction except under medical supervision.

Packaging and storage Ginger Tea shall be kept in well-closed containers, protected from light.

Labelling The label on the container states (1) the amounts of gingerols, gingerdiones and shogaols; (2) the amount of volatile oil; (3) the expiration date; (4) "If you are pregnant or nursing, consult a qualified health care professional before using".

Identification

A. The tea contents exhibit diagnostic structures of the powdered drug described under *Ginger*.

B. The tea contents comply with the tests for Identification A, B and C described under *Ginger Capsules*.

Water Of the tea contents, not more than 11.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Microbial limit Complies with the requirements for Category 2 in the "Limits for Microbial Contamination" (Appendix 10.5).

Assay

FOR VOLATILE OIL Mix the contents of not less than 20 sachets of Ginger Tea and transfer about 20 g, accurately weighed, to a 500-mL round-bottomed flask. Use 250 mL of *water* as the distillation liquid and distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube (Appendix 7.3H). Calculate the content of volatile oil, in mL, in the portion of the Tea taken with reference to anhydrous substance.

FOR GINGEROLS, GINGERDIONES AND SHOGAOLS Carry out the determination as described in the "Liquid Chromatography" (Appendix 3.5).

Mobile phase A, **Mobile phase B**, **System suitability solution**, **Standard preparation**, **Chromatographic procedure**, and **Procedure** Proceed as directed in the Assay under *Ginger Capsules*.

Assay preparation Grind the contents of not less than 20 sachets of Ginger Tea to *fine powder*. Transfer about 2 g of the powdered ginger, accurately weighed, to a glass-stoppered conical flask. Add 50 mL of *ethanol*, insert a stopper into the flask, macerate for 24 hours, shaking frequently during the first 8 hours, and then allowing to stand for 16 hours. Filter.

Calculation Calculate the percentage of the labelled amount of gingerols, gingerdiones, and shogaols in the portion of the Tea taken by the expression:

$$(r_U/r_S) \times C \times (V/D) \times (W/L) \times 100,$$

in which r_U is the sum of the peak responses for gingerols, gingerdiones, and shogaols from *Assay preparation*, r_S is the peak response of capsaicin from *Standard preparation*, C is the concentration, in mg per mL, of Capsaicin RS in *Standard preparation*, V is the final volume, in mL, of *Assay preparation*, D is the weight, in mg, of the portion of the tea taken, W is the average weight, in mg, of the tea content, and L is the labelled amount, in mg per sachet, of gingerols, gingerdiones and shogaols.

(**Note** Calculate the sum of the peak responses due to gingerols and gingerdiones occurring at about the following retention times relative to 1.0 for capsaicin: 0.8 for 6-gingerol, 1.5 for 8-gingerol A, 2.2 for 8-gingerol B, 2.5 for 6-gingerdiol, 2.6 for 6-gingerdione, 3.4 for 10-gingerol, and 5.2 for 8-gingerdione and calculate the sum of the peak responses due to shogaols, occurring at about the following retention times, relative to 1.0 for capsaicin: 1.9 for 6-shogaol, 4.2 for 8-shogaol, and 5.8 for 10-shogaol).

Other requirements Complies with the requirements described under "Herbal Teas" (Appendix 1.16H).

คูน, เนื้อในฝัก (KHUN, NUEA NAI FAK)

ลมแล้ง, เนื้อในฝัก (LOM LAENG, NUEA NAI FAK)
Cassiae Fistulae Pulpa
Purging Cassia Pulp

Synonyms Golden Shower Pulp, Indian Laburnum Pulp, Pudding Pine Pulp, Pudding Pipe Pulp, Purging Fistula Pulp, Riding Pipe Pulp

Category Laxative.

Purging Cassia Pulp is the aril of the ripe pod of *Cassia fistula* L. (Family Leguminosae), Herbarium Specimen Number: DMSC 5162, BKF 114900, Crude Drug Number: DMSc 1142.

Constituents Purging Cassia Pulp contains anthraquinones (e.g., rhein and its glycosides). It also contains flavonoids, tannins, etc.

Description of the plant (Figs. 1a, 1b) Deciduous tree, up to 20 m high; bark smooth, greenish grey when young, becoming rough and dark brown when mature. Leaves pinnately compound, 10 to 60 cm long; petiole 7 to 10 cm long; rachis 15 to 25 cm long; stipule small and caducous; leaflets opposite, 3- to 8-paired, ovate to ovate-oblong, 6 to 20 cm long, 3.5 to 9 cm wide, apex acute to acuminate, base cuneate, upper surface glabrous, lower surface silvery pubescent when young, becoming glabrous when mature. Inflorescence raceme, axillary, drooping, lax, many-flowered, 20 to 40(–60) cm long; pedicel 1.5 to 5 cm long; bract about 1 cm long, caducous. Flower: sepals 5, ovate-elliptic, about 1 cm long, velutinous, reflexed at anthesis; petals 5, subequal, broadly ovate or obovate, 2 to 3.5 cm long, 1 to 2 cm wide, distinctly veined, short-clawed, yellow; stamens 10, 3 long, 4 short and 3 reduced forms, long stamens much curled and bearing large oblong anther, opening by apical and basal slits, short stamens with straight filaments, reduced stamens with minute anther; ovary stalked, velutinous, style velutinous, stigma small. Fruit pod, terete, 20 to 60 cm long, 1 to 2.5 cm wide, pendulous, indehiscent, blackish brown to black. Seeds numerous, elliptic, 7.5 to 9 mm long, 5 to 7 mm wide, flat, glossy brown, embedded in blackish pulp, separated by spongy septa.

Description Odour, characteristic; taste, unpleasantly sweet.

Macroscopical (Fig. 1a) Sticky lump of pulp, dark brown to black.

Microscopical [**Note** Even though the pulp (aril) is used as a crude drug, microscopical description of the young pod is provided here for better understanding of the entire structure enclosing the pulp and the seed within.] (Figs. 2a, 2b, 2c, 2d) Transverse section of the pod shows pericarp and seed. Pericarp, consisting of a rectangular epidermal layer (rarely with unicellular trichome), parenchyma cells, some of which contain prismatic crystals, vascular bundles, and layers of elongated sclereids. Seed, containing aril and seed coat; aril, parenchyma cells, some of which contain rosette aggregate crystals; seed coat, covered with thick cuticle layer, layers of non-lignified macrosclereids and two layers of non-lignified lagenosclereids separated by layers of thick-walled parenchyma.

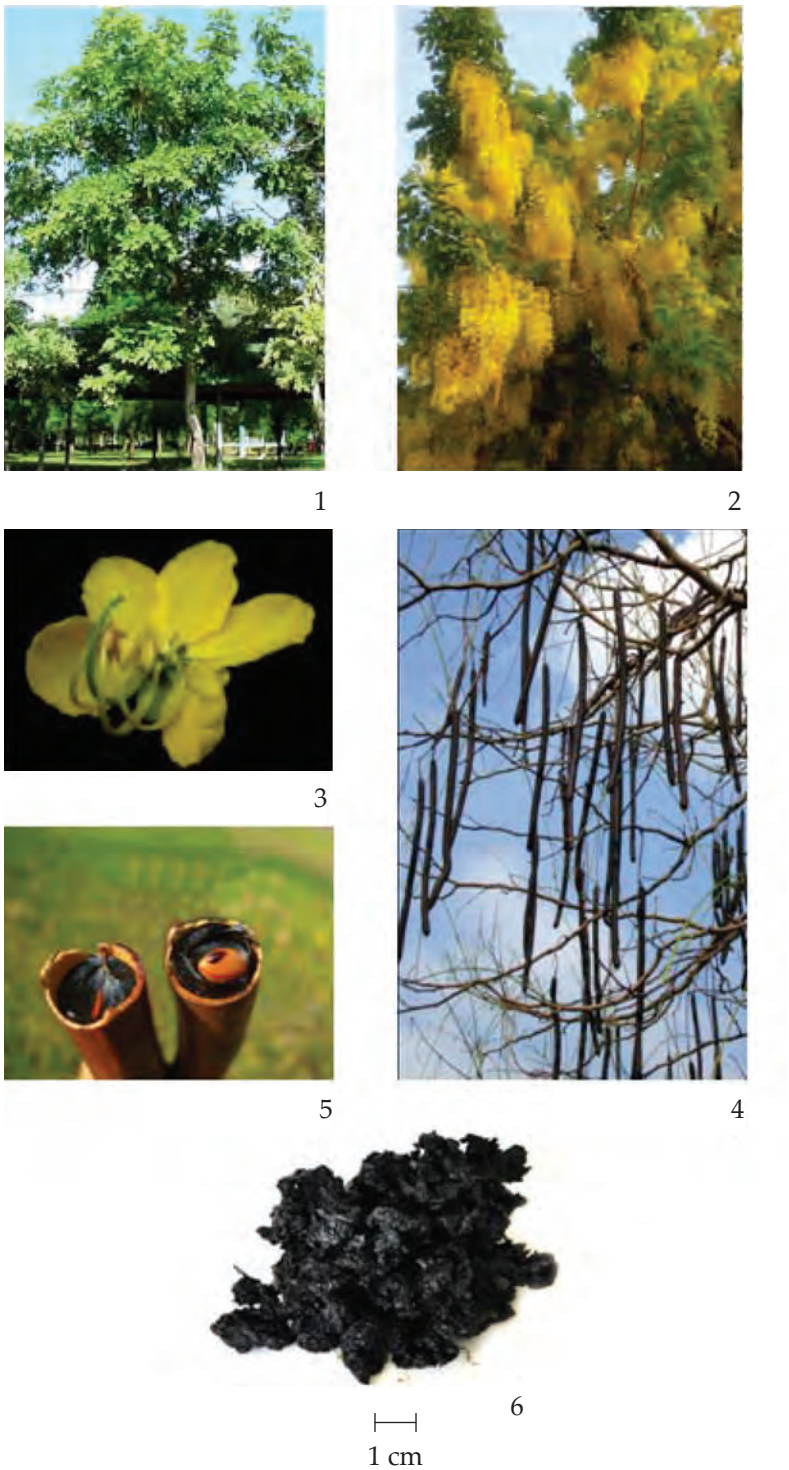


Fig. 1a *Cassia fistula* L.
1. habit 2. inflorescences 3. flower
4. ripe pods 5. pulp and seed inside ripe pod 6. crude drug

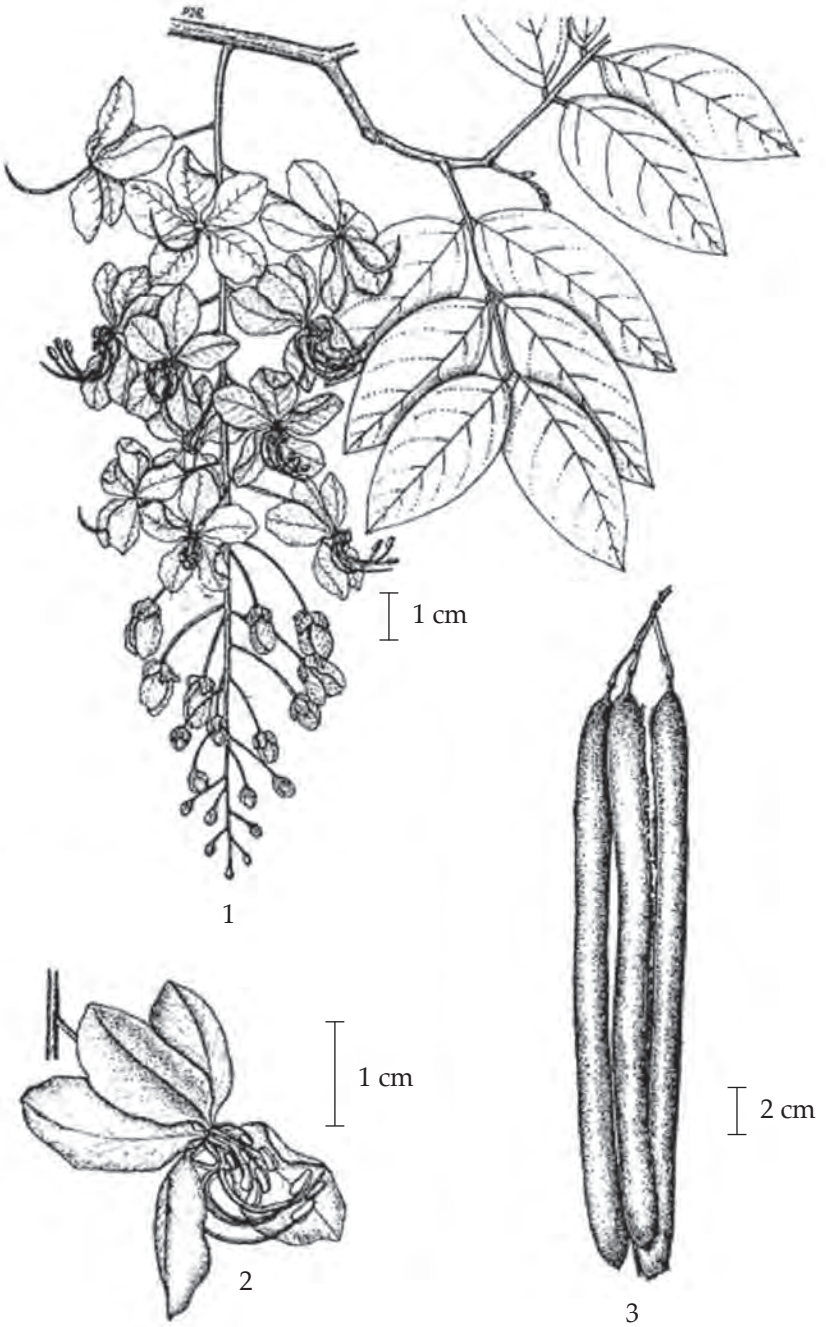


Fig. 1b *Cassia fistula* L.
1. flowering branch 2. flower 3. pods

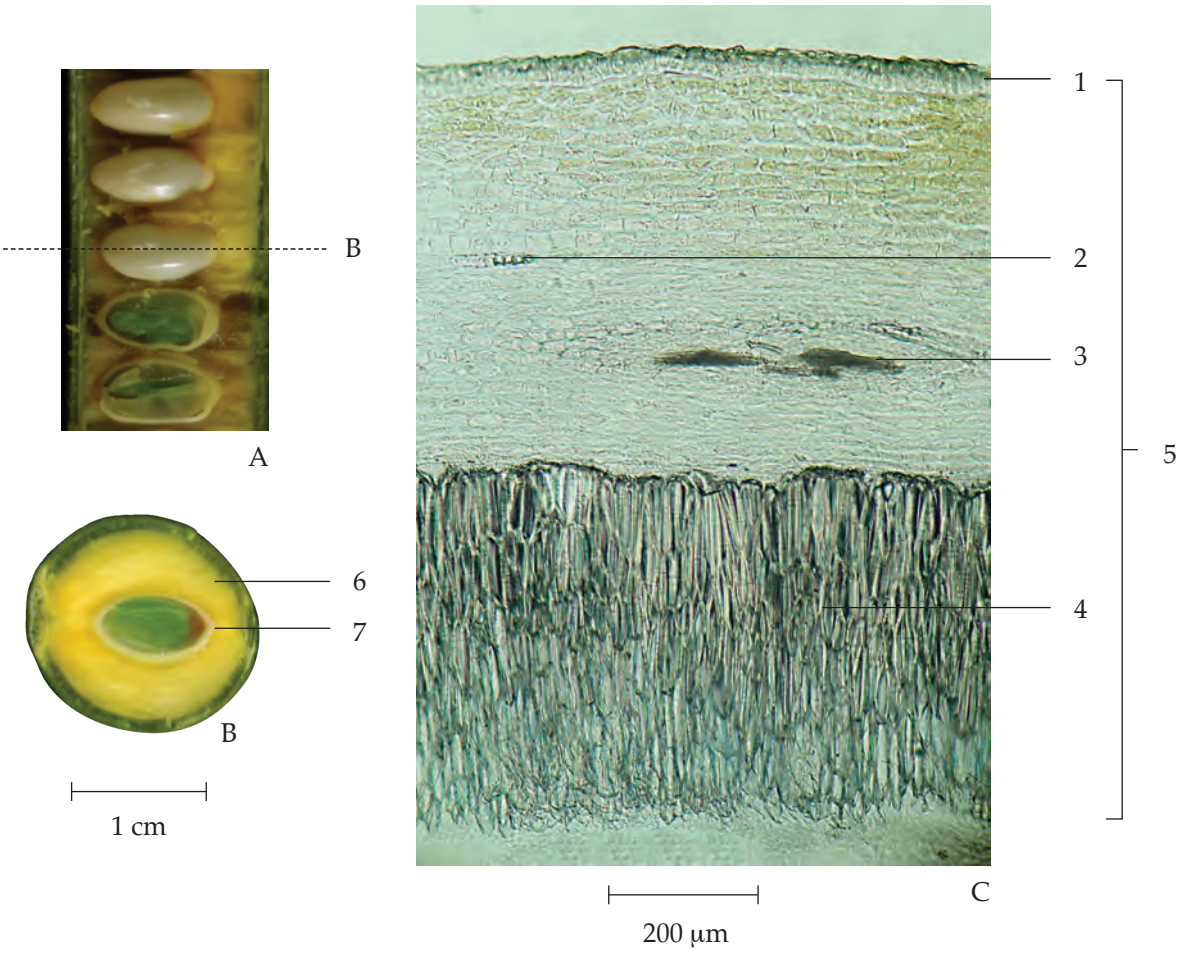


Fig. 2a Sections of the Young Pod of *Cassia fistula* L.
A. Longitudinal Section of Part of the Pod
B. Transverse Section through the Seed
C. Photomicrograph of Transverse Section of the Pericarp

1. epidermis
2. prismatic crystal of calcium oxalate
3. group of spiral vessels
4. elongated sclereid
5. pericarp
6. pulp
7. seed coat

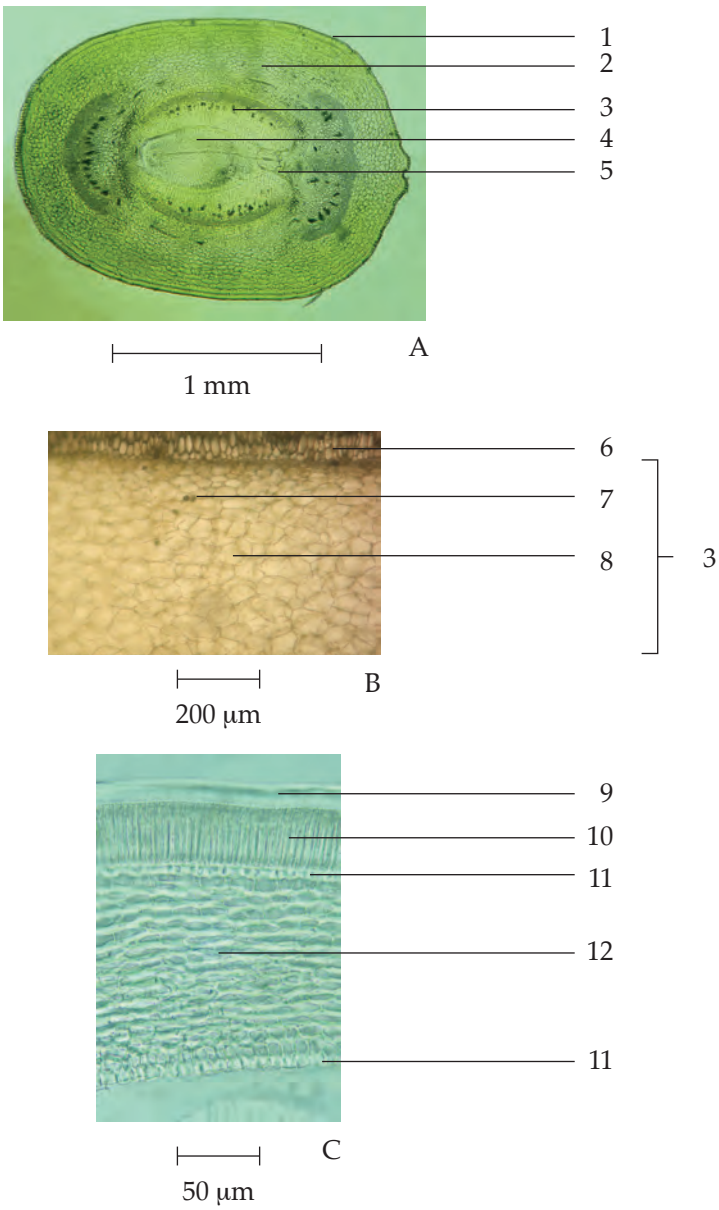


Fig. 2b Photomicrographs of Transverse Sections of the Young Pod of *Cassia fistula* L.
A. Through the Seed and Funiculus
B. Part of the Pericarp and Pulp
C. Part of the Seed Coat

1. epidermis
2. pericarp
3. pulp
4. seed
5. funiculus
6. elongated sclereids of inner pericarp
7. rosette aggregate crystals
8. parenchyma of the pulp
9. cuticle
10. macrosclereids
11. lagenosclereids
12. thick-walled parenchyma

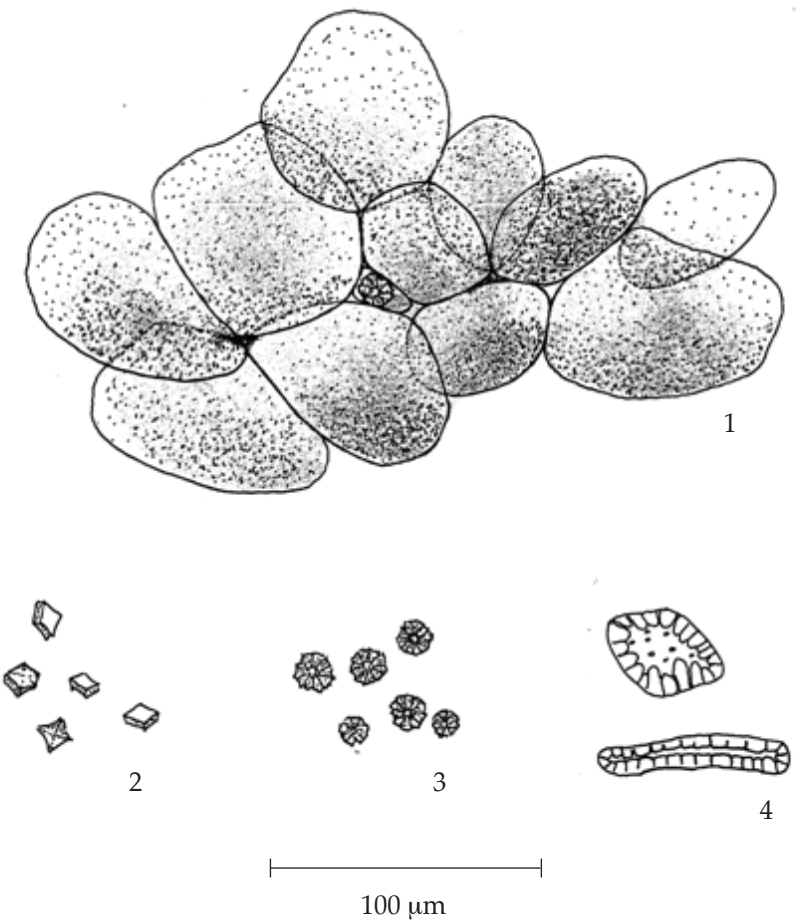


Fig. 2c Line Drawings of Powdered Drug of the Pulp of *Cassia fistula* L.
1. parenchyma containing microcrystals and brown pigment, some with rosette aggregate crystals
2. prismatic crystals
3. rosette aggregate crystals
4. sclereids

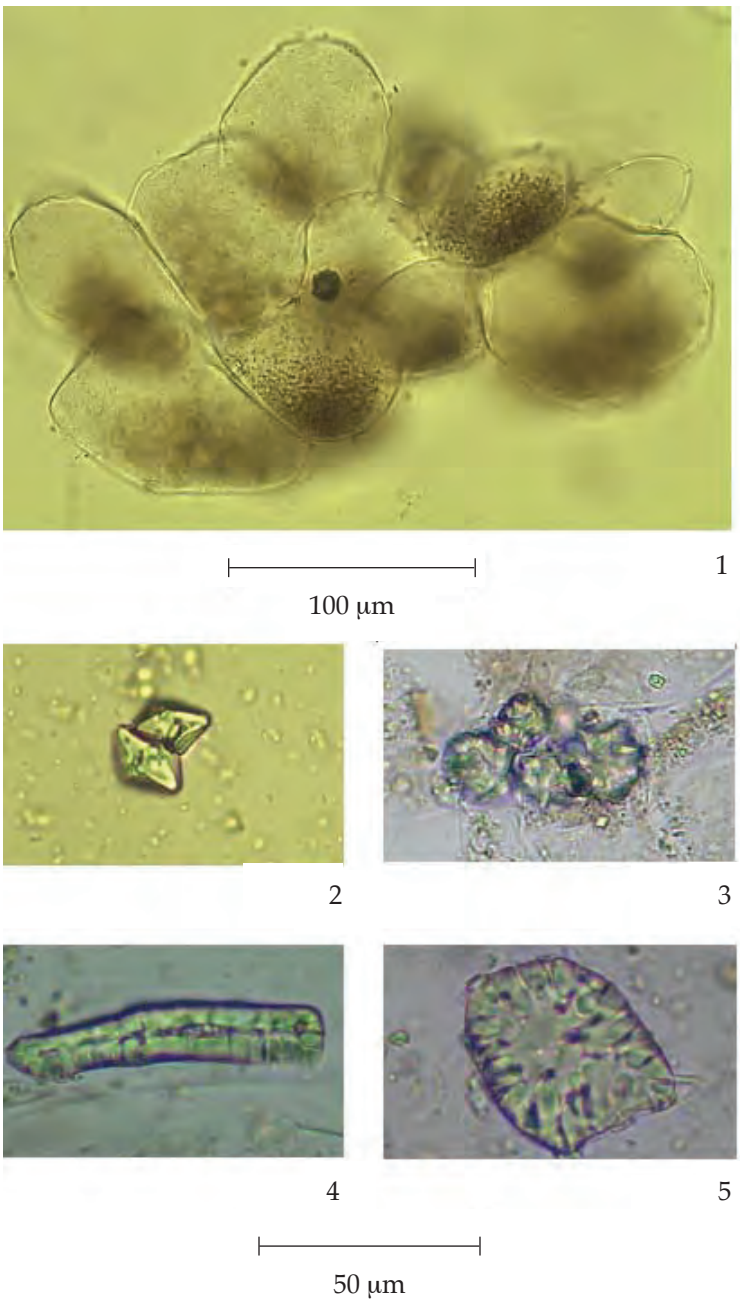


Fig. 2d Photomicrographs of Powdered Drug of the Pulp of *Cassia fistula* L.

1. parenchyma containing microcrystals and brown pigment, some with rosette aggregate crystals
2. prismatic crystals
3. rosette aggregate crystals in parenchyma
4. elongated sclereids
5. rhomboidal sclereid

Purging Cassia Pulp possesses the diagnostic microscopical characters of the aril of the drug. The parenchyma cells containing brownish to blackish granular mass is characteristic.

Contra-indication It is contra-indicated in patients with constipation from intestinal obstruction, diarrhea, abdominal pain, nausea, and vomiting.

Warning

1. Prolonged use should be avoided since it may result in laxative dependence.
2. Pod shell and seeds should be removed from the pulp since they may cause vomiting.

Additional information

1. Although in Thai traditional remedies the crude drug is usually addressed as "ฝักคูน (FAK KHUN)" which means a purging cassia pod, only the pulp after removal of shell and seeds [เนื้อในฝักคูน (KHUN, NUEA NAI FAK)] is used in the preparations. Therefore, it is chosen to be the title of this monograph.
2. To obtain its maximum benefit, it is recommended that the pulp be freshly taken from the purging cassia pod.

Packaging and storage Purging Cassia Pulp shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. To 3 g of the sample, add 25 mL of 2 M *hydrochloric acid*, heat on a water-bath for 30 minutes, and immediately filter through a plug of cotton wool. Allow the filtrate to cool and shake with 20 mL of *dichloromethane*. Collect the dichloromethane layer and shake with 10 mL of *ammonia TS*: the aqueous layer becomes red.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 100 volumes of *ethyl acetate*, 17 volumes of *methanol* and 3 volumes of *water* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply separately to the plate, 4 μL each of the following solutions. Prepare solution (A) by refluxing 5 g of the sample with 50 mL of *chloroform* on a water-bath for 30 minutes, filtering and evaporating the filtrate to dryness. Dissolve the residue in 1.0 mL of *chloroform*. For solution (B) dissolve 3 mg of *rhein* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under daylight, locating the spots. The chromatogram obtained from solution (A) shows a yellow spot corresponding to the rhein spot (hR_f value 49 to 52) from solution (B). Subsequently examine under ultraviolet light (254 nm), marking the quenching spots. The chromatogram obtained from solution (A) shows a quenching spot corresponding to the rhein spot from solution (B), and other two quenching spots of the lower hR_f values. Examine the plate under ultraviolet light (366 nm); the spot due to rhein is a brownish purple; one blue fluorescent spot is also observed. Spray the plate with a 10 per cent w/v solution of *potassium hydroxide* in *ethanol*; the spot corresponding to rhein is reddish pink (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Chloroform Extract of the Aril of the Ripe Pods of *Cassia fistula* L.

Spot	hR_f Value	Detection			
		Daylight	UV 254	UV 366	10 Per Cent W/V Solution of *Potassium Hydroxide* in *Ethanol*
1	25–28	–	quenching	–	–
2	30–32	–	–	blue	–
3	40–44	–	quenching	–	–
4*	49–52	yellow	quenching	brownish purple	reddish pink

*rhein

Loss on drying Not more than 14.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Total ash Not more than 4.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 66.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 67.0 per cent w/w (Appendix 7.12).

Dose 3 to 10 g at bed time.

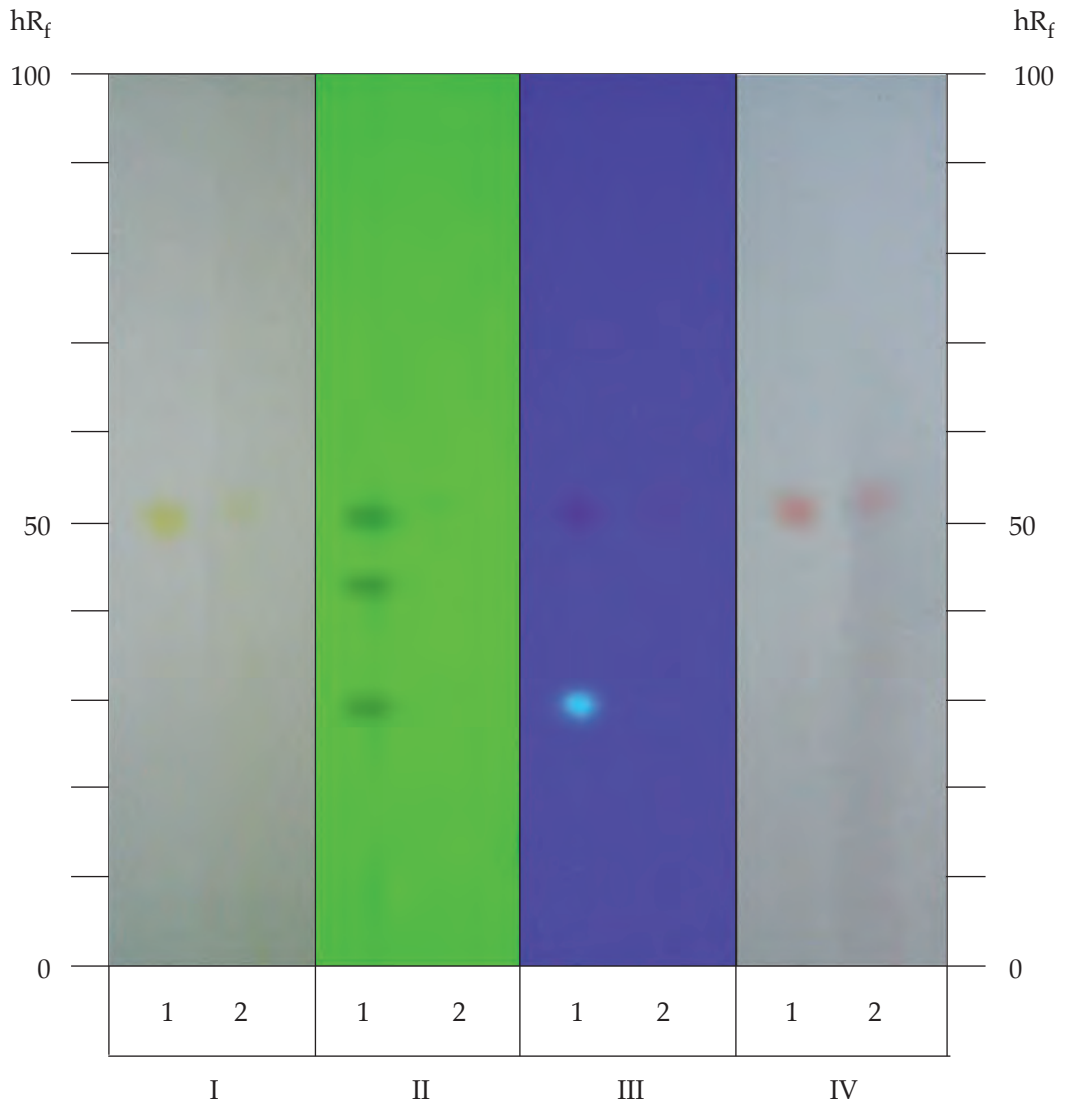


Fig. 3 Thin-Layer Chromatogram of Chloroform Extract of the Aril of the Ripe Pods of *Cassia fistula* L.

1 = solution (A)
2 = solution (B)
I = detection under daylight
II = detection under UV light (254 nm)
III = detection under UV light (366 nm)
IV = detection with a 10 per cent w/v solution of *potassium hydroxide* in *ethanol*

โกฐชฎามังสี (KOT CHADA MANGSI)

ชะดามังสี (CHADA MANGSI)
Nardostachyos Radix et Rhizoma
Spikenard

Synonyms Chinese Spikenard, Jatamansi

Category Mild sedative, treatment of dysmenorrhea.

Spikenard is the dried root and rhizome, with remnants of stem and leaves, of *Nardostachys jatamansi* (D. Don) DC. (*N. grandiflora* DC.) (Family Caprifoliaceae), Herbarium Specimen Number: see *Additional information 1*, Crude Drug Number: DMSc 0939.

Constituents Spikenard contains volatile oil of which sesquiterpenoids (e.g., jatamansone or valeranone, nardosinone) are its major components. It also contains other sesquiterpenoids (e.g., nardin), alkaloids (e.g., actinidine), coumarins, etc.

Description of the plant (Figs. 1a, 1b) Perennial herb; flowering stems 10 to 60 cm high, puberulous; rhizome woody, foetid, spindle-shaped, elongated, covered with reddish brown fibres. Leaves simple, opposite, basal leaves rosulate, blade elliptic-lanceolate or oblanceolate, 5 to 20 cm long, apex obtuse, base attenuate into petiole, margin entire or sparsely serrate; petiole subequal to leaf blade in length. Inflorescence terminal cymose; capitula 1.5 to 2 cm in diameter; involucral bracts 4 to 6, lanceolate; bract narrowly ovate to ovate, subequal to flower length; peduncles sometime elongated. Flower purple-red, pinkish white, pink, or magenta; calyx 5-lobed, lobe suborbicular to triangular-lanceolate, enlarged in fruit, usually ciliate; corolla tube campanulate, 4.5 to 9 mm long, 5-lobed, lobe broadly ovate to oblong, 2 to 3.8 mm long; stamens 4, subequal to corolla length, filament villous; ovary inferior, style subequal to stamen length. Fruit achene, obovoid, 3 to 4 mm long.

Description Odour, characteristic, pungent and foetid; taste, bitter and pungent.

Macroscopical (Fig. 1a) A bundle of compressed rhizomes, cylindrical, 2.5 to 7.5 cm long, about 1.5 cm in diameter, dark grey or brown, covered by bundles of fine brown fibres forming a network of leaf sheath, easily broken. Root simple- or multiple-joined, branched or juxtaposed, 0.3 to 1 cm in diameter, externally brown, shrunken, with rootlets, texture fragile, easily broken, fracture rough, bark dark brown.

Microscopical (Figs. 2a, 2b, 2c, 2d) Transverse section of the crude drug exhibits remnants of leaves and stem, roots and rhizomes. Remnant leaf composed of cork layers and vascular tissue. Remnant stem comprises cork layers, cortex, vascular tissues, and pith. Root composed of cylindrical epidermal layer, cortex, vascular tissue, and pith. Rhizome comprises cork layers, cortex and vascular tissue.

Transverse section of the remnant leaf shows several layers of thin-walled, cork-like cells with small groups of vascular bundles.

Transverse section of the remnant of stem illustrates several layers of thin-walled cork cells, fibre, numerous round parenchyma in cortex, vascular tissue and numerous thin-walled pith parenchyma in the centre.

Transverse section of the root shows a layer of cylindrical epidermis, round or polygonal, slightly thick-walled parenchyma and endodermis in cortex, polyarch of vascular bundles and numerous thick-walled parenchyma in pith.

Fig. 1a *Nardostachys jatamansi* (D. Don) DC.
1. whole plant 2. habit and inflorescences 3. roots and rhizomes 4. crude drug

Fig. 1b *Nardostachys jatamansi* (D. Don) DC.
1. plant showing leaves, inflorescences and rhizome with roots 2. flower

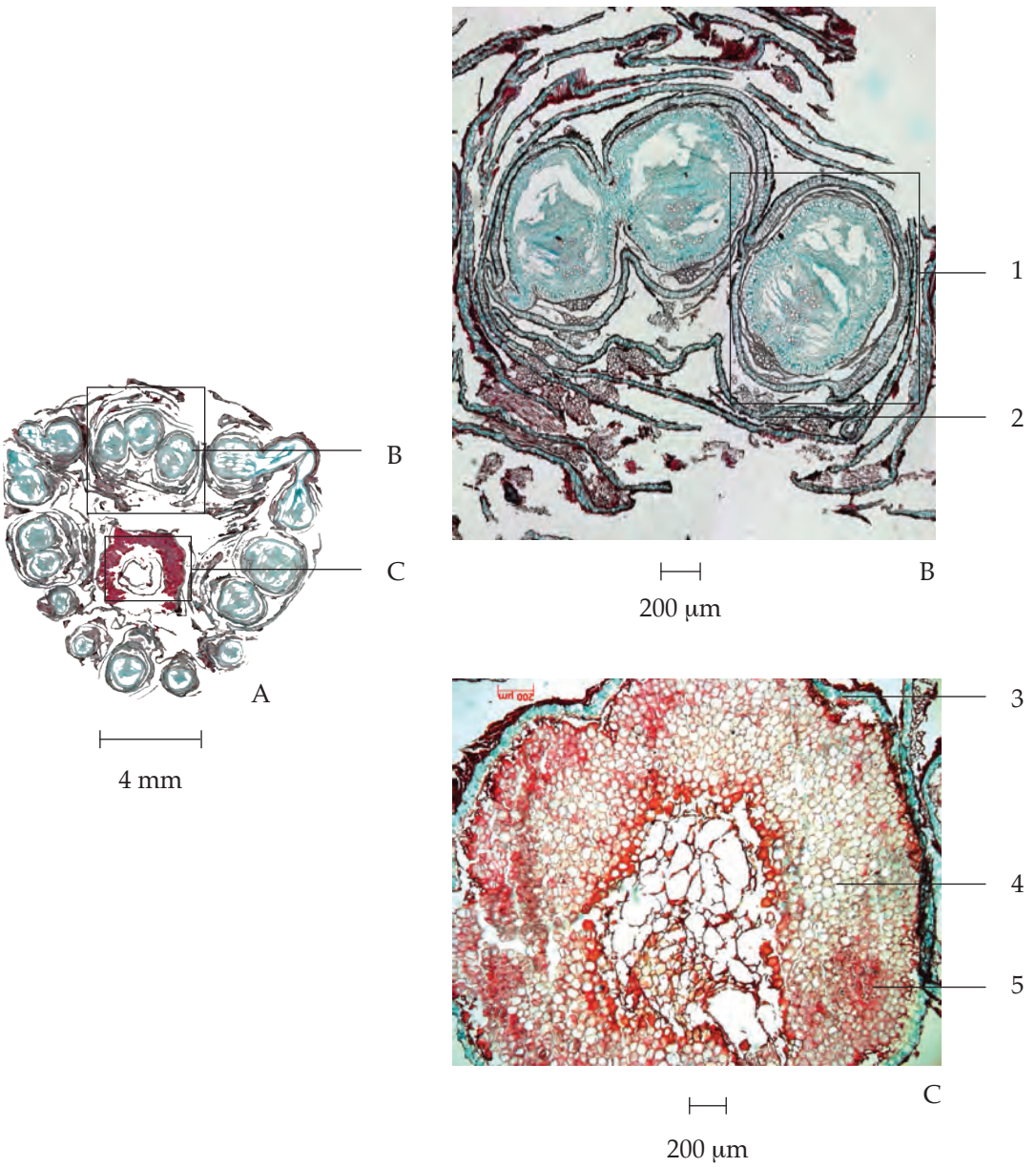


Fig. 2a Photomicrographs of Transverse Sections of the Rhizomes and Remnants of Stem and Leaves of *Nardostachys jatamansi* (D. Don) DC., Stained with Safranin-Fast Green

A. Rhizome Arrangement
B. Rhizomes and Remnant Leaves
C. Remnant Stem

1. rhizome
2. remnant leaf
3. cork cell
4. parenchyma
5. fibre

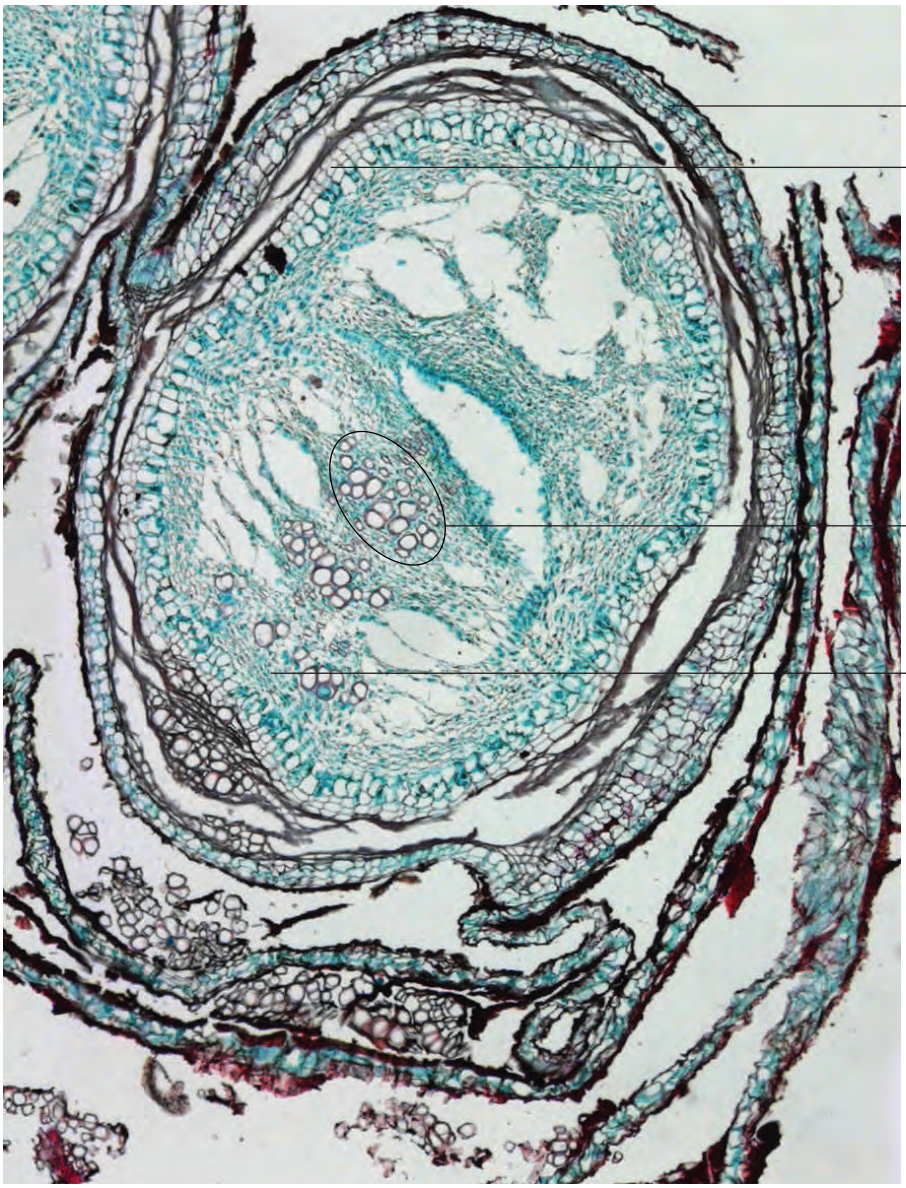


Fig. 2b Photomicrograph of Transverse Section of the Rhizome and Remnant Leaves of *Nardostachys jatamansi* (D. Don) DC., Stained with Safranin-Fast Green

1. cork-like ring of remnant leaf
2. cork layer of rhizome
3. xylem tissue
4. phloem tissue

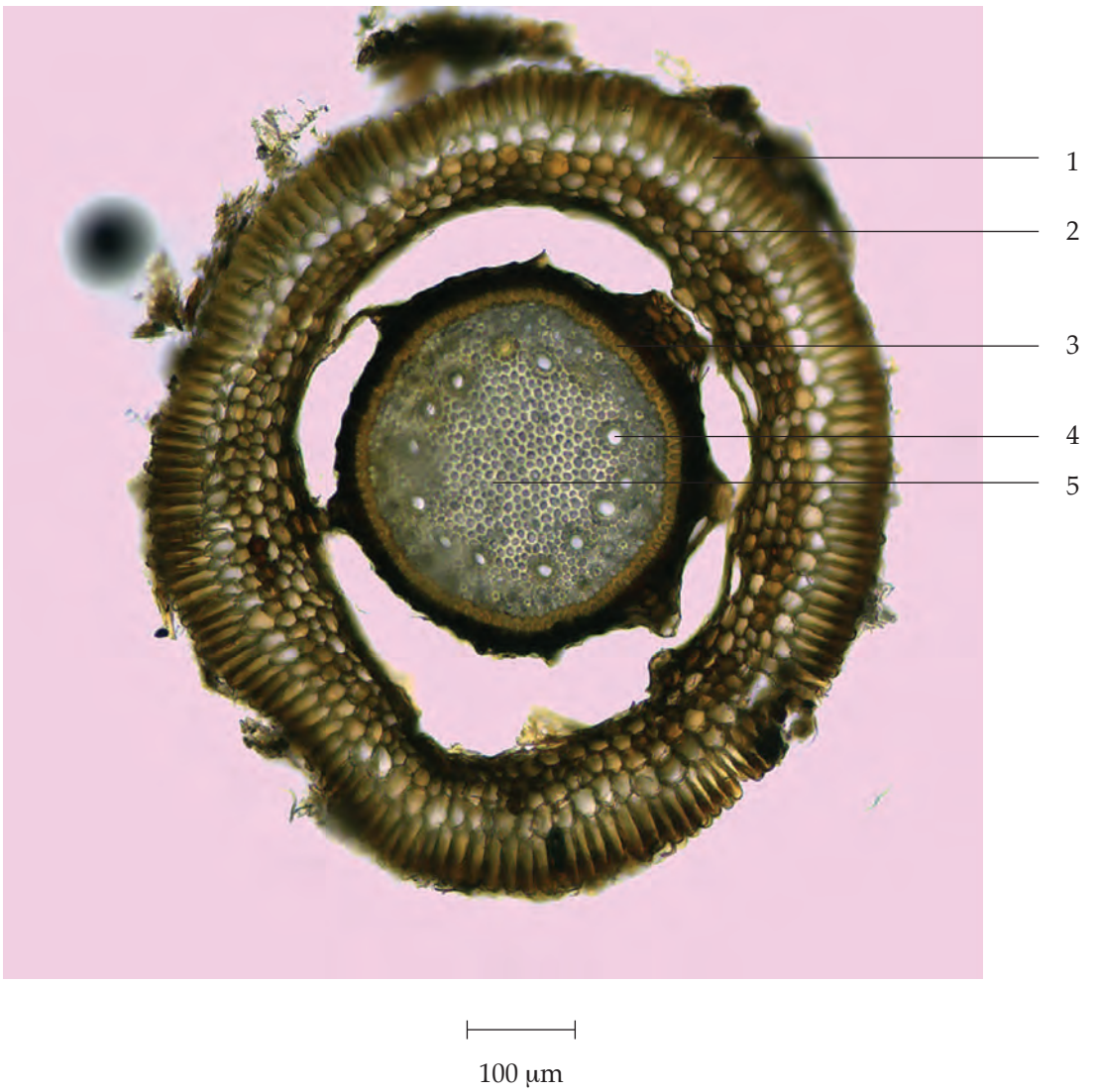


Fig. 2c Photomicrograph of Transverse Section of the Root of *Nardostachys jatamansi* (D. Don) DC.

1. epidermis
2. cortex
3. endodermis
4. vessel
5. pith

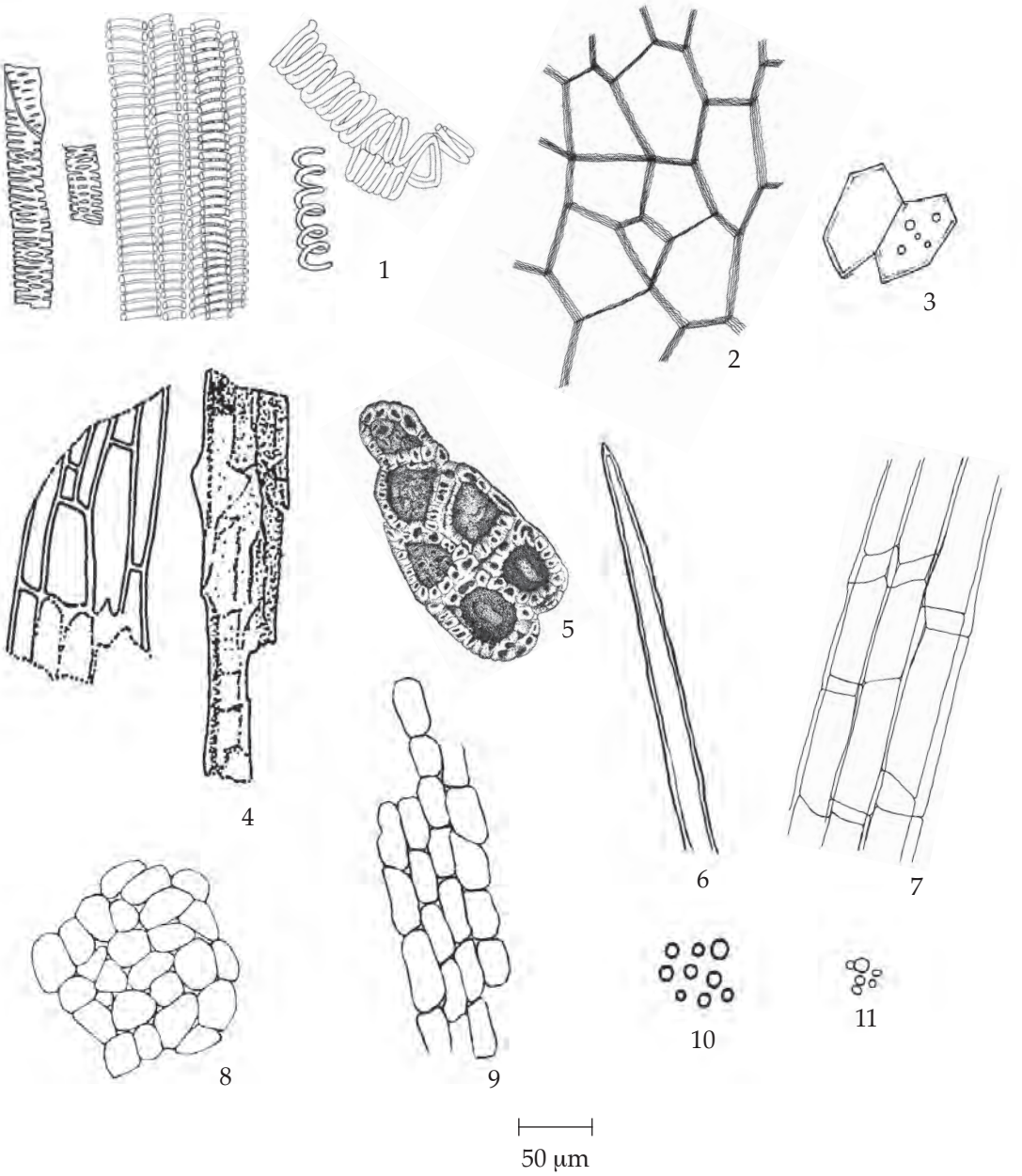


Fig. 2d Powdered Drug of the Roots and Rhizomes of *Nardostachys jatamansi* (D. Don) DC.

1. reticulate, scalariform and spiral vessels
2. cork cells in surface view
3. cork cells with oil droplets
4. remnants of leaf blades
5. brownish thick-walled sclereids
6. fibre
7. cork cells in longitudinal view
8. parenchyma in sectional view
9. parenchyma in longitudinal view
10. oil droplets
11. starch grains

Transverse section of the rhizome shows more than two layers of cork cells, several layers of thin-walled parenchyma in cortex, vascular tissue, parenchyma and large holes in the centre.

Spikenard in powder possesses the diagnostic microscopical characters of the unground drug. Thin-walled, cork-like cells, lignified thick-walled brownish sclereids and oil droplets are abundant.

Contra-indication It is contra-indicated in pregnant women.

Additional information

1. Spikenard plant is not native to nor commercially cultivated in Thailand. The plant yielding spikenard root and rhizome, with remnants of stem and leaves is here referred to the herbarium specimen number K000762790, collector's number N. Wallich 431, deposited at the Herbarium, Royal Botanic Gardens Kew (K), London, United Kingdom. The photographic illustration of the specimen can be seen at the Department of Medical Sciences Herbarium (DMSC), Nonthaburi, Thailand.
2. It is commonly used with other herbal drugs in Thai traditional herbal preparations.

Packaging and storage Spikenard shall be kept in well-closed containers, preferably of metal or glass, protected from light, and stored in a cool and dry place.

Identification

A. Shake 2 g of the sample, in powder, with 10 mL of *chloroform* for 15 minutes and filter. To 2 mL of the filtrate, slowly add 1 mL of *sulfuric acid* to make two layers: a brown ring is produced at the zone of contact.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 70 volumes of n-*hexane*, 30 volumes of *ethyl acetate* and 1 volume of *acetic acid* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply to the plate, 5 μL of the test solution prepared by refluxing 1 g of the sample, in powder, with 25 mL of *methanol* for 30 minutes, filtering and evaporating the filtrate to dryness. Dissolve the residue in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; several blue fluorescent spots are observed. Spray the plate with *anisaldehyde TS* and heat at 110° for 10 minutes; several violet spots appear (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Roots and Rhizomes, with Remnants of Stems and Leaves, of *Nardostachys jatamansi* (D. Don) DC.

Spot	hR_f Value	Detection		
		UV 254	UV 366	*Anisaldehyde TS*
1	2–6	quenching	–	–
2	16–20	quenching	light blue	violet
3	30–32	–	light blue	–
4	32–36	–	–	violet
5	43–48	quenching	–	violet
6	52–58	quenching	blue	–
7	58–63	quenching	–	violet
8	66–72	quenching	–	violet

Water Not more than 12.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 6.0 per cent w/w (Appendix 7.6).

Total ash Not more than 11.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 2.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 5.0 per cent w/w (Appendix 7.12).

Volatile oil Not less than 1.0 per cent v/w (Appendix 7.3H). Use 20 g, in *coarse powder*, freshly prepared and accurately weighed. Use 200 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube.

Dose 2 to 3 g of the powdered drug a day.

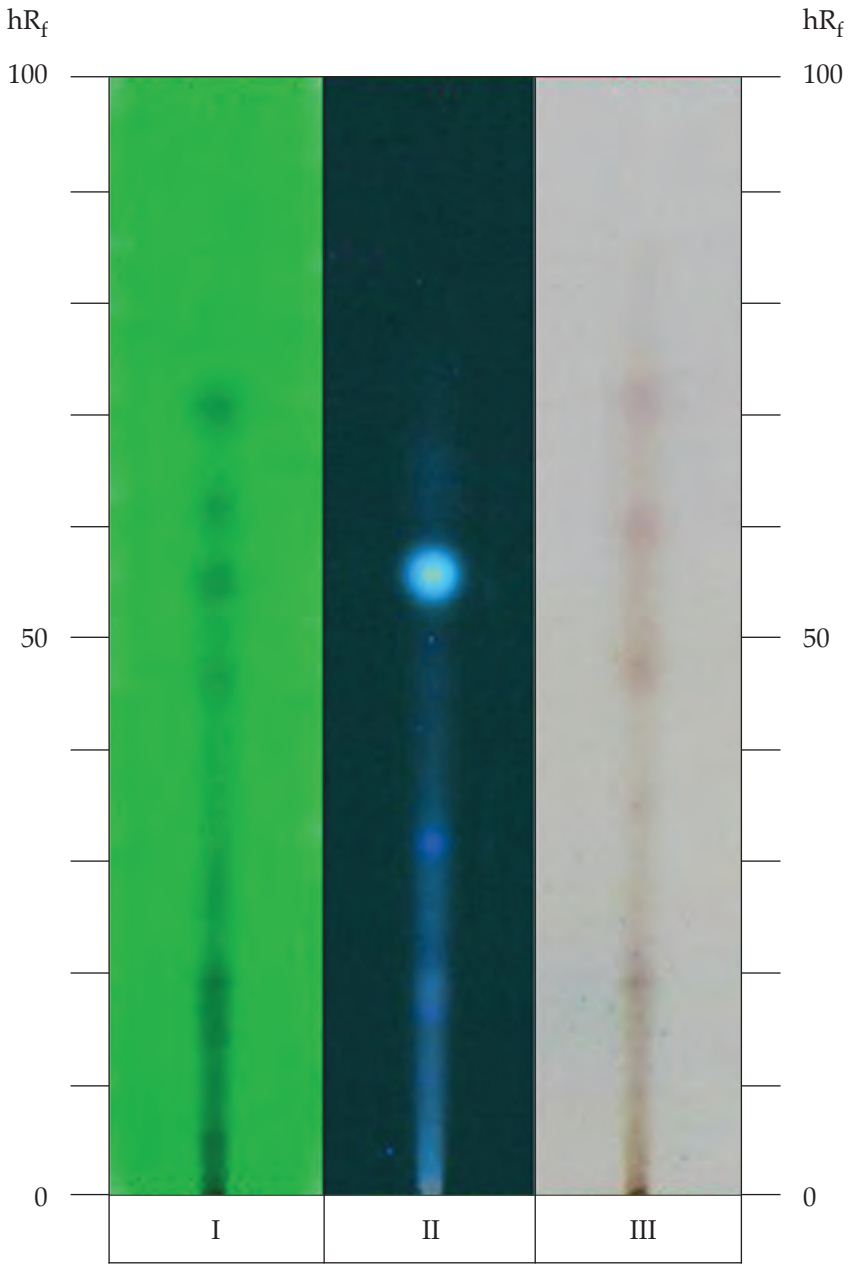


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Roots and Rhizomes, with Remnants of Stems and Leaves, of *Nardostachys jatamansi* (D. Don) DC.

I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *anisaldehyde TS*

โกฐเชียง (KOT CHIANG)

กุยเหว่ย (KUIWEI), ตังกุยบ้วย (TANG KUI BOUA)
Angelicae Sinensis Radix Lateralis
Chinese Angelica Lateral Root

Category Blood tonic, treatment of menstrual disorders.

Chinese Angelica Lateral Root is the dried lateral root of *Angelica sinensis* (Oliv.) Diels (*A. polymorpha* var. *sinensis* Oliv.) (Family Umbelliferae), Herbarium Specimen Number: see *Additional information 1*, Crude Drug Number: DMSc 1139.

Constituents Chinese Angelica Lateral Root contains alkyl phthalides (e.g., *Z*-ligustilide, *Z*-butylidenephthalide, angelicide) and phenylpropanoids (e.g., *E*-ferulic acid, coniferyl ferulate). It also contains terpenoids (e.g., carvacrol, *cis*-*β*-ocimene, *β*-cadinene), benzenoids (e.g., vanillic acid), polysaccharides, etc.

Description of the plant (Figs. 1a, 1b) Perennial herb up to 1 m high; stem purplish green, linear striation, branched above, glabrous; root stout, conic or cylindrical, branched, lateral roots numerous. Leaves pinnately or ternately compound, alternate, blade ovate in outline, 10 to 30 cm long, 12 to 25 cm wide; pinnae 3 to 4 pairs; leaflets ovate or ovate-lanceolate, 2 to 3.5 cm long, 0.8 to 2.5 cm wide, 2- to 3-lobed, margin irregularly cuspidate-serrate, nerves and margins sparsely papillose to hairy; petiole 5 to 20 cm long, purplish green, base of petiole sheathing, inflated, ovate, margin membranous. Inflorescence compound umbel, terminal or axillary, umbels 10 to 30; peduncle 8 to 20 cm long, pubescent or subglabrous; bract(s) absent or 2, linear, unequal; bracteoles 2 to 4, linear, 3 to 5 mm long, glabrous. Flowers small, white, rarely purplish red, 13 to 36 per umbel; pedicel slender, 1 to 3 cm in fruit; calyx teeth obsolete; petals 5, obovate, apex incurved; ovary inferior, 2-loculed, 1-ovuled per locule, stylopodium shortly conic. Fruit schizocarp, ellipsoid, ovoid or subglobose, 4 to 6 mm long, 3 to 4 mm wide, dorsal ribs prominent, filiform, lateral ribs broadly thin-winged, wings as wide as or wider than the body, vitta(e) 1 on each furrow, absent or 2 on commissure, split into 2 single-seeded mericarps. Seed plane or slightly concave.

Description Odour, strongly aromatic; taste sweet, slightly bitter and pungent.

Macroscopical (Fig. 1a) Lateral roots 0.3 to 1 cm in diameter, the upper portion thick and the lower portion thin, mostly twisted and exhibiting a few rootlet scars. Texture flexible, fracture yellowish white or yellowish brown; bark thick, showing some clefts and numerous brown-dotted secretory cavities; wood paler in colour, cambium ring yellowish brown.

Microscopical (Figs. 2a, 2b) Transverse section of the dried lateral root shows periderm, cortex, phloem, xylem, schizogenous oil cavities, longitudinal clefts, cambium, and pith. Periderm, 4 to 6 layers of thin-walled, rectangular cork cells. Cortex, narrow, with polygonal parenchyma cells, oil cavities and longitudinal clefts. Xylem, solitary or groups, 2 to 5, radially arranged, surrounded by small parenchyma; xylem rays 3 to 7 layers of cells. Phloem, broad, with polygonal parenchyma, oil cavities and longitudinal clefts. Cambium in a ring, several layers of small rectangular cells. Schizogenous oil cavities, abundant, scattered from phloem tissues to cortex, diameter increase from phloem tissues to outer part of cortex. Pith, distinct, several layers of parenchyma cells filled with starch grains.

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Fig. 1a *Angelica sinensis* (Oliv.) Diels
1. flowering and fruiting shoot 2. and 3. inflorescences 4. crude drug

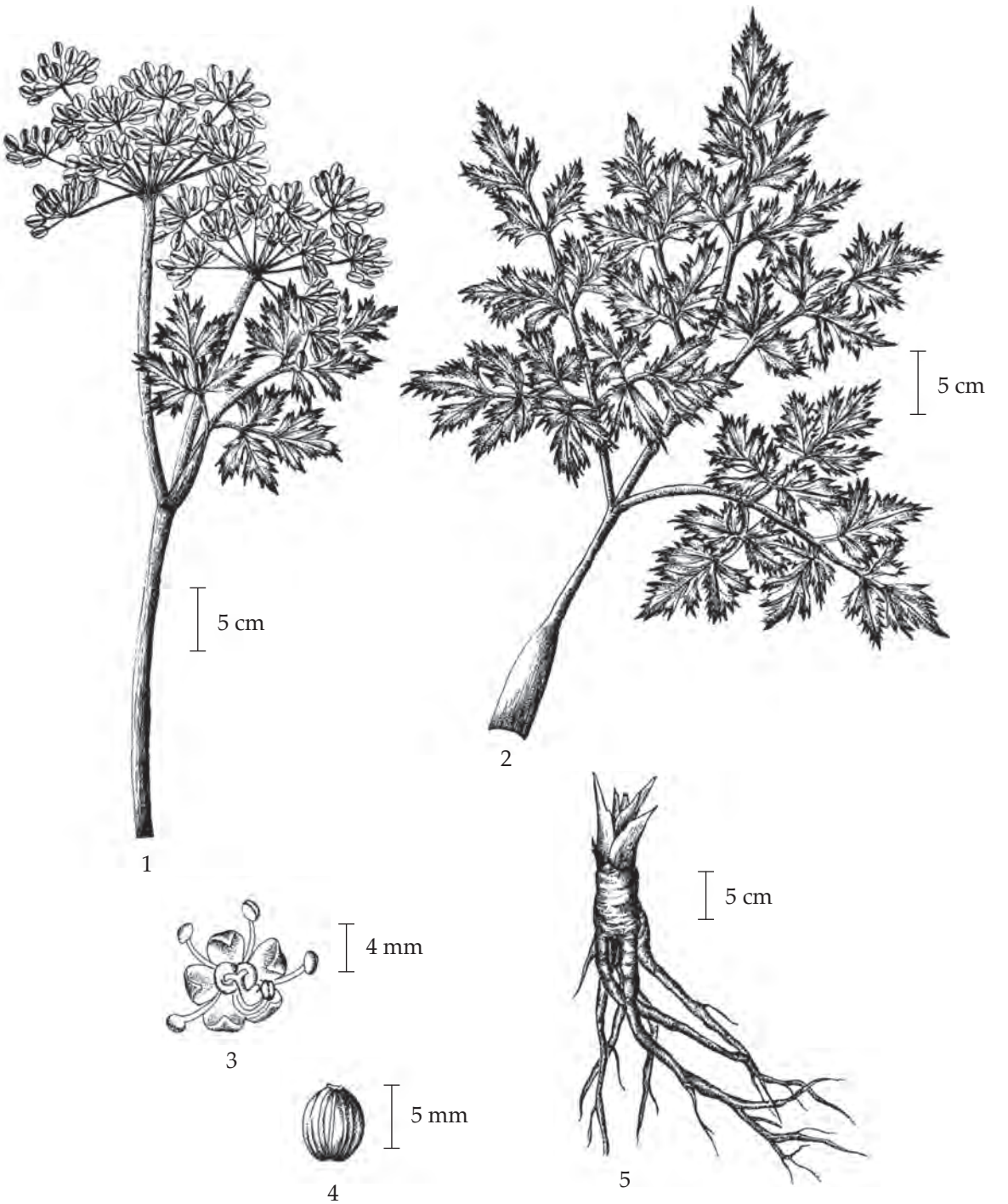

Fig. 1b *Angelica sinensis* (Oliv.) Diels
1. fruiting shoot 2. leaf 3. flower (top view) 4. schizocarp 5. root

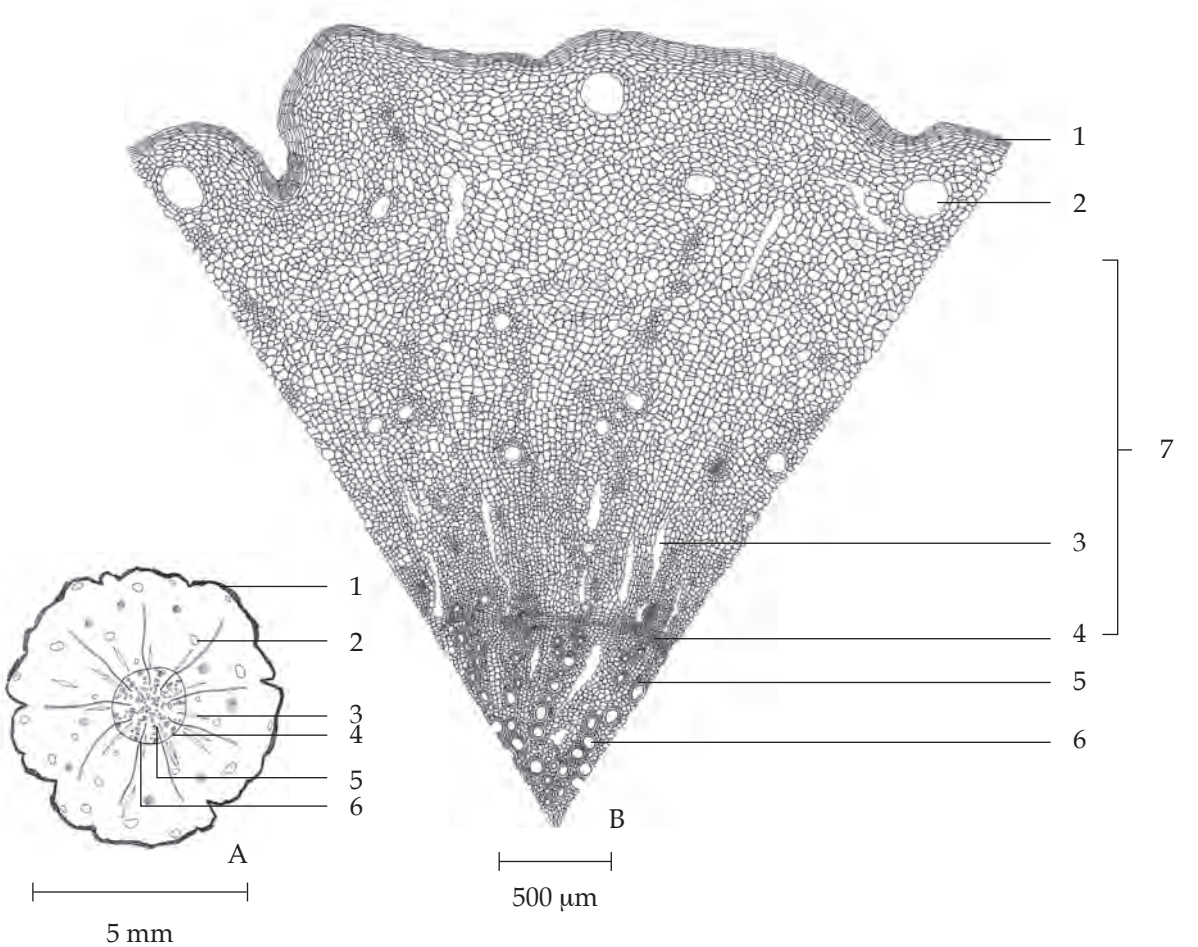

Fig. 2a Transverse Section of the Lateral Root of *Angelica sinensis* (Oliv.) Diels

A. Diagram

B. Part of Sectional View

1. cork
2. oil cavity
3. longitudinal cleft
4. cambium
5. xylem ray
6. vessel
7. phloem

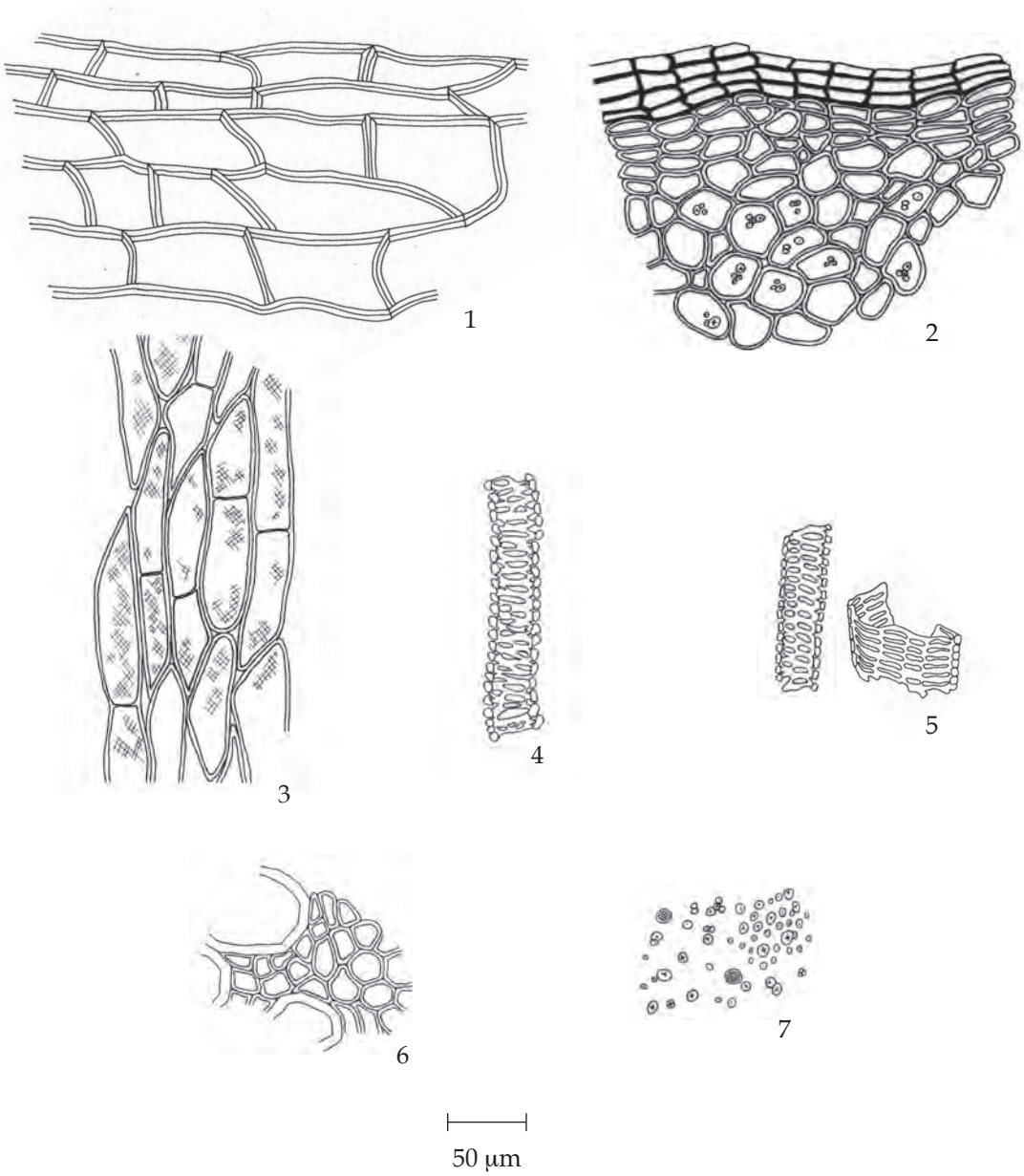

Fig. 2b Powdered Drug of the Lateral Roots of *Angelica sinensis* (Oliv.) Diels

1. cork in surface view
2. cork in sectional view associated with cortical parenchyma, some containing starch grains
3. fusiform-shaped parenchyma with very fine oblique criss-cross striations, some with septum
4. fragment of reticulate vessel
5. fragments of scalariform vessels
6. fragment of vessels in sectional view associated with parenchyma
7. starch grains

Chinese Angelica Lateral Root in powder possesses the diagnostic microscopical characters of the unground drug. Fusiform phloem parenchyma with slightly thick-walled, very fine oblique criss-cross striations and thin-walled septum is characteristic. Large and thin-walled cork, or cork associated with parenchyma, is frequently observed.

Contra-indication

1. It is contra-indicated in patients prior to surgery and in patients with diarrhea, hemorrhagic diseases or hypermenorrhoea.
2. It is contra-indicated in children and in pregnant and nursing women.

Warning

1. It may cause phototoxicity, i.e. eczema, burns.
2. Caution should be exercised when it is to be used concomitantly with anticoagulant drugs such as warfarin and antiplatelet drugs.

Additional information

1. Chinese angelica plant is not native to nor commercially cultivated in Thailand. The plant yielding chinese angelica lateral root is here referred to the herbarium specimen, collector's number Aug. Henry 7143, deposited at New York Botanical Garden, New York, the United States of America. The photographic illustration of the specimen can be seen at the Department of Medical Sciences Herbarium (DMSC), Nonthaburi, Thailand.
2. It is commonly used with other herbal drugs in Thai traditional herbal preparations.
3. It is recommended to keep in a refrigerator.

Packaging and storage Chinese Angelica Lateral Root shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Reflux 1 g of the sample, in powder, with 10 mL of *ethanol* for 30 minutes and filter (solution 1). To 2 mL of solution 1, add a few drops of *iron(III) chloride TS*: a green colour is produced.

B. Drop solution 1 on a filter paper and examine under ultraviolet light (366 nm): a blue fluorescence is produced.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 86 volumes of *toluene*, 14 volumes of *ethyl acetate* and 5 volumes of *formic acid* as the mobile phase. Apply separately to the plate as bands of 10 mm, 25 μL of solution (A) and 10 μL of solution (B). Prepare solution (A) by refluxing 1 g of the sample, in powder, with 10 mL of *dichloromethane* for 30 minutes and filtering. Evaporate the filtrate until dryness and dissolve the residue in 1 mL of *toluene*. For solution (B), dissolve 1 mg of *ferulic acid* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching bands. The chromatogram obtained from solution (A) shows a quenching band (hR_f value 31 to 38) corresponding to the ferulic acid band from solution (B). Other several quenching bands are also observed. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; the band corresponding to ferulic acid shows violet fluorescence. Other several fluorescent bands of different colours are also observed. Spray plate with *anisaldehyde TS* and heat at 105° for 10 minutes; the band corresponding to ferulic acid is violet. Other several bands of different colours also appear (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Dichloromethane Extract of the Lateral Roots of *Angelica sinensis* (Oliv.) Diels

Band	hR_f Value	Detection		
		UV 254	UV 366	*Anisaldehyde TS*
1	2–5	–	–	violet
2	5–9	–	–	green
3	7–13	–	–	violet
4	15–20	–	–	violet
5	26–32	–	violet	–
6	29–35	–	yellow	–
7*	31–38	quenching	violet	violet
8	39–46	quenching	violet	grey
9	52–58	weak quenching	light blue	green
10	57–63	–	–	violet
11	57–65	weak quenching	blue	–
12	64–71	weak quenching	intense blue	green
13	69–75	–	–	green
14	71–79	quenching	intense blue	yellow
15	79–82	quenching	–	–
16	89–95	quenching	–	dark green

*ferulic acid

Water Not more than 14.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 2.0 per cent w/w (Appendix 7.6).

Total ash Not more than 7.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 12.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 52.0 per cent w/w (Appendix 7.12).

Dose 6 to 12 g, as a decoction, a day.

