

Thai Herbal Pharmacopoeia 2021

SUPPLEMENT 2025



กรมวิทยาศาสตร์การแพทย์
DEPARTMENT OF MEDICAL SCIENCES



กรมวิทยาศาสตร์การแพทย์
DEPARTMENT OF MEDICAL SCIENCES

Thai Herbal Pharmacopoeia 2021 SUPPLEMENT 2025

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PREFACE

Herbal medicine continues to hold both popularity and significance in Thai society. It has also been integrated into the mainstream healthcare system.

In recent years, the rapid expansion of e-commerce has led to a flood of herbal products in the digital marketplace. Therefore, stringent oversight of these products is essential to safeguard consumers. The Thai Herbal Pharmacopoeia serves this role as the national compendium, establishing specifications, criteria, and standard test methods to ensure the quality, safety, and efficacy of herbal drugs and preparations available in the Thai market.

The current Thai Herbal Pharmacopoeia 2021 Supplement 2025 contains 23 new monographs on herbal drugs and preparations. It is published in electronic book (e-book) format for convenient access.

This publication has been prepared by six Subcommittees under the supervision of the Thai Pharmacopoeia Committee, namely the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia, the Subcommittee on Pharmacognostic and Botanical Specifications for the Thai Herbal Monographs, the Subcommittee on Physico-chemical Specifications and Safety for the Thai Herbal Monographs, the Subcommittee on Standards for Thai Herbal Drug Preparations, the Subcommittee on Standards and Analytical Methods, and the Subcommittee on Editorial Style.

The Subcommittees and the Department of Medical Sciences gratefully acknowledge the contributions of government agencies, academic institutions, organizations, and individuals who provided comments, advice, and expertise, making the publication of this volume possible.

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¹Effective from October 2002 (formerly Drug Analysis Division)

²Effective from October 2002 (formerly Thai Pharmacopoeia Section)

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

⁴Effective from October 2007 (formerly Thai Pharmacopoeia Section)

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Pairin **Thongkhoom**, B.Sc., M.Sc. in Pharm., *Representative*
Wilawan **Rattanathirakul**, B.Sc., M.Sc., *Representative*
Sopidawan **Wichenkun**, B.S., *Representative*

Director, Bureau of Drug and Narcotic (2014–)
 Suratchanee **Savetsila**, B.Sc. in Pharm., M.Sc. in Pharm.
 Somsak **Sunthornphanich**, B.Sc. in Pharm., M. Chem.
 Siritwan **Chaisomboonpan**, B.Sc. in Pharm., M.Sc. in Pharm.
 Supanee **Duangteerapreecha**, B.Sc. in Pharm., M.S., Ph.D., *Representative*
 Jiranuch **Jamtaweekul**, B.Sc. in Pharm., M.Sc. in Pharm., *Representative*
 Chief, Phytochemistry Section, Medicinal Plant Research Institute,
 Department of Medical Sciences (2000–2015)
 Thidarat **Boonruad**, B.Sc., M.Sc. in Pharm.
 Yenchit **Techadamrongsin**, B.Sc., B.S. Phar., Post. Cert.
 Prapai **Wongsinkongman**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D.,
Representative
 Chief, Pharmacognosy Section, Medicinal Plant Research Institute,
 Department of Medical Sciences (2000–2015)
 Pranom **Dechwisissakul**, B.Sc., M.Sc. in Pharm.
 Pairin **Thongkhoom**, B.Sc., M.Sc. in Pharm.
 Chief, Herbal Quality Assurance Center, Medicinal Plant Research
 Institute, Department of Medical Sciences (2004–)
 Thidarat **Boonruad**, B.Sc., M.Sc. in Pharm.
 Prapai **Wongsinkongman**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D.
 Nawarat **Chadchen**, B. Pharm., M.Sc. in Pharm., *Representative*
 Jiranuch **Mingmuang**, B. Pharm., M.Sc. in Pharm., *Representative*
 Duangpen **Pattamadilok**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D.,
Representative
 Puritat **Ratanasiri**, B.Sc. in Pharm., *Representative*
 Apirak **Sakpetch**, B.S. Pharm., *Representative*
 Chief, Pharmaceutical Chemistry Laboratory, Medicinal Plant Research
 Institute, Department of Medical Sciences (2012–2015)
 Prapai **Wongsinkongman**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D.
 Jaree **Bansiddhi**, B.Sc., M.Sc. (2010–)
 Phichet **Banyati**, M.D., B.TTM, MPH, (2021–)
 Rapepol **Bavovada**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (1993–2006)
 Chitra **Chaiyawat**, B. Pharm. (2010–2014)
 Kongkanda **Chayamarit**, B.Sc., M.Sc., D.Sc. (2013–)
 Thaweephol **Dechatiwongse Na Ayudhya**, B.Sc. in Pharm. (1989–2024)
 Supatra **Im-erb**, B.Sc. in Pharm., M.Sc. (Pharm. Chem.) (1990–1991, 2009–)
 Panida **Kanchanapee** (deceased), B.Sc. in Pharm. (1993–2000)
 Surapong **Kengtong**, B.Sc. in Pharm., M.Sc. in Pharm (2014–)
 Sirichai **Krabesri**, B.Sc. in Pharm., M. Pharm., LL.B., B.L. (2014–)
 Kaisee **Limprasert**, Cert. in TTM (2021–)
 Wantana **Ngamwat**, B.Sc. in Pharm., M.Sc. (1989–1993)
 Yupadee **Payakkapan**, B.Sc. in Pharm., M.Sc. in Pharmaceutical
 Analysis (1991–2021)
 Thatree **Phadungcharoen**, B.Sc. in Pharm., M.Sc. in Pharm. (1989–)
 Kalaya **Pharadai**, B.Sc. in Pharm., M.Eng. (1989–)
 Chamlong **Phengklai**, B.S. (Forestry), Hon. D.Sc. in Forestry (KU), FRI
 (2000–2002)
 Chayan **Picheansoonthon**, B.S. in Pharm., Ph.D., FRI (1995–)

Suratchanee **Savetsila**, B.Sc. in Pharm., M. Pharm. (2021–)
Kamol **Sawasdimongkol**, B.Sc. in Pharm., M.S. (1995–2004)
Sawanee **Sathornviriyapong**, B.S. (Agriculture), M.S. (Horticulture),
Ph.D. (2002–)
Chantra **Shaipanich**, B.Sc. in Pharm., M.S., Ph.D. (1989–1994)
Nantana **Sittichai**, B.Sc. in Pharm., M.S. (2008–)
Taweesak **Suntorntanasat**, B.Sc. in Pharm., M.Sc. in Pharm. (2000–)
Khanit **Suwanborirux**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (1993–2021)
Yenchit **Techadamrongsin**, B.Sc., B.S. Phar., Post. Cert. (2008–)
Kanokwan **Watanayothin**, B.S. (Agriculture), M.S. (Agriculture),
Ph.D. (2000–2009)
Prapai **Wongsinkongman**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (2021–)

Secretaries:

Sasiwan **Aim-ot**, B.Sc. in Pharm. (2003–2004)
Chitra **Chaiyawat**, B. Pharm. (1996–2010)
Buussayamas **Charoensuk**, B. Pharm. (1999–2000)
Kornvika **Charupant**, B.S. Pharm., M.Sc. in Pharm., Ph.D. (1998–1999,
2001–2003, 2008–)
Supanee **Duangteerapreecha**, B.Sc. in Pharm., M.S., Ph.D. (1989–1991)
Supatra **Im-erb**, B.Sc. in Pharm., M.Sc. (1989–1990)
Anuwat **Ittirittanon**, B.Sc. in Pharm. (1991–1992)
Jiranuch **Jamtaweekul**, B.Sc. in Pharm., M.Sc. in Pharm. (2010–2015)
Wichuda **Jariyaphun**, B.Sc., M.Sc. (1989–1990)
Sarunyaporn **Kongchira**, B.S. in Pharm., M.S. (1993–1996)
Sarinee **Lenapun**, B.S. Pharm., M.Sc. in Pharm. (2004–2008)
Santi **Nimnoi**, B.S. in Pharm. (2017–)
Sasiwimon **Patasema**, B. Pharm., M.Sc. in Pharm. (2009, 2015–)
Thanita **Patthamajinda**, B.S. in Pharm., M.A. MS in Regulatory
Affairs and Health Policy (2009–2015)
Supattra **Phongsri**, B.Sc. (Pharm.) (2000–2001)
Thanyarat **Putta**, B.Sc. in Pharm., M.Sc. in Pharm. (1996–1998)
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 PHARMACOGNOSTIC AND BOTANIC SPECIFICATIONS FOR THAI HERBAL MONOGRAPHS (2010–)

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** (deceased), B.Sc., M.Sc., Hon. Ph.D., FRI (2010–2015)

Members: Kongkanda **Chayamarit**, B.Sc., M.Sc., D.Sc. (2010–2015)
Chief, Pharmacognosy Section, Medicinal Plant Research Institute,
Department of Medical Sciences (2010–)
Pairin **Thongkhoom**, B.Sc., M.Sc. in Pharm.
Wilawan **Rattanathirakul**, B.Sc., M.Sc., *Representative*
Paweena **Sakhee**, B.S., *Representative*
Sopidawan **Wichienkul**, B.Sc. in applied Biology, *Representative*
Jaree **Bansiddhi**, B.S., 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–)
Thaweesak **Juengwatanatrakul**, B. Pharm., M.Sc. in Pharm., Ph.D. (2024–)
Ornusa **Khamsuk**, B.S., M.S., Ph.D. (2014–2019)
Thatree **Phadungcharoen**, B.Sc. in Pharm., M.Sc. in Pharm. (2015–)
Kalaya **Pharadai**, B.Sc. in Pharm., M.Eng. (2010–)
Sawanee **Sathornviriyapong**, B.S. (Agriculture), M.S. (Horticulture),
Ph.D. (2010–)
Sukontip **Sirimongkol**, B.S. (Forestry), M.S. (Forestry), Ph.D. (2024–)
Anitthan **Srinual**, B.Sc. in Biology, M.Sc. in Biology, Ph.D. in Biology (2019–)

Secretaries: Sasiphimol **Boontavee**, Pharm. D., LL.B., (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 PHYSICO-CHEMICAL SPECIFICATIONS AND SAFETY FOR THAI HERBAL MONOGRAPHS (2010–)

Chairperson: Khanit **Suwanborirux**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (2010–2021)
Prapai **Wongsinkongman**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (2021–)

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*
Jiranuch **Mingmuang**, B. Pharm., M.Sc. in Pharm., *Representative*
Apirak **Sakpetch**, B.S. Pharm., *Representative*
Head, Physical and Chemical Testing Section, Bureau of Drug and Narcotic (2024–)
Jiranuch **Jamtaweekul**, B.Sc. in Pharm., M.Sc. in Pharm.
Methinee **Nimnoi**, B.S. (Pharmacy), M.S. (Pharm Chemistry), *Representative*
Chitra **Chaiyawat**, B. Pharm. (2010–2014)
Veena **Satitpatipan**, B.S. in Pharm., Ph.D. (2014–)
Yupadee **Payakkapan**, B.Sc. in Pharm., M.Sc. in Pharmaceutical Analysis (2015–2021)
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 **Suntorntanat**, 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. (2011–2021)

Secretaries: Sasiphimol **Boontavee**, Pharm. D., LL.B. (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. SUBCOMMITTEE ON STANDARDS FOR HERBAL DRUG PREPARATIONS (2010–)¹

Chairperson: Yupadee **Payakkapan**, B.Sc. in Pharm., M.Sc. in Pharmaceutical Analysis (2010–2021)

Nantana **Sittichai**, B.Sc. in Pharm., M.S. (2021–)

Members: Director, Research Development and Innovation Department, The Government Pharmaceutical Organization (2024–)
Saidanee **Wangpattanapanich**, B.Sc.(Chemistry), M.Sc. (Organic Chemistry), *Representative*

Head, Physical and Chemical Testing Section, Bureau of Drug and Narcotic (2024–)

Jiranuch **Jamtaweekul**, B.S. in Pharm., M.Sc. in Pharm.

Kornvika **Charupant**, B.S. Pharm., M.Sc. in Pharm., Ph.D. (2015–)

Jiranuch **Jamtaweekul**, B.Sc. in Pharm., M.Sc. in Pharm. (2017–2024)

Piyaporn **Prayakprom**, B.Sc. in Pharm., Ph.D. (2017–2024)

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. (2010–2021)

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., LL.B. (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 attending to all matters related to establishing the specifications for Thai herbal drug preparations;

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

5. SUBCOMMITTEE ON EDITORIAL STYLE (1980–)

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)

¹Effective from June 2017 (formerly The Ad Hoc Subcommittee on Standards of the Thai Herbal Drug Preparations)

Rachanee **Pinthaworn**, B.Sc. in Pharm. (2003–2005, 2009–2010)
Manat **Pohmakotr**, B.Sc., M.Sc., Dr. rer. nat. (2005–2013)
Kamphol **Raksrivong**, B.Sc. in Pharm. (2000–2013)
Nadhirat **Sangkawibha** (deceased), M.D., M.P.H. (1997–2009)
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:

Director, Bureau of Drug and Narcotic (2015–)
Suratchanee **Savetsila**, B.Sc. in Pharm., M.Sc. in Pharm (2015–2021)
Somsak **Sunthornphanich**, B.Sc. in Pharm., M.chem. (2021–2024)
Siriwan **Chaisomboonpan**, B.Sc. in Pharm., M.Sc. in Pharm. (2024–)
Supong **Akesiripong**, B. Pharm. (Hons.), Ph.D. (2000–2021)
Chantana **Aromdee**, B.Sc. in Pharm., M.Sc. (1986–1989)
Manas **Attawish**, B.S. (Pharm.) (2013–2015, 2017–)
Rapepol **Bavovada**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (2006–2008)
Kornvika **Charupant**, B.S. in Pharm., M.Sc. in Pharm., Ph.D. (2008–)
Boonchua **Dhorranintra**, M.D., Dr. med.(magna cum laude) (Freiburg U.)
FRCP(T) (2000–2010)
Supatra **Im-erb**, B.Sc. in Pharm., M.Sc. (1989–1997)
Vichiara A. **Jirawongse** (deceased), B.Sc. in Pharm., Ph.D., Hon. D.Sc. in
Pharm. (CU), Hon. Ph.D. (KKU) (1989–2006)
Than Phuying Preeya **Kashemsant Na Ayudhya** (deceased), B.Sc. in Pharm., M.Sc.,
Hon. D.Sc. in Pharm. (CU) (1989–1992)
Sirichai **Krabesri**, B.Sc. in Pharm., M. Pharm., LL.B., B.L. (2009–)
Prachaksvich **Lebnak**, M.D. (1997–2000)
Wantana **Ngamwat**, B.Sc., B.Sc. in Pharm., M.Sc. (1989–2015)
Rachanee **Pinthaworn**, B.Sc. in Pharm. (2005–2009)
Manat **Pohmakotr**, B.Sc., M.Sc., Dr. rer. nat. (1989–2005)
Aruneer **Poompanich**, B.Sc. in Pharm. (1993–2015)
Sompol **Prakongpan**, B.Sc. in Pharm., M.Sc., Ph.D. (1989–1997)
Sunibhond **Pummangura**, B.Sc. in Pharm., M.Sc., M.S.P., Ph.D. (1989–1997)
Kamphol **Raksrivong**, B.Sc. in Pharm. (1993–1997)
Churairat **Rakwatin**, B.Sc. in Pharm. (2006–)
Nidapan **Ruangrittinon**, B.Sc. in Pharm., M.Sc. in Pharm. (2005–)
Chanai **Sambhandharaksa** (deceased), B.S. Phar., Hon. D.Sc. in Pharm.
(MU) (1989–2008)
M.L. Othong **Sawasdimongkol** (deceased), B.Sc. in Pharm. (1993–2015)
Nantana **Sittichai**, B.Sc. in Pharm., M.S. (2005–)
Nongluck **Sookvanichsilp**, B.Sc. in Pharm. (Hons.), M.Sc. in Pharm.,
Dr.Ph.M.Sc., LL.B., B.B.A. (2005–)
Suntana **Sutadarat**, B.Ed. (Hons.), M.A., Ph.D. (1989–1996, 1998–)
Parkpoom **Tengamnuay**, B. Pharm., Ph.D. (1993–)
Charurat **Tantraporn**, B.A., M.A. (1997–2000)
Opa **Vajragupta**, B.S. (Pharm.), M.Sc., Ph.D. (2000–2003)
Rewadee **Vongsaraj** (deceased), B.Sc. in Pharm., M.Sc. (1989–1997)

Chongdee **Wongpinairat**, B.Sc. in Pharm., M.Sc., Ph.D. (1989–1997)
Sumana **Vardhanabhuti** (deceased), B.Sc. in Pharm., M.Sc. in Pharm.,
M.P.H., Cert. in Immunol. (WHO) (1989–1997)
M.L. Pranod **Xumsaeng** (deceased), Ph.G., B.Sc. in Pharm. (1989–1991)

Secretaries: Manas **Attawish**, B.S. (Pharm.) (1997–2013)
Kornvika **Charupant**, B.S. Pharm., M.Sc. in Pharm., Ph.D. (1997–1999, 2003)
Sarinee **Lenapun**, B. Pharm., M.Sc. in Pharm. (2005–2013)
Santi **Nimnoi**, B.S. in Pharm. (2013–)
Sasiwimon **Patasema**, B.Pharm., M.Sc. in Pharm. (2003–)
Thanita **Patthamajinda**, B.S. in Pharm., M.A, MS in Regulatory Affairs and
Health Policy (2010–2015, 2018–)
Yupadee **Payakkapan**, B.Sc. in Pharm., M.Sc. in Pharmaceutical Analytical
Analysis (1980–1991)
Thomayant **Prueksaritanont**, B.Sc. in Pharm., Ph.D. (1989–1991)
Kamphol **Raksrivong**, B.Sc. in Pharm. (1980–2000)
Nongluck **Ruangwises**, B.S. (Pharm.), M.S., Ph.D. (1989–1991)
Nantana **Sittichai**, B.Sc. in Pharm., M.S. (1980–2005)
Panit **Somhom**, B.Sc. in Pharm., M.Sc. in Pharm. (1991–1993)
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 all subcommittees into a pharmacopoeial form and completing the final draft of the Pharmacopoeia;
- 5.5 attending to all matters related to editing the Pharmacopoeia.

6. SUBCOMMITTEE ON STANDARDS AND ANALYTICAL METHODS (2019–)

Chairperson: Nantana **Sittichai**, B.Sc. in Pharm., M.S. (2019–)

Members: Director, Bureau of Drug and Narcotic
Suratchanee **Savetsila**, B.Sc. in Pharm., M.Sc. in Pharm. (2019–2021)
Somsak **Sunthornphanich**, B.Sc. in Pharm., M. Chem., (2021–2024)
Siriwan **Chaisomboonpan**, B.Sc. in Pharm., M.Sc. in Pharm. (2024–)
Boontarika **Boonyapiwat**, B.Sc. in Pharm., M.Sc. in Biopharm.,
Ph.D. in Biopharm, *Representative*
Kornvika **Charupant**, B.S. Pharm., M.Sc. in Pharm., Ph.D., *Representative*
Jiranuch **Jamtaweekul**, B.Sc. in Pharm., M.Sc. in Pharm., *Representative*
Maytinee **Limsiriwong**, B.Sc. in Pharm., M.Sc. in Pharm., *Representative*
Ladda **Poolsawat**, B.Sc. in Pharm., *Representative*
Sasida **Yoosuk**, B.Sc. in Pharm., M.Sc. in Pharm., *Representative*
Director, Medicinal Plant Research Institute, Department of Medical
Sciences (2019–)
Nawarat **Chadchen**, B. Pharm., M.Sc. in Pharm., *Representative*

Warunee **Jirawattanapong**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D.,
Representative
 Jiranuch **Mingmuang**, B. Pharm., M.Sc. in Pharm., Ph.D., *Representative*
 Puritat **Rattanasiri**, B.Sc. in Pharm., *Representative*
 Head, Physical and Chemical Testing Section, Bureau of Drug and Narcotic
 Sasida **Yoosuk**, B.Sc. in Pharm., M.Sc. in Pharm. (2019–2021)
 Jiranuch **Jamtaweekul**, B.Sc. in Pharm., M.Sc. in Pharm. (2021–)
 Wicharane **Tongsima**, B.Sc. in Pharm., M.Sc. in Pharm. (Pharmaceutics),
Representative
 Tharntip **Wachirasakwong**, B. Pharm., M.Sc. in Pharm., *Representative*
 Prapapun **Sukphan**, B. Pharm., M.Sc. in Pharm., *Representative*
 Jidapha **Kanogsunthornrat**, B.Sc. in Pharm., M.P.H. (2019–)
 Sirichai **Krabesri**, B.Sc. in Pharm., M. Pharm., LL.B., B.L. (2019–)
 Puangkaew **Lukkannatinaporn**, B.Sc. in Pharm., M.Sc. (Pharmacy)
 Santi **Nimnoi**, B.S. in Pharm. (2019–)
 Brompoj **Prutthiwanasan**, B.S. in Pharm., M.Sc. in Pharm., Ph.D. (2024–)
 Churairat **Rakwatin**, B.Sc. in Pharm. (2019–)
 Nidapan **Ruangrittinon**, B.Sc. in Pharm., M.Sc. in Pharm. (2019–)
 Yaowalak **Wattanapisit**, B.Sc. in Pharm., M.Sc. in Pharm. (2019–)

Secretaries: Sasiphimol **Boontavee**, Pharm. D., LL.B. (2019–)
 Sasiwimon **Patasema**, B.Pharm., M.Sc. in Pharm. (2019–)
 Thanita **Patthamajinda**, B.S. in Pharm., M.A., MS in Regulatory Affairs and
 Health Policy (2019–)

This subcommittee is responsible for:

- 6.1 selecting drugs to be included in or excluded from the Thai Pharmacopoeia;
- 6.2 preparing draft specifications, including analytical procedures, for drug monographs in the Thai Pharmacopoeia;
- 6.3 preparing the appendices regarding testing methods and reagents;
- 6.4 performing any other assigned tasks.

7. 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.)
 Jaree **Bansiddhi**, B.Sc., M.Sc.
 Thaweephol **Dechatiwongse Na Ayudhya**, B.Sc. in Pharm.
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INTRODUCTION

In 1989, the Thai Pharmacopoeia Committee appointed the Subcommittee on Establishment of the Thai Herbal Pharmacopoeia with the mission of establishing the Thai Herbal Pharmacopoeia, a companion publication to the 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 Establishment of the Thai Herbal Pharmacopoeia. The responsibilities of each Subcommittee are as described below.

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

- 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. Subcommittee on Physico-Chemical Specifications and Safety for Thai Herbal Monographs:

- 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. Subcommittee on Standards for Thai Herbal Drug Preparations:

- 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.

It is worth mentioning here that the above tasks cannot be completed without the support of the following additional subcommittees.

1. Subcommittee on Editorial Style:

- 1.1 designing the format and style for printing;
- 1.2 editing the text;
- 1.3 keeping conformity of the molecular formulae, chemical names, molecular weights, and expressions of the symbols of units throughout the text;
- 1.4 attending to all matters related to editing the Pharmacopoeia.

2. Subcommittee on Standards and Analytical Methods

- 2.1 selecting drugs to be included in or excluded from the Thai Pharmacopoeia;
- 2.2 preparing draft specifications, including analytical procedure, for drug monographs in the Thai Pharmacopoeia;
- 2.3 preparing the appendices regarding testing methods and reagents;
- 2.4 performing any other assigned tasks.

Starting from the THP 2021 Supplement 2022, the Subcommittee on Establishment of the Thai Herbal Pharmacopoeia and its associates have made some changes by omitting non-essential data such as the table of hR_f values and replacing most line drawings of microscopical characters of herbal drugs with photomicrographs to streamline the content of the monographs. Minor changes of General Notices are made in this publication.

The Subcommittees appreciate all comments and suggestions from the readers/users. They will be incorporated as appropriate into the next revised monographs.

Reference to the previously established monographs

For the previously established monographs, please refer to THP 2021 (Volumes I and II), THP 2021 Supplement 2022, THP 2021 Supplement 2023, and THP 2021 Supplement 2024, or visit the BDN website at: <http://bdn-thp.dmsc.moph.go.th/home>

AMENDMENT

AMENDMENTS TO THP 2021 VOLUME I AND THP 2021 SUPPLEMENT 2024

MONOGRAPHS

บัวบก (BUABOK)

[pp. 29–37 (THP 2021 VOLUME I), pp. XXIX–XXXVII (THP 2021 SUPPLEMENT 2024)]

Replace with the following:

บัวบก, ส่วนเหนือดิน (BUABOK, SUAN NUEA DIN)

ผักหนอก, ส่วนเหนือดิน (PHAK NOK, SUAN NUEA DIN)

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; involucre 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–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



5

Fig. 1a *Centella asiatica* (L.) Urb.

1. habit 2. leaves 3. flowers and fruits 4. inflorescence 5. leaves, flowers and fruits

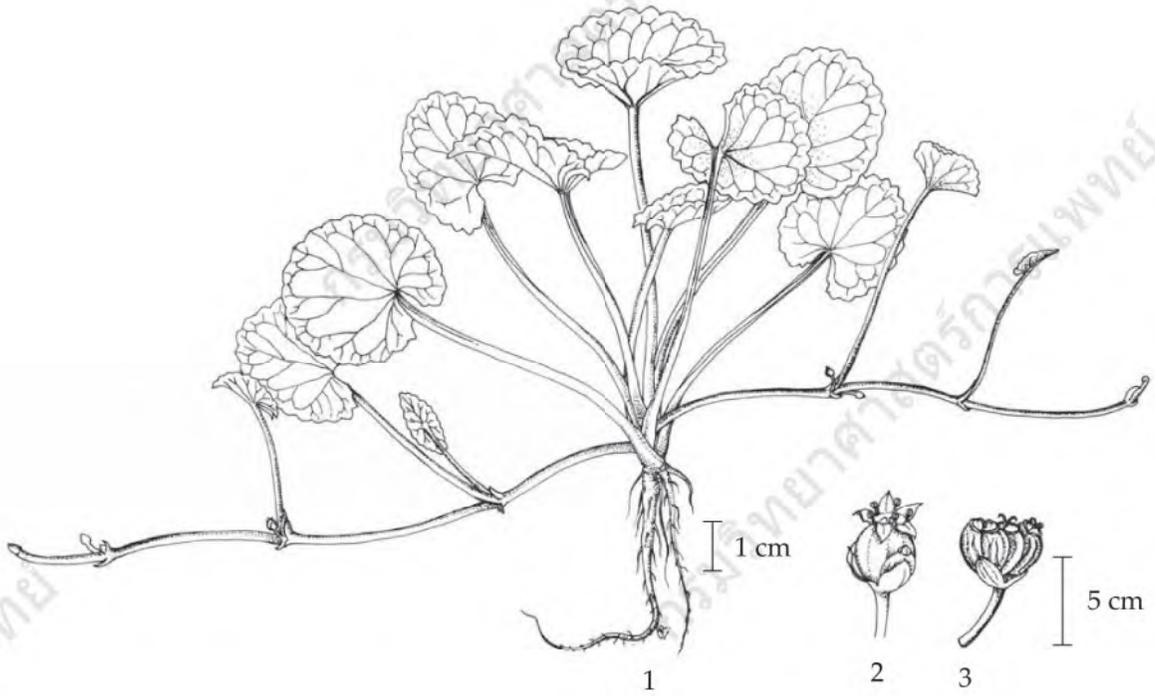
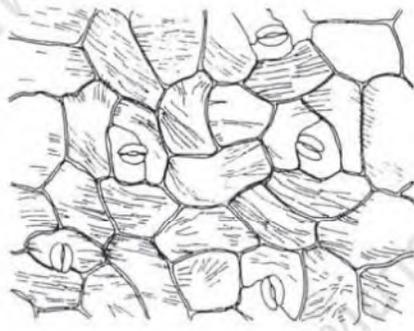
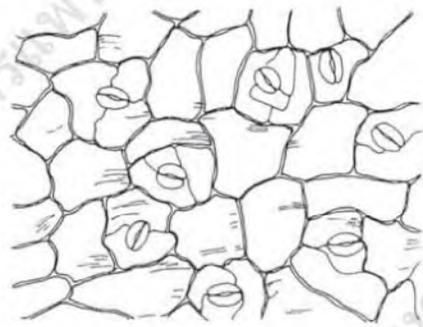


Fig. 1b *Centella asiatica* (L.) Urb.
1. habit 2. inflorescence 3. fruits



50 μm

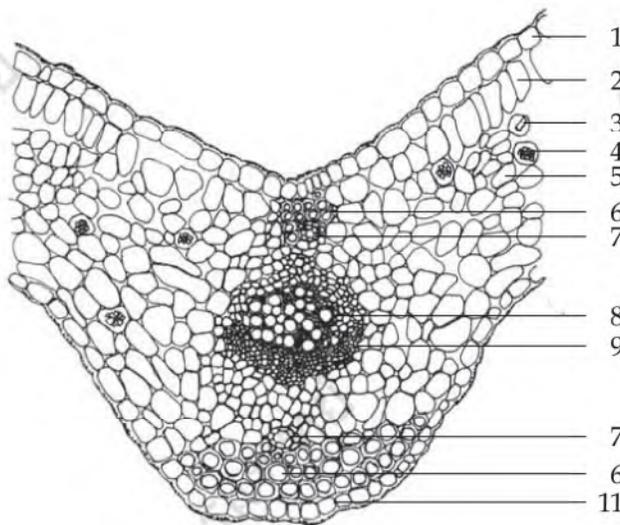
Upper Epidermis of the Lamina



50 μm

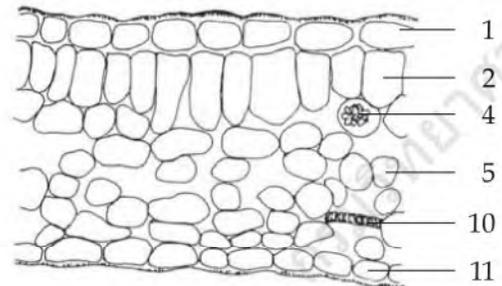
Lower Epidermis of the Lamina

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



100 μm

Transverse Section of the Midrib

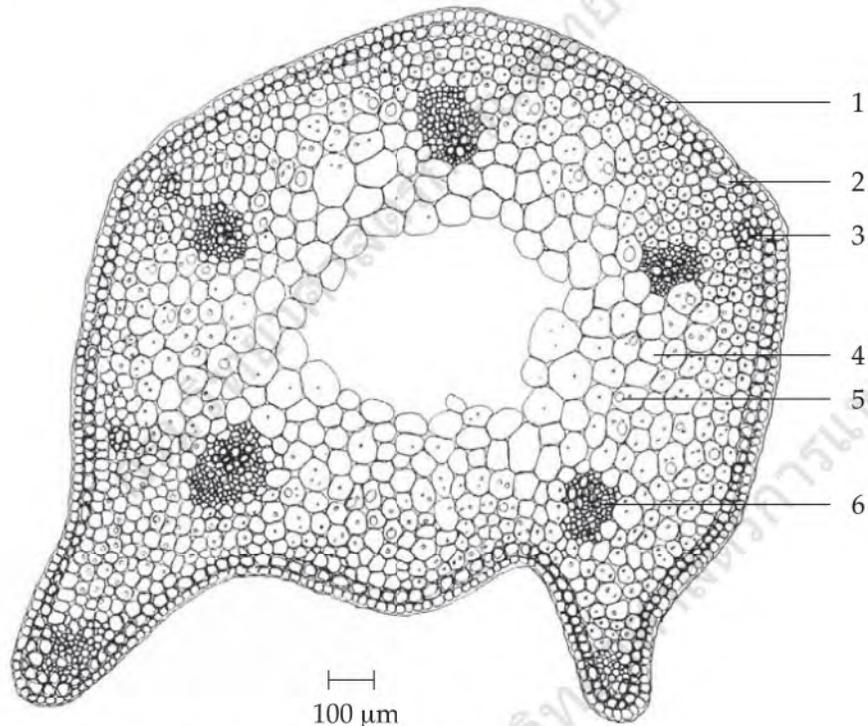


100 μm

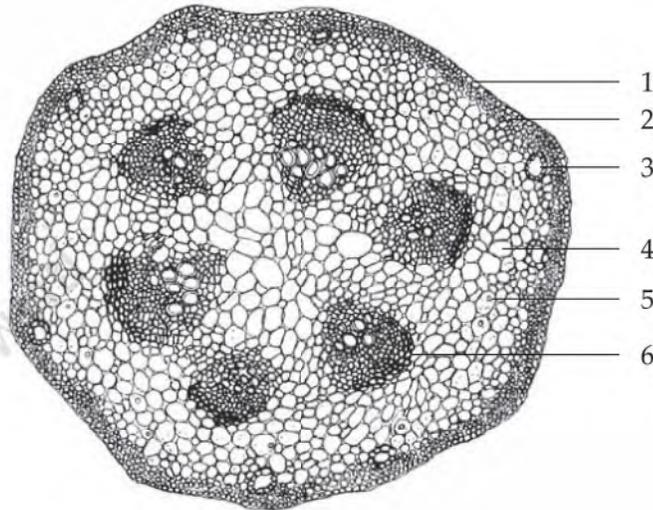
Transverse Section of the Lamina

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

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



Transverse Section of the Petiole



Transverse Section of the Stolon

Fig. 2c Line Drawings of 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

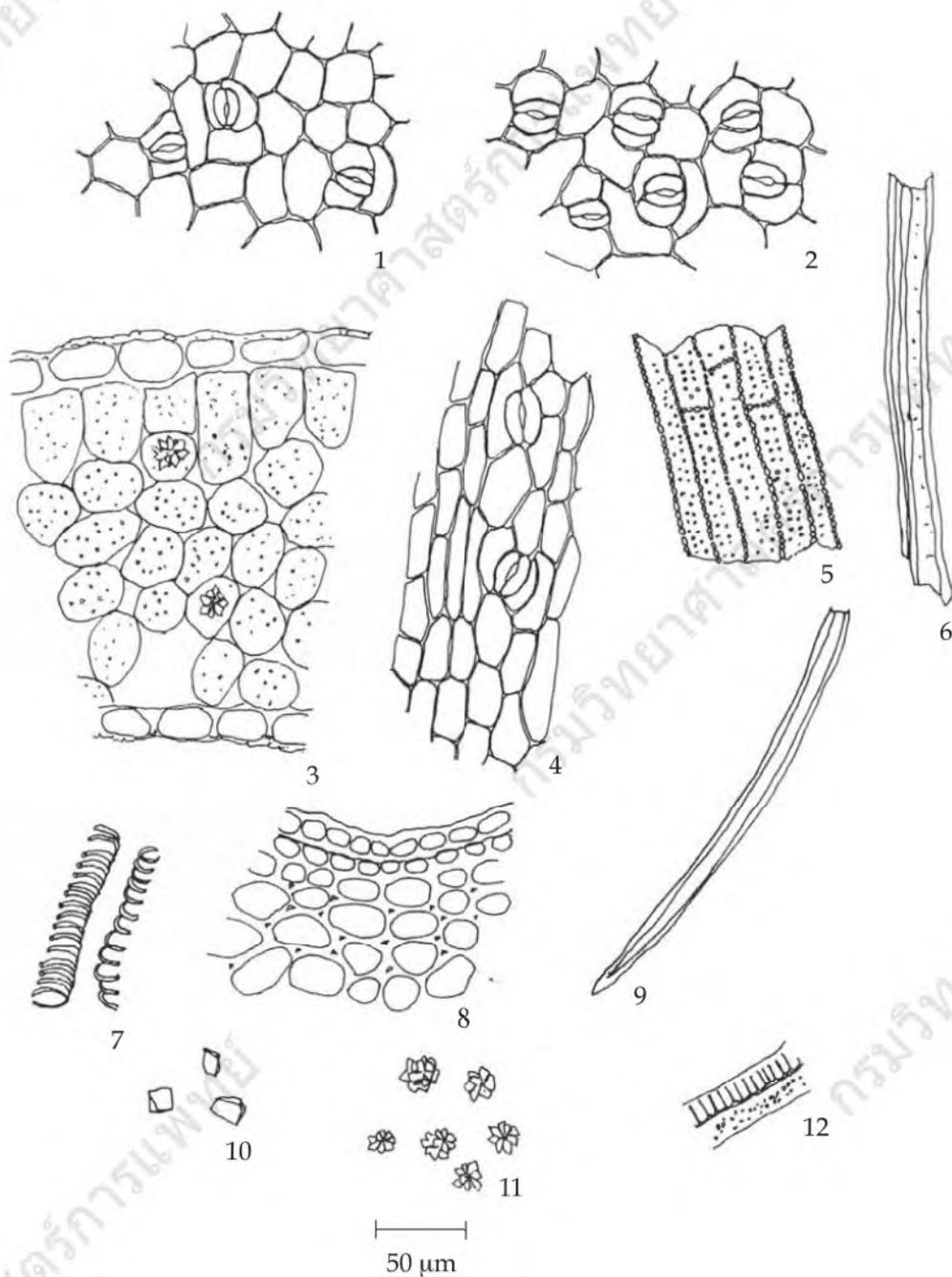


Fig. 2d Line Drawings of Powdered Drug of the Aerial Parts of *Centella asiatica* (L.) Urb.

- | | |
|---|--|
| 1. upper epidermis | 7. spiral vessels |
| 2. lower epidermis | 8. epidermis and collenchyma,
in sectional view |
| 3. lamina in sectional view | 9. unicellular trichome |
| 4. epidermis with stomata
from petiole | 10. prismatic crystals |
| 5. pitted vessels | 11. rosette aggregate crystals |
| 6. fibres | 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 a high-performance plate with *silica gel GF254* as the coating substance and a mixture of 60 volumes of *dichloromethane*, 28 volumes of *methanol*, and 12 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 8 mm, 3 μ L each of the following solutions. Prepare solution (A) by refluxing 500 mg of the sample, in powder, with 10 mL of *ethanol* for 10 minutes and filtering. Evaporate the filtrate under reduced pressure at 40° until dry and dissolve the residue in 4 mL of *ethanol*. For solution (B), dissolve 1 mg of *madecassoside* in 1 mL of *ethanol*. For solution (C), dissolve 1 mg of *asiaticoside* in 1 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 3 minutes. The chromatogram obtained from solution (A) shows a yellowish brown band (hR_f value 12 to 18) and a blue band (hR_f value 20 to 26) corresponding to the madecassoside and asiaticoside bands from solutions (B) and (C), respectively. Ten violet, two yellowish brown, and one blue bands are also observed (Fig. 3).

E. The chromatogram of the Sample preparation shows several peaks, two of which correspond to the asiaticoside and madecassoside peaks of the Standard preparations, as obtained in the *Contents of asiaticoside and madecassoside*.

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).

Contents of asiaticoside and madecassoside Not less than 3.0 per cent w/w for the sum of asiaticoside and madecassoside, calculated on the dried basis. Carry out the determination as described in the “Liquid Chromatography” (Appendix 3.5).

Mobile phase A Use *acetonitrile*.

Mobile phase B Use *water*.

Standard preparation A Dissolve a suitable quantity of *asiaticoside*, accurately weighed, in sufficient *methanol* to obtain a stock solution having a known concentration of about 250 µg of asiaticoside per mL. Dilute the solution quantitatively and stepwise with the same solvent to obtain six solutions having known concentrations ranging from 10 to 60 µg per mL.

Standard preparation B Dissolve a suitable quantity of *madecassoside*, accurately weighed, in sufficient *methanol* to obtain a stock solution having a known concentration of about 300 µg of madecassoside per mL. Dilute the solution quantitatively and stepwise with the same solvent to obtain six solutions having known concentrations ranging from 30 to 180 µg per mL.

Sample preparation Transfer about 200 mg of *Centella*, in *coarse powder*, accurately weighed, into a 50-mL round-bottomed flask and add 25 mL of *methanol*. Heat under a reflux condenser for 1 hour, filter into a 50-mL volumetric flask, and add the same solvent to volume. Filter through a membrane having a 0.22-µm porosity.

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 0.6 mL per minute, and (c) an ultraviolet photometer set at 205 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	15	85
1.5	60	40
2	0	100
3	0	100
4	15	85

To determine the suitability of the chromatographic system, chromatograph *Standard preparation A* and *Standard preparation B* having known concentrations of 30 µg per mL of asiaticoside and 90 µg per mL of madecassoside, respectively, and record the peak responses as directed under *Procedure* and *Calculation*: the relative standard deviation for replicate injections is not more than 2.0 per cent.

Procedure Separately inject equal volumes (about 4 µL) of *Standard preparation A* and *Standard preparation B* into the chromatograph, record the chromatograms, and measure the responses for asiaticoside and madecassoside peaks. Plot the readings and draw the standard curves of best fit: the curves show the correlation coefficient of not less than 0.999. Inject about 4 µL of *Sample preparation* into the chromatograph, record the chromatogram, and measure the responses for asiaticoside and madecassoside peaks.

Calculation By reference to the standard curves, calculate the sum of asiaticoside (C₄₈H₇₈O₁₉) and madecassoside (C₄₈H₇₈O₂₀) contents, in the portion of the *Centella* taken.

Dose 0.6 g three times a day.

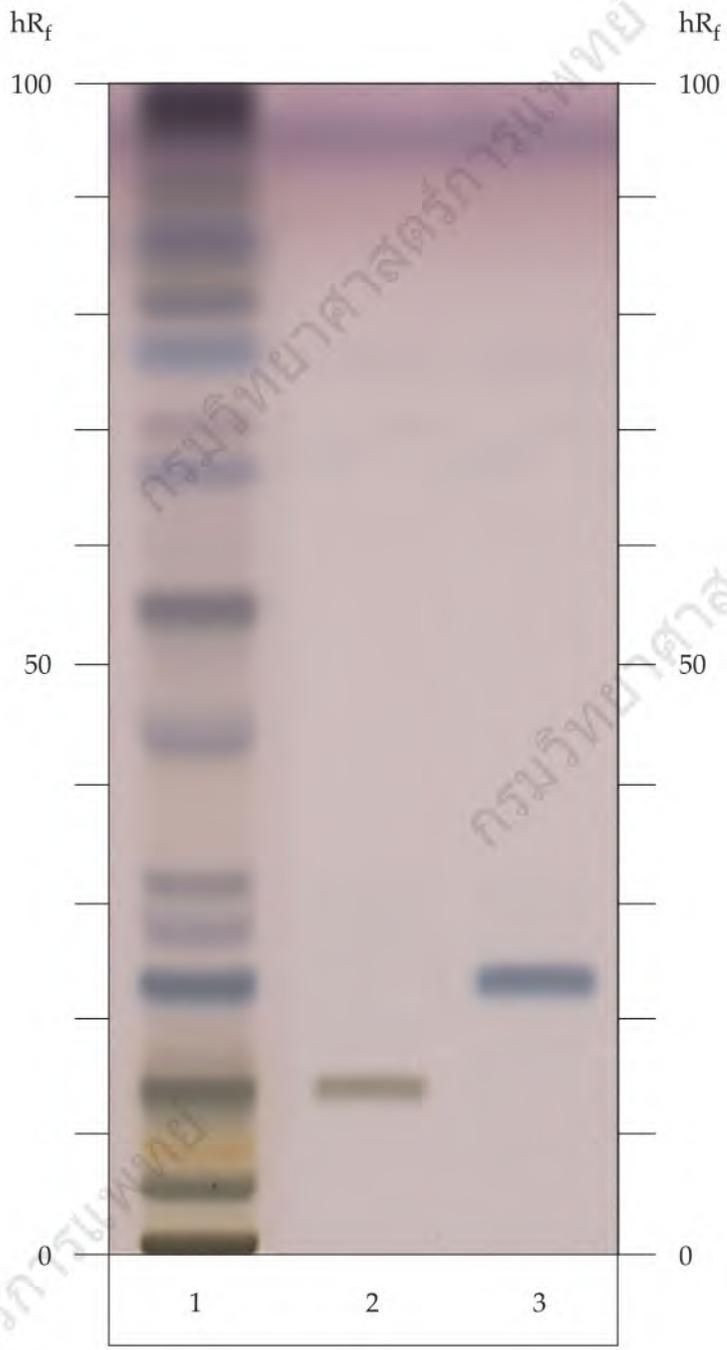


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Aerial Parts of *Centella asiatica* (L.) Urb., Detected with *Anisaldehyde TS*

- 1 = solution (A)
- 2 = solution (B)
- 3 = solution (C)

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. The Thai name consists of the name of the herbal drug or the other Thai name related to the herbal drug. It is transcribed into English according to the Royal Institute’s official transliteration system and printed with capital letters. Subsidiary titles, where applicable, include the Thai Latin genitives of plants, English common name(s), and English synonym(s).

In the text, English common names are generally used in place of the main titles. If no common name is available, English names derived from the Latin genitives of plants are used instead. All titles–main, subsidiary, synonyms, and 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),

¹Rules 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 markers¹. 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.

¹Constituent(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

Unless otherwise indicated, the test procedures are provided in the “Limit Tests for Heavy Metals in Herbal Drugs and Herbal Drug Preparations” (Appendix 5.2).

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.

In a dry place means a place where its relative humidity should be between 40 and 60 per cent. If necessary, air conditioners and dehumidifiers should be installed.

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 -10° but not higher than 8° . A *refrigerator* is a very cold place in which the temperature is maintained thermostatically between 2° and 8° .

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

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

MONOGRAPHS

เจตมูลเพลิงขาว, ราก (CHETTAMUN PHLOENG KHAO, RAK)

ปัดปัวขาว, ราก (PIT PIO KHAO, RAK)

Plumbago Zeylanicae Radix

White Leadwort Root

Synonyms Ceylon Leadwort Root, Doctorbush Root, Wild White Plumbago Root, White-Flowered Leadwort Root

Category Stomachic.

White Leadwort Root is the dried root of *Plumbago zeylanica* L. (*Findlaya alba* Bowdich, *Plumbago lactea* Salisb., *P. scandens* L., *P. viscosa* Blanco, *Thela alba* Lour.) (Family Plumbaginaceae), Herbarium Specimen Number: DMSC 5249, Crude Drug Number: DMSc 1247.

Constituents White Leadwort Root contains naphthoquinones (e.g., chitranone and plumbagin), alkaloids, coumarins, flavonoids, etc.

Description of the plant (Fig. 1) Herb or shrub up to 3 m tall; stem scandent or erect, cylindric, dark green, smooth, much branched. Leaves simple, alternate, ovate to ovate-oblong, 2.7 to 13 cm long, 1.2 to 5.8 cm wide, apex acute, acuminate, or mucronate, base obtuse or cuneate, margin entire, blade thin, glabrous, with whitish or greyish dots scattered on lower surface; petiole up to 1.5 cm long, with dilated amplexicaul base, occasionally auriculate. Inflorescences racemose, terminal, up to 30 cm long, usually branched; peduncle green, covered with sessile glandular hairs; rachis 2 to 8 cm long with glands; bract triangular to ovate, 0.3 to 1 cm long, 1.5 to 2.5 mm wide, apex acuminate, often with sessile glandular hairs outside. Flowers 3 to 70, 1 to 1.5 cm in diameter: calyx oblong, 0.9 to 1.2 cm long, tube short, about 2 mm in diameter, 5-ribbed, glandular, producing sticky exudate, lobes 5, narrowly triangular, 7.5 to 8 mm long, 0.8 to 1.2 mm wide; corolla white to bluish white, tube 1.1 to 2.3 cm long, lobes 5, obovate, 6.5 to 8 mm long, 2.7 to 3.5 mm wide; stamens 5, as long as corolla tube, filament free, about 1.2 mm long; anther oblong, about 1.3 mm long, violet; ovary superior, elliptic, 5-loculed, short-stalked, style glabrous. Fruit a capsule, horizontally dehiscent when mature, oblong, with 5 longitudinally furrows, pale yellow to brown, with remaining calyx. Seed 1, about 7 mm long, about 1.5 mm wide, apex acute, red-brown.

Description Odour, mild and characteristic; taste, spicy.

Macroscopical (Fig. 1) Roots, varied in length, 1 to 5 mm in diameter, somewhat twisted, longitudinally grooved, brown.

Microscopical (Figs. 2a, 2b) Transverse section of the root shows periderm, cortex, and vascular tissue. Periderm: several layers of rectangular cork cells, some containing brown substances. Cortex: parenchyma, containing numerous starch grains, some containing brown substances. Vascular tissue: phloem and xylem; phloem comprising phloem rays, phloem fibres, and phloem parenchyma, containing numerous starch grains, some containing brown substances; xylem comprising xylem rays (some containing starch grains), xylem fibres, xylem parenchyma, some containing brown substances, and vessels.

White Leadwort Root in powder possesses the diagnostic microscopical characters of the unground drug. The combination of ray cells containing numerous starch grains, cork, fibres, and starch grains is commonly seen.



1



2



3



4



┆
1 cm

5

Fig. 1 *Plumbago zeylanica* L.

1. habit 2. inflorescences 3. flowers 4. fruits enclosed in persistent calyces 5. crude drug

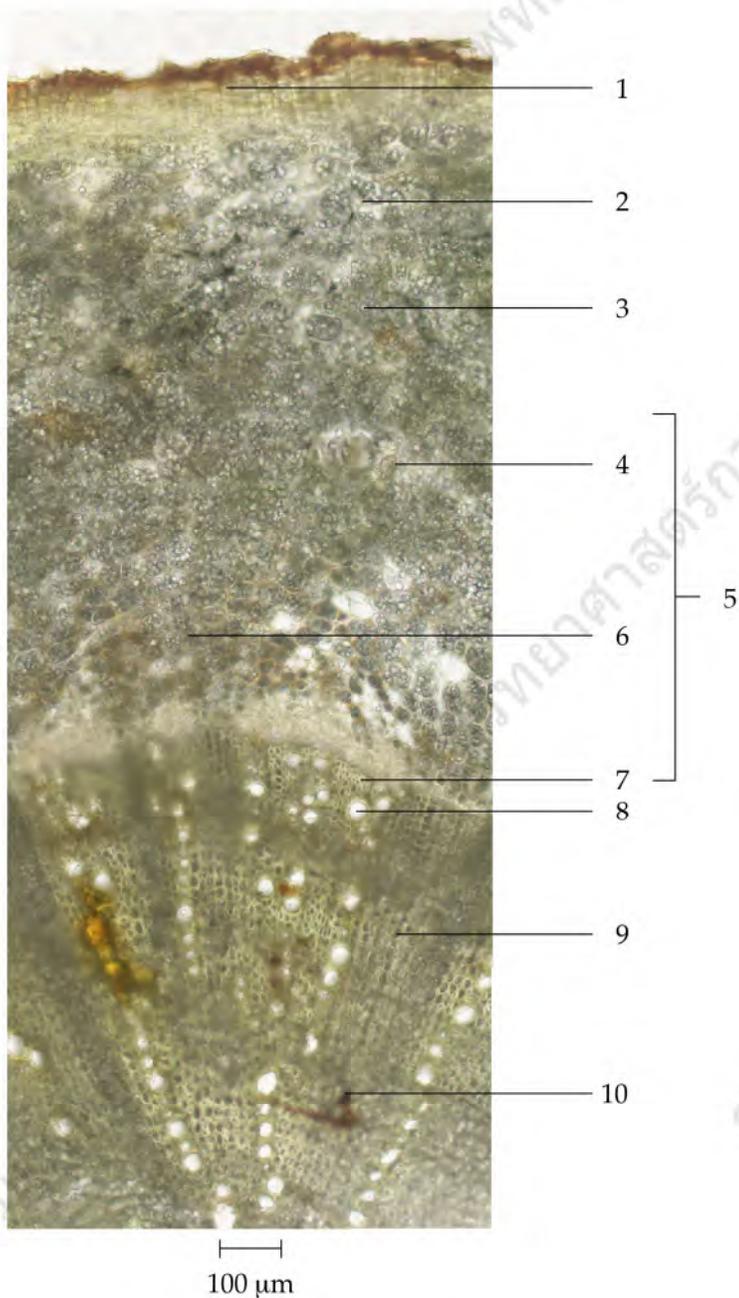


Fig. 2a Photomicrograph of Transverse Section of the Root of *Plumbago zeylanica* L.