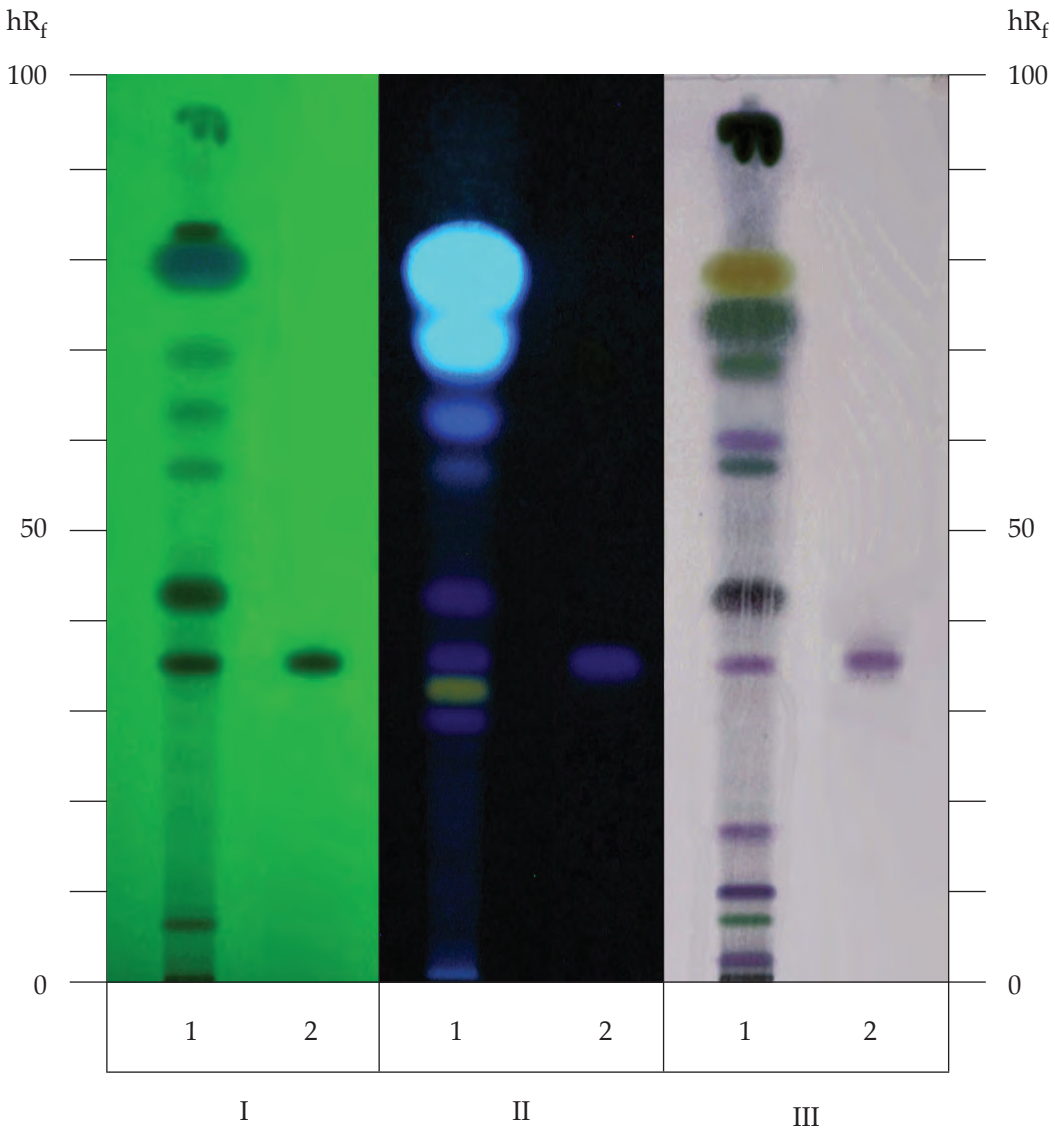

Fig. 3 Thin-Layer Chromatogram of Dichloromethane Extract of the Lateral Roots of *Angelica sinensis* (Oliv.) Diels

1 = solution (A)
2 = solution (B)
I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *anisaldehyde TS*

โกฐจุฬาลัมพา (KOT CHULA LAMPHA)

โกฐจุฬา (KOT CHULA), โกดจุฬาลัมพา (KOT CHULA LAMPHA)[1], โกฐจุฬาลัมพาจีน (KOT CHULA LAMPHA CHIN), ชิงเฮา (QINGHAO)
Artemisiae Annuae Herba
Sweet Wormwood Herb

Synonyms Annual Wormwood Herb, Chinese Wormwood Herb

Category Antipyretic.

Sweet Wormwood Herb is the dried aerial part of *Artemisia annua* L. (Family Compositae), Herbarium Specimen Number: see *Additional information 1*, Crude Drug Number: DMSc 1147.

(**Note** Sweet Wormwood Herb should be harvested during the blooming period.)

Constituents Sweet Wormwood Herb contains sesquiterpenoids (e.g., artemisinin, artemisinic acid, arteannuin B). It also contains volatile oil, flavonoids, coumarins, etc.

Description of the plant (Figs. 1a, 1b) Annual herb, 70 to 150 cm high, fragrant; stem furrowed, much branched, puberulous, soon glabrous. Leaves simple, spirally arranged, oblong or ovate in outline, 3- or 4- pinnatipartited, glandular-dotted; petioles of middle cauline leaves 1 to 2 cm long; radical leaves withering early; lowermost cauline leaves ovate or triangular-ovate, 3 to 7 cm long, 2 to 6 cm wide; segments 5 to 10 pairs; lobule deeply serrate; tooth triangular, 1 to 2 mm long, 0.5 mm wide; midvein prominent adaxially; rachis narrowly winged, sparsely serrate; middle cauline leaves 2- or 3-pinnati or pectinatisect; upper leaves and leafy bract 1- or 2- pinnatipartited. Inflorescences in broad pyramidal paniculate; capitula globose, numerous, 1 to 3 mm in diameter, nodding, shortly pedicellate; bract linear, oval-acuminate or oval; involucre globose, glabrous; phyllaries 2 to 3 seriate, the outer ones narrowly oblong, green, the inner elliptic or obovate, margin hyaline. Marginal florets pistillate, 10 to 18 minute; disc florets bisexual, 10 to 30, minute, dark yellow or yellow. Achene ellipsoid-ovoid, faintly nerved, glabrous.

Description Odour, characteristic and aromatic; taste, slightly bitter.

Macroscopical (Fig. 1a) Stems, vary in diameter and length, cylindrical, furrowed, greenish brown to brown; texture slightly hard, fracture medullated in the centre. Leaves, greenish brown to brown, rolled and crumpled, easily broken. Capitula abundant, 2 to 3 mm in diameter.

Microscopical (Figs. 2a, 2b, 2c, 2d, 2e) Transverse section of the fresh leaflet shows epidermis, mesophyll and vascular bundle. Epidermis, a layer of rectangular cells with glandular trichomes and slightly raised stomata, T-shape trichomes may be seen. Mesophyll, bifacial, 1 to 3 layers of palisade cells and thin-walled parenchyma cells in between. Vascular bundle, xylem in the upper part and phloem in the lower part.

Transverse section of the fresh stem illustrates epidermal layer, cortex, vascular tissue, and pith. Epidermal layer, rectangular cells, covered with cuticle layer. Cortex, few layers of angular collenchyma cells, groups of angular collenchyma cells and groups of cortical fibre cells in small ridges. Vascular tissue, narrow zone of phloem tissue, vascular cambium, large zone of xylem tissue, and 1 to 3 layers of medullar rays. Pith, numerous, polygonal parenchyma cells.

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[1]The two Thai names, โกฐจุฬาลัมพา and โกดจุฬาลัมพา, are spelled differently in Thai. However, both terms can be transcribed into the same English phonetic transcription “KOT CHULA LAMPHA”.

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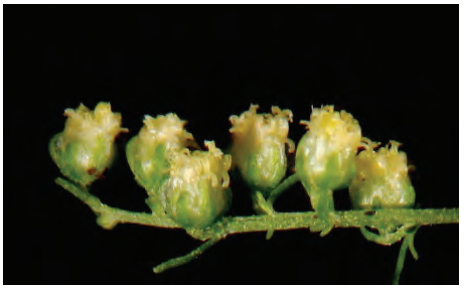

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Fig. 1a *Artemisia annua* L.
1. habit 2. part of leaf 3. and 4. part of flowering twig 5. capitulum 6. crude drug

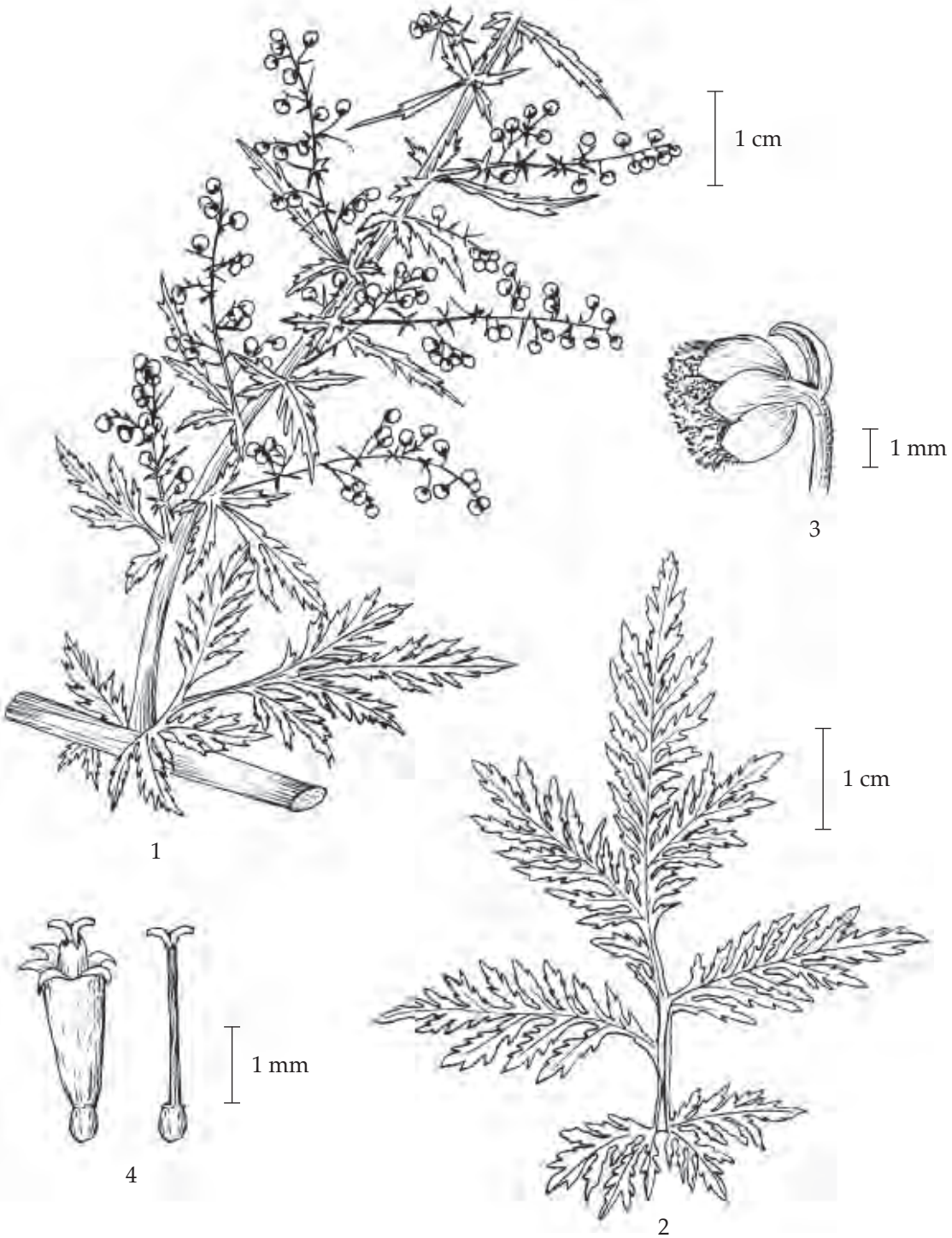
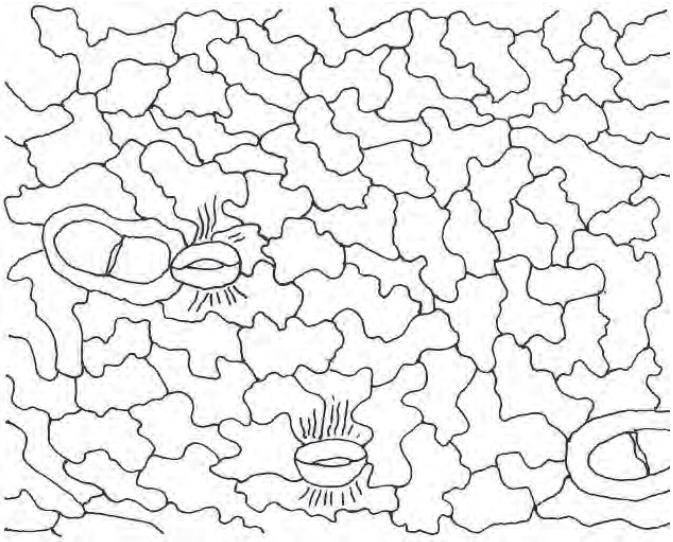


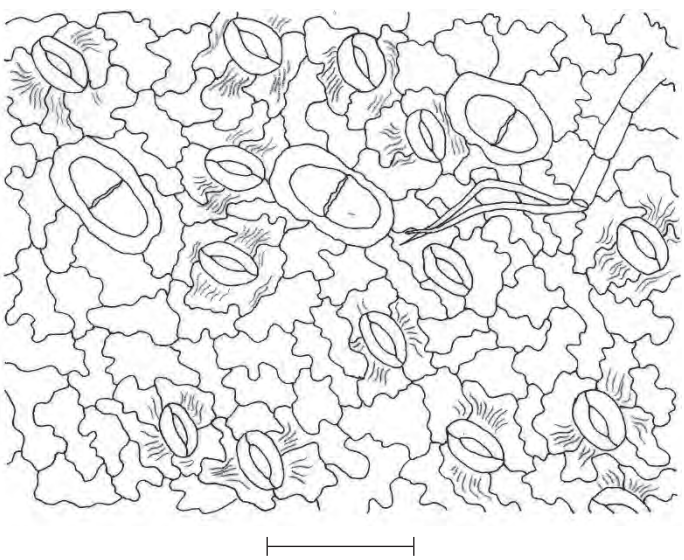
Fig. 1b *Artemisia annua* L.

1. flowering branch 2. part of leaf 3. capitulum 4. disc floret and pistil



50 μm

Upper Epidermis of the Lamina



50 μm

Lower Epidermis of the Lamina

Fig. 2a Epidermises of the Fresh Leaf of *Artemisia annua* L.

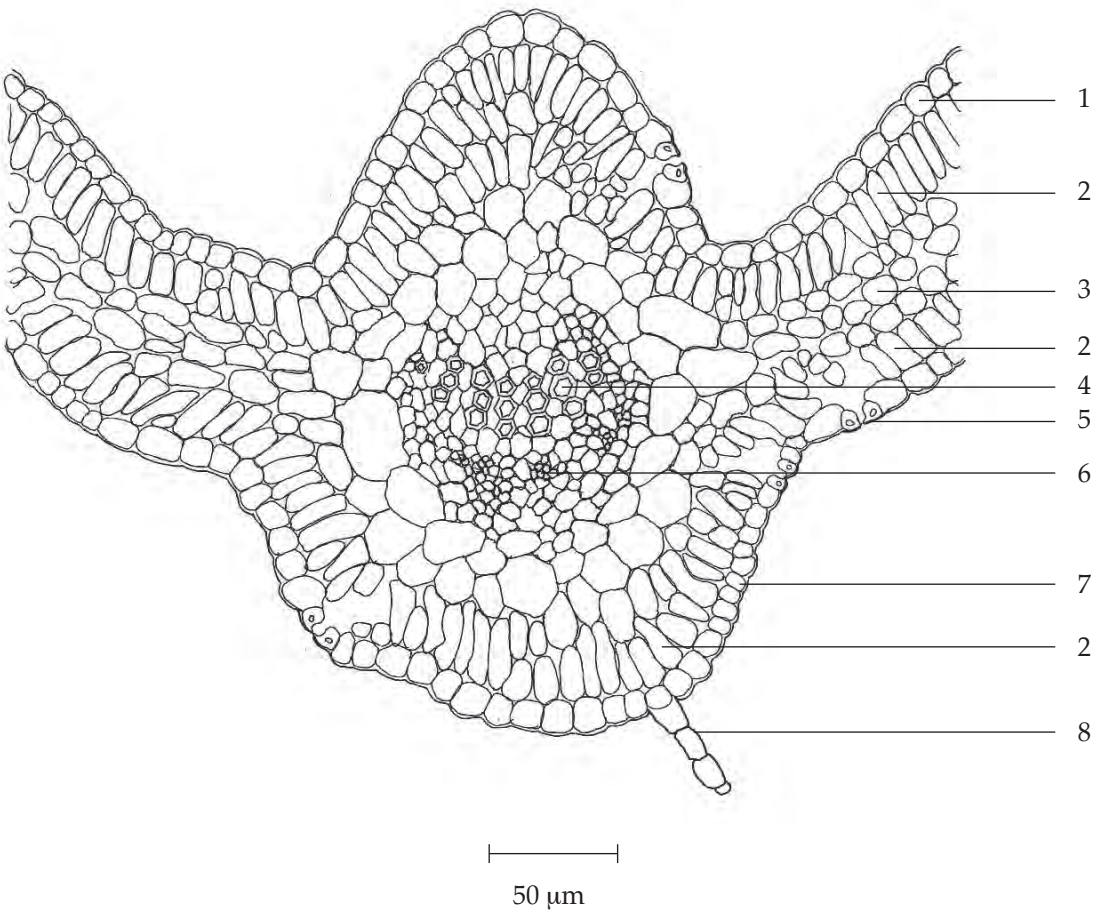


Fig. 2b Transverse Section of the Fresh Leaf of *Artemisia annua* L.

1. upper epidermis
2. palisade cell
3. parenchyma
4. vessel
5. slightly raised stoma
6. phloem cell
7. lower epidermis
8. stalk of T-shaped trichome

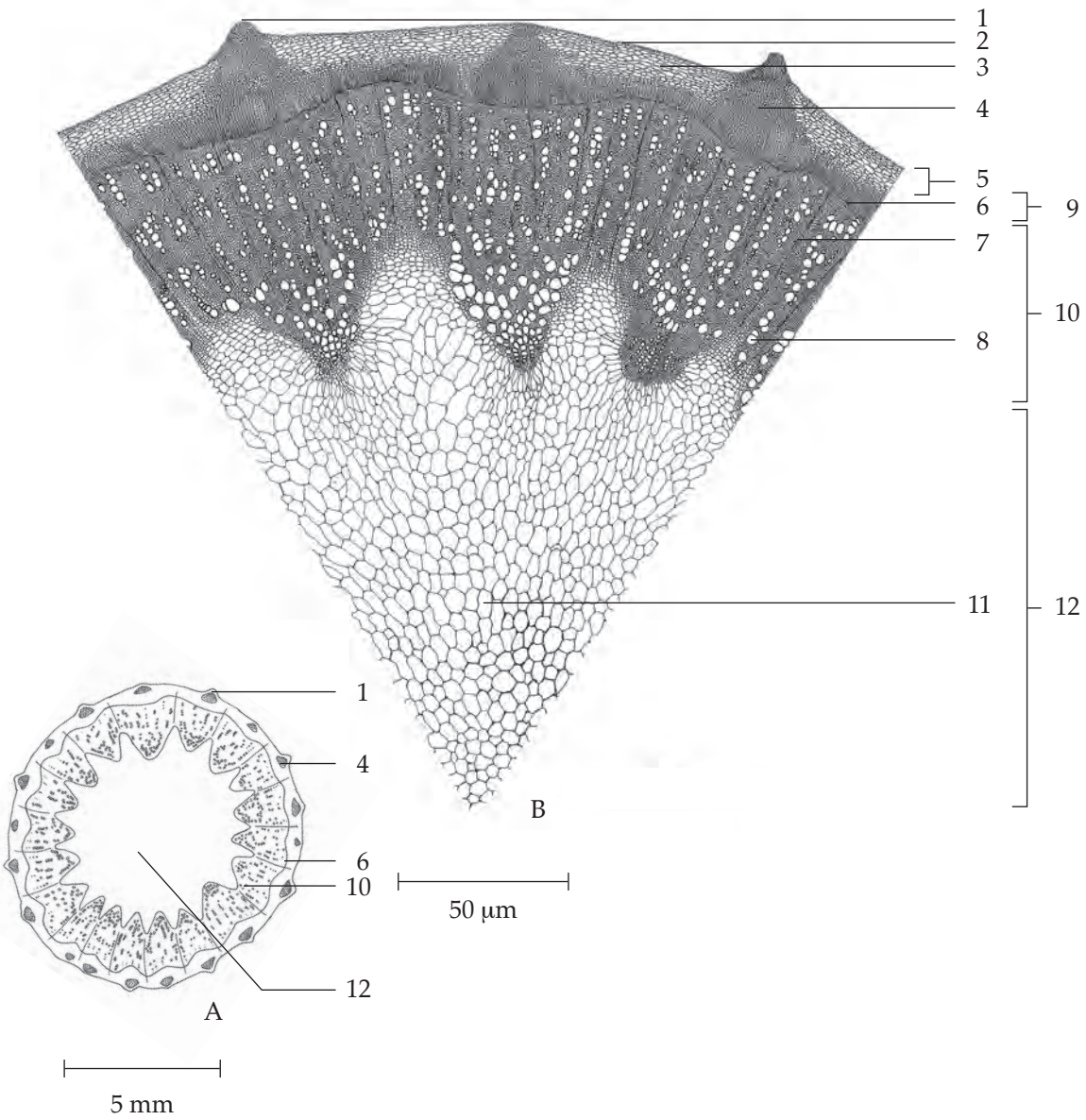


Fig. 2c Transverse Section of the Fresh Stem of *Artemisia annua* L.

A. Diagram
B. Part of Transverse Section

1. ridge
2. epidermis
3. angular collenchyma
4. cortical fibre
5. cortex
6. cambium
7. xylem ray
8. vessel
9. phloem tissue
10. xylem tissue
11. parenchyma
12. pith

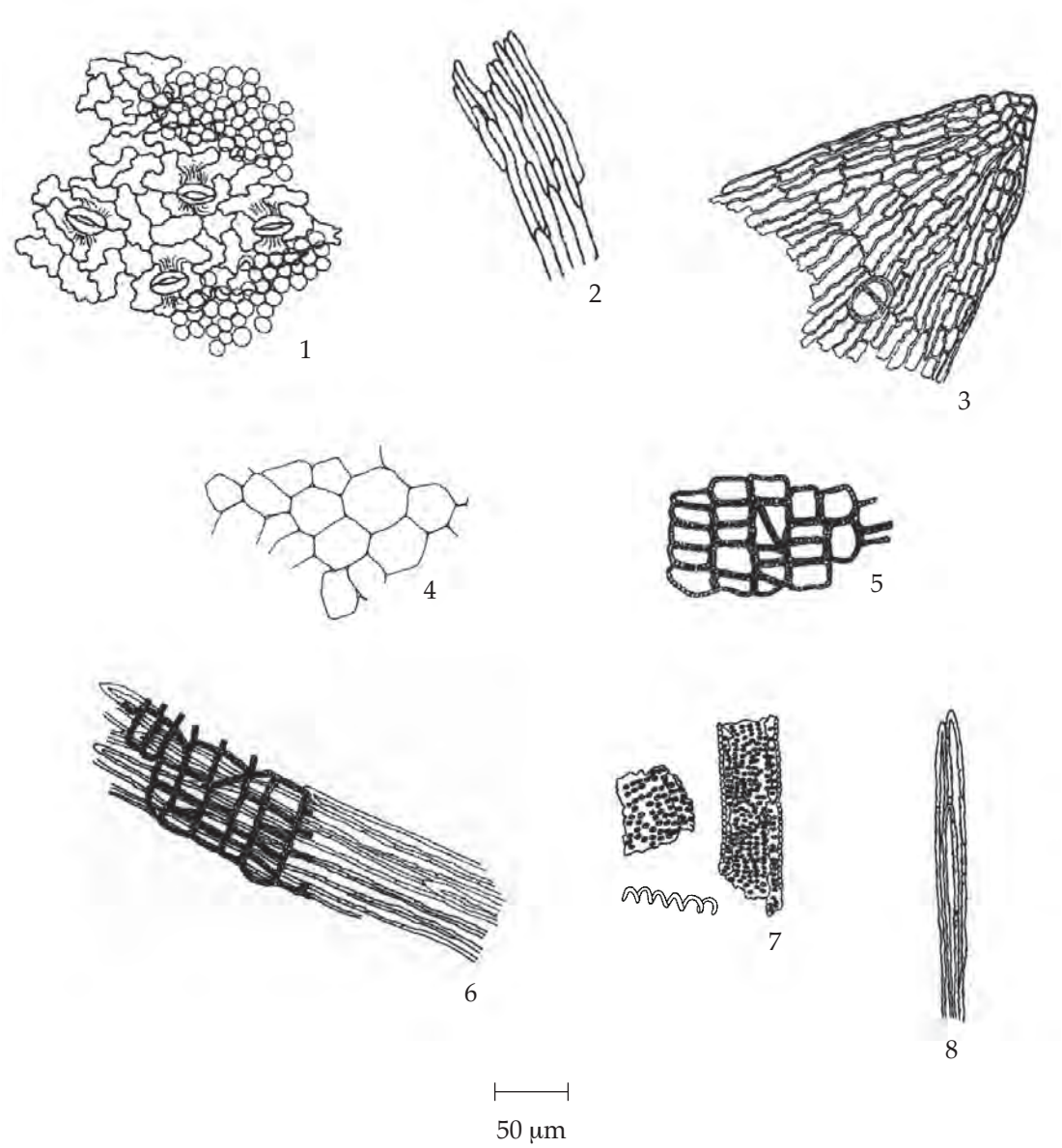


Fig. 2d Line Drawings of Powdered Drug of the Aerial Parts of *Artemisia annua* L.

1. epidermis with stomata and underlying palisade cells in surface view
2. epidermis of corolla in surface view
3. epidermis at apex of corolla showing glandular trichome in surface view
4. parenchyma
5. xylem parenchyma
6. fibres and xylem parenchyma in radial longitudinal view
7. fragment of bordered-pitted and spiral vessels
8. fibres

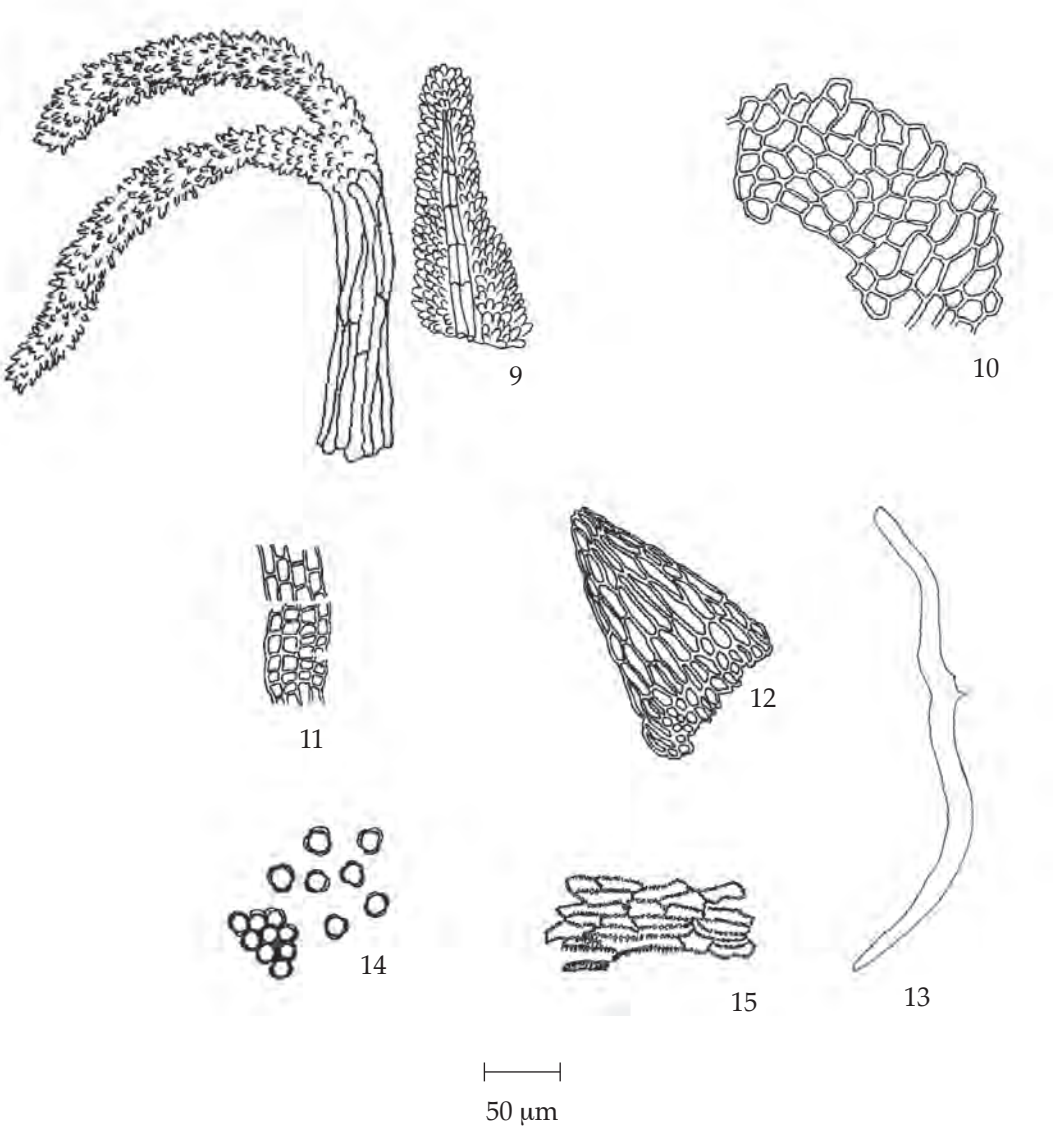


Fig. 2d Line Drawings of Powdered Drug of the Aerial Parts of *Artemisia annua* L. (continued)

9. papillosed stigma in surface view
10. ovary wall in surface view
11. filament of stamen in surface view
12. tip of anther lobe in surface view
13. part of T-shaped trichome
14. pollen grains
15. fibrous layer of anther sac in surface view

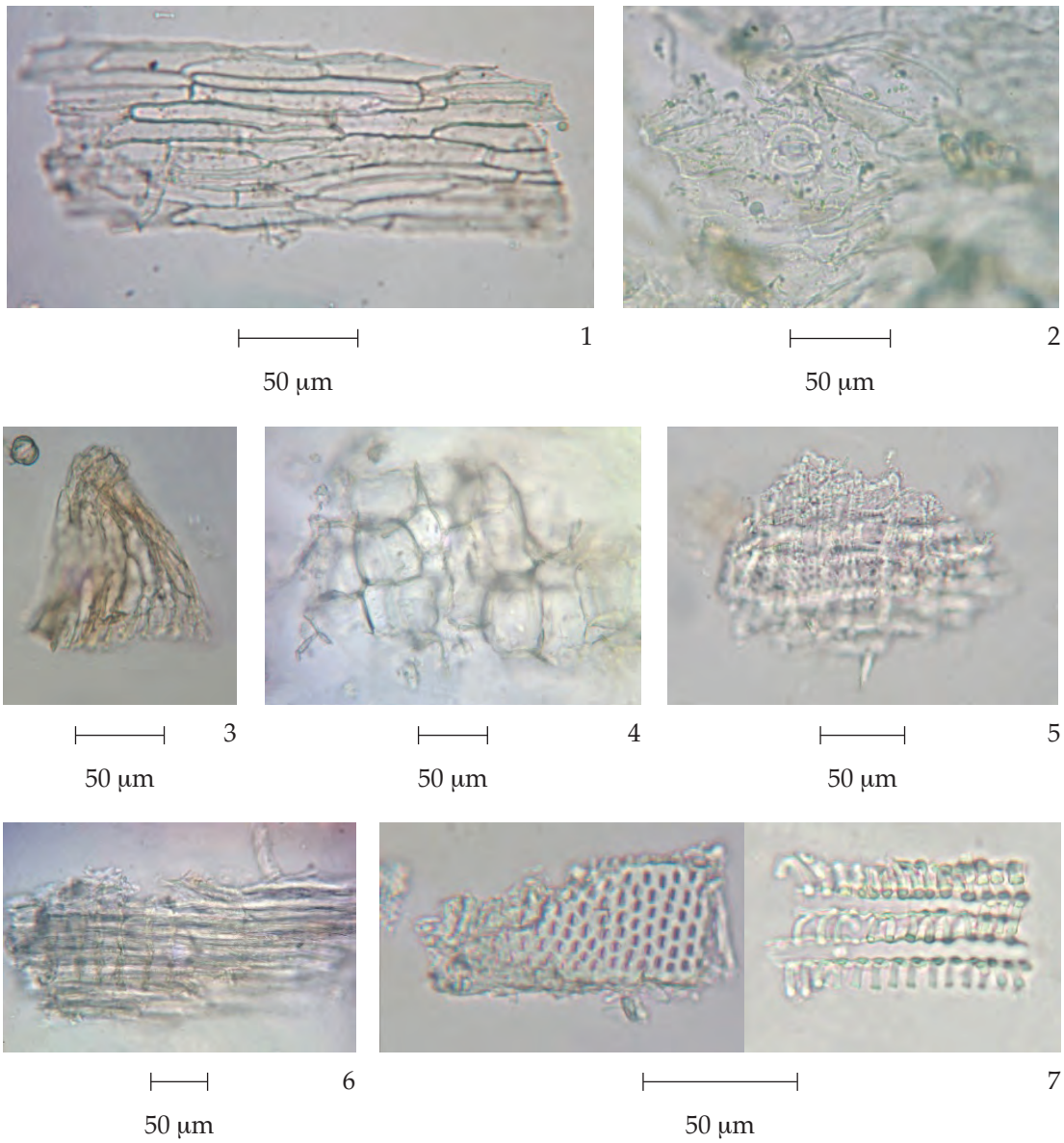


Fig. 2e Photomicrographs of Powdered Drug of the Aerial Parts of *Artemisia annua* L.

1. epidermis with stomata in surface view
2. epidermis of corolla in surface view
3. epidermis at apex of corolla in surface view
4. parenchyma
5. xylem parenchyma with underlying bordered-pitted vessels
6. fibres and xylem parenchyma in radial longitudinal view
7. bordered-pitted vessel and spiral vessels

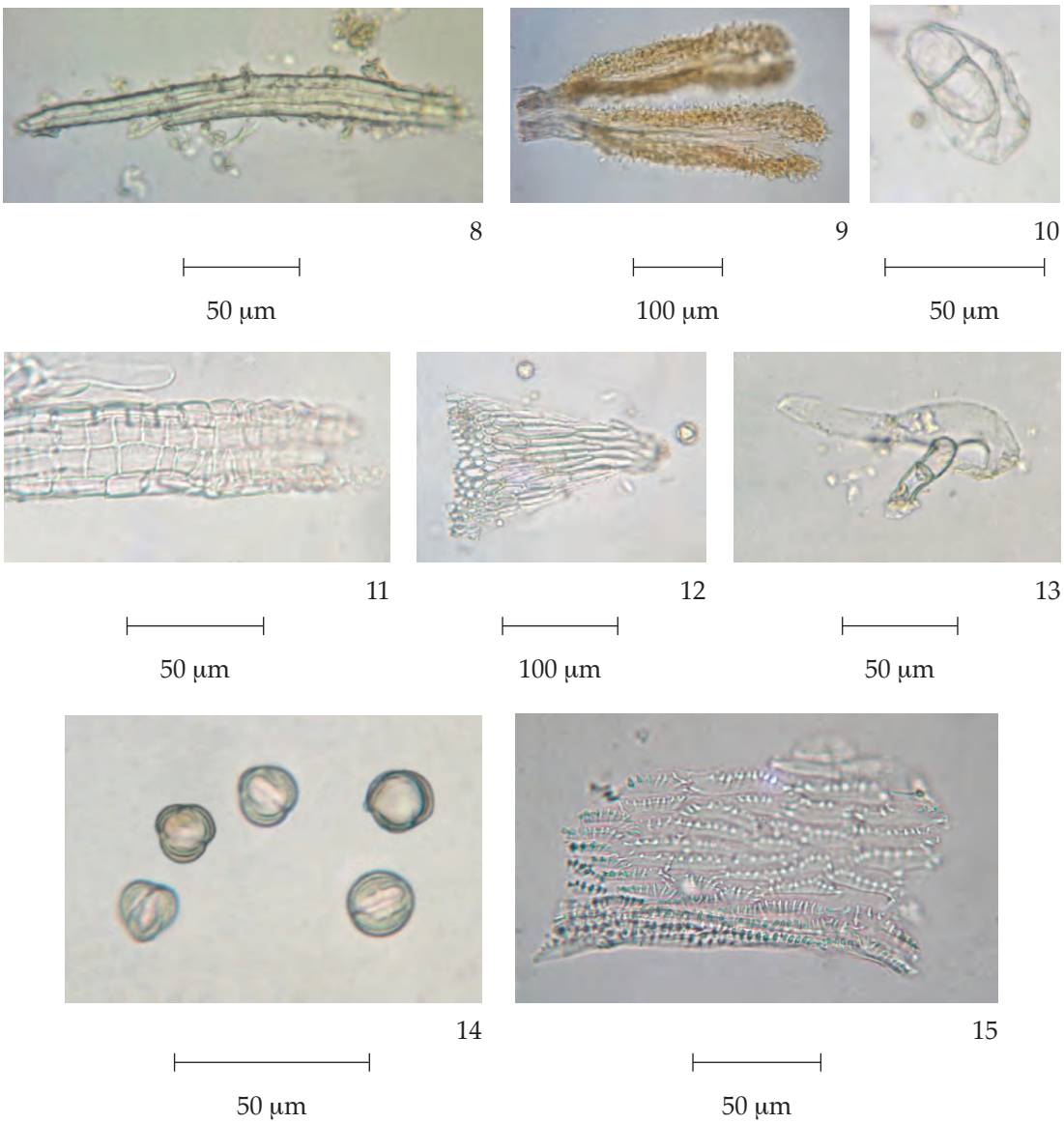


Fig. 2e Photomicrographs of Powdered Drug of the Aerial Parts of *Artemisia annua* L. (continued)

8. fibres
9. 2-branched papillosed stigmas in surface view
10. top view of 2-celled glandular trichome
11. filament in surface view
12. anther-lobed tip in surface view
13. T-shaped trichome
14. pollen grains
15. fibrous layer of anther sac in surface view

Sweet Wormwood Herb in powder possesses the diagnostic microscopical characters of the unground drug. Two-celled glandular trichomes, 2-branched papillosed stigmas, tip of anther lobes, and triporate pollen grains are characteristic. Typical T-shaped trichomes of leaves may be seen.

Warning It should be used with caution in pregnant women and in patients with frequent diarrhea.

Additional information

1. Sweet wormwood plant is not native to nor commercially cultivated in Thailand. The plant yielding sweet wormwood herb is here referred to the herbarium specimen number K000891904, collector's number A. Regel s.n., deposited at the Herbarium, Royal Botanic Gardens Kew (K), London, United Kingdom. The photographic illustration of the specimen can be seen at the Department of Medical Sciences Herbarium (DMSC), Nonthaburi, Thailand.
2. It is commonly used with other herbal drugs in Thai traditional herbal preparations.
3. In Thai traditional drugstores, *A. pallens* Wall. ex Besser may be found as "Kot Chula Lampha".

Packaging and storage Sweet Wormwood Herb shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Reflux 1 g of the sample, in powder, with 10 mL of *ethanol* for 30 minutes and filter (solution 1). Drop solution 1 on a filter paper and examine under ultraviolet light (366 nm): a blue fluorescence is produced.

B. To 2 mL of solution 1, add 1 or 2 pieces of *magnesium ribbon*, 2 drops of *hydrochloric acid* and warm in a water-bath for a few minutes: a reddish colour is produced.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 30 volumes of *petroleum ether* (*boiling range, 60° to 80°*) and 20 volumes of *ether* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply separately to the plate as bands of 10 mm, 5 μL each of the following two solutions. Prepare solution (A) by refluxing 3 g of the sample, in powder, with 50 mL of *petroleum ether (boiling range, 60° to 80°)* for 1 hour, filtering and evaporating the filtrate to dryness. Dissolve the residue in 30 mL of n-*hexane.* Extract with three 10-mL portions of a 20 per cent v/v solution of *acetonitrile* and evaporate the combined extract to dryness. Dissolve the residue in 0.5 mL of *ethanol*. For solution (B), dissolve 1 mg of *artemisinin* in 1 mL of *ethanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching bands. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; several fluorescent bands of different colours are observed. Spray the plate with a 10 per cent v/v solution of *sulfuric acid* in *ethanol,* heat at 105° for 10 minutes and examine under ultraviolet light (366 nm). The chromatogram obtained from solution (A) shows a yellow-green fluorescent band (hR_f value 34 to 38) corresponding to the artemisinin band from solution (B). Several other fluorescent bands of different colours are also observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in the Extract of the Aerial Parts of *Artemisia annua* L.

Band	hR_f Value	Detection		
		UV 254	UV 366	10 Per Cent V/V Solution of *Sulfuric Acid* in *Ethanol* and UV 366
1	5–7	blue	intense blue	intense blue
2	10–13	quenching	–	–
3	17–20	quenching	–	–
4	21–25	–	yellow	–
5	28–32	–	blue	blue
6*	34–38	–	–	yellow-green
7	44–48	–	yellow	yellow
8	75–79	–	yellow	–

*artemisinin

Water Not more than 11.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Total ash Not more than 7.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 2.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 6.0 per cent w/w (Appendix 7.12).

Dose 3 to 12 g, as a decoction, a day.

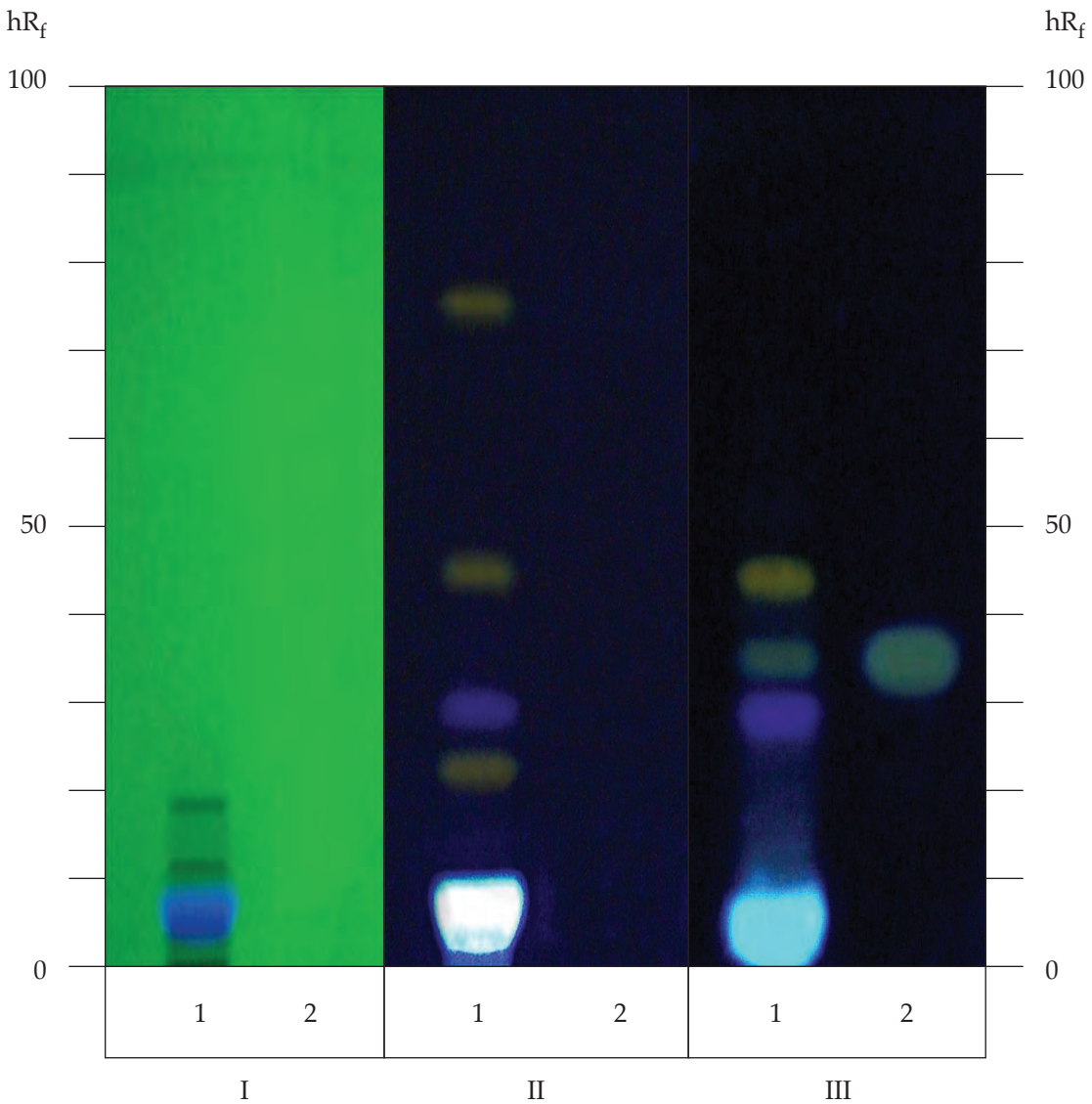


Fig. 3 Thin-Layer Chromatogram of the Extract of the Aerial Parts of *Artemisia annua* L.

1 = solution (A)
2 = solution (B)
I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection under UV light (366 nm) after spraying with a 10 per cent v/v solution of *sulfuric acid* in *ethanol*

โกฐหัวบัว (KOT HUA BUA)

โกฐหัวบัวน้อย (KOT HUA BUA NOI), โกฐหัวบัวใหญ่ (KOT HUA BUA YAI)
Chuanxiong Rhizoma
Sichuan Lovage Rhizome

Synonyms Szechuan Lovage Rhizome, Szechwan Lovage Rhizome

Category Carminative, blood tonic for menstrual disorder.

Sichuan Lovage Rhizome is the dried rhizome of *Ligusticum sinense* Oliv. cv. *Chuanxiong* (*Ligusticum chuanxiong* Hort.) (Family Umbelliferae), Herbarium Specimen Number: see *Additional information 1*, Crude Drug Number: DMSc 1148.

Constituents Sichuan Lovage Rhizome contains alkylphthalides (e.g., Z-ligustilide, senkyunolides). It also contains coniferyl ferulate, ferulic acid, levislolide A, volatile oil, etc.

Description of the plant (Figs. 1a, 1b) Perennial herb, 30 to 100 cm high; rhizome thick, apparently swollen at nodes, internodes short; stem erect, striate and branching. Leaves alternate, bipinnate or tripinnate; petioles sheathing at base, clasping the stem; basal one 10 to 20 cm long; blade triangular-ovate in outline, 15 to 20 cm long, 10 to 15 cm wide, ternate to 1- or 2-pinnated, primary pinnae 4 to 6 pairs, proximal pinnae remote, ultimate segments ovate or oblong-ovate, 2 to 3 cm long, 1 to 2 cm wide, margin irregularly serrate, glabrous on both surfaces except for the nerves; cauline leaves similar to basal, reduced, sessile, 1-pinnated. Inflorescence compound umbel, terminal and axillary, 6 to 8 cm across when anthesis; bracts 5 to 6(–10); rays 15 to 30, subequal, 3 to 5 cm; bracteoles 5 to 8, linear, shorter than pedicels, reflexed. Flowers small, white; calyx teeth obsolete; petals obovate, base cuneate; styles reflexed. Fruits schizocarp, oblong-ovoid, 2 to 3 mm long, 1.5 to 2 mm wide; dorsal and intermediate ribs prominent, filiform; lateral ribs narrowly winged; vittae 1 to 3(–4) in each furrow, 4 to 6 on commissure. Seeds smooth.

Description Odour, strongly aromatic; taste, bitter, pungent and slightly numb, and with a sweet aftertaste.

Macroscopical (Fig. 1a) Irregularly knotty, subround and fist-like, 2 to 7 cm in diameter. Externally yellowish brown, greyish brown to blackish brown, rough and shrunken, dented scars or short remains of stems on the apex; numerous tuberculous rootlet scars on the lower part and at the nodes. Texture compact, uneasily broken, fracture yellowish white or greyish brown, scattered with yellowish brown oil dots.

Microscopical (Figs. 2a, 2b) Transverse section of the rhizome shows periderm, cortex, cambium, phloem, xylem, and pith. Periderm, over 10 layers of narrow rectangular cork. Cortex, numerous polygonal parenchyma cells containing simple and compound starch grains. Phloem, broad layers of polygonal parenchyma cells containing starch grains. Cambium, undulate rings of cambium cells. Pith, broad zone of slightly large polygonal parenchyma cells. Schizogenous oil canals, scattered in cortex, phloem, xylem, and pith.

Sichuan Lovage Rhizome in powder possesses the diagnostic microscopical characters of the unground drug. Dentate fibres, thick-walled parenchyma cells and numerous starch grains are characteristic.

Fig. 1a *Ligusticum sinense* Oliv. cv. *Chuanxiong*
1. and 2. habit 3. plant showing swollen nodes 4. leaves 5. inflorescence 6. crude drug

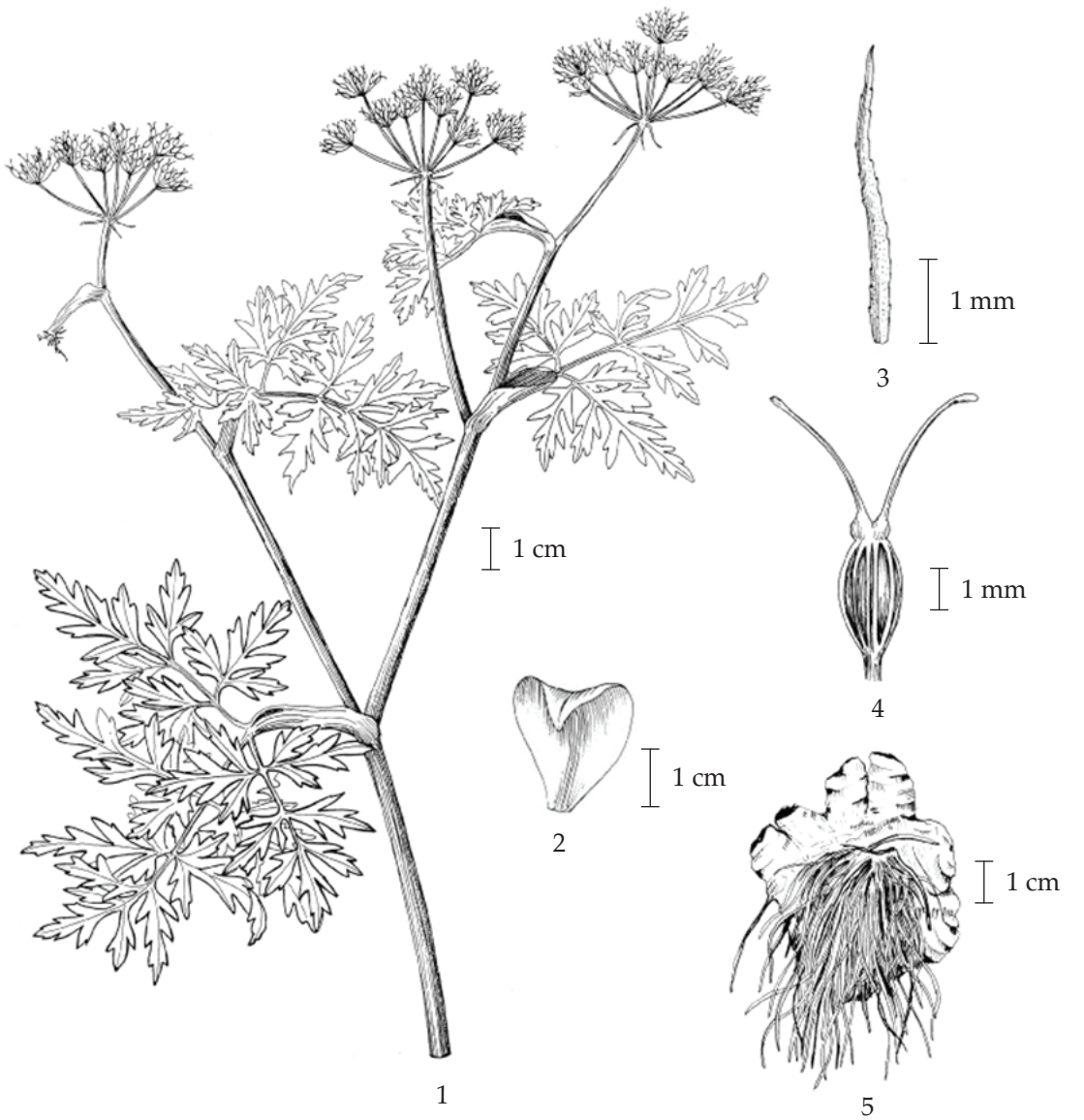


Fig. 1b *Ligusticum sinense* Oliv. cv. *Chuanxiong*
1. flowering branch 2. bract 3. bracteole 4. fruit 5. rhizome and roots

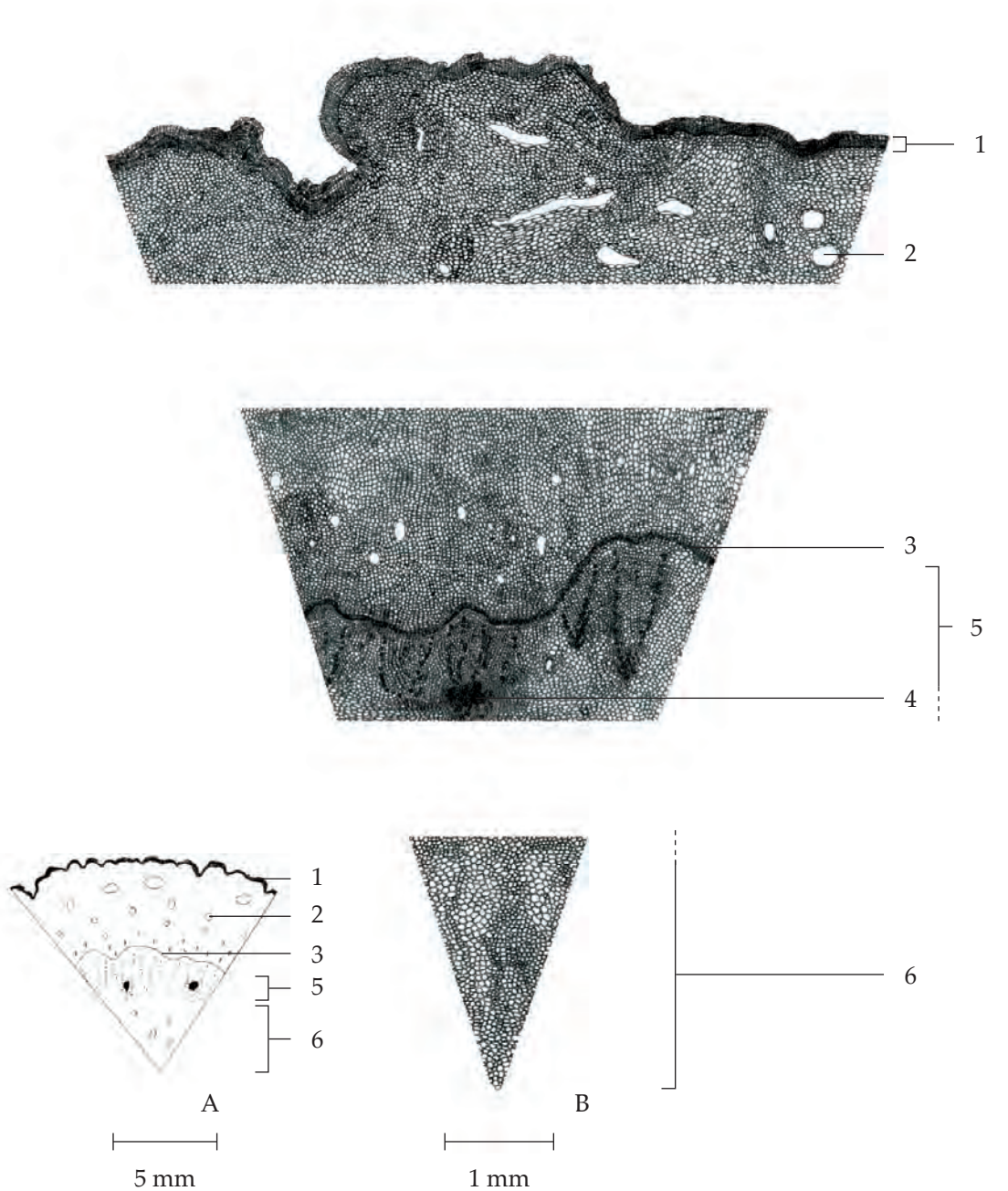


Fig. 2a Transverse Section of the Rhizome of *Ligusticum sinense* Oliv. cv. *Chuanxiong*

A. Diagram
B. Parts of Transverse Section

1. periderm
2. oil canal
3. cambium
4. fibre
5. xylem
6. pith

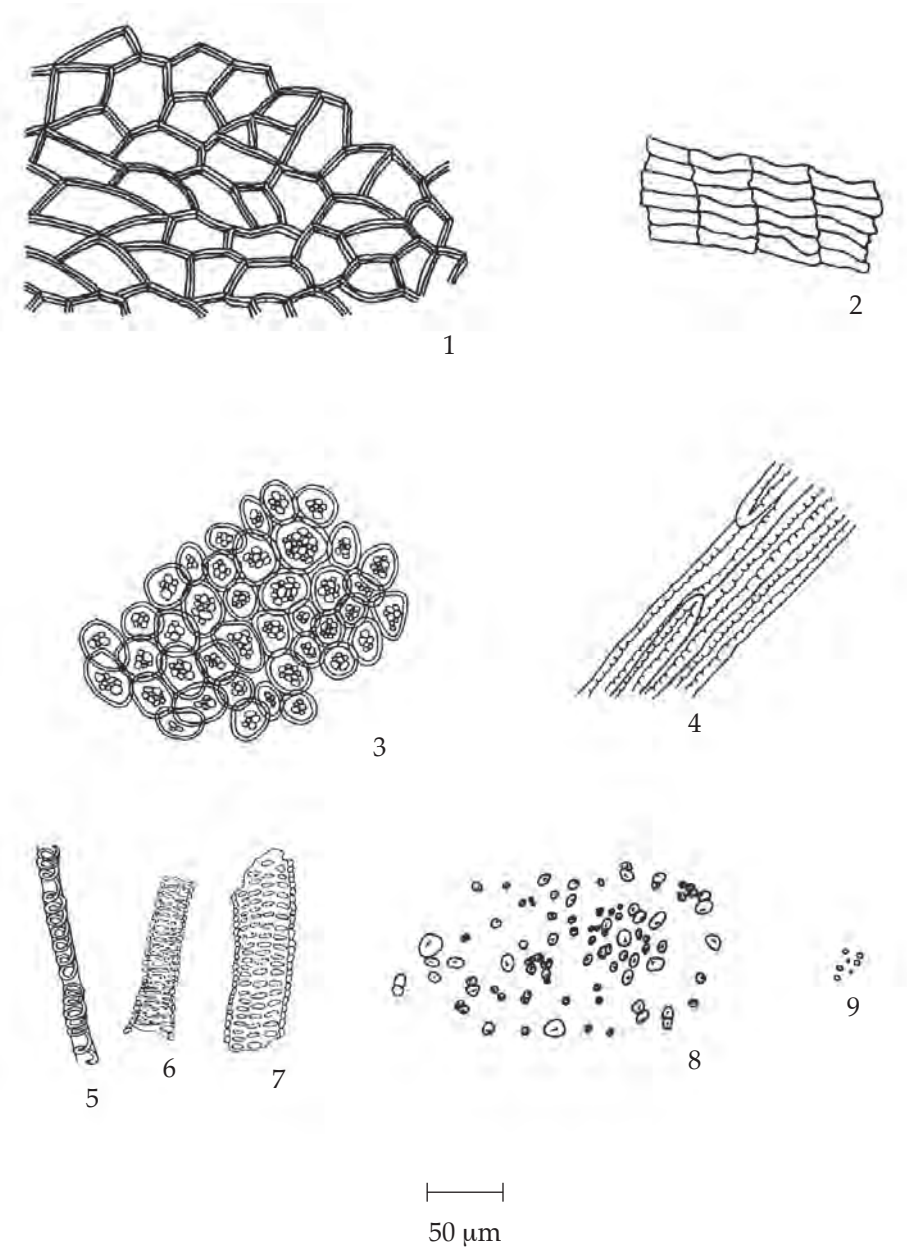


Fig. 2b Powdered Drug of the Rhizomes of *Ligusticum sinense* Oliv. cv. *Chuanxiong*

1. cork in surface view
2. cork in sectional view
3. thick-walled parenchyma cells containing starch grains
4. dentate fibres
5. spiral vessel
6. reticulate vessel
7. scalariform vessel
8. starch grains
9. oil droplets

Contra-indication It is contra-indicated in pregnant women with vaginal bleeding.

Warning Overdosage may cause vomiting and dizziness.

Additional information

1. Sichuan lovage plant is not native to nor commercially cultivated in Thailand. The plant yielding sichuan lovage rhizome is here referred to the herbarium specimen, collector's number Aug. Henry 66139A, deposited at the Institute of Botany (PE), Chinese Academy of Sciences, Beijing, People's Republic of China. The photographic illustration of the specimen can be seen at the Department of Medical Sciences Herbarium (DMSC), Nonthaburi, Thailand.
2. It is commonly used with other herbal drugs in Thai traditional herbal preparations.

Packaging and storage Sichuan Lovage Rhizome shall be kept in well-closed containers, protected from light, and stored in a cool and dry place.

Identification

A. Reflux 1 g of the sample, in powder, with 10 mL of *ethanol* for 30 minutes and filter (solution 1). To 2 mL of solution 1, add a few drops of *iron(III) chloride TS*: a green colour is produced.

B. Drop solution 1 on a filter paper and examine the filter paper under ultraviolet light (366 nm): a blue fluorescence is produced.

C. Macerate 1 g of the sample, in powder, in 5 mL of *petroleum ether (boiling range, 60° to 80°)* and allow to stand overnight. Evaporate 1 mL of the supernatant to dryness and dissolve the residue in 1 mL of *methanol*. Add 2 or 3 drops of a 2 per cent w/v solution of *3,5-dinitrobenzsoic acid* in *methanol* and 2 drops of a saturated solution of *potassium hydroxide* in *methanol*: a purple colour is produced.

D. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 86 volumes of *toluene*, 14 volumes of *ethyl acetate* and 5 volumes of *formic acid* as the mobile phase. Apply separately to the plate as bands of 10 mm, 20 μL of solution (A) and 10 μL of solution (B). Prepare solution (A) by refluxing 1 g of the sample, in powder, with 10 mL of *dichloromethane* for 30 minutes and filtering. Evaporate the filtrate until dryness and dissolve the residue in 1 mL of *toluene*. For solution (B), dissolve 1 mg of *ferulic acid* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air, and examine under ultraviolet light (254 nm), marking the quenching bands. The chromatogram obtained from solution (A) shows a quenching band (hR_f value 31 to 38) corresponding to the ferulic acid band from solution (B). Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; the band due to ferulic acid shows a violet fluorescence. Other several fluorescent bands of different colours are also observed. Spray the plate with *anisaldehyde TS* and heat at 105° for 10 minutes; the band corresponding to ferulic acid is violet. Other several bands of different colours are also observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Dichloromethane Extract of the Rhizomes of *Ligusticum sinense* Oliv. cv. *Chuanxiong*

Band	hR_f Value	Detection		
		UV 254	UV 366	*Anisaldehyde TS*
1	2–5	–	–	violet
2	5–9	quenching	–	green
3	7–13	–	–	violet
4	9–16	–	–	pink
5	11–18	quenching	–	green
6	15–20	–	–	violet
7	16–21	–	blue	–
8	26–32	–	violet	–
9	29–35	–	yellow	–
10*	31–38	quenching	violet	violet
11	39–46	quenching	violet	grey
12	52–58	–	blue	green
13	57–65	quenching	blue	–
14	64–71	quenching	blue	green
15	70–76	–	–	green
16	71–79	blue	intense blue	yellow
17	79–86	quenching	–	–
18	89–95	quenching	–	green

*ferulic acid

Water Not more than 12.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 2.0 per cent w/w (Appendix 7.6).

Total ash Not more than 6.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 18.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 35.0 per cent w/w (Appendix 7.12).

Dose 3 to 9 g, as a decoction, a day.

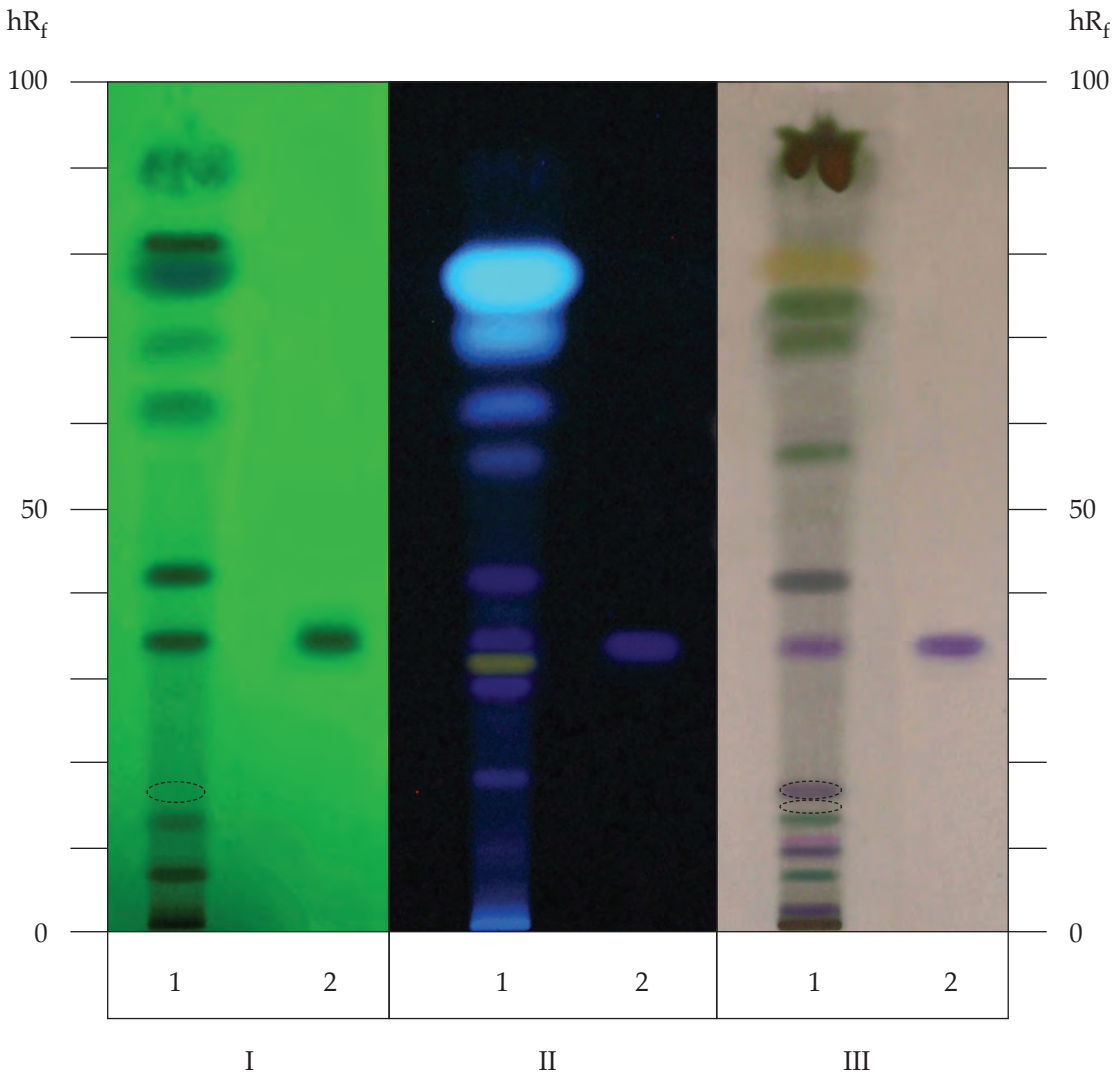


Fig. 3 Thin-Layer Chromatogram of Dichloromethane Extract of the Rhizomes of *Ligusticum sinense* Oliv. cv. *Chuanxiong*

1 = solution (A)
2 = solution (B)
I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *anisaldehyde TS*
⬭ = bands developed in some samples

โกฐก้านพร้าว (KOT KAN PHRAO)

โกฐก้านมะพร้าว (KOT KAN MAPHRAO), โกดก้านพร้าว (KOT KAN PHRAO)
Neopicrorhizae Scrophulariiflorae Rhizoma
Figwortflower Picrorhiza Rhizome

Synonyms Katuka, Kutki

Category Antipyretic, stomachic.

Figwortflower Picrorhiza Rhizome is the dried rhizome of *Neopicrorhiza scrophulariiflora* (Pennell) Hong (*Picrorhiza scrophulariiflora* Pennell) (Family Plantaginaceae), Herbarium Specimen Number: see *Additional information 1*, Crude Drug Number: DMSc 0936.

Constituents Figwortflower Picrorhiza Rhizome contains iridoid glycosides (e.g., kutkoside, picrosides, picrorosides) and cucurbitacin triterpenoids. It also contains apocynin, cinnamic acid, vanillic acid, etc.

Description of the plant (Figs. 1a, 1b) Perennial herb 4 to 30 cm high; rhizome elongated, 15 to 25 cm long, about 1 cm in diameter, giving rise to stems and roots; root stout. Leaves simple, spiral, basal leaves fasciculate, spathulate or narrowly elliptic, 5 to 15 cm long, upper leaves spathulate, 5 to 10 cm long, apex obtuse, base attenuate, margin serrate, leathery, black when dry. Inflorescence spike, terminal; scape semi-cylindrical, 5 to 15 cm long, naked or with few bracts below the inflorescence; bract elliptic or lanceolate, about half of the length of the sepal. Flowers numerous, pale blue to dark purple, hirsute; calyx nearly equally 5-partite; corolla 8 to 10 mm long, bilabiate, upper lip 1-lobed, hooked, emarginate, lower lip 3-lobed, about half the length of the upper lip; stamens 4, more or less equalling corolla, exerted from corolla tube, anther divergent; ovary superior, 2-loculed, ovules numerous per locule, style 1, stigma capitate. Fruit capsule, septicidally dehiscent, ellipsoid or ovoid, about 1 cm long, turgid, tapered at top. Seeds numerous, about 1 mm long.

Description Odour, characteristic; taste, extremely bitter.

Macroscopical (Fig. 1a) Dried rhizome, cylindrical, 2.5 to 12 cm long, about 1 cm wide, easily broken, externally greyish brown, rough, irregularly wrinkled, sometimes bearing roots, or circular root scars and bud scales. Broken, surface black, surrounding with white vascular bundle.

Microscopical (Figs. 2a, 2b) Transverse section of the rhizome shows periderm, cortex, vascular tissue, and pith. Periderm, several layers of cork cells and some of which in the outer layer cracked. Cortex, broad zone of thin-walled polygonal parenchyma with scattered groups of fibres. Vascular tissue, secondary phloem, xylem and broad zone of medullary ray. Pith, numerous thin-walled polygonal parenchyma.

Figwortflower Picrorhiza Rhizome in powder possesses the diagnostic microscopical characters of the unground drug. Parenchyma with dark brown substance and beaded-wall parenchyma are characteristic.

1

2

1 cm

Fig. 1a *Neopicrorhiza scrophulariiflora* (Pennell) Hong
1. habit 2. crude drug

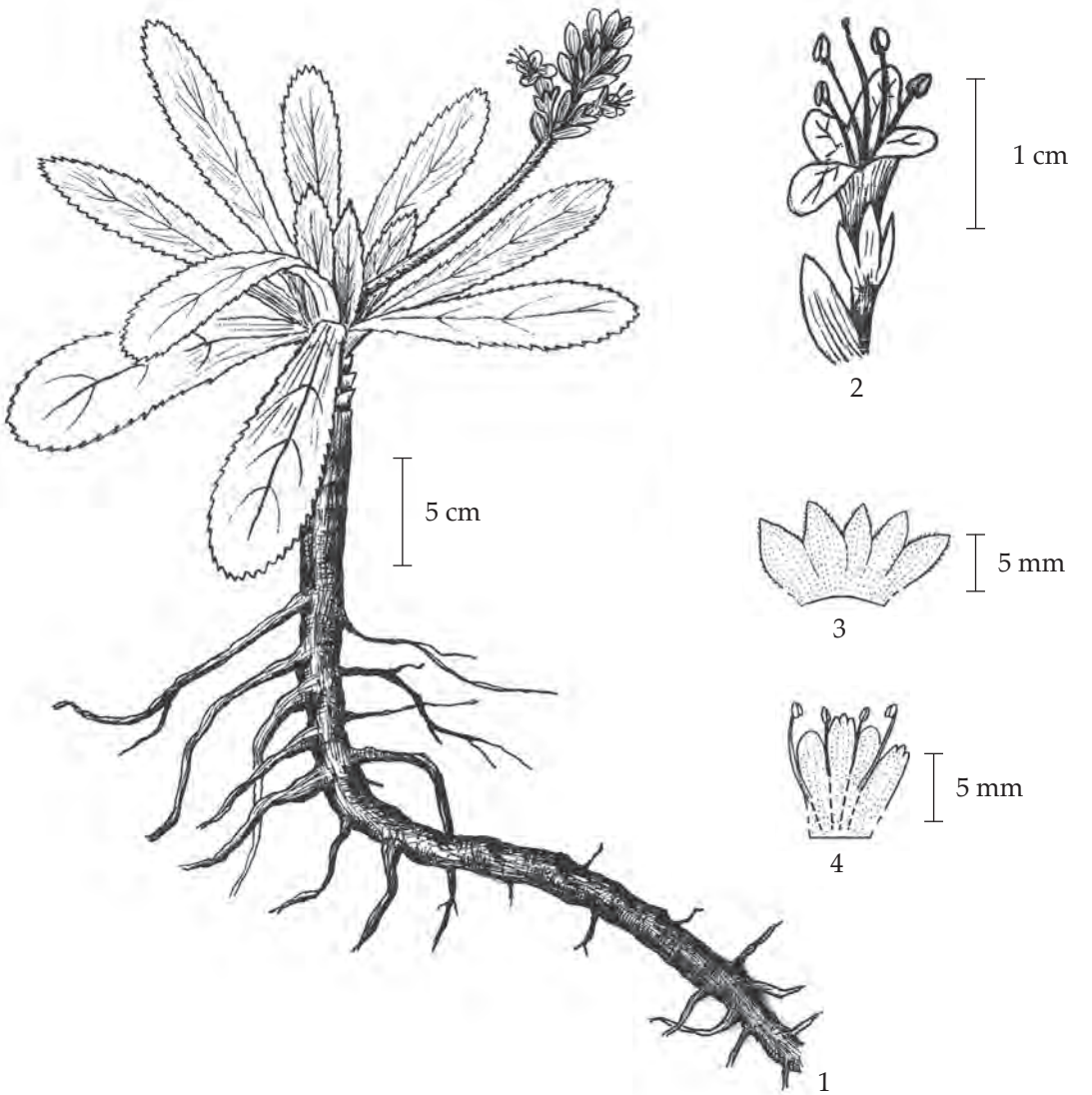


Fig. 1b *Neopicrorhiza scrophulariiflora* (Pennell) Hong
1. habit 2. blooming flower 3. opened calyx 4. opened corolla

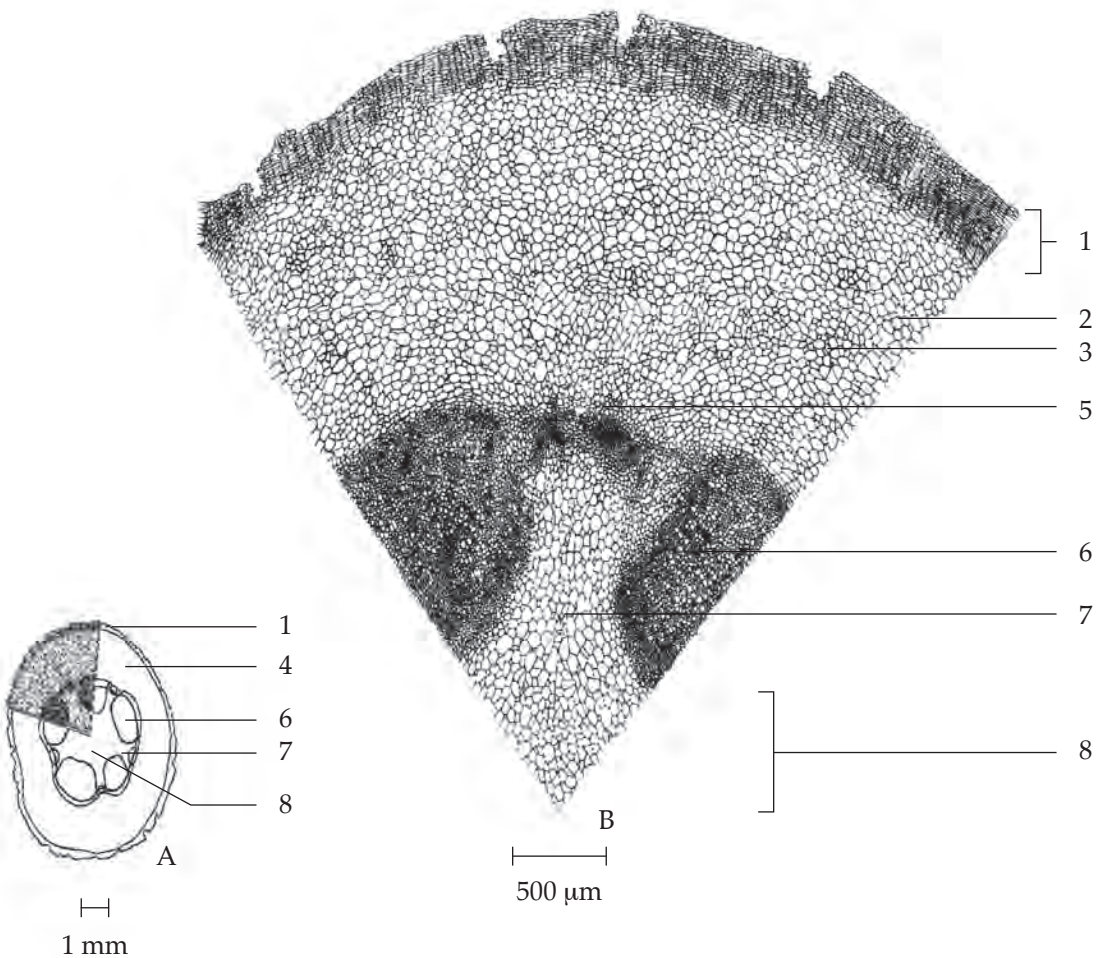


Fig. 2a Transverse Section of the Rhizome of *Neopicrorhiza scrophulariiflora* (Pennell) Hong

A. Diagram
B. Part of Transverse Section

1. periderm
2. parenchyma
3. group of fibres
4. cortex
5. phloem
6. xylem
7. medullary ray
8. pith

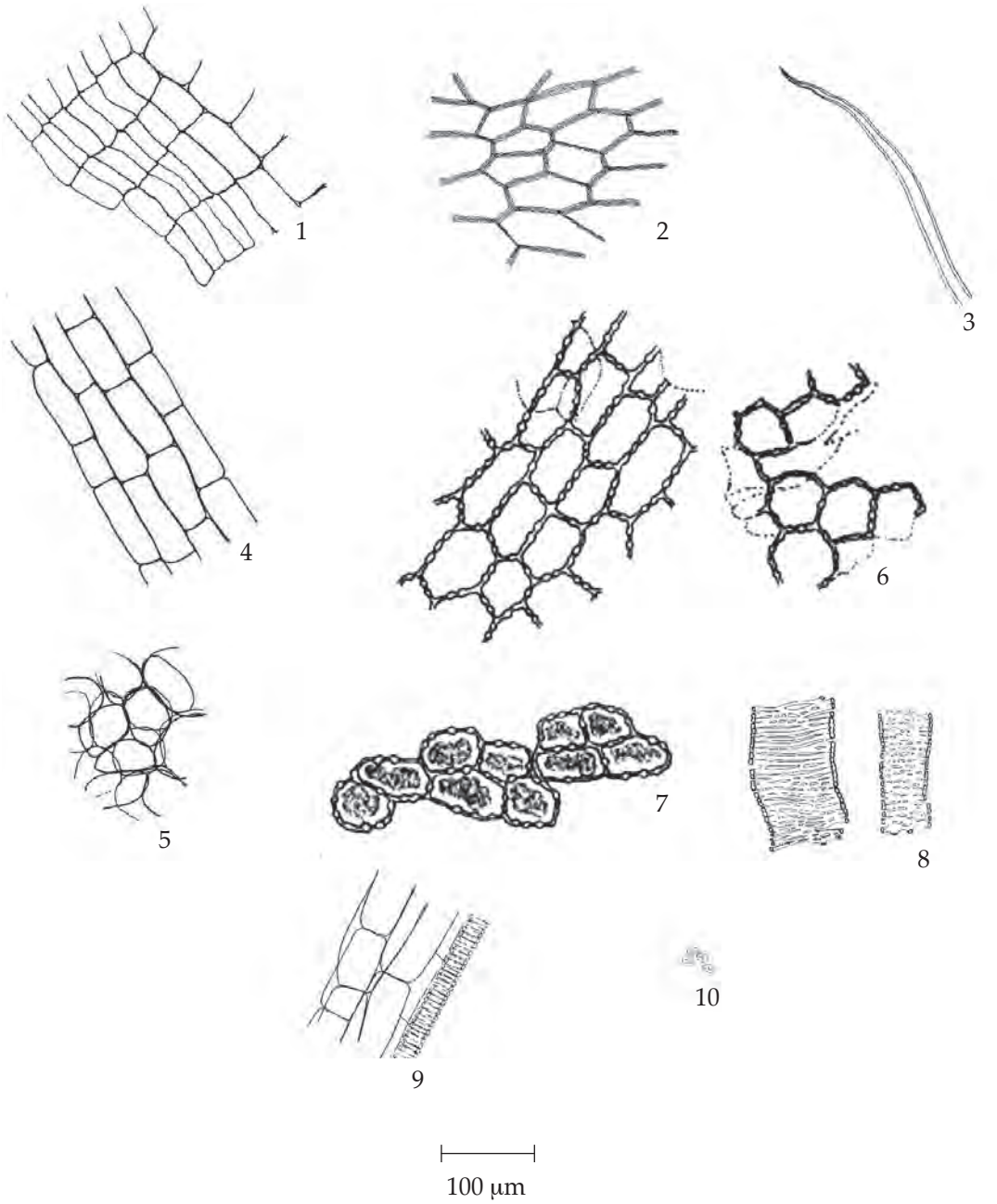


Fig. 2b Powdered Drug of the Rhizomes of *Neopicrorhiza scrophulariiflora* (Pennell) Hong

1. cork cells in sectional view
2. cork cells in surface view
3. fibre
4. parenchyma in longitudinal view
5. parenchyma in sectional view
6. beaded-wall parenchyma
7. beaded-wall parenchyma containing dark brown substance
8. reticulate and pitted vessels
9. parenchyma with attached vessel
10. starch grains

Additional information

1. Figwortflower picrorhiza plant is not native to nor commercially cultivated in Thailand. The plant yielding figwortflower picrorhiza rhizome is here referred to the herbarium specimen number 01434339 (PE), deposited at the Institute of Botany (PE), Chinese Academy of Sciences, Beijing, People's Republic of China. The photographic illustration of the specimen can be seen at the Department of Medical Sciences Herbarium (DMSC), Nonthaburi, Thailand.
2. It is commonly used with other herbal drugs in Thai traditional herbal preparations.