- | | |
|--|---------------------|
| 1. cork | 6. phloem ray |
| 2. parenchyma containing starch grains | 7. xylem fibre |
| 3. starch grain | 8. vessel |
| 4. phloem fibre | 9. xylem ray |
| 5. phloem | 10. brown substance |

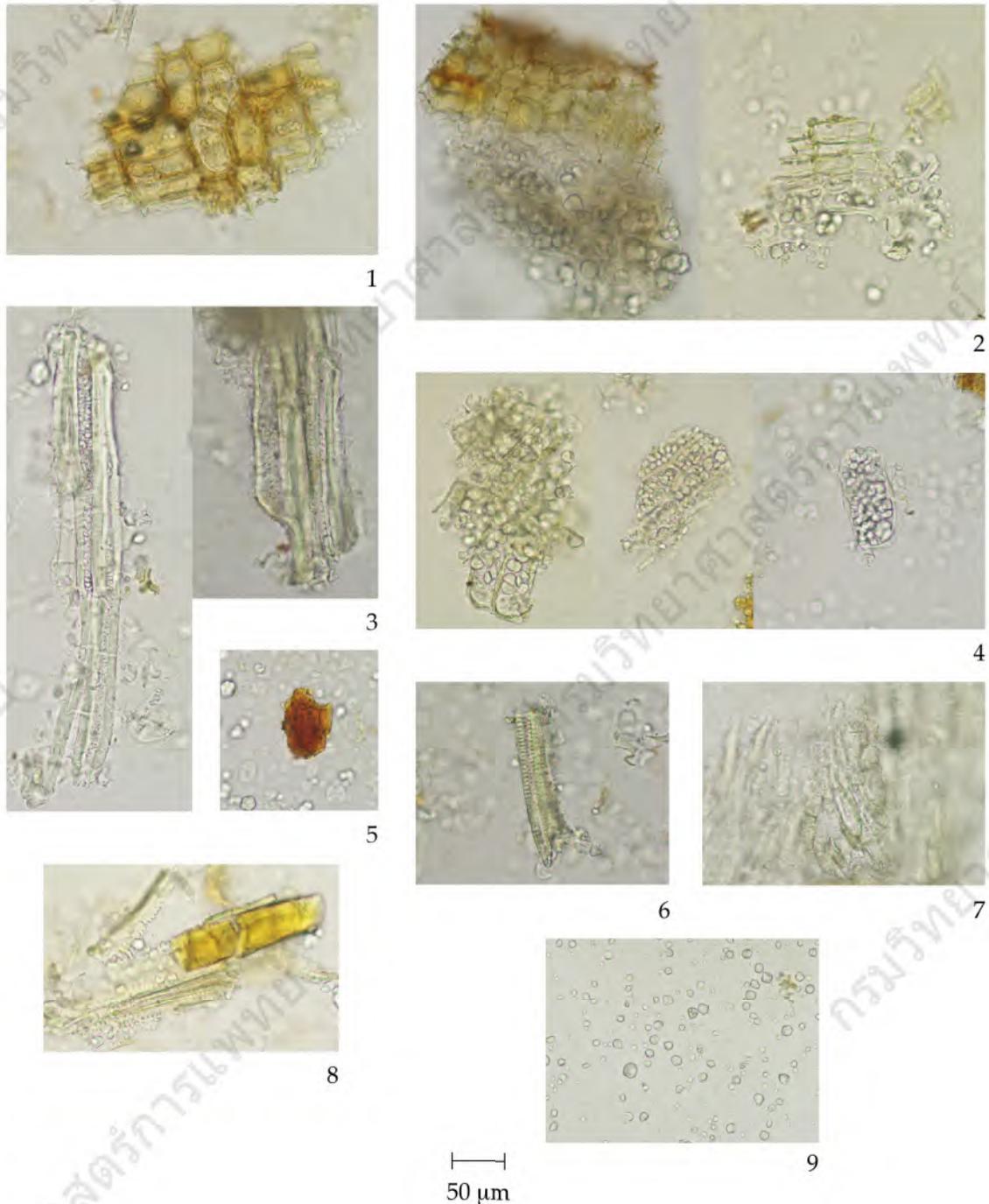


Fig. 2b Photomicrographs of Powdered Drug of the Roots of *Plumbago zeylanica* L.

1. cork with brown substances in surface view
2. cork with brown substances and parenchyma containing starch grains, in sectional view
3. parenchyma, some containing starch grains, and fibres
4. parenchyma containing starch grains
5. brown substance
6. fragment of bordered-pitted vessels and xylem parenchyma
7. xylem ray cells and parenchyma, in tangential longitudinal view
8. vessels with brown substance associated with fibres and parenchyma
9. simple and compound starch grains

Contra-indication It is contra-indicated in pregnant women since it may cause miscarriage.

Packaging and storage White Leadwort Root 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 *fine powder*, with 10 mL of *methanol* for 30 minutes and filter. To 2 mL of the filtrate, add a few drops of *ammonia TS*: a pink 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 90 volumes of *toluene* 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 5 mm, 10 μ L of solution (A) and 2 μ L of solution (B). Prepare solution (A) by macerating 1 g of the sample, in *fine powder*, with 5 mL of *methanol* for 30 minutes and filtering. For solution (B) dissolve 1 mg of *plumbagin* in 4 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 80 to 85) corresponding to the *plumbagin* band from solution (B); other two quenching bands are also observed. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; a band due to *plumbagin* is red fluorescent. One green, one blue, and one red fluorescent bands are also observed. Expose the plate to ammonia vapour; the band due to *plumbagin* is orange and another purple band is also observed (Fig. 3).

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).

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

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

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

Ethanol-soluble extractive Not less than 17.0 per cent w/w (Appendix 7.12).

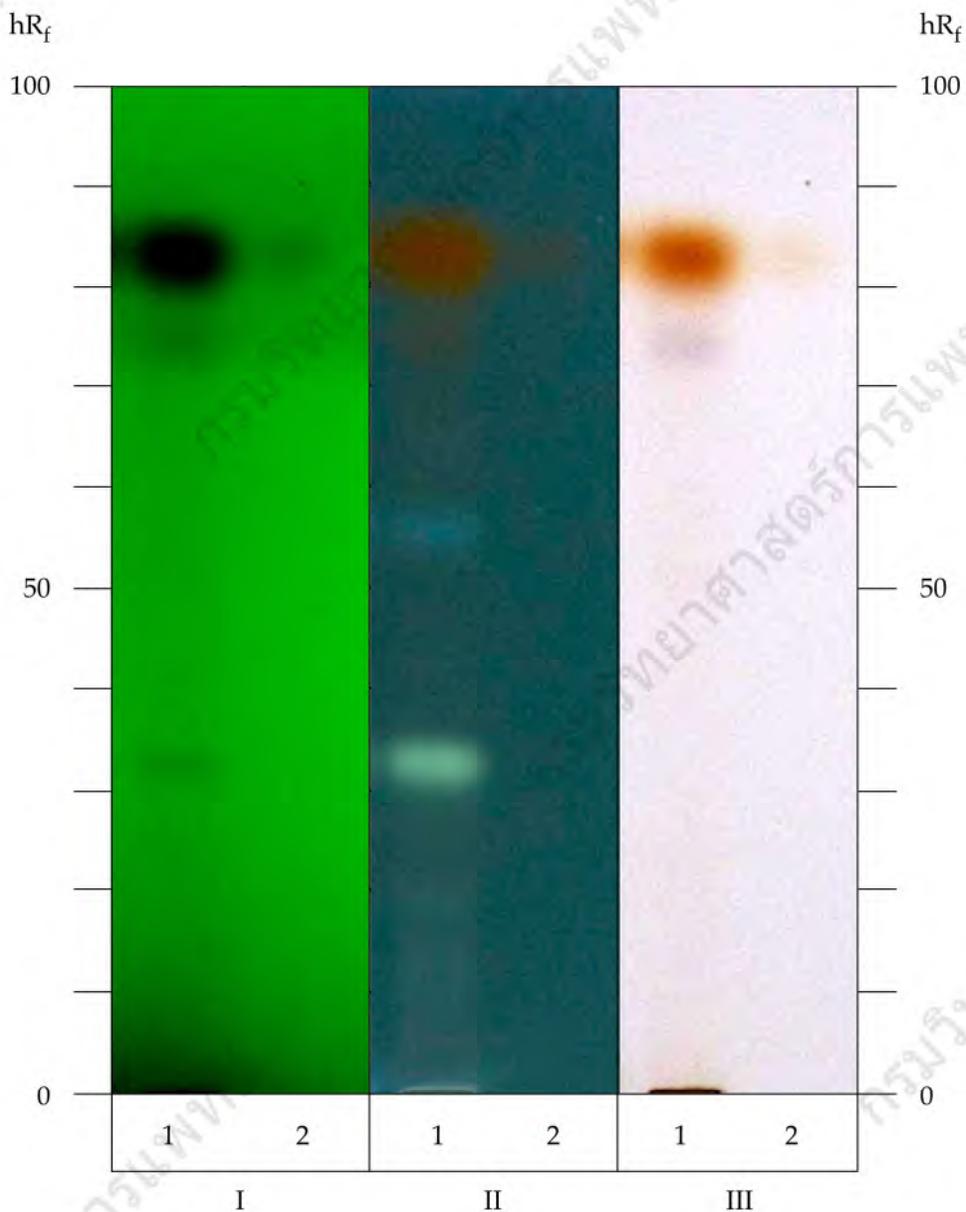


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Roots of *Plumbago zeylanica* L.

1 = solution (A)

2 = solution (B)

I = detection under UV light (254 nm)

II = detection under UV light (366 nm)

III = detection with ammonia vapour

เจตมูลเพลิง, ราก (CHETTAMUN PHLOENG, RAK)

เจตมูลเพลิงแดง, ราก (CHETTAMUN PHLOENG DAENG, RAK), ไฟใต้ดิน, ราก (FAI TAI DIN, RAK),

ปัดบัวแดง, ราก (PIT PIO DAENG, RAK)

Plumbago Indicae Radix

Indian Leadwort Root

Synonyms Rose-Coloured Leadwort Root, Scarlet Leadwort Root, Whorled Plantain Root

Category Stomachic.

Indian Leadwort Root is the dried root of *Plumbago indica* L. (*P. rosea* L., *Thela coccinea* Lour.) (Family Plumbaginaceae), Herbarium Specimen Number: DMSC 5248, Crude Drug Number: DMSc 0978.

Constituents Indian Leadwort Root contains naphthoquinones (e.g., plumbagin), flavonoids, etc.

Description of the plant (Fig. 1) Perennial herb, up to 2 m tall; stem erect or scandent, branching from base; young shoot reddish or reddish green; bark smooth; root woody, tan outside, whitish inside. Leaves simple, alternate or fascicled, narrowly ovate, elliptic-ovate or elliptic, 4 to 16.5 cm long, (0.8–)2 to 7.6 cm wide, apex obtuse to acute, often mucronate, base rounded to obtuse, margin entire, papery, often twisted; petiole and rachis reddish when young, glandular hairs. Inflorescence spicate-racemose, terminal, up to 50 cm long, hardly branched; peduncle 1 to 3 cm long; rachis (8–)10 to 40(–50) cm long, glabrous; bract ovate, 2 to 4.5 mm long, 1.2 to 2 mm wide, apex acuminate; bracteole ovate to elliptic, 2 to 3 mm long, 1.2 to 2 mm wide, apex acute. Flowers (20–)35 to 90: calyx red, tube oblong, about 1 cm long, about 2 mm wide, stalked sticky glandular hairs, lobes 5, narrowly triangular, about 8 mm long, about 1 mm wide; corolla pinkish, bright red, or dark red, tube 2 to 3.5 cm long, about 2 cm wide, lobes 5, obovate, about 1 cm long, about 7 mm wide, apex rounded and mucronate; stamen attached to upper part of corolla tube, free part of filament about 1 mm long, light pink, anther oblong, about 2 mm long; ovary superior, ellipsoid-ovoid, indistinctly angular, 1-locular with 1 ovule, style basally hairy, stigmas 5, with small capitate papillae above. Fruit a capsule, ellipsoid, included in persistent calyx and (often twisted) corolla, pericarp thin, circumscissile near base. Seed 1.

Description Odour, characteristic; taste, bitter and spicy.

Macroscopical (Fig. 1) Roots, varied in length, 1 to 4 mm in diameter, occasionally with rootlets; longitudinally wrinkled, dark brown to blackish brown.

Microscopical (Figs. 2a, 2b) Transverse section of the root shows periderm, cortex, and vascular tissue. Periderm: rectangular cork cells, some containing brown substances. Cortex: collenchyma and thin-walled parenchyma, some containing yellow substances and/or brown substances. Vascular tissue: phloem and xylem; phloem comprising phloem rays, and phloem parenchyma, some containing yellow substances and/or brown substances; xylem comprising xylem rays, xylem fibres, xylem parenchyma, some containing brown substances, and vessels.

Indian Leadwort Root in powder possesses the diagnostic microscopical of the unground drug. Collenchyma associated with cork and fibre with several connecting pores can be unique in characters.



Fig. 1 *Plumbago indica* L.

1. habit 2. part of inflorescence 3. flowers 4. crude drug

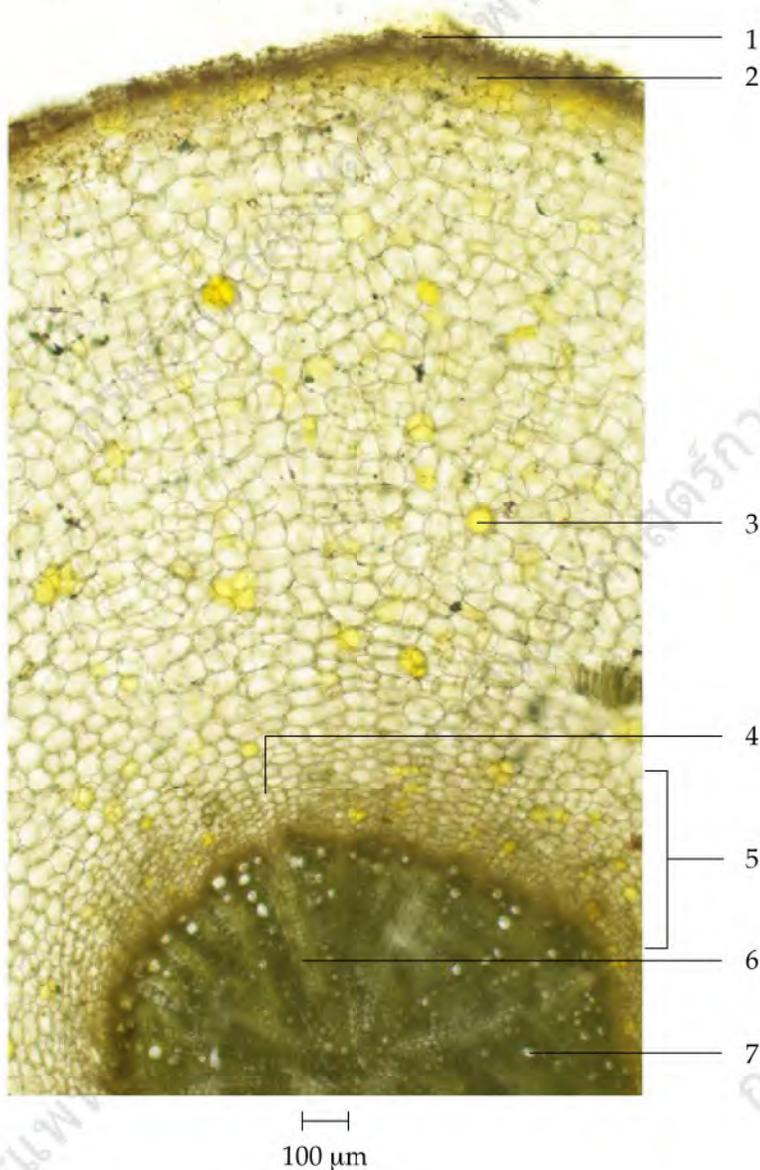


Fig. 2a Photomicrograph of Transverse Section of the Root of *Plumbago indica* L.

- | | |
|-------------------------------------|------------------|
| 1. cork | 4. phloem ray |
| 2. collenchyma | 5. phloem tissue |
| 3. parenchyma with yellow substance | 6. xylem ray |
| | 7. vessel |

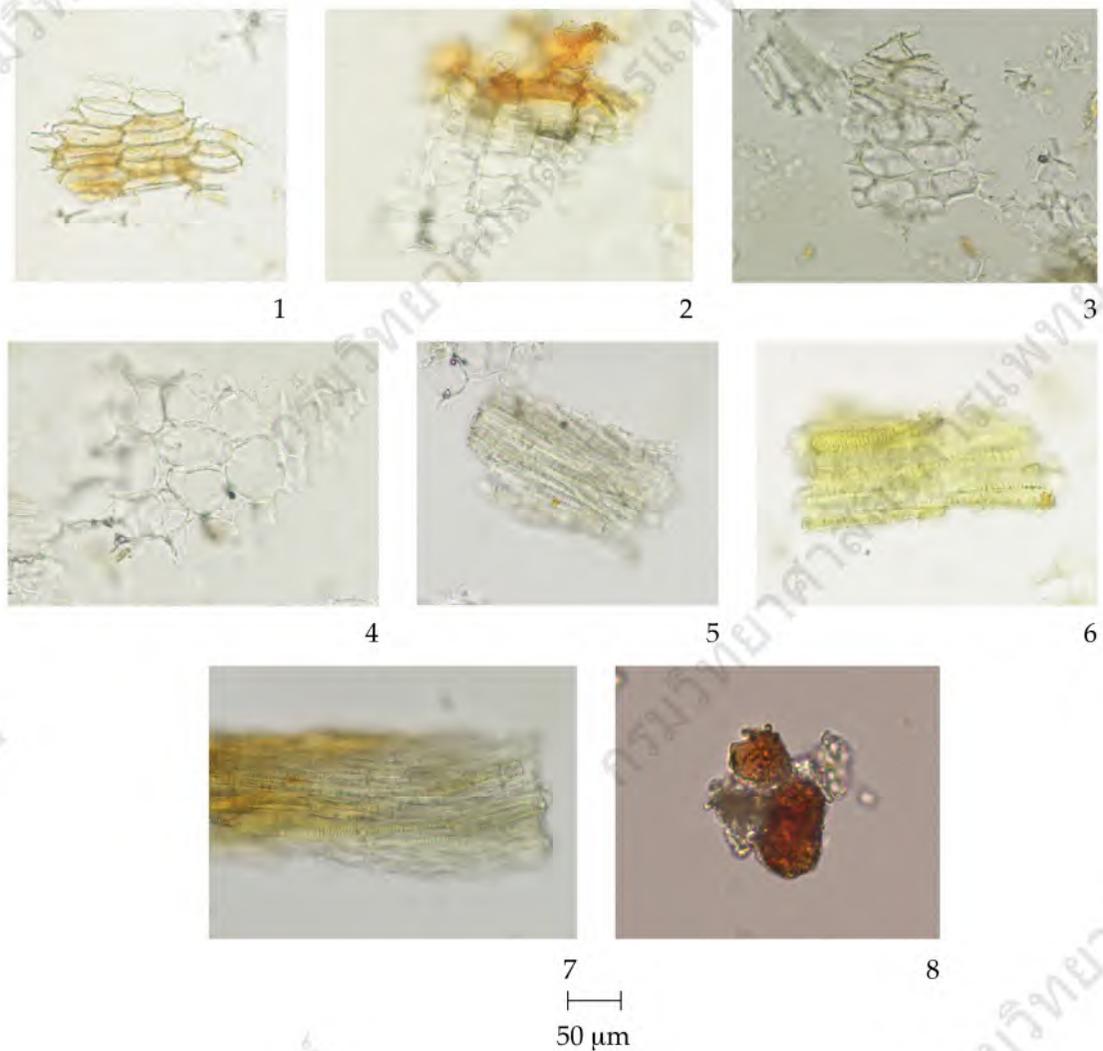


Fig. 2b Photomicrographs of Powdered Drug of the Roots of *Plumbago indica* L.

- | | |
|---|--|
| 1. cork in surface view with brown substances | 4. parenchyma |
| 2. cork with brown substances, collenchyma, and parenchyma, in sectional view | 5. fragment of fibres |
| 3. cork and collenchyma | 6. parenchyma and pitted vessels |
| | 7. xylem parenchyma, fibres, and reticulate and pitted vessels |
| | 8. parenchyma containing brown substances |

Contra-indication It is contra-indicated in pregnant women since it may cause miscarriage.

Packaging and storage Indian Leadwort Root 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 *fine powder*, with 10 mL of *methanol* for 30 minutes and filter. To 2 mL of the filtrate, add a few drops of *ammonia TS*: a pink 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 90 volumes of *toluene* 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 5 mm, 10 μ L of solution (A) and 2 μ L of solution (B). Prepare solution (A) by macerating 1 g of the sample, in *fine powder*, with 5 mL of *methanol* for 30 minutes and filtering. For solution (B) dissolve 1 mg of *plumbagin* in 4 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 67 to 71) corresponding to the *plumbagin* band from solution (B); other three quenching bands are also observed. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; a band due to *plumbagin* is red fluorescent. One green, three blue, and three red fluorescent bands are also observed. Expose the plate to ammonia vapour; the band due to *plumbagin* is purple and two purple bands are also observed (Fig. 3).

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).

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).

Water-soluble extractive Not less than 22.0 per cent w/w (Appendix 7.12).

Ethanol-soluble extractive Not less than 14.0 per cent w/w (Appendix 7.12).

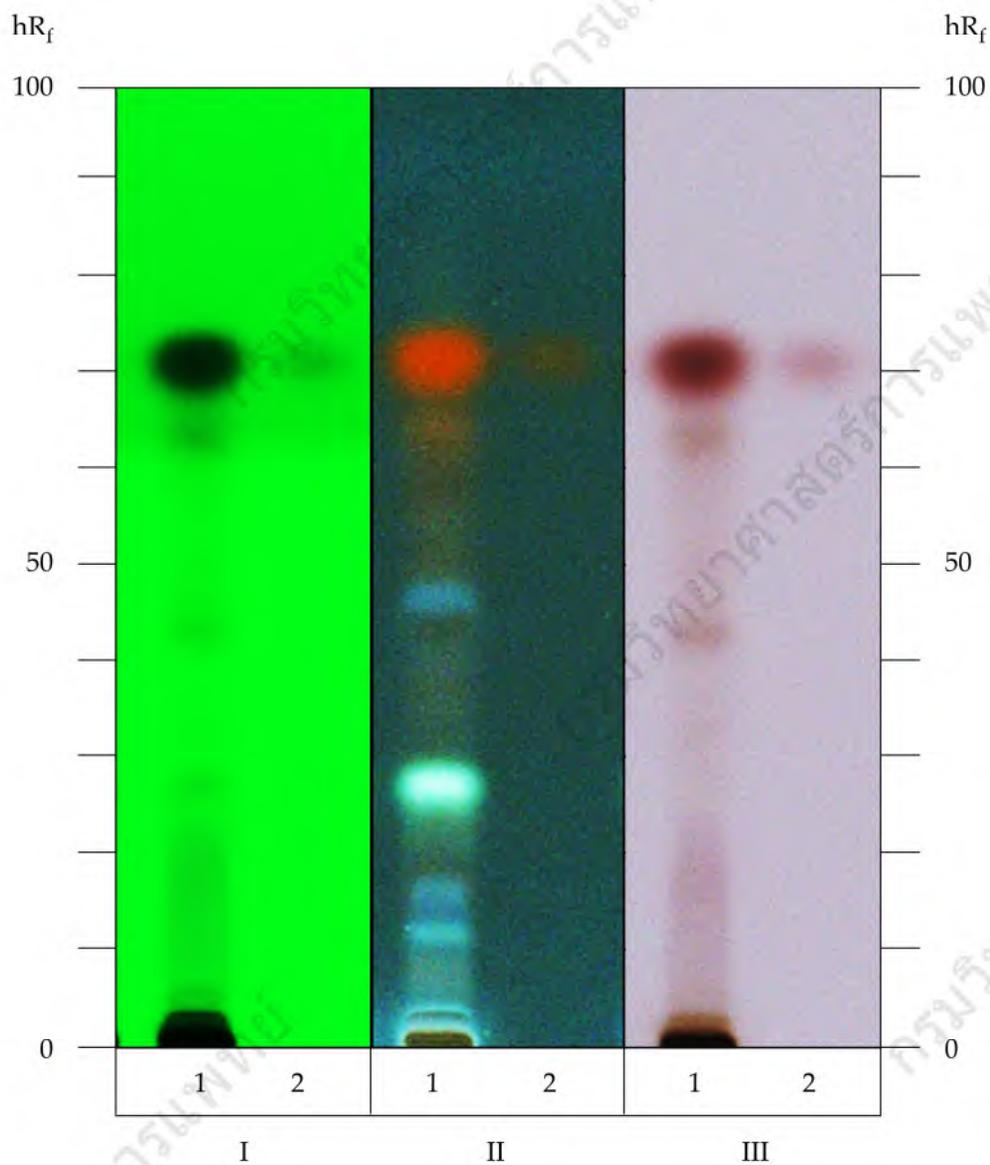


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Roots of *Plumbago indica* L.

1 = solution (A)

2 = solution (B)

I = detection under UV light (254)

II = detection under UV light (366 nm)

III = detection with ammonia vapour

ฝาง, แก่น (FANG, KAEN)

ฝางเสน, แก่น (FANG SEN, KAEN), ฝางส้ม, แก่น (FANG SOM, KAEN)

Biancaee Sappan Lignum

Sappan Wood

Synonyms Indian Redwood, Sappanwood

Category Antidiarrheal, anti-inflammatory, hemodynamic.

Sappan Wood is the dried heartwood of *Biancaea sappan* (L.) Tod. (*Caesalpinia sappan* L.) (Family Leguminosae), Herbarium Specimen Number: DMSC 5286, Crude Drug Number: DMSc 1215.

Constituents Sappan Wood contains homoisoflavonoids (e.g., brazilein, brazilin, haematoxylin). It also contains flavonoids, sterols, etc.

Description of the plant (Fig. 1) Tree or scrambling shrub up to 13 m tall; stem and branch with recurved prickles, conspicuous lenticels. Leaves bipinnately compound, alternate, 20 to 45 cm long; petiole 2.5 to 4 cm long; rachis 15 to 40 cm long, often prickly; pinnae 5 to 18 pairs, opposite, 8 to 12 cm long, leaflets 6 to 20 pairs, opposite, oblong or asymmetrical rhombic, 1 to 2.3 cm long, 0.6 to 1 cm wide, apex round to emarginate, base oblique, margin entire, blade papery, both surfaces glabrous or sparsely hairy; petiolule sessile; stipule 3 to 4 mm long, caducous. Inflorescence paniculate or racemose, axillary or terminal, 10 to 40 cm long; bract lanceolate, 5 to 8 mm long, apex acuminate, hairy, caducous. Flower yellow; pedicel 1.5 to 2 cm long, puberulent or pubescent, jointed near top; sepals 5, imbricate, hood-shaped, 0.7 to 1.2 cm long, 3 to 5 mm wide, unequal, lowest one larger than others, glabrous with ciliate margin; petals 5, broadly ovate to obovate, 0.9 to 1.4 cm long, 0.6 to 1 cm wide, unequal, uppermost one clawed, tinged pink at base, hairy inside towards middle; stamens 10, free, slightly exerted, filament densely pubescent at base; ovary superior, elliptic, pubescent, sessile or shortly stalked, 1-loculed, style slender, hairy, stigma truncate; receptacle shallowly campanulate. Fruit a pod, obliquely oblong, widest towards top, 5 to 12 cm long, 1.5 to 4 cm wide, woody, flattened, apex truncate with prominently beaked, base obtuse, reddish brown to brown when aged, shiny. Seeds 2 to 4, light brown, elliptic-oblong, flattened, 1.5 to 1.8 cm long, 0.8 to 1 cm wide.

Description Odour, mild; taste, slightly bitter.

Macroscopical (Fig. 1) Longitudinal pieces of heartwood, orange-yellowish red to reddish, varied in shape and size; surface, rough.

Microscopical (Figs. 2a–2d) Transverse section of the heartwood shows vessels, axial parenchyma, ray parenchyma, fibres, and pith. Vessel: large, thick-walled cells, scattered, solitary or small cluster of 2 to 3 cells, some containing brown substances. Axial parenchyma: polygonal, thick-walled, arranged circularly around the vessel. Ray parenchyma: 1 to 3 rows, some containing brown substances. Fibre: thick-walled. Pith: parenchyma and sclereids; parenchyma, large, elongated, thin-walled, some containing prismatic crystals and/or brown substances; sclereid, large, elongated, thick- and pitted-walled.

Radial longitudinal section of the heartwood shows vessels, axial parenchyma, ray parenchyma, and fibres. Vessel: large, with bordered-pitted and simple perforation plate, some containing brown substances. Axial parenchyma: elongated, thick-walled cells, some containing prismatic crystals, and/or starch grains, and/or brown substances. Ray parenchyma: multiseriate, thick-walled, rectangular cells, some containing prismatic crystals, and/or brown substances, and/or starch grains. Fibre: thick-walled.

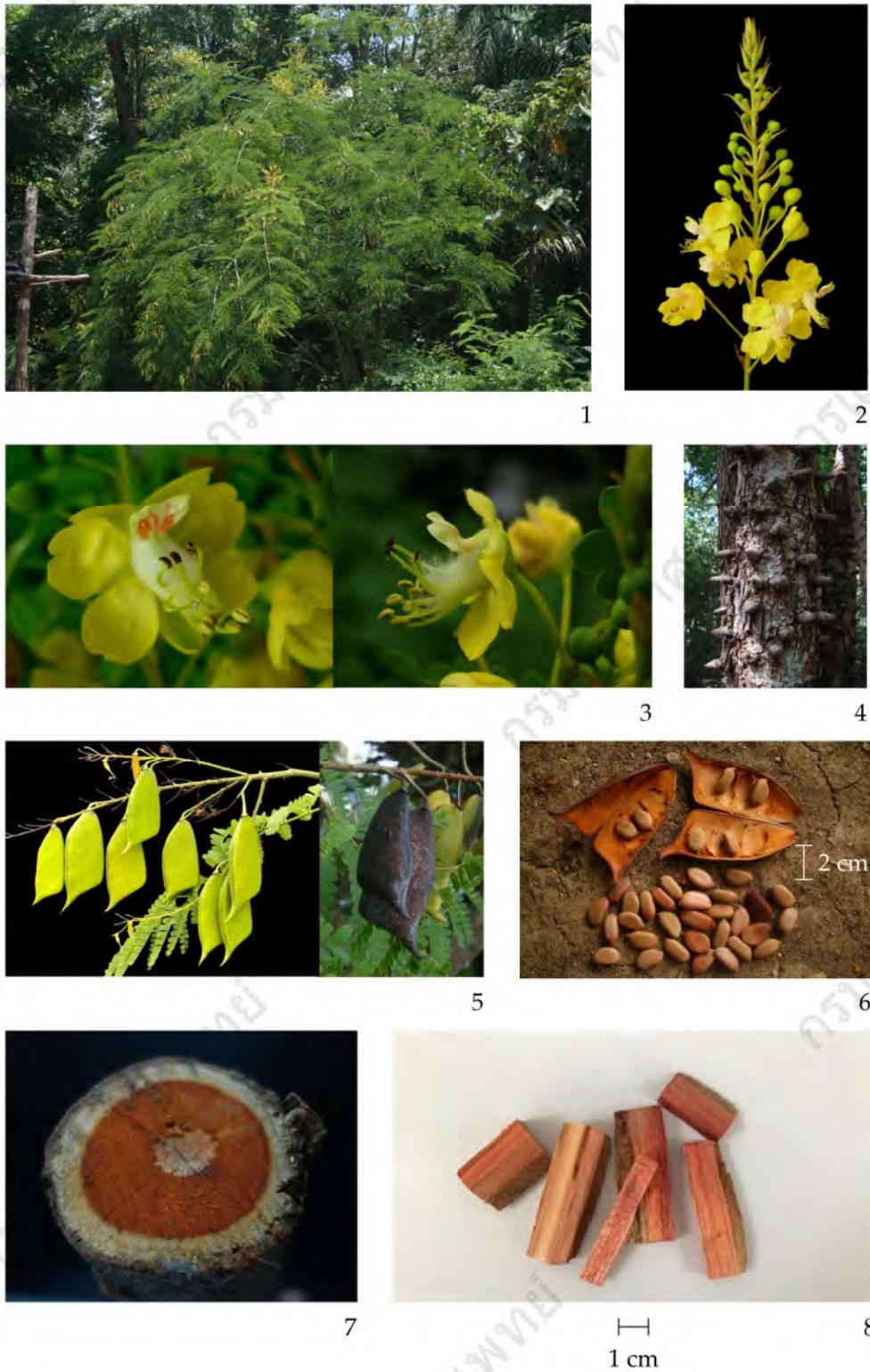


Fig. 1 *Biancaea sappan* (L.) Tod.

1. habit 2. inflorescence 3. flowers 4. stem showing prickles 5. fruits
6. seeds 7. cross section of stem showing bark, sapwood, and heartwood 8. crude drug

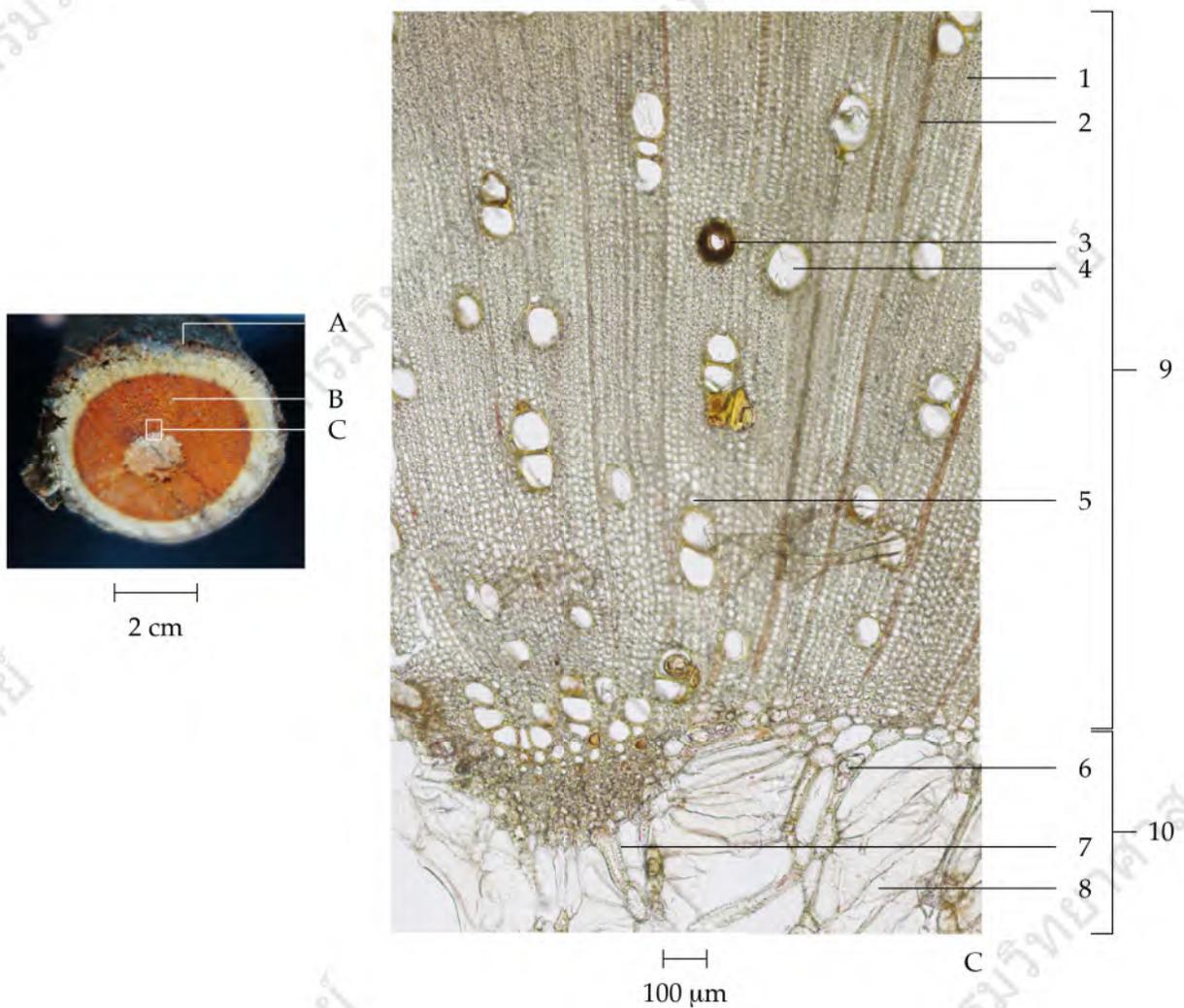


Fig. 2a Photomicrograph of Transverse Section of the Heartwood of *Biancaea sappan* (L.) Tod.

- A. Bark
- B. Heartwood
- C. Heartwood and Pith

- | | |
|---------------------|----------------------|
| 1. fibre | 6. prismatic crystal |
| 2. ray parenchyma | 7. sclereid |
| 3. brown substance | 8. parenchyma |
| 4. vessel | 9. heartwood |
| 5. axial parenchyma | 10. pith |

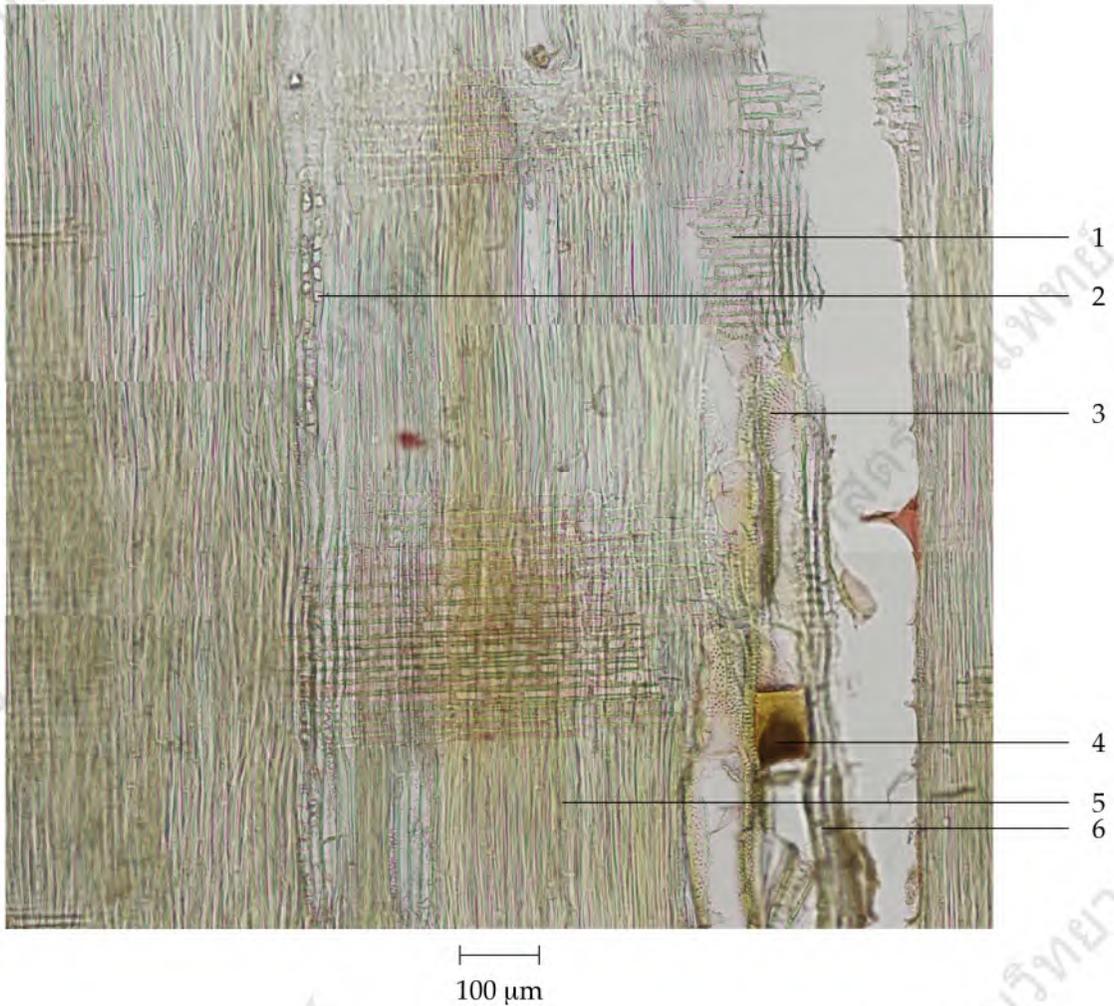


Fig. 2b Photomicrograph of Radial Longitudinal Section of the Heartwood of *Biancaea sappan* (L.) Tod.

- | | |
|---------------------------|---------------------|
| 1. ray parenchyma | 4. brown substance |
| 2. prismatic crystal | 5. fibre |
| 3. bordered-pitted vessel | 6. axial parenchyma |

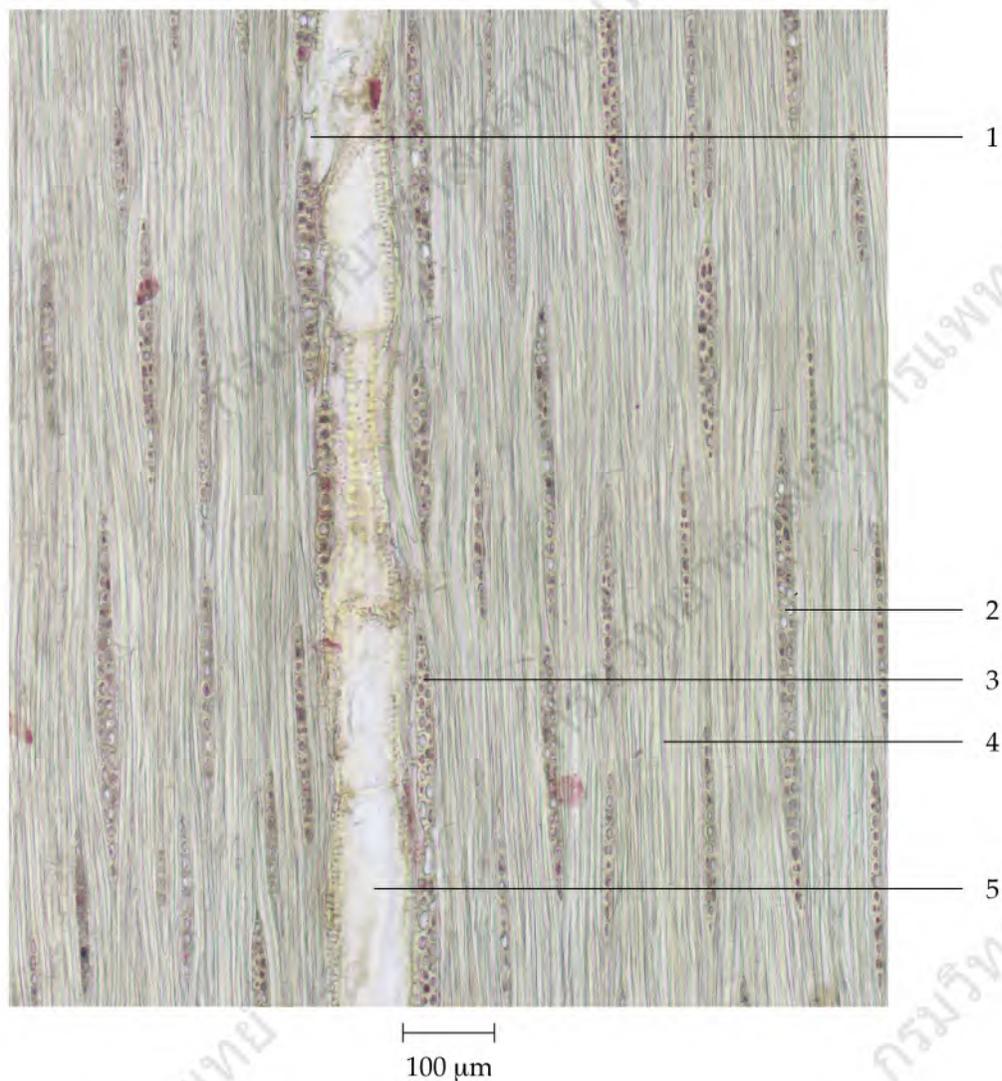


Fig. 2c Photomicrograph of Tangential Longitudinal Section of the Heartwood of *Biancaea sappan* (L.) Tod.

- | | |
|---------------------|-----------|
| 1. axial parenchyma | 4. fibre |
| 2. ray parenchyma | 5. vessel |
| 3. brown substance | |

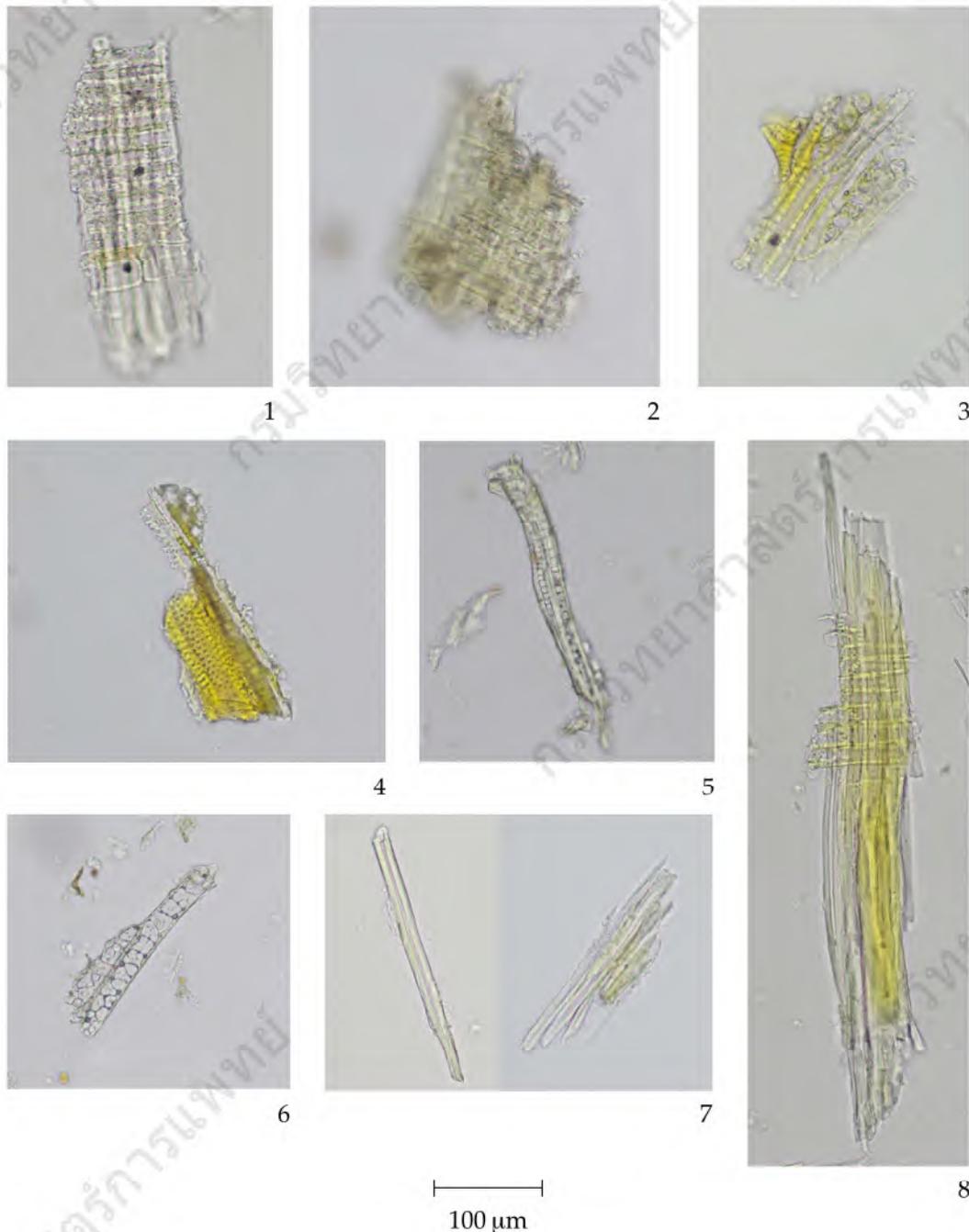


Fig. 2d Photomicrographs of Powdered Drug of the Heartwood of *Biancaea sappan* (L.) Tod.

1. ray parenchyma and underlying fibres, in radial longitudinal view
2. ray parenchyma, some containing starch grains
3. fibres associated with ray parenchyma, containing starch grains, in tangential longitudinal view
4. bordered-pitted vessels associated with axial parenchyma and fibres
5. fragment of fibres containing starch grains and prismatic crystals
6. parenchyma, in longitudinal view, containing starch grains
7. fibres
8. ray parenchyma adjacent to fibres, in radial longitudinal view

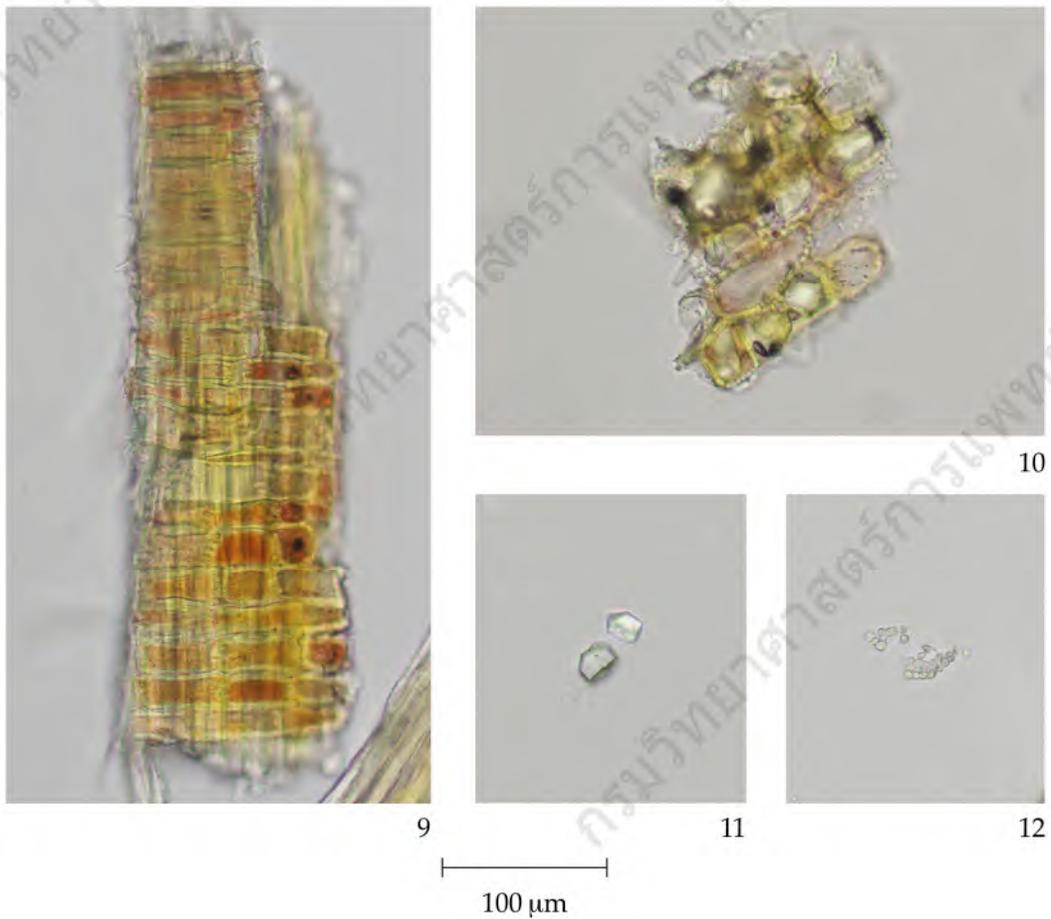


Fig. 2d (continued)

- 9. ray parenchyma, some containing red to brown substances, and underlying fibres, in radial longitudinal view
- 10. sclereids, some containing prismatic crystals, starch grains, and red to brown substances

- 11. prismatic crystals
- 12. starch grains

Tangential longitudinal section of the heartwood shows vessels, axial parenchyma, ray parenchyma, and fibres. Vessel: large, with bordered-pitted and simple perforation plate, some containing brown substances. Axial parenchyma: thick-walled, elongated cells, some containing prismatic crystals, and/or starch grains, and/or brown substances. Ray parenchyma: 1 to 3 rows, thick-walled, oval cells, some containing brown substances. Fibre: thick-walled.

Sappan Wood in powder possesses the diagnostic microscopical characters of the unground drug. Fibres containing starch grains and ray parenchyma containing red to brown substances are characteristics. Various views of ray parenchyma and large bordered-pitted vessels are commonly observed. Starch grains, prismatic crystals, and red to brown substances can also be seen.

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

Identification

A. Macerate 500 mg of the sample, in *fine powder*, with 10 mL of *ethanol* for 5 minutes and filter. To 2 mL of the filtrate, add 2 mL of a 1 per cent w/v solution of *sodium carbonate* and mix: a dark red colour develops.

B. Macerate 100 mg of the sample, in *fine powder*, with 10 mL of *ethanol* for 15 minutes and filter. Mix 2 mL of the filtrate with 2 or 3 pieces of *magnesium ribbon* and a few drops of *hydrochloric acid*: a pink colour develops.

C. The chromatogram of the Sample preparation shows several peaks, one of which corresponds to the brazilin peak of the Standard preparation, as obtained in the *Brazilin* content (Fig. 3).