Packaging and storage Figwortflower Picrorhiza Rhizome shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Heat 500 mg of the sample, in powder, with 10 mL of *water* in a water-bath for 10 minutes, allow to cool and filter. To 2 drops of the filtrate, add a few drops of a 1 per cent w/v solution of *iron(III) chloride*: a dark green colour is produced.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 50 volumes of *chloroform*, 30 volumes of *ethyl acetate*, 20 volumes of *methanol* and 1 volume of *strong ammonia solution* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply to the plate, 5 μL of the test solution prepared by refluxing 1 g of the sample, in powder, in 25 mL of *methanol* for 30 minutes, filtering and evaporating the filtrate to dryness. Dissolve the residue in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. Examine the plate under ultraviolet light (366 nm) through the cut-off filter. Several blue fluorescent spots are observed. Spray the plate with *anisaldehyde TS* and heat at 110° for 10 minutes. Several spots of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Rhizomes of *Neopicrorhiza scrophulariiflora* (Pennell) Hong

Spot	hR_f Value	Detection		
		UV 254	UV 366	*Anisaldehyde TS*
1	4–10	quenching	blue	brown
2	20–27	quenching	intense blue	brown
3	29–34	quenching	–	brown
4	35–41	quenching	blue	violet
5	45–49	–	–	pale brown
6	47–51	quenching	intense blue	–
7	60–64	quenching	–	–
8	67–71	–	–	pale violet
9	76–79	–	blue	pale violet
10	83–87	–	–	pale violet

Loss on drying Not more than 11.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 2.0 per cent w/w (Appendix 7.6).

Total ash Not more than 5.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 30.0 per cent w/w (Appendix 7.12).

Dose 1 to 3 g of the powdered drug a day.

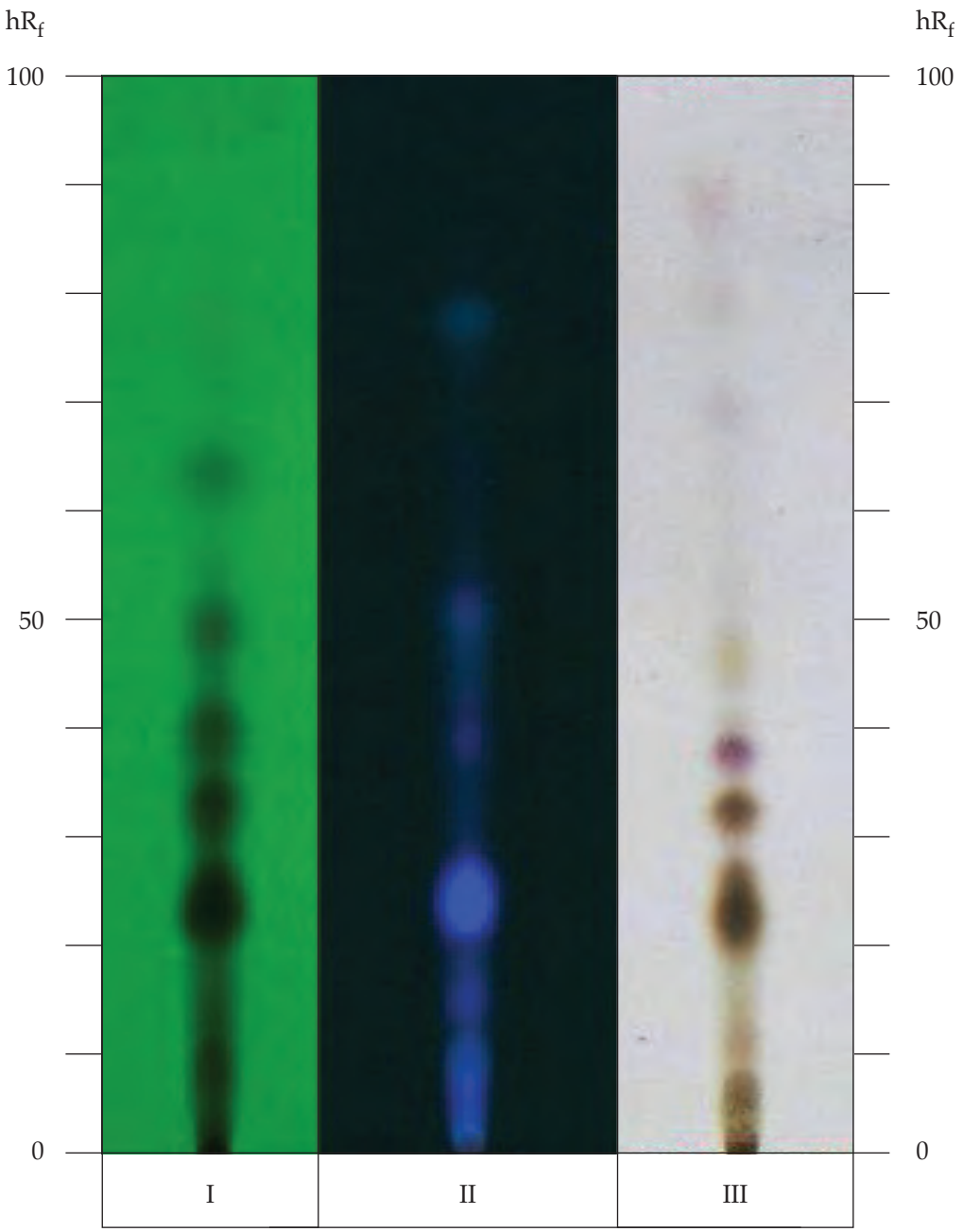


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Rhizomes of *Neopicrorhiza scrophulariiflora* (Pennell) Hong

I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *anisaldehyde TS*

โกฐเขมา (KOT KHAMAO)

โกฐหอม (KOT HOM)
Atractylodis Lanceae Rhizoma
Atractylodes Lancea Rhizome

Synonym Swordlike Atractylodes Rhizome

Category Stomachic.

Atractylodes Lancea Rhizome is the dried rhizome of *Atractylodes lancea* (Thunb.) DC. (*A. chinensis* (Bunge) Koidz.) (Family Compositae), Herbarium Specimen Number: see *Additional information 1*, Crude Drug Number: DMSc 1149.

Constituents Atractylodes Lancea Rhizome contains volatile oil, of which atractylodin and β-eudesmol are its major components. It also contains sesquiterpenoids (e.g., atractylenolides), triterpenoids, sterols, etc.

Description of the plant (Figs. 1a, 1b) Perennial herb, (15–)30 to 100 cm high; rhizome thick, prostrate or ascending, with numerous adventitious roots of even thickness; stem solitary or fascicled, unbranched or apically few-branched, sparsely arachnoid or glabrous. Leaves simple, alternate, green, concolorous, rigidly papery, glabrous, margin spiniform ciliate or spinosely toothed; basal leaves withered at anthesis; lower leaves subsessile to petiolate; petiole to 3.5 cm long; leaf blade 8 to 12 cm long, 5 to 8 cm wide, 3- to 5(–9)-pinnatifid or -binnatipartite, sometimes entire, lateral lobes elliptic, narrowly elliptic, or obovate-elliptic, terminal lobe orbicular, obovate, obliquely ovate, ovate, or elliptic; middle leaves with petiole 0.5 to 2.5 cm long, leaf blade obovate, narrowly obovate, obovate-elliptic, narrowly elliptic, or oblanceolate, base cuneate-attenuate, margin entire or basally sometimes with 1 or 2 triangular and spinose teeth; upper leaves sometimes triangular, with 1 or 2 spinose teeth; leaves subtending inflorescence pinnatipartite to pinnatisect. Capitula 1 to several, in terminal corymb; involucre campanulate, 1 to 1.5 cm in diameter; phyllaries 5 to 7 rows, margin sparsely arachnoid, apex rounded to obtuse, outer and outermost ones ovate to ovate-lanceolate, 3 to 6 mm long, 1.5 to 3 mm wide, middle ones ovate, ovate-elliptic, or elliptic, 6 to 10 mm long, 3 to 4 mm wide, inner ones elliptic to linear, 1.1 to 1.2 cm long, 0.2 to 0.3 mm wide, apically sometimes turning red; marginal florets pistillate; disc florets bisexual, corolla white, slightly tinged with purple, basal tube 9 mm long. Achene obovoid; pappus brown to dirty-white, 7 to 8 mm long.

Description Odour, characteristic; taste, sweetish, pungent and bitter.

Macroscopical (Fig. 1a) Irregularly moniliform or nodular-cylindrical, somewhat curved, occasionally branched, 3 to 10 cm long, 1 to 2 cm in diameter. Externally greyish brown, wrinkled, transversely twisted-lined, with remains of rootlets, and stem scars or remains of stems attached at apex. Texture compact, fracture yellowish white or greyish white, scattered with many orange-yellow or brownish red oil cavities and crystallized out as white fine needle crystals after exposing for a long time.

Microscopical (Figs. 2a, 2b) Transverse section of the rhizome shows periderm, cortex, phloem, xylem and pith. Periderm, several rows of rectangular corks cells and thick-walled sclereids. Cortex, narrow zone of parenchyma cells and cracked cavities. Phloem composed of phloem parenchyma cells, phloem rays and cracked cavities. Xylem comprised vessels,

1

2

3

4

5 mm

Fig. 1a *Atractylodes lancea* (Thunb.) DC.
1. habit 2. and 3. flowering branches 4. crude drug

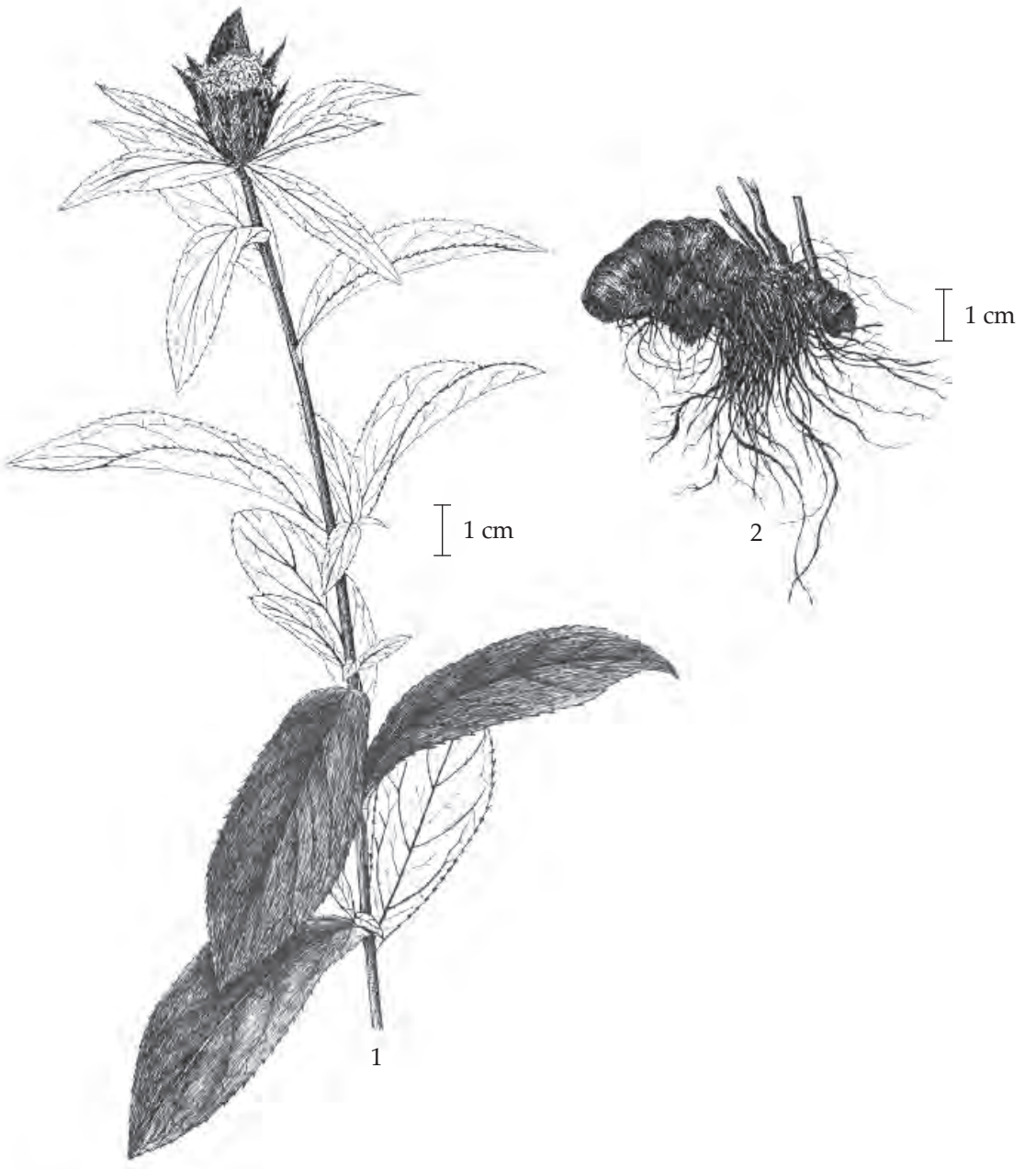


Fig. 1b *Atractylodes lancea* (Thunb.) DC.
1. flowering branch 2. rhizome and roots

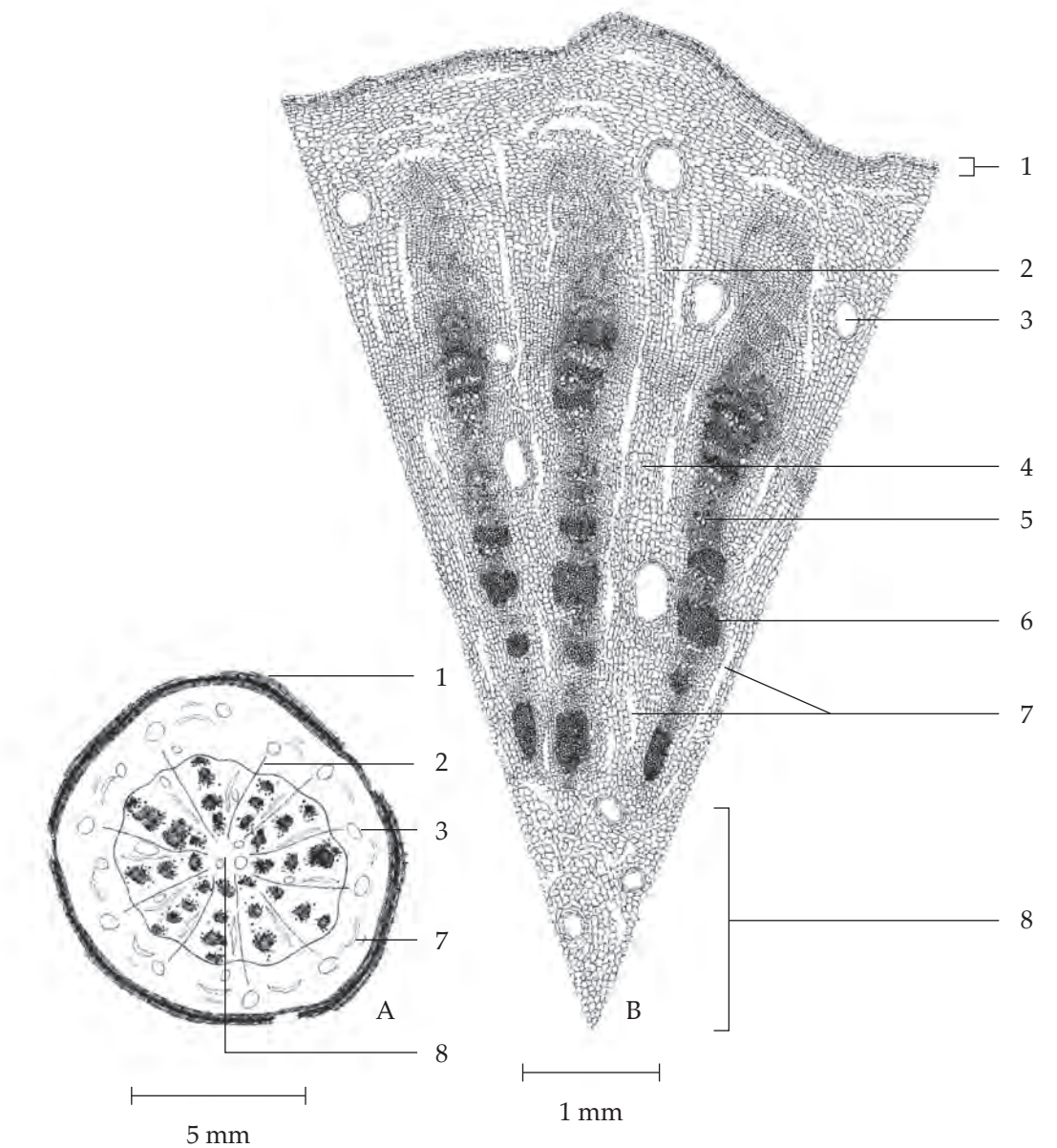


Fig. 2a Transverse Section of the Rhizome of *Atractylodes lancea* (Thunb.) DC.
A. Diagram
B. Part of Transverse Section

1. periderm
2. phloem ray
3. oil cavity
4. xylem ray
5. vessel
6. fibre
7. cracked cavity
8. pith

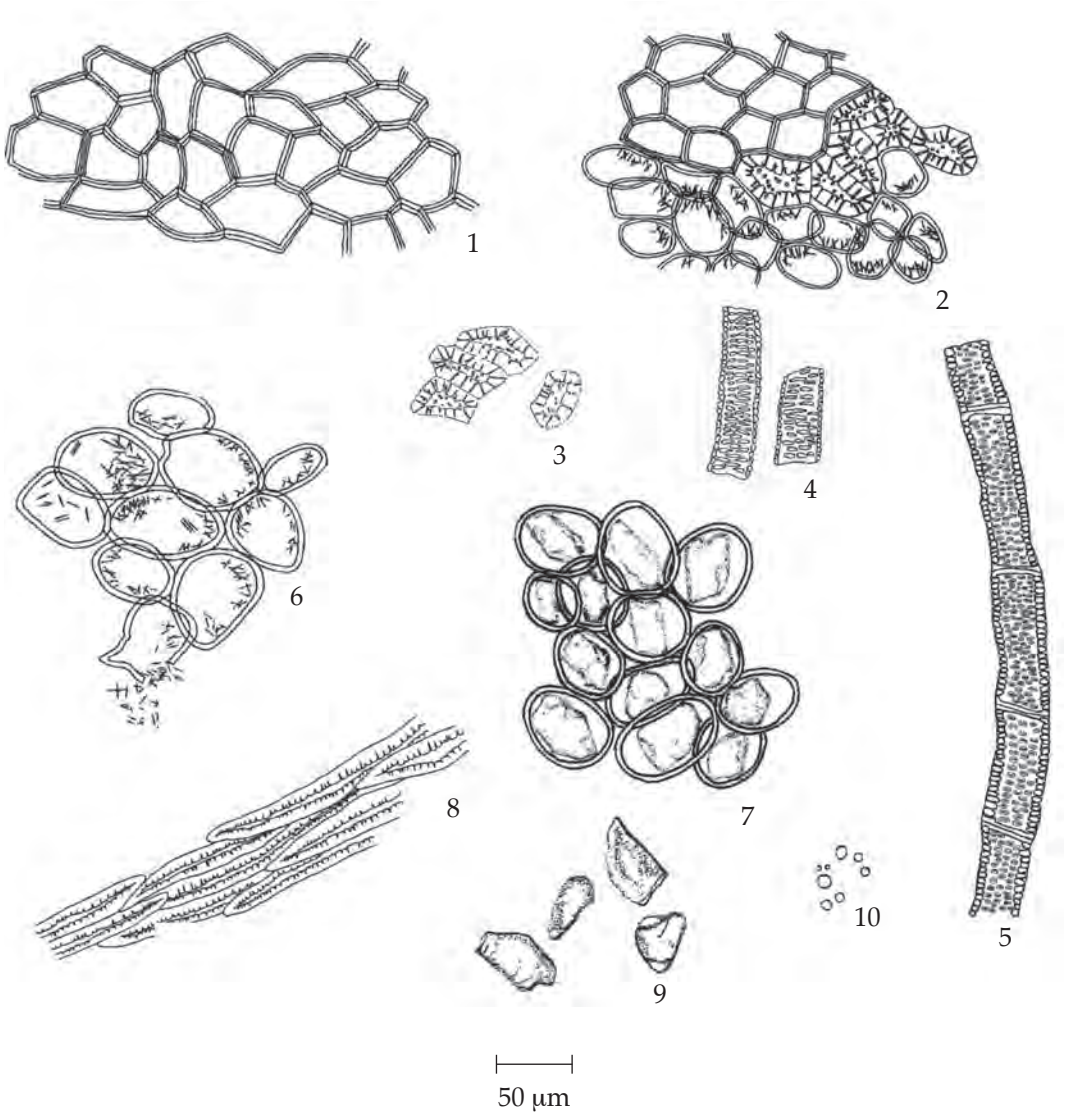


Fig. 2b Powdered Drug of the Rhizomes of *Atractylodes lancea* (Thunb.) DC.

1. cork in surface view
2. cork in surface view associated with sclereids and cortical parenchyma containing acicular crystals
3. sclereids
4. reticulate vessels
5. bordered-pitted vessel
6. parenchyma containing acicular crystals
7. parenchyma containing inulin
8. group of fusiform fibres
9. irregularly shaped fragments of inulin
10. oil droplets

groups of fibres, xylem rays, and cracked cavities. Schizogenous brown oil cavities, scattered in cortex, phloem, xylem, and pith. Pith, numerous polygonal parenchyma cells.

Atractylodes Lancea Rhizome in powder possesses the diagnostic microscopical characters of the unground drug. Cork associated with sclereids, parenchyma cells containing oil droplets, irregularly shaped fragment of inulin, acicular crystals, and reticulate and bordered-pitted vessels are commonly observed.

Warning It should be used with caution in patients with loose, watery stools.

Additional information

1. Atractylodes lancea plant is not native to nor commercially cultivated in Thailand. The plant yielding atractylodes lancea rhizome is here referred to the herbarium specimen, Herbarium Tsumara Laboratory 24217, deposited at the Herbarium Tsumara Laboratory, Japan. The photographic illustration of the specimen can be seen at the Department of Medical Sciences Herbarium (DMSC), Nonthaburi, Thailand.
2. It is commonly used with other herbal drugs in Thai traditional herbal preparations.

Packaging and storage Atractylodes Lancea Rhizome shall be kept in well-closed containers, preferably of metal or glass, protected from light and stored in a cool and dry place.

Identification

A. Reflux 1 g of the sample, in powder, with 10 mL of *ethanol* for 30 minutes and filter. Evaporate 2 mL of the filtrate to dryness. Dissolve the residue in 2 mL of *acetic anhydride* and then slowly add 1 mL of *sulfuric acid* to make two layers: a purple colour appears in the upper layer.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 70 volumes of *hexane*, 20 volumes of *acetone* and 10 volumes of *ethyl acetate* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply to the plate as a band of 10 mm, 5 µL of the test solution prepared by refluxing 1 g of the sample, in powder, with 10 mL of *dichloromethane* for 30 minutes, filtering and evaporating the filtrate to dryness. Dissolve the residue in 1 mL of *toluene.* After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching bands. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter. Several fluorescent bands of different colours appear. Spray the plate with *anisaldehyde TS* and heat at 105° for 10 minutes. Several bands of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Dichloromethane Extract of the Rhizomes of *Atractylodes lancea* (Thunb.) DC.

Band	hR_f Value	Detection		
		UV 254	UV 366	*Anisaldehyde TS*
1	12–16	quenching	–	grey
2	16–22	quenching	–	grey
3	24–28	quenching	blue	–
4	28–31	–	–	grey
5	32–35	quenching	–	–
6	36–38	–	–	grey
7	43–48	quenching	–	–
8	49–58	quenching	–	green
9	68–72	–	blue	blue
10	72–77	quenching	–	blue
11	78–84	quenching	light orange	grey
12	88–94	–	–	violet
13	92–96	–	–	green
14	94–98	–	–	violet

Water Not more than 11.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 7.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 1.5 per cent w/w (Appendix 7.6).

Total ash Not more than 7.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 12.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 35.0 per cent w/w (Appendix 7.12).

Volatile oil Not less than 1.4 per cent v/w (Appendix 7.3H). Use 25 g, in *coarse powder*, freshly prepared and accurately weighed. Use 250 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube.

Dose 3 to 9 g, as a decoction, a day.

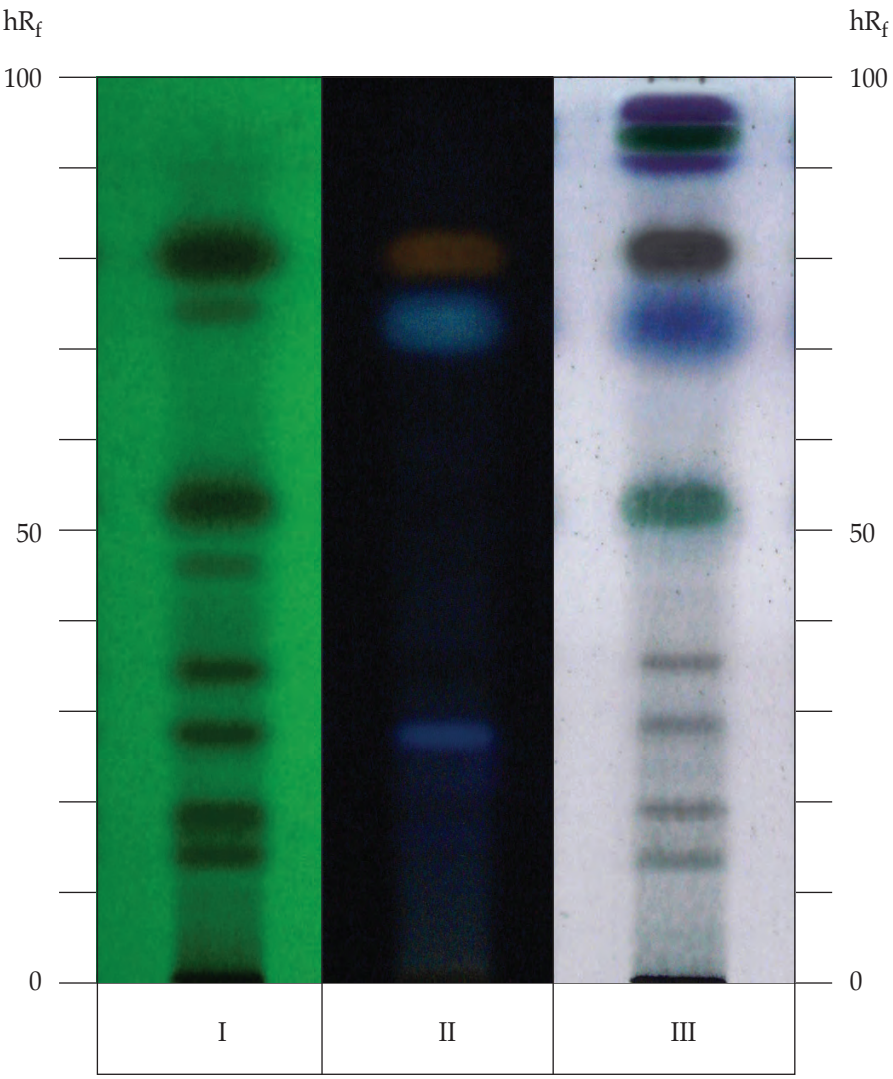


Fig. 3 Thin-Layer Chromatogram of Dichloromethane Extract of the Rhizomes of *Atractylodes lancea* (Thunb.) DC.

I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *anisaldehyde TS*

โกฐกระดูก (KOT KRADUK)

Aucklandiae Lappae Radix
Common Aucklandia Root

Synonyms Costus Root, Kut Root, Kuth Root, Saussurea Root

Category Stomachic, carminative, antispasmodic.

Common Aucklandia Root is the dried root of *Aucklandia lappa* Decne (Family Compositae), Herbarium Specimen Number: see *Additional information 1*, Crude Drug Number: DMSc 0938.

Constituents Common Aucklandia Root contains volatile oil, of which dehydrocostus lactone and costunolide are its major components. It also contains alkaloids (e.g., saussurine), cyanopicrin, etc.

Description of the plant (Figs. 1a, 1b) Perennial herb, 1 to 2 m high; stem erect, robust; root tuberous, large, brown, triangular, about 60 cm long, about 5 cm in diameter, with longitudinal ridges, woody, with peculiar smell. Leaves simple, opposite, triangular or cordate, 0.6 to 1.2 m long, about 30 cm wide, upper leaves 20 to 30 cm long, 17 to 30 cm wide, apex acute or obtuse, base auriculate, margin irregularly toothed, membranous; petiole long, lobately winged, clasping stem. Inflorescence in axillary and terminal corymb, 2.5 to 3.5 cm wide. Capitulum bluish purple, about 2 cm long, 2.5 to 3.8 cm in diameter; involucre globose to campanulate or tubular; phyllaries many-seriate, imbricate, ovate-lanceolate, with scarious apical recurved appendage; receptacle glabrous or setose. Floret usually rose-purple, sometimes white, bisexual, fertile; corolla about 2 cm long, tubular, apex 5-lobed, dark blue-purple or almost black; stamens 5, free, filament glabrous, anther sagittate, with fringed appendage; ovary inferior, 1-loculed, ovule 1, style 2-armed. Fruit achene, up to 8 mm long, curved with narrow tip, compressed, obsoletely 4-angled, hairy; pappus 2-seriate, bristle, about 1.7 cm long, connate at base, persistent, outer short, scabrous to plumose, deciduous, inner plumose.

Description Odour, aromatic and characteristic; taste, slightly bitter.

Macroscopical (Fig. 1a) Cylindrical, 8 to 12 cm long, 1 to 5 cm in diameter. Externally yellowish brown to greyish brown, with distinct wrinkles, longitudinal furrow and lateral root scars. Texture hard, uneasily broken, fracture greyish brown to dark brown.

Microscopical (Figs. 2a, 2b, 2c) Transverse section of the root shows periderm, cortex, phloem, xylem, lysigenous intercellular spaces, and cracked spaces. Periderm, 3 to 12 layers of varying sizes of rectangular cork cells. Cortex, narrow region of thin-walled parenchyma cells and sclereids. Phloem tissue, thin-walled parenchyma, some of which containing oleoresin, 4 to 5 rows of phloem rays and lysigenous intercellular spaces. Xylem tissue, 1 to 2 rows of vessels, 2 to 5 rows of xylem rays and lysigenous intercellular spaces. Cracked space, found in the joint area of phloem tissue and xylem tissue.

Common Aucklandia Root in powder possesses the diagnostic microscopical characters of the unground drug. Elongated, thick-walled sclereids are characteristic features. Thin-walled cork cells and inulin masses are frequently observed. Parenchyma with oleoresin or with inulin masses may also be seen.

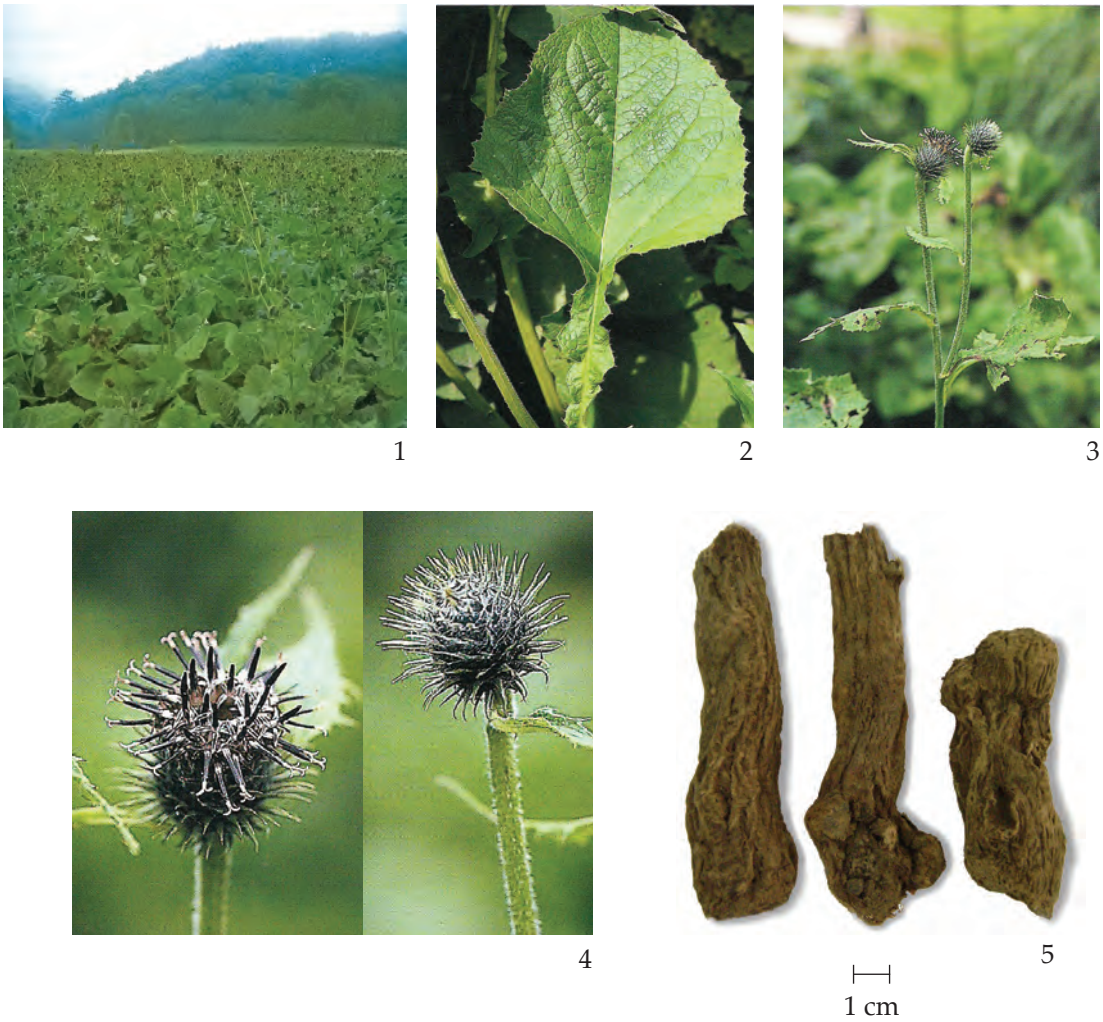


Fig. 1a *Aucklandia lappa* Decne
1. habit 2. leaf 3. and 4. capitula 5. crude drug

Fig. 1b *Aucklandia lappa* Decne
1. root 2. flowering branch showing leaves and capitula

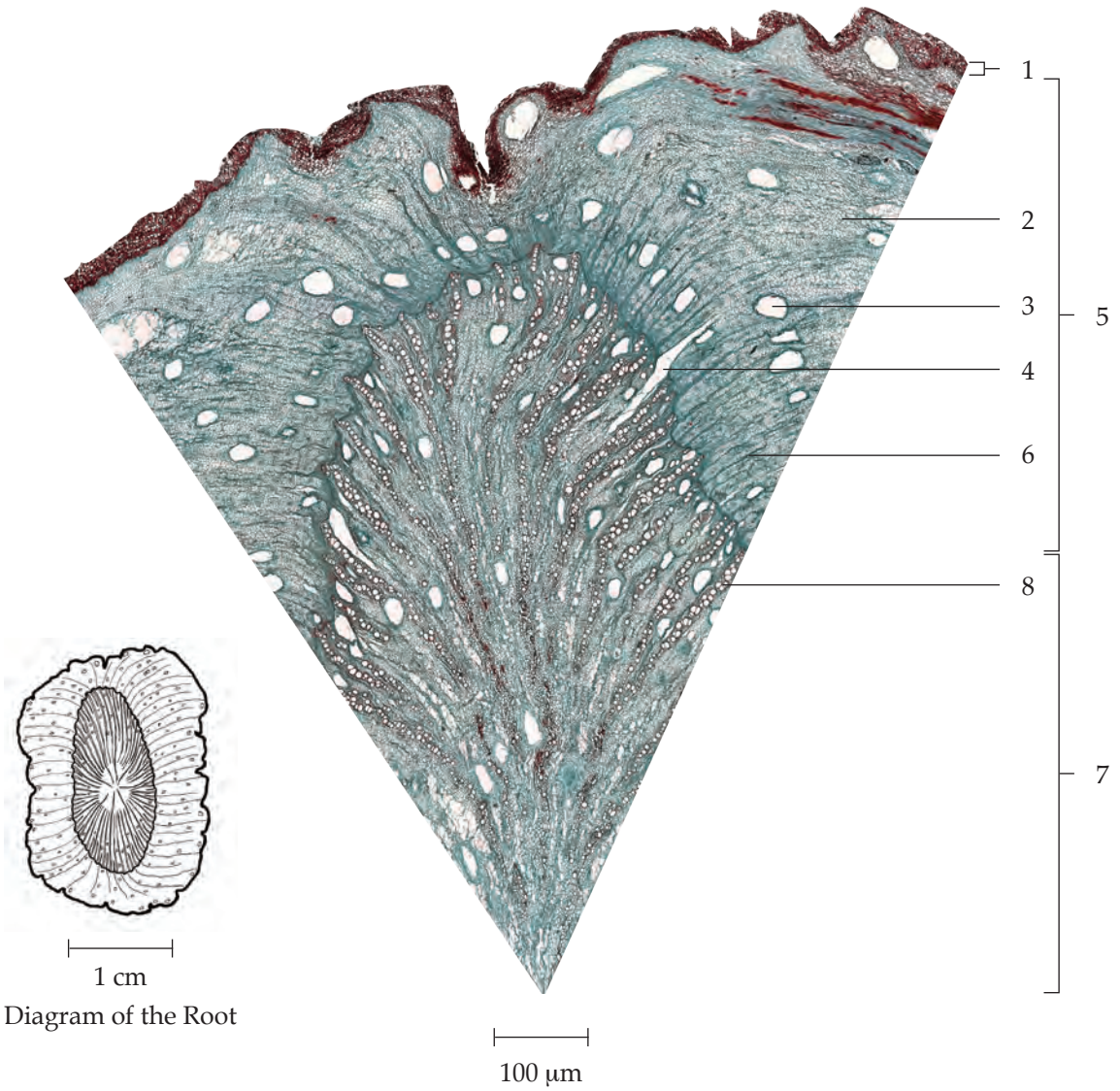


Fig. 2a Photomicrograph of Transverse Section of the Root of *Aucklandia lappa* Decne

1. periderm
2. thin-walled parenchyma
3. lysigenous intercellular space
4. cracked space
5. phloem tissue
6. phloem ray
7. xylem tissue
8. vessel

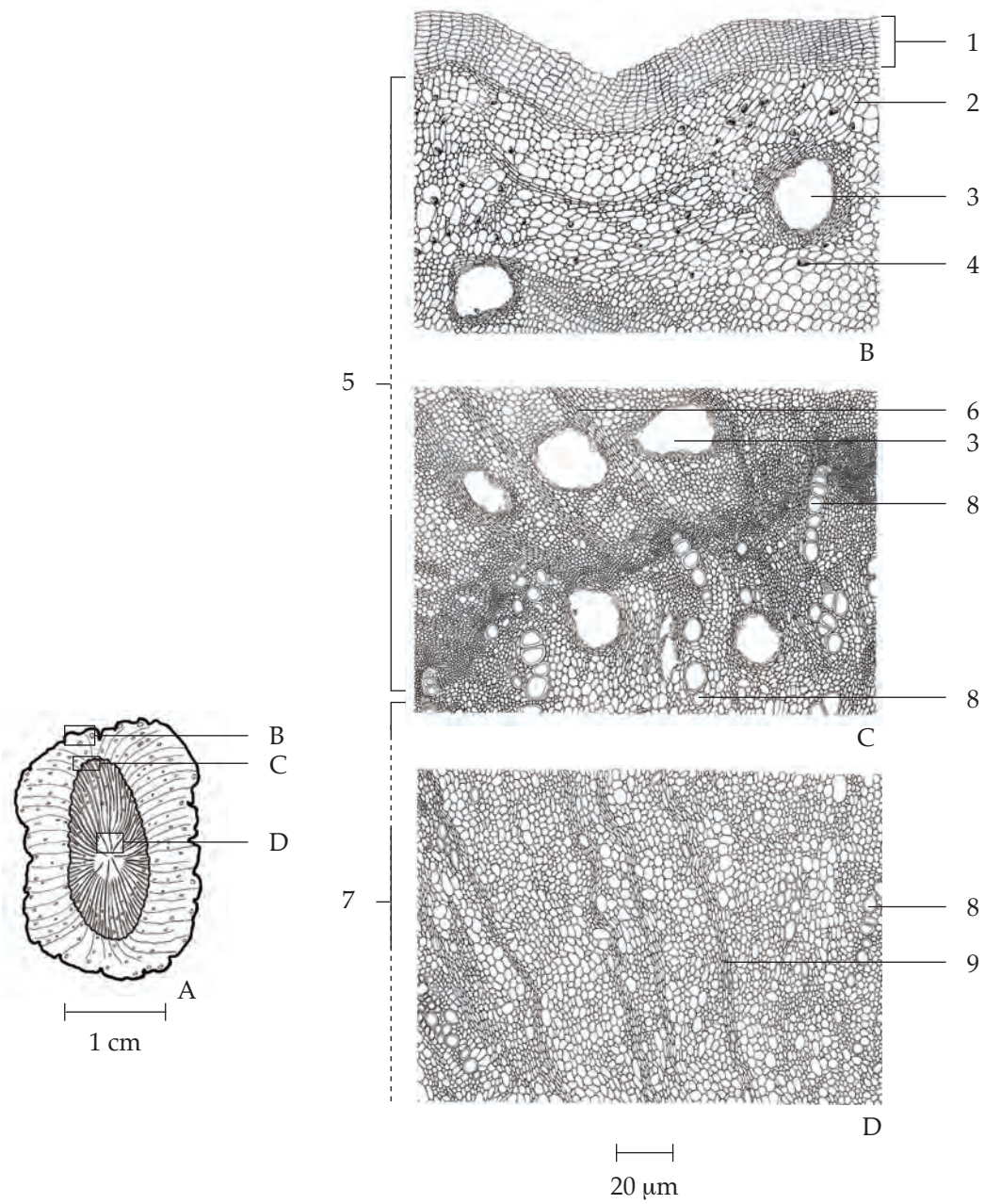


Fig. 2b Line Drawings of Transverse Section of the Root of *Aucklandia lappa* Decne

A. Diagram

B., C. and D. Parts of Sectional View

1. periderm
2. thin-walled parenchyma
3. lysigenous intercellular space
4. oleoresin
5. phloem tissue
6. phloem ray
7. xylem tissue
8. vessel
9. xylem ray

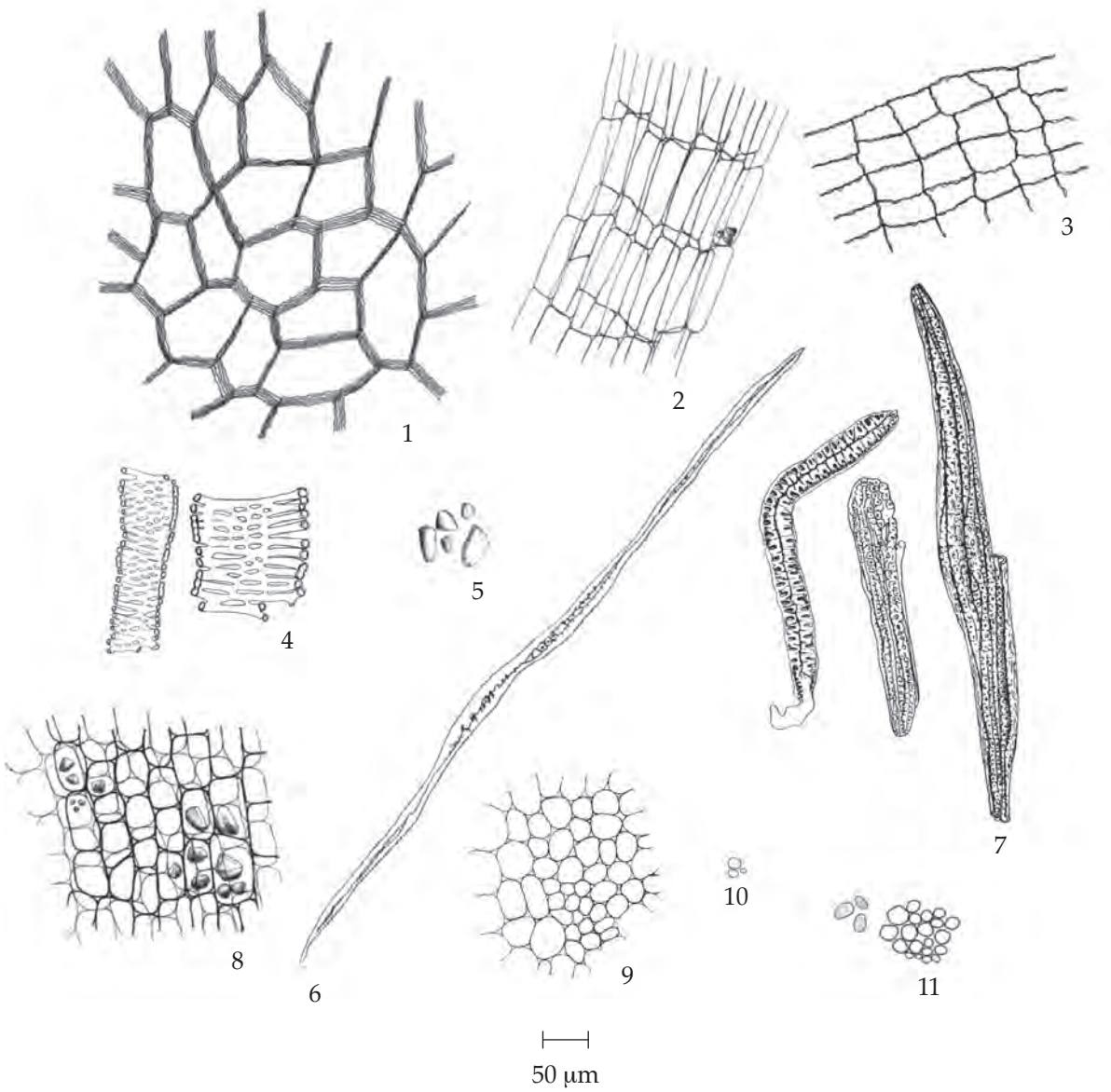


Fig. 2c Powdered Drug of the Roots of *Aucklandia lappa* Decne

1. cork cells in surface view
2. cork cells in longitudinal view
3. cork cells in sectional view
4. reticulate and scalariform vessels
5. inulin
6. fibre
7. sclereids
8. overlapping parenchyma containing oleoresin
9. parenchyma in sectional view
10. oil droplets
11. starch grains

Additional information

1. Common aucklandia plant is not native to nor commercially cultivated in Thailand. The plant yielding common aucklandia root is here referred to the herbarium specimen number K000372736, deposited at the Herbarium, Royal Botanic Gardens Kew (K), London, United Kingdom. The photographic illustration of the specimen can be seen at the Department of Medical Sciences Herbarium (DMSC), Nonthaburi, Thailand.
2. It is commonly used with other herbal drugs in Thai traditional herbal preparations.

Packaging and storage Common Aucklandia Root shall be kept in well-closed containers, protected from light and moisture, and stored in a cool and dry place.

Identification

A. Reflux 1 g of the sample, in powder, with 10 mL of *ethanol (80 per cent)* for 30 minutes, allow to cool and filter. Evaporate the filtrate to dryness, dissolve the residue in 5 mL of a 5 per cent w/v solution of *hydrochloric acid* and filter. To 1 mL of the filtrate, add a few drops of *modified Dragendorff TS*: an orange precipitate is produced.

B. Shake 2 g of the sample, in powder, with 10 mL of *chloroform* for 15 minutes and filter. To 2 mL of the filtrate, slowly add 1 mL of *sulfuric acid* to make two layers: a reddish purple ring is produced at the zone of contact.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 30 volumes of *dichloromethane*, 10 volumes of *ethyl acetate*, 10 volumes of *methanol*, and 1 volume of *strong ammonia solution* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply to the plate, 5 μL of the test solution prepared by refluxing 1 g of the sample, in powder, with 25 mL of *methanol* for 30 minutes, filtering and evaporating the filtrate to dryness. Dissolve the residue in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. Spray the plate with *anisaldehyde TS* and heat at 110° for 10 minutes; two brown and two purple spots are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Roots of *Aucklandia lappa* Decne

Spot	hR_f Value	Detection	
		UV 254	*Anisaldehyde TS*
1	5–13	quenching	brown
2	32–34	quenching	–
3	34–37	–	purple
4	50–52	–	pale brown
5	75–83	quenching	purple

Water Not more than 11.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 1.0 per cent w/w (Appendix 7.6).

Total ash Not more than 6.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 11.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 27.0 per cent w/w (Appendix 7.12).

Volatile oil Not less than 0.7 per cent v/w (Appendix 7.3H). Use 20 g, in *coarse powder*, freshly prepared and accurately weighed. Use 200 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube.

Dose 200 mg to 1 g of the powdered drug a day.

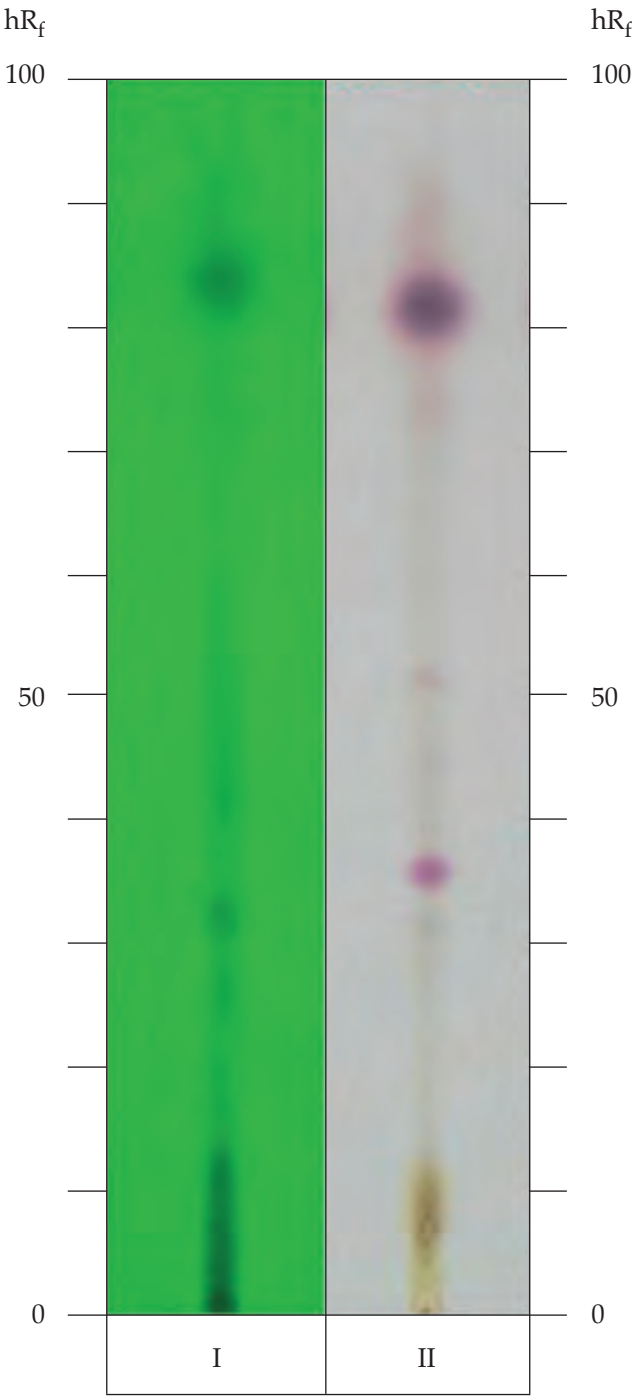


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Roots of *Aucklandia lappa* Decne
I = detection under UV light (254 nm)
II = detection with *anisaldehyde TS*

โกฐพุงปลา (KOT PHUNG PLA)

ปูดกกส้มมอ (PUT KOK SOM MO)
Terminaliae Chebulae Galla
Terminalia Chebula Gall

Synonym Chebulic Myrobalan Gall

Category Astringent, antidiarrheal.

Terminalia Chebula Gall is the dried leaf gall of *Terminalia chebula* Retz. (Family Combretaceae), Herbarium Specimen Number: DMSC 899, Crude Drug Number: DMSc 0937.

Constituents Terminalia Chebula Gall contains phenolic acids (e.g., gallic acid) and hydrolyzable tannins (e.g., chebulagic acid, tannic acid). It also contains flavonoids, triterpenoids, etc.

Description of the plant (Figs. 1a, 1b) Medium- to large-sized tree, up to 30 m high, up to 1.3 m in girth; bark rough, scaly; shoot and young leaves usually rusty villous. Leaves simple, opposite, broadly ovate to ovate-elliptic, 8 to 15 cm long, 6 to 10 cm wide, apex acute or abruptly acuminate, base cuneate, slightly cordate or rounded, coriaceous, glabrescent, nerves obscure above, slightly raised and usually brownish pubescent beneath; petiole 1 to 3 cm long, glabrous or sparsely pubescent with a pair of nodular glands near leaf base. Inflorescence axillary or terminal panicles, usually with 3 to 6 spikes; spike 3 to 6 cm long; rachis pubescent. Flower 3 to 4 mm in diameter; bract nearly glabrous, 1.5 to 2 mm long; calyx tube infundibuliform, calyx segment triangular, outside glabrous, inside densely villous; stamen 3 to 4 mm long; disc lobed, densely villous; ovary inferior, glabrous, ovoid, about 1 mm long, style glabrous, 2.5 to 3 mm long. Fruit drupe, subglobose to ellipsoid, 2.5 to 5.0 cm long, 1.5 to 2.5 cm wide, glabrous, usually smooth or frequently 5-angulate ridged, wrinkled and turning blackish when dry. Seed 1, ellipsoid, 1.5 to 2 cm long, 0.5 to 0.7 cm wide, rough, without ridges.

Description Odourless; taste, astringent and slightly bitter.

Macroscopical (Fig. 1a) Leaf gall, hot-water-bottle like or vasiform, flat, truncate or 2-lobed, yellowish brown, 1.5 to 3.5 cm long, about 1.5 cm broad, 0.5 to 1.5 cm thick, conspicuously longitudinally striated, ribbed or ridged; dehiscent, unilocular, the gall cavity dark brown and filled with tubercles.

Microscopical (Figs. 2a, 2b) Transverse section of the gall shows periderm, cortex, vascular bundles, and a large cavity in the centre. Periderm, 3 to 5 layers of thin, non-suberized wavy-walled of cork-like cells. Cortex, various shapes (e.g., polygonal, oblong and round) of thin-walled parenchyma, of which minute rosette aggregate crystals may be seen. Vascular bundles, small, arranged in longitudinal and transverse views.

Terminalia Chebula Gall in powder possesses the diagnostic microscopical characters of the unground drug. Tannin mass and cork-like cells of outer gall surface are characteristic. Insect parts inside the gall are also found.

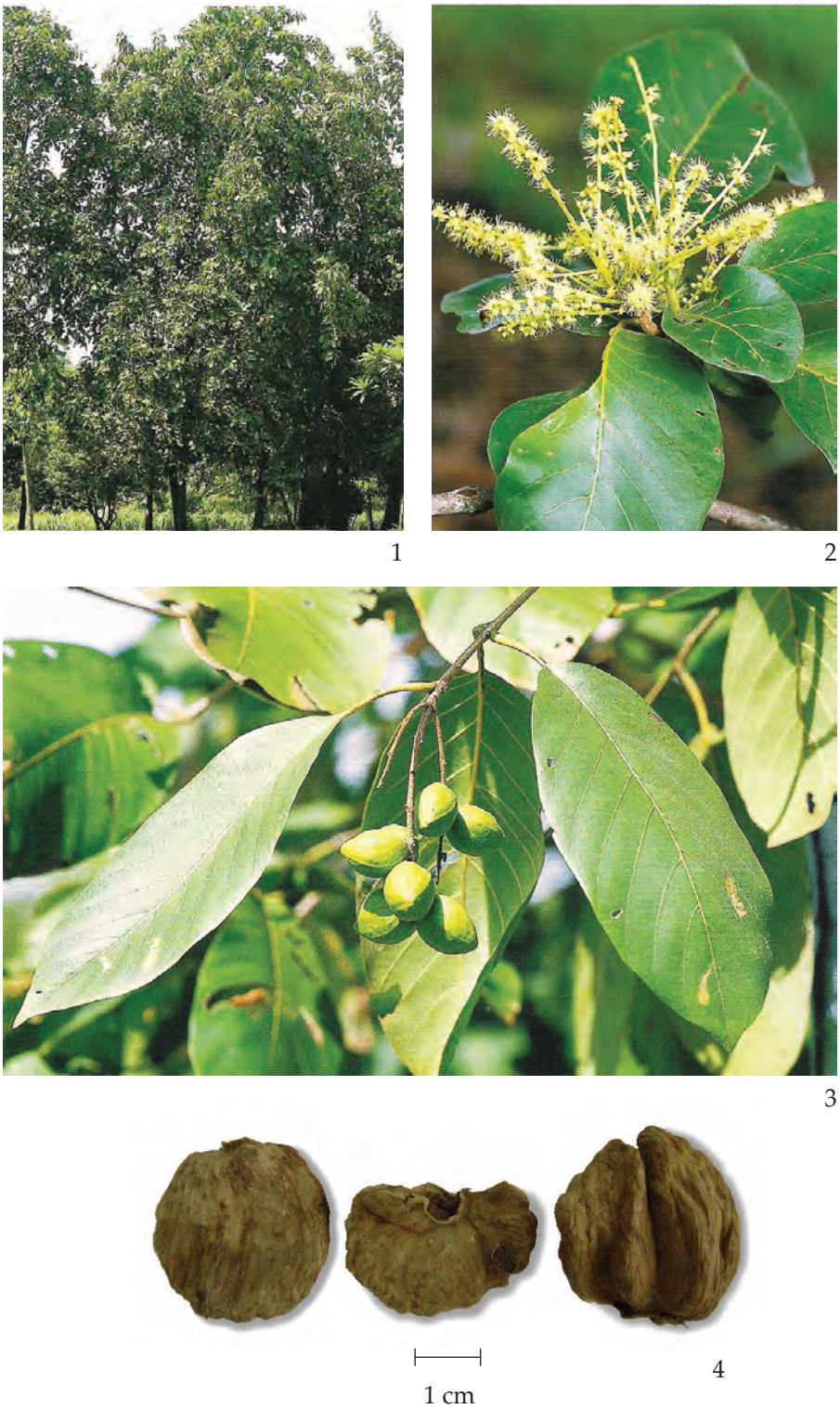


Fig. 1a *Terminalia chebula* Retz.
1. habit 2. flowering twig 3. fruiting twig 4. crude drug

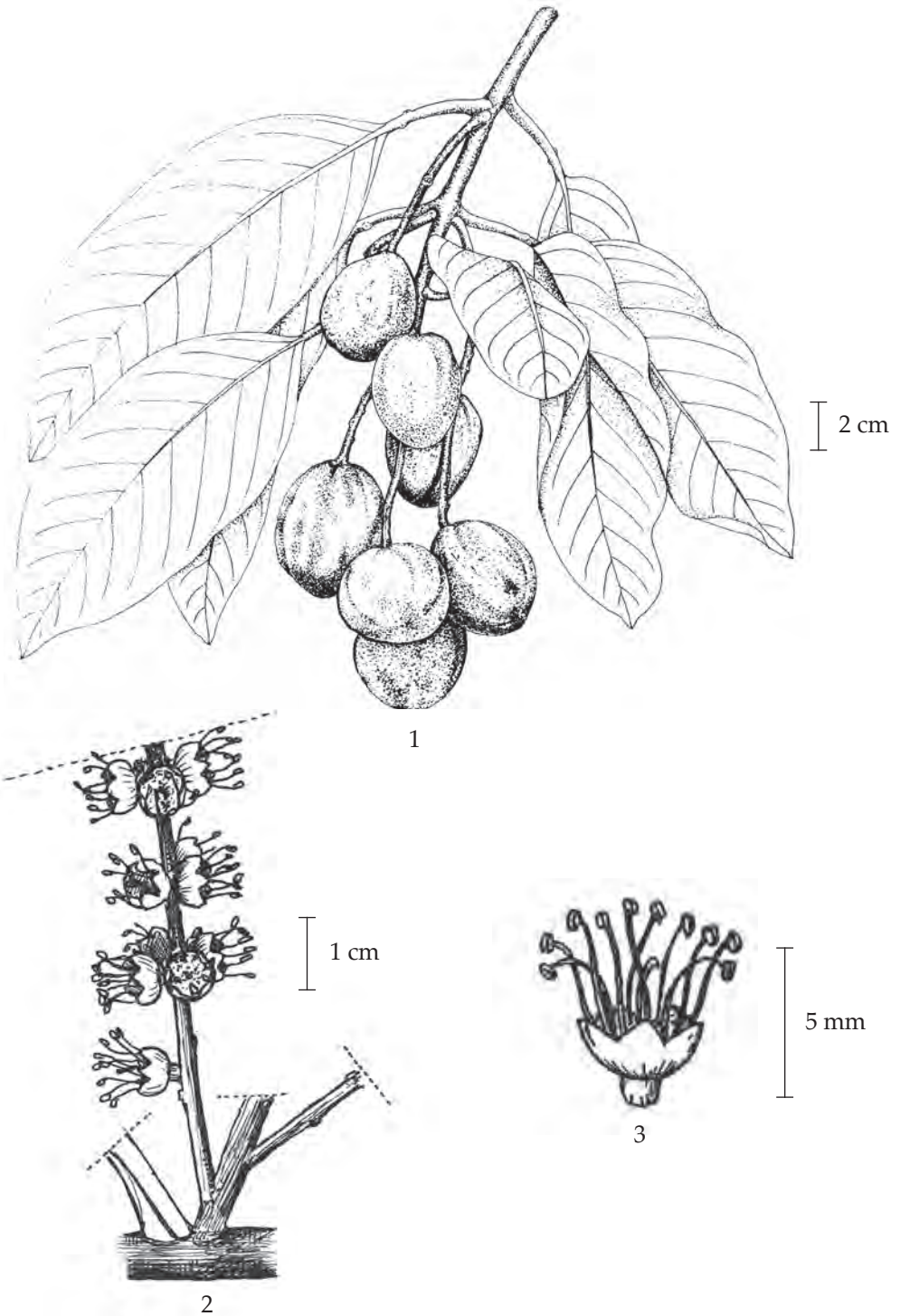


Fig. 1b *Terminalia chebula* Retz.
1. branch showing leaves and fruits 2. part of inflorescence 3. flower

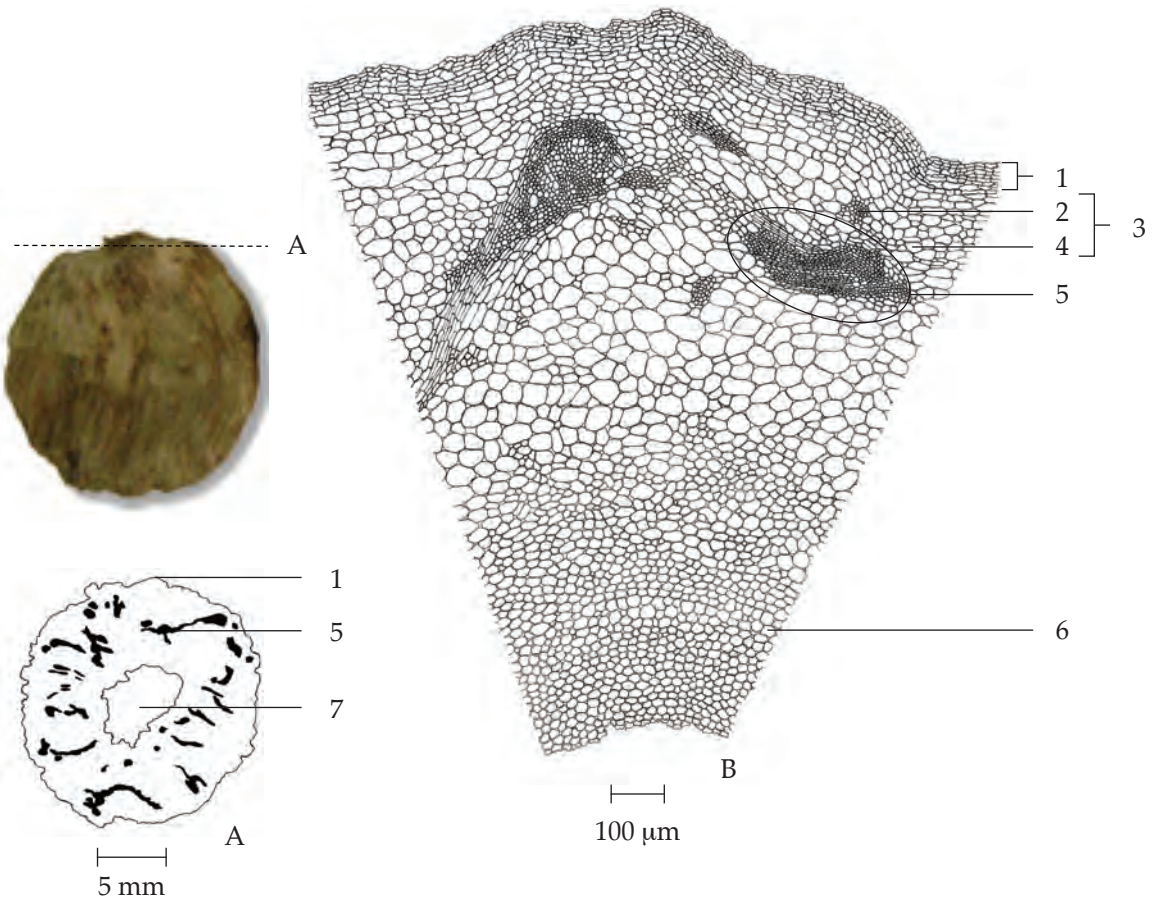


Fig. 2a Transverse Section of the Leaf Gall of *Terminalia chebula* Retz.

A. Diagram Nearby the Base of Gall

B. Part of Transverse Section

1. periderm
2. group of non-lignified fibres
3. cortex
4. thin-walled parenchyma
5. vascular bundle
6. lignified parenchyma
7. large cavity

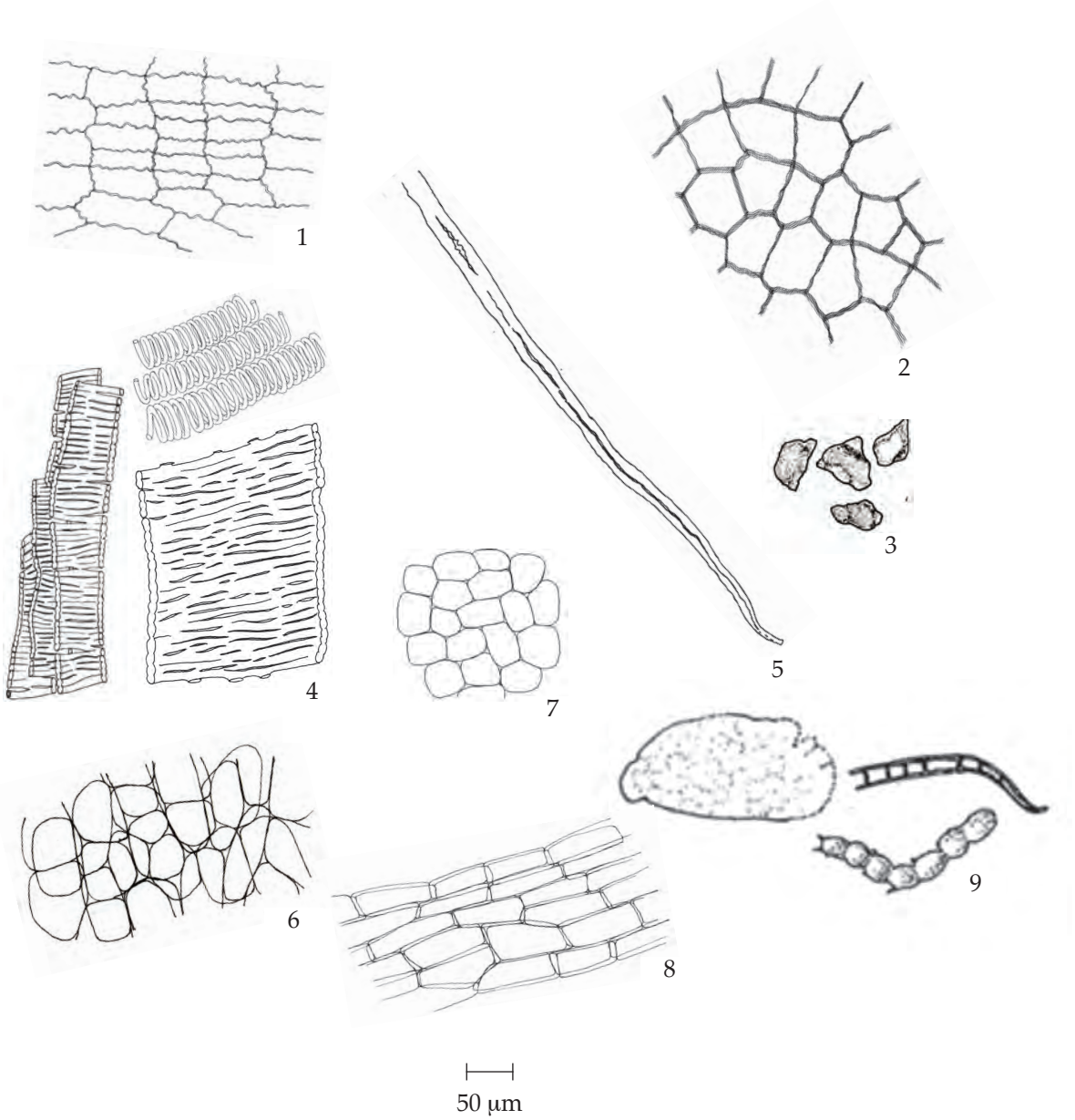


Fig. 2b Powdered Drug of the Leaf Galls of *Terminalia chebula* Retz.

1. cork-like cells in sectional view
2. cork-like cells in surface view
3. tannin mass
4. reticulate and spiral vessels
5. fibre
6. thin-walled parenchyma
7. lignified parenchyma near cavity
8. lignified parenchyma near cavity in longitudinal view
9. insect parts

Additional information It is commonly used with other herbal drugs in Thai traditional herbal preparations.

Packaging and storage Terminalia Chebula Gall shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Heat 500 mg of the sample, in powder, with 10 mL of *water* in a water-bath for 10 minutes, allow to cool and filter. To 2 drops of the filtrate, add a few drops of a 1 per cent w/v solution of *iron(III) chloride*: a dark green colour is produced.

B. Heat 200 mg of the sample, in powder, with 10 mL of *water* in a water-bath for 5 minutes and filter. To 2 mL of the filtrate, add a few drops of a 1 per cent w/v solution of *gelatin*: a yellowish cloudy precipitate is produced.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 100 volumes of *ethyl acetate*, 11 volumes of *formic acid*, 11 volumes of *acetic acid*, and 10 volumes of *water* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply separately to the plate, 5 μL each of the following solutions. Prepare solution (A) by refluxing 1 g of the sample, in powder, with 25 mL of *water* for 30 minutes, filtering and evaporating the filtrate to almost dryness. For solution (B), dissolve 2 mg of *gallic acid* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. The chromatogram obtained from solution (A) shows a quenching spot (hR_f value 84 to 89) corresponding to the gallic acid spot from solution (B). Spray the plate with *anisaldehyde TS* and heat at 110° for 10 minutes; the spot corresponding to gallic acid is brown. Other several brown spots also appear (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Water Extract of the Leaf Galls of *Terminalia chebula* Retz.

Spot	hR_f Value	Detection	
		UV254	*Anisaldehyde TS*
1	25–28	quenching	–
2	30–37	quenching	–
3	41–47	quenching	brown
4	48–51	quenching	brown
5	56–63	quenching	brown
6	70–73	quenching	brown
7*	84–89	quenching	brown

*gallic acid

Loss on drying Not more than 13.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 1.0 per cent w/w (Appendix 7.2).

Total ash Not more than 4.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 42.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 50.0 per cent w/w (Appendix 7.12).

Tannins content Not less than 30.0 per cent w/w (Appendix 7.21 H). Use 4 g of Terminalia Chebula Gall, in powder, accurately weighed.