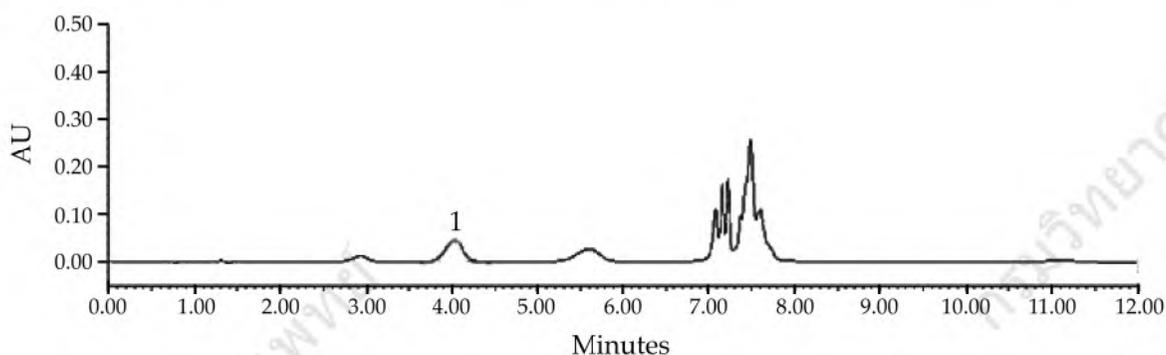


Fig. 3 HPLC Chromatogram of Sappan Wood Showing Brazilin (1)

D. Carry out the test as described in the “Thin-Layer Chromatography” (Appendix 3.1), using a high-performance plate with *silica gel GF254* as the coating substance and a mixture of 60 volumes of *chloroform*, 40 volumes of *acetone*, and 5 volumes of *formic acid* 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, 5 μ L of solution (A) and 3 μ L of solution (B). Prepare solution (A) by macerating 100 mg of the sample, in *fine powder*, with 5 mL of *methanol* for 10 minutes and filtering. For solution (B) dissolve 1 mg of *brazilin* 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 bands. The chromatogram obtained from solution (A) shows a quenching band (hR_f value 49 to 53) corresponding to brazilin from solution (B) and other three quenching bands are also 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; the band due to brazilin is red-brown fluorescent. One red-brown, one yellow, and two dark fluorescent bands are also observed (Fig. 4).

Loss on drying Not more than 7.0 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 1.0 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 4.0 per cent w/w (Appendix 7.12).

Brazilin content Not less than 0.7 per cent w/w of brazilin (C₁₆H₁₄O₅). Carry out the determination as described in the “Liquid Chromatography” (Appendix 3.5).

Mobile phase A Use *methanol*.

Mobile phase B Prepare a 0.3 per cent v/v solution of *glacial acetic acid*.

Standard preparation Dissolve an accurately weighed quantity of Brazilin RS in *methanol* to obtain a solution containing 200 µg per mL.

Sample preparation Sonicate about 100 mg of Sappan Wood, in *fine powder* and accurately weighed, with 10.0 mL of *methanol* for 30 minutes and filter through a membrane having a 0.45-µm porosity.

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	23	77
5	23	77
6	100	0
9	100	0
10	23	77
12	23	77

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 (2.7 µm), equipped with a similarly packed guard column and maintained at a temperature of 27°, (b) *Mobile phase* at a flow rate of about 1.4 mL per minute, and (c) an ultraviolet photometer set at 290 nm.

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.

Procedure Separately inject about 10 µL each of *Standard preparation* and *Sample preparation* into the chromatograph, record the chromatograms, and measure the responses for the major peaks.

Calculation Calculate the content of C₁₆H₁₄O₅ in the portion of the Sappan Wood taken, using the declared content of C₁₆H₁₄O₅ in Brazilin RS.

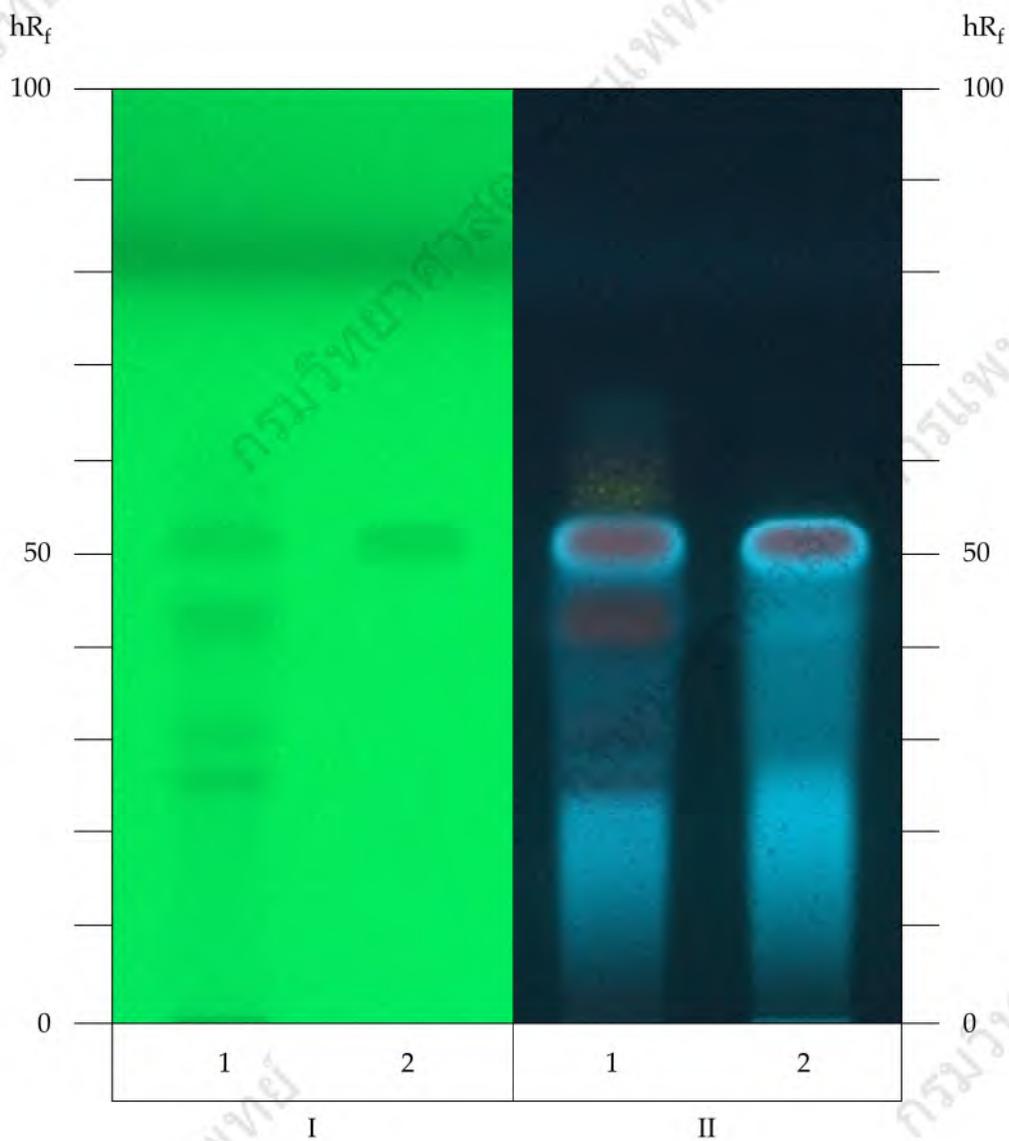


Fig. 4 Thin-Layer Chromatogram of Methanolic Extract of the Heartwood of *Biancaea sappan* (L.) Tod.

1 = solution (A)

2 = solution (B)

I = detection under UV light (254 nm)

II = detection under UV light (366 nm) after spraying with NP/PEG TS

สารสกัดแห้งฝาง (FANG DRY EXTRACT)

Sappan Wood Dry Extract

Category Sappan Wood Antidiarrheal, anti-inflammatory, hemodynamic.

Sappan Wood Dry Extract is prepared from the powdered Sappan Wood 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 **brazilin** ($C_{16}H_{14}O_5$); the labelled amount of brazilin is not less than 3.0 per cent, calculated on the dried basis.

Description Brownish yellow powder.

Packaging and storage Sappan Wood 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 amount of brazilin; (2) the expiration date.

Identification

A. Dissolve about 10 mg of the sample, in powder, in 10 mL of *ethanol*. To 2 mL add 2 mL of a 1 per cent w/v solution of *sodium carbonate* and mix: a pinkish red colour develops.

B. The chromatogram of the Assay preparation shows several peaks, one of which corresponds to that of the Standard preparation, as obtained in the Assay (Fig. 1).

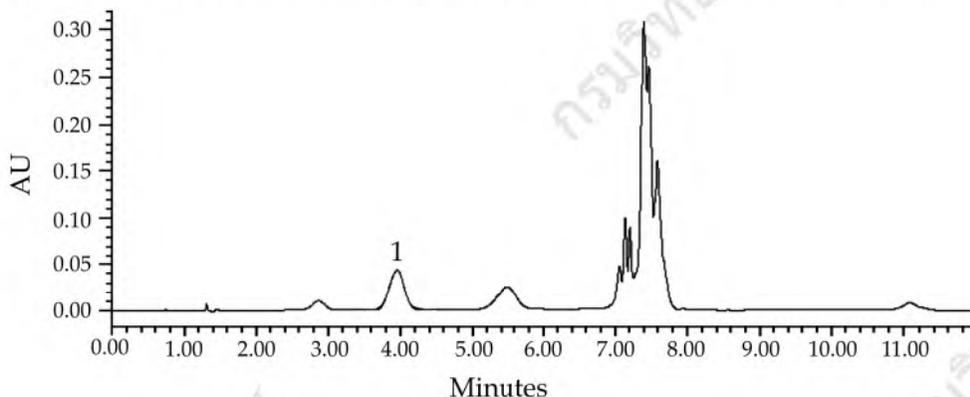


Fig. 1 HPLC Chromatogram of Sappan Wood Dry Extract Showing Brazilin (1)

C. Carry out the test as described in the “Thin-Layer Chromatography” (Appendix 3.1), using a high-performance plate with *silica gel GF254* as the coating substance and a mixture of 60 volumes of *chloroform*, 40 volumes of *acetone*, and 5 volumes 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 bands of 8 mm, 5 μ L of solution (A) and 3 μ L of solution (B). Prepare solution (A) by dissolving 10 mg of the sample, in powder, in 5 mL of *methanol*. For solution (B) dissolve 1 mg of *brazilin* 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 bands. The chromatogram obtained from solution (A) shows a quenching band (hR_f value 46 to 49) corresponding to brazilin from solution (B) and other three quenching bands are also 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; the band due to brazilin is red-brown fluorescent. One dark, one yellow, and two red-brown fluorescent bands are also observed (Fig. 2).

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 *methanol*.

Mobile phase B Prepare a 0.3 per cent v/v solution of *glacial acetic acid*.

Standard preparations Dissolve an accurately weighed quantity of Brazilin RS in sufficient *methanol*, dilute quantitatively and stepwise with *methanol* to obtain a stock solution having a known concentration of about 200 µg per mL. Dilute the solution quantitatively and stepwise with *methanol* to obtain six solutions having known concentrations of 10, 40, 80, 120, 160, and 200 µg per mL.

Assay preparation Dissolve about 10 mg of Sappan Wood Dry Extract, accurately weighed, in 10.0 mL of *methanol*, mix well, and filter through a 0.45-µm membrane filter.

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 (5 µm), equipped with a similarly packed guard column, and maintained at a temperature of 27°, (b) *Mobile phase* at a flow rate of about 1.4 mL per minute, and (c) an ultraviolet photometer set at 290 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	23	77
5	23	77
6	100	0
9	100	0
10	23	77
12	12	77

To determine the suitability of the chromatographic system, chromatograph *Standard* preparation having a known concentration of 120 µg per mL and record the peak response as directed under *Procedure*: the relative standard deviation for replicate injections is not more than 2.0 per cent.

Procedure Separately inject about 10 µL each of *Standard preparations* into the chromatograph, record the chromatograms, and measure the responses for brazilin peaks. 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 10 µL of *Assay preparation* into the chromatograph, record the chromatogram, and measure the response for the major peak.

Calculation By reference to the standard curve, calculate the content of brazilin (C₁₆H₁₄O₅) in the portion of the Extract taken.

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

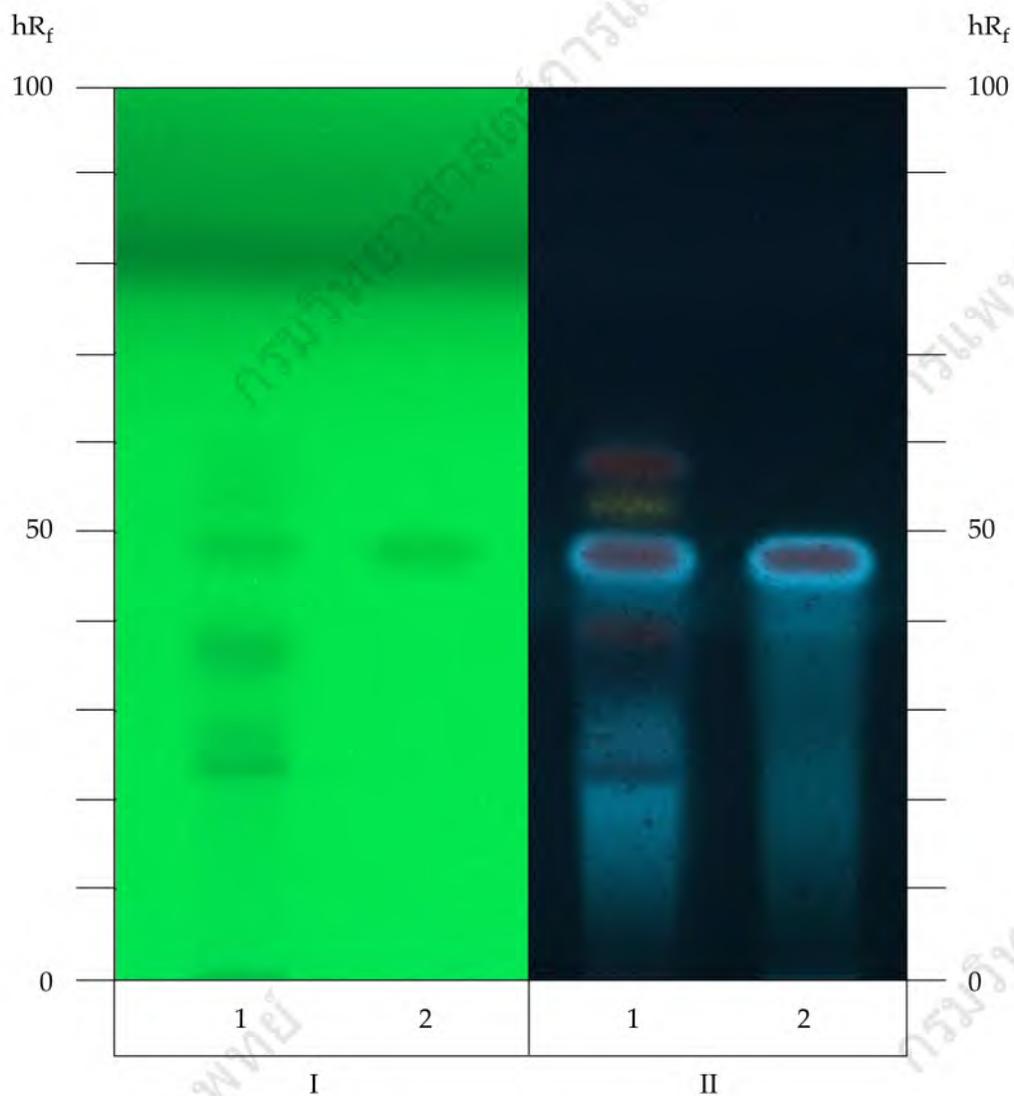


Fig. 2 Thin-Layer Chromatogram of Sappan Wood Dry Extract

1 = solution (A)

2 = solution (B)

I = detection under UV light (254 nm)

II = detection under UV light (366 nm) after spraying with NP/PEG TS

กำลั่งเสื่อโคร่ง, เถา (KAMLANG SUEA KHRONG, THAO)

Ziziphi Attopenis Caulis

Ziziphus Attopenis Vine

Category Analgesic.

Ziziphus Attopenis Vine is the dried stem of *Ziziphus attopenis* Pierre (*Z. trichocarpa* H. T. Chang) (Family Rhamnaceae), Herbarium Specimen Number: DMSC 5381, Crude Drug Number: DMSc 1269.

Constituents Ziziphus Attopenis Vine contains triterpenoids such as betulinic acid. It also contains lupeol, etc.

Description of the plant (Fig. 1) Climbing shrub, up to 6 m tall; branch subcylindrical, greenish grey to brownish, pubescent when young, becoming purplish grey or reddish brown pubescent when aged, often densely lenticellate; stipulary thorn 1 per node, recurved. Leaves simple, alternate, ovate to elliptic, 7 to 14 cm long, 3 to 6 cm wide, apex acute to acuminate, base rounded, slightly oblique, margin serrulate, chartaceous to subcoriaceous, abaxially pubescent, distinctly triplinerved, midrib adaxially sunken, glabrous; petiole slender, 0.4 to 1 cm long, glabrous. Inflorescence compound cyme or panicle, terminal and/or axillary, up to 25 cm long; peduncle dichotomously divided 2 to 3 times, densely brownish pubescent. Flower yellowish green, 3 to 4 mm in diameter; pedicel slender, 4 to 8 mm long; hypanthium shallow, disc-shaped, pubescent; sepals 5, triangular, densely pubescent, apex acute; petals 5, creamy, spatulate, shorter than sepal, shortly clawed; stamens 5, slightly shorter than petal; ovary superior, globose, densely pubescent, apically 2-clefted, basally connate. Fruit a drupe, ellipsoid to globose, 1.9 to 2.2 cm long, 1.3 to 1.8 cm wide; stipe 0.5 to 1 cm long, pubescent. Seed 1, oblong-ellipsoid, about 1.3 mm long, about 1.1 mm wide, reddish brown.

Description Odour, mild; taste, bland.

Macrosopical (Fig. 1) Entire or fragmented pieces of transverse or longitudinal sliced stems, varied in shape and size; externally, greenish brown to dark brown, rough; internally, yellowish brown to brown, smooth.

Microscopical (Figs. 2a, 2b) Transverse section of the stem shows periderm, cortex, phloem, xylem, and pith. Periderm: several layers of rectangular cork cells, some containing brown substances. Cortex: parenchyma cells with brown substances and a sclereid band. Phloem: fibres, phloem rays containing starch grains, phloem parenchyma, some containing brown substances and starch grains. Xylem: vessels, axial parenchyma, some containing brown substances and starch grains, xylem fibres, and xylem rays, containing starch grains. Pith: parenchyma, some containing brown substances and prismatic crystals, and secretory ducts, containing brown substances.

Ziziphus Attopenis Vine in powder possesses the diagnostic microscopical of the unground drug. Cork showing pitted canals, some containing brown substances, is characteristic.



1



2



3



4



2 cm

5

Fig. 1 *Ziziphus attopensis* Pierre

1. habit 2. leaves and inflorescences 3. flowers 4. stem 5. crude drug

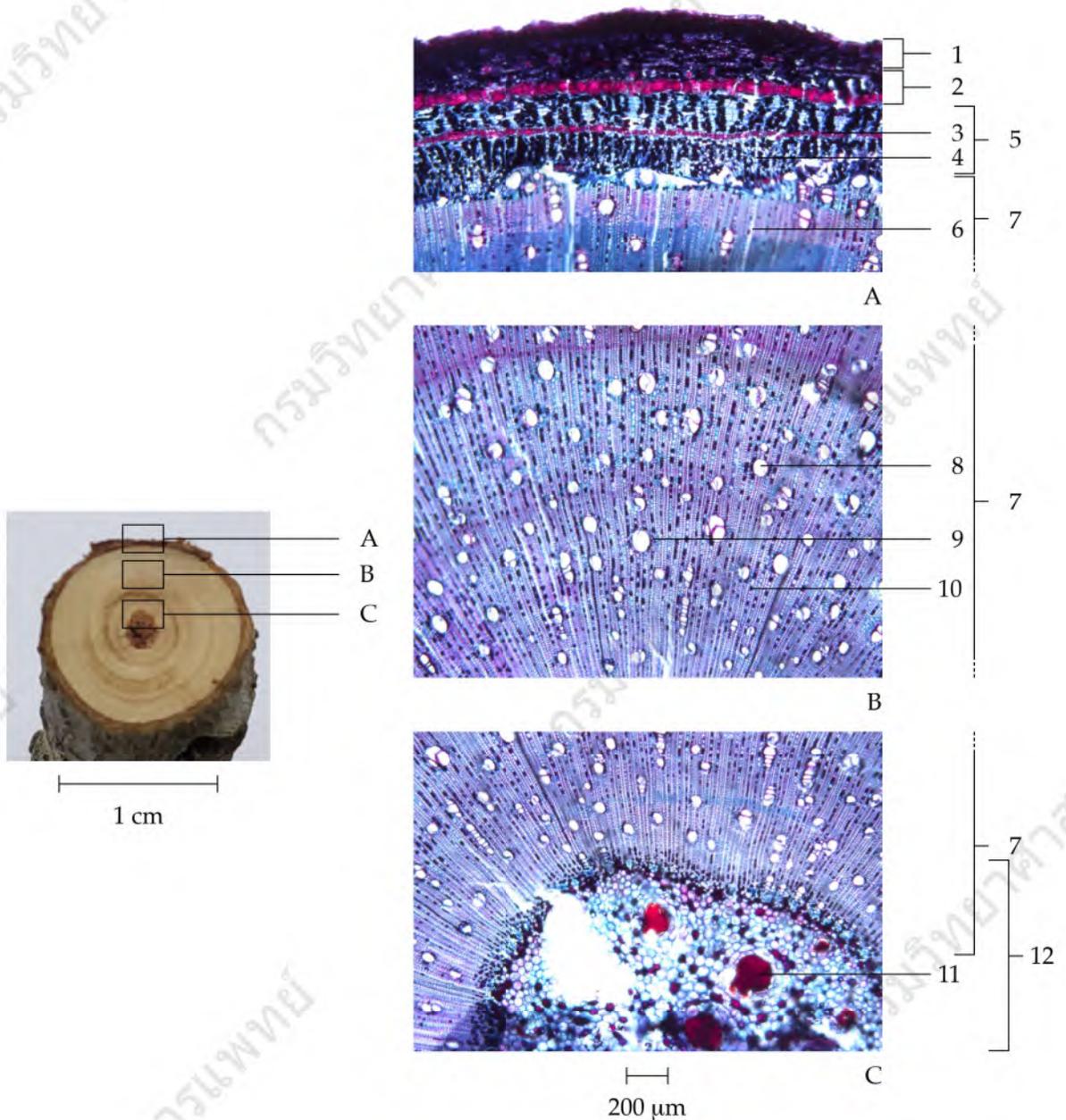


Fig. 2a Photomicrographs of Transverse Section of the Stem of *Ziziphus attopensis* Pierre, Stained With Safranin-Fast Green

A. Periderm, Cortex, and Vascular Tissue

B. Xylem

C. Xylem and Pith

1. periderm

2. cortex

3. fibre

4. phloem ray

5. phloem

6. xylem ray

7. xylem

8. vessel

9. axial parenchyma

10. parenchyma with brown substance

11. brown substance in secretory duct

12. pith

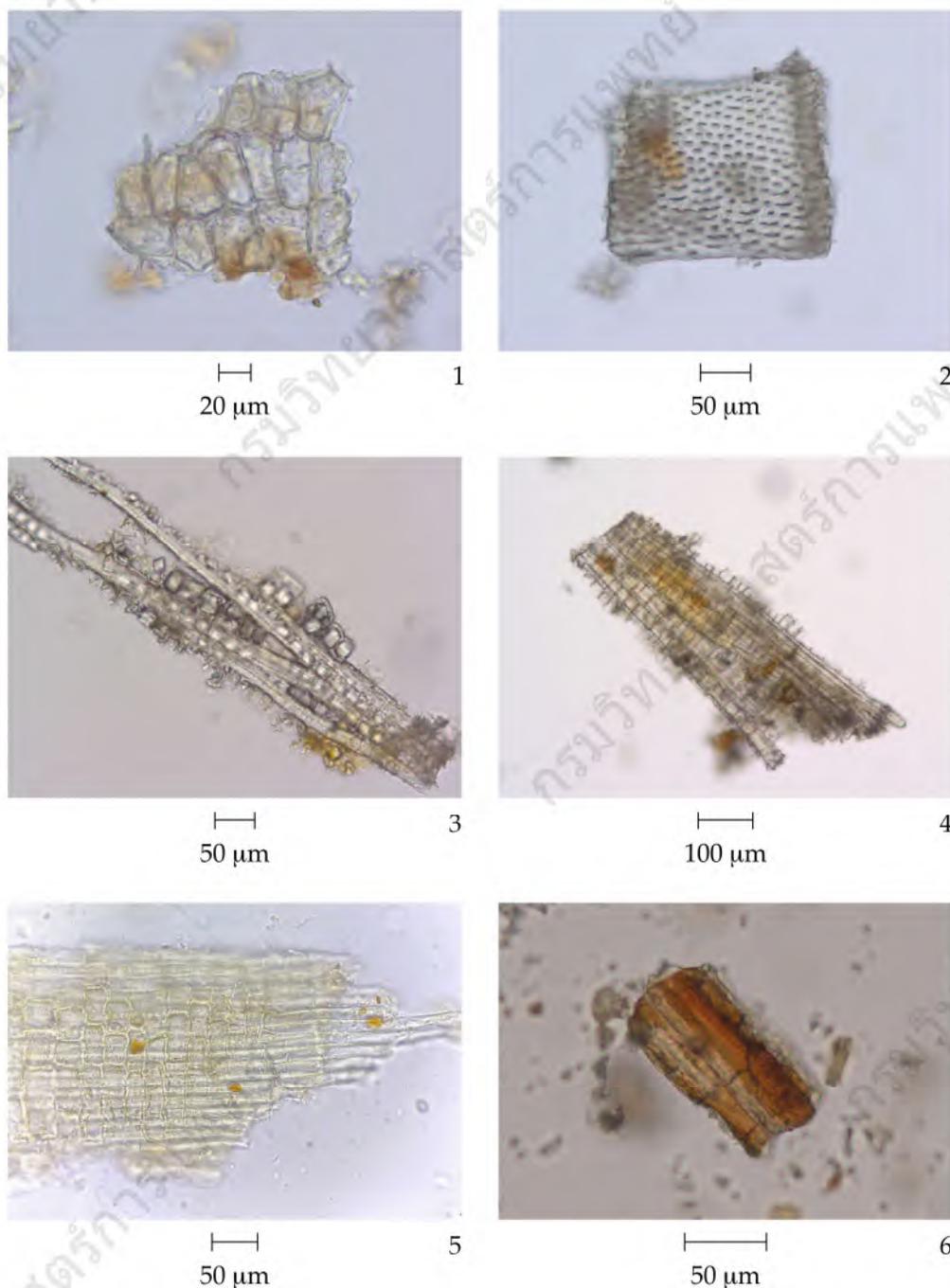
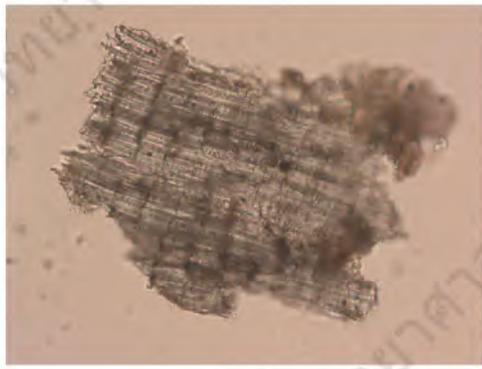


Fig. 2b Photomicrographs of Powdered Drug of the Stems of *Ziziphus attopensis* Pierre

1. cork in surface view, some containing brown substances	4. parenchyma and ray parenchyma, some containing prismatic crystals and fibres, in longitudinal view
2. large bordered-pitted vessel	5. parenchyma with underlying fibres
3. ray parenchyma, some containing prismatic crystals, adjacent with fibres and prismatic sheath, in tangential longitudinal view	6. parenchyma with brown substances, in longitudinal view



50 μm 7



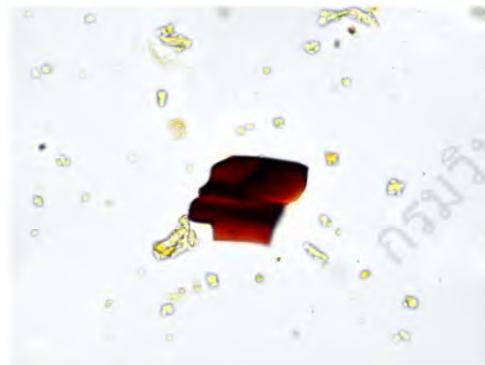
50 μm 8



50 μm 9



20 μm 10



20 μm 11

Fig. 2b (continued)

7. parenchyma, some containing starch grains, and underlying fibres
8. vessels

9. sclereids
10. prismatic crystals
11. brown substance

Additional information The crude drug used in Thai traditional medicine as “Kamlang Suea Khrong” refers to two different plant sources and parts: Kamlang Suea Khrong, Plueak Ton (the bark of *Betula alnoides* Buch.-Ham. ex D. Don) and Kamlang Suea Khrong, Thao (the dried stem of *Ziziphus attopensis* Pierre). Traditionally, both sources are used under the Thai name “กำลิ่งเสื่อโค้ง” (Kamlang Suea Khrong).