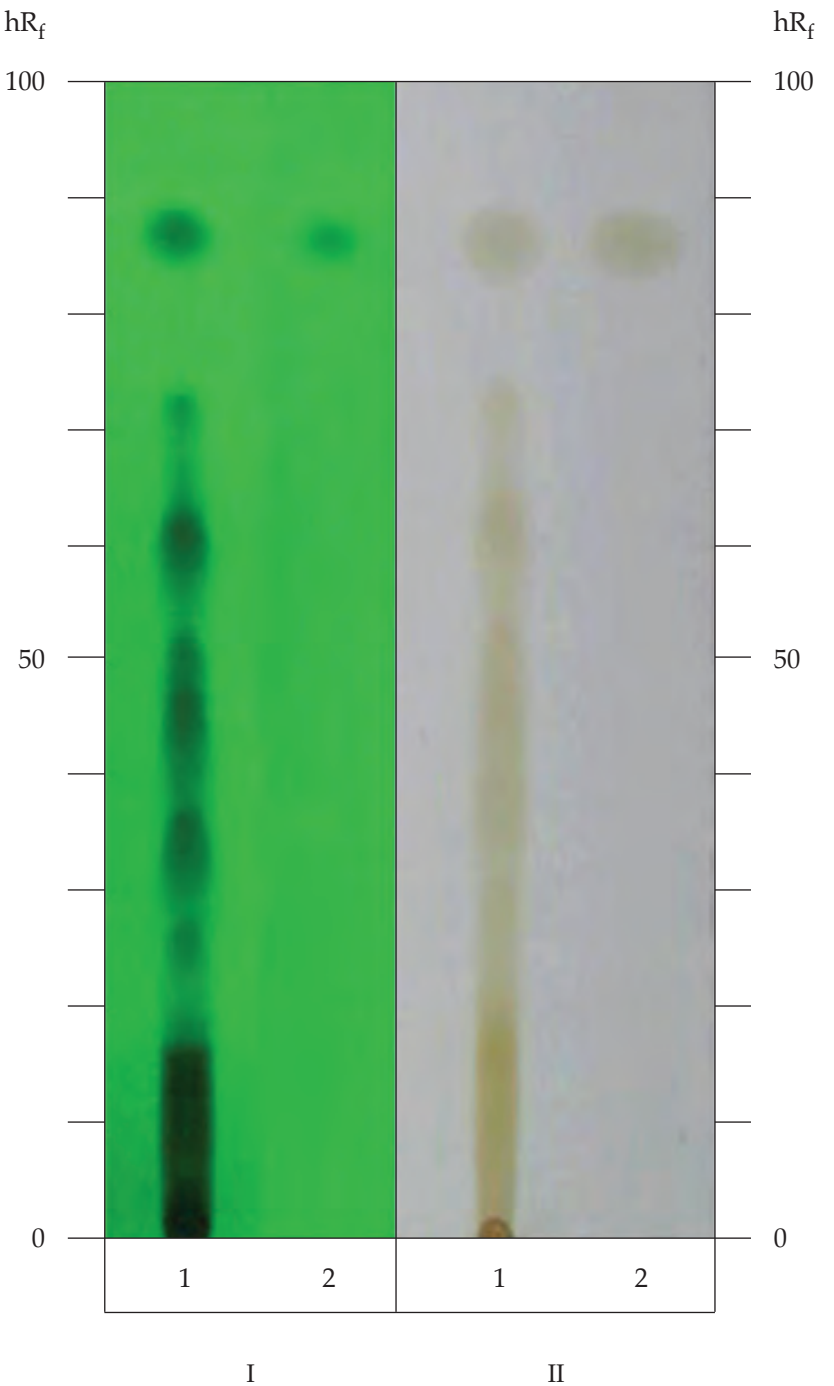


Fig. 3 Thin-Layer Chromatogram of Water Extract of the Leaf Galls of *Terminalia chebula* Retz.
1 = solution (A)
2 = solution (B)
I = detection under UV light (254 nm)
II = detection with *anisaldehyde TS*

โกฐสอ (KOT SO)

โกฐสอจีน (KOT SO CHIN)
Angelicae Dahuricae Radix
Dahurian Angelica Root

Category Antipyretic, analgesic (for headache).

Dahurian Angelica Root is the dried root of *Angelica dahurica* (Hoffm.) Benth. & Hook. f. ex Franch. & Sav. var. *dahurica* (*A. macrocarpa* H. Wolff) (Family Umbelliferae), Herbarium Specimen Number: see *Additional information 1*, Crude Drug Number: DMSc 1146.

Constituents Dahurian Angelica Root contains furanocoumarins such as imperatorin, isoimperatorin, phellopterin, etc.

Description of the plant (Figs. 1a, 1b) Perennial herb 1 to 2.5 m high; stem purplish green, hollow, pubescent above; root stout, cylindrical. Leaves pinnately or ternately compound, alternate; blade triangular-ovate in outline, 10 to 50 cm long, 25 to 40 cm wide; leaflets sessile, terminal leaflet deeply 3-lobed, blade usually oblong or ovate-elliptic, 4 to 10 cm long, 1 to 5 cm wide, apex acute to acuminate, base slightly decurrent, margin white-cartilaginous, sharply serrate, pubescent along nerves adaxially, upper leaves reduced, basal and lower leaves long-petiolate, broadly dilated at base into saccate-inflated sheaths. Inflorescence compound umbel, 10 to 30 cm in diameter; peduncle 5 to 20 cm long, scabrous; bract(s) absent or 2, broadly lanceolate; bracteoles many, linear-lanceolate, scarious. Flowers white, 18 to 40(–70) per umbel; pedicellate, scabrous; calyx teeth obsolete; petals 5, obovate, apex incurved; ovary inferior, glabrous or pubescent, 2-loculed, 1 ovule per locule, stylopodium shortly conic. Fruit schizocarp, suborbicular, 4 to 7 mm long, 4 to 6 mm wide, dorsal ribs prominent, obtusely thick-rounded, much wider than furrow, lateral ribs broad-winged; vitta(e) 1 in each furrow, 2 on commissure; split into 2 single-seeded mericarps. Seed plane or slightly concave.

Description Odour, aromatic; taste, pungent and bitterish.

Macroscopical (Fig. 1a) Long-conical, 10 to 25 cm long, 1.5 to 2.5 cm in diameter. Externally greyish brown or yellowish brown, root stock obtusely quadrangular or subrounded, with longitudinal wrinkles, rootlet scars and lenticel-like transverse protrudings, some of them arranged in 4 longitudinal rows. Apex with dented stem scar. Texture compact, fracture white or greyish white and starchy, cambium ring brown, subsquare or subrounded, scattered with many brown oil dots in bark.

Microscopical (Figs. 2a, 2b) Transverse section of the root shows periderm, cortex, phloem, cambium, and xylem; with schizogenous oil cavities distributed throughout. Periderm, 5 to 10 layers of rectangular, thin- and slightly wavy-walled cork cells. Cortex, narrow, with polygonal or elliptical parenchyma cells. Phloem, a broad zone of polygonal parenchyma and phloem rays. Cambium layers, containing subsquare or subround cells. Xylem, containing vessels, radially arranged in row, with polygonal or subround xylem parenchyma cells and xylem rays. Medullary ray, 2 to 3 rows, rectangular and elliptical cells. Parenchyma cells, containing starch grains and some with prismatic crystals of calcium oxalate.

1

2

3

5 cm

Fig. 1a *Angelica dahurica* (Hoffm.) Benth. & Hook. f. ex Franch. & Sav. var. *dahurica*
1. flowering and fruiting shoot 2. flowering twig 3. crude drug

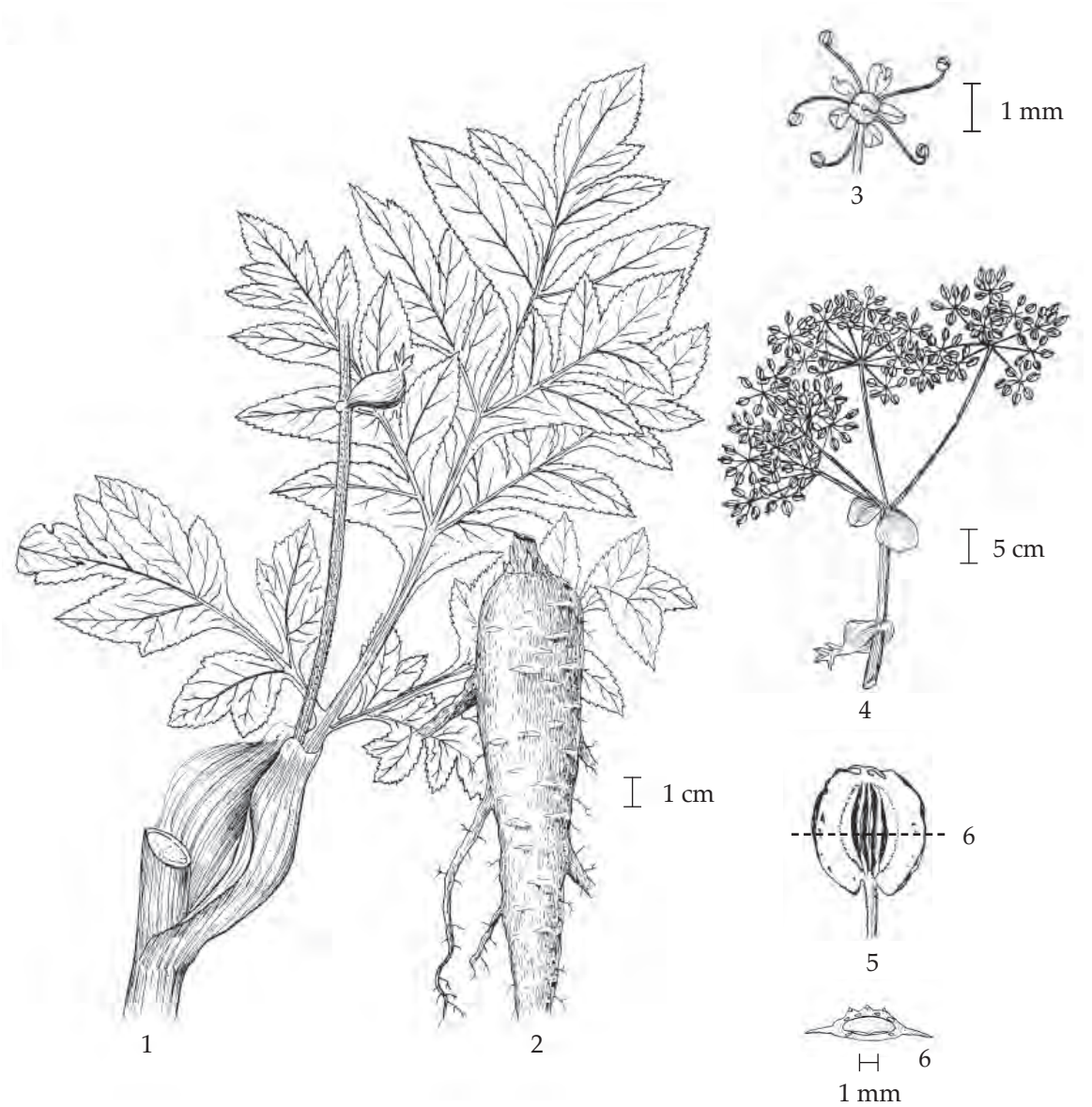


Fig. 1b *Angelica dahurica* (Hoffm.) Benth. & Hook. f. ex Franch. & Sav. var. *dahurica*
1. part of stem showing leaf with characteristic leaf sheath 2. root 3. flower
4. infructescence 5. fruit (mericarp) 6. fruit (cross section)

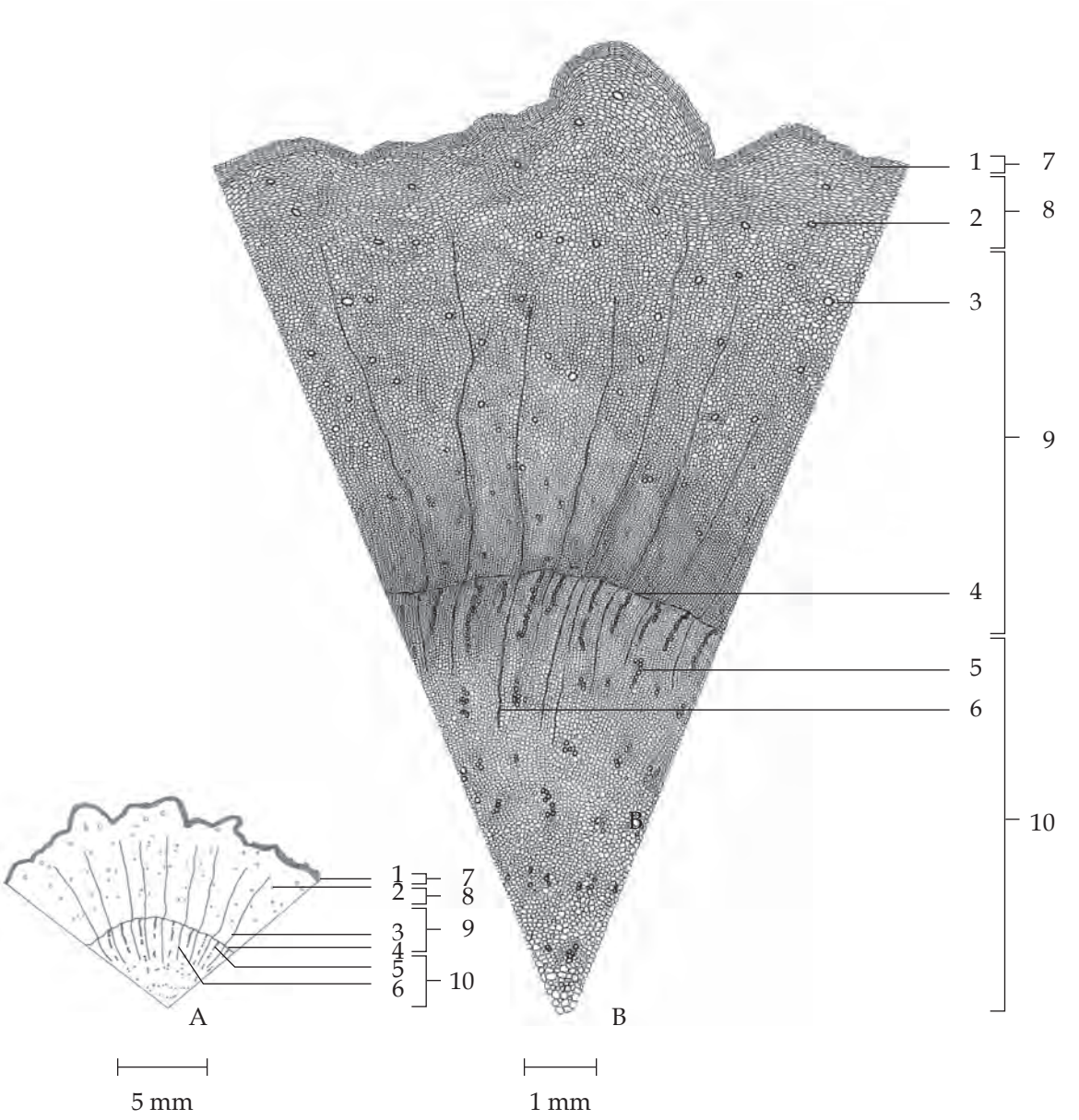


Fig. 2a Transverse Section of the Root of *Angelica dahurica* (Hoffm.) Benth. & Hook. f. ex Franch. & Sav. var. *dahurica*

A. Part of Diagram
B. Part of Sectional View

1. cork
2. oil cavity
3. phloem ray
4. cambium
5. vessel
6. xylem ray
7. periderm
8. cortex
9. phloem
10. xylem

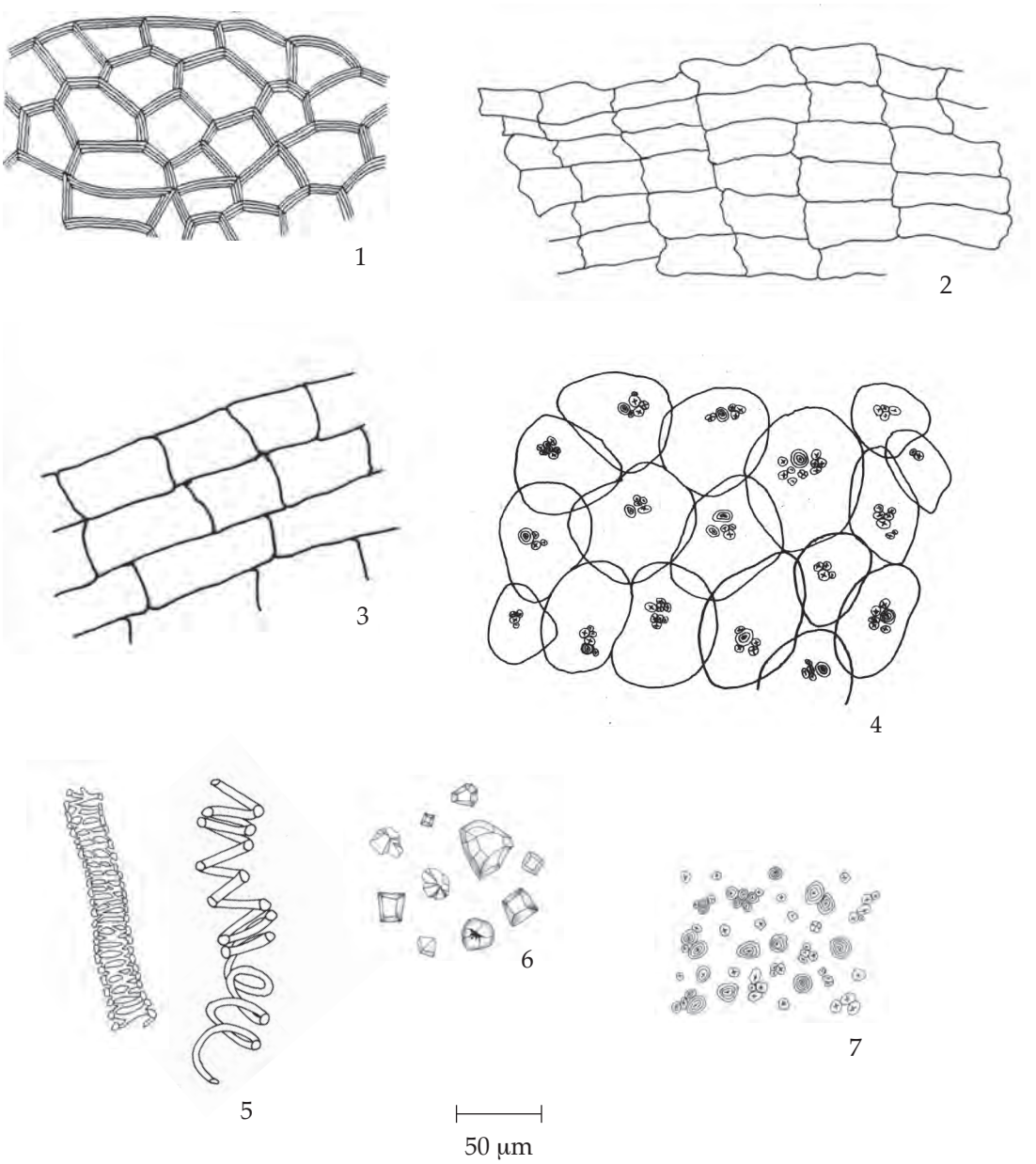


Fig. 2b Powdered Drug of the Roots of *Angelica dahurica* (Hoffm.) Benth. & Hook. f. ex Franch. & Sav. var. *dahurica*

1. cork in surface view
2. cork in sectional view
3. parenchyma in longitudinal view
4. parenchyma in sectional view containing starch grains
5. reticulate and spiral vessels
6. prismatic crystals of calcium oxalate
7. starch grains

Dahurian Angelica Root in powder possesses the diagnostic microscopical characters of the unground drug. Thin-walled cork cells, abundant parenchyma cells (mostly with starch grains and/or prismatic crystals of calcium oxalate) and abundant starch grains of different shapes and sizes (with prominent lamella and hilum) are commonly found.

Additional information

1. Dahurian angelica plant is not native to nor commercially cultivated in Thailand. The plant yielding dahurian angelica root is here referred to the herbarium specimen number K001097137, collector's number C.J. Maximowicz s.n., deposited at the Herbarium, Royal Botanic Gardens Kew (K), London, United Kingdom. The photographic illustration of the specimen can be seen at the Department of Medical Sciences Herbarium (DMSC), Nonthaburi, Thailand.
2. Two varieties of *Angelica dahurica* (Hoffm.) Benth. & Hook. f. ex Franch. & Sav., var. *dahurica* and var. *formosana* (Boiss.) Shan et Yuan, are official in the Pharmacopoeia of the People's Republic of China 2010. However, only the prior variety is imported from China and sold in Thai herbal markets as KOT SO.
3. It is commonly used with other herbal drugs in Thai traditional herbal preparations.

Packaging and storage Dahurian Angelica Root shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. To 200 mg of the sample, in powder, add 5 mL of *ethanol*, shake, allow to stand for 5 minutes, and filter. Drop the filtrate on a filter paper moistened with 1 M *sodium hydroxide* and examine under ultraviolet light (366 nm): a green fluorescence is produced.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 75 volumes of *toluene*, 25 volumes of *ethyl acetate* and 5 volumes of *glacial acetic acid* as the mobile phase. Apply separately to the plate, as bands of 10 mm, 20 μL of solution (A) and 10 μL of solution (B). Prepare solution (A) by refluxing 1 g of the sample, in powder, with 10 mL of *dichloromethane* for 30 minutes and filtering. Evaporate the filtrate to dryness and dissolve the residue in 1 mL of *toluene*. For solution (B), dissolve 1 mg of *imperatorin* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching bands. The chromatogram obtained from solution (A) shows a quenching band (hR_f value 66 to 76) corresponding to the imperatorin band from solution (B), and several quenching bands are also observed (Table 1); see also Fig. 3. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; the band due to imperatorin exhibits a yellow fluorescence. Other several fluorescent bands are also observed. Spray the plate with a 5 per cent w/v solution of *potassium hydroxide*, and examine the plate under ultraviolet light (366 nm) through the cut-off filter; the band corresponding to imperatorin is orange fluorescence. Several fluorescent bands of different colours are also observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Dichloromethane Extract of the Roots of *Angelica dahurica* (Hoffm.) Benth. & Hook.f. ex Franch. & Sav. var. *dahurica*

Band	hR_f Value	Detection		
		UV 254	UV 366	5 Per Cent W/V Solution of *Potassium Hydroxide* and UV 366
1	13–17	quenching	yellow	yellow
2	17–20	–	violet	blue
3	24–27	–	violet	blue
4	30–34	–	violet	blue
5	33–42	–	–	blue
6	41–44	–	–	blue
7	43–48	quenching	blue	blue
8	49–53	quenching	–	–
9	51–57	–	intense blue	intense blue
10	59–62	quenching	yellow	yellow
11	65–69	–	–	blue
12*	66–76	quenching	yellow	orange
13	75–80	–	violet	violet
14	77–83	quenching	yellow	yellow
15	81–85	–	violet	violet

*imperatorin

Water Not more than 14.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 2.0 per cent w/w (Appendix 7.6).

Total ash Not more than 5.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 4.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 15.0 per cent w/w (Appendix 7.12).

Dose 3 to 9 g, as a decoction, a day.

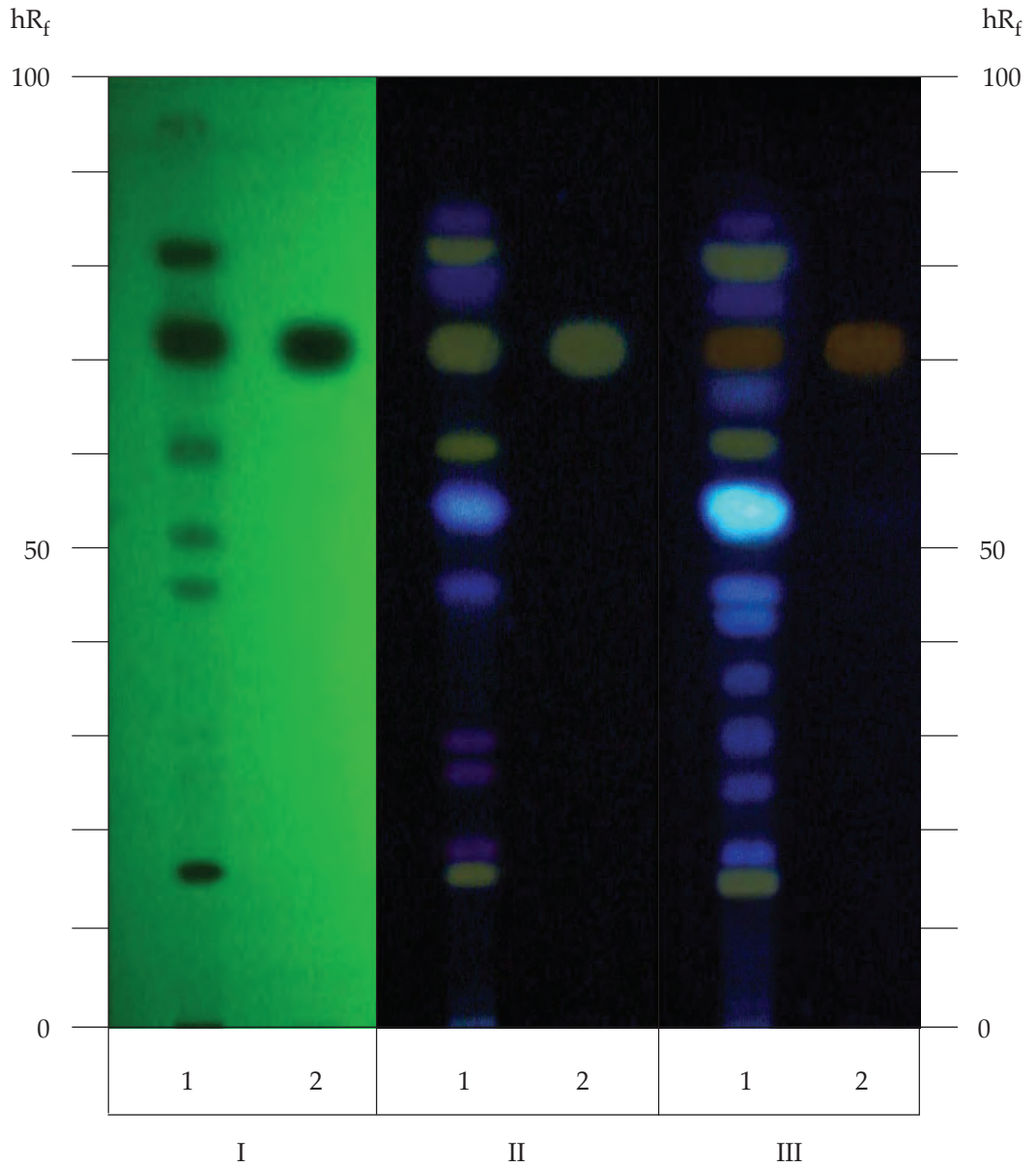


Fig. 3 Thin-Layer Chromatogram of Dichloromethane Extract of the Roots of *Angelica dahurica* (Hoffm.) Benth. & Hook. f. ex Franch. & Sav. var. *dahurica*

1 = solution (A)
2 = solution (B)
I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection under UV light (366 nm) after spraying with a 5 per cent w/v solution of *potassium hydroxide*

กระชายดำ (KRACHAI DAM)

Kaempferiae Parviflorae Rhizoma
Kaempferia Parviflora Rhizome

Category Tonic, carminative.

Kaempferia Parviflora Rhizome is the dried rhizome of *Kaempferia parviflora* Wall. ex Baker [*K. rubromarginata* (S. Q. Tong) R. J. Searle, *Stahlianthus rubromarginatus* S. Q. Tong] (Family Zingiberaceae), Herbarium Specimen Number: DMSC 1575, Crude Drug Number: DMSc 548.

Constituents Kaempferia Parviflora Rhizome contains volatile oil, of which borneol is major component. It also contains flavonoids, anthocyanins, etc.

Description of the plant (Figs. 1a, 1b) Herb up to 25 cm tall; rhizome, subglobose to globose, light to dark purple within, with several succulent roots in a fascicle. Leaves one to several; blades ovate or elliptic, slightly unequal sided, 7 to 20 cm long, 4 to 9 cm wide, apex acute or mucronate, base subcordate, upper surface glabrous, under surface hairy; leaf-sheaths 6 to 12 cm long, margin membranous, green or with red-tinted; bladeless sheaths greenish, purple-tinted or purple; ligule broadly triangular, about 2 mm long, membranous, caducous. Inflorescence enclosed by two innermost leaf-sheaths or leaf-sheath and the bladeless sheath, usually elongate; peduncle 5 to 6 cm long; bract oblong, 1.7 to 2.3 cm long, about 6 mm wide, glabrous, apex rounded; bracteole linear, 6 to 12 mm long, 1 to 2 mm wide, glabrous, apex rounded. Flowers many, up to 20; calyx 1.8 to 2.2 cm long, finely hairy, apex bifid; corolla tube about 3 cm long, lobes linear; dorsal lobe about 1.2 cm long, about 3 mm wide, apex hooded, aristate, lateral lobes slightly smaller, apex rounded; staminode white, oblong, 1 to 1.3 cm long, about 3 mm wide, apex acute or rounded. Labellum, white to light purple, darker at the base, obovate, 1.2 to 1.5 cm long, 8 to 9 mm wide, apex emarginate; stamen with very short filament, about 1 mm long, anther about 2 mm long, anther-crest suborbicular, entire or emarginate, 1 to 1.5 mm long, about 2 mm wide; ovary about 2 mm long, about 1 mm wide, hairy; stylode filiform, about 5 mm long.

Description Odour, characteristic and aromatic; taste, slightly bitter.

Macroscopical (Fig. 1a) Subglobose to globose horizontally continuous rhizomes, sometimes with roots and rootlets; outer surface slightly wrinkled, brown to dark brown, with scars of pseudostems; fracture light to dark purple, mealy. Some occur as transverse slices, varying in shape and size.

Microscopical (Figs. 2a, 2b) Transverse section of the rhizome shows several layers of corky parenchyma cells. Cortex, broad zone of parenchyma cells, filled with numerous simple starch grains and purple anthocyanins, some of which containing yellowish oleoresins with small particles. Pseudoendodermis, layers of thin-walled rectangular cells. Vascular bundles, scattered; fibres, non-lignified; vessels, spiral, scalariform and reticulate, non-lignified.

Kaempferia Parviflora Rhizome in powder possesses the diagnostic microscopical characters of the unground drug.

1

2

Fig. 1a *Kaempferia parviflora* Wall. ex Baker
1. habit 2. flower 3. crude drug

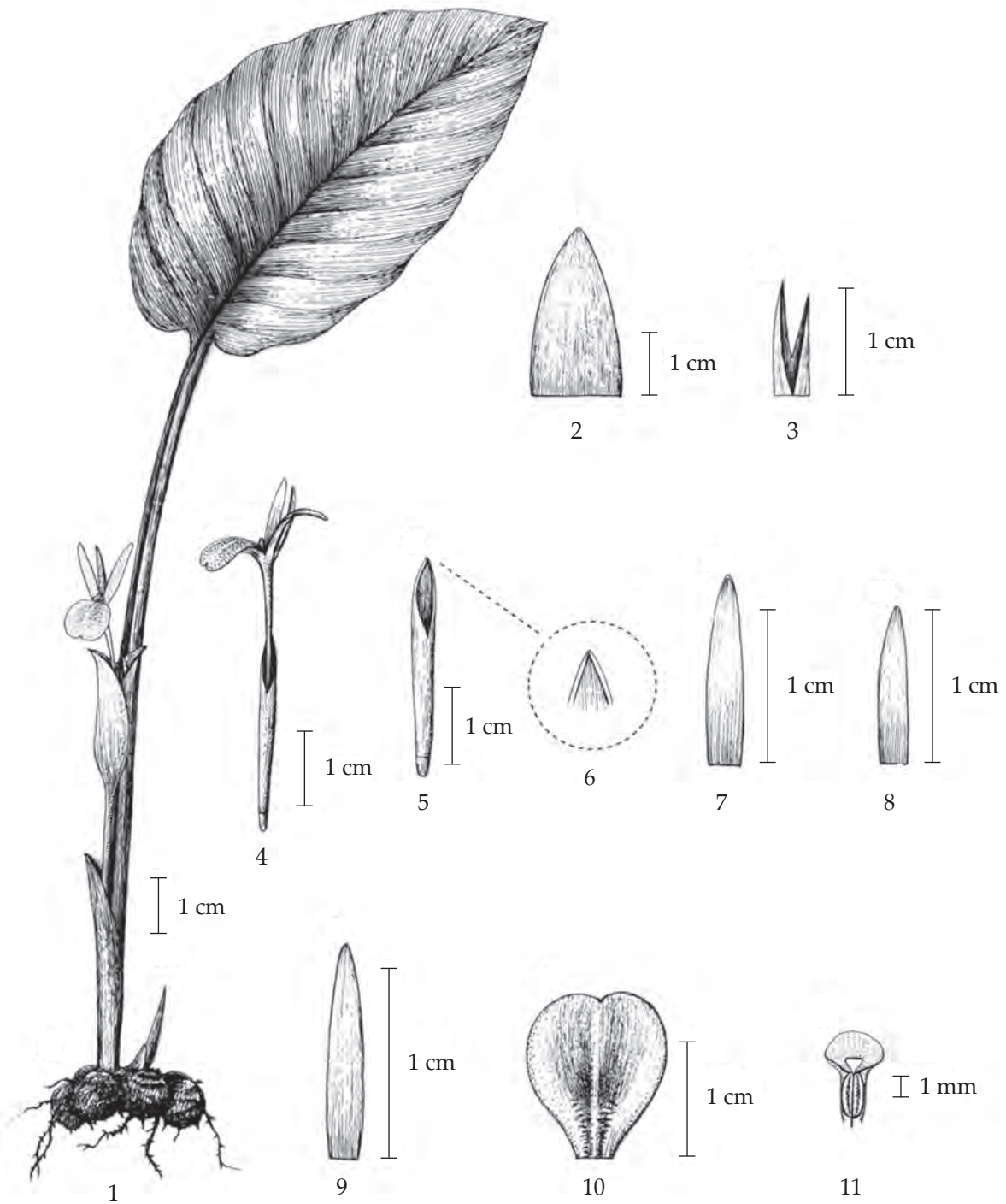


Fig. 1b *Kaempferia parviflora* Wall. ex Baker
1. habit 2. bract 3. bracteole 4. flower 5. ovary and calyx tube 6. apex of calyx tube 7. dorsal corolla lobe 8. lateral corolla lobe 9. lateral staminode 10. labellum 11. anther, stigma and anther crest

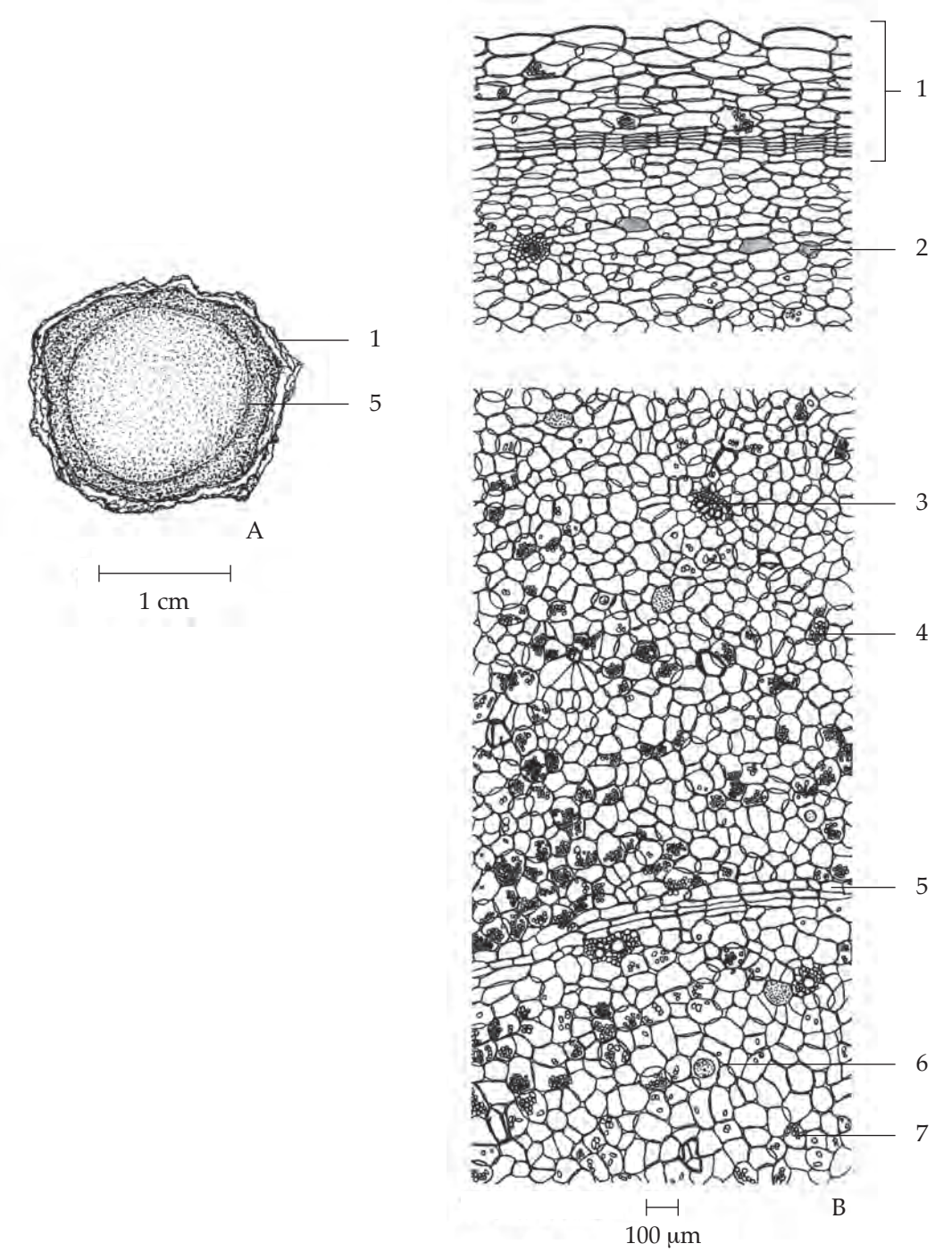


Fig. 2a Transverse Section of the Rhizome of *Kaempferia parviflora* Wall. ex Baker

A. Diagram

B. Part of Transverse Section

1. corky parenchymatous layer
2. parenchyma with purple matter of anthocyanins
3. vascular bundle
4. parenchyma containing starch grains
5. pseudoendodermis
6. parenchyma containing yellow oleoresin
7. starch grains

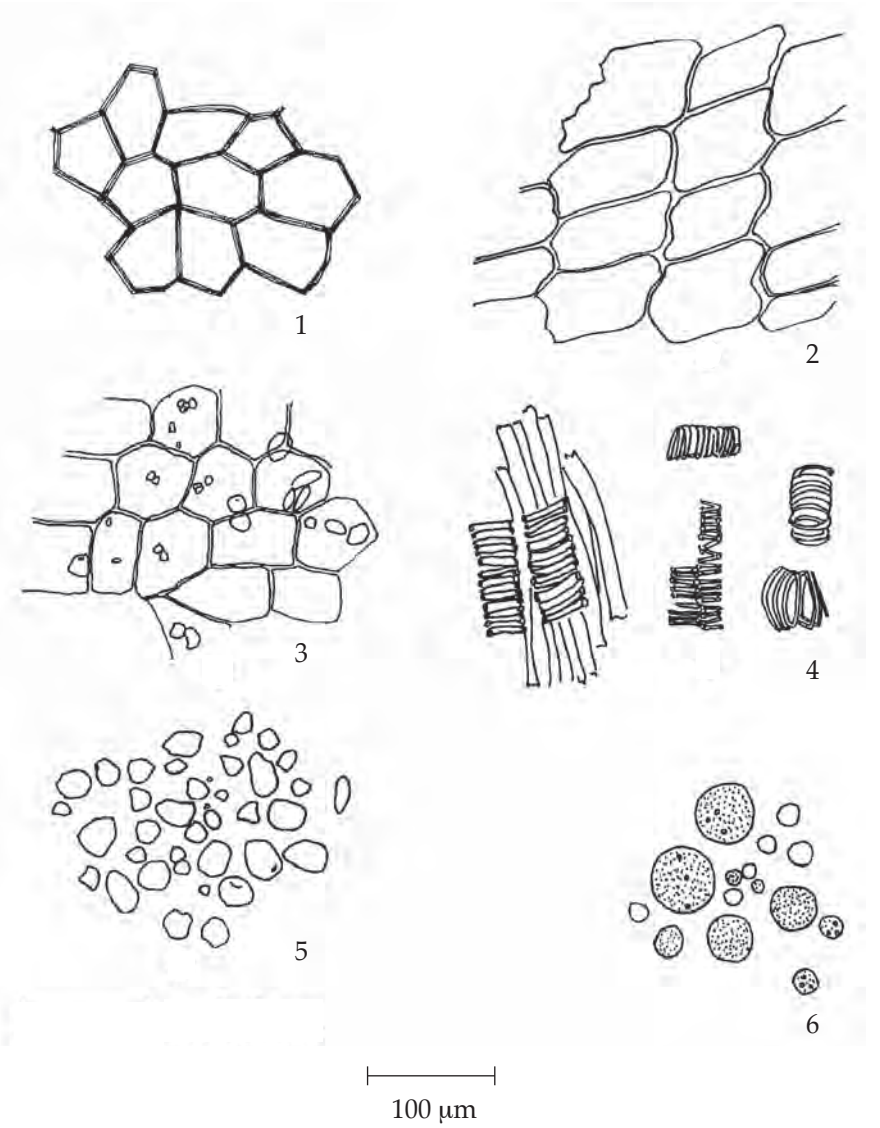


Fig. 2b Powdered Drug of the Rhizomes of *Kaempferia parviflora* Wall. ex Baker
1. corky parenchyma cells in surface view
2. corky parenchyma cells in sectional view
3. parenchyma cells containing starch grains
4. spiral vessels and reticulate vessels associated with fibres
5. starch grains
6. yellowish oleoresins containing small particles

Packaging and storage Kaempferia Parviflora Rhizome shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Reflux 1 g of the sample, in *fine powder*, with 20 mL of *ethanol* for 5 minutes and filter (solution 1). To 5 mL of solution 1, add 1 g of *decolorizing charcoal*, mix and filter. Add 2 drops of a freshly prepared 1 per cent w/v solution of *vanillin* in *ethanolic sulfuric acid*, mix well and heat in a water-bath for 2 minutes: a blue colour is produced.

B. To 2 mL of solution 1, add 1 drop of a 5 per cent w/v solution of *potassium hydroxide*: a green to blue colour is produced and changed to red after adding 1 drop of a 20 per cent v/v solution of *sulfuric acid*.

C. Apply 2 drops of solution 1 to a filter paper and air-dry. Add to the same spot, 1 drop of *ethanolic ninhydrin TS* and dry in a current of hot air: a violet colour develops.

D. To 2 mL of solution 1, add 1 piece of *magnesium ribbon*, shake well and mix with 2 drops of *hydrochloric acid*: a red colour develops.

E. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 60 volumes of n-*hexane*, 30 volumes of *ethyl acetate* and 5 volumes of *formic acid* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply to the plate, 5 μL of the test solution prepared by refluxing 500 mg of the sample, in *fine powder*, with 10 mL of *methanol* for 5 minutes and filtering. Dilute the filtrate with *methanol* to 10 mL. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. Several blue spots also appear. Examine the plate under ultraviolet light (366 nm) through the cut-off filter, five blue fluorescent spots of different hR_f values are observed. Heat the plate at 80° for 10 minutes and then spray with *natural products (NP) TS* while the plate is still warm. Subsequently spray the plate with *polyethyleneglycol (PEG) TS* and observe the colours of the spots under ultraviolet light (366 nm) through the cut-off filter within 5 to 15 minutes. Several fluorescent spots of different colours appear (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Rhizomes of *Kaempferia parviflora* Wall. ex Baker

Spot	hR_f Value	Detection		
		UV 254	UV 366	UV 366 after spraying with *NP/PEG TS*
1	17–26	blue	blue	blue
2	29–35	blue	blue	blue
3	36–40	blue	blue	blue
4	41–46	blue	blue	blue
5	46–52	blue	blue	blue
6	64–69	weak quenching	–	yellow
7	74–78	weak quenching	–	yellow-green
8	78–82	weak quenching	–	yellow
9	83–86	weak quenching	–	yellow
10	87–90	weak quenching	–	orange

Water Not more than 10.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 2.0 per cent w/w (Appendix 7.6).

Total ash Not more than 6.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 8.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 17.0 per cent w/w (Appendix 7.12).

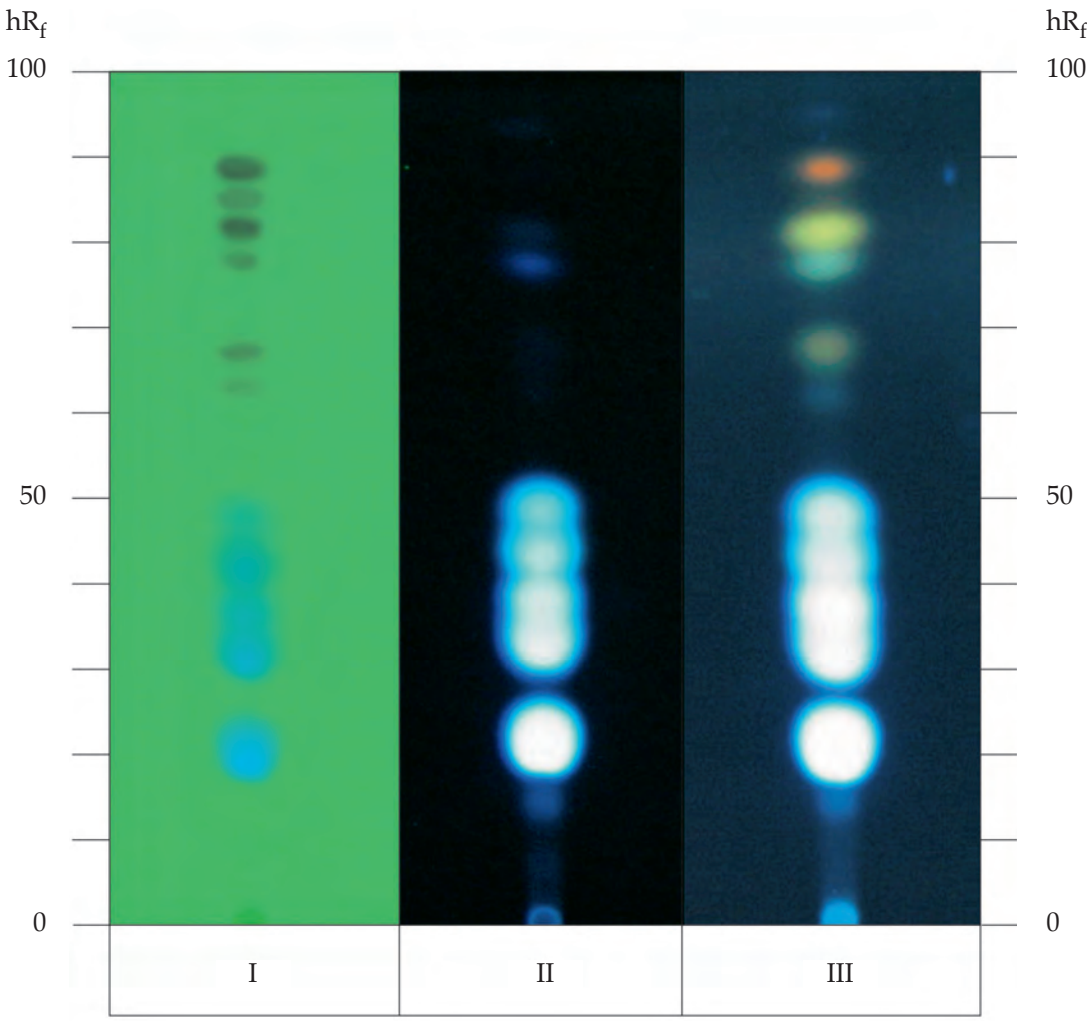


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Rhizomes of *Kaempferia parviflora* Wall. ex Baker

I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection under UV light (366 nm) after spraying with *NP/PEG TS*

กระเจี๊ยบแดง (KRACHIAP DAENG)

กระเจี๊ยบเปรี้ยว (KRACHIAP PRIAO), ส้มปู (SOM PU)
Hibisci Sabdariffae Calycis et Epicalycis
Roselle

Synonyms Jamica Sorrel, Red Sorrel, Sorrel

Category Diuretic.

Roselle is the dried persistent calyx and epicalyx collected during fruiting of *Hibiscus sabdariffa* L. (Family Malvaceae), Crude Drug Number: DMSc 0437.
(**Note** Only dried reddish to dark red Roselle is recommended for medicinal uses.)

Constituents Roselle contains anthocyanins, of which delphinidin-3-sambubioside and cyanidin-3-sambubioside are major components. It also contains organic acids (e.g., citric acid, hibiscus acid, hydroxycitric acid, malic acid), phenolic acids (e.g., protocatechuic acid), flavonoids, mucilages, pectins, potassium salts, etc.

Description of the plant (Figs. 1a, 1b) Annual herb or subshrub 1 to 2(–5) m high; stem erect, cylindrical, branched, woody at base, green when young becoming reddish to purplish with age, glabrous or covered with aculeate warts or caducous bristles. Leaves simple, alternate, dimorphic, proximal leaves ovate, margin serrate, distal leaves palmately 3- to 5-lobed, 6 to 15 cm long, lobes lanceolate, elliptic to oblong, 2 to 8 cm long, 0.5 to 1.5 cm wide, apex obtuse or acuminate, base round or broadly cuneate, margin serrate or dentate, blade glabrous or pubescent, basal veins 3 to 5, green or red, bearing a gland at base of midrib; petiole 4 to 15 cm long, somewhat spiny near the top; stipule filliform, about 1 cm long. Flower solitary, axillary; pedicel less than 3 cm long; epicalyx reddish, 8- to 12-lobed, 6 to 10 mm long, connate at base, adnate to the base of calyx, lobe lanceolate, 0.5 to 1.8 cm long, 2 to 3 mm wide, sparsely hirsute, with spiny appendix near apex; calyx fleshy, reddish or purplish, hirsute, lobes 5, connate below the middle into cup-shaped, each lobe triangular, with a prominent costa extending as far as its apex, base of each sinus between lobes terminated by a bifurcate nerve and bearing a distinct nectary gland, calyx after anthesis becoming thick-fleshy, 2.5 to 5.5 cm long, distinctly longer than fruit; corolla pink or yellow with dark red centre, petals 5, obovate, 4 to 6 cm long, 1 to 4 cm wide; staminal tube 1.5 to 2 cm long, anthers along the tube, pistils in the tube; ovary superior, 5-loculed, ovules 3 to many per locule, style branches 5, stigmas capitate. Fruit capsule, reddish, ovoid to globose, 1.5 to 3 cm long, 1 to 1.5 cm wide, loculicidally 5-valved, beaked, sparsely to densely appressed hairy, enclosed by red, fleshy, accrescent calyx. Seeds numerous, reniform, 2 to 6 mm long, brownish to blackish.

Description Odour, mild, berry-like; taste, sour.

Macroscopical (Fig. 1a) Dried calyx and epicalyx, irregularly shaped and sized, reddish to dark red, somewhat hard. A nectary found in the lower surface at the basal part of each calyx.

Microscopical (Figs. 2a, 2b, 2c) Transverse section of the epicalyx shows epidermis layer, cortex, vascular bundles and pith. Epidermis, a layer of small rectangular cells and some with unicellular trichomes. Cortex, several thin-walled of polygonal parenchyma cells, some containing anthocyanins or rosette aggregate crystals. Vascular bundles, collateral. Aerenchyma, some containing rosette aggregate crystals located at the innermost region.

1

2

3

4

1 cm

Fig. 1a *Hibiscus sabdariffa* L.
1. habit 2. flower 3. persistent calyx and epicalyx 4. crude drug

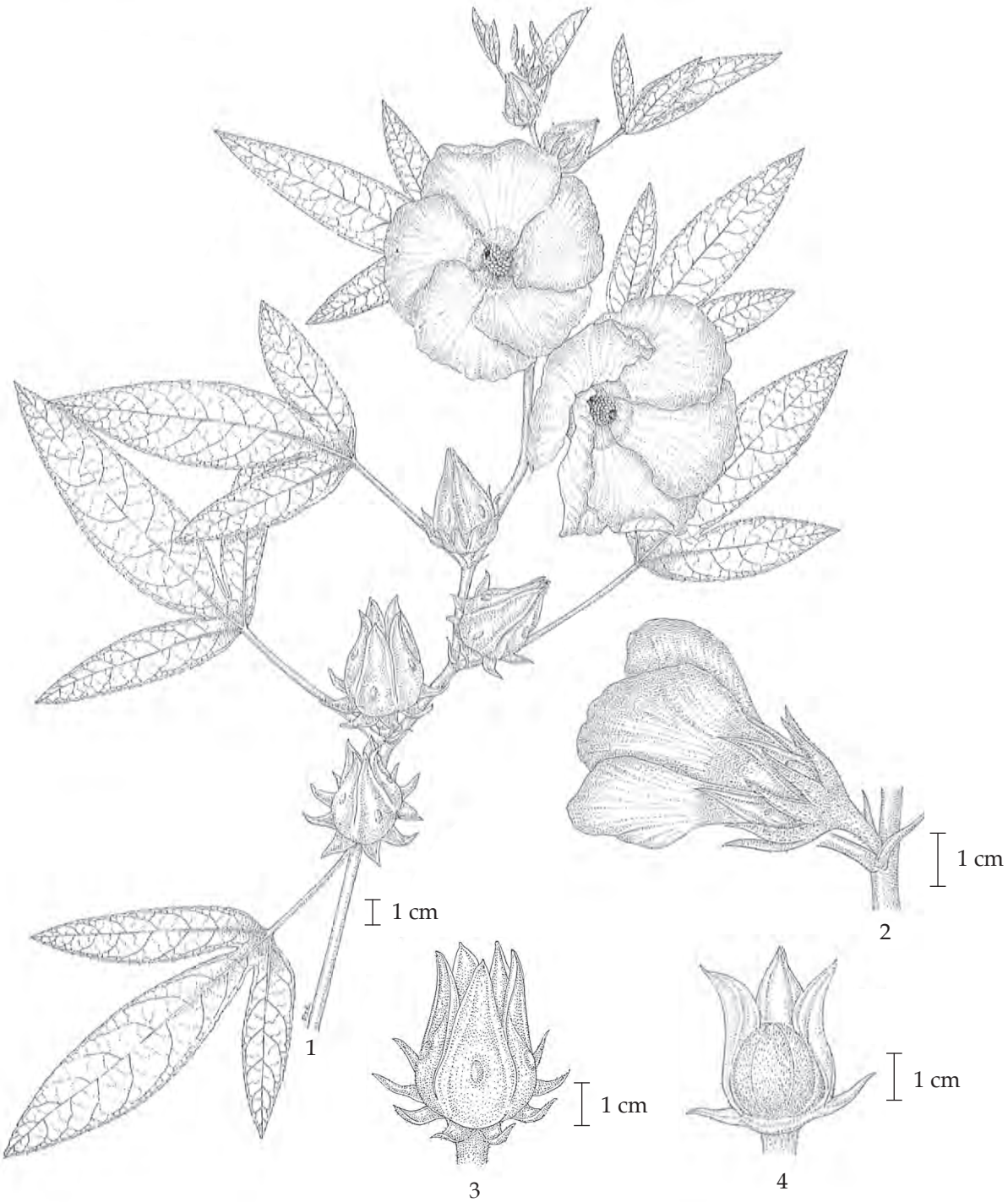


Fig. 1b *Hibiscus sabdariffa* L.
1. flowering and fruiting twig 2. flower 3. persistent calyx and epicalyx
4. persistent calyx and epicalyx, part of calyx removed showing fruit

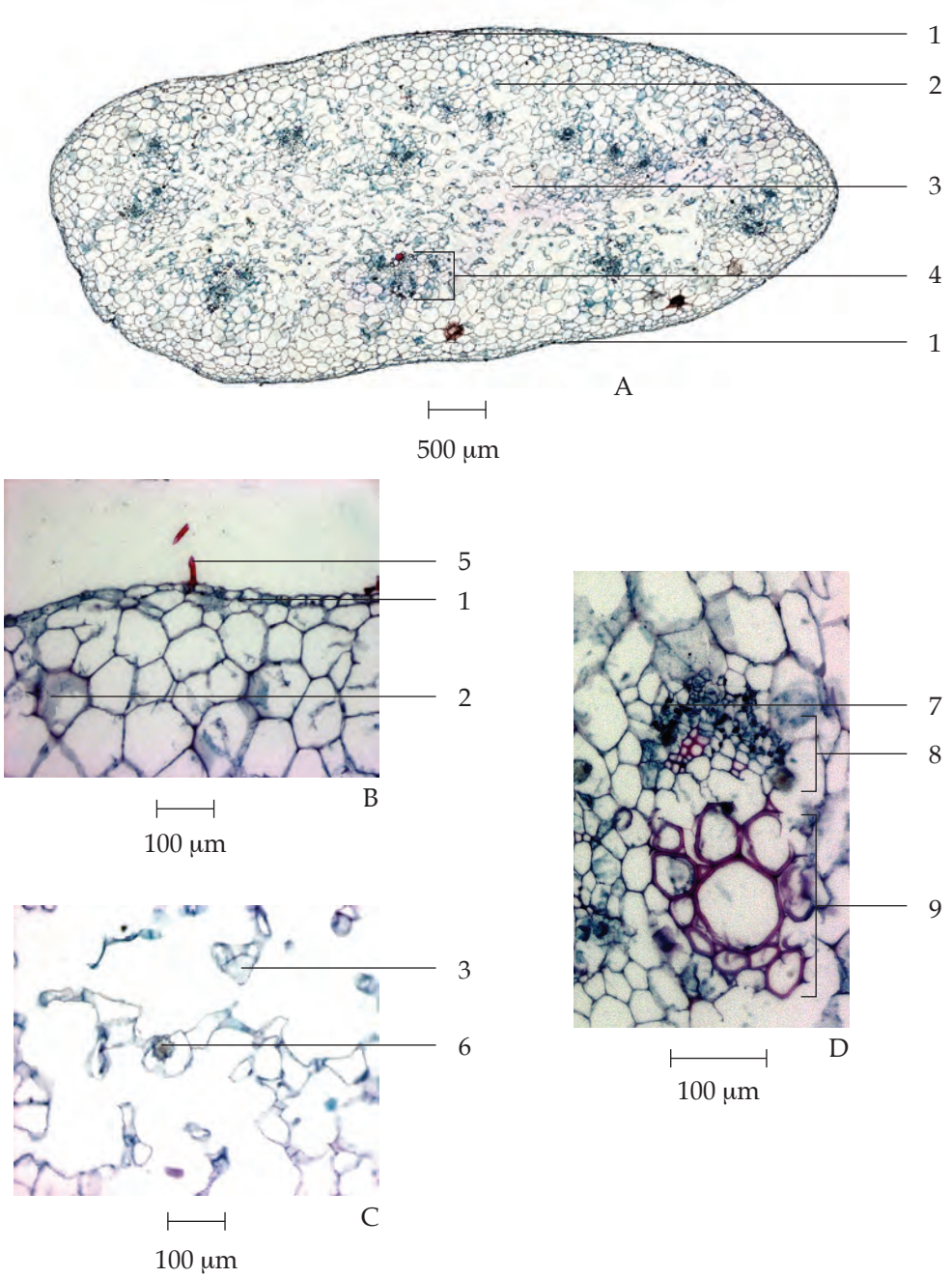


Fig. 2a Photomicrographs of Transverse Sections of the Epicalyx of *Hibiscus sabdariffa* L., Stained with Safranin-Fast Green

A. Whole Epicalyx
B. Outermost Part
C. Innermost Part
D. Vascular Bundle

1. epidermis
2. parenchyma with anthocyanins
3. aerenchyma
4. vascular bundle
5. unicellular trichome
6. rosette aggregate crystal
7. fibre
8. phloem
9. xylem

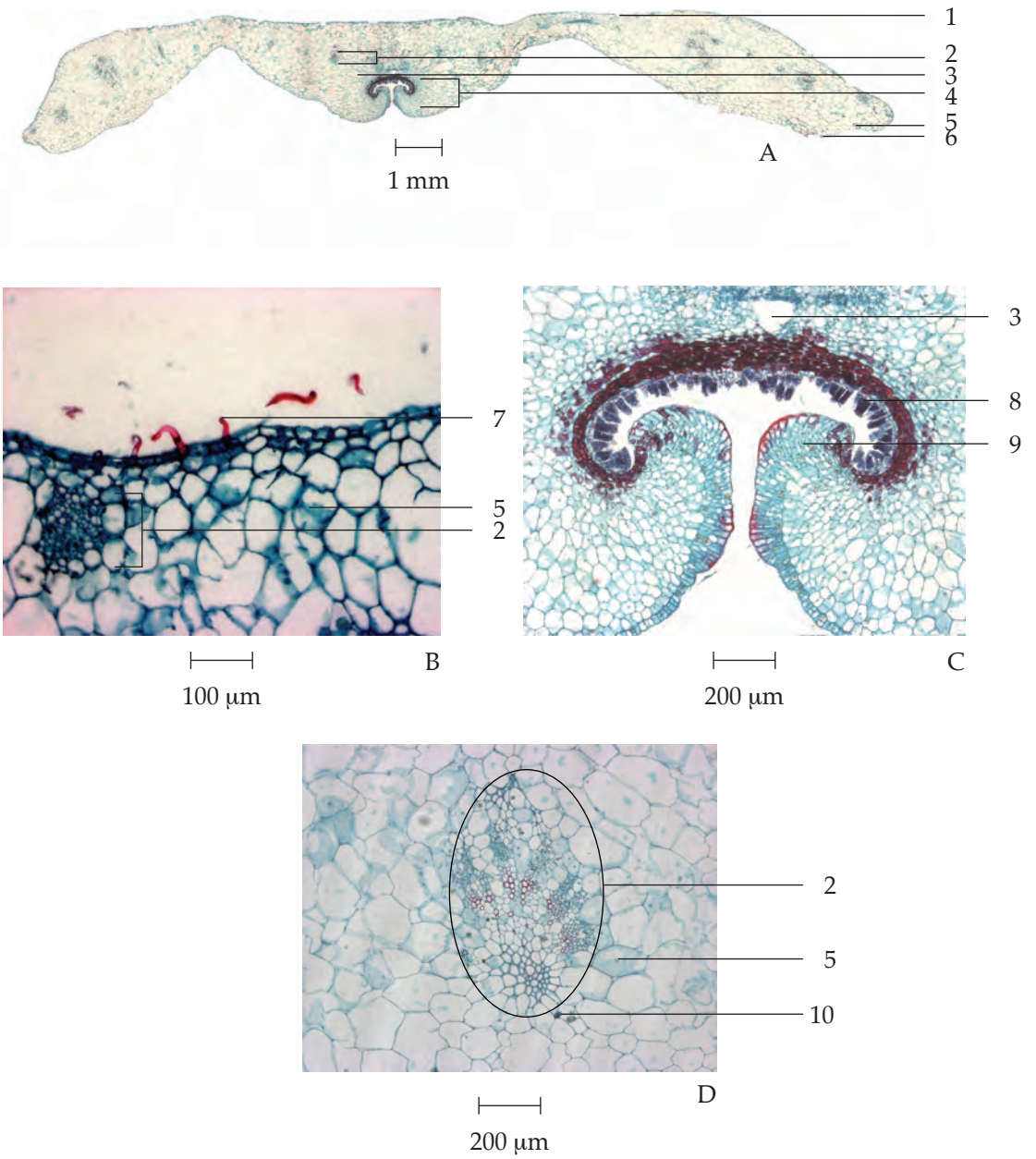


Fig. 2b Photomicrographs of Transverse Sections of the Calyx of *Hibiscus sabdariffa* L., Stained with Safranin-Fast Green

A. Whole Calyx through the Nectary
B. Outermost Part
C. Nectary
D. Innermost Part

1. upper epidermis
2. vascular bundle
3. schizolysigenous duct
4. nectary
5. parenchyma with anthocyanins
6. lower epidermis
7. unicellular trichome
8. glandular trichome
9. columnar parenchyma
10. rosette aggregate crystal

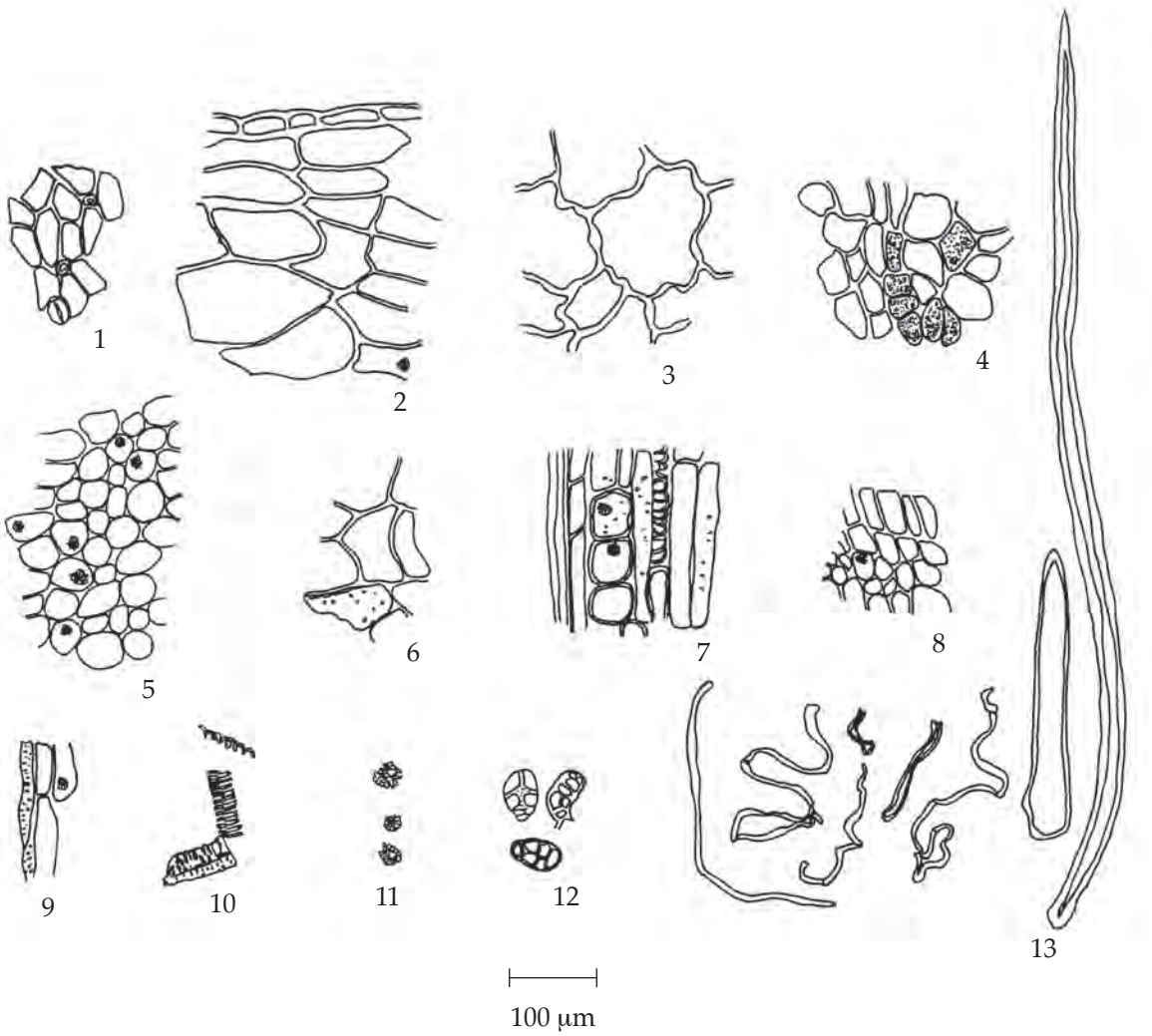


Fig. 2c Powdered Drug of the Calyces and Epicalyces of *Hibiscus sabdariffa* L.

1. lower epidermis, stomata and cicatrices
2. epidermis associated with parenchyma and rosette aggregate crys tal in sectional view
3. parenchyma
4. parenchyma, some containing anthocyanins
5. parenchyma, some containing rosette aggregate crystals
6. parenchyma and pitted parenchyma
7. parenchyma containing rosette aggregate crystals, associated with fibres and vessel
8. columnar parenchyma of nectary
9. parenchyma and pitted vessels
10. spiral and pitted vessels
11. rosette aggregate crystals
12. glandular trichomes
13. unicellular trichomes

Transverse section of the calyx through the nectary shows a layer of upper and lower epidermises, cortex, vascular bundles, and nectary. Upper and lower epidermises, small rectangular cells with some modified unicellular trichomes. Cortex, round parenchyma cells, some containing anthocyanins, rosette aggregate crystals, and schizolysigenous ducts. Vascular bundles, collateral, containing phloem and xylem tissues. Nectary, composed of glandular trichome, small rectangular epidermis and several layers of slightly thick-walled, columnar parenchyma cells, connected with large vascular bundles and schizolysigenous ducts.

Roselle in powder possesses the diagnostic microscopical characters of the unground drug. Columnar parenchyma of nectary, unicellular and glandular trichomes, rosette aggregate crystals, and parenchyma containing anthocanins are characteristic.

Contra-indication It is contra-indicated in patients with impaired renal function.

Packaging and storage Roselle shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. To 300 mg of the sample, in powder, add 8 mL of *water*, shake for 15 minutes and filter (solution 1). To 0.2 mL of solution 1, add 2 M *sodium hydroxide* dropwise: a bluish green colour develops and changes to red after immediately adding a few drops of 2 M *hydrochloric acid*.

B. To 0.2 mL of solution 1, add 4 drops of *iron(III) chloride TS*: a brownish green colour develops.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 60 volumes of *ethyl acetate*, 20 volumes of *2-propanol*, 20 volumes of *water*, and 10 volumes of *formic acid* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply to the plate as a band of 10 mm, 10 µL of the test solution freshly prepared by macerating 1 g of the sample, in powder, in 10 mL of a 0.1 per cent v/v solution of *hydrochloric acid* in *methanol*, shaking frequently for 15 minutes and filtering. After removal of the plate, allow it to dry in air and examine under daylight. Two violet and several purple bands are observed. Spray the plate with a 5 per cent v/v solution of *sulfuric acid* in *methanol* and heat at 100° for 10 minutes; two pink and other several bands of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Calyces and Epicalyces of *Hibiscus sabdariffa* L.

Band	hR_f Value	Detection	
		Daylight	5 Per Cent V/V Solution of *Sulfuric Acid* in *Methanol*
1	3–5	pale violet	–
2	5–7	–	pale brown
3	5–8	pale purple	–
4	11–13	–	pale brown
5	12–14	pale purple	–
6	15–22	pale purple	–
7	17–22	–	grey
8	31–35	violet	pink
9	34–39	–	pale grey
10	40–44	purple	pink
11	43–47	–	pale grey
12	56–59	–	pale grey
13	70–73	–	pale violet
14	73–75	–	pale brown
15	89–90	–	pale violet
16	93–95	–	grey

Loss on drying Not more than 12.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 1.5 per cent w/w (Appendix 7.6).

Total ash Not more than 10.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 7.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 45.0 per cent w/w (Appendix 7.12).

Acid content Not less than 12.0 per cent w/w of acids, calculated as citric acid on the dried basis, when determined by the following method.

Shake 1 g of Roselle, in *No. 250 powder*, accurately weighed, with 100.0 mL of *carbon dioxide-free water* for 15 minutes and filter. To 50.0 mL of the filtrate, add 100 mL of *carbon dioxide free-water*. Titrate with 0.1 M *sodium hydroxide VS* until pH 7.0, determining the end-point potentiometrically (Appendix 6.4). Perform a blank determination, and make any necessary correction. Each mL of 0.1 M *sodium hydroxide VS* is equivalent to 6.4 mg of citric acid.

Dose 1.5 to 3 g of powdered roselle, taken as an infusion, three times a day.

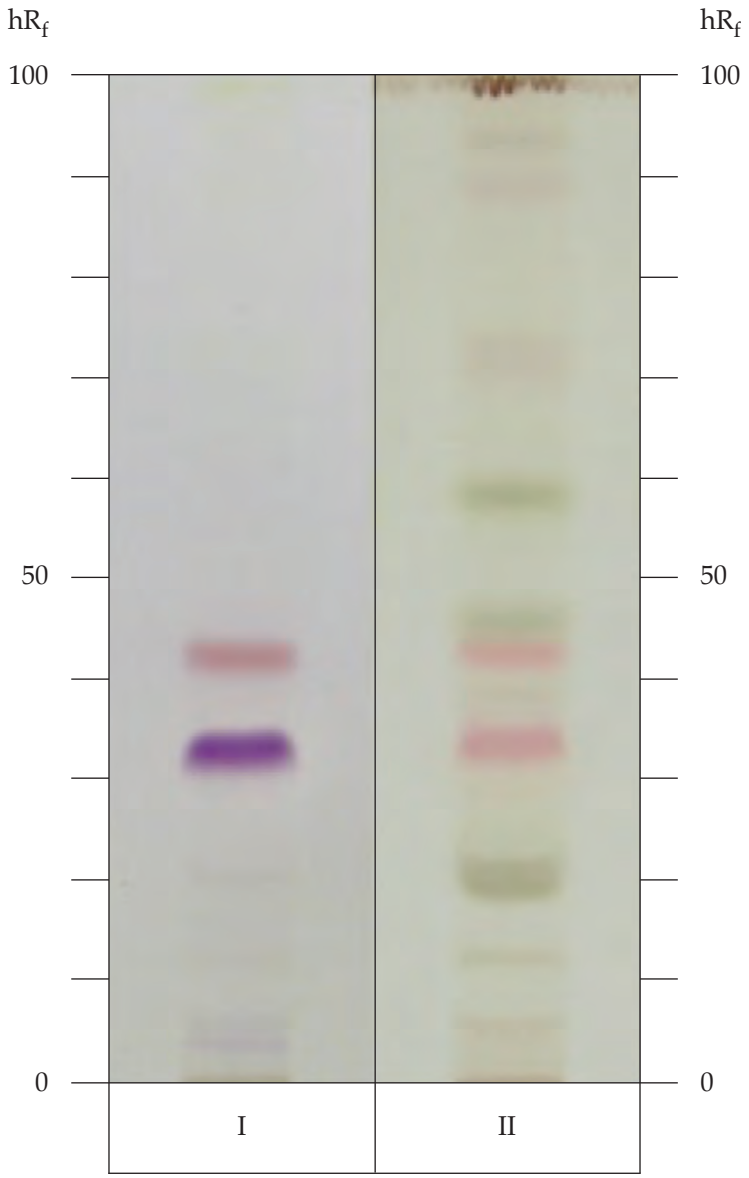


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Calyces and Epicalyces of *Hibiscus sabdariffa* L.

I = detection under daylight

II = detection with a 5 per cent v/v solution of *sulfuric acid* in *methanol*

ยาชงกระเจี๊ยบแดง (YA CHONG KRACHIAP DAENG)

Roselle Tea

Synonym Sour Tea

Category Diuretic.

Roselle Tea contains an amount of powdered Roselle equivalent to not less than 90.0 per cent and not more than 110.0 per cent of the labelled amount of organic acids, calculated as citric acid on the dried basis.

Strengths available 2, 2.5 and 3 g (powder), supplied in a sachet.

Dose One sachet, containing 2 to 3 g of powdered roselle, prepared as an infusion by soaking each with 120 mL of boiling water for 10 minutes, three times a day after meals.

Contra-indication It is contra-indicated in patients with impaired renal function.

Warning

1. It may cause abdominal discomfort.
2. It may cause diarrhea due to its laxative effect.

Packaging and storage Roselle Tea shall be kept in well-closed containers, protected from light, and stored at a temperature not exceeding 30°.

Labelling The label on the container states (1) the equivalent amount of organic acids calculated as citric acid; (2) the expiration date.

Identification

A. The tea contents exhibit diagnostic structures of the powdered drug described under *Roselle*.

B. The tea contents comply with the tests for Identification A, B and C described under *Roselle*.

Loss on drying Of the tea contents, not more than 12.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Microbial limit Complies with the requirements for Category 2 in the "Limits for Microbial Contamination" (Appendix 10.5).

Assay Grind the contents of not less than 20 sachets of Roselle Tea to *No. 250 powder*. Shake about 1 g, accurately weighed, with 100.0 mL of *carbon dioxide-free water* for 15 minutes and filter. To 50.0 mL of the filtrate, add 100 mL of *carbon dioxide free-water*. Titrate with 0.1 M *sodium hydroxide VS* until pH 7.0, determining the end-point potentiometrically (Appendix 6.4). Perform a blank determination, and make any necessary correction. Each mL of 0.1 M *sodium hydroxide VS* is equivalent to 6.4 mg of citric acid.

Other requirements Complies with the requirements described under "Herbal Teas" (Appendix 1.16H).

กระเทียม (KRATHIAM)

Allii Sativi Bulbus
Garlic

Category Carminative, expectorant, antimicrobial (topical), antihyperlipidemic.

Garlic is the fresh compound bulb of *Allium sativum* L. (Family Amaryllidaceae), Herbarium Specimen Number: DMSC 901.

Constituents Garlic contains 0.1 to 0.3 per cent of volatile oil containing allyl disulfide and diallyl disulfide, other organic sulfur compounds including alliin and allicin. It also contains alliinase, mucilage, albumin, vitamins, thioglycosides, etc.

Description of the plant (Figs. 1a, 1b) Herb 30 to 60 cm high; subterraneous bulb broadly ovoid, 1 to 4 cm in diameter, often consisting of several crowded bulbils, enclosed by whitish or purplish sheath. Leaves simple, alternate, linear, up to 60 cm long, 0.4 to 2.5 cm wide, longitudinally folded with keel on lower surface, sheathing at base. Inflorescence umbel, globose, with large spathe, usually with bulb-like nodules; peduncle up to 60 cm high. Flower small; tepals 6, oblong, acuminate, white to greenish white, or purple; stamens 6. Fruits capsule small, 3-valved.

Description Odour, aromatic and characteristic; taste, pungent and persistent.

Macroscopical (Fig. 1a) Subglobular compound bulb 3 to 5 cm broad, consisting of 8 to 20 cloves, the whole surrounded by 2 to 5 layers of white scale leaves attached to a flattened circular base. Cloves ovoid and 3- to 4-sided, summit acute, narrowed into a thread-like portion of fibre, base truncate. Each clove is covered with a white scale leaf and a pinkish white epidermis easily separated from the solid portion, consisting of two flaky scale leaves and two yellowish green conduplicate foliage leaves.

Microscopical (Fig. 2) Outer and inner scale leaves have outer epidermis of elongated, subrectangular cells with beaded walls; outer epidermis of inner scale are markedly sclerenchymatous. The hypodermal cells are elongated and thick-walled with triangular intercellular spaces at the corners. Each cell contains a prism of calcium oxalate 20 to 50 μm long. Broad zone of large thin-walled parenchyma in which vascular bundles scattered. Inner epidermis consists of elongated beaded walled cells. Scale leaf cells lignified. Fleshy leaf bases have a thin-walled epidermis, a mesophyll of oval parenchyma cells and faintly lignified annular and spiral vessels.

1

2

3

4

5

Fig. 1a *Allium sativum* L.
1. habit 2. inflorescence 3. fruits 4. fresh bulbs and roots 5. crude drug

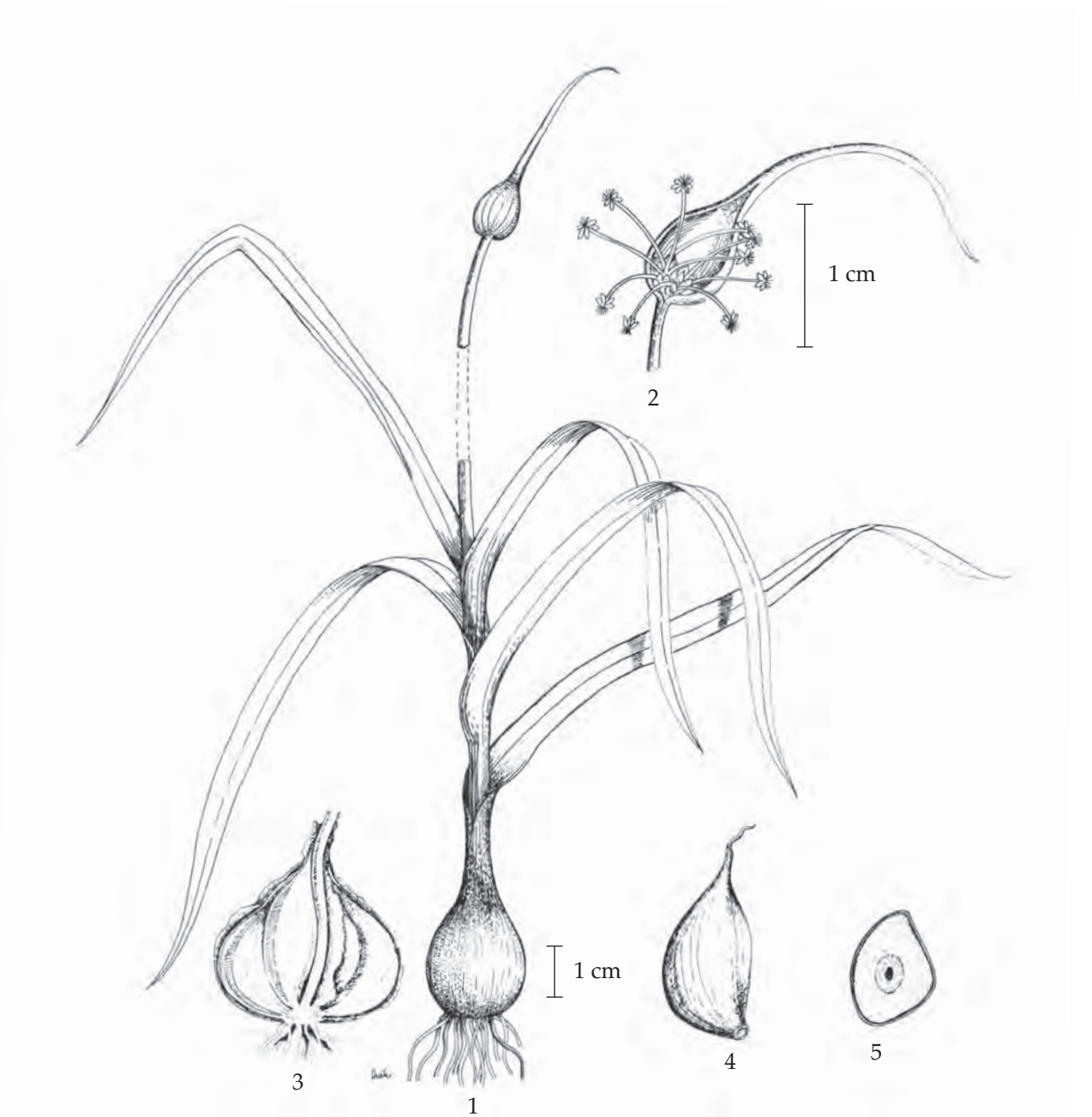


Fig. 1b *Allium sativum* L.
1. habit 2. inflorescence 3. garlic bulb 4. garlic clove 5. cross section of garlic clove

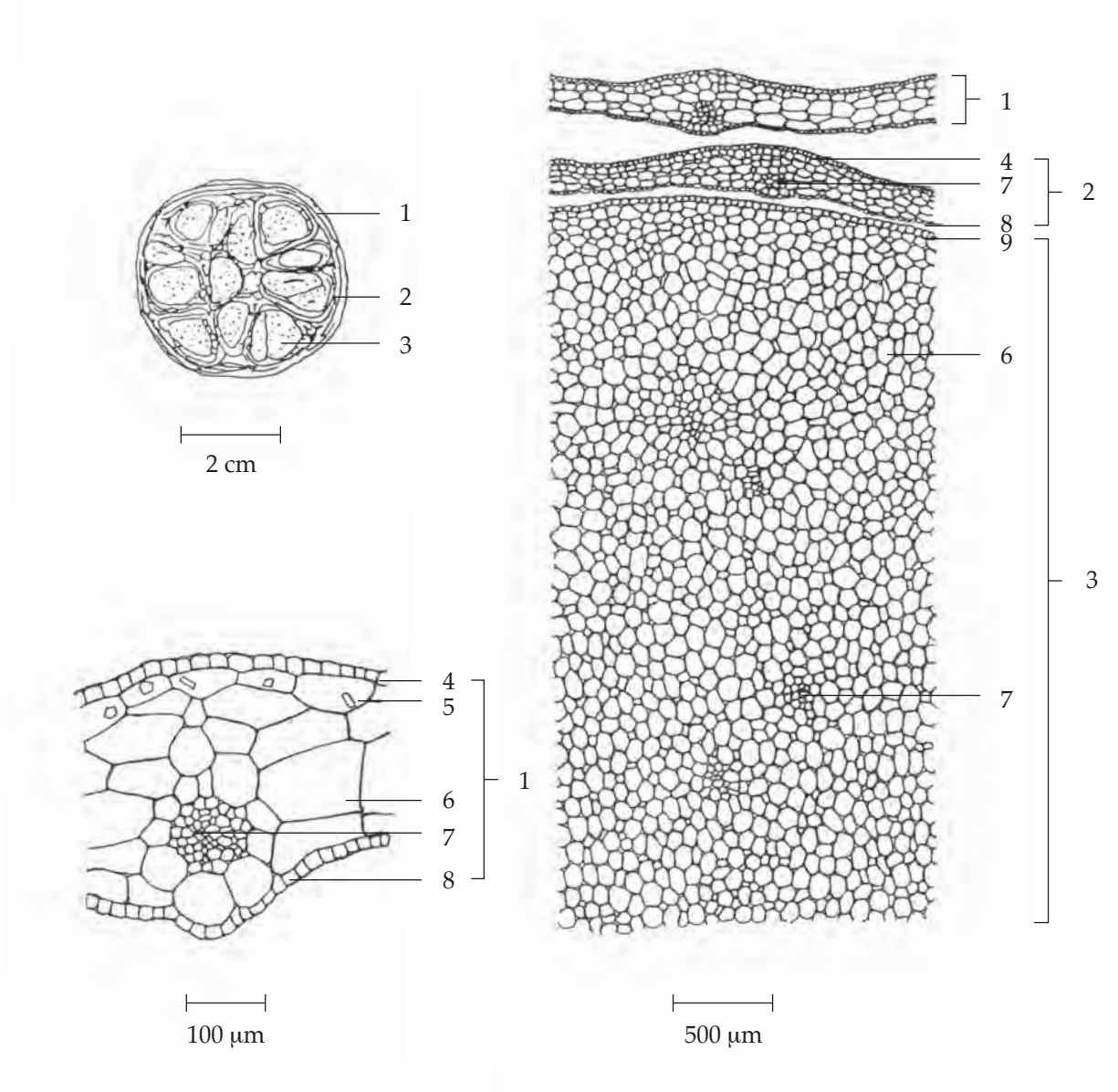


Fig. 2 Transverse Section of the Bulblet of *Allium sativum* L.

1. outer scale leaf
2. inner scale leaf
3. fleshy leaf base
4. outer epidermis
5. hypodermis containing prism
6. parenchyma
7. vascular bundle
8. inner epidermis
9. epidermis

Storage Garlic shall be stored in a well-ventilated, dry place, protected from light; under these conditions it may be stored for about 6 months after harvesting.

Identification

A. Shake 500 mg of crushed, peeled sample with 25 mL of *methanol* for 5 minutes and filter. Dilute 0.5 mL of the filtrate to 2 mL with *methanol*, add 2 drops of *ninhydrin TS* and immerse in a water-bath for a few minutes: a violet-blue colour is produced.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 30 volumes of *1-butanol*, 10 volumes of *water*, 10 volumes of *1-propanol*, and 10 volumes of *glacial acetic acid* as the mobile phase. Apply separately to the plate, 20 μL each of the following two solutions. Prepare solution (A) by refluxing 1 g of the crushed, peeled sample, with 10 mL of an 80 per cent v/v solution of *methanol* on a water-bath for 15 minutes, cooling and filtering. For solution (B), dissolve 25 mg of L-*methionine* in 100 mL of *methanol*. After removal of the plate and allow it to dry in air. Spray with *ethanolic ninhydrin TS*, heat at 105° for about 10 minutes and examine in daylight. Major spots relative to L-*methionine* (RR_f 1) are approximately as follows: purplish brown (RR_f 0.9), purplish brown (RR_f 0.8), orange-brown (RR_f 0.6), pale orange (RR_f 0.38).

In case L-*methionine* cannot be obtained, follow the same procedure but use only solution (A). Several spots of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Mathanolic Extract of the Cloves of *Allium sativum* L.

Spot	hR_f Value	Detection
		Ethanolic Ninhydrin TS
1	10–13	reddish orange
2	17–26	pale orange
3	22–30	violet
4	28–38	orange-brown
5	34–39	purple
6	41–47	purplish brown
7	50–54	purplish brown

Acid-insoluble ash Not more than 2.0 per cent w/w (Appendix 7.6).

Total ash Not more than 5.0 per cent w/w (Appendix 7.7).

GARLIC CLOVES
Allii Sativi Bulbletus.

Description Odour, aromatic; taste, pungent and persistent.

Macroscopical Cloves ovoid and 3- to 4-sided, summit acute, narrowed into a thread like portion of fibre, base truncate. Each clove is covered with a white scale leaf and a pinkish white or purplish white epidermis easily separated from the solid portion, consisting of two flaky scale leaves and two yellowish green conduplicate foliage leaves.

Microscopical (Fig. 2) Inner epidermis consists of bead-walled elongated cells, hypodermis of thick-walled elongated cells with triangular intercellular spaces at the corners. Scale leaf cells lignified. Fleshy scale leaves have a thin-walled epidermis, a mesophyll of oval parenchyma cells and faintly lignified annular and spiral vessels.

Identification Complies with the test for Identification described under *Garlic*.

Water Not more than 68.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter The proportion of scale leaves, degenerated cloves and other foreign matter does not exceed 3.0 per cent w/w, of which the degenerated cloves do not exceed 1.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 1.0 per cent w/w (Appendix 7.6).

Total ash Not more than 2.5 per cent w/w (Appendix 7.7).

Water-soluble extractive Not less than 15.0 per cent w/w (Appendix 7.12).

Dose 2 to 4 g three times a day.

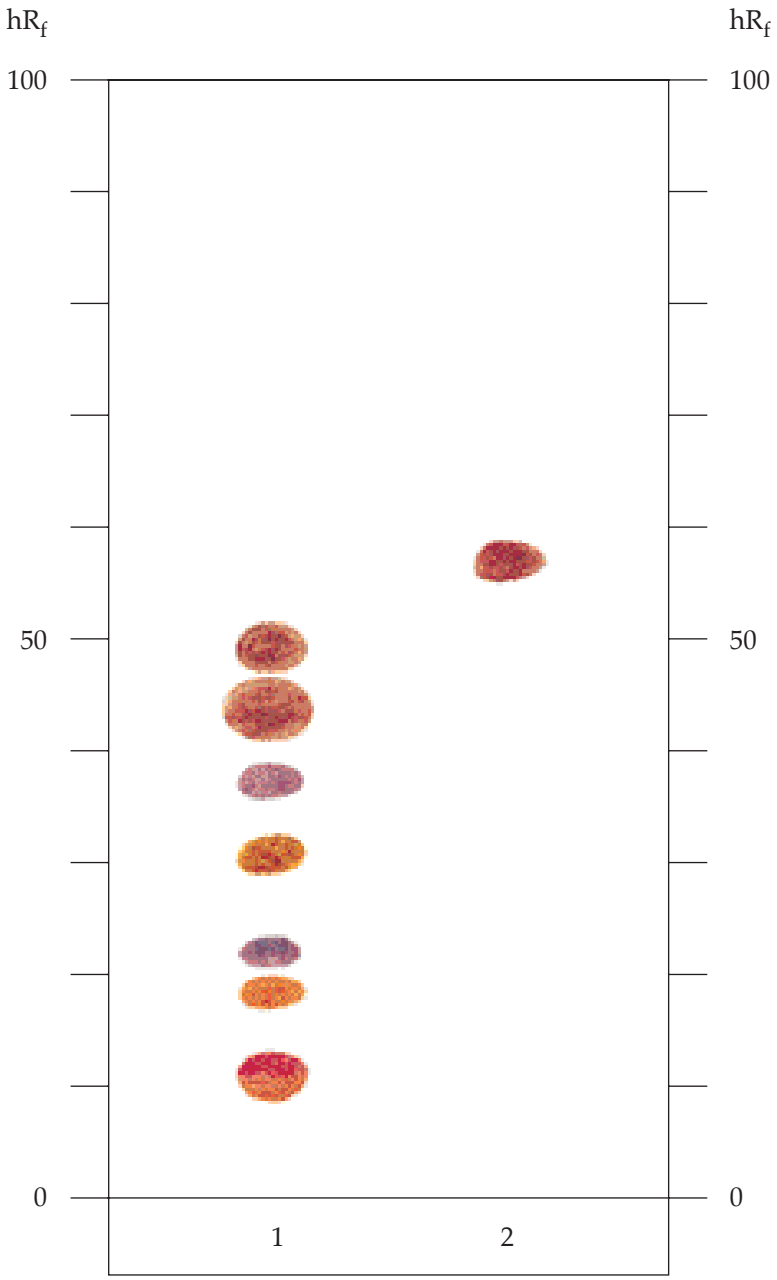


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Cloves of *Allium sativum* L., Detected with *Ethanolic Ninhydrin TS*

1 = solution (A)

2 = solution (B)

กระทือ (KRATHUE)

หัวทือ (HUA THUE), อีทือ (I THUE), กระทือบ้าน (KRATHUE BAN)
Zingiberis Zerumbeti Rhizoma
Zerumbet Ginger

Synonyms Bitter Ginger, Pinecone Ginger, Shampoo Ginger

Category Antiflatulent, stomachic.

Zerumbet Ginger is the dried rhizome of *Zingiber zerumbet* (L.) Sm. (Family Zingiberaceae), Herbarium Specimen Number: DMSC 5169, Crude Drug Number: DMSc 0787.

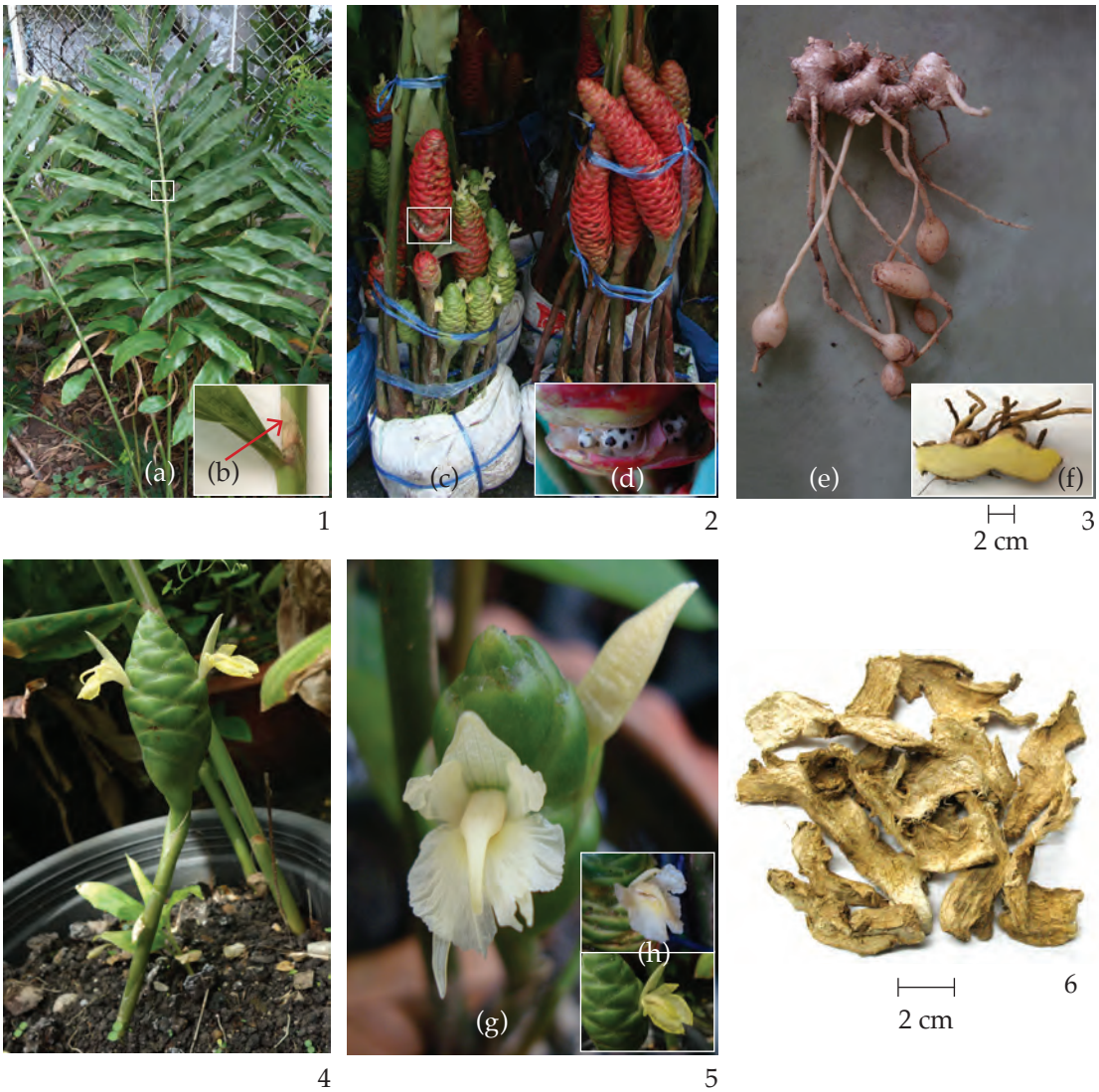
Constituents Zerumbet Ginger contains volatile oil, of which sesquiterpenoids (e.g., α-caryophyllene, zerumbone) and monoterpenoids (e.g., camphene, camphor, 1,8-cineole) are its major components. It also contains flavonoids (e.g., kaempferol and its derivatives), etc.

Description of the plant (Figs. 1a, 1b) Perennial herb with thick rhizome; rhizome branched, tuberous, light yellow to yellow, aromatic. Leafy shoot 1 to 1.8 m high with 11 to 20 leaves, leaves distichous; leaf blade obovate to oblong-lanceolate, 36 to 42 cm long, 9 to 11 cm wide, apex acuminate, base narrow, glabrescent or abaxially somewhat pilose; ligule thin, appress to the leafy shoot, entire, sometimes dried and scarious, 2.6 to 3 cm long, 1.3 to 1.6 cm wide. Inflorescence(s) scapose, 1 to 2, with yellowish green to dull red sheaths, 10 to 22 cm long; spike ovoid-oblong or oblong, 6 to 15 cm long, 3.5 to 5 cm wide, apex acute to obtuse, with 50 to 70 floral bracts; bract closely imbricate, orbicular to obovate, 3.5 to 3.8 cm long, 2 to 3.5 cm wide, apex round, pubescent, green turning red after flowering, 1-flowered, persistent; bracteole elliptic, 2.4 to 2.8 cm long, 1 to 1.8 cm wide, sparsely hairy on the upper surface. Flower cream, pale yellow, or yellow; calyx tubular, tube about 7 mm long, apex 3-toothed; corolla tube slender, 2.8 to 3.4 cm long, glabrous, apex divided into 3 lobes, dorsal lobe 1.7 to 2 cm long, 0.8 to 1 cm wide, lateral lobes 1.6 to 1.9 cm long, about 0.5 cm wide; lateral staminodes adnate to labellum, forming 3-lobed labellum, mid lobe orbicular or elliptic, 1.1 to 1.9 cm long, 1.1 to 2.2 cm wide, apex emarginate or bilobed, side lobes 7 to 9 mm long, 4 to 9 mm wide, apex obtuse; fertile stamen 1, filament short, anther about 1 cm long, connective appendage beak-like, about 8 mm long, wrapped-around style; ovary inferior, glabrous, about 4 mm long, 3-loculed; ovules numerous per locule. Fruit capsule, ellipsoid, 0.8 to 1.2 cm long. Seeds numerous, oblong, black, covered with arils; aril white, margin irregularly lacerate.

Description Odour, characteristic and slightly aromatic; taste, pungent and slightly bitter.

Macroscopical (Fig. 1a) Oblique or transverse slices of the rhizome, some with longitudinal slices, irregularly shaped, 2 to 5 mm thick; cutting surface yellowish to light brown; outer surface light brown, longitudinally wrinkled, some with root scars. Texture compact, fibrous.

Microscopical (Figs. 2a, 2b) Transverse section of the rhizome shows epidermis, storied cork, parenchyma, pseudoendodermis, and vascular tissues. Epidermis, a single layer of rectangular cells. Storied cork, several layers of suberized thin-walled rectangular cells. Parenchyma, thin-walled cells containing numerous round to oval starch grains, some with oleoresin, or oil droplets. Pseudoendodermis, 1 to 3 layer(s) of suberized thin-walled cells. Vascular bundles, collateral and scattered; vessels, spiral, scalariform and reticulate.



1 2 3 4 5 6

Fig. 1a *Zingiber zerumbet* (L.) Sm.
1. habit (a), ligule (b) 2. flowering and fruiting shoots (c), seeds with arils (d)
3. rhizome with roots and root nodules (e), cutting surface of rhizome (f)
4. spike showing bracts with two flowers 5. flower showing corolla lobe, staminode, labellum, and anther crest (g), whitish- and yellow-coloured flowers (h) 6. crude drug

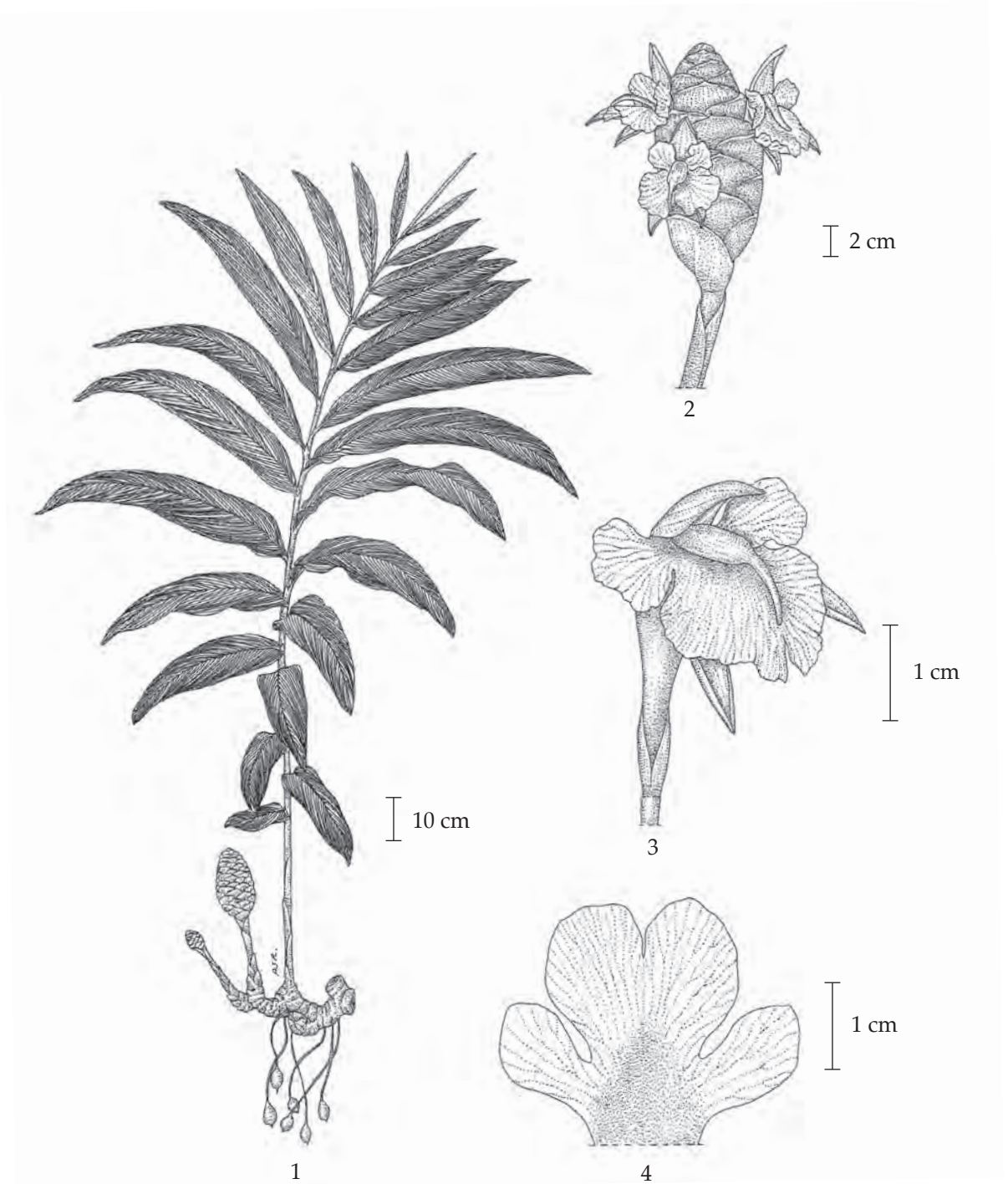


Fig. 1b *Zingiber zerumbet* (L.) Sm.
1. habit 2. flowering scape with flowers 3. flower (oblique view)
4. stamen with attached lateral staminodes

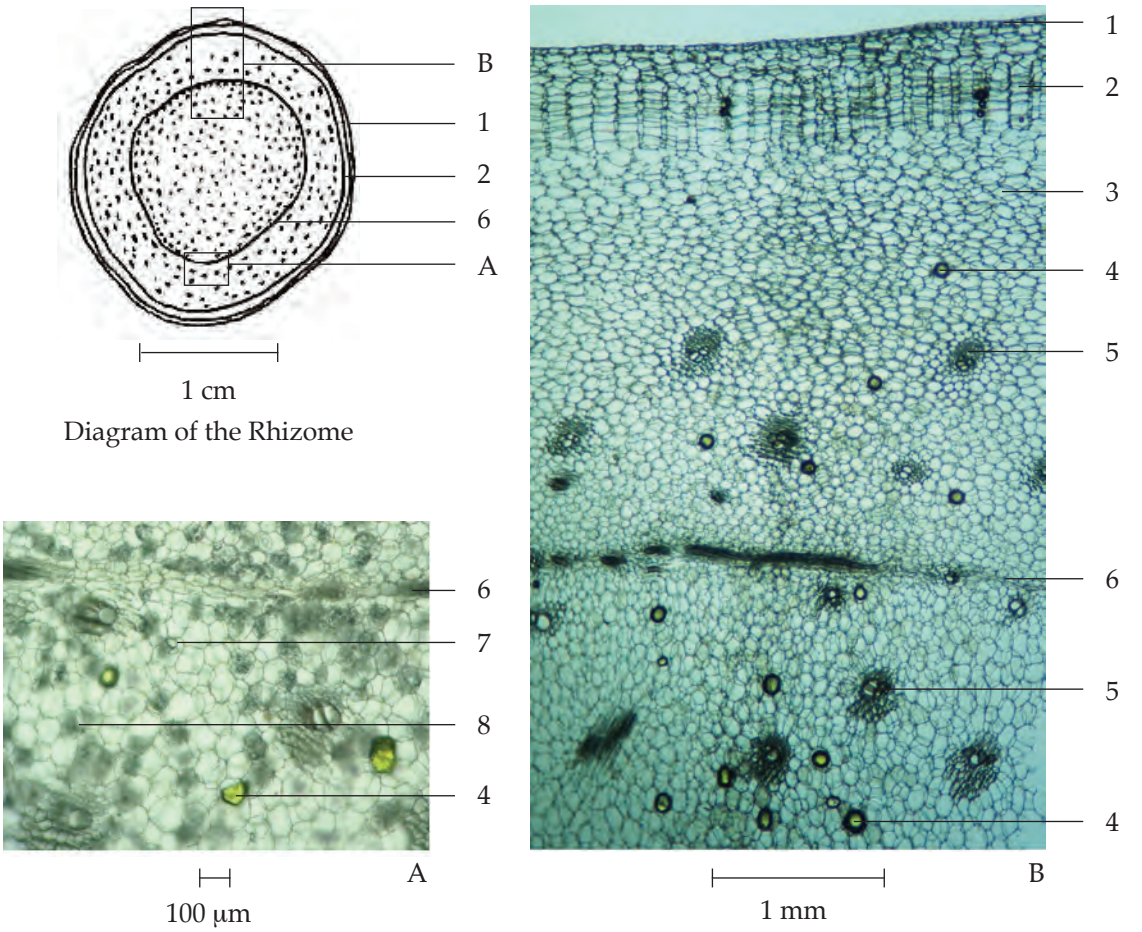


Fig. 2a Photomicrographs of Transverse Sections of the Rhizome of *Zingiber zerumbet* (L.) Sm.
A., B. Parts of Transverse Section

1. epidermis
2. storied cork
3. parenchyma
4. oleoresin
5. vascular bundle
6. pseudoendodermis
7. oil droplet
8. parenchyma with starch grains

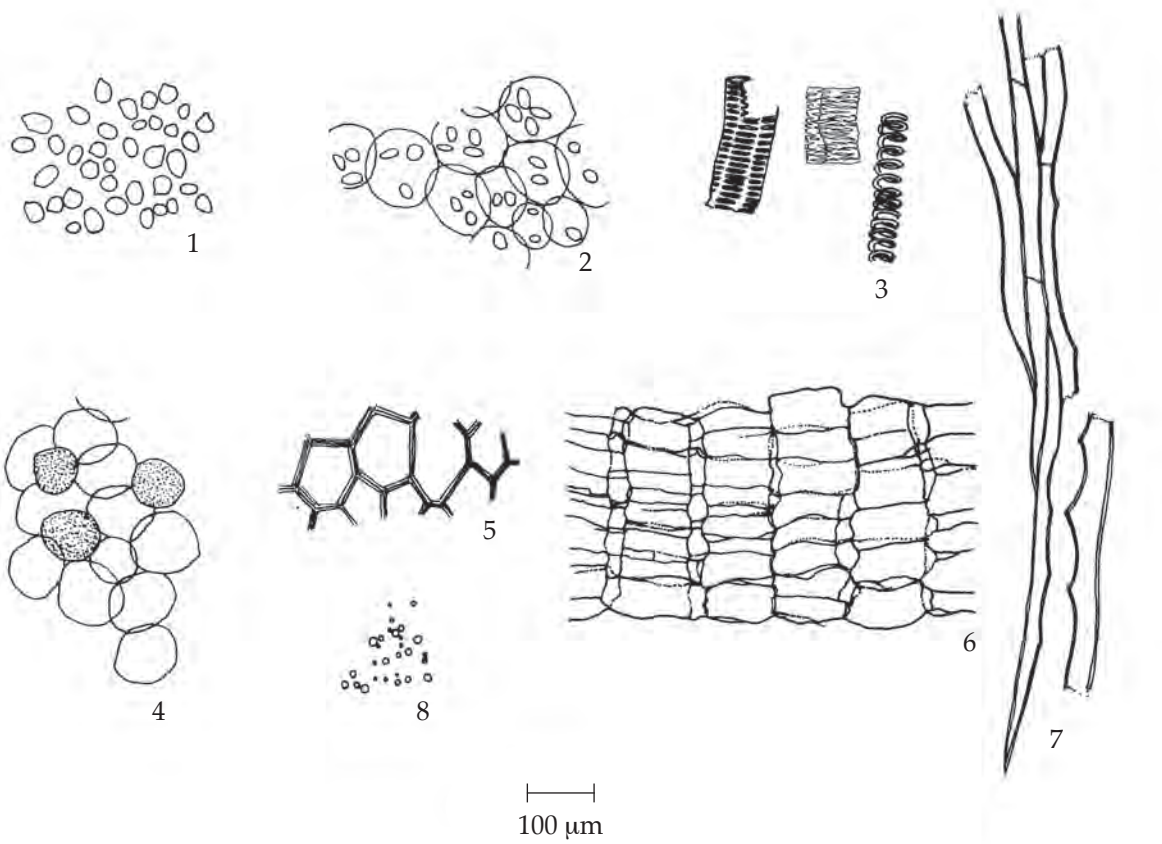


Fig. 2b Powdered Drug of the Rhizomes of *Zingiber zerumbet* (L.) Sm.

1. starch grains
2. parenchyma containing starch grains
3. scalariform, reticulate and spiral vessels
4. parenchyma, some with oleoresin
5. storied cork in surface view
6. storied cork in sectional view
7. septate fibres, some with dentate wall
8. oil droplets

Zerumbet Ginger in powder possesses the diagnostic microscopical characters of the unground drug. Elongate-elliptic, beaked starch grains and scalariform and reticulate vessels are abundant. Oil droplets and oleoresins can also be observed. Septate fibres, some with dentate wall are characteristic.

Additional information The fresh rhizomes are traditionally used as a galactagogue.

Packaging and storage Zerumbet Ginger shall be kept in well-closed containers, preferably of metal or glass, protected from light and stored in a cool and dry place.

Identification

A. Warm 500 mg of the sample, in powder, with 10 mL of *water* on a water-bath for 15 minutes and filter. To 2 mL of the filtrate, add a few drops of *iron(III) chloride TS*: a greenish brown colour is produced.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 75 volumes of *toluene* and 25 volumes of *ethyl acetate* as the mobile phase. Apply to the plate, 5 µL of the test solution prepared by macerating 1 g of the sample, in *No. 250 powder*, in 10 mL of *methanol* for 6 hours, filtering and evaporating the filtrate to dryness. Dissolve the residue in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; one yellow and one bluish yellow fluorescent spots are observed. Spray the plate with *anisaldehyde TS* and heat at 120° for 5 minutes; two pink and three purple spots appear (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Rhizomes of *Zingiber zerumbet* (L.) Sm.

Spot	hR_f Value	Detection		
		UV 254	UV 366	*Anisaldehyde TS*
1	20–24	quenching	–	–
2	24–32	–	yellow	–
3	35–40	–	–	purple
4	48–54	quenching	–	pink
5	55–61	–	–	pale pink
6	57–64	–	bluish yellow	–
7	64–73	strong quenching	–	dark purple
8	78–83	–	–	pale purple

Water Not more than 11.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 1.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 5.0 per cent w/w (Appendix 7.6).

Total ash Not more than 10.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 2.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 9.0 per cent w/w (Appendix 7.12).

Volatile oil Not less than 0.6 per cent v/w (Appendix 7.3H). Use 50 g, in *No. 250 powder*, freshly prepared and accurately weighed. Use 300 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube.

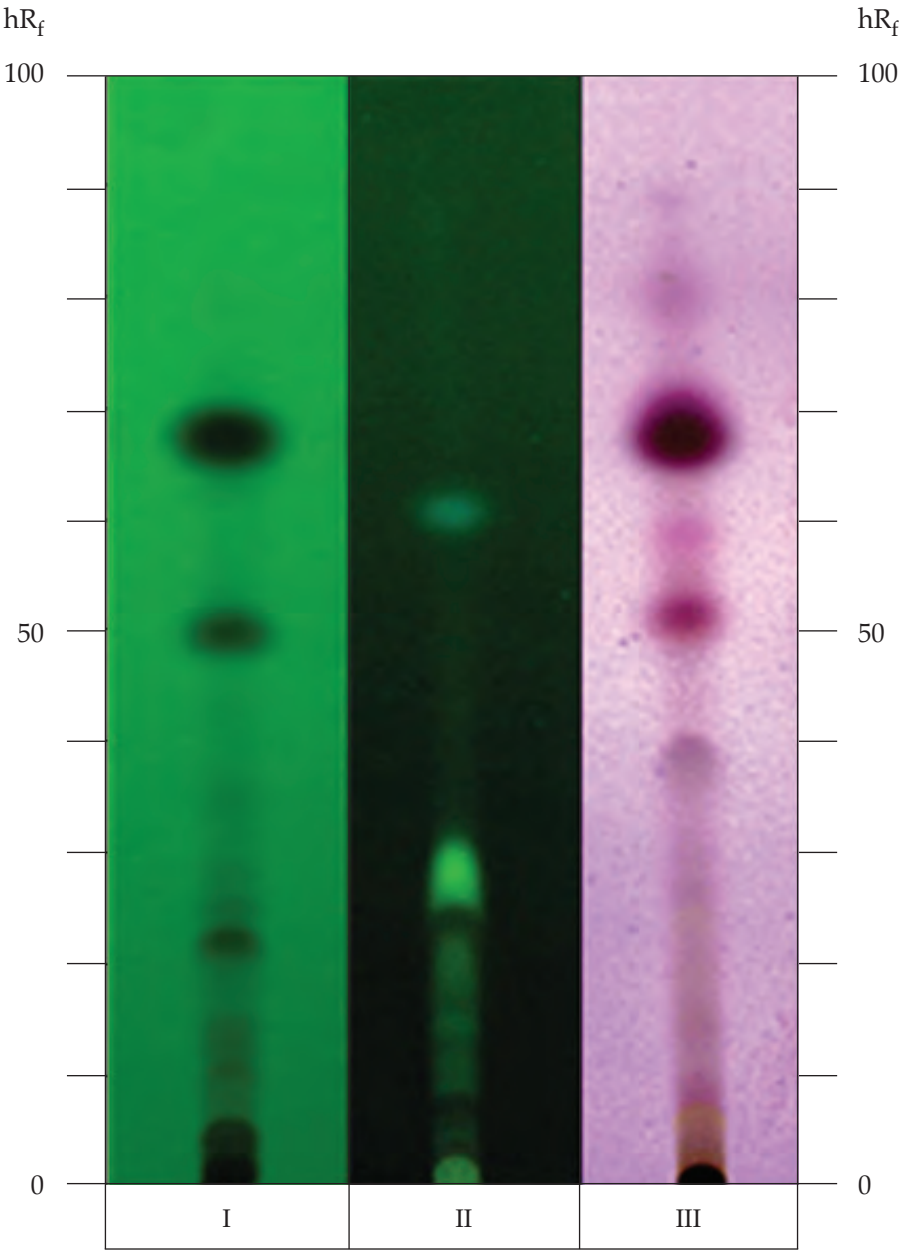


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Rhizomes of *Zingiber zerumbet* (L.) Sm.

I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *anisaldehyde TS*

ลักจั่น (LAKKACHAN)

ลักกะจั่น, ลักจันทน์, ลักกะจันทน์ (LAKKACHAN)[1]
Dracaenae Cochinchinensis Lignum
Dracaena Cochinchinensis Wood

Category Antipyretic, anti-inflammatory.

Dracaena Cochinchinensis Wood is the dried reddish fungal-infected wood of *Dracaena cochinchinensis* (Lour.) S. C. Chen (*Aletris cochinchinensis* Lour., *Dracaena loureiroi* Gagnep., *Pleomele cochinchinensis* Merr. ex Gagnep.) (Family Dracaenaceae), Herbarium Specimen Number: DMSC 5179, BKF 168152, Crude Drug Number: DMSc 0934.

Constituents Dracaenae Cochinchinensis Wood contains flavonoids such as loureirin A and loureirin B, stilbenoids, steroids, etc.

Description of the plant (Figs. 1a, 1b) Tree 5 to 15 m high; stem more or less branched, internodes short, bark smooth, greyish white, becoming greyish brown with age. Leaves simple, spirally arranged, crowded at the top, sword-shaped, 30 to 100 cm long, 2 to 5 cm wide, apex acute, base completely covering internodes, margin entire, blade leathery. Inflorescence terminal, panicle, more than 40 cm long, drooping; rachis densely papillose-pubescent. Flower whitish, in clusters of 2 to 5; pedicel 3 to 6 mm long, articulate distally; perianth campanulate, 6 to 8 mm long, tube 1.5 to 2 mm long, lobes 6, 5 to 6 mm long; stamens 6, inserted in tube of perianth, filament reddish, flat, 0.5 to 0.7 mm wide, anther versatile; ovary superior, 3-loculed, ovule(s) 1 or 2 per locule, style slender, stigma capitate. Fruit berry, subglobose, 8 to 12 mm wide, orange when ripe. Seed(s) 1 to 3.

Description Odour, slightly aromatic; taste, slightly astringent.

Macroscopical (Fig. 1a) Irregular pieces of woody segment, smooth or rough, easily broken, brownish red; longitudinal surface spirally grained.

Microscopical (Figs. 2a, 2b, 2c, 2d) Transverse section of the wood shows parenchyma cells and scattered vascular bundles. Vascular bundle, concentric and amphivasal, surrounded by thick-walled fibre-tracheids; vessels, thick-walled, with orange to reddish resinous mass; phloem tissue, small and thin-walled, located in the centre. Parenchyma cell, thin-walled, round or ovate, some containing raphides or infected by fungal mycelia.

Longitudinal section of the wood shows parenchyma cells and vascular bundles. Vessels, elongated, thick-walled with scalariform, reticulate or bordered pits, some containing orange to reddish resinous mass. Fibre-tracheid, elongated, thick-walled with bordered pits, some containing orange to reddish resinous mass. Phloem tissue, elongated, thin-walled cells. Parenchyma cell, ovate or rectangular, slightly thick-walled, some containing raphides or fungal mycelia.

Dracaena Cochinchinensis Wood in powder possesses the diagnostic microscopical characters of the unground drug.

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[1] The four Thai names, i.e. ลักกะจั่น, ลักจันทน์, and ลักกะจันทน์, spelled and pronounced differently can be transcribed into the same English phonetic transcription “LAKKACHAN”.

Fig. 1a *Dracaena cochinchinensis* (Lour.) S. C. Chen
1. flowering branches 2. inflorescence 3. infructescences
4. ripe fruits and seeds 5. crude drug

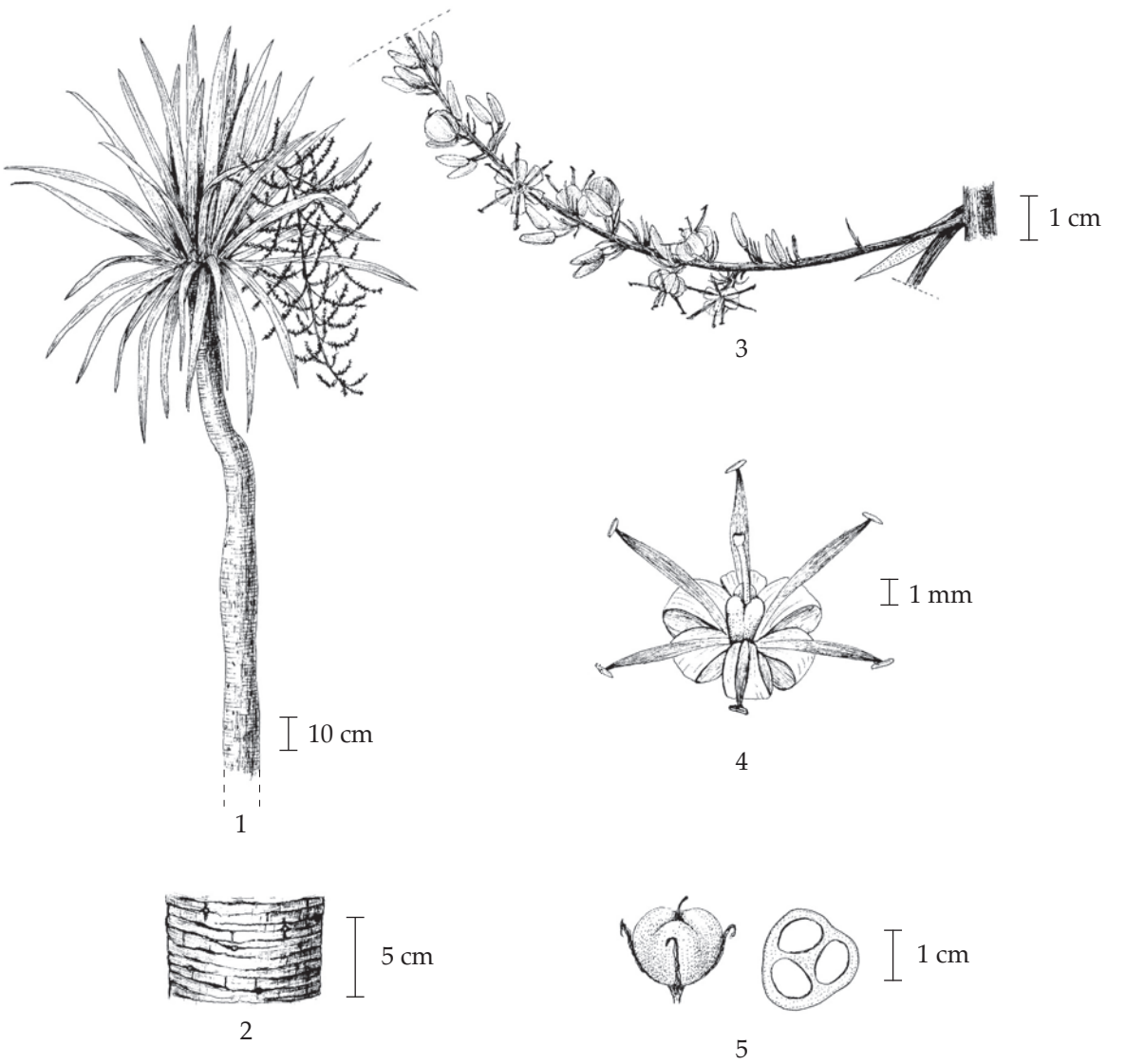


Fig. 1b *Dracaena cochinchinensis* (Lour.) S. C. Chen
1. flowering branch 2. surface of stem 3. part of inflorescence
4. flower 5. fruit and cross section of fruit

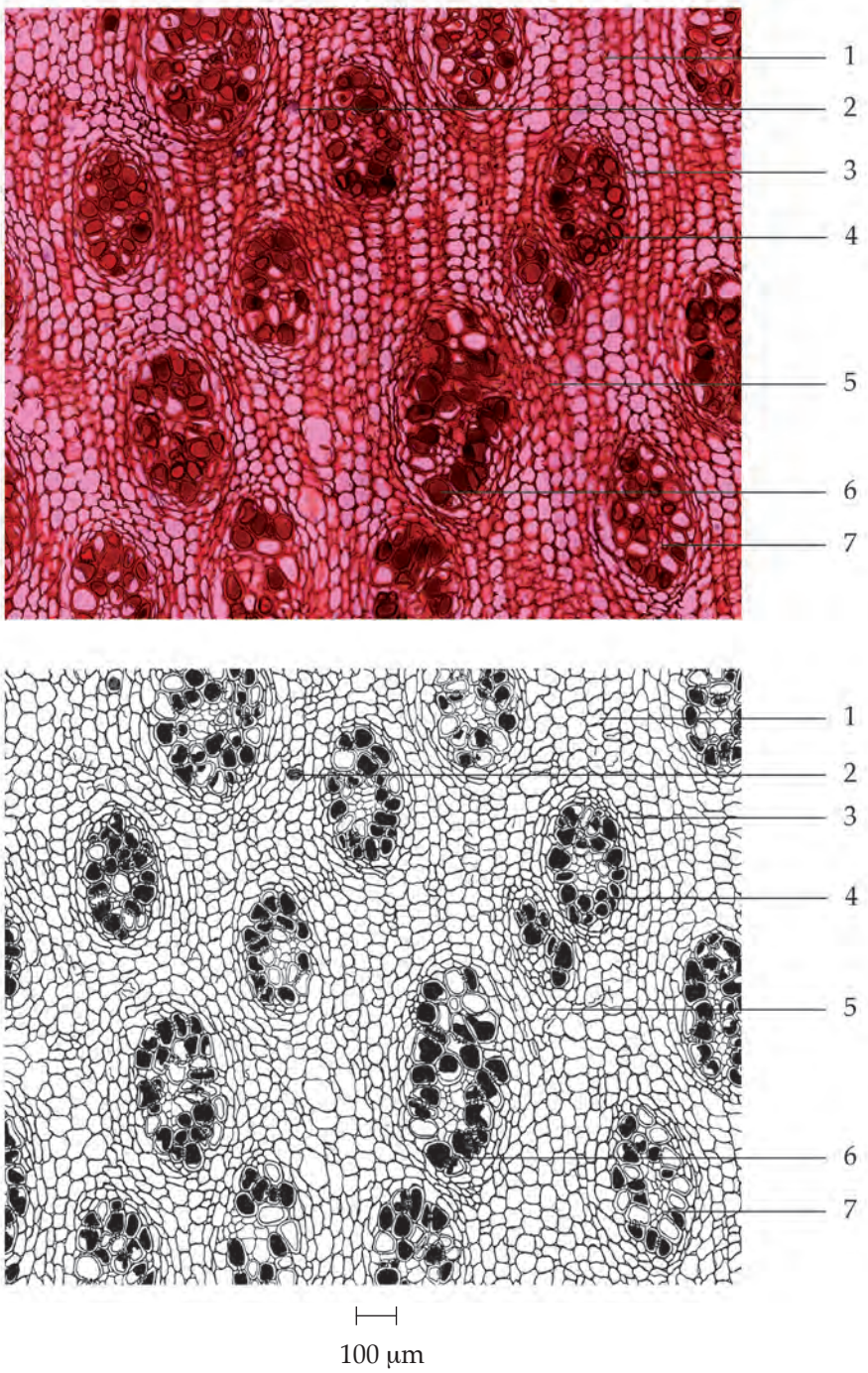


Fig. 2a Photomicrograph and Line Drawing of Transverse Section of the Wood of *Dracaena cochinchinensis* (Lour.) S. C. Chen

1. parenchyma cell
2. raphide
3. fibre-tracheid
4. vessel
5. fungal mycelia in parenchyma cell
6. orange to reddish resin in vessel
7. phloem tissue

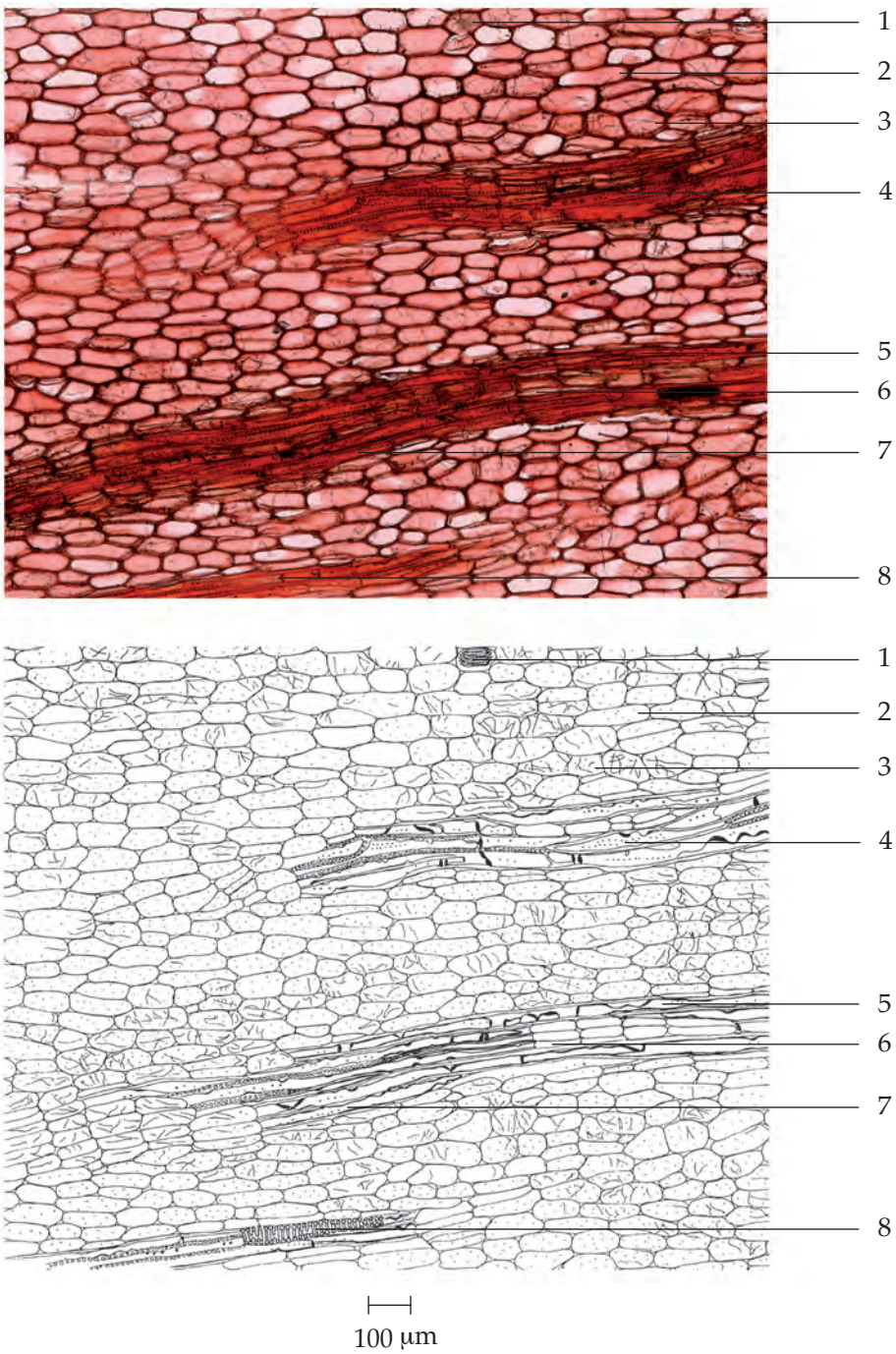


Fig. 2b Photomicrograph and Line Drawing of Longitudinal Section of the Wood of *Dracaena cochinchinensis* (Lour.) S. C. Chen

1. raphide
2. parenchyma cell
3. fungal mycelia in parenchyma cell
4. pitted vessel
5. orange to reddish resin in vessel
6. phloem tissue
7. fibre-tracheid
8. reticulate vessel

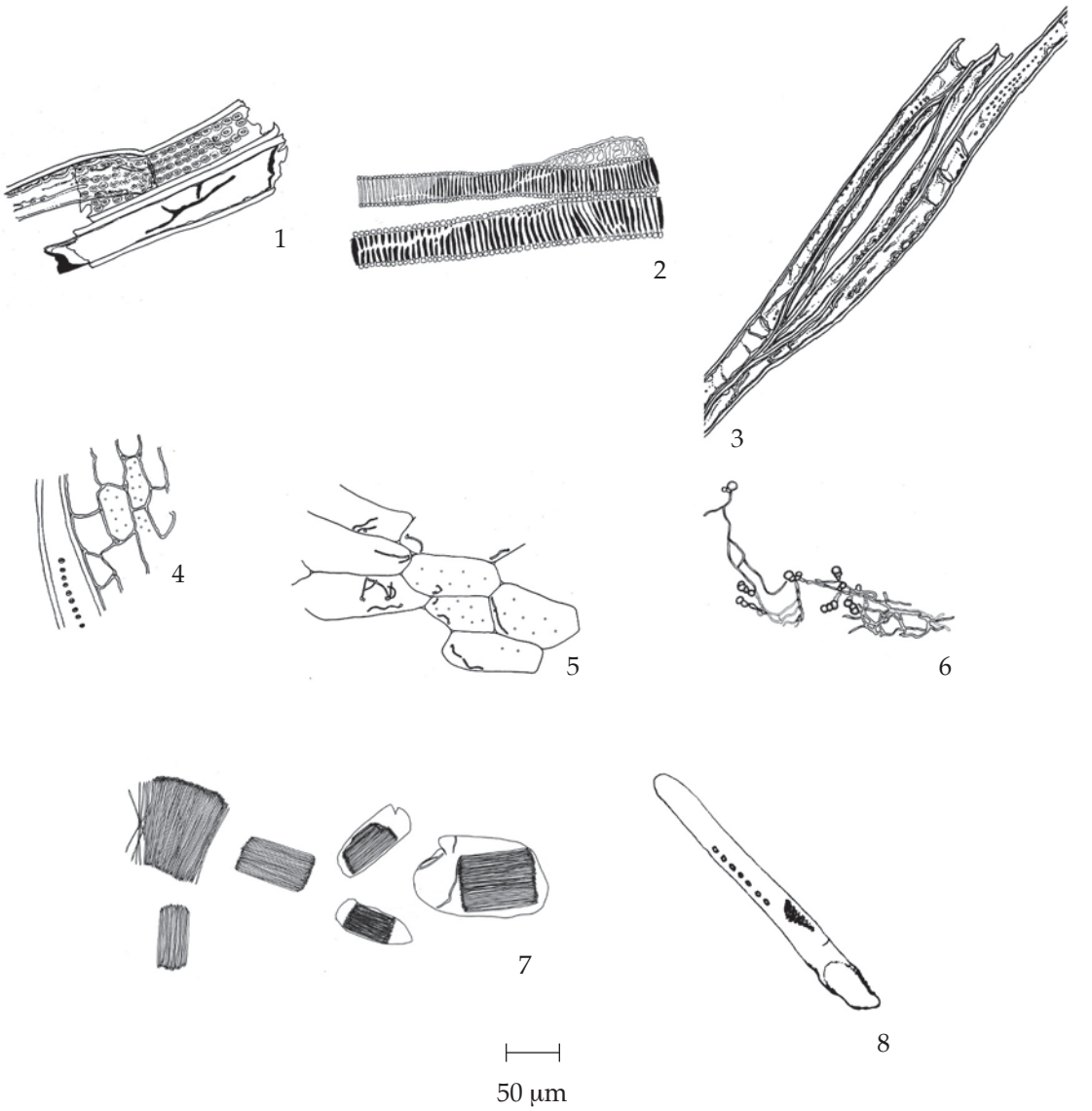


Fig. 2c Line Drawings of Powdered Drug of the Wood of *Dracaena cochinchinensis* (Lour.) S. C. Chen

1. bordered-pitted vessel
2. scalariform, reticulate and bordered-pitted vessels
3. fibre-tracheids
4. parenchyma cells and fibre-tracheid
5. fungal mycelia in parenchyma cells
6. fungal mycelia
7. raphides
8. orange to reddish resin in vessel

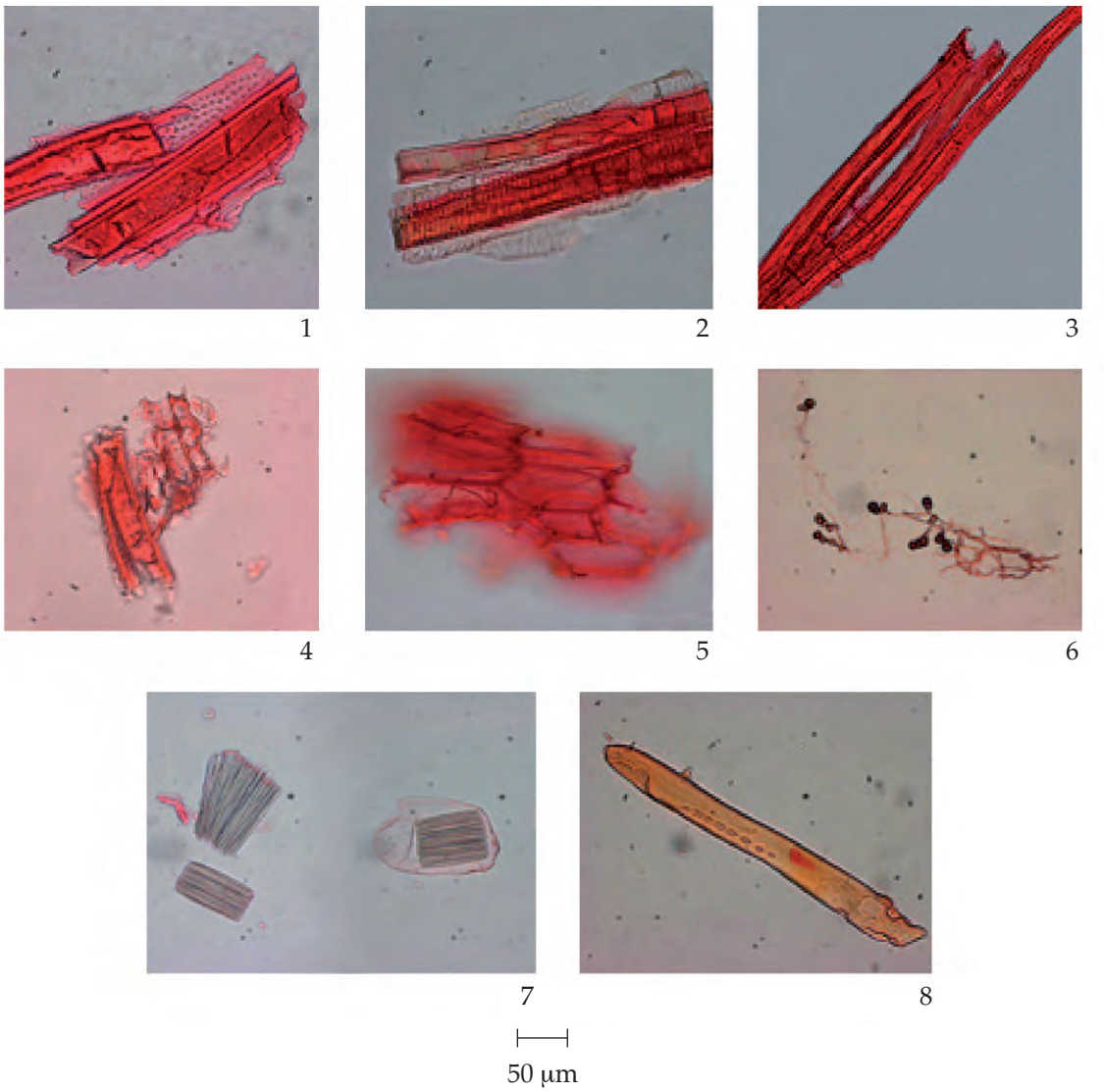


Fig. 2d Photomicrographs of Powdered Drug of the Wood of *Dracaena cochinchinensis* (Lour.) S. C. Chen

1. bordered-pitted vessel
2. scalariform, reticulate and bordered-pitted vessels
3. fibre-tracheids
4. parenchyma cells and fibre-tracheid
5. fungal mycelia in parenchyma cells
6. fungal mycelia
7. raphides
8. orange to reddish resin in vessel

Additional information It commercially available as a substitute for Chan Daeng (red sandalwood) in Thai traditional medicine.

Packaging and storage Dracaena Cochinchinensis Wood shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Reflux 1 g of the sample, in powder, with 30 mL of *methanol* for 30 minutes and filter (solution 1). Evaporate 2 mL of solution 1 to dryness. Dissolve the residue in 1 mL of *acetic anhydride*, slowly add a few drops of *sulfuric acid* and mix: a green colour develops.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 50 volumes of *hexane*, 50 volumes of *ethyl acetate* and 2.5 volumes of *methanol* as the mobile phase. Apply to the plate, 5 μL of the test solution prepared by evaporating about 20 mL of solution 1 to dryness and dissolving the residue in 2 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; several blue fluorescent spots are observed. Spray the plate with *anisaldehyde TS* and heat at 110° for 10 minutes; several spots of different colours appear (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Wood of *Dracaena cochinchinensis* (Lour.) S. C. Chen

Spot	hR_f Value	Detection		
		UV 254	UV 366	*Anisaldehyde TS*
1	16–19	–	bright blue	–
2	19–22	quenching	–	purplish brown
3	33–44	quenching	–	orange
4	45–52	quenching	blue	purplish brown
5	56–62	weak quenching	–	purplish brown
6	65–69	weak quenching	–	orange
7	69–72	–	light blue	–
8	72–74	quenching	–	purplish brown
9	74–79	weak quenching	–	pink
10	79–82	weak quenching	light blue	purplish brown
11	87–90	–	blue	pale violet
12	95–96	–	–	pale violet
13	97–98	–	–	pale violet

Loss on drying Not more than 9.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 0.5 per cent w/w (Appendix 7.2).

Total ash Not more than 1.2 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 17.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 2.0 per cent w/w (Appendix 7.12).

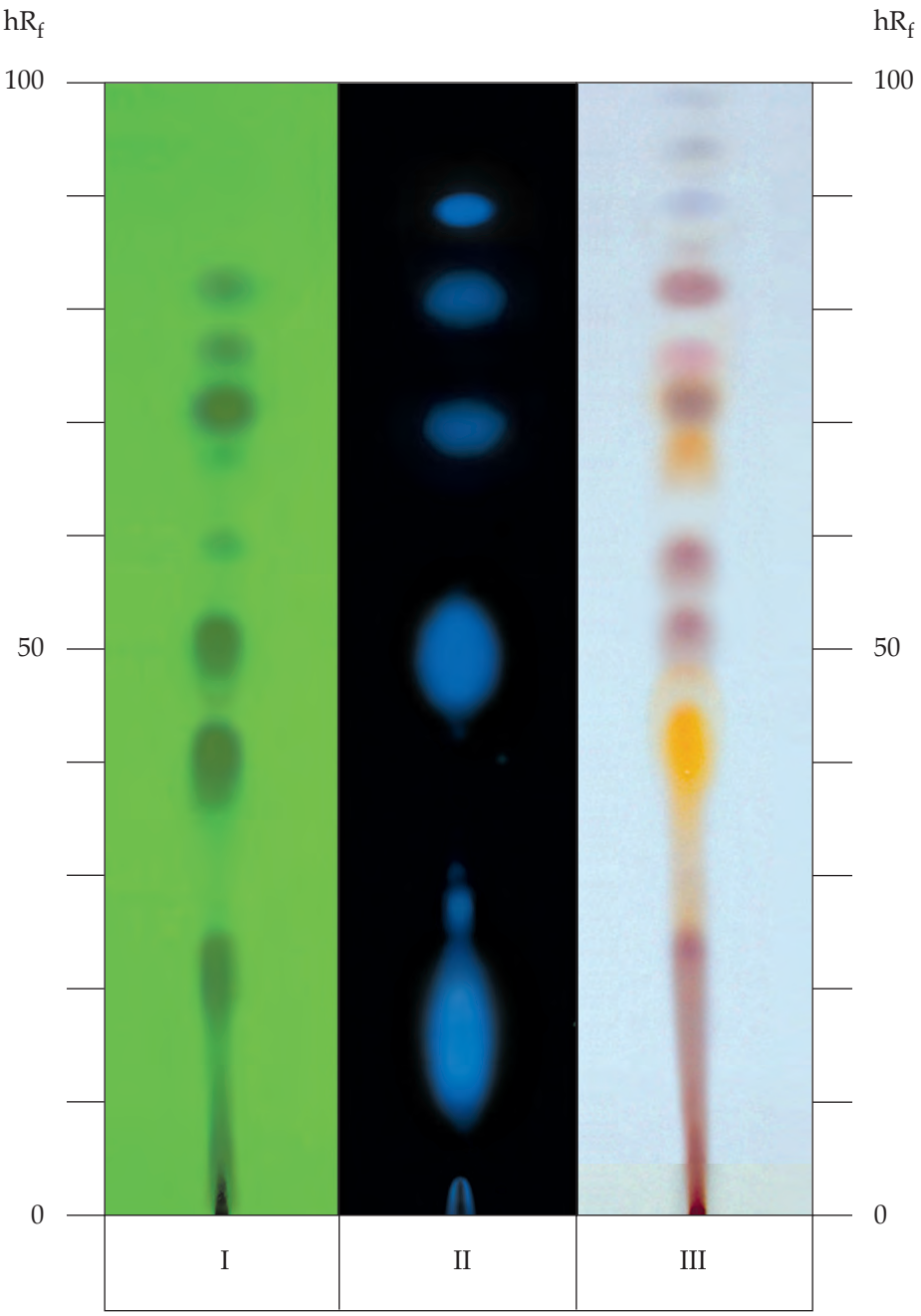


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Wood of *Dracaena cochinchinensis* (Lour.) S. C. Chen
I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *anisaldehyde TS*

มะเดื่ออุทุมพร (MADUEA UTHUMPHON)

เดื่อเกลี้ยง (DUEA KLIANG), มะเดื่อชุมพร (MADUEA CHUMPHON)
Fici Racemosae Radix
Cluster Fig Root

Synonyms Goolar Fig Root, Gular Fig Root

Category Antipyretic.

Cluster Fig Root is the dried root of *Ficus racemosa* L. (*F. glomerata* Roxb.) (Family Moraceae), Herbarium Specimen Number: DMSC 5221, Crude Drug Number: DMSc 1077.

Constituents Cluster Fig Root contains triterpenoids such as lupeol, lupeol acetate, α-amyrin acetate, and β-amyrin acetate. It also contains sterols, tannins, etc.

Description of the plant (Figs. 1a, 1b) Evergreen or deciduous tree up to 30 m high, monoecious; becoming buttressed, often with irregular crown; bark whitish to pinkish brown, smooth when young, cracked when aged, exudating ivory or pinkish latex; young twig solid, finely pubescent. Leaves simple, spirally arranged, elliptic, obovate, oblong, lanceolate or subovate, 5 to 20 cm long, 3 to 10(–12) cm wide, apex acute or acuminate, base obtuse, oblique or cuneate, margin entire, sometimes irregularly dentate or sublobate, coriaceous, sparsely pilose or glabrescent on both surfaces, lateral nerves 4 to 9 pairs, conspicuous on the lower surface; petiole 1.5 to 7.5 cm long, grooved, brownish, minutely hairy; stipule triangular ovate, 1 to 1.5 cm long, about 5 mm wide, brownish, subpersistent or caducous. Inflorescence and fruit known as syconium or fig, cauliflorous or borne on leafless branches, up to 25 cm long; peduncle 0.3 to 1.2 cm long; basal bracts 3, 1 to 2 mm long, persistent; receptacle subpyriform to globose, puberulous; without lateral bracts. Flowers 3 types: male flower sessile, ostiolar bracts many, tepals 3- to 4-connated, lobes dentate-lacerate, reddish, stamens 1 to 3, pistillode present; female flower sessile or subsessile, tepal as in male, ovary with reddish dots, substipitate, style lateral, glabrous, stigma simple; gall flower dispersed among females, pedicellate, ovary dark red and glabrous. Fruit pyriform or depressed subglobose, 3 to 5 cm in diameter when fresh, 1.5 to 3 cm in diameter when dry, green when young, pinkish to purple-red or orange at maturity, usually streaked, puberulous, apex flat to slightly concave, ostiole about 3 mm in diameter, prominent; internal hairs absent.

Description Odourless; taste, bland.

Macroscopical (Fig. 1a) Obliquely, longitudinally or transversely sliced roots, varied in shape and size; bark 1 to 3 mm thick, dark brown, with scattered irregular scars; wood light brown, some with darker rings in the centre.

Microscopical (Figs. 2a, 2b, 2c, 2d) Transverse section of the root shows periderm, cortex, phloem, vascular cambium, and xylem. Periderm, several layers of brown thin-walled rectangular cork cells. Cortex, parenchyma, some containing starch grains, prismatic crystals of calcium oxalate or brown substance, and sclereids. Phloem, small parenchyma, some containing starch grains, prismatic crystals of calcium oxalate or brown substance, phloem fibres, and phloem ray cells. Vascular cambium, several layers of small thin-walled rectangular cells. Xylem, scalariform and bordered-pitted vessels (some containing brown substance), xylem fibres, thick-walled porous xylem parenchyma, and xylem ray cells.

1

2

3

4

5

2 cm

Fig. 1a *Ficus racemosa* L.
1. fruiting stem 2. leafy twig 3. longitudinal section of syconium showing male and female flowers with gall flowers in centre 4. infructescences 5. crude drug

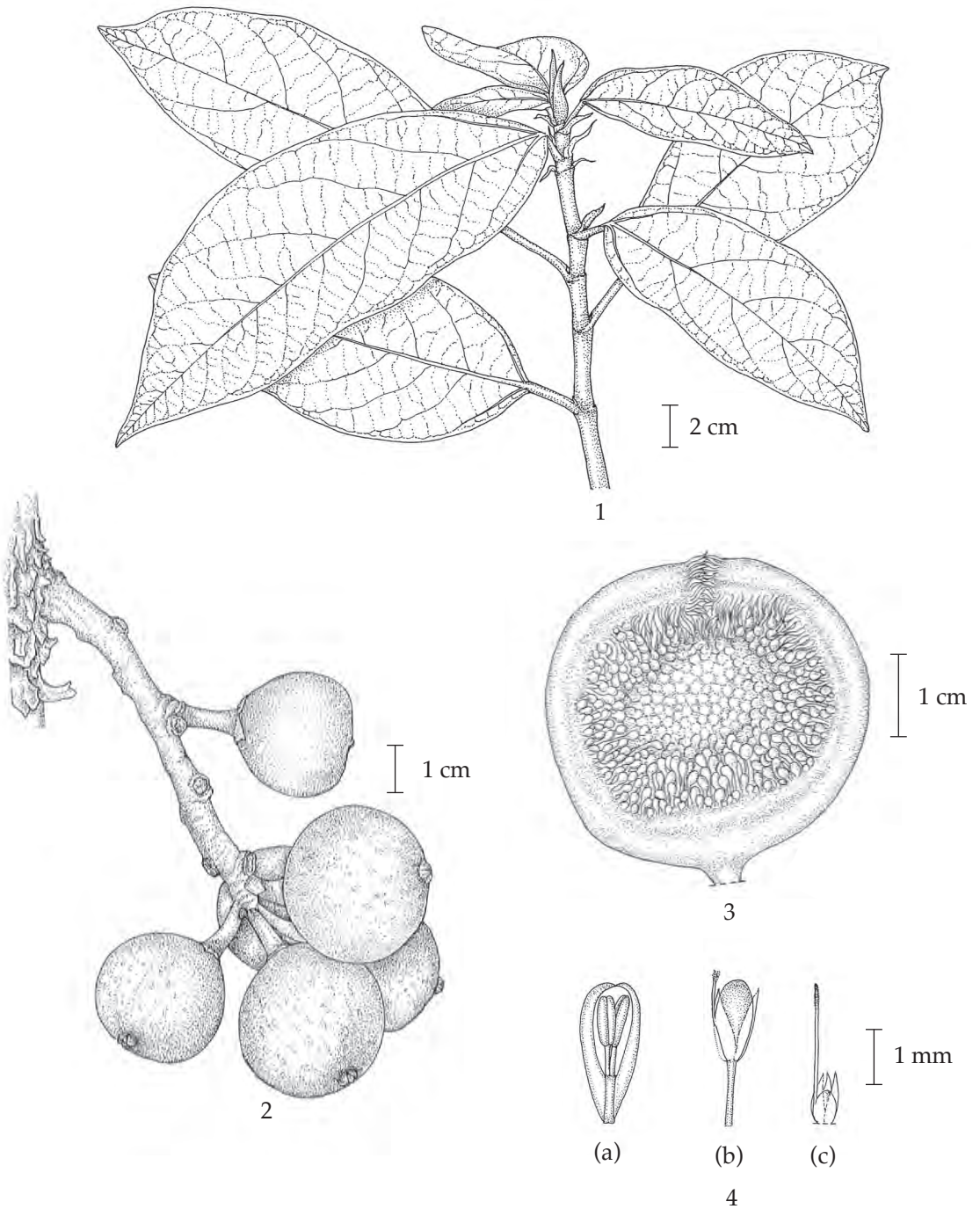


Fig. 1b *Ficus racemosa* L.
1. leafy twig 2. infructescence 3. longitudinal section of mature syconium
4. male flower (a), gall flower (b) and female flower (c)

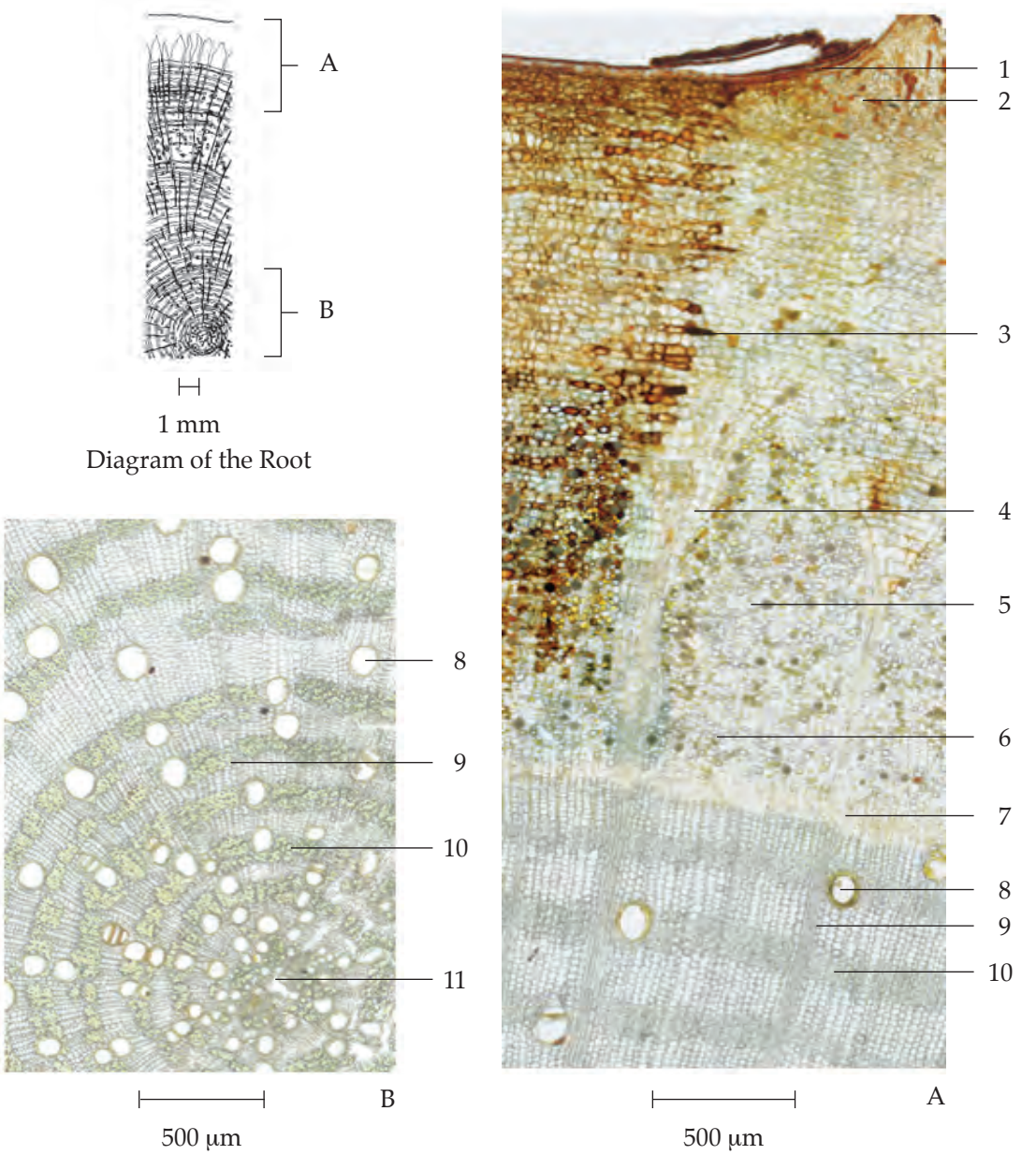


Fig. 2a Photomicrographs of Transverse Section of the Root of *Ficus racemosa* L.
A. Bark and Part of Wood
B. Part of Wood

1. cork
2. parenchyma
3. brown substance
4. phloem ray
5. phloem parenchyma
6. prismatic crystal
7. vascular cambium
8. vessel
9. xylem ray
10. axial parenchyma
11. primary vascular tissue

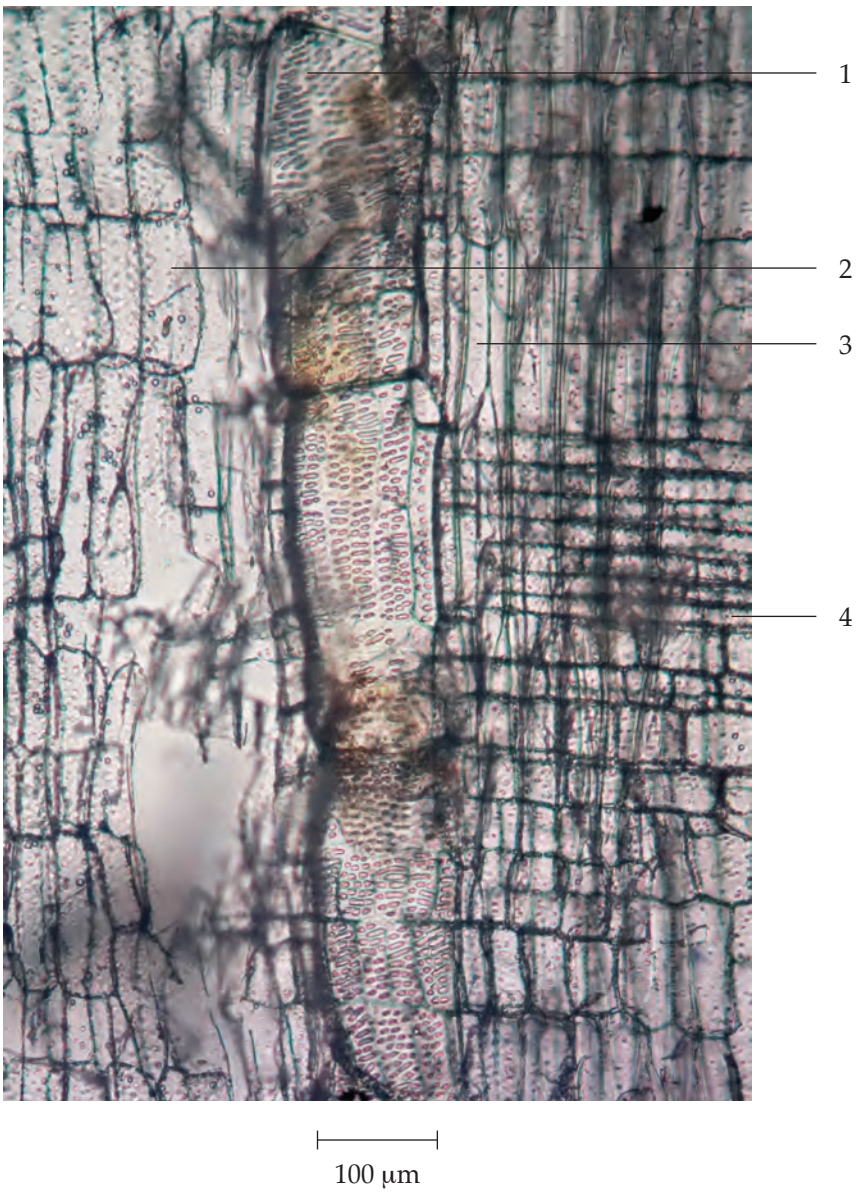


Fig. 2b Photomicrograph of Radial Longitudinal Section of the Woody Part of the Root of *Ficus racemosa* L.