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

Identification

A. Sonicate 5 g of the sample, in powder, with 10 mL of *methanol* for 30 minutes and filter. Evaporate the filtrate to dryness. Dissolve the residue in 2 mL of *acetic anhydride*, shake well, and slowly add 1 mL of *sulfuric acid* to form a layer: a brownish red colour develops 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 *toluene*, 20 volumes of *ethyl acetate*, and 2.5 volumes of *glacial acetic acid* 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, 6 μ L each of the following solutions. Prepare solution (A) by refluxing 5 g of the sample, in powder, with 100 mL of *methanol* for 2 hours, filtering, evaporating the filtrate to dryness, then, adding 1 mL of *methanol* to 25 mg of the residue, and sonicating for a few minutes. For solution (B), dissolve 1 mg of *betulinic 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. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter; four red and five blue fluorescent bands are observed. Spray the plate with a 10 per cent v/v solution of *sulfuric acid* in *methanol* and heat at 105° for 15 minutes. The chromatogram obtained from solution (A) shows a purple band (R_f value 47 to 54) corresponding to the *betulinic acid* band from solution (B). One purple, two orange, and six brownish purple bands are also observed (Fig. 3).

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).

Acid-insoluble ash Not more than 3.0 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 1.0 per cent w/w (Appendix 7.12).

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

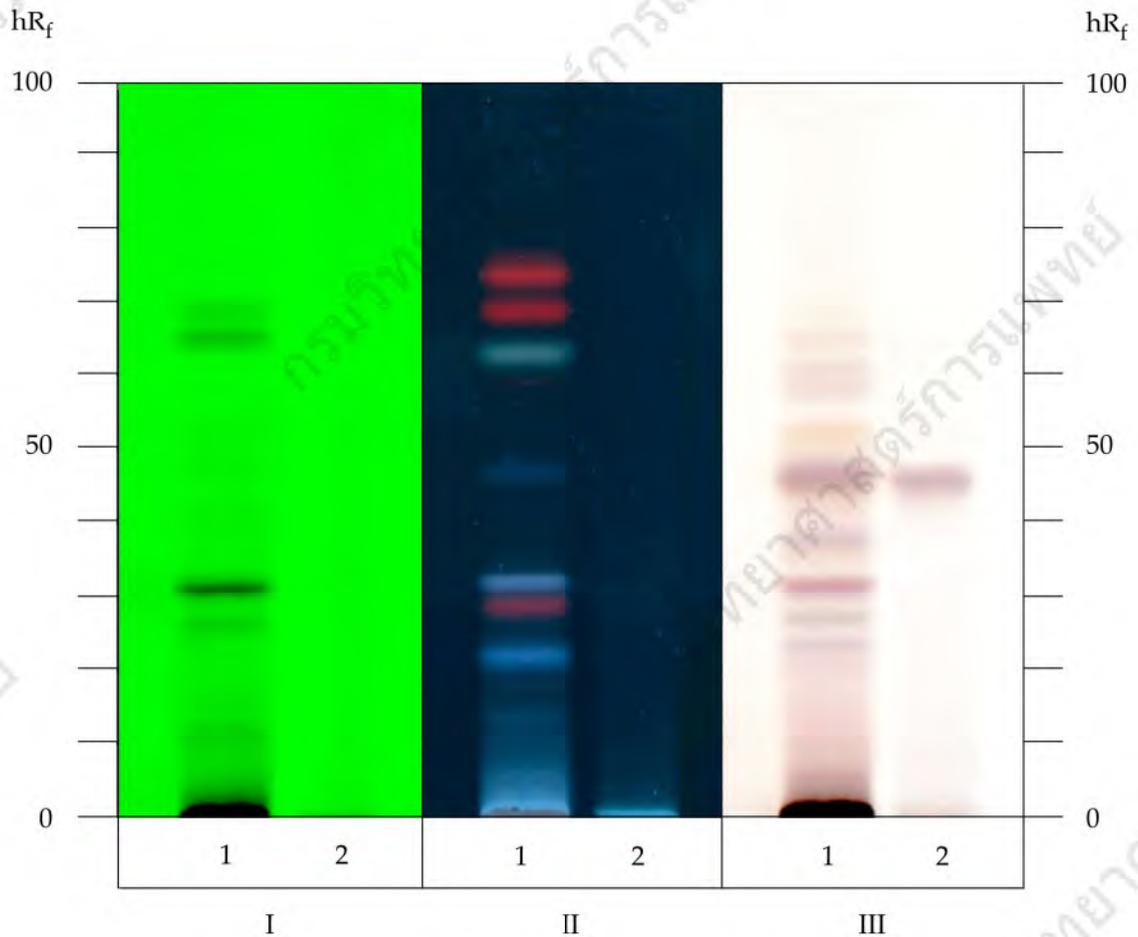


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Stems of *Ziziphus attopensis* Pierre

1 = solution (A)

2 = solution (B)

I = detection under UV light (254 nm)

II = detection under UV light (366 nm)

III = detection with a 10 per cent v/v solution of *sulfuric acid* in *methanol*

ช่อย, ใบ (KHOI, BAI)

Streblis Asperidis Folium
Siamese Rough Bush Leaf

Synonyms Demon Tree Leaf, Sandpaper Tree Leaf, Tooth Brush Tree Leaf

Category Anti-inflammatory in gingivitis.

Siamese Rough Bush Leaf is the dried leaf of *Streblus asper* Lour. (*Diplothorax tonkinensis* Gagnep., *Streblus monoicus* Gagnep., *Trophis cochinchinensis* Poir.) (Family Moraceae), Herbarium Specimen Number: DMSC 5338, Crude Drug Number: DMSc 1245.

Constituents Siamese Rough Bush Leaf contains flavonoids such as rutin. It also contains terpenoids, phenolic compounds, sterols, etc.

Description of the plant (Fig. 1) Tree or shrub, up to 15 m tall, monoecious or dioecious; stem much-branched, lenticel conspicuous when young; outer bark greyish, scabrous, inner bark whitish, thick, exuding white latex; branches usually drooping or straggling, branchlet with short stiff hairs. Leaves simple, spirally arranged or distichous, elliptic, oblong, obovate, or subobovate, 1 to 8(-13) cm long, 0.5 to 3.5(-6.5) cm wide, apex acute to acuminate, base rounded, subcordate or obtuse, margin crenate to dentate, coriaceous, hispidulous to puberulous and/or scabrous on both surfaces, lower part of midrib somewhat prominent in lower surface, lateral veins 4 to 8 pairs; petiole 1 to 5 mm long, puberulous; stipule small, puberulous, caducous. Male inflorescence axillary, capitate, in pairs or solitary; peduncle 0.2 to 1.5 cm long, sparsely puberulous; bracts few, at base of inflorescence, small, narrowly elliptic; bracteoles 2, at base of calyx, larger than bract. Female inflorescence axillary, uniflorous or biflorous; peduncle 0.4 to 2 cm long, puberulent; bracts few, 0.5 to 2 mm long, sparsely puberulous. Male flowers in a head of 4 to 15 flowers, 0.4 to 1 cm in diameter, subsessile; perianth 1.5 to 2 mm long, puberulent; stamens 4, 2 to 2.5 mm long, anther about 1 mm long. Female flowers 1 to 2; perianth 2 to 2.5 mm long, elongated to 5 to 8 mm long in fruit, reflexed, puberulent; ovary superior, about 1 mm long, style 1 to 3 mm long, stigma 2 to 4 mm long, elongated to 1.2 cm long, bifid. Fruit a drupe, subglobose to ovoid, about 6 mm in diameter, indehiscent, enclosed by enlarged perianth lobes when young, yellow to orange when mature. Seed 1, globose, 4 to 5 mm in diameter, greyish white.

Description Odour, mild to green; taste, bland.

Macroscopical (Fig. 1) Whole or broken leaves, with or without petioles. Whole leaves brownish, elliptic, oblong, obovate, or subobovate, apex acute to acuminate, base rounded, subcordate or obtuse, margin crenate to dentate, coriaceous, hispidulous to puberulous, and/or scabrous on both surfaces, lower part of midrib somewhat prominent in lower surface; petiole, puberulous.

Microscopical (Figs. 2a-2d) Transverse section of the leaf through the midrib shows upper epidermis, mesophyll, vascular tissue, and lower epidermis. Upper epidermis: a layer of rectangular cells, some containing rosette aggregate crystals or brown substances; short and long unicellular trichomes with cystolith. Mesophyll: 2 to 3 layers of elongated palisade cells, some containing rosette aggregate crystals; spongy cells, some containing rosette aggregate crystals; angular collenchyma cells, some containing rosette aggregate crystals and parenchyma, some containing rosette aggregate crystals or brown substances, in the upper and lower parts of midrib. Vascular tissue: phloem and xylem. Lower epidermis: a layer of rectangular cells; stomata; and short and long unicellular trichomes with cystolith.



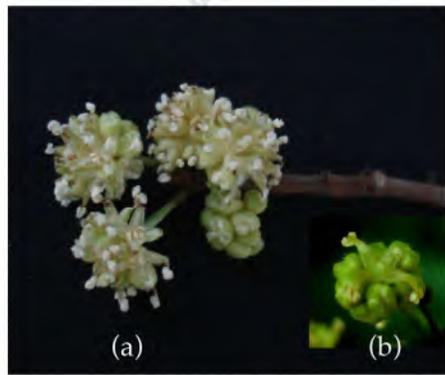
1



2



3



4



5

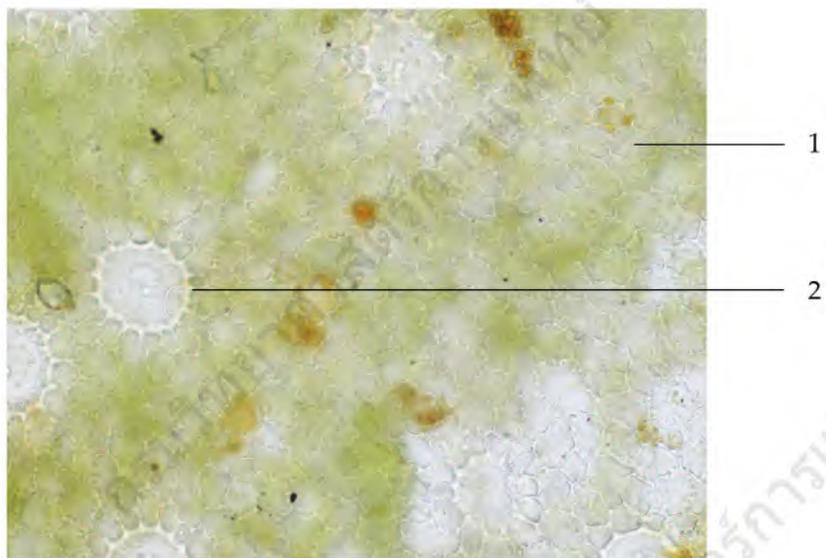


1 cm

6

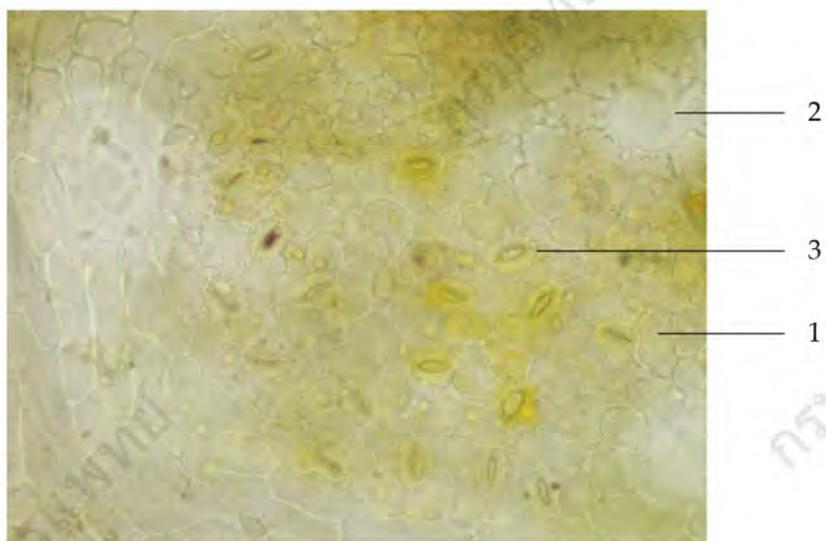
Fig. 1 *Streblus asper* Lour.

1. habit 2. twig showing mature leaves 3. female flowers and young fruits
4. male inflorescences (a), male flower (b) 5. fruits 6. crude drug



50 μ m

Upper Epidermis of the Lamina



50 μ m

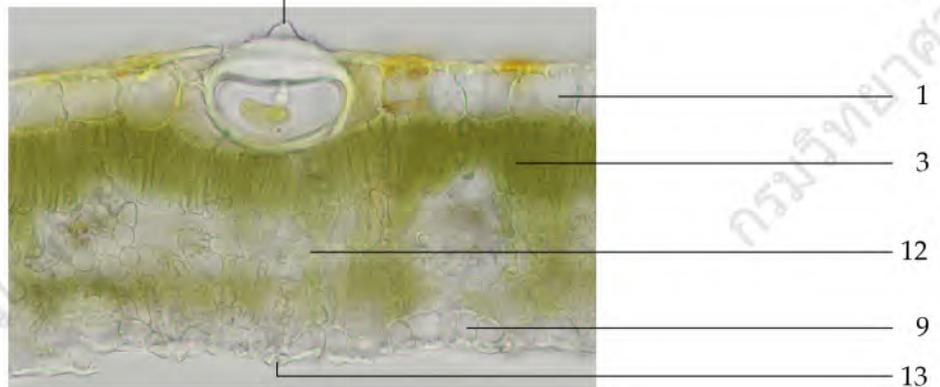
Lower Epidermis of the Lamina

Fig. 2a Photomicrographs of Epidermises of the Leaf of *Streblus asper* Lour.
1. epidermal cell
2. trichome with cystolith
3. stoma



100 μm

Transverse Section of the Midrib



50 μm

Transverse Section of the Lamina

Fig. 2b Photomicrographs of Transverse Sections of the Leaf of *Streblus asper* Lour.

- | | |
|---------------------|---|
| 1. upper epidermis | 8. rosette aggregate crystal |
| 2. collenchyma | 9. lower epidermis |
| 3. palisade cell | 10. long unicellular trichome |
| 4. parenchyma | 11. short unicellular trichome with cystolith |
| 5. phloem | 12. spongy cell |
| 6. vessel | 13. stoma |
| 7. yellow substance | |

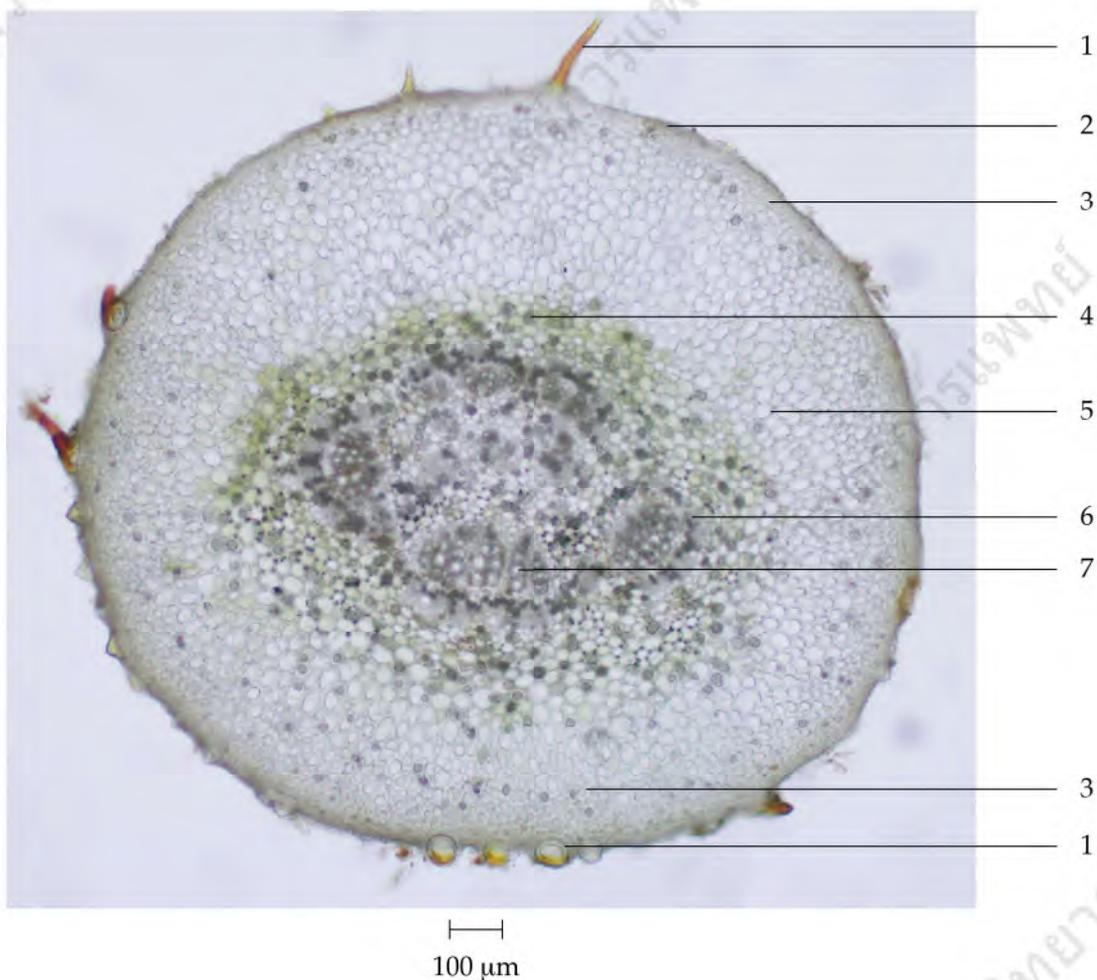


Fig. 2c Photomicrograph of Transverse Section of the Petiole of *Streblus asper* Lour.

- | | |
|------------------------------|---------------|
| 1. unicellular trichome | 5. parenchyma |
| 2. epidermis | 6. phloem |
| 3. collenchyma | 7. vessel |
| 4. rosette aggregate crystal | |

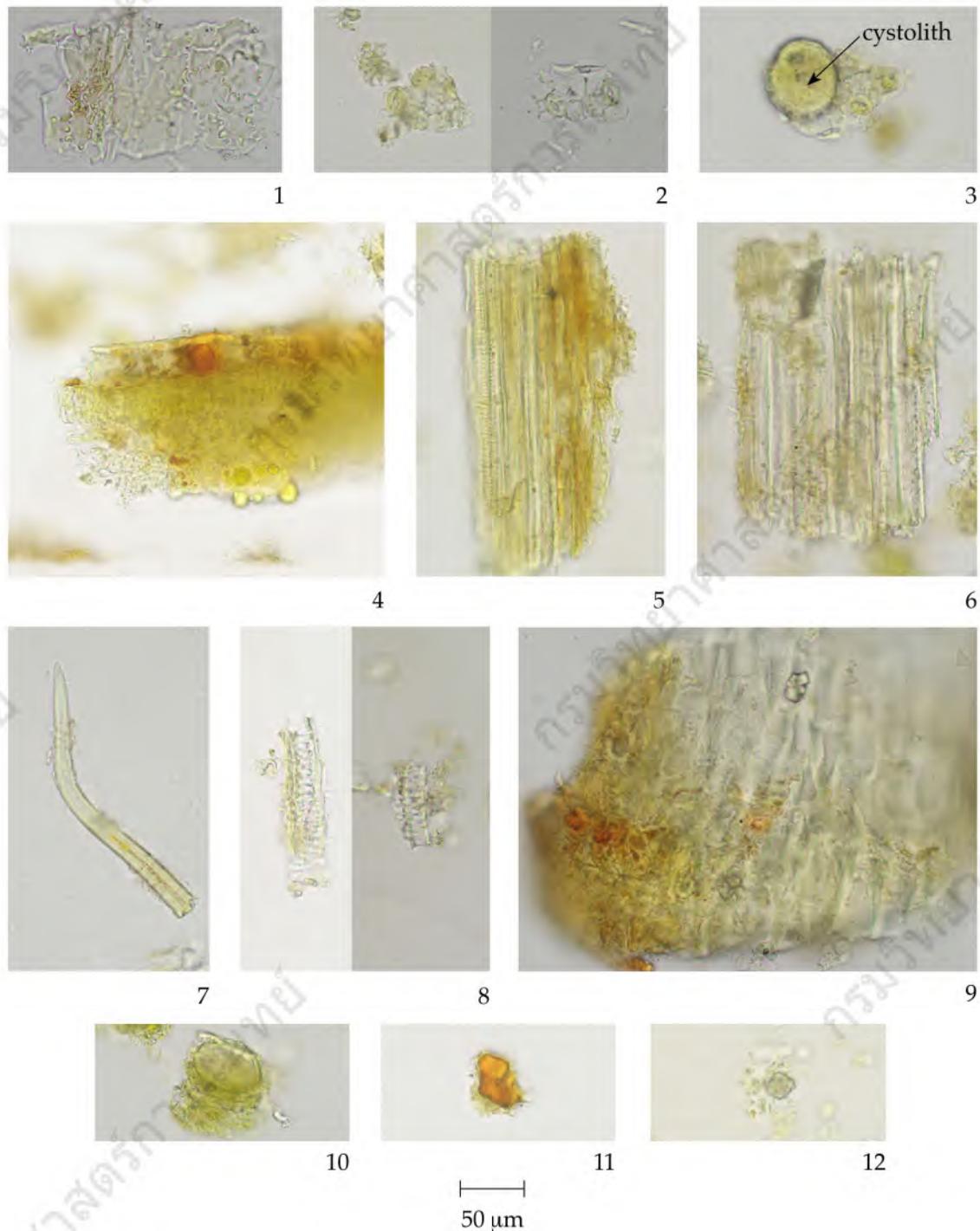


Fig. 2d Photomicrographs of Powdered Drug of the Leaves of *Streblus asper* Lour.

1. upper epidermis, in surface view
2. lower epidermis with stomata, in surface view
3. lower epidermis and trichome with cystolith
4. lamina, in sectional view, showing epidermis, brown substance, palisade cells, spongy cells, and oil droplets
5. reticulate vessels associated with fibres and parenchyma
6. fibres and parenchyma, in longitudinal view
7. long unicellular trichome
8. vessels
9. collenchyma with rosette aggregate crystals, in longitudinal view
10. short unicellular trichome with cystolith
11. brown substance
12. rosette aggregate crystal

In surface view, epidermises show irregularly-shaped epidermal cells, anomocytic stomata, and short unicellular cystolith trichomes.

Transverse section of the petiole shows epidermis, cortex, and vascular tissue. Epidermis: a layer of small rectangular cells with unicellular trichomes, and rarely, multicellular glandular trichomes. Cortex: numerous annular collenchyma, some containing rosette aggregate crystals and thin-walled parenchyma, some containing rosette aggregate crystals. Vascular tissue: phloem and xylem.

Siamese Rough Bush Leaf in powder possesses the diagnostic microscopical characters of the unground drug. The presence of both short and long unicellular trichomes with cystolith are characteristic. The shape of short unicellular trichomes with cystolith are unique. Annular collenchyma can also be found.

Packaging and storage Siamese Rough Bush Leaf 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 *fine powder*, with 20 mL of *methanol* for 15 minutes and filter. To 2 mL of the filtrate, add 2 to 3 pieces of *magnesium ribbon*, shake well, mix with a few drops of *hydrochloric acid*, and warm in a water-bath for about 10 minutes: a reddish brown colour is produced.