1. scalariform vessel with pits, arranging in rows
2. xylem parenchyma
3. axial parenchyma
4. xylem ray

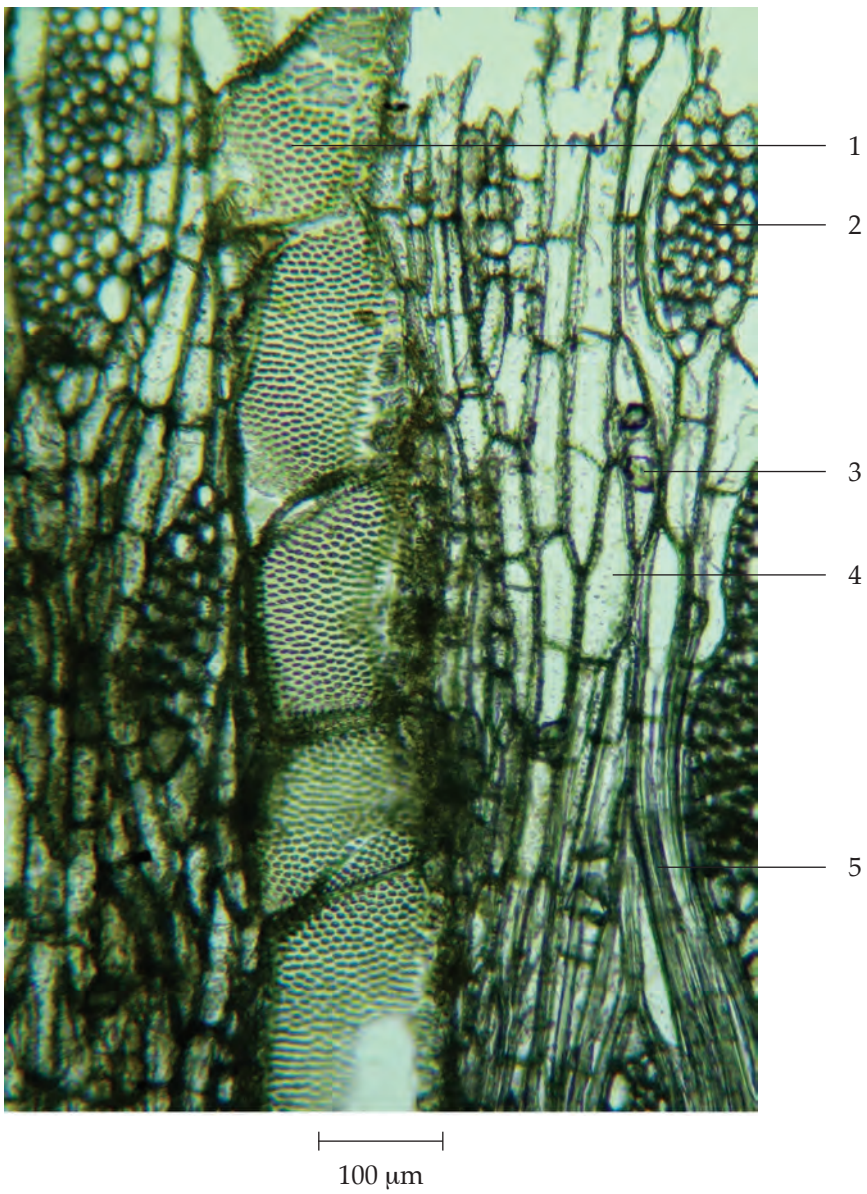


Fig. 2c Photomicrograph of Tangential Longitudinal Section of the Woody Part of the Root of *Ficus racemosa* L.

1. bordered-pitted vessel
2. medullary ray
3. prismatic crystal
4. xylem parenchyma
5. xylem fibre

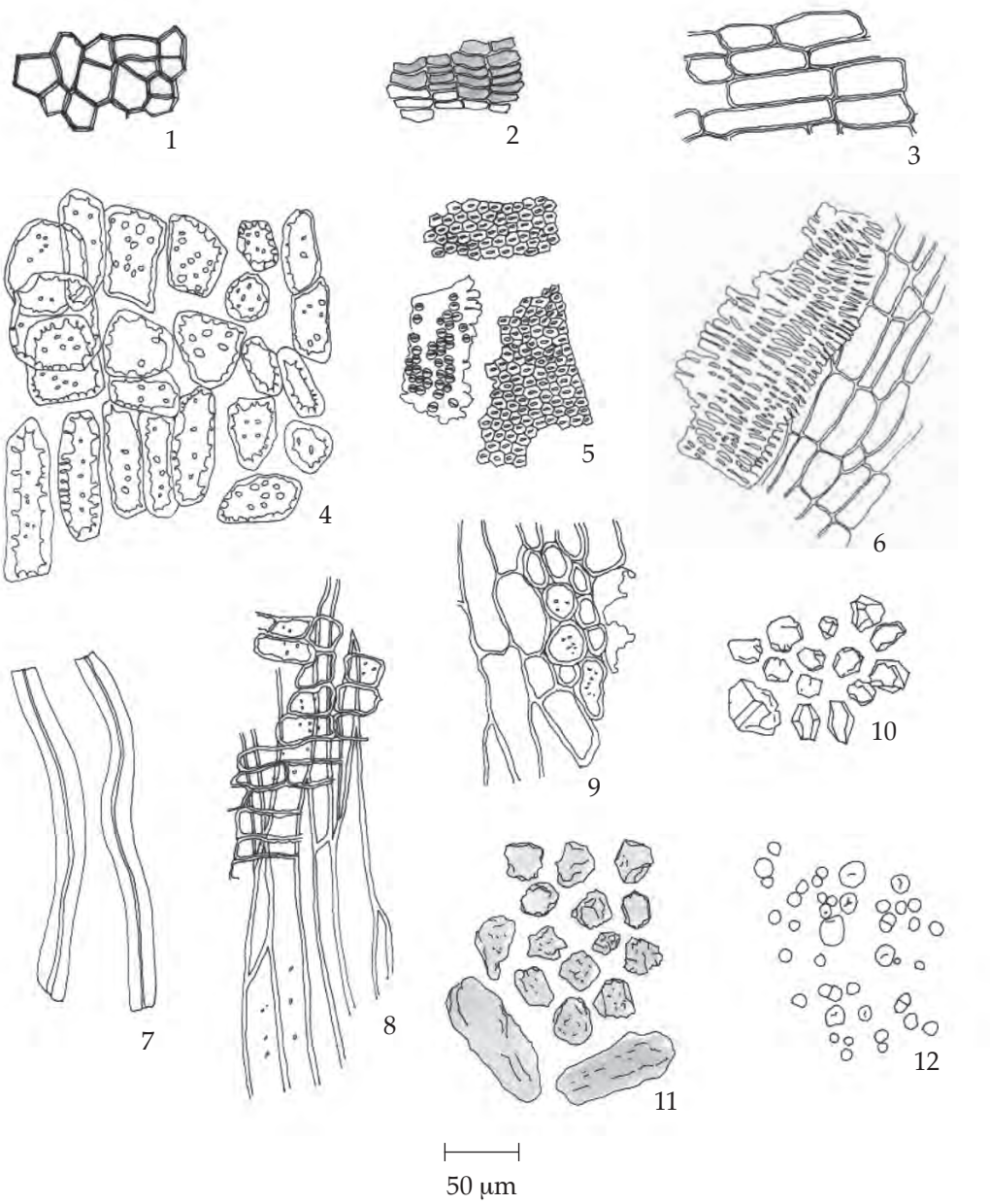


Fig. 2d Powdered Drug of the Roots of *Ficus racemosa* L.

1. cork in surface view
2. cork in sectional view
3. parenchyma
4. sclereids
5. bordered-pitted vessels
6. scalariform vessels with pits, arranging in rows, and xylem parenchyma
7. fibres
8. medullary ray with xylem fibres in radial longitudinal view
9. medullary ray with xylem parenchyma in tangential longitudinal view
10. prismatic crystals
11. brown substance
12. starch grains

Radial and tangential longitudinal sections of the woody part of the root show bordered-pitted and scalariform vessels with pits, arranging in rows, porous thick-walled rectangular xylem parenchyma and ray cells.

Cluster Fig Root in powder possesses the microscopical characters of the unground drug. Sclereids, xylem ray and vessels (some with brown substance) can be seen in abundance. Scalariform vessels with pits arranging in rows are characteristic.

Packaging and storage Cluster Fig Root shall be kept in well-closed containers, protected from light, and stored in a dry place.

Additional information In Thai herbal markets, the adulteration of cluster fig root with stems, branches, etc. may be found.

Identification

A. Reflux 500 mg of the sample, in *fine powder*, with 10 mL of *chloroform* for 10 minutes and filter. Evaporate the filtrate to dryness. Dissolve the residue in 1 mL of *acetic anhydride* and then slowly add 1 mL of *sulfuric acid* to form two layers: a red-brown ring forms at the zone of contact and the upper layer is green.

B. Macerate 100 mg of the sample, in *fine powder*, with 4 mL of *ethanol* for 5 minutes and filter. To 2 mL of the filtrate, add 2 or 3 pieces of *magnesium ribbon*, shake well and mix with a few drops of *hydrochloric acid*: a pinkish orange colour develops.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using a high-performance plate with *silica gel F254* as the coating substance (a precoated plate by Merck Millipore or by Sigma-Aldrich or equivalent is suitable) and a mixture of 90 volumes of n-*hexane* and 10 volumes of *ethyl acetate* as the mobile phase and allowing the solvent front to ascend 8 cm above the line of application. Apply separately to the plate as bands of 8 mm, 10 μL of solution (A) and 1 μL of solution (B). Prepare solution (A) by macerating 1 g of the sample, in *fine powder*, with 10 mL of *methanol* for 20 minutes, filtering and evaporating the filtrate under reduced pressure to dryness. Dissolve the residue in 2 mL of *methanol*. For solution (B), dissolve 1 mg of *lupeol* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (366 nm); one blue fluorescent band is observed. Spray the plate with a 10 per cent w/v solution of *phosphomolybdic acid* in *ethanol*, heat at 105° for 5 minutes and immediately examine the plate. The chromatogram obtained from solution (A) shows a blue band (hR_f 43 to 46) corresponding to the lupeol band from solution (B) and other several blue bands are also observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Roots of *Ficus racemosa* L.

Band	hR_f Value	Detection	
		UV 366	10 Per Cent W/V Solution of *Phosphomolybdic Acid* in *Ethanol*
1	25–28	–	blue
2	39–41	blue	–
3*	43–46	–	blue
4	88–92	–	dark blue
5	94–98	–	dark blue

*lupeol

Loss on drying Not more than 10.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Total ash Not more than 7.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 1.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 2.0 per cent w/w (Appendix 7.12).

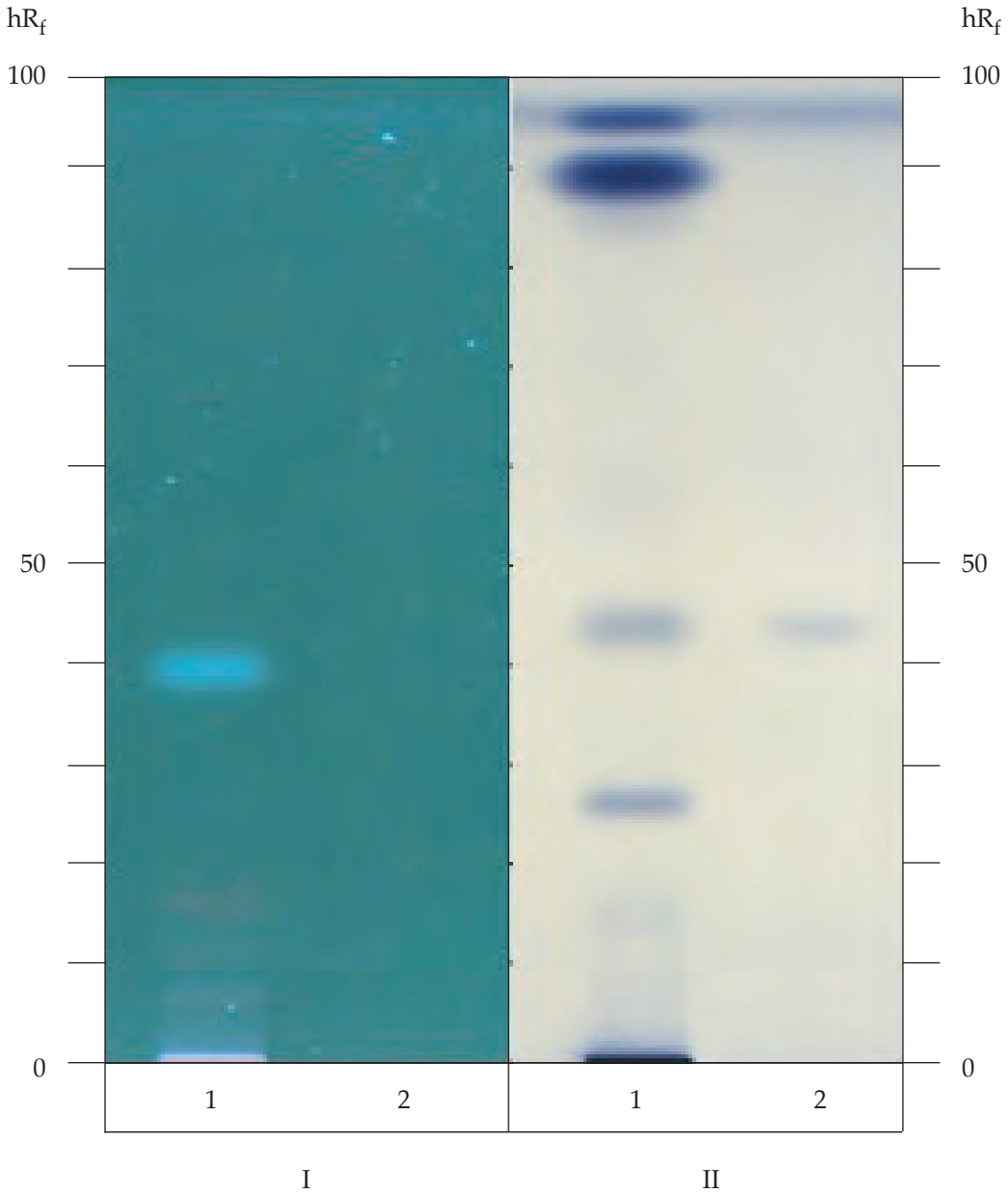


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Roots of *Ficus racemosa* L.
1 = solution (A)
2 = solution (B)
I = detection under UV light (366 nm)
II = detection with a 10 per cent w/v solution of *phosphomolybdic acid* in *ethanol*

แมงลักคา (MAENGLAK KHA)

กะเพราผี (KAPHRAO PHI), แมงลักป่า (MAENGLAK PA)
Hyptidis Suaveolens Herba
Wild Spikenard

Synonyms Horehound, Pignut, West Indian Spikenard

Category Carminative, antimicrobial (topical).

Wild Spikenard is the dried aerial part of *Hyptis suaveolens* (L.) Poit. (Family Labiatae), Herbarium Specimen Number: BKF 194900, Crude Drug Number: DMSc 0436.

Constituents Wild Spikenard contains terpenoids (e.g., betulinic acid, suaveolol, ursolic acid), phenolic compounds (e.g., caffeic acid, rosmarinic acid). It also contains flavonoids, sterols, small amount of volatile oil, etc.

Description of the plant (Figs. 1a, 1b) Annual herb 0.6 to 1.6 m high, strongly aromatic; stem erect, robust, quadrangular, branched, with long spreading white hairs. Leaves simple, opposite decussate, ovate to broadly ovate, 2 to 5 cm long, 2 to 6 cm wide, apex subacute to obtuse, base rounded to shallow cordate, oblique, margin serrulate, subcoriaceous, gland-dotted, both surfaces hairy; petiole slender, 0.5 to 6 cm long. Inflorescence axillary or terminal cyme, 1- or 2- to 5-flowered, in raceme or panicle; bract small. Flower zygomorphic; calyx campanulate, 0.8 to 1(−1.2) cm long in fruit, 3 to 5 mm wide, villous, yellowish glandular, throat tufted villous, prominent 10-nerved, 5-toothed, spine-like, 1.5 to 2 mm long, with simple and glandular hairs; corolla blue, 6 to 8 mm long, puberulent except near base, tube about 2 mm wide at throat, upper lip 2-lobed, reflexed, lower lip 3-lobed, middle lobe shorter, lateral lobes similar to upper lip; stamens 4, filament flattened, minutely hairy, exserted from the corolla tube; ovary superior, 2-carpellate, each carpel deeply 2-lobed, style 1, bifid, stigma minute. Fruit 2 nutlets, broadly obovoid, 3 to 4 mm long, 2 to 3 mm wide, apex truncate and emarginate, mucronate, laterally compressed, dark brown, dotted, with 2 basal white scars, within enlarged calyx tube.

Description Odour, aromatic; taste, slightly bitter.

Macroscopical (Fig. 1a) Stem quadrangular, greenish brown to brown; leaves opposite-decussately arranged, the complete ones ovate to broadly ovate, greenish, venation prominent; remnant inflorescence, persistent calyx, brown, villose.

Microscopical (Figs. 2a, 2b, 2c, 2d) Transverse sections of the leaf through the midrib and the lamina show upper epidermis, mesophyll, vascular bundles, and lower epidermis. Upper epidermis, a layer of wavy epidermal cells; stomata, mostly diacytic with some anomocytic; trichomes, numerous, multicellular uniseriate and glandular. Mesophyll, a layer of columnar palisade cells and several layers of spongy parenchyma, some containing rosette aggregate crystals. Vascular bundle, composed of phloem and xylem; vessels, spiral and scalariform. Collenchyma occurring in the midrib, beneath upper and lower epidermises, round and thick-walled cells.

Transverse section of the stem shows epidermis, cortex and vascular tissue. Epidermis, a layer of rectangular cells; trichomes, multicellular uniseriate, glandular and glandular with stalk. Cortex, layers of angular and lamella collenchyma cells, parenchyma and groups of fibres in the mature stem. Vascular tissue, composed of phloem and xylem; vessels, spiral and scalariform. Pith, numerous round parenchyma.

1

2

3

4

5

2 cm

6

Fig. 1a *Hyptis suaveolens* (L.) Poit.
1. habit (a), leaves (b) 2. flowering top 3. inflorescence 4. flower
5. inflorescence with flowers and fruits (c), nutlet (d) 6. crude drug

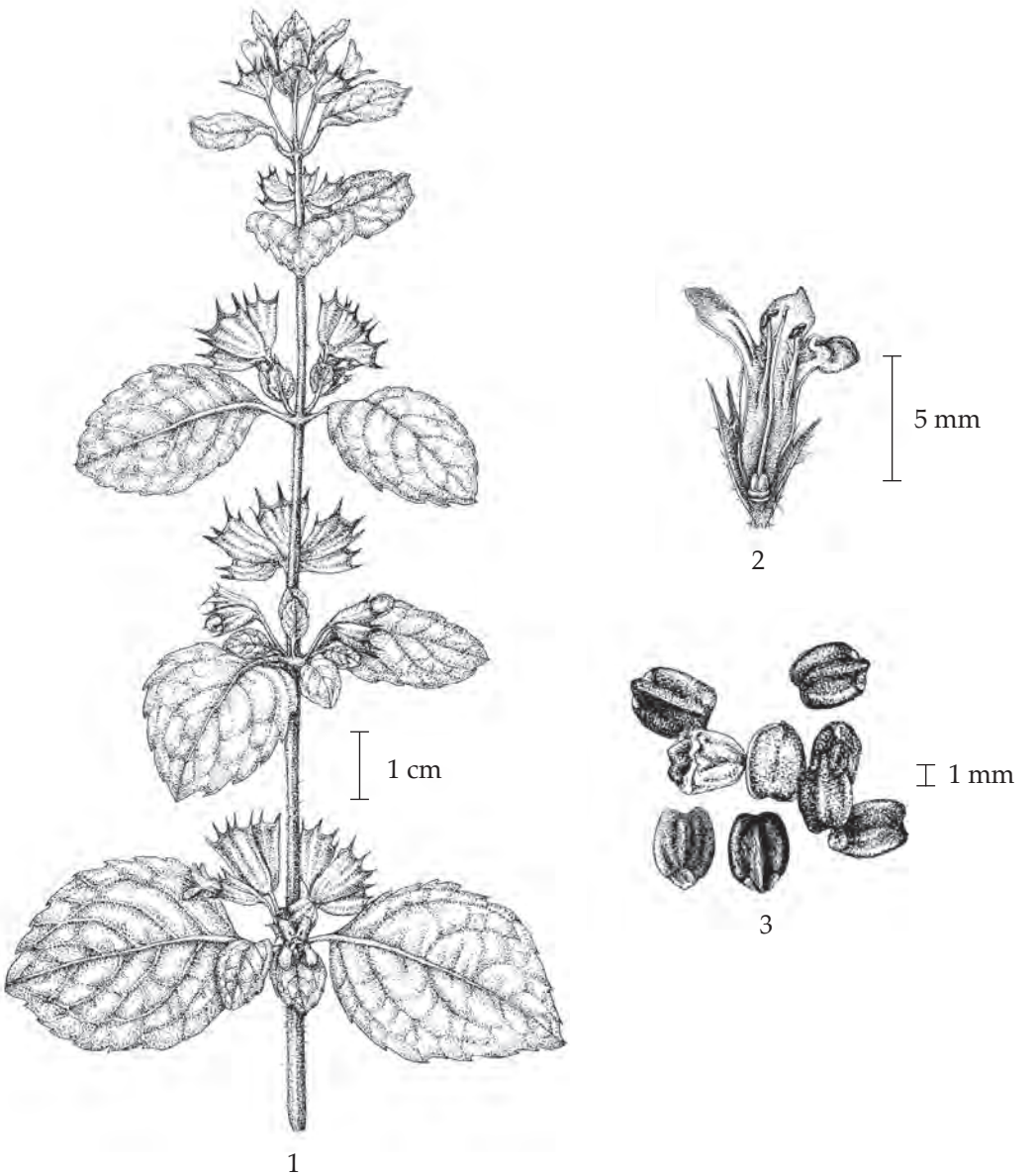
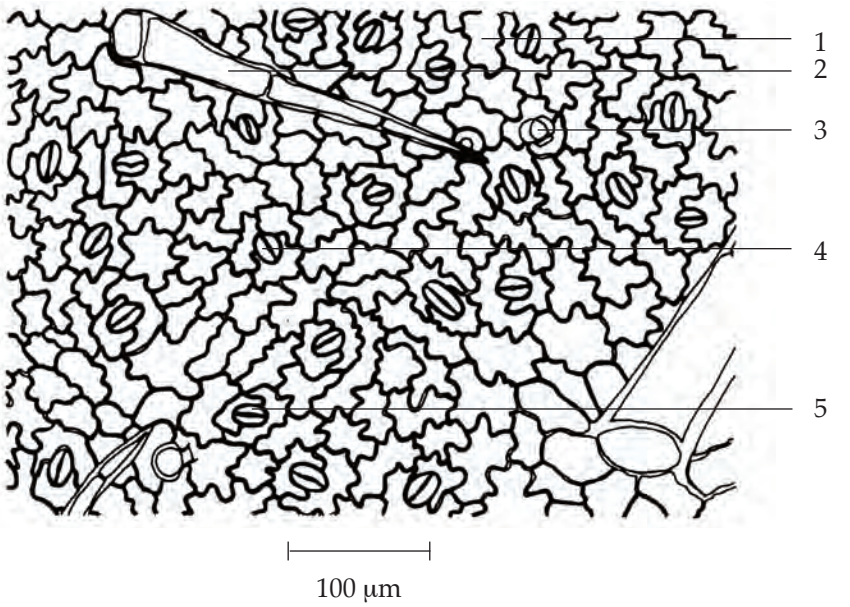
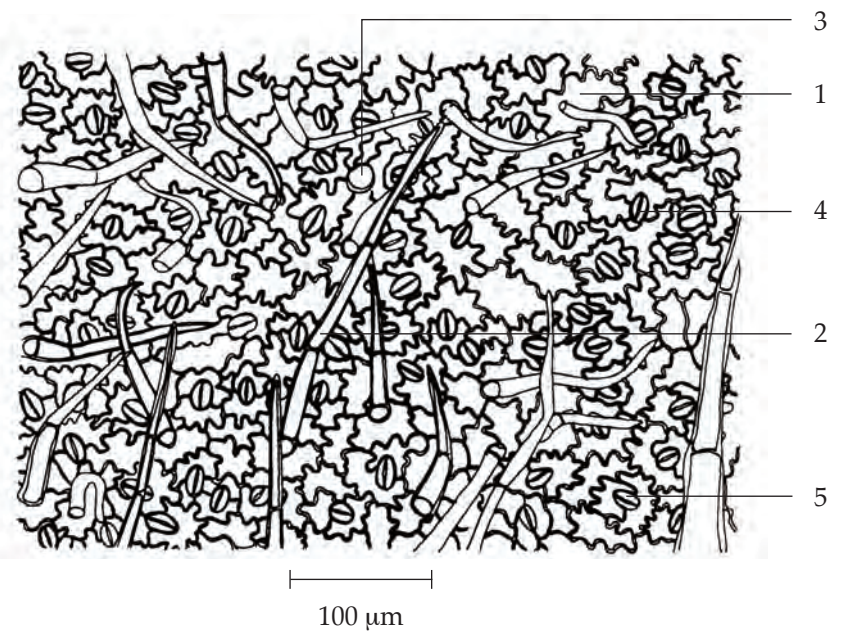


Fig. 1b *Hyptis suaveolens* (L.) Poit.
1. flowering and fruiting top 2. part of flower (longitudinal view, parts of calyx and corolla removed) 3. nutlets



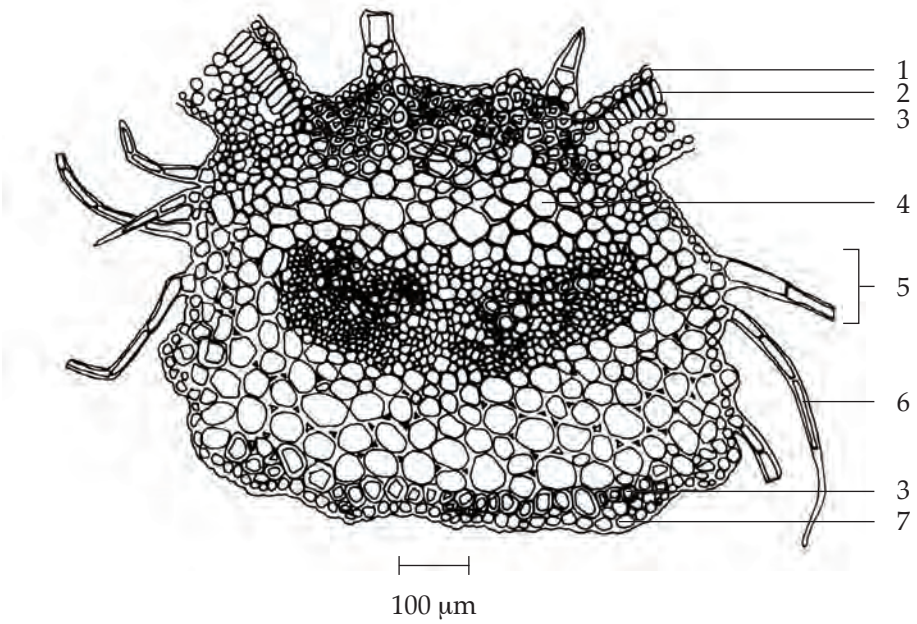
Upper Epidermis of the Lamina



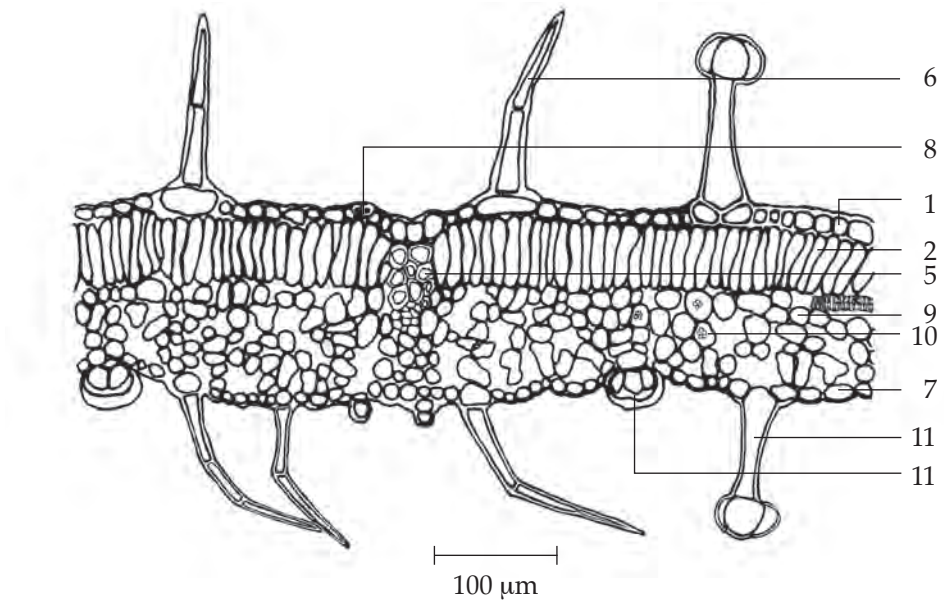
Lower Epidermis of the Lamina

Fig. 2a Epidermises of the Leaf of *Hyptis suaveolens* (L.) Poit.

1. epidermal cell
2. multicellular uniseriate trichome
3. glandular trichome
4. anomocytic stoma
5. diacytic stoma



Transverse Section of the Midrib



Transverse Section of the Lamina

Fig. 2b Transverse Sections of the Leaf of *Hyptis suaveolens* (L.) Poit.

1. upper epidermis
2. palisade cell
3. collenchyma
4. parenchyma
5. vascular bundle
6. multicellular uniseriate trichome
7. lower epidermis
8. stoma
9. spongy cell
10. rosette aggregate crystal
11. glandular trichome

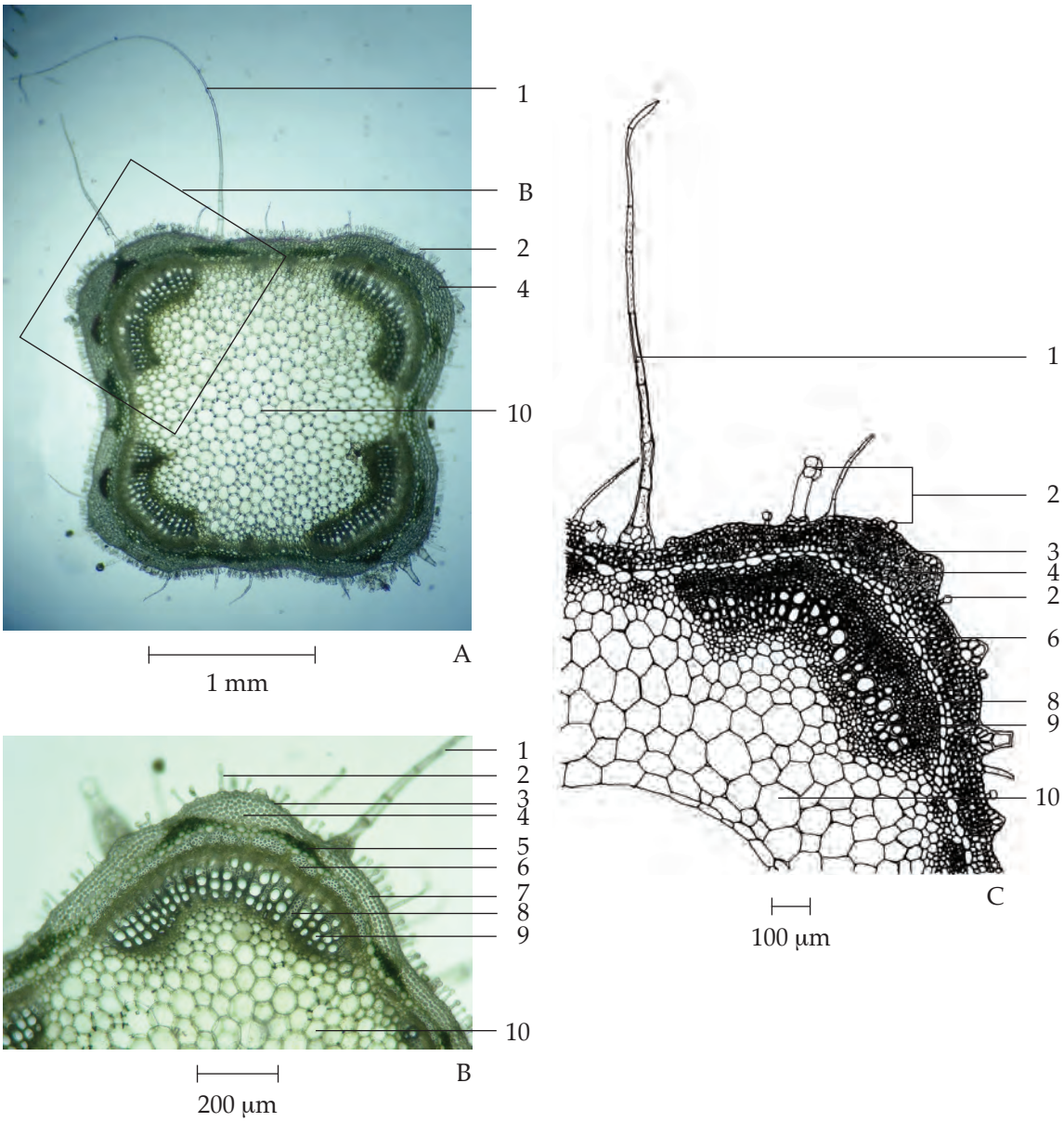


Fig. 2c Photomicrographs and Line Drawing of Transverse Section of the Stem of *Hyptis suaveolens* (L.) Poit.

A. Whole Stem

B. and C. Parts of Transverse Section

1. multicellular uniseriate trichome
2. glandular trichome
3. epidermis
4. angular collenchyma
5. chlorenchyma
6. phloem fibre
7. lamella collenchyma
8. xylem fibre
9. vessel
10. pith parenchyma

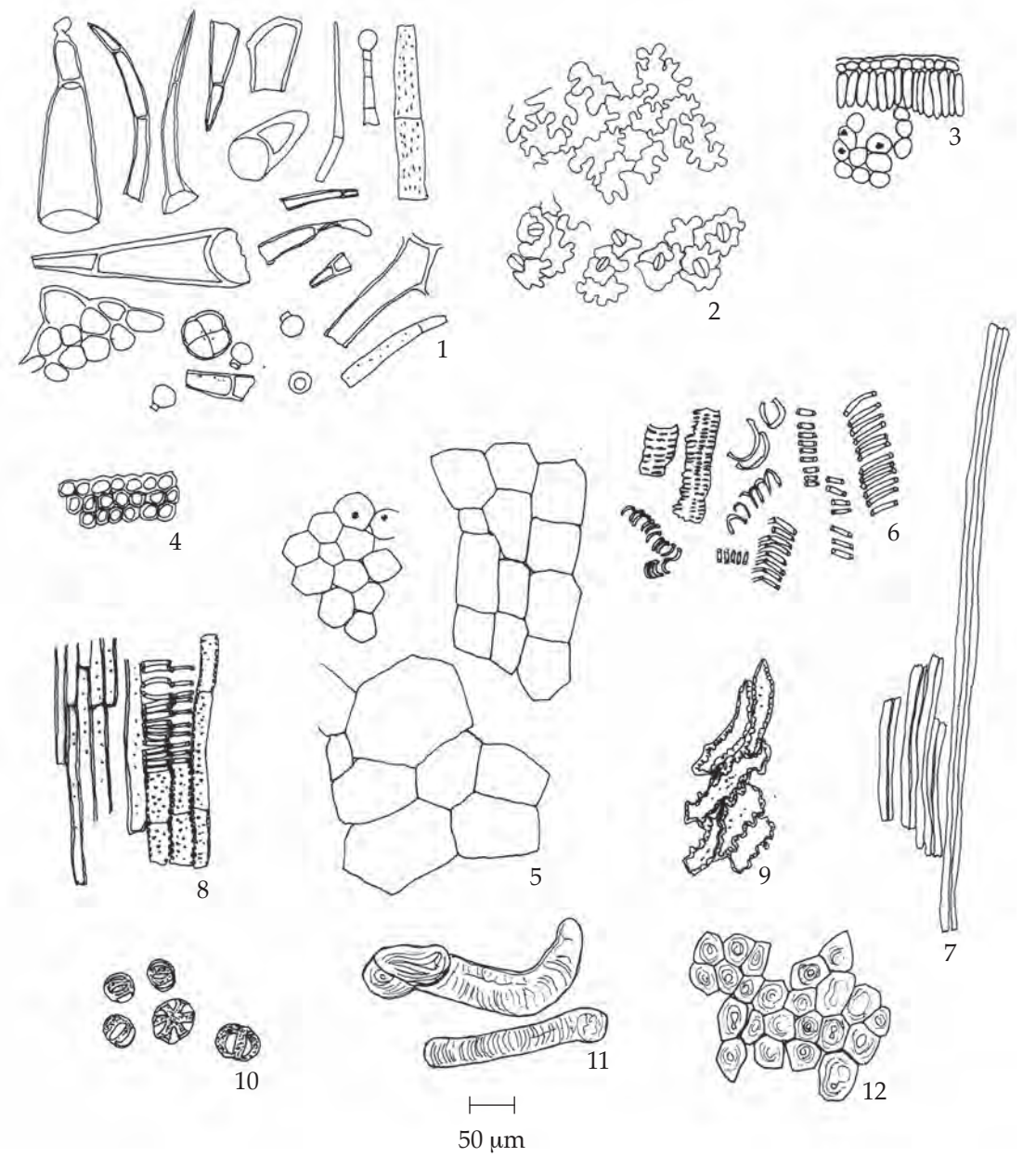


Fig. 2d Powdered Drug of the Aerial Parts of *Hyptis suaveolens* (L.) Poit.

1. trichomes
2. epidermis with diacytic stomata in surface view
3. fragment of lamina in sectional view showing epidermis, palisade cells, and spongy cells, some of which contain rosette aggregate crystals
4. epidermis and collenchyma in sectional view
5. parenchyma and rosette aggregate crystals
6. spiral and scalariform vessels
7. fibres
8. xylem parenchyma and spiral vessels
9. non-lignified sclereids of calyx
10. pollen grains
11. mucilage mass from seed coat
12. seed coat in surface view

Wild Spikenard in powder possesses the diagnostic microscopical characters of the unground drug. Wavy epidermal cells, diacytic with some anomocytic stomata, numerous multicellular uniseriate trichomes with some collapsed cells, glandular trichomes, and collenchyma are distinguished features. Sclereids of calyx, mucilage mass from seed coat and hexacolpate pollen grains are also unique.

Packaging and storage Wild Spikenard shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Reflux 500 mg of the sample, in powder, with 10 mL of *methanol* on a water-bath for 15 minutes and filter. To the filtrate, add 300 mg of *decolorizing charcoal*, swirl for a few minutes and filter. Evaporate the filtrate to dryness. Dissolve the residue in 1 mL of *acetic anhydride* and slowly add 1 mL of *sulfuric acid*: a reddish pink colour ring develops.

B. Heat 2 g of the sample, in powder, with 20 mL of *water* on a water-bath for 30 minutes, and filter. To 2 mL of the filtrate, add a few drops of a freshly prepared 1 per cent w/v solution of *iron(III) chloride*: a greenish blue colour is produced.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 70 volumes of *dichloromethane*, 30 volumes of *ethyl acetate* and 1 volume of *water* as the mobile phase and allowing the solvent front to ascend 12 cm above the line of application. Apply separately to the plate, 2 μL each of solution (A) and solution (B). Prepare solution (A) by refluxing 1 g of the sample, in powder, with 20 mL of *methanol* for 30 minutes, filtering while hot and evaporating the filtrate to dryness under reduced pressure at 50°. Dissolve the residue in 10 mL of *methanol*. For solution (B), dissolve 2 mg of *ursolic acid* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air. Spray the plate with a 20 per cent v/v solution of *sulfuric acid* in *ethanol* and heat at 105° for 5 minutes. The chromatogram obtained from solution (A) shows a red spot (hR_f value 73 to 74) corresponding to the ursolic acid spot from solution (B) and other several spots of different colours are also observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Aerial Parts of *Hyptis suaveolens* (L.) Poit.

Spot	hR_f Value	Detection
		20 Per Cent V/V Solution of *Sulfuric Acid* in *Ethanol*
1	3–4	violet
2	13–14	brown
3	26–27	violet
4	33–36	violet
5	38–40	brown
6	46–48	brown
7	49–50	brown
8	51–52	brown
9*	73–74	red
10	76–77	brown
11	87–88	violet
12	89–90	violet

*ursolic acid

Water Not more than 10.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 2.0 per cent w/w (Appendix 7.6).

Total ash Not more than 10.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 4.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 7.0 per cent w/w (Appendix 7.12).

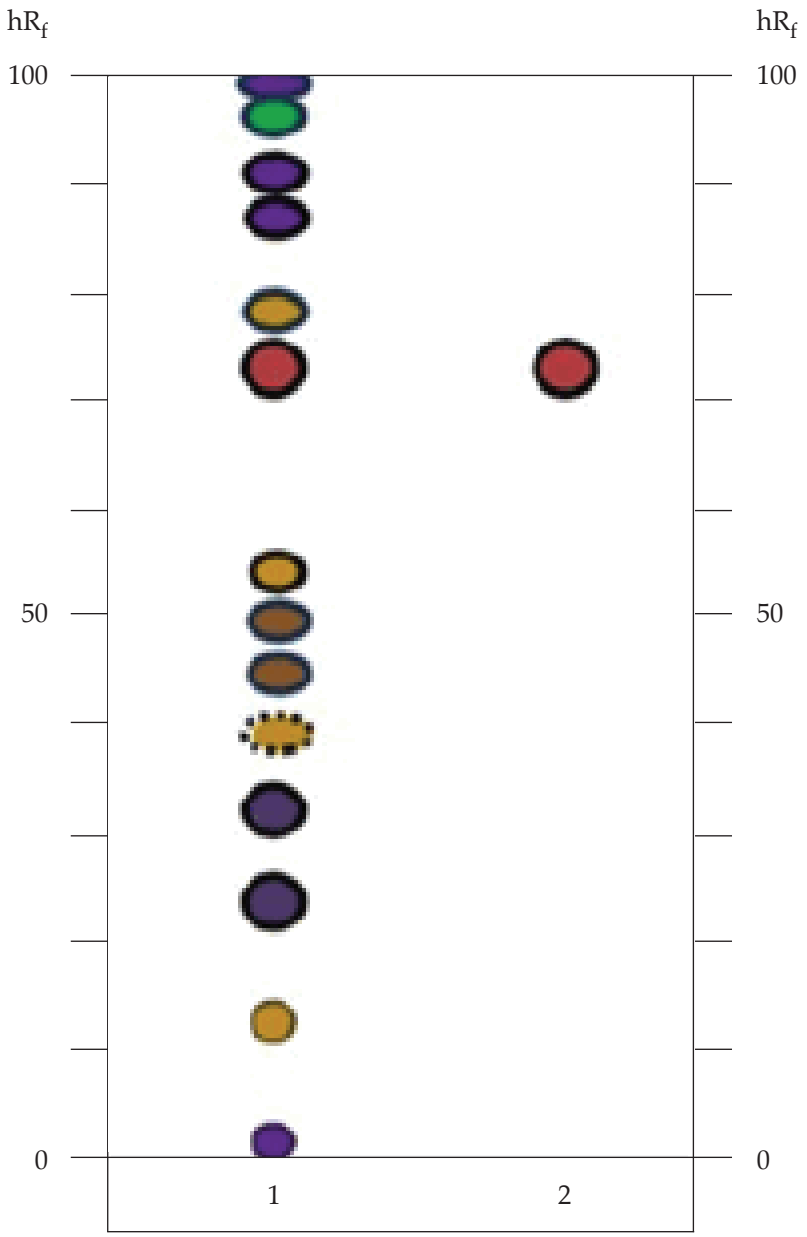


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Aerial Parts of *Hyptis suaveolens* (L.) Poit., Detected with a 20 Per Cent V/V Solution of *Sulfuric Acid* in *Ethanol*

1 = solution (A)

2 = solution (B)

◌ = spot developed in some samples

มะขามป้อม (MAKHAM POM)

Phyllanthi Emblicae Fructus
Emblic Myrobalan

Category Expectorant, laxative with secondary astringent action, antiscorbutic.

Emblic Myrobalan is the dried mature fruit of *Phyllanthus emblica* L. (*Emblica officinalis* Gaertn.) (Family Euphorbiaceae), Herbarium Specimen Number: DMSC 904.

Constituents Emblic Myrobalan contains ascorbic acid, rutin, mucic acid, gallic acid, phyllemblic acid, etc.

Description of the plant (Figs. 1a, 1b) Small or medium-sized tree, up to 20 m high, deciduous, with crooked trunk and spreading branches; bark greenish grey, peeling off in conchoidal flakes; branchlets glabrous or finely pubescent, 10 to 20 cm long. Leaves imbricate when young, subsessile, 0.5 to 2.5 cm long, 1.5 to 5.5 mm wide, closely set along the branchlets, distichous, light green, glabrous, narrowly linear, obtuse, having appearance of pinnate leaves; stipule minute, ovate, finely acute. Flower small, monoecious, apetalous, greenish yellow, in axillary fascicles on the leaf-bearing branchlets, often on the naked portion below the leaves, with fimbricate bracts at the base. Male flowers numerous, on short slender pedicel; calyx-lobes 6, oblong, obtuse, 1.2 mm long; anthers 3, filaments united in a short central column; disk-glands 6, alternating with the calyx-segments. Female flowers few, subsessile or sessile; calyx as in the male; ovary 3-celled, half immersed in the lacerate, cup-shaped disc, style connate at the base, stigmas 3, bilobed, lobes dilated, recurved. Fruit sessile, 1.3 to 2.7 cm in diameter, fleshy, globose or depress globose, with 6 longitudinal faint lines, glabrous, lucid, pale yellow; endocarp of triangular cocci, bony, dehiscent, with 3 short bundles of vascular tissue at the base. Seeds 6, trigonous.

Description Odour, slightly aromatic; taste, slightly sour and astringent.

Macroscopical (Fig. 1a) Entire fruit, subspherical, wrinkled, about 1.3 to 2 cm in diameter, often dehiscent; fruit pulp dark brown to black, coriaceous; endocarp, brown, hard, globular, acutely hexangular; testa brown; seed brown, bony, trigonous.

Microscopical (Figs. 2a, 2b) Transverse section of the fruit pulp shows a layer of epicarp. Parenchyma, thin-walled ground tissue, containing prismatic crystals in some cells. Sclereid, lignified, occurring in 3 forms: rectangular sclereid, occurring in groups of a large number of cells near epicarp, containing water-soluble grey masses; spherical sclereid, occurring as single cell or in small groups of 2 to 10 cells; fibrous sclereid, occurring in bundles of 2 to 5 cells. Vascular bundle, lignified, composed of fibres and spiral vessels. Tannin granules, found in parenchyma, more often in the inner layer than in the outer layer.

Emblic Myrobalan in powder possesses the diagnostic microscopical characters of the fruit pulp with additional characters: sclerenchyma; thick-walled parenchyma, containing reddish masses.

1

2

3

4

1 cm

Fig. 1a *Phyllanthus emblica* L.
1. habit 2. flowering twig 3. fruiting twig 4. crude drug

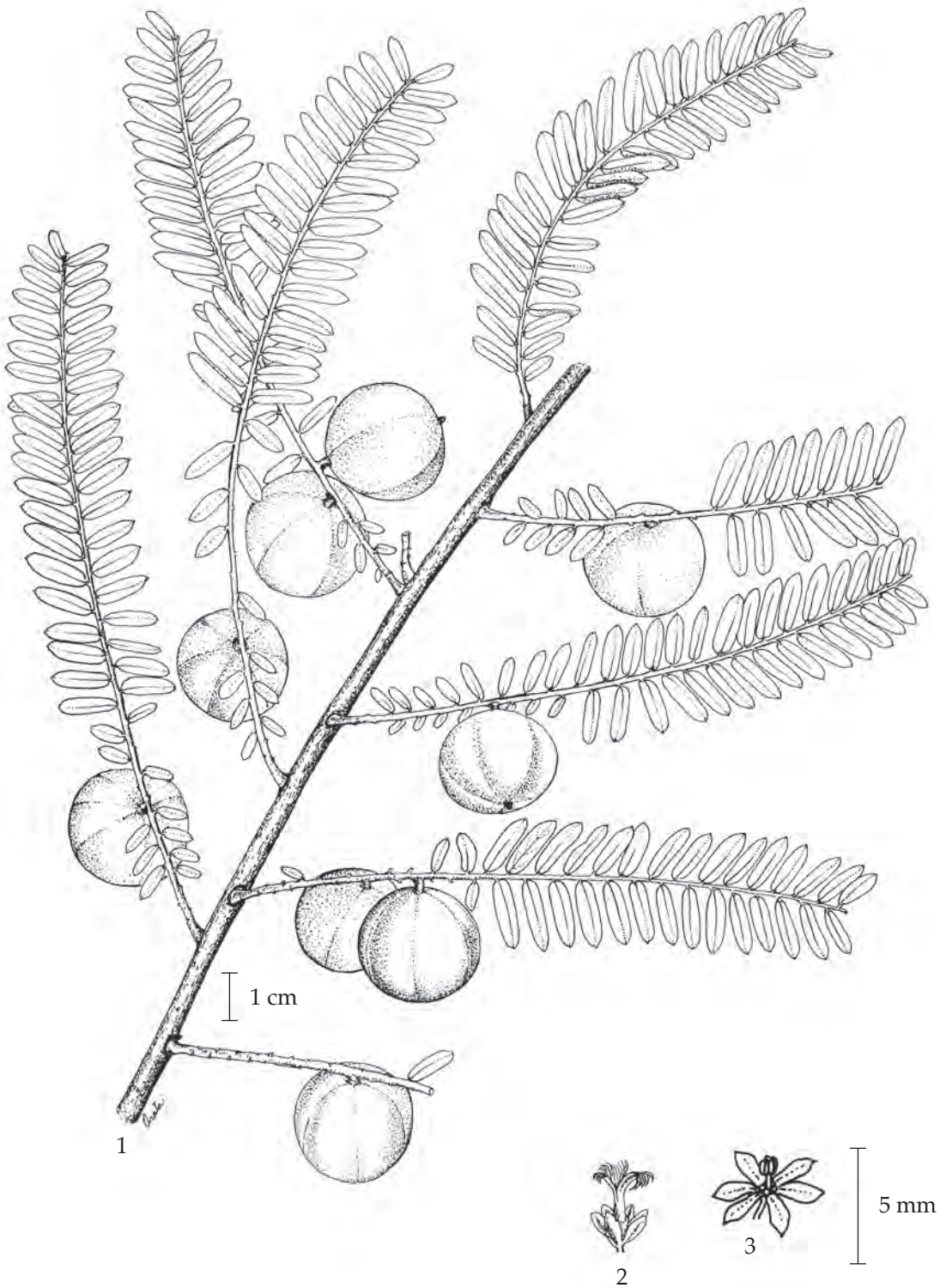


Fig. 1b *Phyllanthus emblica* L.
1. fruiting twig 2. female flower 3. male flower

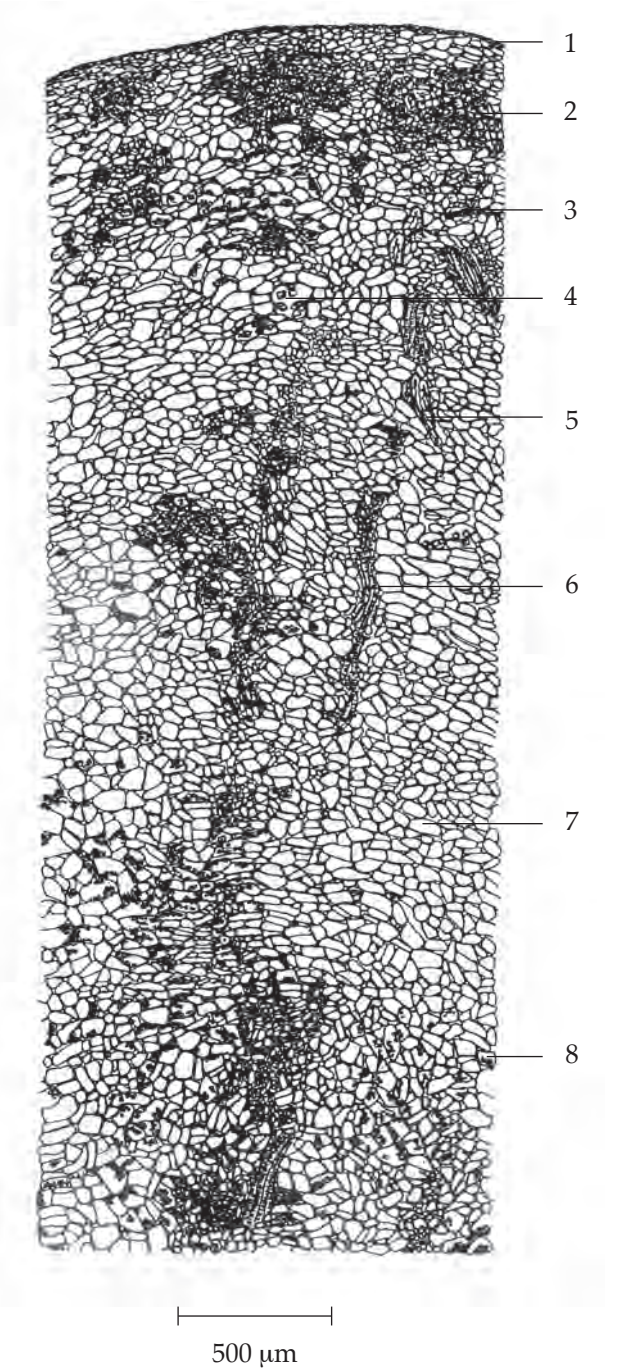


Fig. 2a Transverse Section of the Fruit Pulp of *Phyllanthus emblica* L.

1. epicarp
2. group of sclereids containing grey masses
3. sclereid
4. parenchyma containing prismatic crystals
5. fibrous sclereid
6. vascular bundle
7. parenchyma
8. parenchyma containing tannin granules

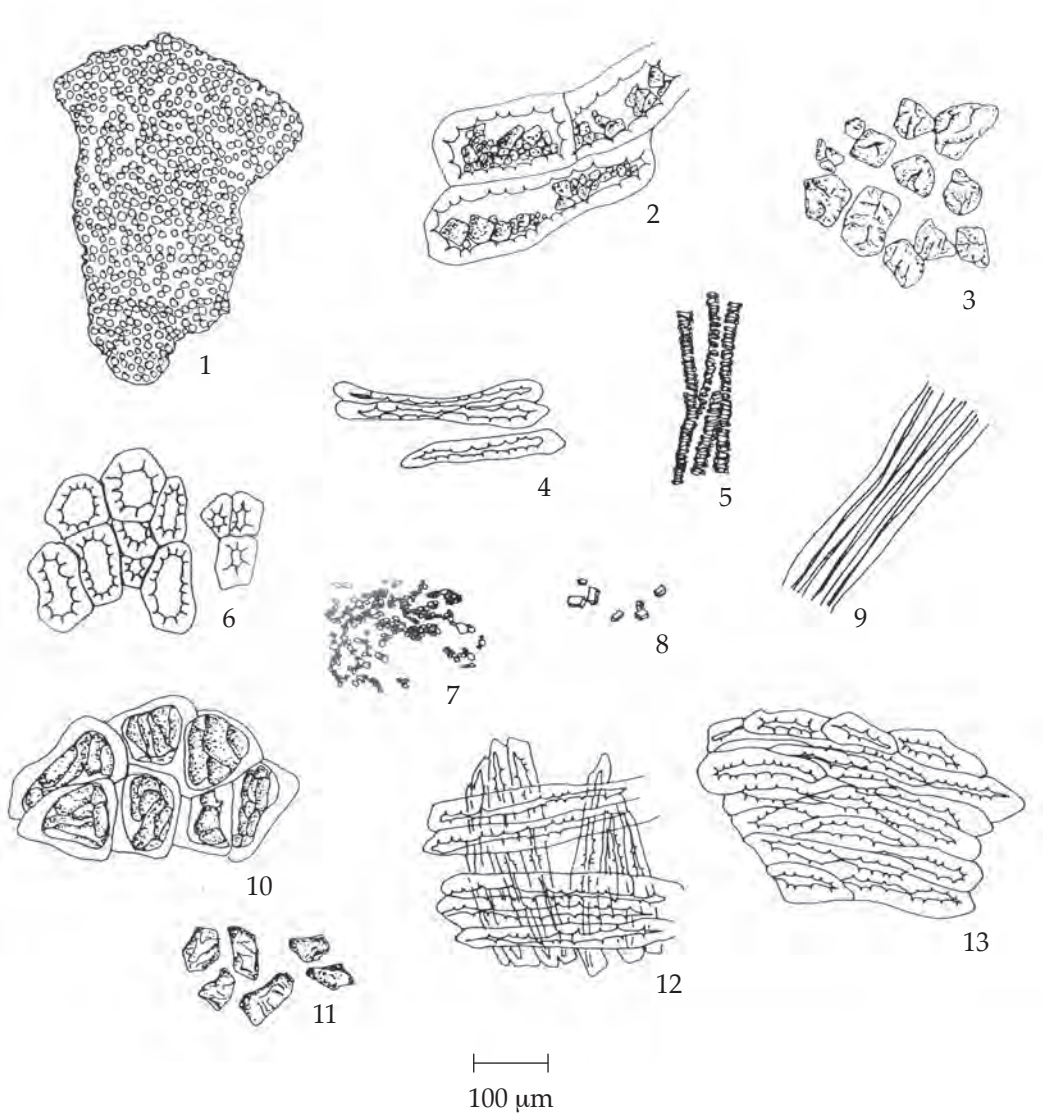


Fig. 2b Powdered Drug of the Fruit Pulp of *Phyllanthus emblica* L.

1. epicarp in surface view
2. sclereids containing grey masses
3. grey masses
4. fibrous sclereids
5. spiral thickenings
6. sclereids
7. tannin granules
8. prismatic crystals
9. fragment of fibres
10. thick-walled parenchyma containing reddish masses
11. reddish masses
12. fibrous sclereids from seed coat
13. sclerenchyma from seed coat

Additional information As an expectorant, it is suggested to frequently sip a juice freshly prepared by squeezing 10 to 30 fresh fruits of emblic myrobalan.

Packaging and storage Emblic Myrobalan shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Reflux 1 g of the sample, in powder, with 20 mL of *water* for 10 minutes and filter (solution 1). To 2 mL of solution 1, add a few drops of *sodium hydrogencarbonate TS* and *iron(II) sulfate TS*: a deep violet colour develops. Then add 0.5 mL of a 6 per cent v/v solution of *sulfuric acid*: a deep violet colour disappears.

B. To 2 mL of solution 1, add 1 mL of *ethanol* and shake well: a white gelatinous mass is produced.

C. Reflux 1 g of the sample, in powder, with 25 mL of *ethanol* for 15 minutes, and filter (solution 2). To 2 mL of solution 2, add a few drops of *iron(III) chloride TS*: a blue-black colour develops.

D. To 1 mL of solution 2, add a few drops of *fuming nitric acid*: a red colour develops.

E. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 5 volumes of *toluene*, 4 volumes of *ethyl formate* and 1 volume of *formic acid* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply separately to the plate, 20 μL of solution (A) and 1 μL of solution (B). Prepare solution (A) by refluxing 500 mg of the sample, in powder, with 10 μL of *ethanol* for 10 minutes and filtering. To the filtrate, add 500 mg of *decolorizing charcoal*, reflux for a few minutes, filter, wash the filter paper and the funnel with small amount of *ethanol*, and adjust to 10 mL with *ethanol*. For solution (B), dissolve 3 mg of *gallic acid* in 1 mL of *ethanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. The chromatogram obtained from solution (A) shows a quenching spot (hR_f value 43 to 44) corresponding to the gallic acid spot from solution (B), and one spot of lower hR_f value. Spray the plate with *iron(III) chloride TS*; the spot due to gallic acid is blue-black and the other blue-black spot is observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Ethanolic Extract of the Fruits of *Phyllanthus emblica* L.

Spot	hR_f Value	Detection	
		UV 254	*Iron(III) Chloride TS*
1	4–6	quenching	blue-black
2*	43–44	quenching	blue-black

*gallic acid

Loss on drying Not more than 9.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Acid-insoluble ash Not more than 1.0 per cent w/w (Appendix 7.6).

Total ash Not more than 4.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 16.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 26.0 per cent w/w (Appendix 7.12).

Tannins content Not less than 20.0 per cent w/w (Appendix 7.12H). Use 4 g of Emblic Myrobalan, in *fine powder*, accurately weighed.

Dose 6 to 12 g a day, as a decoction, sip as needed.

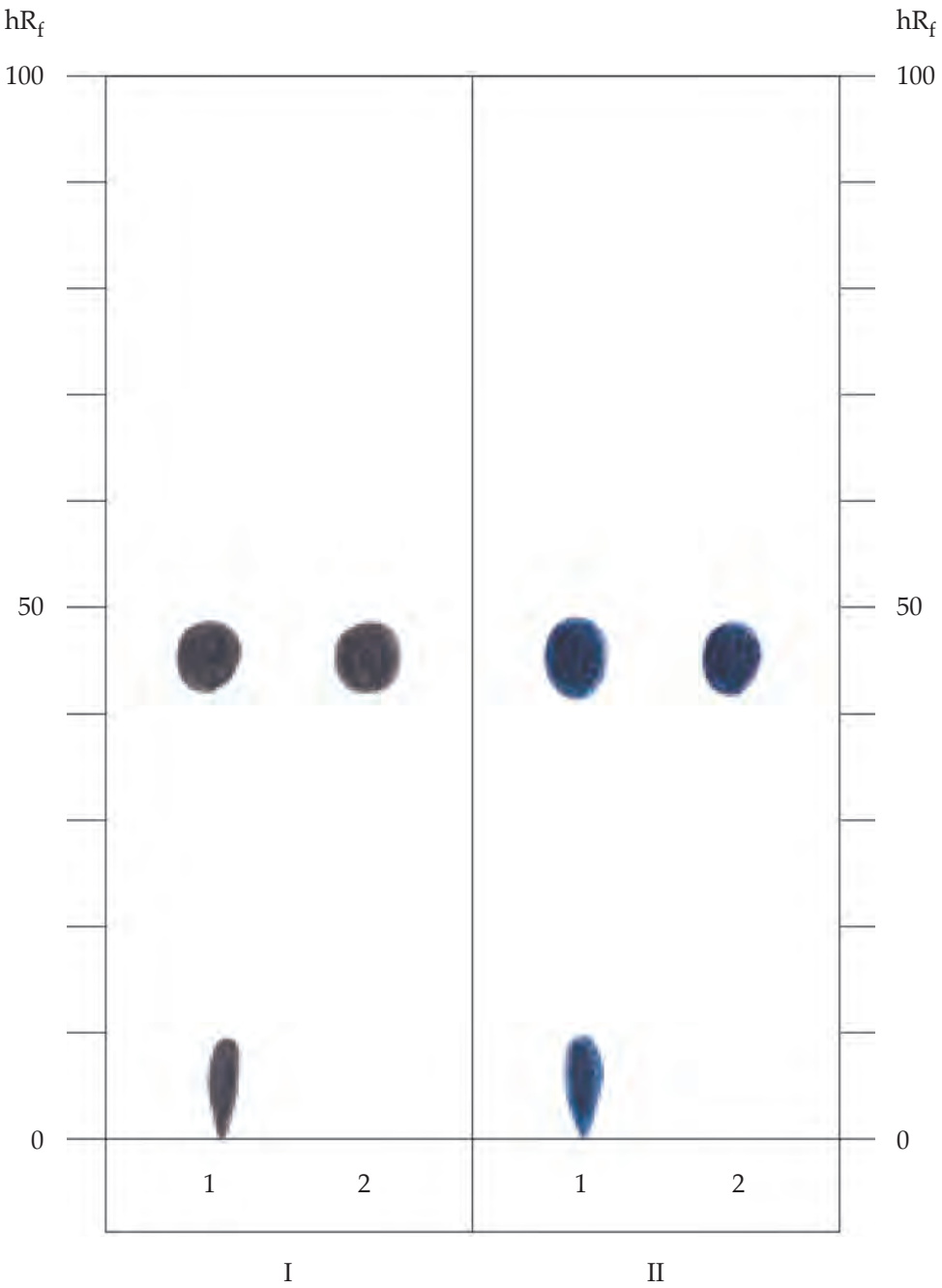


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Fruits of *Phyllanthus emblica* L.
1 = solution (A)
2 = solution (B)
I = detection under UV light (254 nm)
II = detection with *iron(III) chloride TS*

มะกรูด, ใบ (MAKRUT, BAI)

Citri Hystricis Folium
Citrus Hystrix Leaf

Synonyms Kaffir Lime Leaf, Leech Lime Leaf, Mauritius Papeda Leaf, Porcupine Orange Leaf

Category Pharmaceutic aid (flavouring agent), carminative.

Citrus Hystrix Leaf is the dried leaf of *Citrus hystrix* DC. (*C. papeda* Miq., *C. tuberoides* J. W. Benn.) (Family Rutaceae), Herbarium Specimen Number: DMSC 342.

Constituents Citrus Hystrix Leaf contains volatile oil, of which citronellal, citronellol and citronellol acetate are its major components; sabinene, α- and β-pinene, α-phellandrene, limonene, α- and γ-terpinene, cymene, linalool, indole alkaloids are also found. It also contains rutin, hesperidin and diosmin.

Description of the plant (Figs. 1a, 1b) Shrub or small tree 2 to 12 m high; branchlets compressed-angular when young; spine solitary, 0.5 to 1.5 cm long. Leaves alternate or spirally arranged, very young leaves light reddish purple; winged petioles obovate to obcordate-oblong, 1 to 8 cm long, 1 to 4.5 cm wide; lamina orbicular-ovate or ovate-oblong, 3 to 15 cm long, 2.5 to 6 cm wide, apex obtuse to obtusely acuminate or slightly emarginate, base cuneate or rounded, margin more or less crenate. Inflorescence axillary or terminal, 1- to 15-flowered, fragrant; pedicel 2 to 5 mm long; calyx cupular, 1 to 1.5 mm long, 4-lobed; petals 4 to 5, oval-oblong, 6 to 10 mm long, 3 to 5 mm wide, obtusely acuminate, yellowish white or suffused with violet, with scattered pellucid dots; stamens 24 to 30, free, filaments 2 to 6 mm long; ovary superior, subglobose. Fruit ellipsoid, ovoid or globose, 5 to 7 cm in diameter, irregular bumpy; fruit-pulp yellowish green, very sour, slightly bitter. Seeds ovoid-oblong, 1 to 1.5 cm long, 3 to 5 mm wide.

Description Odour, characteristic, aromatic; taste, slightly bitter.

Macroscopical (Fig. 1a) Citrus Hystrix Leaf occurs as a mixture of entire and broken, greenish brown to brown dried leaves. Petioles obovate, 1 to 8 cm long, 1 to 4.5 cm wide. Lamina ovate, 3 to 15 cm long, 2.5 to 6 cm wide; apex obtuse or retuse or slighty emarginate, undulate at margin.

Microscopical (Figs. 2a, 2b) Transverse section of the leaf shows upper epidermis, a layer of rectangular cells in sectional view or slightly wavy-walled cells in surface view, stomata absent. Mesophyll composed of 2 to 3 layers of palisade and several layers of spongy cells with idioblasts containing calcium oxalate prismatic crystals; fibrovascular bundle and schizolysigenous oil cavity containing oil droplets located in spongy tissues. Fibrovascular bundle composed of fibre surrounding amphicribal vascular bundle; xylem composed of spiral, reticulate, and bordered-pitted vessels and xylem parenchyma some of which containing prismatic crystals of calcium oxalate. Collenchyma, 2 to 3 layers of cells, located in the central part of midrib beneath lower epidermis. Lower epidermis, a layer of rectangular cells in sectional view or wavy-walled cells in surface view with anomocytic type of stomata.

Citrus Hystrix Leaf in powder possesses the diagnostic microscopical characters of the unground drug.

1

2

3

4

5

1 cm

Fig. 1a *Citrus hystrix* DC.
1. habit 2. flowering twig 3. fruits 4. fresh leaves 5. crude drug

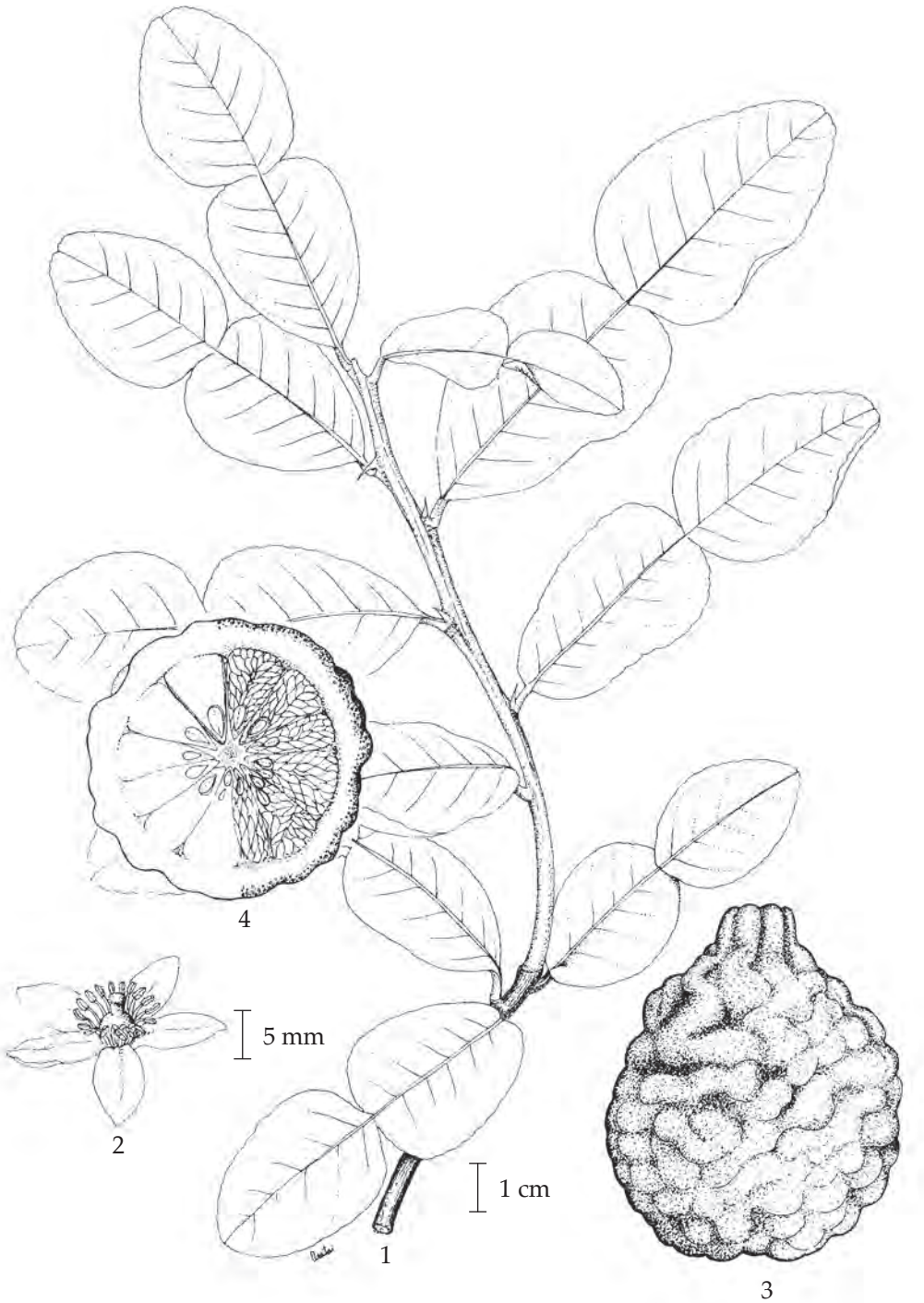


Fig. 1b *Citrus hystrix* DC.
1. twig 2. flower 3. mature fruit 4. cross section of the fruit

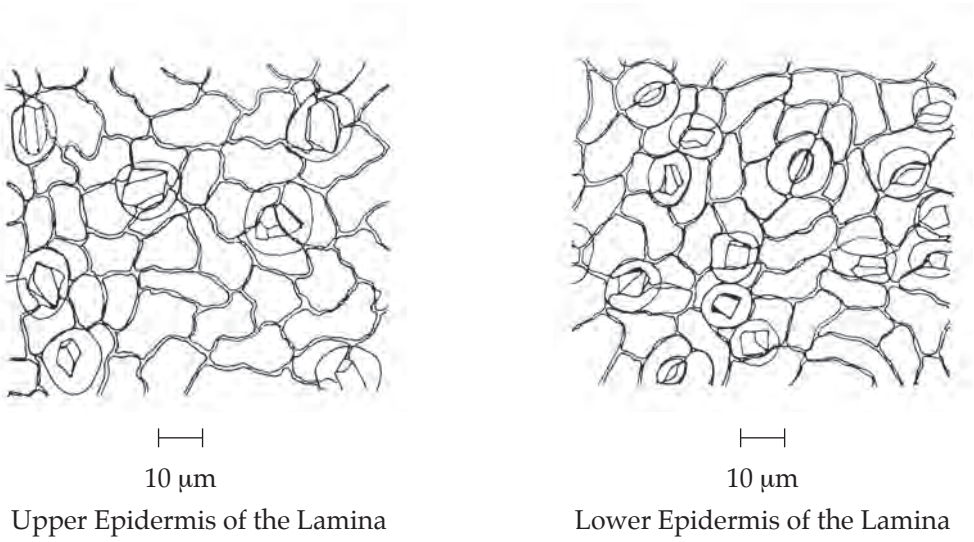


Fig. 2a Epidermises of the Leaf of *Citrus hystrix* DC.

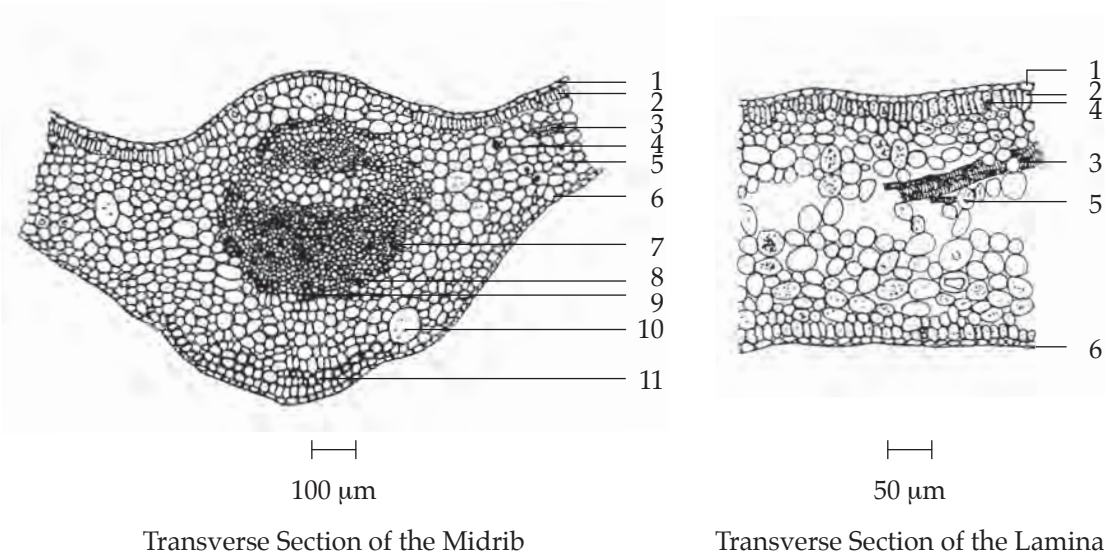


Fig. 2b Transverse Sections of the Leaf of *Citrus hystrix* DC.