B. Reflux 1 g of the sample, in *fine powder*, with 20 mL of *water* for 15 minutes and filter. To 2 mL of the filtrate, add a few drops of a 1 per cent w/v solution of *iron (III) chloride* and shake well: a bluish 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 100 volumes of *ethyl acetate*, 8 volumes of *water*, 4 volumes of *glacial acetic acid*, and 4 volumes of *formic acid* 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 7 mm, 15 μ L of solution (A) and 2 μ L of solution (B). Prepare solution (A) by refluxing 500 mg of the sample, in *fine powder*, with 10 mL of *methanol* for 15 minutes and filtering. Evaporate the filtrate to dry and dissolve the residue in 3 mL of *methanol*. For solution (B), dissolve 1 mg of *rutin* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air. Examine the plate under ultraviolet light (254 nm); marking the quenching bands, the chromatogram obtained from solution (A) shows a quenching band (hR_f value 14 to 16) corresponding to the rutin band obtained from solution (B). Other four quenching bands are also observed. Subsequently examine the plate under ultraviolet light (366 nm); the band due to rutin is dark fluorescent; one blue fluorescent band is 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) within 5 to 15 minutes; the band due to rutin is orange fluorescent. Four green and five blue fluorescent bands are also observed (Fig. 3).

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).

Acid-insoluble ash Not more than 9.0 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 7.0 per cent w/w (Appendix 7.12).

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

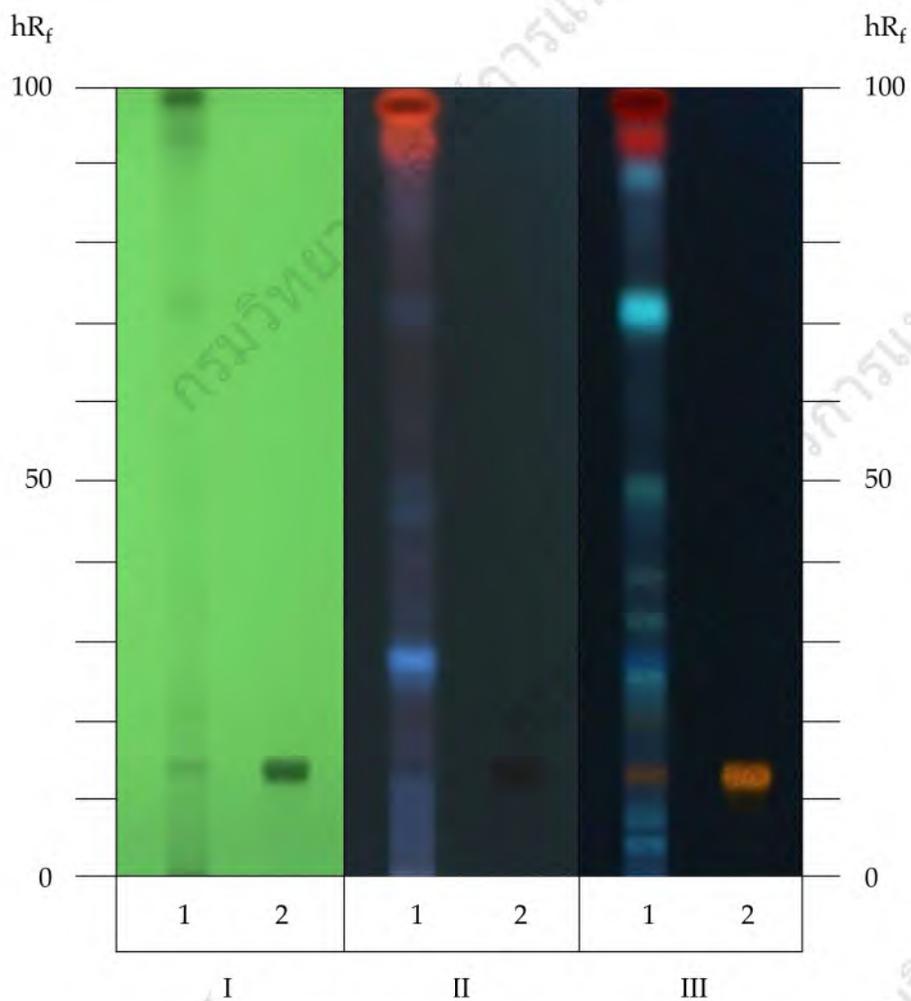


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Leaves of *Streblus asper* Lour.

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 NP/PEG TS

กระตุกไก่ดำ, ใบ (KRADUK KAI DAM, BAI)

Justiciae Gendarussae Folium

Justicia Gendarussa Leaf

Category Anti-inflammatory.

Justicia Gendarussa Leaf is the dried leaf of *Justicia gendarussa* Burm. f. (*Gendarussa vulgaris* Nee) (Family Acanthaceae), Herbarium Specimen Number: DMSC 5347, Crude Drug Number: DMSc 1260.

Constituents Justicia Gendarussa Leaf contains amino acids such as alanine. It also contains flavonoids (e.g., gendarusins A-E), aromatic amines, triterpenoids, alkaloids, sterols, etc.

Description of the plant (Fig. 1) Shrub up to 1.5 m tall; stem erect, much branched, obtusely quadrangular, swollen at nodes, glabrous, purplish to blackish purple. Leaves simple, opposite decussate, narrowly lanceolate, 6 to 14 cm long, 1 to 2.5 cm wide, apex acute to acuminate, base cuneate or attenuate, margin slightly sinuate, glabrous on both sides, midrib prominently blackish red; petiole 1 to 2.5 cm long. Inflorescence spike, terminal or axillary, 3 to 12 cm long; rachis glabrous or sparsely puberulous; peduncle 0.5 to 1.5 cm long; bract leaf-like, triangular, 2 to 6 mm long, 1 to 2.5 mm wide, basal bract longer than calyx, margin ciliate, apex acute; bracteole caducous, elliptic to linear-lanceolate, about 3 mm long, about 1 mm wide, apex acute, margin ciliate. Flower: calyx deeply 5-lobed, subequal, 4 to 7 mm long, lobe linear-lanceolate, 3 to 4 mm long, about 0.5 mm wide, apex acuminate; corolla creamy white to light purple, with purple spots or blotches on corolla lips, bilabiate, 1.2 to 1.6 cm long, glabrous, tube basally cylindric, 8 to 9 mm long, about 2 mm wide, upper lip flat or slightly hooded, triangular-ovate, 5 to 6 mm long, about 3.5 mm wide, apex emarginate, lower lip spreading, 3-lobed, elliptic-ovate, 0.6 to 1 cm long; stamens 2, filament 3 to 6 mm long, attached on upper part of corolla tube, glabrous, anther thecae oblong, about 1.2 mm long, superposed, upper one mucous at base, lower one spurred; ovary superior, 2-loculed, ovules 2 per locule, glabrous, style about 1 cm long, glabrous, stigma capitate, shortly 2-lobed. Fruit a capsule, clavate, 1 to 1.2 cm long. Seeds 2 to 4, dark brownish, orbicular, flattened.

Description Odour, mild; taste, slightly bitter.

Macroscopical (Fig. 1) Whole or broken leaves; leaf petiolate, yellowish green, lanceolate, glabrous, apex acute to acuminate, base cuneate or attenuate, margin slightly sinuate.

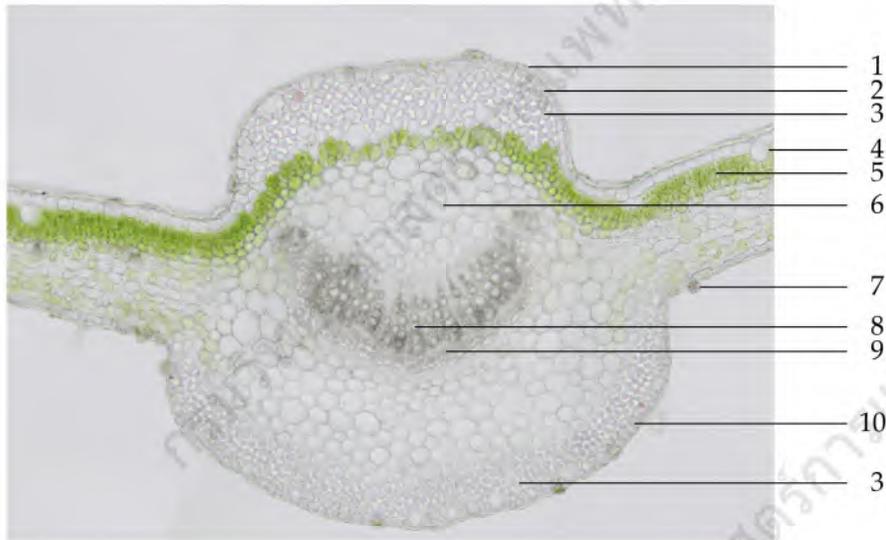
Microscopical (Figs. 2a–2d) Transverse section of the leaf through the midrib shows upper epidermis, mesophyll, vascular tissue, and lower epidermis. Upper epidermis: 1 to 3 layers of cells containing purple substances, cuticle layer, unicellular warty-walled trichome, multicellular glandular trichomes, multicellular trichomes, and lithocyst. Mesophyll: 1 to 3 layers of palisade cells, containing starch grains or some containing purple substances; spongy cells, containing starch grains or some containing purple substances; angular collenchyma and parenchyma, containing starch grains or some containing purple substances. Vascular tissue: phloem and xylem. Lower epidermis: layers of rectangular cells, some containing purple substances, cuticle layer, multicellular glandular trichomes, multicellular trichomes, lithocyst, and stomata.

In surface view, upper epidermis shows wavy-walled cells, multicellular glandular trichomes; lower epidermis, slightly wavy-walled cells, diacytic stomata, multicellular glandular trichomes, and lithocyst.



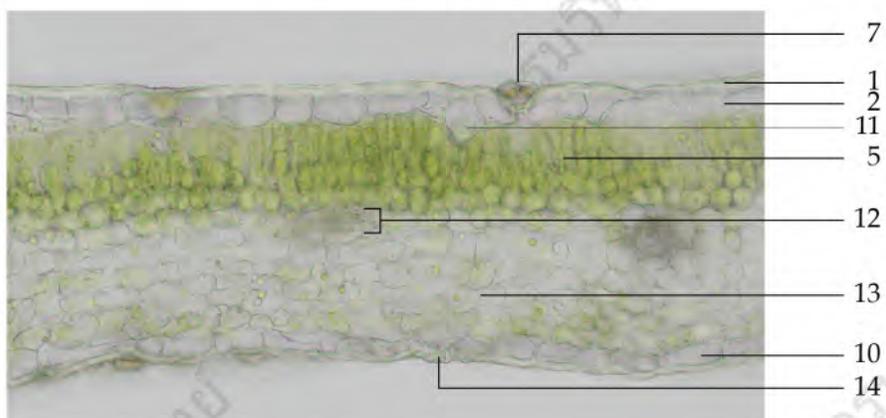
Fig. 1 *Justicia gendarussa* Burm. f.

1. habit 2. leafy twigs 3. inflorescences 4. flowers 5. fruits and seeds 6. crude drug



100 μm

Transverse Section of the Midrib



100 μm

Transverse Section of the Lamina

Fig. 2b Photomicrographs of Transverse Sections of the Leaf of *Justicia gendarussa* Burm. f.

- | | |
|---|--|
| 1. cuticle | 8. vessel |
| 2. upper epidermis | 9. phloem |
| 3. collenchyma | 10. lower epidermis |
| 4. lithocyst | 11. cystolith |
| 5. palisade cell containing starch grains | 12. vascular tissue |
| 6. parenchyma | 13. spongy cell containing starch grains |
| 7. multicellular glandular trichome | 14. stoma |

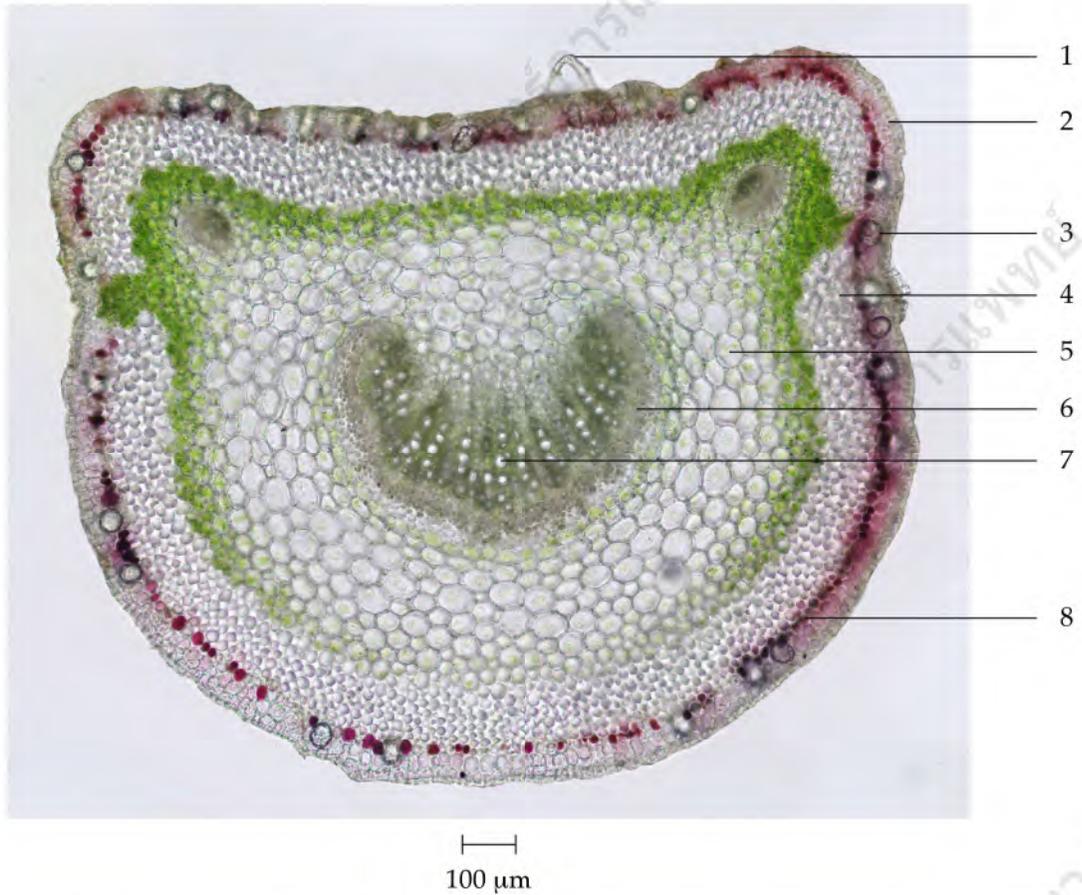


Fig. 2c Photomicrograph of Transverse Section of the Petiole of *Justicia gendarussa* Burm. f.

- | | |
|-------------------|----------------------|
| 1. trichome | 5. parenchyma |
| 2. epidermal cell | 6. phloem |
| 3. lithocyst | 7. vessel |
| 4. collenchyma | 8. purple substances |

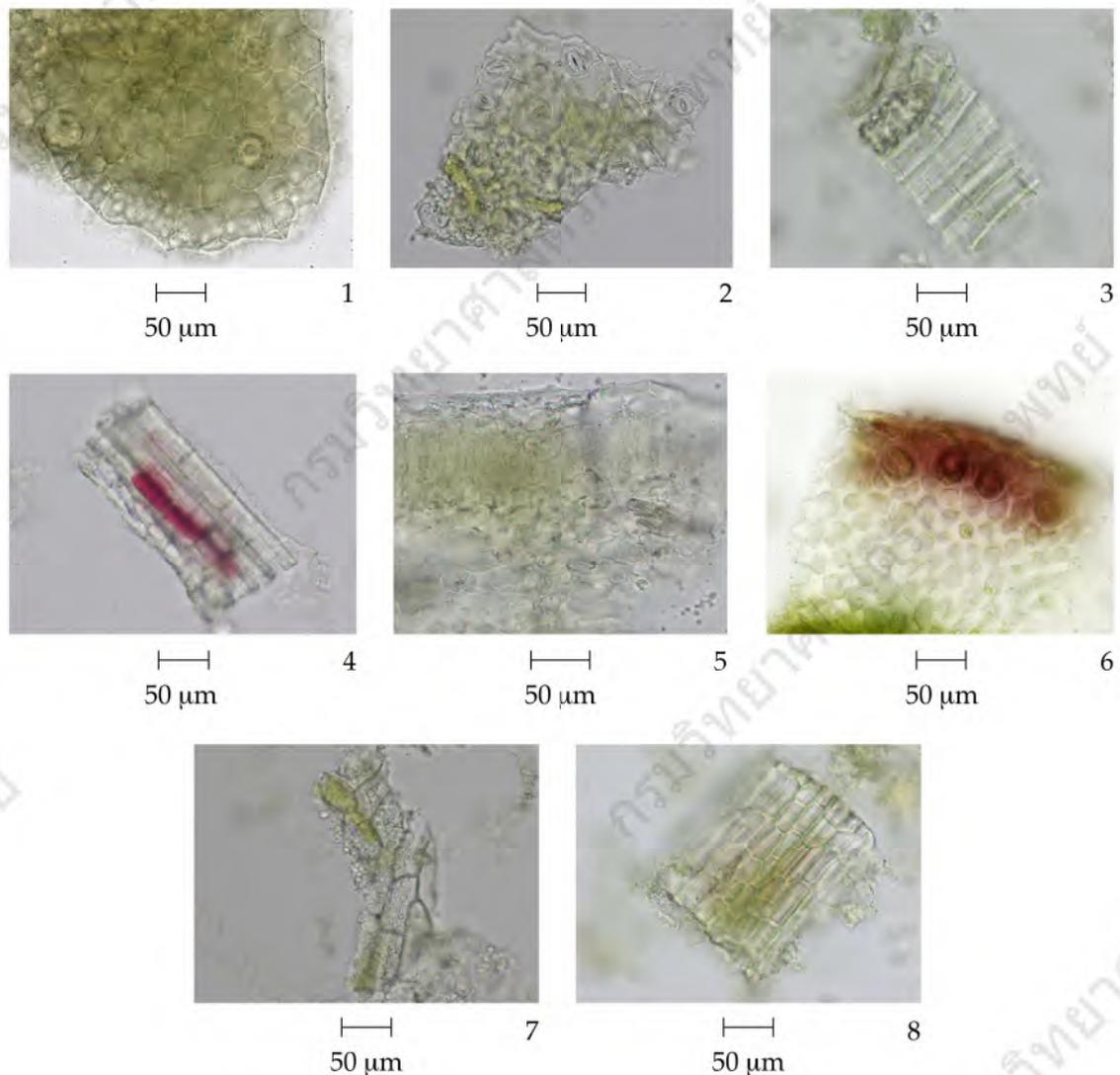


Fig. 2d Photomicrographs of Powdered Drug of the Leaves of *Justicia gendarussa* Burm. f.

1. upper epidermis, glandular trichome and underlying palisade cells, in surface view
2. lower epidermis with diacytic stomata and lithocysts, in surface view
3. epidermis with lithocyst and collenchyma, in longitudinal view
4. epidermis and collenchyma, some containing purple substances, in longitudinal view
5. lamina, in sectional view, showing upper epidermis, palisade cells, vascular tissues, and spongy cells
6. epidermis, collenchyma, and lithocyst, some containing purple substances, in sectional view
7. parenchyma containing starch grains
8. epidermal cells of petiole in surface view

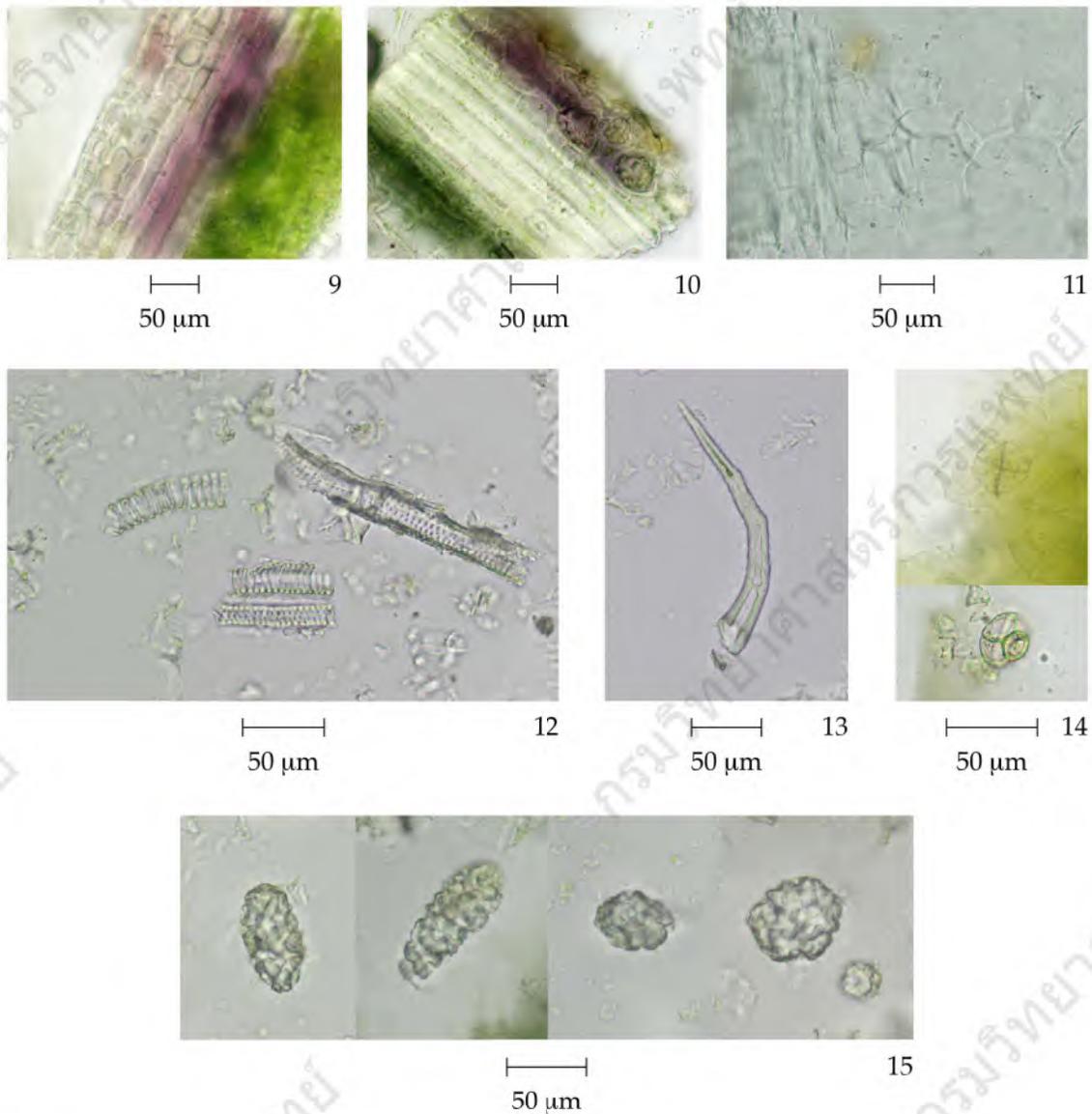


Fig. 2d (continued)

- | | |
|---|--|
| 9. epidermis and collenchyma, some containing purple substances and chlorenchyma, in longitudinal view | 11. parenchyma containing rod-shaped crystals and fibres |
| 10. epidermis, cystoliths, collenchyma, some containing purple substances, and chlorenchyma, in longitudinal view | 12. spiral, reticulate, and pitted vessels |
| | 13. multicellular trichome |
| | 14. glandular trichomes |
| | 15. cystoliths |

Transverse section of the petiole shows epidermis, cortex, and vascular tissue. Epidermis: 1 to 2 layers of epidermal cells, some containing purple substances, cuticle layer, multicellular glandular trichomes, multicellular trichomes, lithocyst, and stomata. Cortex: angular collenchyma, some containing purple substances and parenchyma, some containing purple substances and/or starch grains and/or crystals. Vascular tissue: phloem and xylem.

Justicia Gendarussa Leaf in powder possesses the diagnostic microscopical of the unground drug. The purple substance, although characteristic, is visible only in freshly dried and ground samples. The combination of lithocysts, multicellular glandular trichomes, and collenchyma is also uniquely present.

Packaging and storage Justicia Gendarussa Leaf 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 15 minutes and filter. To 2 mL of the filtrate, add a few drops of *ninhydrin TS* and warm in a water-bath for about 5 minutes: a violet colour is produced.

B. Carry out the test as described in the “Thin-Layer Chromatography” (Appendix 3.1), using a high-performance plate with *silica gel GF254* as the coating substance and a mixture of 48 volumes of *butanol*, 26 volumes of *glacial acetic acid*, 16 volumes of *2-propanol*, and 4 volumes 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, 8 μ L of solution (A) and 1 μ L of solution (B). Prepare solution (A) by refluxing 1 g of the sample, in *fine powder*, with 30 mL of *ethanol* for 30 minutes and filtering. Evaporate the filtrate to dryness and dissolve the residue in 3 mL of *ethanol*. For solution (B), dissolve 1 mg of *alanine* in 1 mL of *water*, add 9 mL of *ethanol*, and mix. After removal of the plate, allow it to dry in air. Examine the plate under ultraviolet light (254 nm); marking the quenching bands. Subsequently examine the plate under ultraviolet light (366 nm); two red and three blue fluorescent bands are observed. Spray the plate with *ninhydrin TS* and heat at 110° for 10 minutes; the chromatogram obtained from solution (A) shows a pink band (R_f value 29 to 35) corresponding to the alanine band from solution (B). Other five pink bands are observed (Fig. 3).

Repeat the same procedure on another plate but omitting solution (B). After removal of the plate, allow it to dry in air. Heat the plate at 80° for 10 minutes and then spray the plate 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) within 5 to 15 minutes. One blue and three yellow fluorescent bands are observed (Fig. 3).

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).

Acid-insoluble ash Not more than 3.0 per cent w/w (Appendix 7.6).

Total ash Not more than 15.0 per cent w/w (Appendix 7.7).