1. upper epidermis
2. palisade cell
3. vascular bundle
4. idioblast
5. spongy cell
6. lower epidermis
7. xylem
8. phloem
9. fibre
10. schizolysigenous oil cavity
11. collenchyma

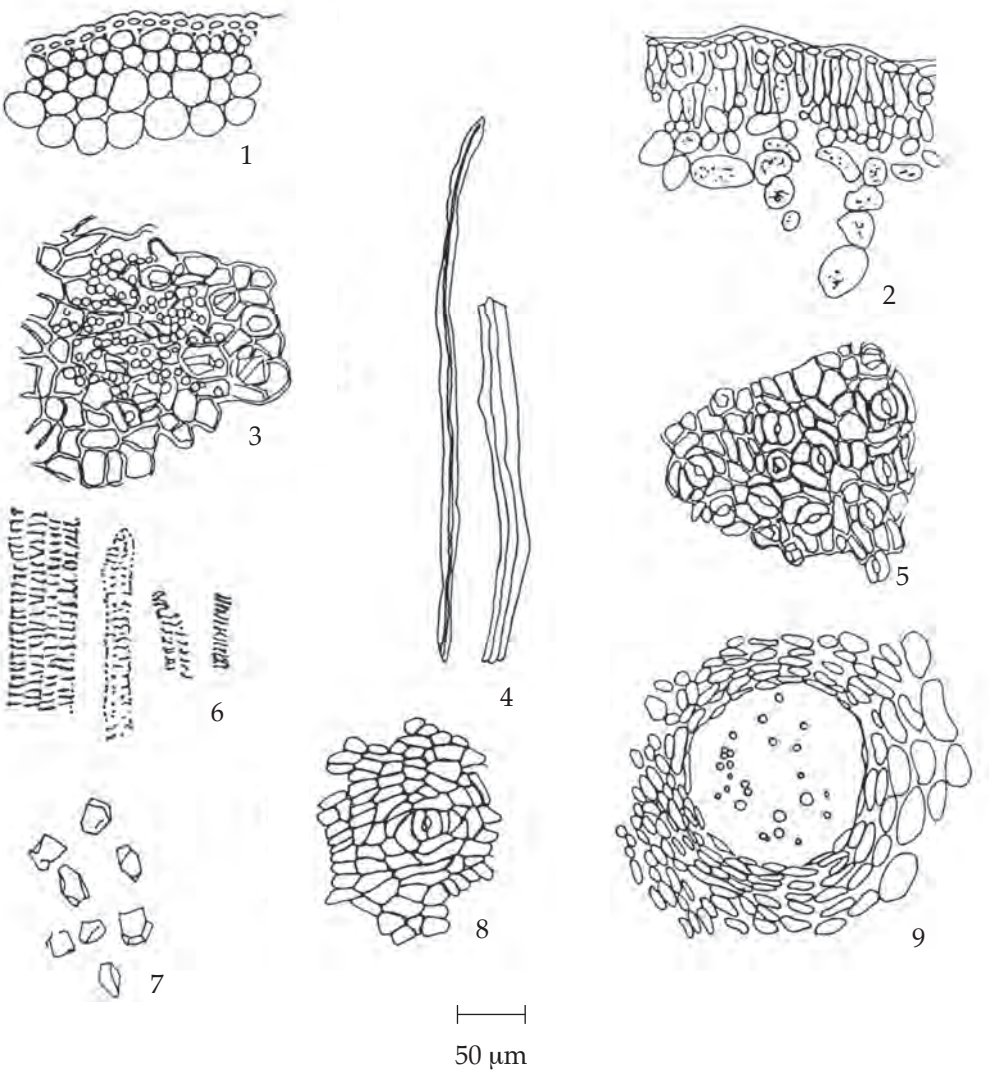


Fig. 2c Powdered Drug of the Leaves of *Citrus hystrix* DC.

1. epidermis an collenchyma in sectional view
2. lamina in sectional view
3. upper epidermis in surface view showing underlying palisade cells and idioblasts containing prismatic crystals of calcium oxalate
4. fibres
5. lower epidermis in surface view showing stomata and the underlying idioblasts containing prismatic crystals of calcium oxalate
6. vessels
7. prismatic crystals of calcium oxalate
8. epidermis of midrib in surface view
9. schizolysigenous oil cavity

Packaging and storage Citrus Hystrix Leaf shall be kept in well-closed containers, preferably of metal or glass, protected from light and stored in a cool and dry place. It should be used within 1 year and air-dried every 2 to 3 months.

Identification

A. Reflux 1 g of the sample, in powder, with 30 mL of *ethanol* for 15 minutes, and filter (solution 1). To 2 mL of solution 1, add a few drops of *ammonium molybdate TS*: a yellowish green precipitate is produced.

B. To 2 mL of solution 1, add a few drops of a freshly prepared 1 per cent w/v solution of *iron(III) chloride*: a deep greenish brown colour is produced.

C. Extract 1 g of the sample, in powder, with 10 mL of *chloroform*, shake occasionally for 20 minutes, and filter. Evaporate 2 mL of the filtrate to dryness, dissolve the residue in 2 mL of *acetic anhydride*, and add slowly 1 mL of *sulfuric acid* to make two layers: a brown colour forms at the zone of contact and the upper layer is green.

D. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and *chloroform* as the mobile phase. Apply to the plate, 10 μL of the test solution prepared by refluxing 1 g of the sample, in powder, with 30 mL of *ethanol* for 15 minutes, filtering, and concentrating the filtrate to 5 mL. After removal of the plate, allow it to dry in air, and examine under ultraviolet light (254 nm), marking the quenching spots. Examine the plate under ultraviolet light (366 nm) (Table 1); see also Fig. 3. Spray the plate with *anisaldehyde TS* and heat at 105° for 5 minutes. Several spots of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Ethanolic Extract of the Leaves of *Citrus hystrix* DC.

Spot	hR_f Value	Detection		
		UV 254	UV 366	*Anisaldehyde TS*
1	1–3	–	yellow	grey
2	3–6	–	red	–
3	3–7	quenching	–	bluish violet
4	6–8	–	red	–
5	9–12	quenching	pink	–
6	12–14	quenching	light violet	bluish violet
7	15–18	quenching	blue	–
8	18–20	–	red	–
9	20–22	–	blue	–
10	23–24	–	red	violet
11	25–27	–	green	–
12	28–32	–	red	–
13	31–35	–	–	pale violet
14	36–40	–	–	bluish violet
15	41–44	–	blue	–
16	44–46	quenching	–	–
17	57–61	–	–	violet
18	64–67	quenching	–	–
19	68–72	–	–	pale violet
20	72–76	–	–	bluish violet
21	76–79	quenching	–	violet
22	84–85	–	–	bluish violet
23	86–91	quenching	–	bluish violet

Water Not more than 11.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 3.0 per cent w/w (Appendix 7.6).

Total ash Not more than 17.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 6.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 18.0 per cent w/w (Appendix 7.12).

Chloroform-soluble extractive Not less than 5.0 per cent w/w (Appendix 7.12H).

Volatile oil Not less than 0.6 per cent v/w (Appendix 7.3H). Use 25 g of hand-crushed leaves, accurately weighed. Use 250 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube.

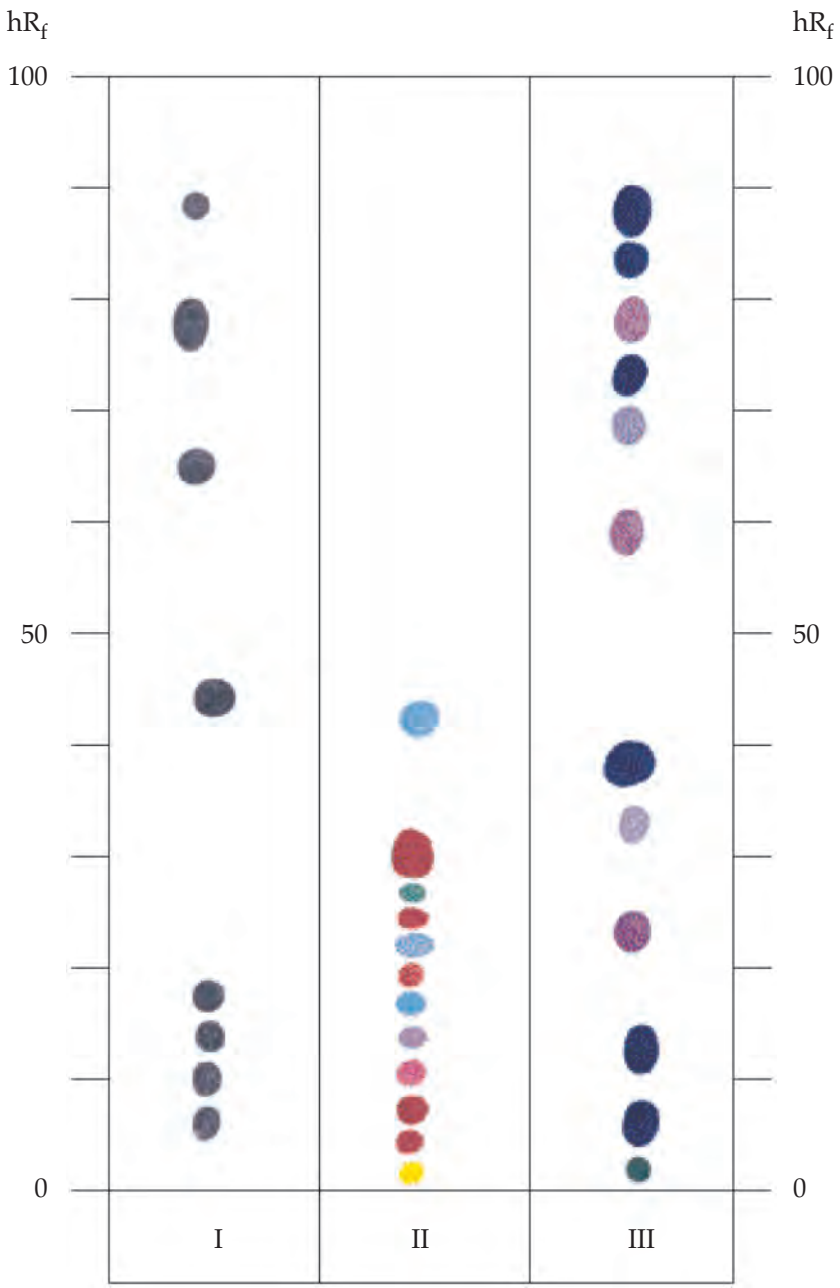


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Leaves of *Citrus hystrix* DC.
I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *anisaldehyde TS*

มะกรูด, ผิว (MAKRUT, PHIO)

Citri Hystricis Exocapium et Mesocarpium
Citrus Hystrix Peel

Synonyms Kaffir Lime Peel, Leech Lime Peel, Mauritius Papeda Peel, Porcupine Orange Peel

Category Pharmaceutic aid (flavouring agent), carminative.

Citrus Hystrix Peel is the dried exocarp and mesocarp of green mature fruit of *Citrus hystrix* DC. (*C. papeda* Miq., *C. tuberoides* J. W. Benn.) (Family Rutaceae), Herbarium Specimen Number: DMSC 1459.

Constituents Citrus Hystrix Peel contains volatile oil, of which β-pinene, limonene, β-phellandrene, and citronellal are its major components. It also contains linalool, borneol, camphor, sabinene, germacrene D, aviprin, umbelliferone, β-sitosterol, etc.

Description of the plant See under *Citrus Hystrix Leaf*, See also Figs. 1a, 1b.

Description Odour, characteristic, aromatic; taste, bitter.

Macroscopical (Fig. 1) Citrus Hystrix Peel occurs as strips of dried fruit rind; outer surface dark green to brown, rough with pits of oil glands; inner surface exhibiting whitish spongy part.

Microscopical (Figs. 2a, 2b) Transverse section of the exocarp and mesocarp shows exocarp, a layer of rectangular cells covered by thick cuticle. Mesocarp, the outer part composed of several layers of thick-walled parenchyma containing chromoplastids; the inner part composed of thick-walled spongy parenchyma; vascular bundles, scattered; vessels, lignified reticulate and spiral. Prismatic crystals of calcium oxalate and schizolysigenous oil cavities containing oil droplets are also found.

Citrus Hystrix Peel in powder possesses the diagnostic microscopical characters of the unground drug.

Additional information Citrus Hystrix Peel in this monograph refers to exocarp with attached unremovable mesocarp.

Packaging and storage Citrus Hystrix Peel shall be kept in well-closed containers, preferably of metal or glass, protected from light and stored in a cool and dry place. It should be used within 1 year and air-dried every 2 to 3 months.

2

1

3

Fig. 1 *Citrus hystrix* DC.
1. habit 2. fruiting twig 3. crude drug

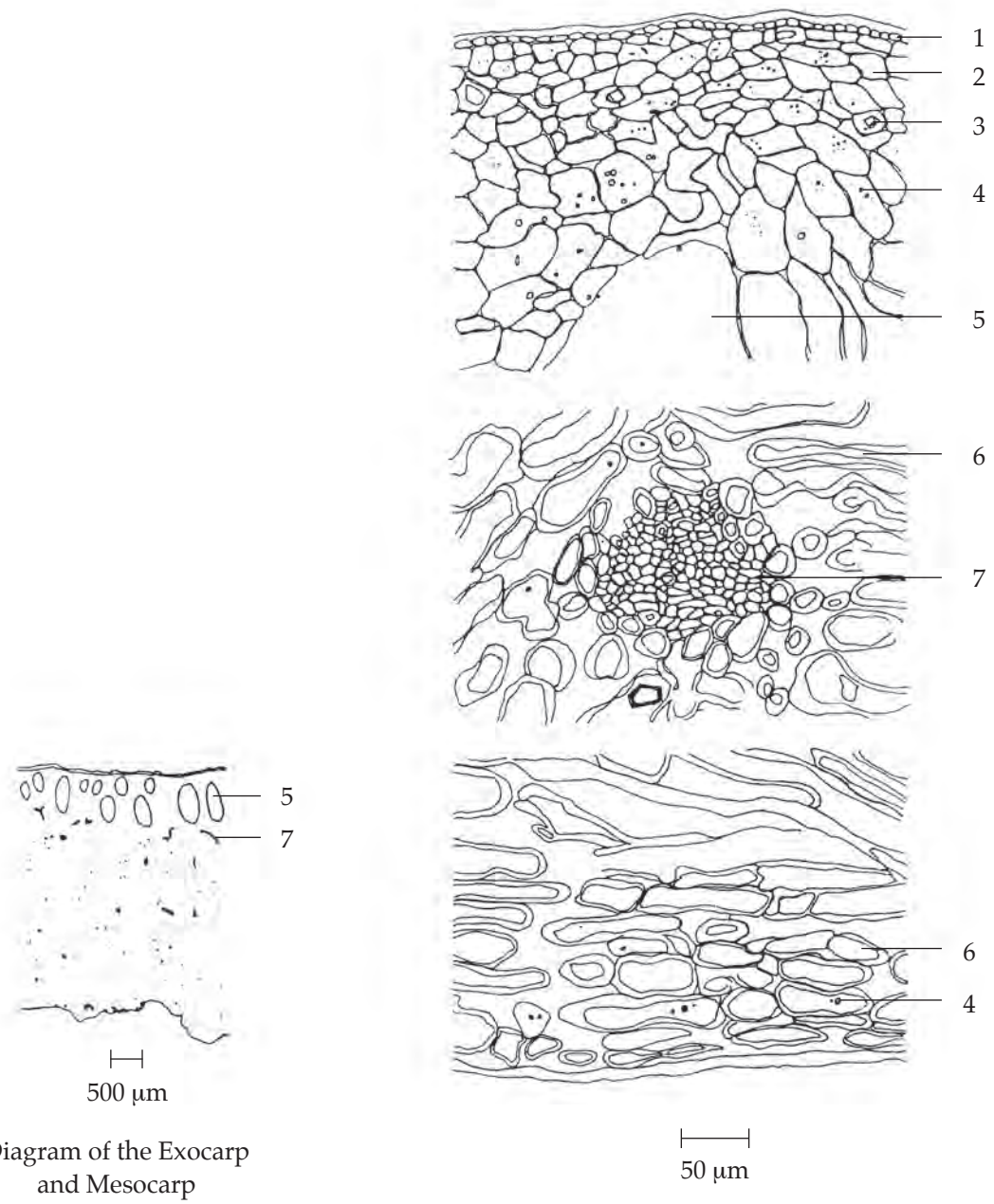


Diagram of the Exocarp and Mesocarp

Fig. 2a Transverse Section of the Exocarp and Mesocarp of the Fruit of *Citrus hystrix* DC.

1. epicarp with cuticle
2. thick-walled parenchyma containing chromoplastids
3. prismatic crystal of calcium oxalate
4. oil droplet
5. schizolysigenous oil cavity
6. thick-walled spongy parenchyma cell
7. vascular bundle

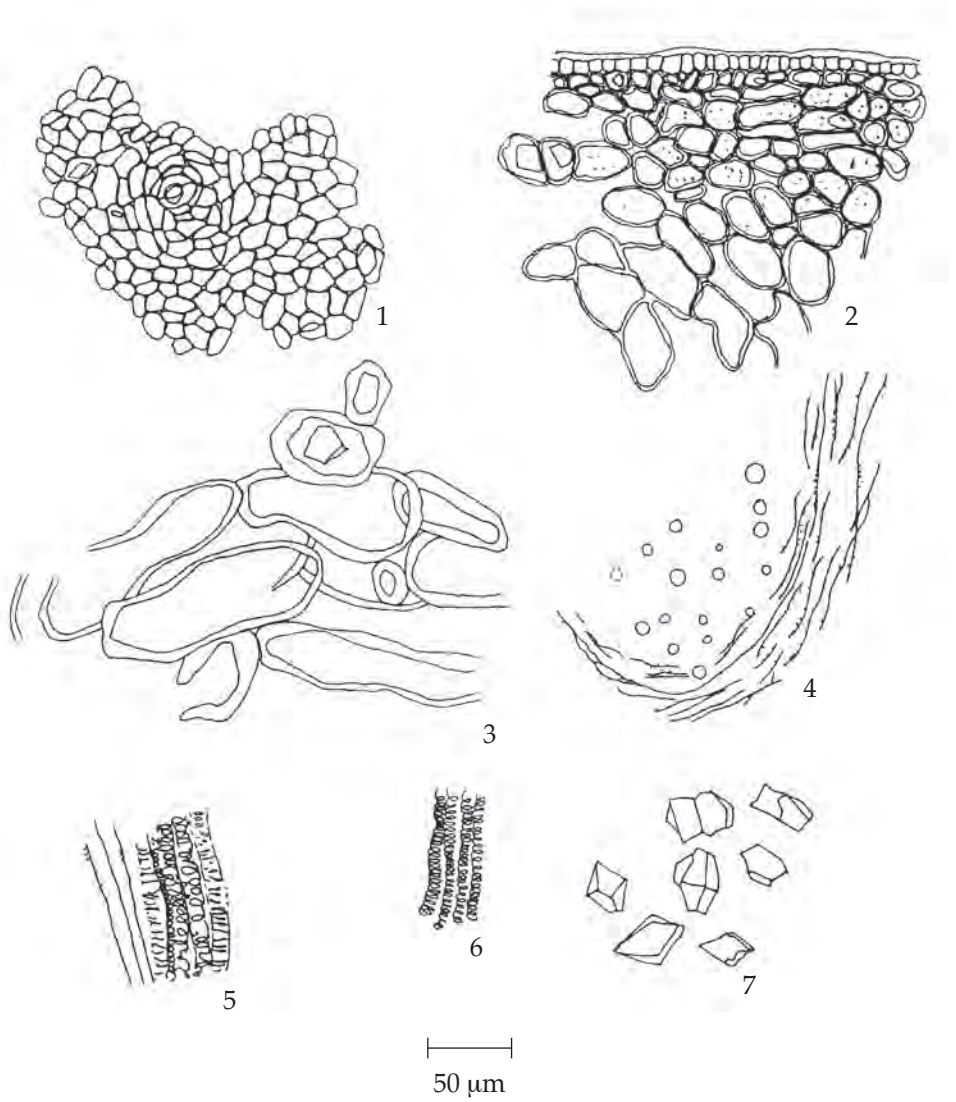


Fig. 2b Powdered Drug of the Exocarp and Mesocarp of the Fruits of *Citrus hystrix* DC.

1. epicarp in surface view showing anomocytic stoma
2. pericarp in sectional view showing epicarp and parenchyma of mesocarp containing prismatic crystals and chromoplastids
3. thick-walled spongy cells with crystals
4. schizolysigenous oil cavity with oil droplets
5. spiral and reticulate vessels and fibres
6. spiral vessel thickenings
7. prismatic crystals of calcium oxalate

Identification

A. Reflux 1 g of the sample, in powder, with 30 mL of *ethanol* for 15 minutes, and filter (solution 1). To 2 mL of solution 1, add a few drops of *ammonium molybdate TS*: a bright yellow precipitate is produced.

B. To 2 mL of solution 1, add a few drops of a freshly prepared 1 per cent w/v solution of *iron(III) chloride*: a deep greenish brown colour is produced.

C. To 2 mL of solution 1, add a few drops of *ninhydrin TS* and warm on a water-bath for a few minutes: a reddish purple colour is produced.

D. Moisten 1 g of the sample, in powder, with 0.5 mL of *strong ammonia solution*, add 5 mL of *chloroform*, occasionally shaking for 10 minutes, and filter. Evaporate the filtrate until dryness and dissolve the residue in 1 mL of *ethanol*, and add a few drops of *modified Dragendorff TS2*: an orange precipitate is produced.

E. Extract 1 g of the sample, in powder, with 10 mL of *chloroform*, shake occasionally for 20 minutes, and filter. Evaporate 2 mL of the filtrate to dryness, dissolve the residue in 2 mL of *acetic anhydride*, and add slowly 1 mL of *sulfuric acid* to make two layers: a brown colour forms at the zone of contact and the upper layer is green.

F. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and *chloroform* as the mobile phase. Apply to the plate, 5 µL of the test solution prepared by moistening 1 g of the sample, in powder, with 1 mL of *strong ammonia solution* for a while, extracting with 10 mL of *chloroform* by occasionally shaking for 15 minutes, filtering, and concentrating the filtrate to 1 mL. After removal of the plate, allow it to dry in air, and examine under ultraviolet light (254 nm), marking the quenching spots. Examine the plate under ultraviolet light (366 nm) (Table 1); see also Fig. 3. Spray the plate with *anisaldehyde TS* and heat at 105° for 5 minutes. Several spots of different colours are observed (Table 1); see also Fig. 3.

Repeat the same procedure on other two plates but use a mixture of 20 volumes of *chloroform* and 1 volume of *methanol* as the mobile phase and allow the solvent front to ascend 12 cm above the line of application. After removal of the plates, allow them to dry in air, and spray one plate with *modified Dragendorff TS2*: two orange spots are observed. Spray another plate with *iodoplatinate TS*: one dark blue spot and one brown spot are observed (Table 1); see also Fig. 4.

Table 1 hR_f Values of Components in Chloroform Extract of the Peels of *Citrus hystrix* DC.

a. Mobile phase: *chloroform*

Spot	hR_f Value	Detection		
		UV 254	UV 366	*Anisaldehyde TS*
1	0–2	–	light green	–
2	1–4	quenching	–	green
3	2–3	–	blue	–
4	4–5	–	blue	–
5	5–7	quenching	light green	bluish violet
6	7–9	quenching	light green	bluish violet
7	8–11	quenching	light green	brown
8	10–13	quenching	light green	bluish violet
9	12–15	quenching	light green	bluish violet
10	15–20	quenching	light green	green
11	20–26	quenching	light green	brown
12	25–28	–	red	–
13	29–31	–	–	bluish violet
14	33–34	–	–	blue
15	36–38	–	–	pink
16	36–39	–	blue	–
17	39–41	–	–	brown
18	41–48	quenching	green	violet
19	46–50	quenching	green	–
20	51–54	–	–	brown
21	58–61	–	–	pink
22	68–70	–	–	violet
23	73–76	–	–	bluish violet
24	77–80	–	–	violet
25	81–84	quenching	–	–
26	84–86	–	–	bluish violet
27	86–90	quenching	–	violet

b. Mobile phase: 20 volumes of *chloroform* and 1 volume of *methanol*

Spot	hR_f Value	Detection	
		Modified Dragendorff TS2	*Iodoplatinate TS*
1	33–40	orange	dark blue
2	87–92	orange	brown

Water Not more than 12.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 1.0 per cent w/w (Appendix 7.6).

Total ash Not more than 9.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 11.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 23.0 per cent w/w (Appendix 7.12).

Chloroform-soluble extractive Not less than 8.0 per cent w/w (Appendix 7.12H).

Volatile oil Not less than 2.0 per cent v/w (Appendix 7.3H). Use 25 g, in *coarse powder,* freshly prepared and accurately weighed. Use 250 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube.

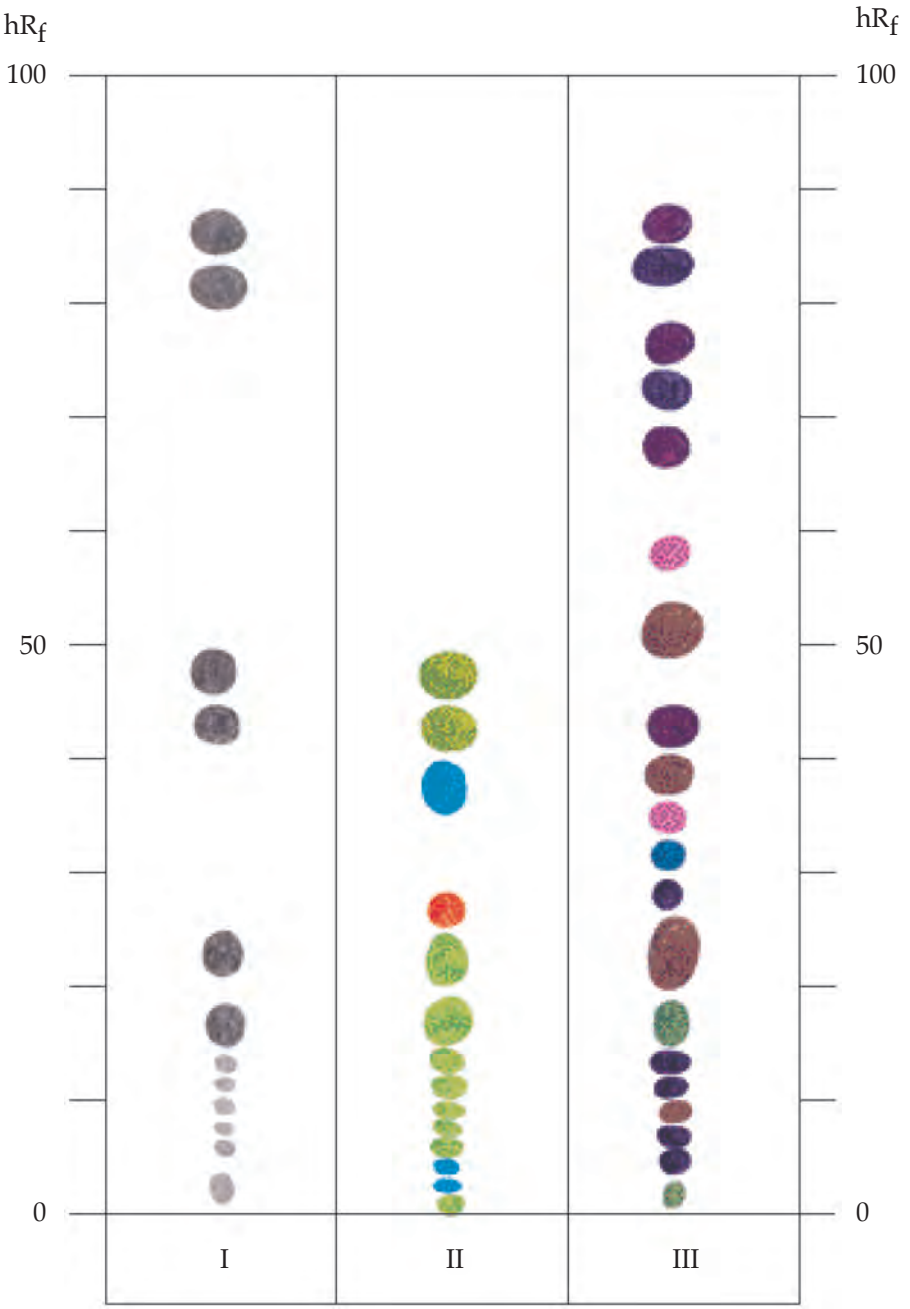


Fig. 3 Thin-Layer Chromatogram of Chloroform Extract of the Peels of *Citrus hystrix* DC.
I = detection under UV light (254 nm)
II = detection under UV light (366 nm)
III = detection with *anisaldehyde TS*

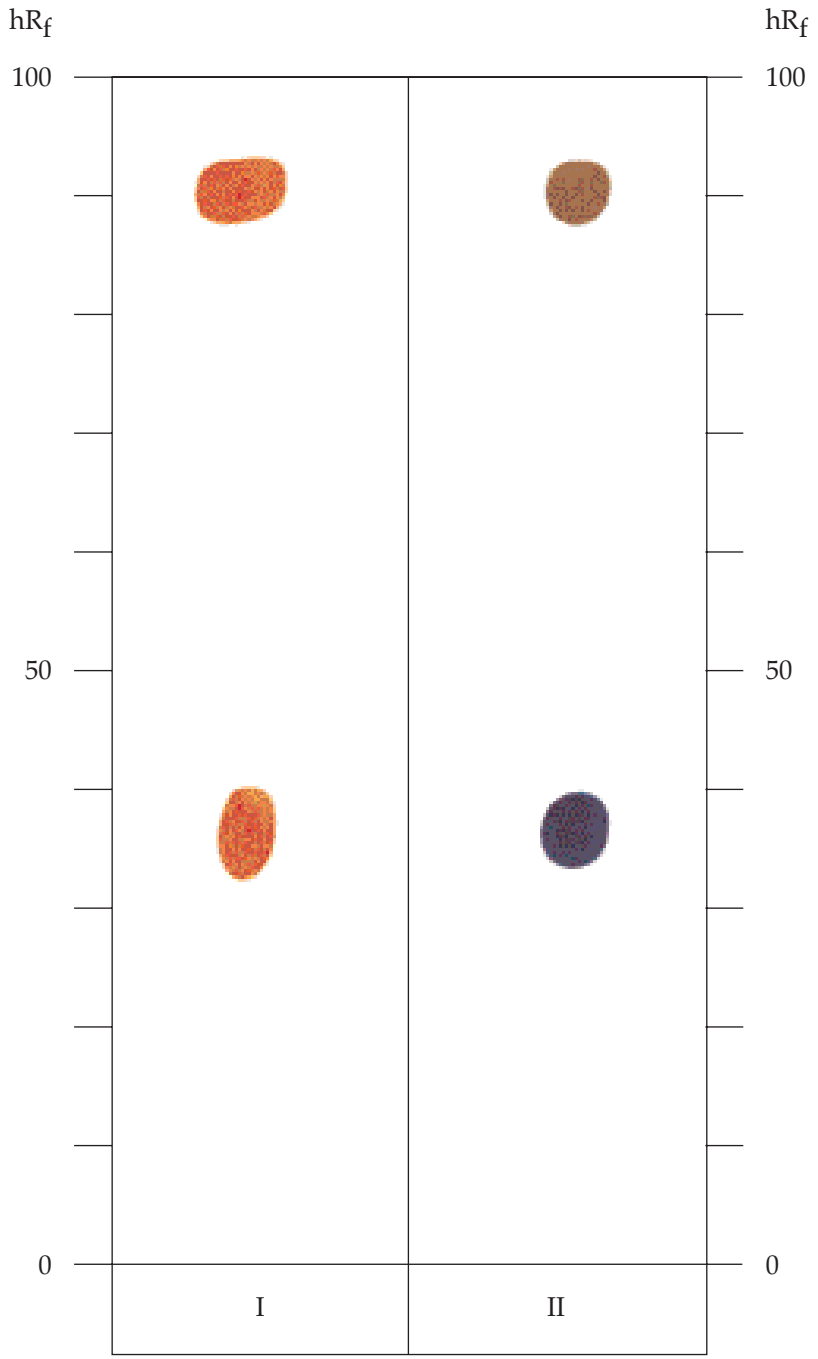


Fig. 4 Thin-Layer Chromatogram of Chloroform Extract of the Peels of *Citrus hystrix* DC.
I = detection with *modified Dragendorff TS2*
II = detection with *iodoplatinate TS*

หมากสง (MAKSONG)

Arecae Catechi Semen
Areca Seed

Synonyms Areca Nut Seed

Category Anthelmintic (taeniasis, ascariasis), antidiarrheal.

Areca Seed is the dried seed of reddish orange mature fruit of *Areca catechu* L. (Family Palmae), Herbarium Specimen Number: DMSC 1089.

Constituents Areca Seed contains the major alkaloid arecoline and other minor alkaloids which are arecolidine, arecaine (arecaidine), guvacine, guvacoline and isoguvacine. It also contains condensed tannins, (+)-catechin, (-)-epicatechin, fatty acids, amino acids, etc.

Description of the plant (Figs. 1a, 1b) Small to medium-sized tree up to 30 m high; trunk solitary, straight, annulate, usually about 50 cm in circumference, uniformly thick. Leaves pinnate, 1 to 2 m long; petiole base expanding into a smooth, outside green, amplexicaul sheath, 75 to 100 cm long; leaflets numerous, 30 to 60 cm long, upper confluent glabrous, attached to the rachis in a vertical line. Inflorescence spadix, much branched, bearing male and female flowers; peduncle up to 60 cm high; rachis stout, compressed, branches with filiform tips. Male flowers numerous, sessile, without bracts, occupying the upper portion of the spikes; calyx 1-leaved, small, 3-cornered, 3-parted; petals 3, oblong, rigid, striated; stamens 6, anther sagittate. Female flowers much larger, solitary, or 2 to 3, at or near the base of each ramification of the spadix, sessile, without bracts; sepals 3, cordate, rigid, fleshy, permanent; petals 3, sepaloid, permanent; staminodes 6, connate; style scarcely any; stigmas 3, short triangular. Fruit glabrous, ovoid or ellipsoid, 3 to 7 cm long, orange or scarlet when ripe, supported by the persistent perianth, mesocarp fibrous. Seed 1, globose with truncate base; endosperm deeply ruminate; embryo basilar.

Description Odour, slight, characteristic; taste, astringent.

Macroscopical (Fig. 1a) Oblate or rounded-conical, 1.5 to 3.5 cm long, base 1.5 to 3 cm wide. Externally pale yellowish brown or pale reddish brown, with slightly concaved reticulate furrows, having a round, hollow micropyle in the centre of the base, beside which bearing an obvious scar-shaped hilum. Texture hard, uneasily broken; fractured surface showing marble-like striations alternated with brown seed coats and white endosperm.

Microscopical (Figs. 2a, 2b) Transverse section of the seed shows testa, several loosely packed layers of reddish brown cells with moderately thickened walls with a few scattered, small, rounded or slit-shaped pits. Testa rumination, several layers of large, pitted thin-walled cells, some of them filled with brown pigment and fixed oil globules, embedded with groups of vessels. Endosperm, large polygonal cells with beaded and porous cellulose walls, perforated by rounded to oval, conspicuous pits containing fixed oil globules and aleurone grains, some with rather smooth walls. Embryo, occupying the central region of the seed near the base.

Areca Seed in powder possesses the diagnostic microscopical characters of the unground drug.

1

2

3

4

5

1 cm

Fig. 1a *Areca catechu* L.
1. habit 2. and 3. inflorescences 4. bunch of ripe fruits 5. crude drug

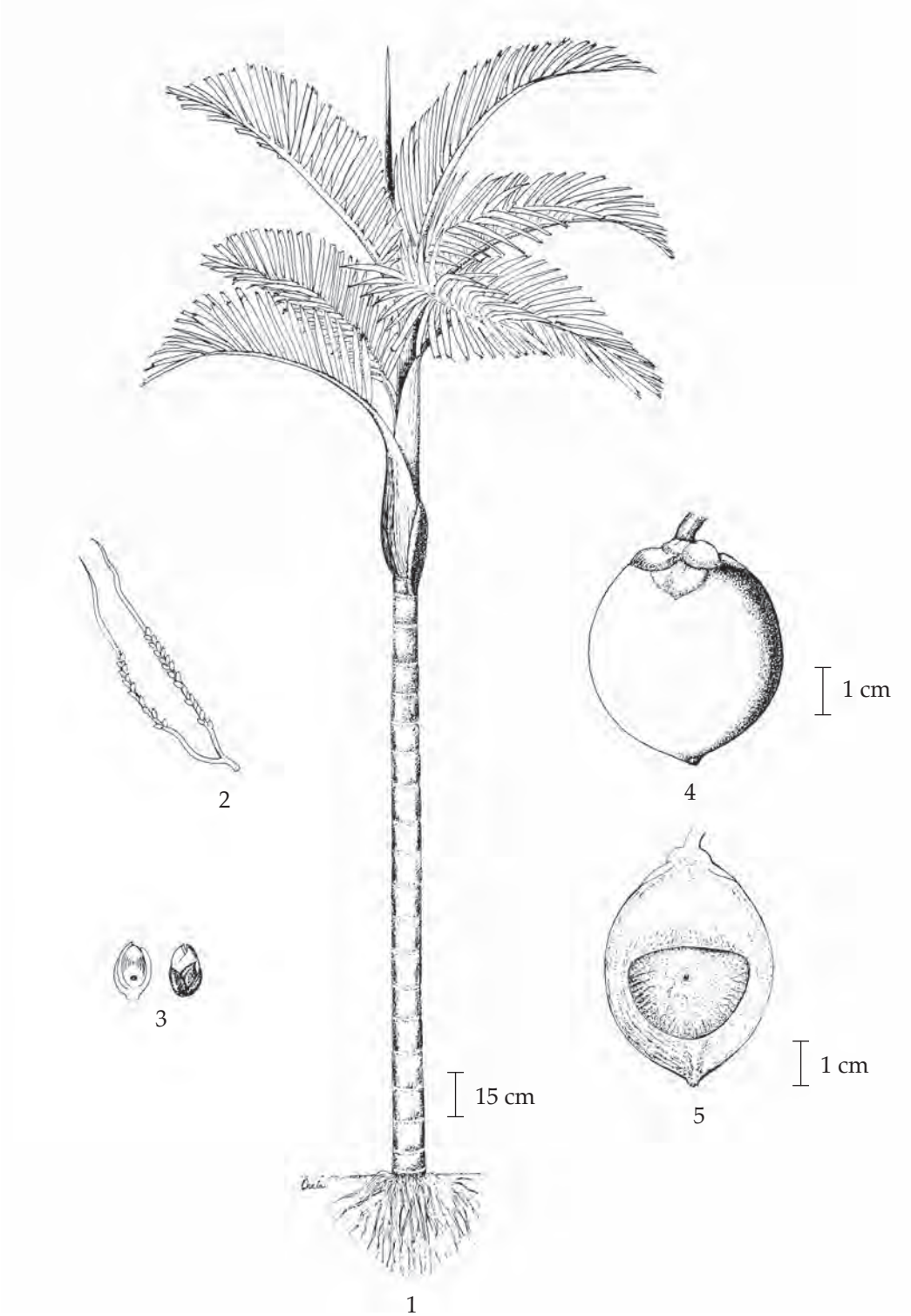


Fig. 1b *Areca catechu* L.
1. habit 2. inflorescences (scale omitted) 3. female flowers (scale omitted)
4. fruit 5. longitudinal section of the fruit

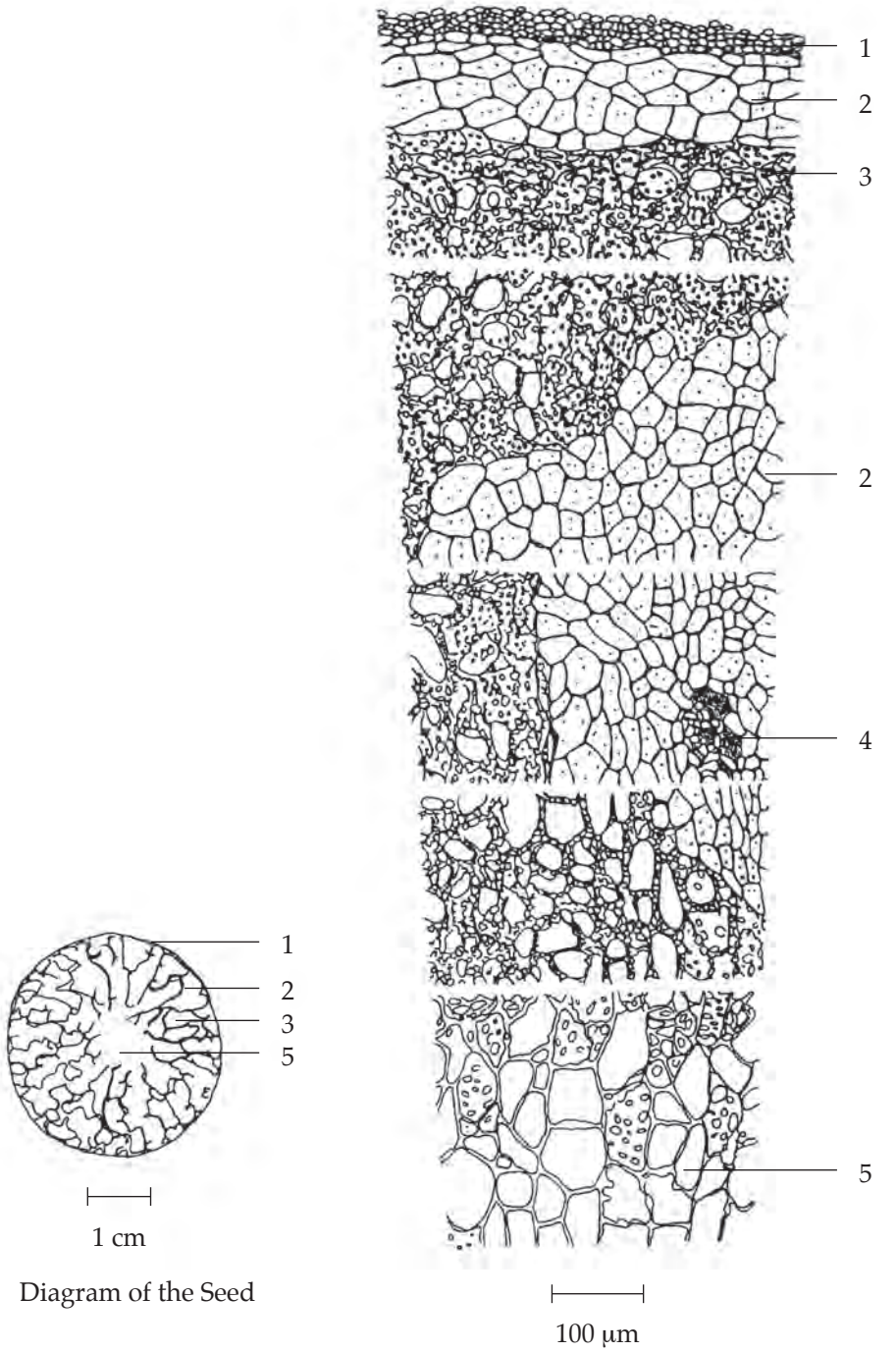


Fig. 2a Transverse Section of the Seed of *Areca catechu* L.
1. testa
2. testa rumination with yellowish brown pigment
3. endosperm with beaded and porous walls
4. vessel
5. endosperm

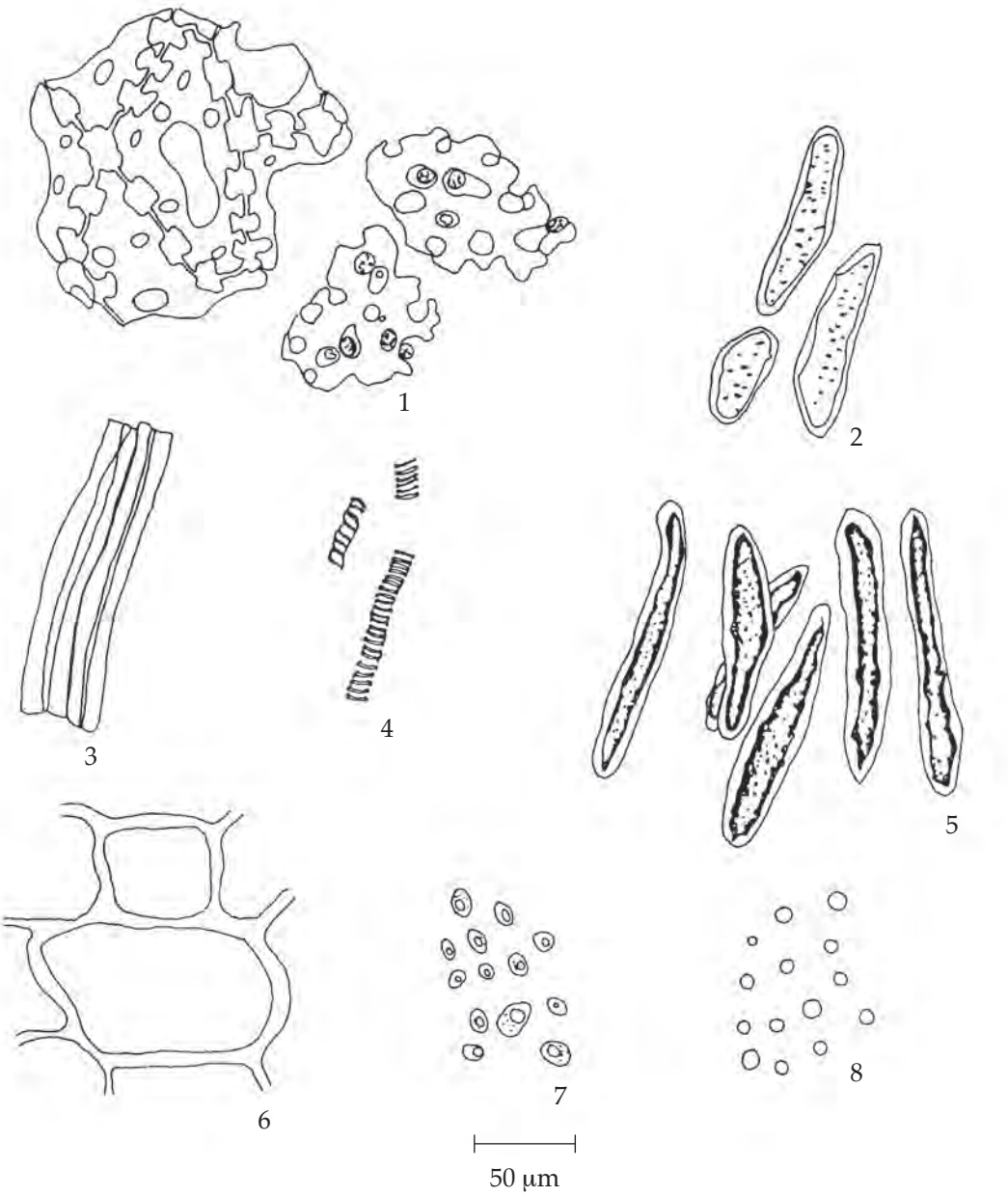


Fig. 2b Powdered Drug of the Seeds of *Areca catechu* L.

1. endosperm cells showing beaded and porous walls
2. testa rumination in longitudinal view
3. fibres
4. vessel
5. cells containing brown pigment
6. endosperm cells showing smooth walls
7. aleurone grains
8. oil droplets

Packaging and storage Areca Seed shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Macerate 1 g of the sample, in powder, with 20 mL of *water* for 15 minutes and filter. Dip a wooden stick in the filtrate for a few seconds and dry at room temperature. Dip again in *hydrochloric acid*, remove immediately and dry: the wooden stick stains red.

B. To 100 mg of the sample, in powder, add 25 mL of *water*, heat in a water-bath for 5 minutes and filter. To the filtrate add 2.5 mL of *hydrochloric acid* and 5 mL of *formaldehyde solution* and warm: a pale brown precipitate is produced. Cool and filter. To 5 mL of the filtrate, add 2.5 g of *sodium acetate* and 0.5 mL of *iron(III) chloride TS*, and shake well: a reddish brown colour is produced which does not change to blue.

C. Macerate 1 g of the sample, in powder, with 10 mL of *water* for 10 minutes and filter. To 2 mL of the filtrate, add a few drops of a 5 per cent w/v solution of *iron(III) chloride*, and then make slightly alkaline with a 4 per cent w/v solution of *sodium hydroxide*: the colour is changed from dark green to purple.

D. Reflux 1 g of the sample, in powder, with 20 mL of *chloroform* in a water-bath for 15 minutes and filter. Evaporate 2 mL of the filtrate to dryness and dissolve the residue in 2 mL of *acetic anhydride*. Carefully add 1 mL of *sulfuric acid* to form a layer: a brown colour develops at the zone of contact and the colour of the upper layer changes from violet to blue and finally to yellowish-green.

E. Moisten 2 g of the sample, in powder, with 2 mL of *strong ammonia solution*, add 20 mL of *ether*, shake well, set aside for 1 hour, and filter. Dry the filtrate over *anhydrous sodium sulfate*, filter, and evaporate to dryness. Dissolve the residue in 4 mL of *ethanol* (solution 1). To 1 mL of solution 1, add a few drops of *mercuric-potassium iodide TS*: a white precipitate is produced. To 1 mL of solution 1, add a few drops of *modified Dragendorff TS*2: a precipitate is produced.

F. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 75 volumes of *benzene*, 25 volumes of *methanol* and 1 volume of *formic acid* as the mobile phase and allowing the solvent front to ascend 12 cm above the line of application. Apply separately to the plate, 20 μL each of the following solutions. Prepare solution (A) by boiling 500 mg of the sample, in powder, with 50 mL of *water* for a few minutes and filtering. Allow the filtrate to cool and shake with 30 mL of *ether*. Dry the ether layer over *anhydrous sodium sulfate*, filter, evaporate to dryness, and dissolve the residue in 1 mL of *ethanol*. For solution (B), dissolve 2 mg of *catechin* in 1 mL of *ethanol*. After removal of the plate, allow it to dry in air, and examine under ultraviolet light (254 nm), marking the quenching spots. The chromatogram obtained from solution (A) shows a quenching spot (hR_f value 31 to 36) corresponding to the catechin spot from solution (B); other one or two spots are also observed (Table 1); see also Fig. 3. Spray the plate with *vanillin-hydrochloric acid TS*; the spot due to catechin is dark pink. Several other pink spots may appear (Table 1); see also Fig. 3.

Repeat the same procedure but use a mixture of 70 volumes of *toluene*, 20 volumes of *ethyl acetate* and 10 volumes of *diethylamine* as the mobile phase. Apply to the plate, 15 μL of solution 1 obtained from *test E*. After removal of the plate, allow it to dry in air, and examine under ultraviolet (254 nm), marking the quenching spots. The chromatogram shows three to four quenching spots (Table 2); see also Fig. 4. Spray the plate with *iodoplatinate TS*; several spots of different colours are observed (Table 2); see also Fig. 4.

Table 1 hR_f Values of Components in the Extract of the Seeds of *Areca catechu* L.

Spot	hR_f Value	Detection	
		UV 254	*Vanillin-Hydrochloric Acid TS*
1	13–15	–	pale pink
2	19–22	–	pale pink
3	24–29	–	pale pink
4*	31–36	quenching	dark pink
5	49–52	quenching	pale pink
6	62–65	quenching	–

*catechin

Table 2 hR_f Values of Components in Ethereal Extract of the Seeds of *Areca catechu* L.

Spot	hR_f Value	Detection	
		UV 254	*Iodoplatinate TS*
1	20–23	quenching	dark orange
2	25–28	–	blue
3	33–37	quenching	wine-red
4	73–77	quenching	scarlet
5	87–91	–	blue
6	95–97	quenching	yellow

Loss on drying Not more than 12.0 per cent w/w (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 1.0 per cent w/w (Appendix 7.6).

Total ash Not more than 2.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 25.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 20.0 per cent w/w (Appendix 7.12).

Hexane-soluble extractive Not less than 0.5 per cent w/w (Appendix 7.12H).

Alkaloids content Not less than 0.5 per cent w/w of alkaloids, calculated as arecoline, when determined by the following method.

Place 8 g of Areca Seed, in *coarse powder*, accurately weighed, in a conical flask with a stopper, add 80 mL of *ether* and shake. Add 4 mL of *ammonia TS,* shake for 10 minutes, add 10 g of *anhydrous sodium sulfate*, shake again for 5 minutes and allow to stand and precipitate. Transfer the ether solution to a separator, wash the residue with three successive 10-mL portions of *ether*. Combine the ether solutions, add 500 mg of *talc*, shake for 3 minutes, add 2.5 mL of *water*, and then shake for 3 minutes. Allow to stand until the supernatant ether solution is clear. Separate the ether solution, wash the aqueous layer with a small quantity of *ether*, combine the ether solutions and evaporate to about 20 mL at low temperature. Transfer to a separator, carefully add 20.0 mL of 0.01 M *sulfuric acid VS*, shake and allow to stand. Separate the ether layer, wash with three successive 5-mL portions of *water*. Combine the washings and the acid solution, filter, and wash the filter with *water*. Combine the washings and the acid solution, add several drops of *methyl red TS*, and titrate with 0.02 M *sodium hydroxide VS*. Perform a blank determination (Residual Titrations, Appendix 6.17). Each mL of 0.01 M *sulfuric acid VS* is equivalent to 3.104 mg of arecoline ($C_8H_{13}NO_2$).

Tannins content Not less than 24.0 per cent w/w (Appendix 7.21 H). Use 4 g of Areca Seed, in powder, accurately weighed.

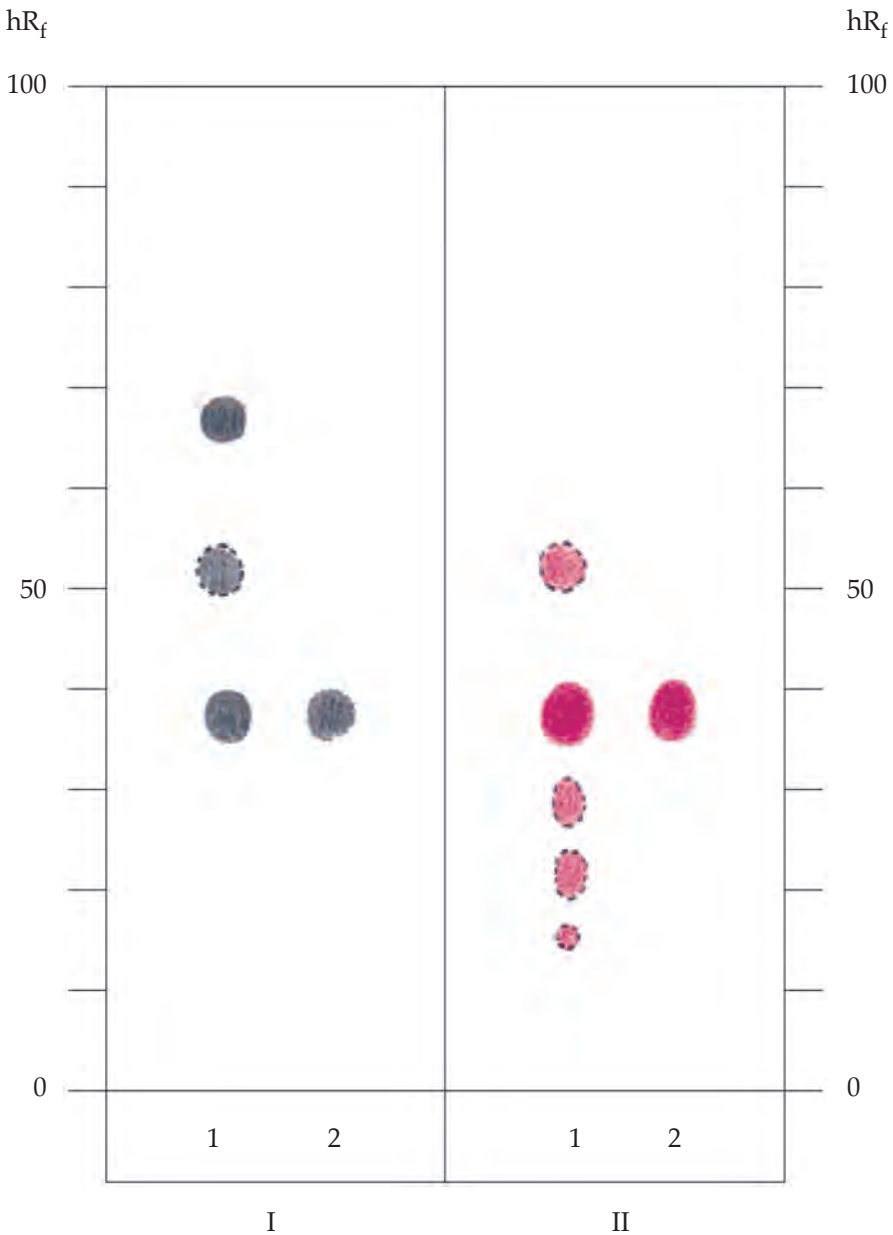


Fig. 3 Thin-Layer Chromatogram of the Extract of the Seeds of *Areca catechu* L.

1 = solution (A)
2 = solution (B)
I = detection under UV light (254 nm)
II = detection with *vanillin-hydrochloric acid TS*
◌ = spots developed in some samples

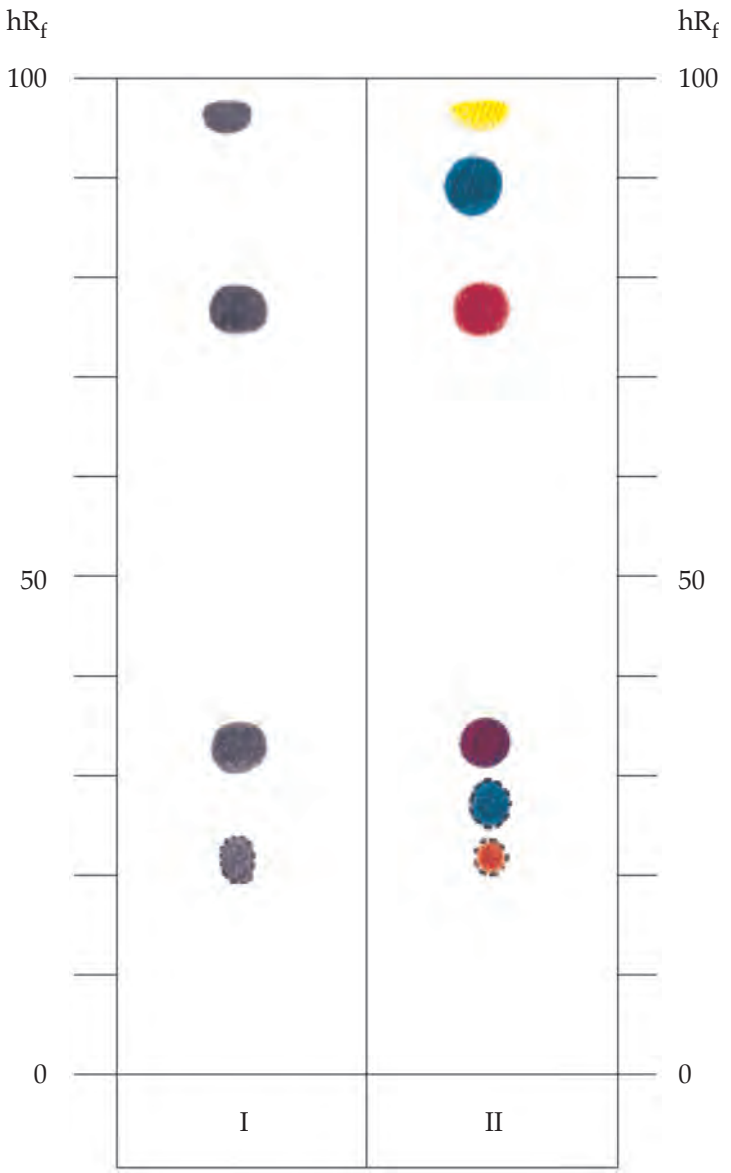


Fig. 4 Thin-Layer Chromatogram of Ethereal Extract of the Seeds of *Areca catechu* L.
I = detection under UV light (254 nm)
II = detection with *iodoplatinate TS*
◌ = spots developed in some samples

มะระขี้นก (MARA KHI NOK)

มะระไทย (MARA THAI), มะไห่ (MA HAI)
Momordicae Charantiae Fructus
Thai Bitter Cucumber

Synonyms Thai Bitter Gourd, Thai Bitter Melon, Thai Bitter Squash

Category Bitter tonic, internal heat alleviating.

Thai Bitter Cucumber is the dried green mature fruit of *Momordica charantia* L. (*M. muricata* Willd.) (Family Cucurbitaceae), Herbarium Specimen Number: DMSC 5159, Crude Drug Number: DMSc 0889.

Constituents Thai Bitter Cucumber contains charantin, a mixture of sitosteryl and stigmasteryl glucosides, and bitter triterpenoids (e.g., momordicins). It also contains polypeptides (e.g., *p*-insulin), phenolic compounds, etc.

Description of the plant (Figs. 1a, 1b) Annual or perennial climber, monoecious, 3 to 4 m long, slender, angled, many-branched, pubescent; tendril unbranched, up to 20 cm long, slender. Leaves simple, spirally arranged, suborbicular to orbicular, 4 to 12 cm long, 2.5 to 12 cm wide, deeply palmately, 5- to 7(–9)-lobed, lobe ovate-oblong or ovate-elliptic, apex acute or obtuse, base cordate, margin crenate, mucronate or irregularly toothed, glabrous or pubescent, pellucidly dotted; petiole 1.5 to 7.5 cm long. Flower solitary, axillary, yellow; sepals 5; petals 5. Male flower peduncle 2 to 6 cm long, slender; bract green, reniform to suborbicular, 0.5 to 1.5 cm wide, apex more or less mucronate, margin subentire; receptacle cup-shaped, 2 to 4 mm long and wide; sepal ovate-elliptic (-oblong), 4 to 6 mm long, 2 to 3 mm wide, acute, pale green; petal obovate to oblong, 1 to 2 cm long, 0.3 to 1.5 cm wide, apex more or less mucronate, basal scales 2; stamens 3, filament 1.5 to 2 mm long, free, inserted in the throat of cup-shaped receptacle, anthers coherent; disc cup-shaped, about 1.5 mm in diameter. Female flower peduncle 0.5 to 5 cm long; bract 0.1 to 1 cm in diameter; sepal oblong-lanceolate, 4 to 6 mm long, 2 to 3 mm wide; petal smaller than those of male flower, 0.7 to 1.2 cm long; ovary inferior, fusiform or narrowly rostrate, ribbed, warty or papillose, long-beaked, style about 2 mm long, stigma 3-lobed, lobe bifid or notched. Fruit pendulous, fusiform or ellipsoid, 2 to 8.5 cm long, up to 3.5 cm wide, tapering towards apex, beaked, longitudinally 8- to 10-ridged, tuberculate, orange when ripe, splitting incompletely with 3-valved exposing orange pulp; fruit stalk 3.5 to 15 cm long. Seeds few to numerous, oblong, 0.8 to 1.3 cm long, 5 to 9 mm wide, flattened, sculptured, whitish or brown, embedded in reddish pulp.

Description Odour, characteristic; taste, bitter.

Macroscopical (Fig. 1a) Transverse or oblique pieces, varying in size, up to 3 cm in diameter; externally warty, greenish to brownish; internally creamy white to pale brown.

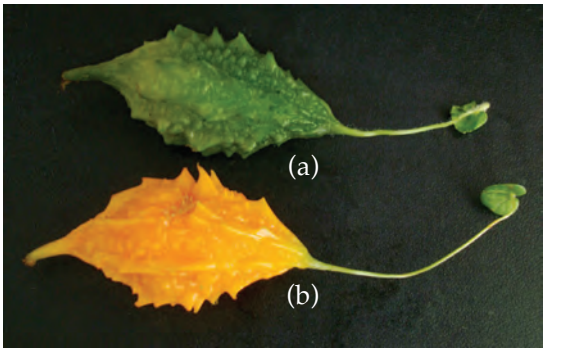
Microscopical (Figs. 2a, 2b, 2c) Transverse section of the fruit shows epicarp, mesocarp, endocarp, seed coat, and cotyledons. Epicarp, a layer of rectangular cells with stomata and glandular trichomes. Mesocarp, diffentiated in 3 zones: thin-walled parenchyma cells which increase in size from periphery towards the interior, the smaller cells near the periphery

1

2

3

4



5

6

1 cm

Fig. 1a *Momordica charantia* L.
1. flowering and fruiting vine 2. young shoot showing unbranched tendril
3. male flower 4. female flower 5. green mature fruit (a), ripe fruit (b) 6. crude drug

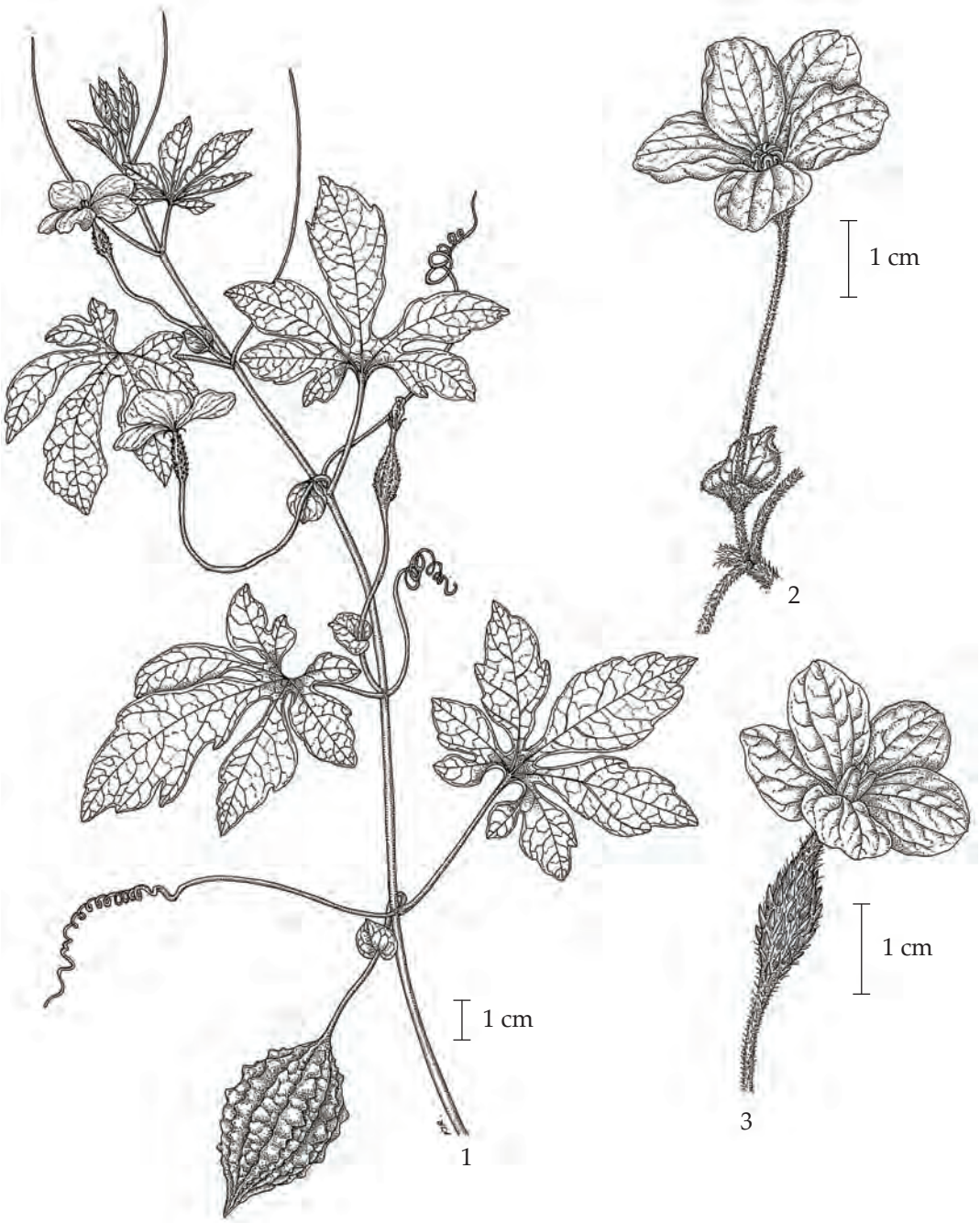


Fig. 1b *Momordica charantia* L.
1. vine showing leaves, tendrils, female flowers, and fruit
2. male flower 3. female flower

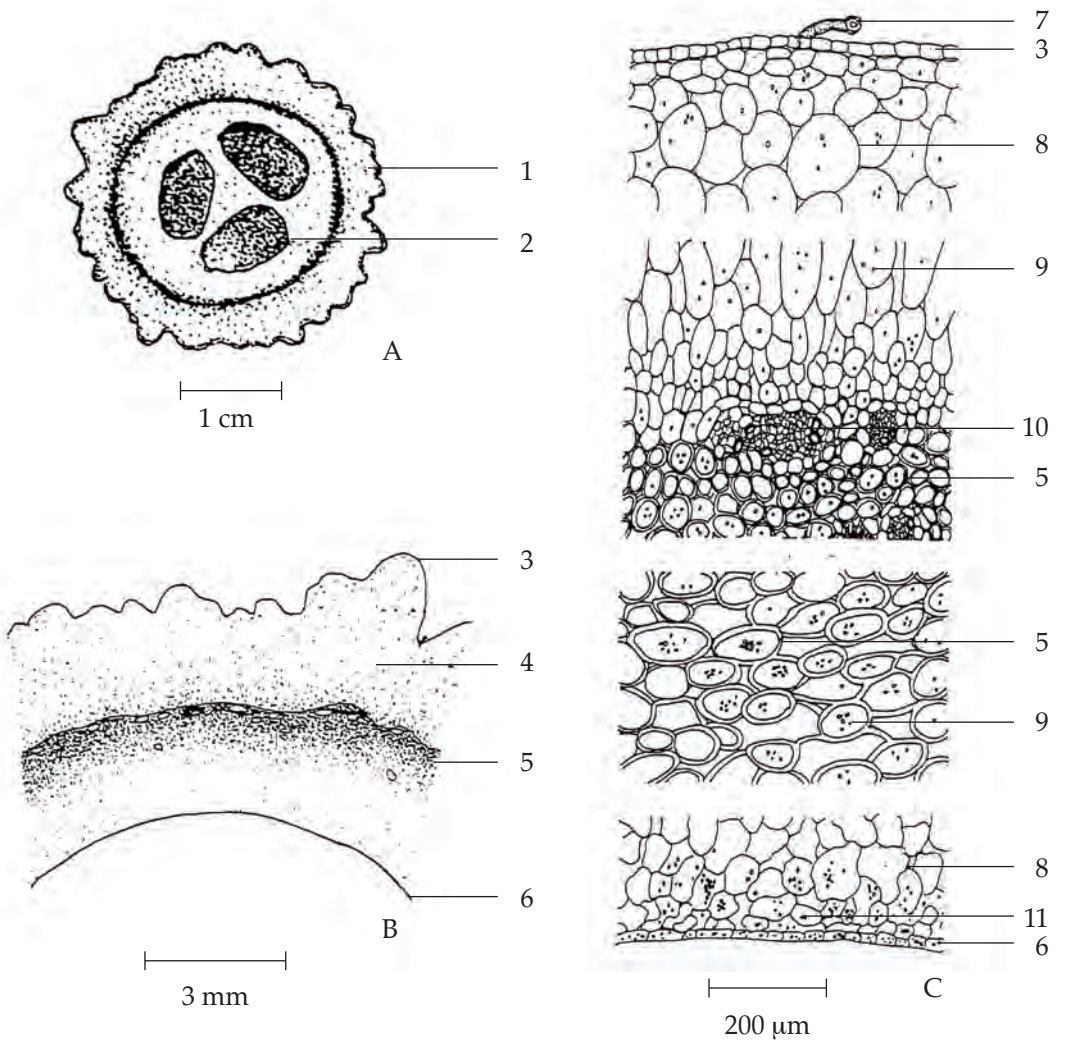


Fig. 2a Transverse Section of the Fruit of *Momordica charantia* L.

A. Diagram
B. Diagram of the Pericarp
C. Section of Part of Seed

1. pericarp
2. seed
3. epicarp
4. mesocarp
5. thick-walled parenchyma, some containing starch grains
6. endocarp
7. glandular trichome
8. thin-walled parenchyma, some containing starch grains
9. starch grains
10. vascular bundle
11. cuboidal protein crystal

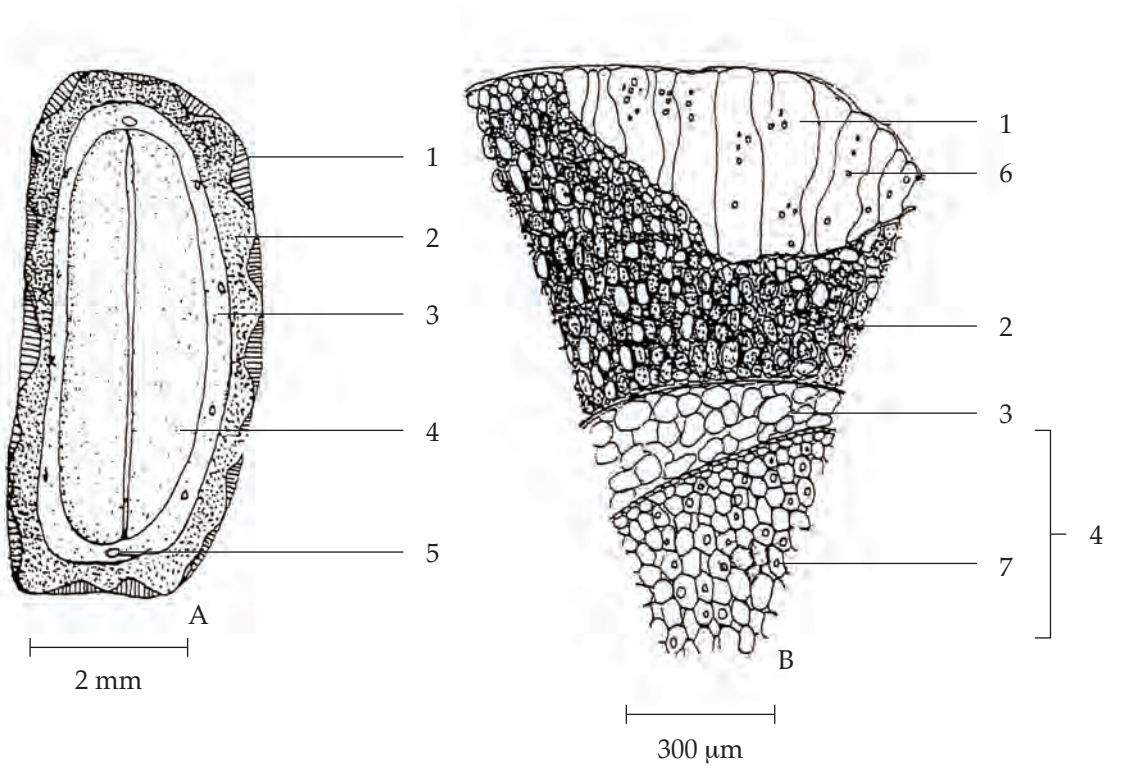


Fig. 2b Transverse Section of the Seed of *Momordica charantia* L.
A. Diagram
B. Section of Part of Seed
1. epidermis of seed coat
2. sclerenchyma of seed coat
3. parenchyma of seed coat
4. cotyledon
5. vascular bundle
6. starch grain
7. oil globule

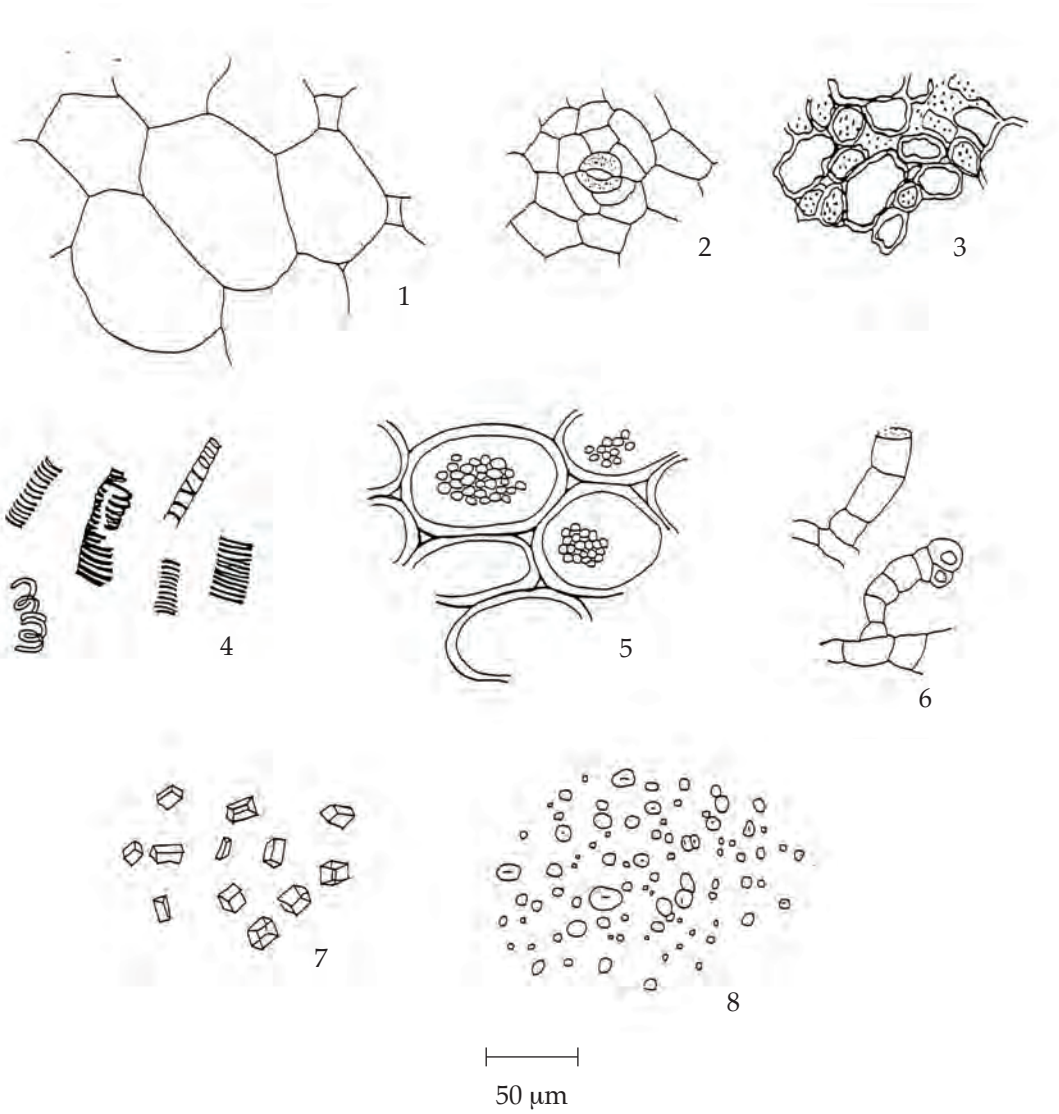


Fig. 2c Powdered Drug of the Fruits of *Momordica charantia* L.

1. thin-walled parenchyma
2. epicarp showing stoma
3. sclerenchyma of seed coat
4. annulo-spiral and spiral vessels
5. thick-walled parenchyma containing starch grains
6. uniseriate-stalked trichomes with and without gland
7. cuboidal protein crystals
8. starch grains

contained most of chloroplasts, vascular bundles found at the innermost part of this zone; moderately thick-walled parenchyma cells, composed of several layers of loosely packed cells with intercellular spaces, containing numerous starch grains; and thin-walled parenchyma cells, several layers of cells containing cuboidal protein crystals and numerous starch grains. Endocarp, a layer of small thin-walled cells containing starch grains. Seed coat composed of epidermis, a layer of thin-walled cells filled with starch grains; sclerenchyma, several layers of lignified thick-walled or pitted cells containing starch grains; parenchyma, several layers of thin-walled cells. Cotyledons 2, composed of a layer of epidermis and reserved parenchyma cells which are fairly large and filled with oil globules.

Thai Bitter Cucumber in powder possesses the diagnostic microscopical characters of the unground drug. Thick-walled parenchyma cells containing starch grains; lignified thick-walled or pitted cells of sclerenchyma of seed coat; occasionally uniseriate-stalked glandular trichomes; and occasionally cuboidal protein crystals are characteristic.

Warning

1. It should not be used in nursing women and children unless recommended by a physician.
2. It should be used with caution in patients with existing liver diseases including alcoholic cirrhosis.
3. Concomitant use with oral hypoglycemic agents and insulin intake should be avoided due to hypoglycemic risks.

Additional information It is commonly used with other herbal drugs in Thai traditional herbal preparations.

Packaging and storage Thai Bitter Cucumber shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Reflux 1 g of the sample, in powder, with 10 mL of *ethanol* for 15 minutes and filter. Evaporate the filtrate to dryness in a porcelain dish. Add 5 drops of *acetic anhydride* to the residue and then slowly add 1 drop of *sulfuric acid* along the inner side of the dish: a purple colour develops and gradually changes to brownish black.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 90 volumes of *dichloromethane* and 10 volumes of *methanol* as the mobile phase and allowing the solvent front to ascend 9 cm above the line of application. Apply separately to the plate as bands of 7 mm, 20 μL each of the following two solutions. Prepare solution (A) by refluxing 1 g of the sample, in powder, with 5 mL of a mixture of equal volumes of *dichloromethane* and *methanol* in a water-bath and filtering. For solution (B), dissolve 1 mg of *charantin* in 1 mL of a mixture of equal volumes of *dichloromethane* and *methanol*. After removal of the plate, allow it to dry in air and examine the plate under ultraviolet light (366 nm) through the cut-off filter; two red fluorescent bands are observed. Spray the plate with a 10 per cent v/v solution of *sulfuric acid* in *ethanol* and heat at 110° for 1 to 2 minutes; the chromatogram obtained from solution (A) shows a violet band (hR_f value 28 to 30) corresponding to the charantin band from solution (B). Other several bands of different colours are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in the Extract of the Fruits of *Momordica charantia* L.

Band	hR_f Value	Detection	
		UV 366	10 Per Cent V/V Solution of *Sulfuric Acid* in *Ethanol*
1	9–10	–	pale violet
2	18–19	–	pale violet
3*	28–30	–	violet
4	50–53	–	pale purple
5	55–58	red	violet
6	58–61	light red	–
7	62–64	–	brownish yellow
8	72–75	–	pale brown

*charantin

Loss on drying Not more than 16.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 0.1 per cent w/w (Appendix 7.6).

Total ash Not more than 13.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 1.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 4.5 per cent w/w (Appendix 7.12).

Dose 500 mg to 1 g three times a day.

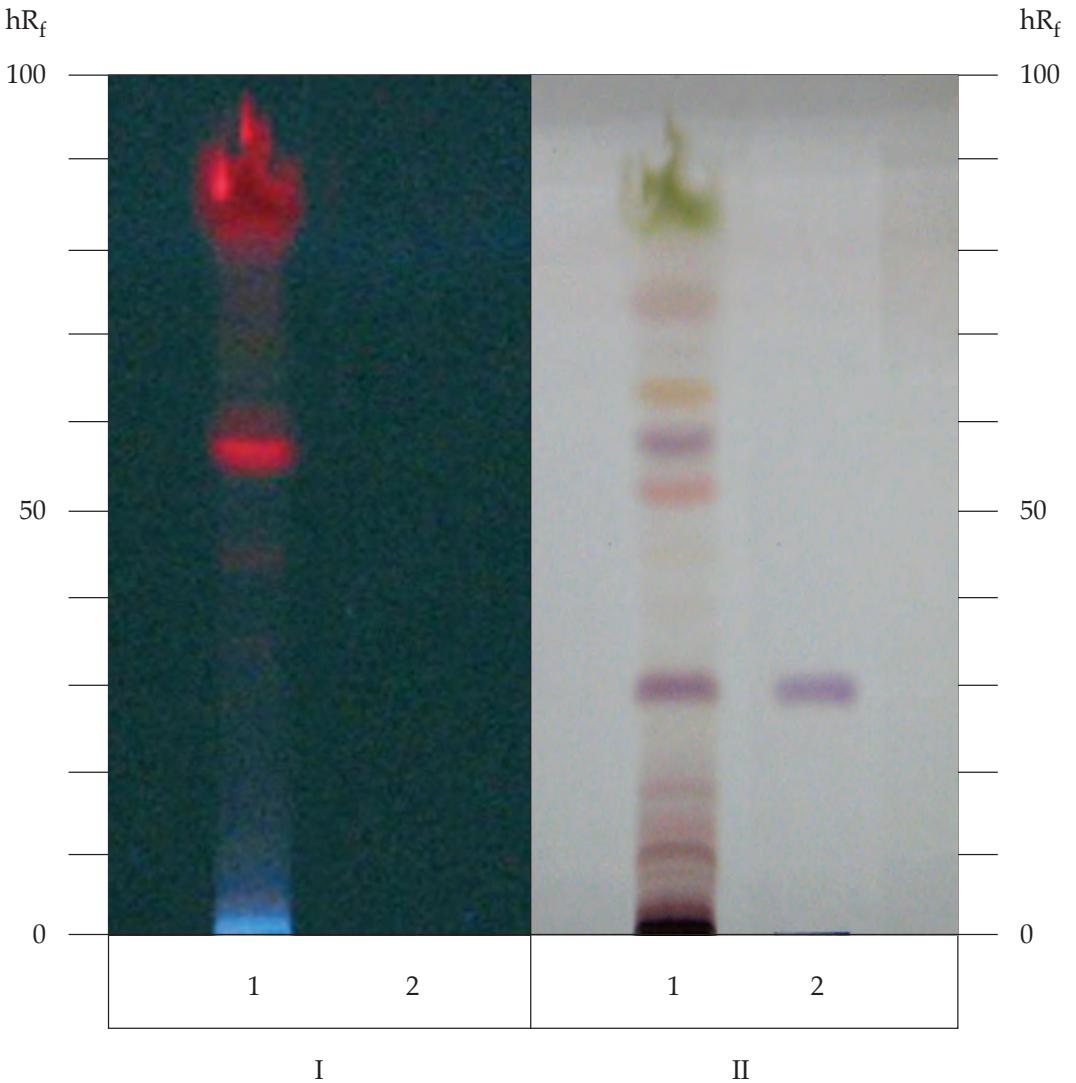


Fig. 3 Thin-Layer Chromatogram of the Extract of the Fruits of *Momordica charantia* L.
1 = solution (A)
2 = solution (B)
I = detection under UV light (366 nm)
II = detection with a 10 per cent v/v solution of *sulfuric acid* in *ethanol*

ມະຕູມ (MATUM)

ມະປິນ (MAPIN)
Aegles Marmelotis Fructus
Bael Fruit

Synonyms Bengal Quince Fruit, Golden Apple Fruit, Holy Fruit, Indian Bael Fruit, Indian Quince Fruit

Category Antidiarrheal, stomachic.

Bael Fruit is the dried mature fruit of *Aegle marmelos* (L.) Corrêa [*Belou marmelos* (L.) A. Lyons, *Crateva marmelos* L., *Feronia pellucida* Roth] (Family Rutaceae), Herbarium Specimen Number: DMSC 5187, Crude Drug Number: DMSc 1137.

Constituents Bael Fruit contains coumarins (e.g., imperatorin or marmelosin, psoralen). It also contains alkaloids, flavonoids, tannins, volatile compounds, gum, etc.

Description of the plant (Figs. 1a, 1b) Tree 6 to 12 m high; stem and branch spiny; spine(s) single or paired, subulate, 1 to 4 cm long. Leaves digitately trifoliolate, alternate, petiolate; petiole 2 to 4 cm long, slightly swollen at base; leaflet elliptic, ovate or ovate-lanceolate, terminal one 5 to 16 cm long, 2 to 10 cm wide, lateral ones subsessile, up to 7 cm long, up to 4 cm wide, apex acute to acuminate, base obtuse to cuneate, margin crenulate, glabrous, pellucid-dotted. Inflorescence racemose or cymose, some branched, axillary or terminal, 3 to 6 cm long; peduncle minutely puberulent. Flower fragrant, greenish white, 2 to 3 cm wide; pedicel 0.4 to 1.5 cm long, pubescent; calyx 4- or 5-lobed, lobe deltoid-ovate or lanceolate, 1.5 to 3 mm long, pubescent, caducous; petals 4 or 5, thick, externally greenish, internally greenish white, oblong-obovate, about 1.4 cm long, about 8 mm wide; stamens 35 to 50, white, filament subulate, 4 to 7 mm long, anther narrow lanceolate with sagittate base, hairy; ovary superior, urn-shaped, light green, glabrous, 8- to 22-loculed, each with 5 or more ovules, style short, stigma capitate. Fruit globose or slightly pear-shaped, 5 to 12 cm wide, greenish turning yellowish brown when ripe, glabrous, rind hard, about 3 mm thick, inside with 8 to 22 segments; pulp orange, slimy, aromatic. Seeds 6 to 10 in each segment, brown, oblong, flat, about 1 cm long, densely clothed with thick fibrous hairs, embedded in transparent sticky gum.

Description Odour, aromatic, characteristic; taste, sweet and sour, astringent.

Macroscopical (Fig. 1a) Transverse slices of fruit, round or ovate, curved, 3 to 10 cm wide, 0.5 to 1 cm thick; rind greyish brown to brownish, smooth, hard; pulp shrunken, brownish orange or reddish brown, with radially arranged elliptic cavities, some containing seeds and viscous substance.

Microscopical (Figs. 2a, 2b) Transverse section of the fruit shows epicarp, mesocarp and endocarp. Epicarp, cuticle layer, a thick-walled epidermal layer, a region of thick-walled parenchyma, some of which containing prismatic crystals or dark brown to brownish substance, large lysigenous oil cavities, and scattering sclereids. Mesocarp, region of thick-walled sclereids, numerous ribbon or sectional view of vascular bundles, thick- and thin-walled parenchyma, some of which containing starch grains. Endocarp, layers of thin-walled parenchyma cells, some of which containing starch grains, layers of thick-walled sclereids and scattering oil droplets surrounding seed cavities.

1

2

3

4

1 cm

5

1 cm

Fig. 1a *Aegle marmelos* (L.) Corrêa
1. habit 2. inflorescences 3. fruits 4. sections of fresh fruit 5. crude drug

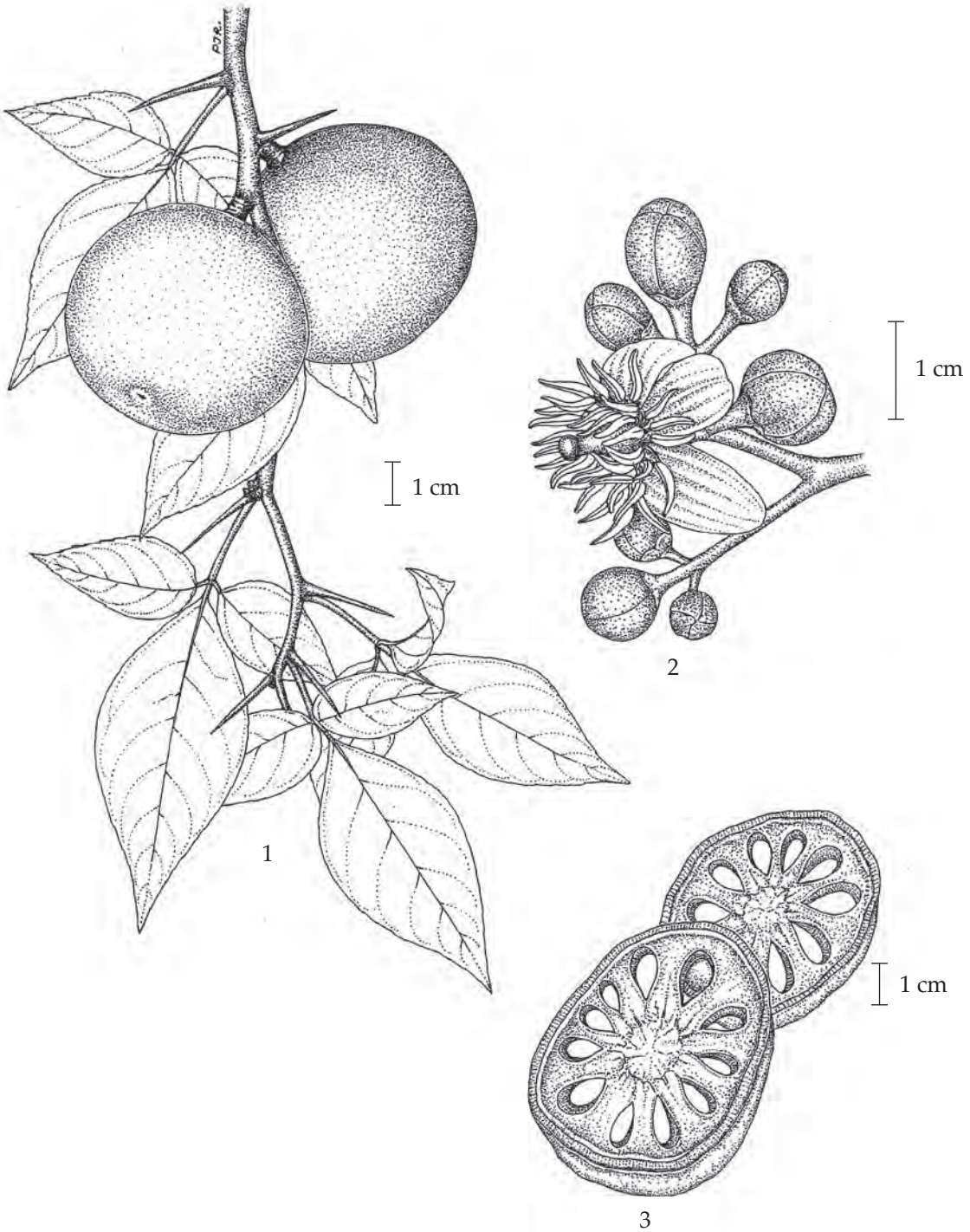


Fig. 1b *Aegle marmelos* (L.) Corrêa
1. fruiting twig showing leaves and spines 2. inflorescence
3. transverse slices of young fruit

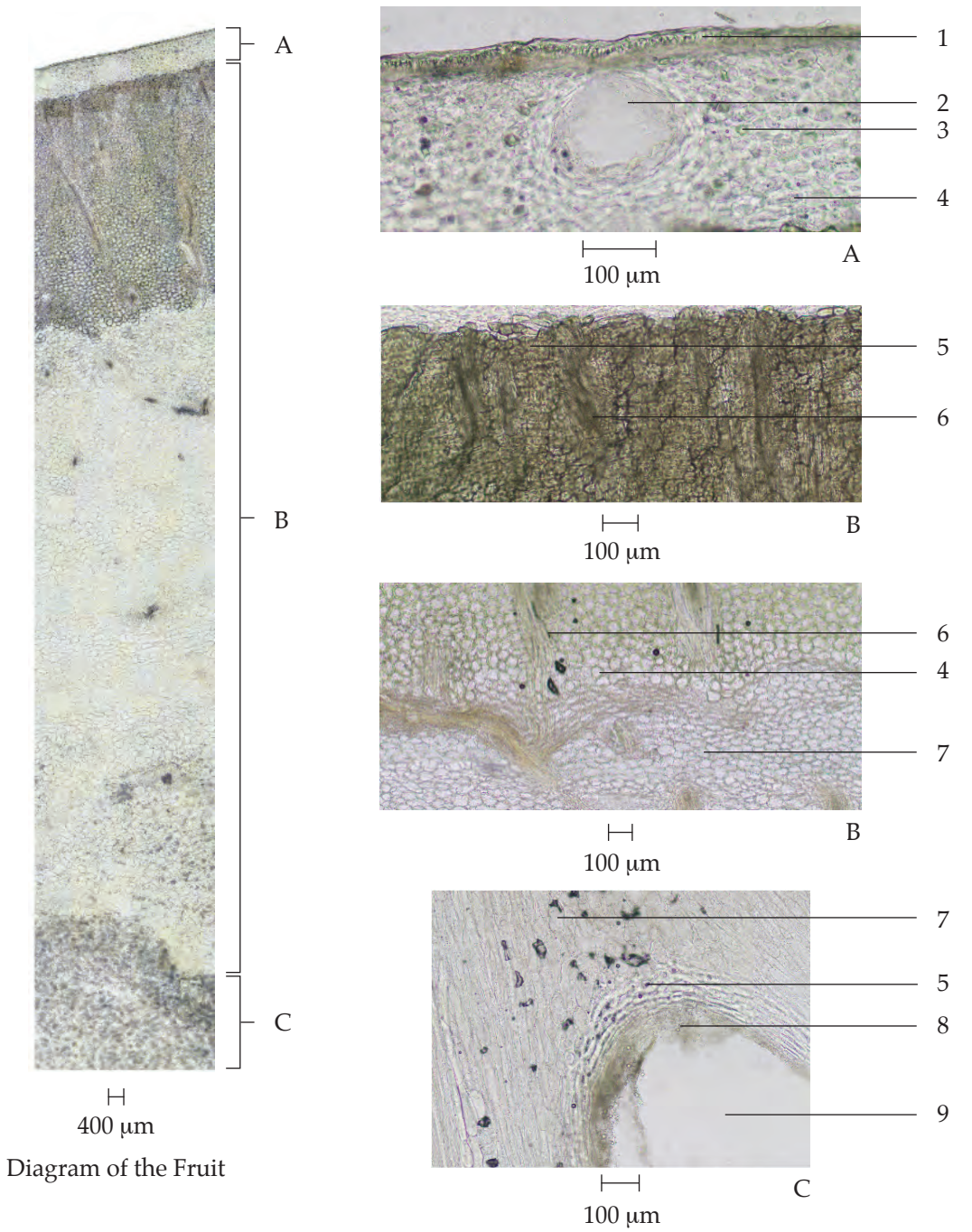


Fig. 2a Photomicrographs of Transverse Section of the Fruit of *Aegle marmelos* (L.) Corrêa

A. Epicarp
B. Mesocarp
C. Endocarp

1. epidermis
2. oil cavity
3. prismatic crystal
4. thick-walled parenchyma
5. sclereid
6. vascular bundle
7. parenchyma
8. oil droplet
9. seed cavity

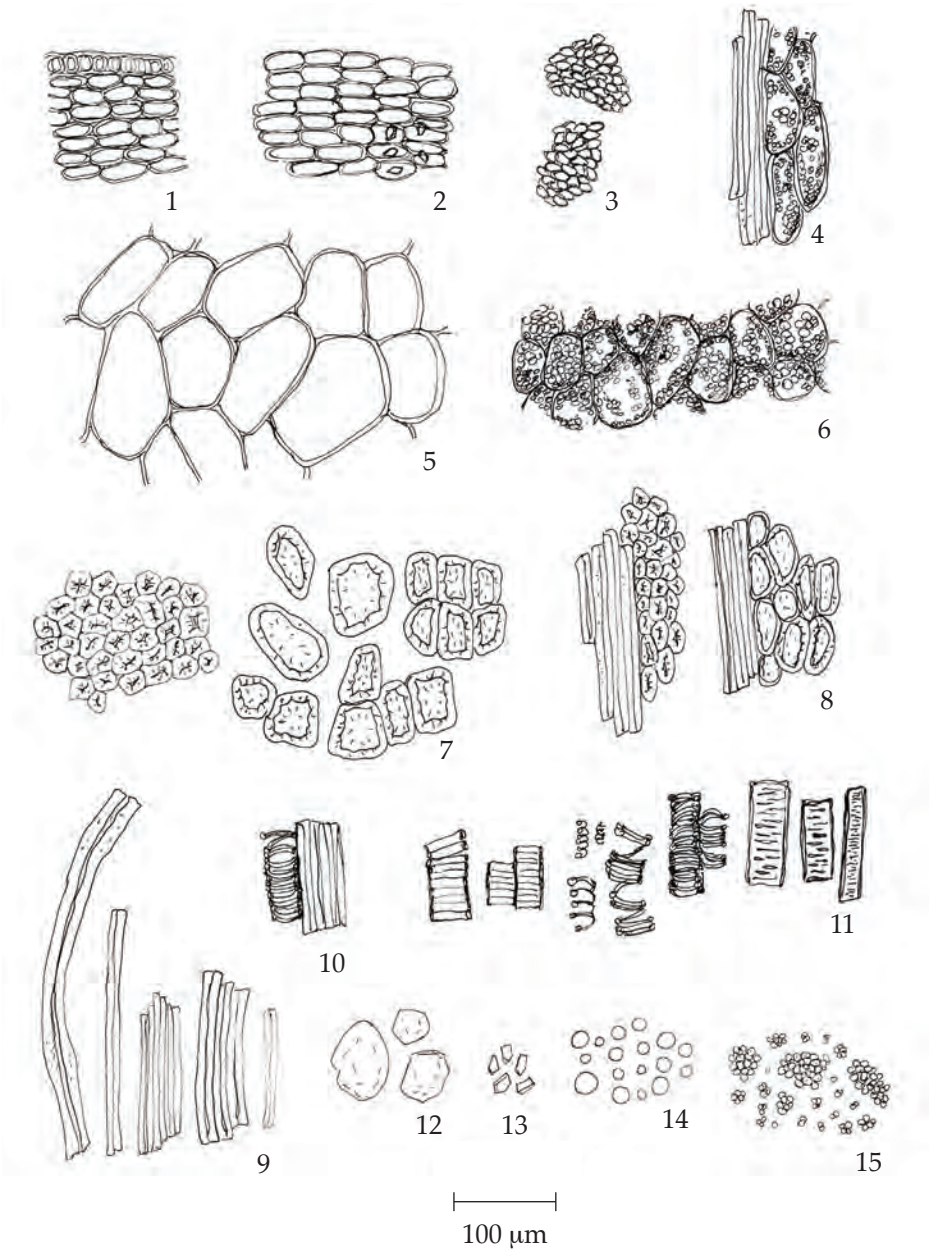


Fig. 2b Powdered Drug of the Fruits of *Aegle marmelos* (L.) Corrêa

1. epidermis and thick-walled parenchyma
2. thick-walled parenchyma, some containing prismatic crystals
3. epidermis in surface view
4. fibres and parenchyma containing starch grains, in longitudinal view
5. parenchyma
6. parenchyma containing starch grains
7. sclereids
8. fibres and sclereids in longitudinal view
9. fragments of fibres
10. spiral vessel and fibres in longitudinal view
11. scalariform, spiral and reticulate vessels
12. brownish substance
13. prismatic crystals
14. oil droplets
15. starch grains

Bael Fruit in powder possesses the diagnostic microscopical characters of the unground drug. Thick-walled parenchyma, various-sized and -shaped sclereids and minute starch grains are abundant. Brownish substance, although rare, is characteristic.

Additional information In Thailand, there are three commonly known Matum cultivars: Matum Khai (มะตูมไข่), Matum Ban (มะตูมบ้าน) or Matum Kwai (มะตูมควาย), and Matum Nim (มะตูมนิ่ม). However, Matum Ban or Matum Kwai is commercially available in local markets.

Packaging and storage Bael Fruit shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Boil 500 mg of the sample, in *fine powder*, with 20 mL of *ethanol* on a water-bath for 10 minutes and filter (solution 1). Examine 2 mL of solution 1 under ultraviolet light (366 nm): a blue fluorescence is observed.

B. To 2 mL of solution 1, add a few drops of *sulfuric acid* and mix: a pinkish red colour is produced.

C. To 2 mL of solution 1, add a few drops of a 1 per cent w/v solution of *iron(III) chloride* and mix: a green colour is produced.

D. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 60 volumes of *toluene* and 40 volumes of *diethyl ether* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply separately to the plate, 20 μL of solution (A) and 5 μL of solution (B). Prepare solution (A) by refluxing 1 g of the sample, in *fine powder*, with 20 mL of n-*hexane* for 20 minutes, filtering and evaporating the filtrate to dryness. Dissolve the residue in 2 mL of *methanol*. For solution (B), dissolve 1 mg of *imperatorin* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under ultraviolet light (254 nm), marking the quenching spots. The chromatogram obtained from solution (A) shows a quenching spot (hR_f value 63 to 70) corresponding to the imperatorin spot from solution (B) and other two spots of lower hR_f values. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; several greenish blue and blue fluorescent spots are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Hexane Extract of the Fruits of *Aegle marmelos* (L.) Corrêa

Spot	hR_f Value	Detection	
		UV 254	UV 366
1	14–18	–	blue
2	18–19	–	greenish blue
3	26–32	weak quenching	greenish blue
4	33–38	weak quenching	greenish blue
5	42–45	–	blue
6*	63–70	quenching	greenish blue
7	72–74	–	blue
8	77–81	–	blue

*imperatorin

Loss on drying Not more than 9.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Total ash Not more than 4.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 10.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 40.0 per cent w/w (Appendix 7.12).

Imperatorin content Not less than 0.1 per cent w/w of imperatorin ($C_{16}H_{14}O_4$). Carry out the determination as described in the "Liquid Chromatography" (Appendix 3.5).

Mobile phase Prepare a mixture of 60 volumes of *methanol* and 40 volumes of *water*. Make adjustments if necessary.

Standard preparations Dissolve an accurately weighed quantity of *imperatorin* in sufficient *methanol*, dilute quantitatively and stepwise with *methanol* to obtain a stock solution having a known concentration of about 400 μg per mL. Dilute the solution quantitatively and stepwise with *methanol* to obtain six solutions having known concentrations of 40, 80, 120, 160, 200, and 240 μg per mL.

Sample preparation Reflux about 1 g of Bael Fruit, in *fine powder*, accurately weighed, with 50 mL of n-*hexane* for 30 minutes, filter and evaporate the filtrate to dryness. Dissolve the residue in sufficient *methanol*. Transfer quantitatively to a 25-mL volumetric flask, dilute with *methanol* to volume and mix.

Chromatographic system The chromatographic procedure may be carried out using (a) a stainless steel column (5 cm × 2.1 mm) packed with octadecylsilane chemically bonded to porous silica or ceramic microparticles (1.7 μm), (b) *Mobile phase* at a flow rate of about 0.5 mL per minute (the retention time is about 1.2 minutes for imperatorin), and (c) an ultraviolet photometer set at 302 nm.

Procedure and Calculation Separately inject about 3 μL each of *Standard preparations* into the chromatograph, record the chromatograms and measure the responses for the major peaks: the relative standard deviation for the replicate injections is not more than 2.0 per cent. Plot the readings and draw the standard curve of best fit: the curve shows a correlation coefficient of not less than 0.999. Inject about 3 μL of *Sample preparation* into the chromatograph, record the chromatogram and measure the response for the major peak. By reference to the standard curve, calculate the content of imperatorin ($C_{16}H_{14}O_4$) in the Bael Fruit taken.

Dose 3 to 6 g of the powdered drug a day.

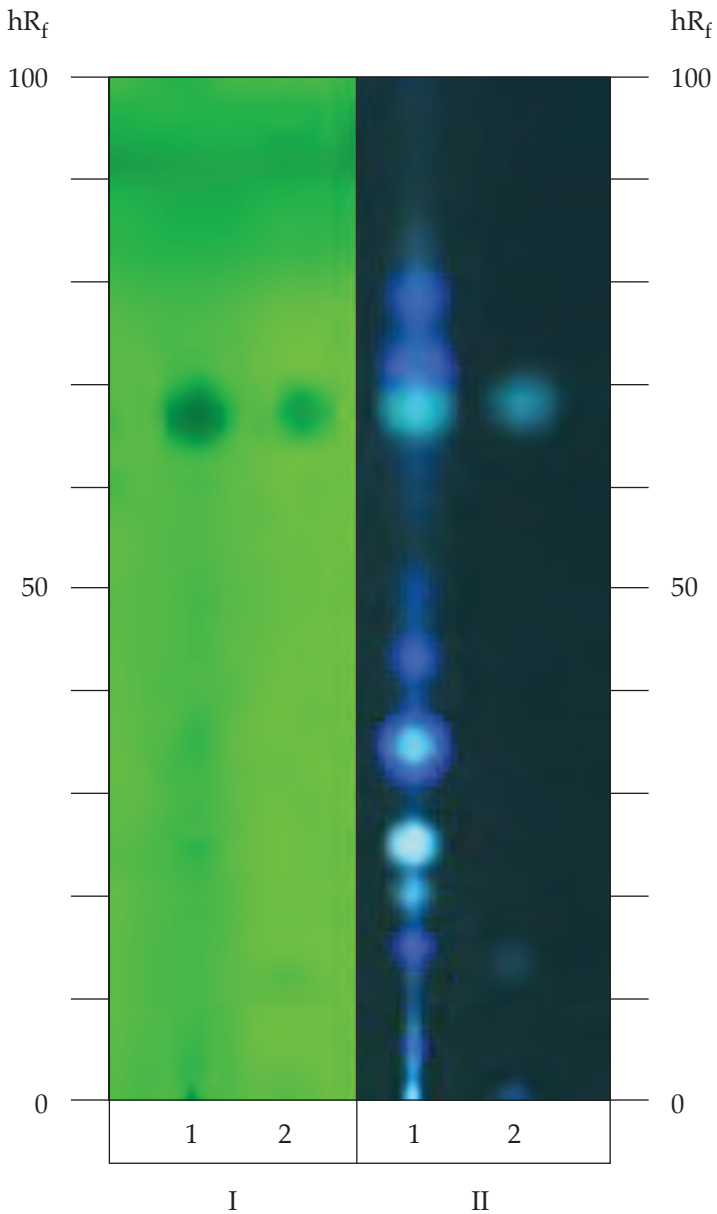


Fig. 3 Thin-Layer Chromatogram of Hexane Extract of the Fruits of *Aegle marmelos* (L.) Corrêa

1 = solution A
2 = solution B
I = detection under UV light (254 nm)
II = detection under UV light (366 nm)

มะแว้งเครือ (MAWAENG KHRUEA)

Solani Trilobati Fructus
Solanum Trilobatum Fruit

Category Expectorant.

Solanum Trilobatum Fruit is the dried green mature fruit of *Solanum trilobatum* L. (Family Solanaceae), Herbarium Specimen Number: DMSC 147, 163, Crude Drug Number: DMSc 1019.

Constituents Solanum Trilobatum Fruit contains solasodine.

Description of the plant (Figs. 1a, 1b) Slender scrambling shrub up to 3.6 m long; prickles hooked, broad-based, yellowish and numerous along the stem, otherwise almost glabrous; branches long divaricate, the young ones sometimes with a few stellate hairs, the older glabrous. Leaves simple, alternate, ovate or rotund-ovate, 2 to 7 cm long, 1 to 4 cm wide, obtuse, irregularly sinuate or 3- to 5-lobed, sparsely stellately hairy or glabrous; petiole and midrib with or without a few prickles, 1.3 to 3.8 cm long, base broadly cuneate-truncate, sometimes unequal. Inflorescence extra-axillary racemose cyme; peduncle short, 3- to 9-flowered. Flower showy, violet-purple; pedicel 1 to 2 cm long, widely divergent, often prickly; calyx cyathiform, 3 to 4 mm long with narrow teeth, sparsely stellately hairy; corolla 1.2 to 1.6 cm long, tube 2 mm long, deeply lobed, stellate-pubescent outside, usually reflexed; stamen protruding, anther 7 mm long, narrowly oblong, yellow, filament 1.2 mm long; ovary 2-celled, ovoid or subglobose, style glabrous. Fruit berry, globose, about 1 cm in diameter, mature berry green with white mottling, scarlet when ripe. Seeds numerous, compressed, 3 mm in diameter, slightly pitted.

Description

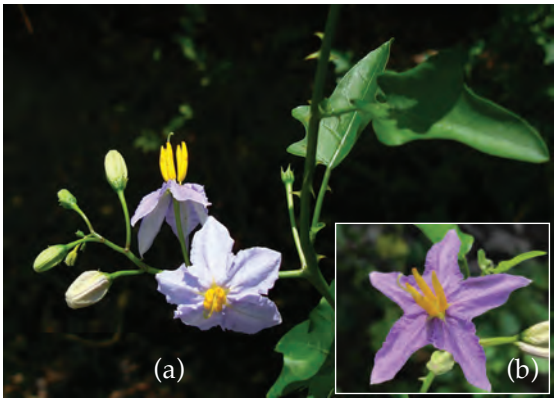
Macroscopical (Fig. 1a) Nearly globular, from 6 to 10 mm in diameter, externally light brown to dark brown, more or less wrinkled. The base marked by a circular stalk scar, about 1 mm in diameter.

Microscopical (Figs. 2a, 2b) Transverse section of the fruit shows epidermis, a single layer of rectangular cells with cutinized outer walls. Hypodermis, 1 to 2 layers of rectangular cells. Two zones of parenchyma cells, the outer composed of 6 to 9 layers of thick-walled, polygonal cells containing chloroplastids, the inner composed of more layers of larger and thin-walled cells containing mucilage and numerous starch grains and small vascular bundles are scattered in this region. Epidermis of seed coat, a single layer of large lignified sclereids, more or less columnar-shaped, inner walls are thicker with irregularly flamelike thickened appendages. Endosperm, small thin-walled, polygonal parenchyma cells containing oil droplets. Cotyledon, several layers of small polygonal cells containing oil droplets.

Solanum Trilobatum Fruit in powder possesses the diagnostic microscopical characters of the unground drug.

Packaging and storage Solanum Trilobatum Fruit shall be kept in well-closed containers, protected from light, and stored in a dry place.

1



2

3

4

1 cm

Fig. 1a *Solanum trilobatum* L.
1. habit 2. flowering twig (a), flower (b) 3. different stages of fruits 4. crude drug

Fig. 1b *Solanum trilobatum* L.

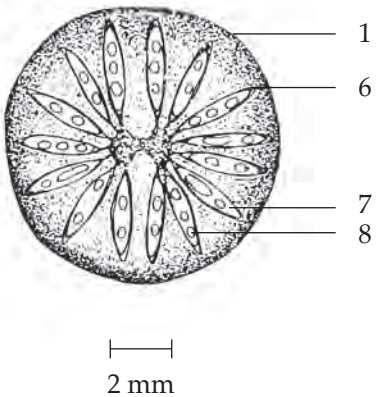


Diagram of the Whole Fruit

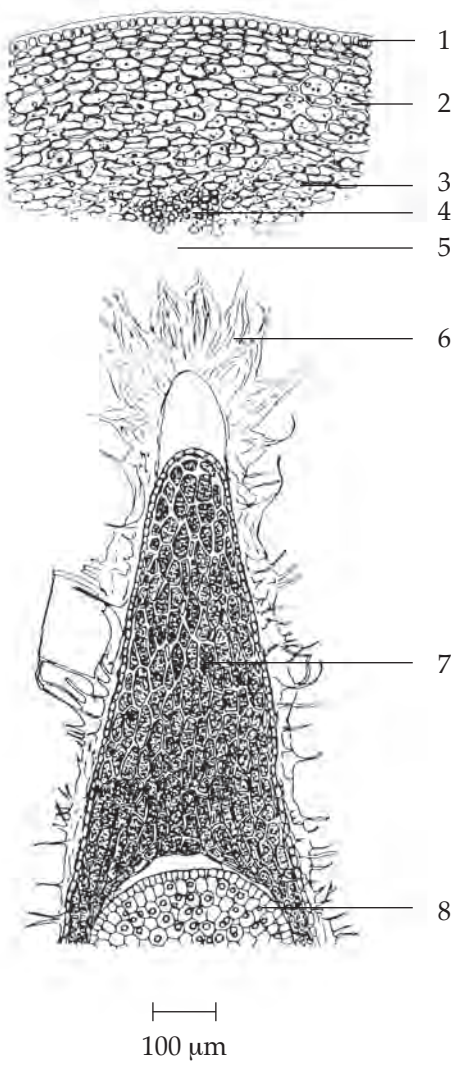


Fig. 2a Transverse Section of the Fruit of *Solanum trilobatum* L.

1. epidermis
2. thick-walled parenchyma containing starch grains and oil droplets
3. thin-walled parenchyma containing starch grains and oil droplets
4. vascular bundle
5. cavity
6. sclereids
7. endosperm containing oil droplets
8. embryo containing oil droplets

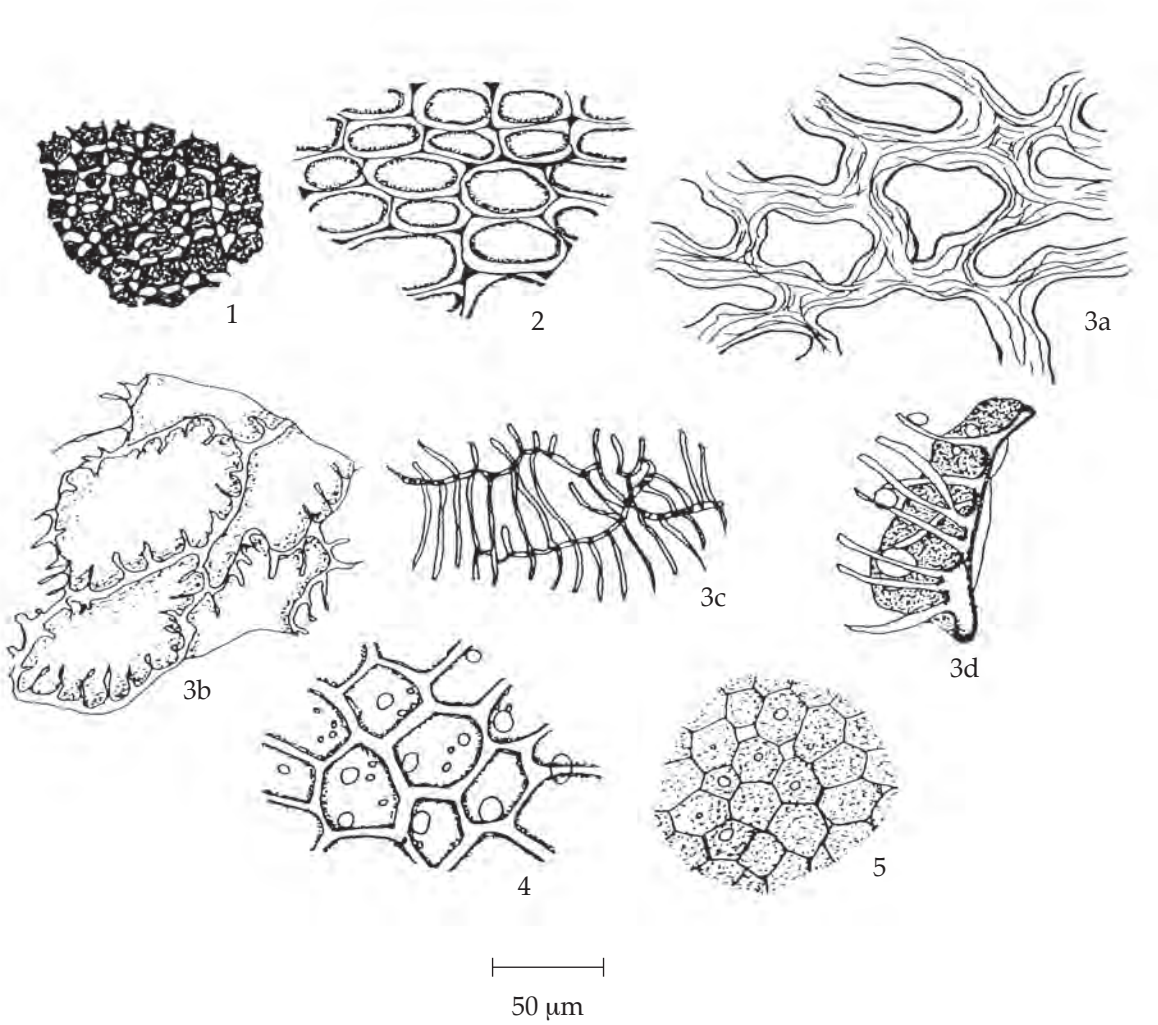


Fig. 2b Powdered Drug of the Fruits of *Solanum trilobatum* L.

1. epidermis of pericarp in surface view
2. thick-walled parenchyma of pericarp
3. sclerenchymatous layer of testa
   a. surface view seen from raphe
   b. surface view seen from below
   c. surface view seen from above
   d. sectional view
4. endosperm with oil droplets
5. embryo with oil droplets

Identification

A. Reflux 500 mg of the sample, in powder, with 10 mL of *ethanol* for 30 minutes, and filter. Evaporate 2 to 3 mL of the filtrate to dryness and add 2 to 3 drops of *acetic anhydride* and a few drops of *sulfuric acid*: a violet colour is produced.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using s*ilica gel G* as the coating substance and a mixture of 55 volumes of *chloroform* and 45 volumes of *toluene* as the mobile phase. Apply to the plate, 10 µL of the test solution prepared by refluxing 5 g of the sample, in powder, with 10 mL of *methanol* for 20 minutes, and filtering. After removal of the plate, allow it to dry in air and examine under ultraviolet light (366 nm); two blue and two red fluorescent spots appear. Spray the plate with *vanillin-sulfuric acid TS* and heat at 120° for 5 to 10 minutes; six violet spots are observed (Table 1); see also Fig. 3.

Repeat the same procedure on another plate but using 90 volumes of *cyclohexane* and 10 volumes of *diethanolamine* as the mobile phase. After removal of the plate, allow it to dry in air and examine under ultraviolet light (366 nm); three blue fluorescent spots appear. Spray the plate with *modified Dragendorff TS*; two orange-yellow spots are observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Methanolic Extract of the Fruits of *Solanum trilobatum* L.

a. Mobile phase: 55 volumes of *chloroform* and 45 volumes of *toluene*

Spot	hR_f Value	Detection	
		UV 366	*Vanillin-Sulfuric Acid TS*
1	3–6	blue	–
2	5–7	red	–
3	5–7	–	violet
4	7–9	blue	–
5	8–12	–	violet
6	10–15	red	–
7	12–17	–	violet
8	15–21	–	violet
9	18–25	–	violet
10	43–53	–	violet

b. Mobile phase: 90 volumes of *cyclohexane* and 10 volumes of *diethanolamine*

Spot	hR_f Value	Detection	
		UV 366	*Modified Dragendorff TS*
1	2	light blue	–
2	23–24	–	orange-yellow
3	40–44	light blue	–
4	58–61	light blue	–
5	58–61	–	orange-yellow

Loss on drying Not more than 6.0 per cent w/w after drying at 100° to constant weight (Appendix 4.15).

Acid-insoluble ash Not more than 1.0 per cent w/w (Appendix 7.6).

Sulfated ash Not more than 11.0 per cent w/w (Appendix 5.3).

Ethanol-soluble extractive Not less than 3.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 5.0 per cent w/w (Appendix 7.12).

Chloroform-soluble extractive Not less than 1.0 per cent w/w (Appendix 7.12H).

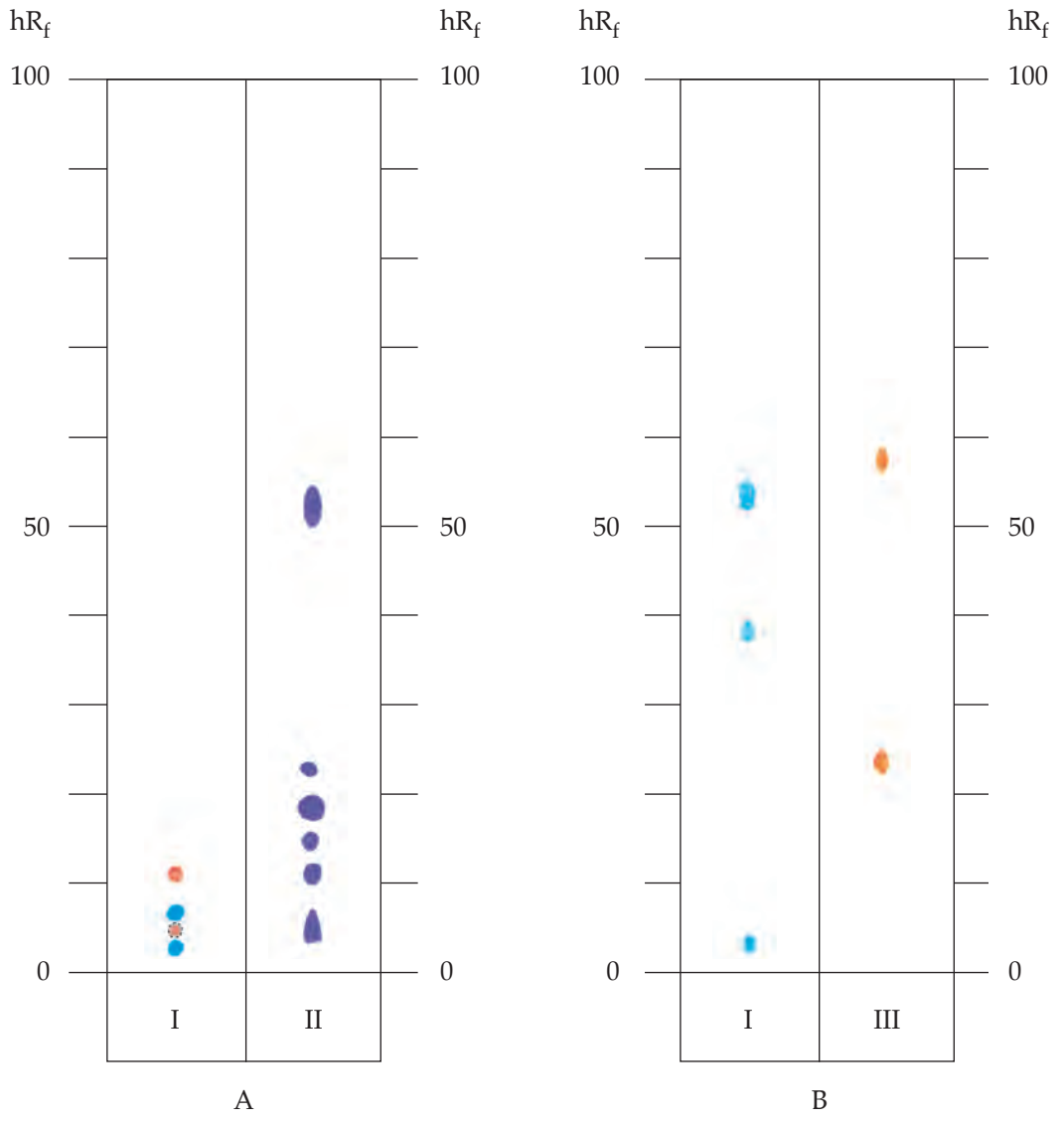


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Fruits of *Solanum trilobatum* L.

A = use 55 volumes of *chloroform* and 45 volumes of *toluene* as the mobile phase.
B = use 90 volumes of *cyclohexane* and 10 volumes of *diethanolamine* as the mobile phase.
I = detection under UV light (366 nm)
II = detection with *vanillin-sulfuric acid TS*
III = detection with *modified Dragendorff TS*
◌ = spots developed in some samples

หม่อน (MON)

Mori Albi Folium
Mulberry Leaf

Synonyms Moral Blanco Leaf, Russian Mulberry Leaf, Silkworm Mulberry Leaf, White Mulberry Leaf, White-Fruited Mulberry Leaf

Category Mild antitussive.

Mulberry Leaf is the dried leaf of *Morus alba* L. (Family Moraceae), Herbarium Specimen Number: DMSC 5157, Crude Drug Number: DMSc 5431, 5432.

Constituents Mulberry Leaf contains flavonoids (e.g., rutin, quercetin 3-(6-malonyl) glucoside, isoquercitrin), alkaloids (e.g., 1-deoxynojirimycin), sterols, etc.

Description of the plant (Figs. 1a, 1b) Deciduous tree or shrub, 3 to 15(–20) m high; stem erect, branched; young branch greenish, pubescent; mature branch greyish green with lenticels; lenticel prominent, reddish or yellowish brown; stem bark thin, rough, shallowly furrowed, grey, reddish or yellowish brown; bud ovoid, 4 to 6 mm long. Leaves simple, alternate, variable in size and shape, usually ovate to broadly ovate, (2.5–)5 to 20(–30) cm long, 2.5 to 14 cm wide, apex acute, acuminate or obtuse, base truncate, round or cordate, margin serrate, serrate-crenate, or irregularly lobed, basal nerves 3, blade abaxially glabrous or sparingly pubescent along major veins or tufted in axils of principle lateral veins and midrib, adaxially glabrous or sparsely pubescent; petiole up to 5.5 cm long; stipule ovate to lanceolate, 5 to 9 mm long, caducous. Inflorescence catkin, axillary, sordid white or greenish white, monoecious or dioecious; male catkin lax, 1 to 4 cm long; female catkin ovoid, 0.5 to 2 cm long; peduncle as long as the catkin. Male flower sessile; sepals 4, imbricate, ovoid, about 2.5 mm long, glabrous or hairy; stamens 4, filament inflexed in buds, anther globose to reniform, 2-loculed, papillose. Female flower sessile; sepals 4, imbricate, glabrous, marginally hairy; ovary 1-celled, glabrous, style, 0.5 to 1 mm long, 2-partite, stigma papillose. Fruit multiple, syncarpous, ovoid, ellipsoid or cylindric, 1 to 2.5 cm long, 0.5 to 1 cm wide, fleshy, becoming reddish, purplish, blackish or whitish when mature.

Description Odour, slightly aromatic; taste, slightly sweet with slightly bitter aftertaste.

Macroscopical (Fig. 1a) Lamina ovate to broadly ovate, irregularly lobed, 5 to 15 cm long, 4 to 10 cm wide, apex acute, acuminate or obtuse, base round to cordate, margin coarsely serrate to crenate, vein prominent; petiole, if present, slender, up to 5.5 cm long.

Microscopical (Figs. 2a, 2b, 2c) Transverse section of the leaf through the midrib and the lamina shows upper and lower epidermises, mesophyll, vascular tissue, and collenchyma. Upper epidermis, a layer of large rectangular cells; large lithocysts forming papillae, some of which boundary cells also contain cystoliths, covered with cuticle layer and unicellular trichomes. Mesophyll composed of a layer of palisade cells and layers of irregular spongy cells, xylem and phloem. Xylem composed of spiral and reticulate vessels. Collenchyma cells, located beneath upper and lower epidermises of the midrib. Lower epidermis, a layer of small oval cells; numerous anomocytic stomata, covered with cuticle layer and unicellular trichomes.

1

2

3

4

5

6

7

1 cm

Fig. 1a *Morus alba* L.
1. habit 2. branch showing polymorphic leaves
3. female flowering branch 4. female inflorescence 5. male inflorescences
6. different stages of infructescences 7. crude drug

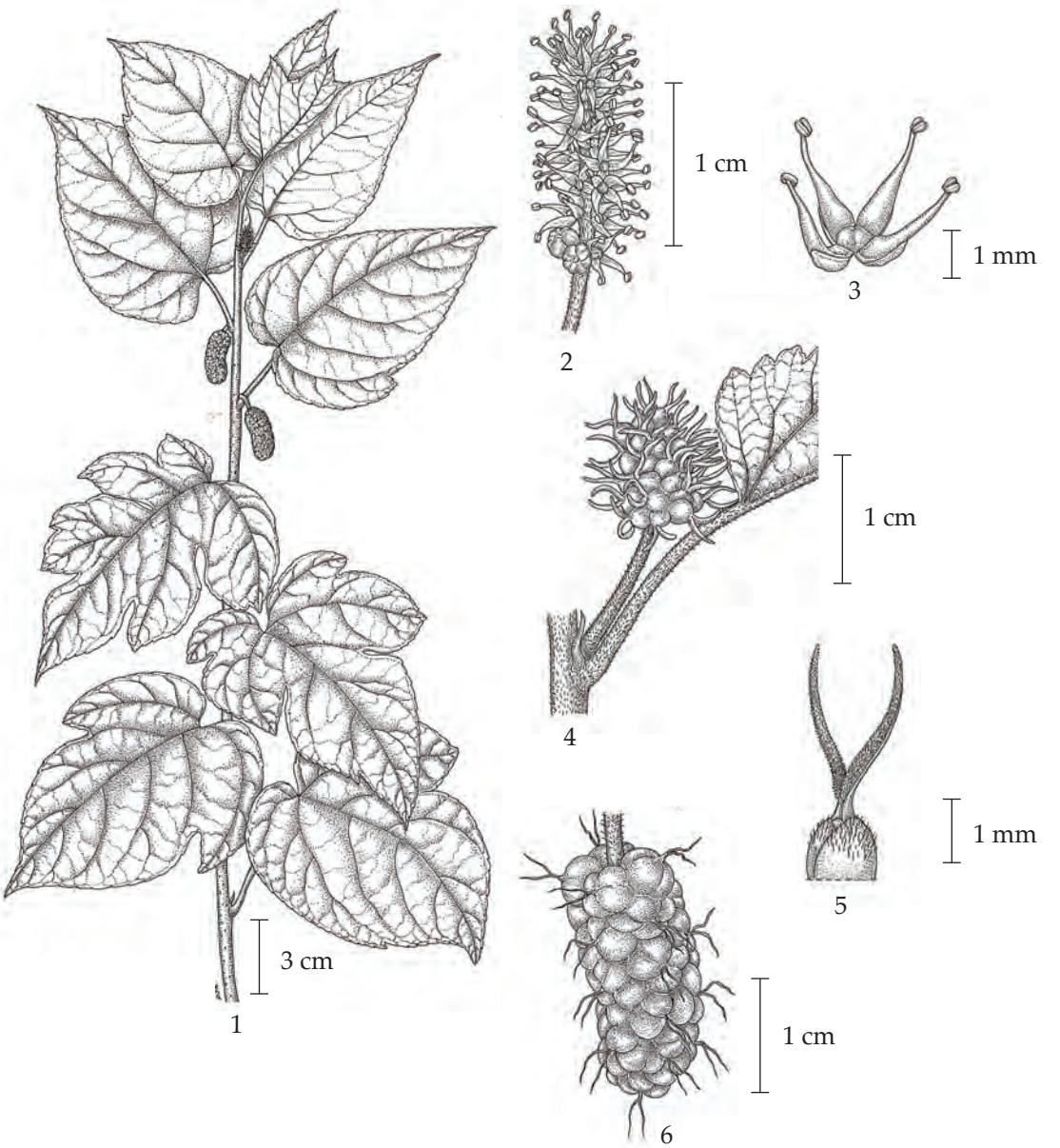
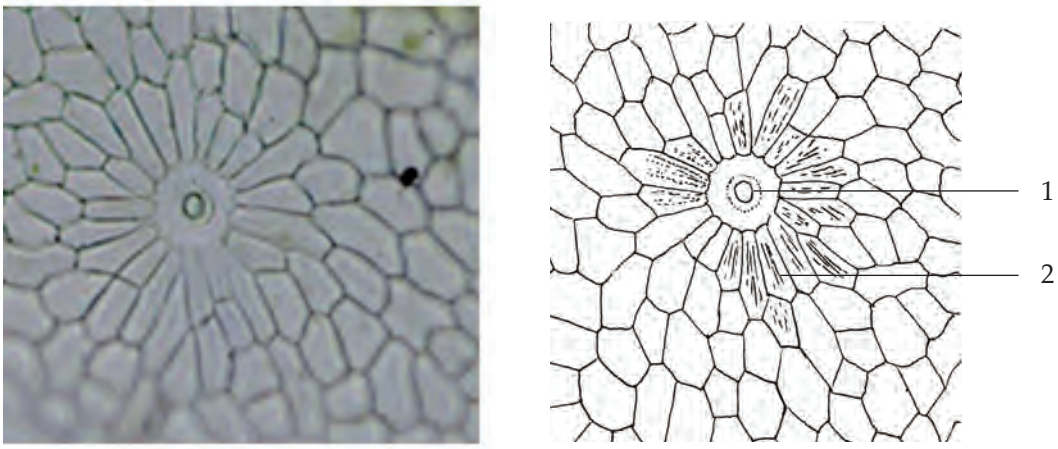
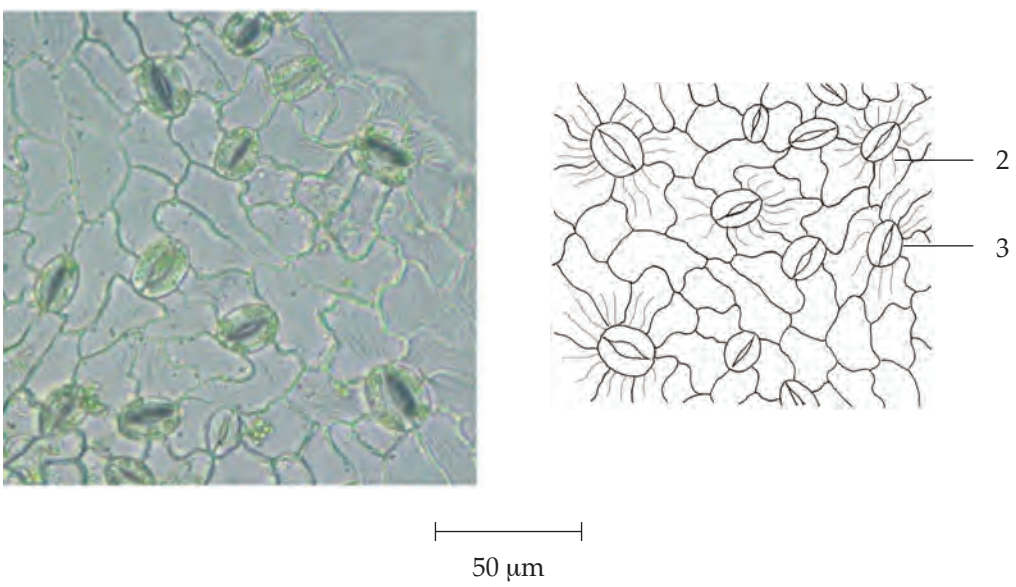


Fig. 1b *Morus alba* L.
1. flowering and fruiting branch showing polymorphic leaves
2. male inflorescence 3. male flower 4. female inflorescence
5. part of ovary, style and stigma 6. infructescence



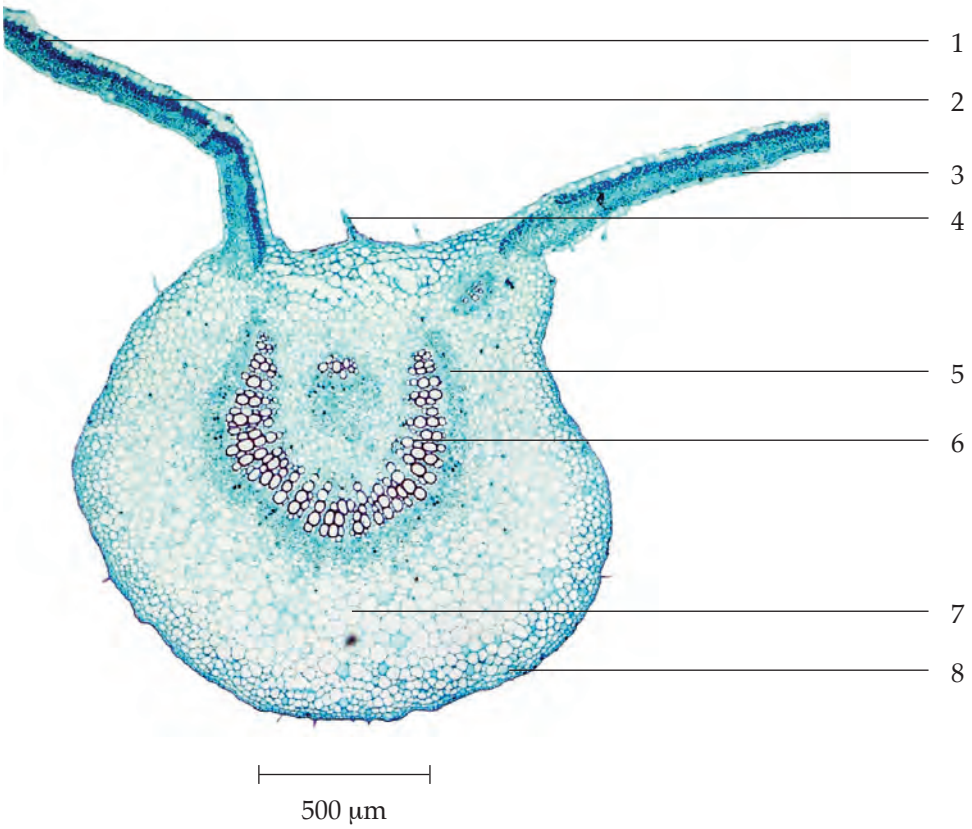
Upper Epidermis of the Lamina



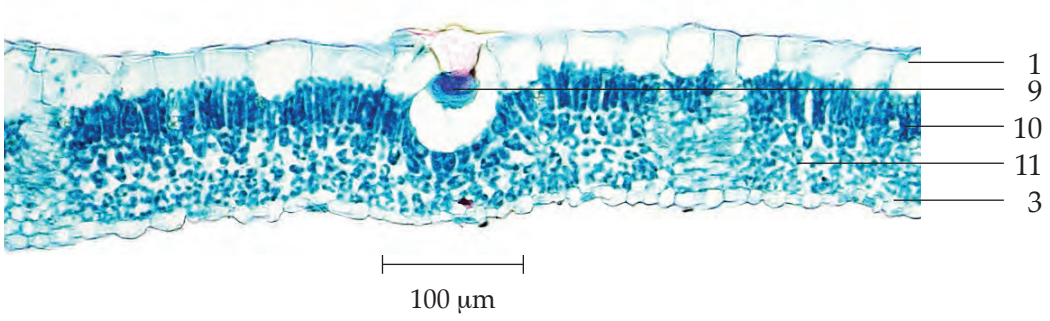
Lower Epidermis of the Lamina

Fig. 2a Photomicrographs and Line Drawings of Epidermises of the Leaf of *Morus alba* L.

1. cystolith trichome
2. striated cuticle
3. anomocytic stoma



Transverse Section of the Midrib



Transverse Section of the Lamina

Fig. 2b Photomicrographs of Transverse Sections of the Leaf of *Morus alba* L., Stained with Safranin-Fast Green

1. upper epidermis
2. leaf blade
3. lower epidermis
4. trichome
5. phloem
6. xylem
7. parenchyma
8. collenchyma
9. cystolith
10. palisade cell
11. spongy cell

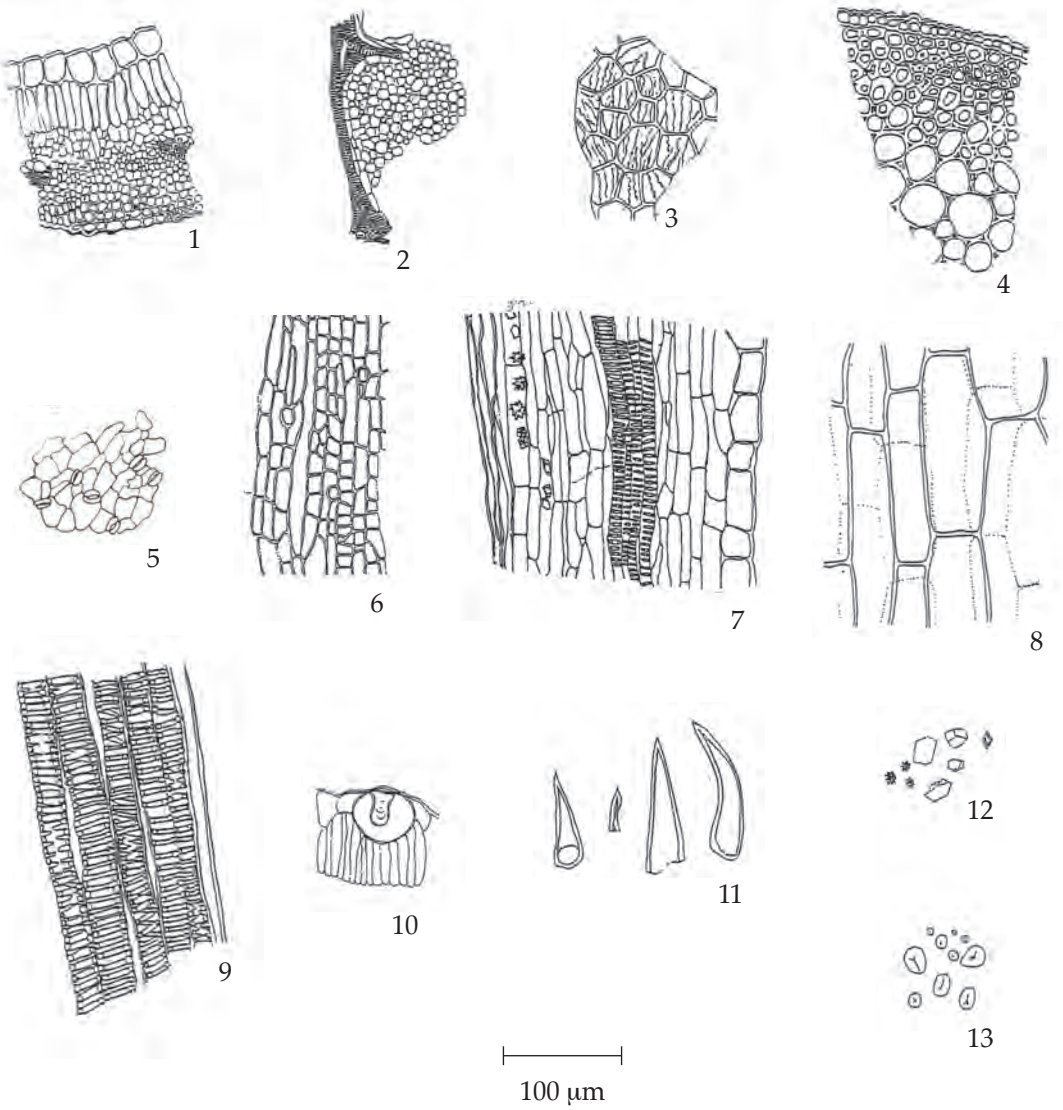


Fig. 2c Powdered Drug of the Leaves of *Morus alba* L.

1. lamina in sectional view showing epidermis, palisade cells, spongy cells, and vascular bundles
2. palisade cells and veinlet in surface view
3. upper epidermis with striated cuticle
4. epidermis associated with collenchyma of midrib
5. lower epidermis showing anomocytic stomata
6. epidermis and cicatrix, over vein in surface view
7. epidermis of petiole in longitudinal view associated with parenchyma, some containing rosette aggreagate or prismatic crystals and vascular tissue
8. rectangular epidermis and underlying parenchyma in surface view
9. fibre, spiral and reticulate vessels
10. epidermis associated with cystolith sac and layer of palisade cells
11. fragments of unicellular trichomes
12. rosette aggregate and prismatic crystals
13. starch grains

Mulberry Leaf in powder possesses the diagnostic microscopical characters of the unground drug. Upper epidermis, large rectangular cells, some with cystoliths; lower epidermis, small oval cells with anomocytic stomata; epidermis of the vein with cicatrix; epidermis with striated cuticle; and unicellular trichomes are characteristic.

Packaging and storage Mulberry Leaf shall be kept in well-closed containers, protected from light, and stored in a dry place.

Identification

A. Warm 500 mg of the sample, in *No. 250 powder*, with 10 mL of *water* on a water-bath for 15 minutes and filter (solution 1). To 1 mL of solution 1, add 3 or 4 pieces of *magnesium ribbon*, shake well, and mix with 1 or 2 drops of *hydrochloric acid*: a brownish red colour develops.

B. To 2 mL of solution 1, add 1 or 2 drops of a 5 per cent w/v solution of *iron(III) chloride*: a greenish brown precipitate is produced.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 80 volumes of *ethyl acetate*, 20 volumes of *acetone*, 20 volumes of *formic acid* and 20 volumes of *water* as the mobile phase and allowing the solvent front to ascend 8.5 cm above the line of application. Apply separately to the plate as bands of 10 mm, 5 μL each of the following two solutions. Prepare solution (A) by shaking 1 g of the sample, in *No. 250 powder*, in 10 mL of *ethanol (30 per cent)*, warming in a water-bath at 50° for 10 minutes, filtering, and washing the filtrate with three 10-mL portions of n-*hexane*. Evaporate the ethanolic layer on a water-bath to dryness and dissolve in 1 mL of *ethanol (30 per cent)*. For solution (B), dissolve 1 mg of *rutin* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine under daylight, locating the bands. The chromatogram obtained from solution (A) shows a yellow band (hR_f value 65 to 67) corresponding to the rutin band from solution (B), and other two yellow bands. Subsequently examine the plate under ultraviolet light (254 nm), marking the quenching bands. One quenching band corresponding to the rutin band from solution (B) and other three quenching bands are observed. Examine the plate under ultraviolet light (366 nm) through the cut-off filter; two blue fluorescent bands are observed. Spray the plate with *anisaldehyde TS* and heat at 105° for 3 minutes; the band due to rutin is yellow. Other yellow and yellowish grey bands are also observed (Table 1); see also Fig. 3.

Table 1 hR_f Values of Components in Ethanolic Extract of the Leaves of *Morus alba* L.

Band	hR_f Value	Detection			
		Daylight	UV 254	UV 366	*Anisaldehyde TS*
1	14–20	–	–	–	yellowish grey
2	29–35	–	–	–	yellowish grey
3*	65–67	pale yellow	quenching	–	pale yellow
4	67–68	–	–	light blue	–
5	68–74	pale yellow	quenching	–	pale yellow
6	73–76	–	–	light blue	–
7	79–81	pale yellow	quenching	–	pale yellow
8	86–88	–	weak quenching	–	–

*rutin

Loss on drying Not more than 11.0 per cent w/w after drying at 105° to constant weight (Appendix 4.15).

Foreign matter Not more than 2.0 per cent w/w (Appendix 7.2).

Acid-insoluble ash Not more than 5.0 per cent w/w (Appendix 7.6).

Total ash Not more than 11.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 4.0 per cent w/w (Appendix 7.12).

Water-soluble extractive Not less than 17.0 per cent w/w (Appendix 7.12).

Dose 5 to 10 g a day.

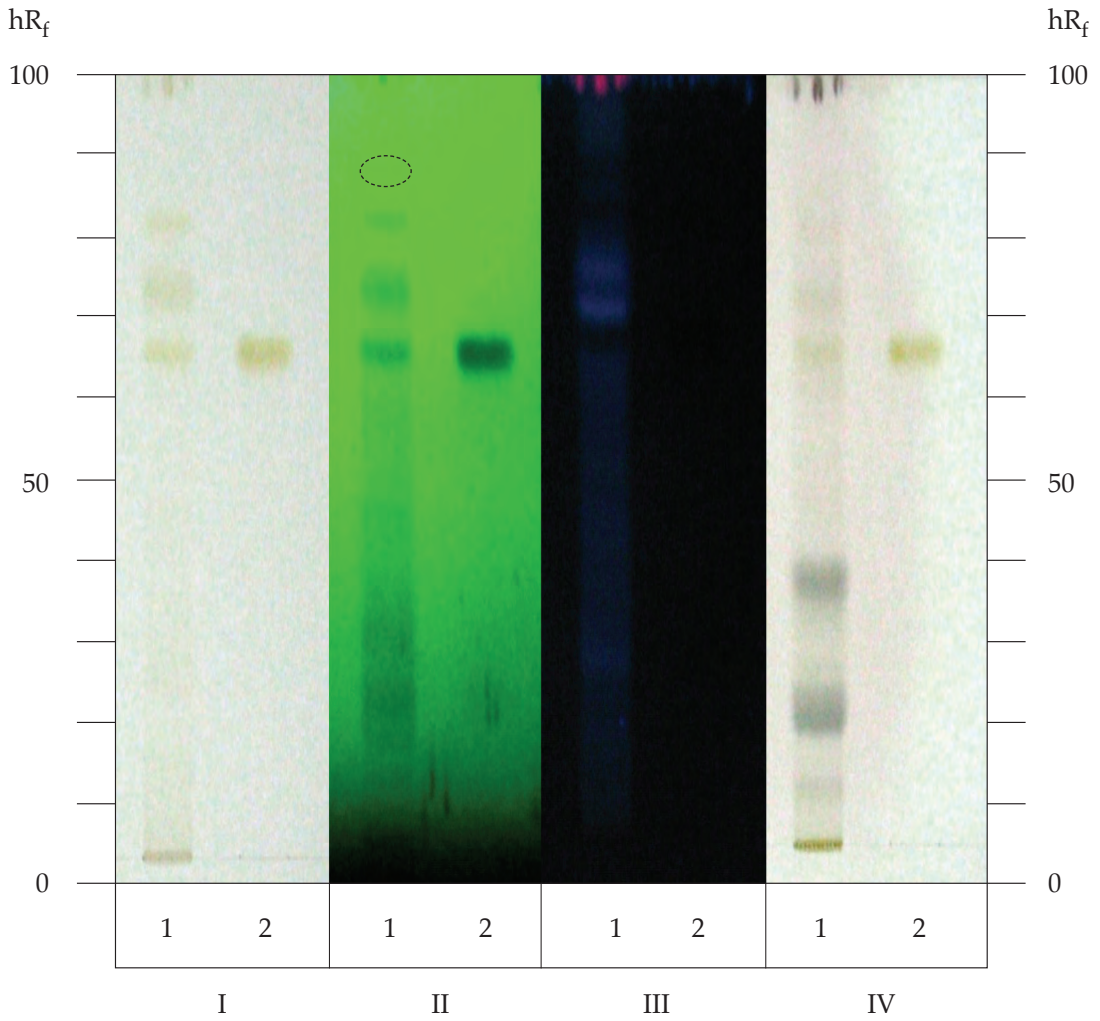


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Leaves of *Morus alba* L.

1 = solution (A)
2 = solution (B)
I = detection under daylight
II = detection under UV light (254 nm)
III = detection under UV light (366 nm)
IV = detection with *anisaldehyde TS*
◌ = band developed in some samples

น้ำมันตะไคร้หอม (NAM MAN TAKHRAI HOM)

Citronella Oil

Category Pharmaceutic aid, insect repellent.

Citronella Oil is the volatile oil obtained by distillation from the fresh aerial parts of *Cymbopogon winterianus* Jowitt.

Description Pale yellow to brownish yellow liquid; odour, strong and characteristic.

Packaging and storage Citronella Oil shall be kept in well-filled, tightly closed containers, preferably of metal or glass, protected from light, and stored at a temperature not exceeding 25°.

Identification

A. The chromatogram of the Test solution shows several peaks, eight of which correspond to those of the Standard solution, as obtained in the *Composition*.
(**Note** Neral and geranial may be absent in the chromatogram obtained from the Test solution.)

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 90 volumes of *toluene* and 10 volumes of *ethyl acetate* as the mobile phase. Apply separately to the plate, 5 µL each of the following two solutions. Prepare solution (A) by diluting 1 mL of the sample with 9 mL of *ethanol*. For solution (B), dilute 2 mL of *citronellal* in 9 mL of *ethanol*. After removal of the plate, allow it to dry in hot air. Spray the plate with *anisaldehyde TS* and heat at 105° for 10 minutes; the spot due to citronellal is purple. The chromatogram obtained from solution (A) shows a purple spot corresponding to the citronellal spot from solution (B). Several other spots of different colours are observed.

Relative density 0.881 to 0.895 (Appendix 4.9).

Refractive index 1.463 to 1.475, at 20° (Appendix 4.7).

Optical rotation –4° to +1.5°, at 20° (Appendix 4.8).

Composition 1.0 to 5.0 per cent of limonene, 30.0 to 45.0 per cent of citronellal, 2.0 to 4.0 per cent of citronellyl acetate, not more than 2.0 per cent of neral, not more than 2.0 per cent of geranial, 3.0 to 8.0 per cent of geranyl acetate, 9.0 to 15.0 per cent of citronellol and 20.0 to 25.0 per cent of geraniol. Carry out the determination as described in the "Gas Chromatography" (Appendix 3.4).

Standard solution Dilute 25 µL of *limonene*, 100 µL of *citronellal*, 25 µL of *citronellyl acetate*, 25 µL of *citral* (mixture of neral and geranial), 25 µL of *geranyl acetate*, 25 µL of *citronellol*, and 100 µL of *geraniol* in 5 mL of *hexane*.

Test solution The substance to be examined.

Chromatographic system The chromatographic procedure may be carried out using (a) a fused-silica column (60 m × 0.25 mm) packed with *macrogol 20000* (0.2 µm) on *silanized diatomaceous support*, (b) the injection port and the detector block maintained at 260°, respectively, (c) split ratio 1:100, (d) *helium for chromatography* as the carrier gas at a flow rate of about 1.0 mL per minute, and (e) a flame ionization detector at 260°. The step gradient of temperature is as follows:

Time (Minutes)	Temperature (°)
0–2	80
2–26	80→150
26–42	150→185
42–49	185→250

To determine the suitability of the chromatographic system, chromatograph *Standard solution*, and record the retention times and peak responses as directed under *Procedure*: the elution order of the substances is limonene, citronellal, citronellyl acetate, neral, geranial, geranyl acetate, citronellol, and geraniol, and the resolution factor between the geranyl acetate peak and the citronellol peak is not less than 1.2.

Procedure Separately inject about 1 μL of *Standard solution* and 0.2 μL of *Test solution* into the chromatograph, record the chromatograms, locate and measure the retention times and peak responses of the limonene, citronellal, citronellyl acetate, neral, geranial, geranyl acetate, citronellol, and geraniol peaks in the chromatogram obtained from the Test solution, using the retention times in the chromatogram obtained from the Standard solution.

Calculation Calculate the percentage of limonene, citronellal, citronellyl acetate, neral, geranial, geranyl acetate, citronellol, and geraniol in the Oil taken, using the normalization procedure (Appendix 3.9).