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

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

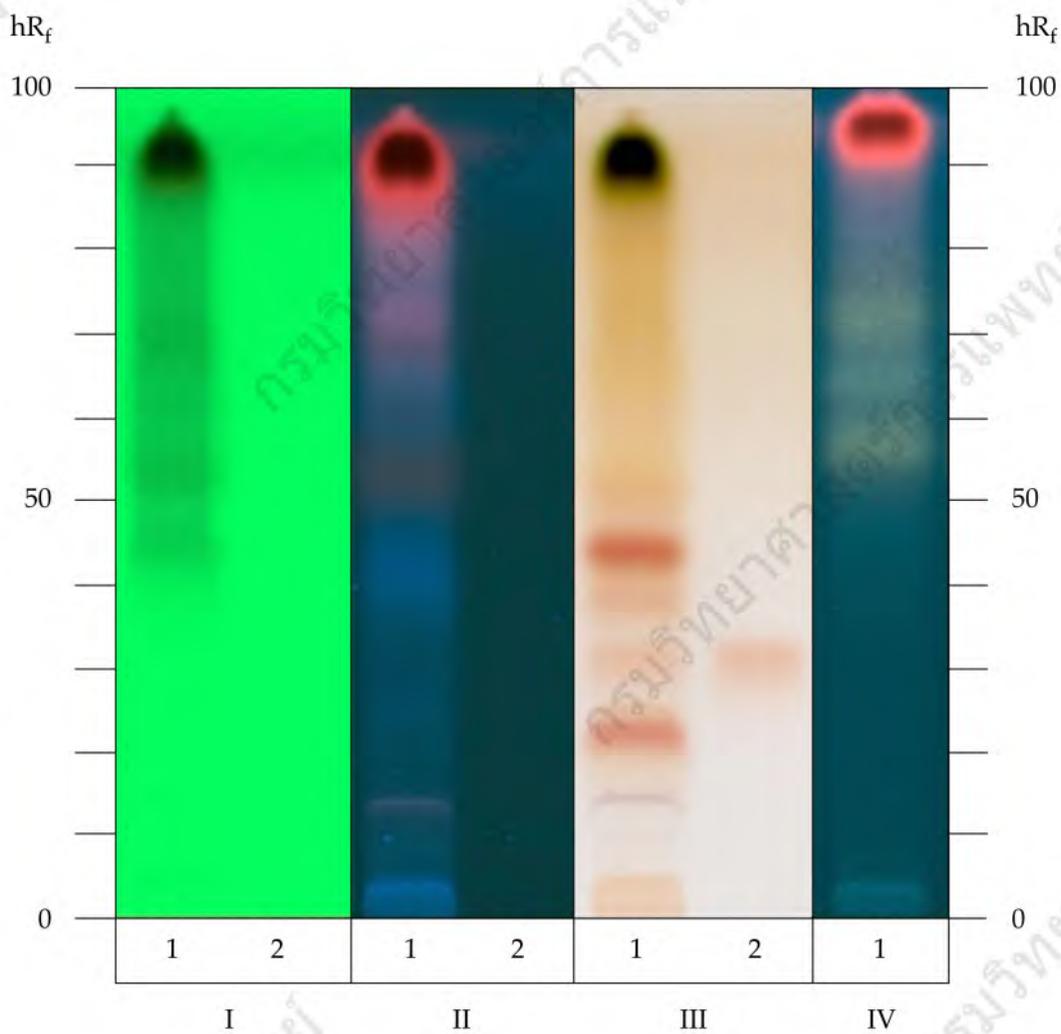


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Leaves of *Justicia gendarussa* Burm. f.

1 = solution A

2 = solution B

I = detection under UV light (254 nm)

II = detection under UV light (366 nm)

III = detection with *ninhydrin* TS

IV = detection under UV light (366 nm) after spraying with *NP/PEG* TS

สารสกัดแห้งกระท่อม (KRATHOM DRY EXTRACT)

Kratom Dry Extract

Category Analgesic, antidiarrheal.

Kratom Dry Extract is prepared from the powdered Kratom by extraction with water. It contains not less than 90.0 per cent and not more than 110.0 per cent of the labelled amount of mitragynine ($C_{23}H_{30}N_2O_4$); the labelled amount of mitragynine is not less than 10.0 per cent, calculated on dried basis.

Description Brownish yellow powder.

Packaging and storage Kratom 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 amount of mitragynine; (2) the expiration date.

Identification The chromatogram of the Assay preparation shows several peaks, one of which corresponds to that of the Standard preparation, as obtained in the Assay (Fig. 1).

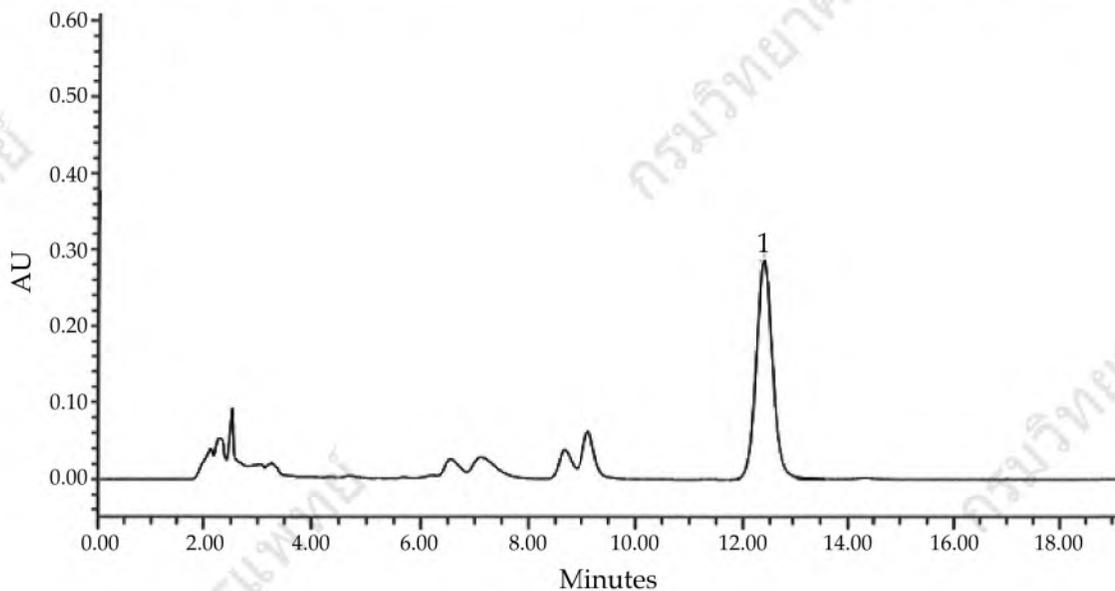


Fig. 1 HPLC Chromatogram of Kratom Dry Extract Showing Mitragynine (1)

Loss on drying Not more than 6.0 per cent w/w after drying at 105° to constant weight, use 1 g (Appendix 4.15).

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

Diluent Prepare a mixture of 8 volumes of *methanol* and 2 volumes of a 0.1 per cent v/v solution of *glacial acetic acid*.

Buffer solution Dissolve 1.54 g of *ammonium acetate* in 500 mL of *water*, adjust with *glacial acetic acid* to pH 6.0, and dilute to 1000.0 mL.

Mobile phase Prepare a mixture of 65 volumes of *acetonitrile* and 35 volumes of *Buffer solution*.

Standard preparations Dissolve a suitable quantity of Mitragynine RS in sufficient *Diluent* to obtain a stock solution having a known concentration of about 100 µg of mitragynine per mL. Dilute the solution quantitatively and stepwise with the same solvent to obtain six solutions of 10, 20, 40, 60, 80, and 100 µg of mitragynine per mL. Filter through a membrane having a 0.45-µm porosity.

Assay preparation Transfer about 25 mg of Kratom Dry Extract, in *fine powder* and accurately weighed, to a 50-mL volumetric flask and add 35 mL of *Diluent*. Sonicate for 30 minutes, allow to cool to room temperature, and adjust to volume with the same solvent. Centrifuge the resulting solution at $3218 \times g$ (5000 rpm) for 5 minutes. Use the supernatant and filter through a membrane having a 0.45-µm porosity.

Chromatographic system The chromatographic procedure may be carried out using (a) a stainless steel column (25 cm \times 4.6 mm) packed with octadecylsilane chemically bonded to porous silica or ceramic microparticles (5 µm), (b) *Mobile phase* at a flow rate of 1.0 mL per minute, and (c) an ultraviolet photometer set at 225 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 response as directed under *Procedure* and *Calculation*: the relative standard deviation for replicate injections is not more than 2.0 per cent. The symmetry factor for mitragynine peak is not more than 1.5.

Procedure and Calculation Separately inject about 20 µL of *Standard preparations* into the chromatograph, record the chromatograms, and measure the responses for the mitragynine peaks. Plot the readings and draw the standard curve of best fit: the curve shows the correlation coefficient of not less than 0.995. Inject about 20 µL of *Assay preparation* into the chromatograph, record the chromatogram, and measure the response for the mitragynine peak. By reference to the standard curve, calculate the content of mitragynine (C₂₃H₃₀N₂O₄) in the portion of the Extract taken.

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

ลำพันหางหมู, เหง้า (LAMPHAN HANG MU, NGAO)

ลำพัน, เหง้า (LAMPHAN, NGAO)

Enhali Acoroidis Rhizoma

Enhalus Acoroides Rhizome

Synonyms Eel Grass Rhizome, Sea Acorus Rhizome, Tape Seagrass Rhizome

Category Carminative.

Enhalus Acoroides Rhizome is the dried rhizome, with remnant of leaves, of *Enhalus acoroides* (L. f.) Royle (*E. koenigii* Rich., *Stratiotes acoroides* L. f.) (Family Hydrocharitaceae), Herbarium Specimen Number: DMSC 5382, Crude Drug Number: DMSc 1257.

Constituents Enhalus Acoroides Rhizome contains flavonoids and their derivatives (e.g., apigenin, luteolin, and rutin). It also contains phenolic acids, tannins, sterols, etc.

Description of the plant (Fig. 1) Aquatic herb, dioecious, submerged; rhizome creeping, up to 1.5 cm in diameter, covered with black fibrous remaining of old leaves; roots whitish, numerous, up to 30 cm long, up to 6 mm in diameter. Leaves simple, distichous, mostly 2 to 6, at apex of rhizome, strap-like, 0.3 to 1.5 m long, 1.2 to 1.8 cm wide, apex rounded or obtuse, sheathing at base, margin entire, thickened by persistent, coarse, tough, parallel veins; leaf sheath compressed, up to 15 cm long, membranous, translucent. Male inflorescence cymose, axillary and/or terminal; peduncle 5 to 10 cm long; bracts 2, sessile, slightly keeled, midvein hairy; male flowers numerous, whitish; pedicel 0.3 to 1.3 cm long; sepals 3, reflexed, oblong, about 2 mm long; petals 3, erect, broader than sepal, about 1.8 mm long; stamens 3, 1.5 to 2 mm long. Female flower solitary, axillary; peduncle 40 to 50 cm long, coiling; bracts 2, sessile, 4 to 6 cm long, 1 to 2 cm wide, greenish red to reddish green, with rough red hairy along keels and nerves; sepals 3, reddish, margin recurved; petals 3, yellowish white with pink dots, 4 to 5 cm long, 3 to 4 mm wide, folded; ovary inferior, ovoid, 6-loculed, densely long fringe-like pubescent. Fruit fleshy, greenish to brownish, ovoid, 5 to 7 cm long, apex acuminate, pericarp rough hairy, with 2 persistent bracts and elongate-coiling peduncle. Seeds 4 to 12, angular, 1 to 1.5 cm long and wide, greenish.

Description Odour, salty; taste, salty.

Macroscopical (Fig. 1) Cylindrical rhizomes, rarely branched, some slightly curved, 0.5 to 1.3 cm in diameter, covered with stiff black or light brown hairs, the remaining vein and veinlet, 3.2 to 18 cm long, and root scars; cut surface brown with dark brown to blackish circular ring in the centre.

Microscopical (Figs. 2a–2c) Transverse section of the rhizome shows epidermis, cortex, and vascular tissue. Epidermis: a layer of rectangular cells. Cortex: several layers of thick-walled parenchyma, some containing dark brown substance and/or orange to brown tannin and/or numerous large or small starch grains; aerenchyma; and pseudoendodermis, a layer of irregularly shaped cells. Vascular tissue: collateral vascular bundles, scattered in the cortex, non-lignified fibres, and vessels.

Transverse section of the hair shows numerous non-lignified bast fibres with brown substance and vascular tissue on one side.

Enhalus Acoroides Rhizome in powder possesses the diagnostic microscopical characters of the unground drug. Bundle of non-lignified fibres of hair is characteristic. The combination of parenchyma containing orange to brown tannin, parenchyma containing various sizes of starch grains, and aerenchyma should be characteristic.



Fig. 1 *Enhalus acoroides* (L. f.) Royle

1. habit
2. plant showing part of leaves, and fruits
3. male inflorescence, with bracts opened (a), and male flower (b)
4. female flower
5. fruits with coiled stalks
6. dehiscent fruits with remaining pericarps, and seeds
7. crude drug

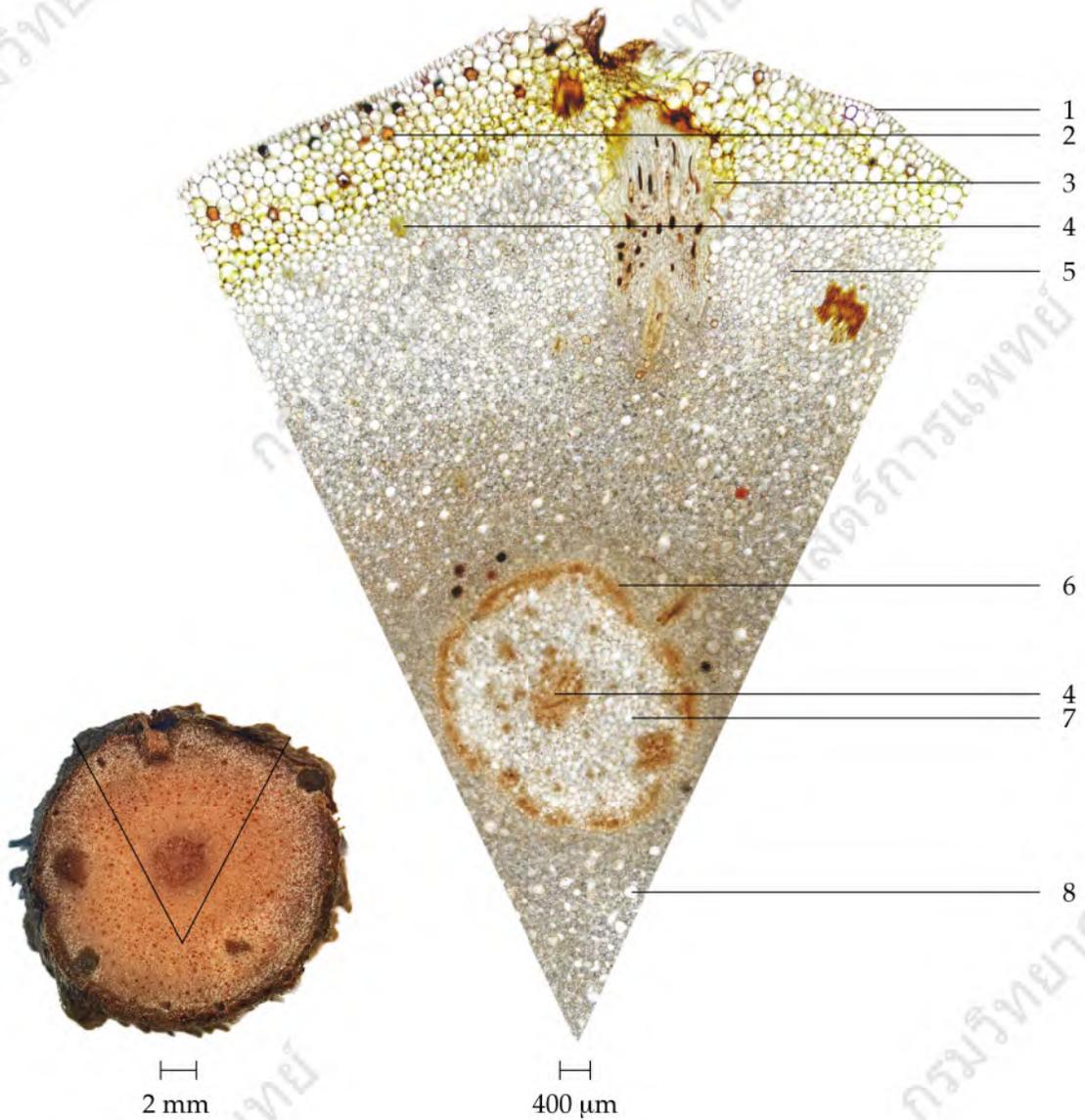


Fig. 2a Photomicrographs of Transverse Sections of the Rhizome of *Enhalus acoroides* (L. f.) Royle

- | | |
|---|--|
| 1. epidermis | 5. parenchyma containing starch grains |
| 2. parenchyma containing orange to brown tannin | 6. pseudoendodermis |
| 3. rootlet primordia | 7. parenchyma |
| 4. vascular tissue | 8. air space |

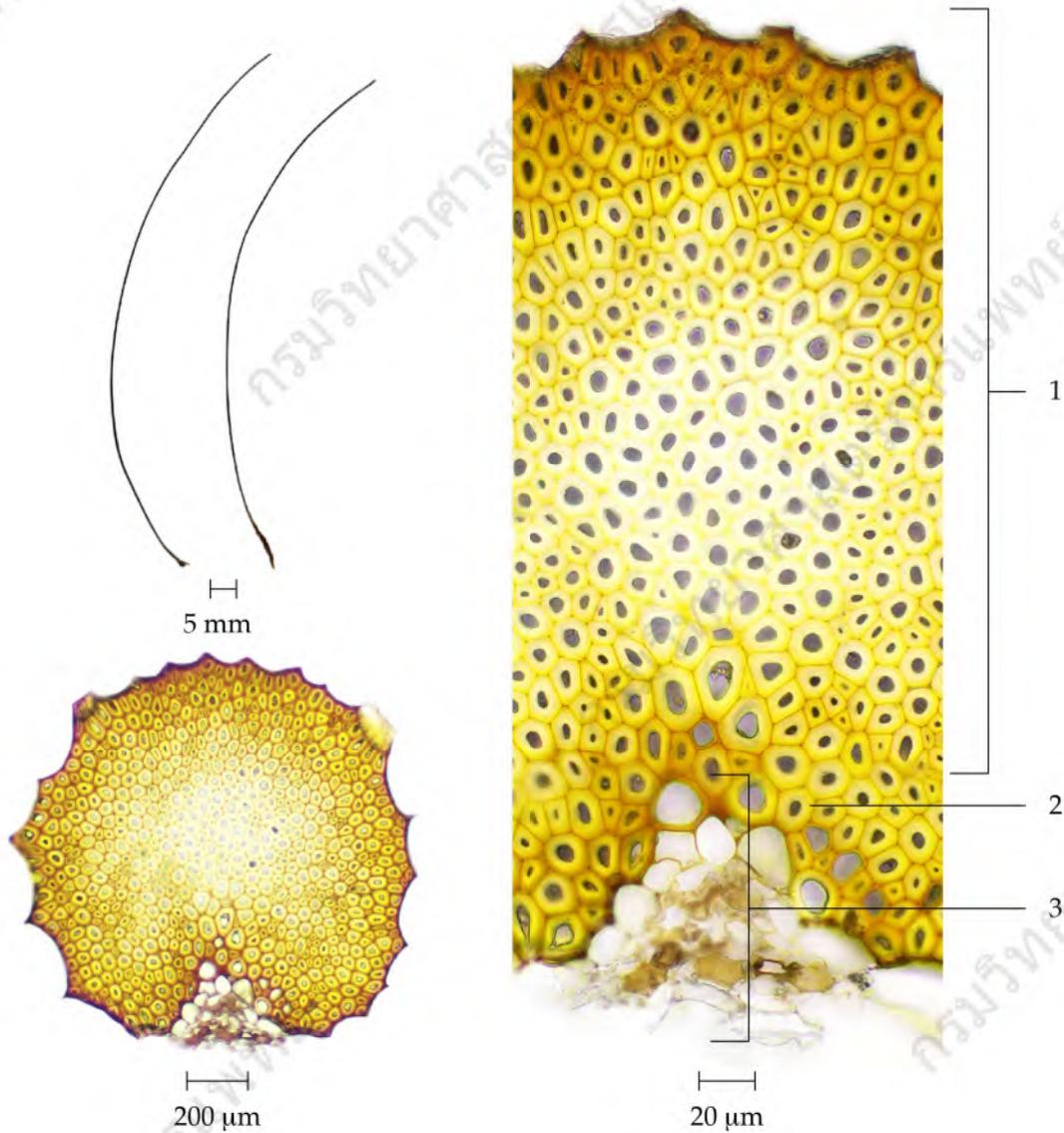


Fig. 2b Photomicrographs of Transverse Sections of the Stiff Black Hair of *Enhalus acoroides* (L. f.) Royle
 1. non-lignified bast fibres
 2. non-lignified bast fibre containing brown substance
 3. vascular tissue

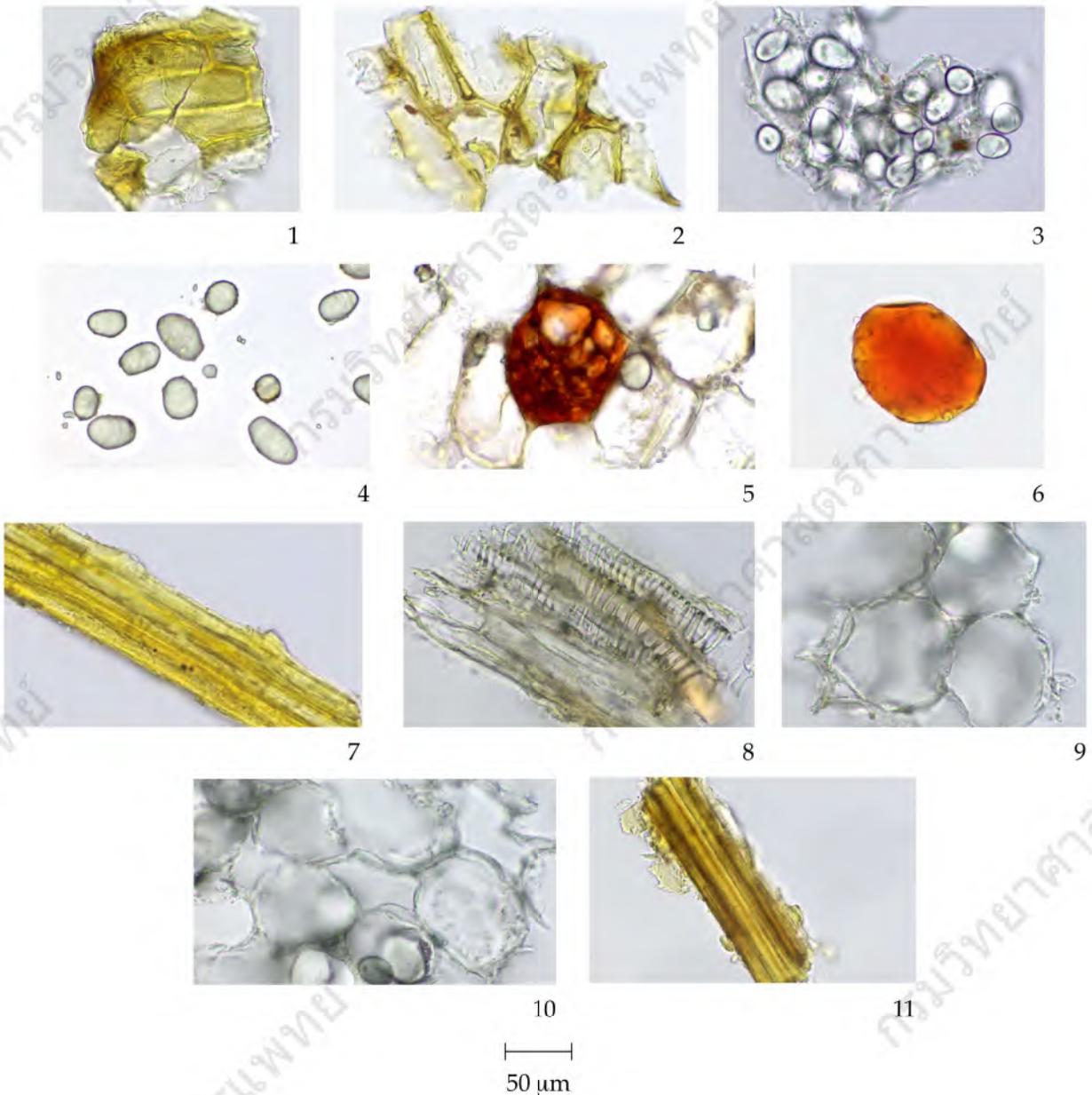


Fig. 2c Photomicrographs of Powdered Drug of the Rhizomes and the Stiff Black Hairs of

Enhalus acoroides (L. f.) Royle

- | | |
|---|---|
| 1. epidermis in surface view | 7. bundle of non-lignified fibres |
| 2. thick-walled parenchyma | 8. reticulate vessels with adjacent parenchyma |
| 3. parenchyma containing starch grains | 9. parenchyma |
| 4. starch grains | 10. aerenchyma |
| 5. parenchyma containing orange to brown tannin and starch grains | 11. non-lignified bast fibres of stiff black hair |
| 6. orange to brown tannin | |

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

Identification

A. Reflux 2 g of the sample, in *fine powder*, with 25 mL of *ethanol* for 10 minutes and filter. To 2 mL of the filtrate, add 2 to 3 pieces of *magnesium ribbon*, shake well, and mix with a few drops of *hydrochloric acid*: a pinkish red colour is produced.

B. Boil 1 g of the sample, in *fine powder*, with 20 mL of *water* for a few minutes and filter. To 1 mL of the filtrate, add a few drops of *iron(III) chloride TS* and shake well: a greenish brown 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 45 volumes of *toluene*, 45 volumes of *ethyl acetate*, 6 volumes of *formic acid*, and 1.5 volumes of *methanol* 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 8 mm, 10 μ L of solution (A) and 2 μ L of solution (B). Prepare solution (A) by refluxing 2 g of the sample, in *fine powder*, with 25 mL of *ethanol* for 10 minutes and filtering. For solution (B), dissolve 1 mg of *luteolin* in 1 mL of *ethanol*. After removal of the plate, allow it to dry in air. Examine the plate under ultraviolet light (254 nm); marking the quenching bands. The chromatogram obtained from solution (A) shows a quenching band (hR_f value 51 to 55) corresponding to the luteolin band obtained from solution (B). Subsequently examine the plate under ultraviolet light (366 nm); the band corresponding to luteolin shows a dark fluorescence. Other three blue fluorescent bands are observed. Spray the plate with *anisaldehyde TS*, heat at 105° for 10 minutes, and examine under ultraviolet light (366 nm); the band due to luteolin is green fluorescent. One dark, two blue, and two white fluorescent bands are also observed (Fig. 3).

Repeat the same procedure on another plate. After removal of the plate, allow it to dry in air. Heat the plate at 80° for 10 minutes and then spray the plate 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) within 5 to 15 minutes; the band due to luteolin is orange fluorescent. One blue and one yellow fluorescent bands are also observed (Fig. 3).

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).

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

Total ash Not more than 14.0 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 8.0 per cent w/w (Appendix 7.12).

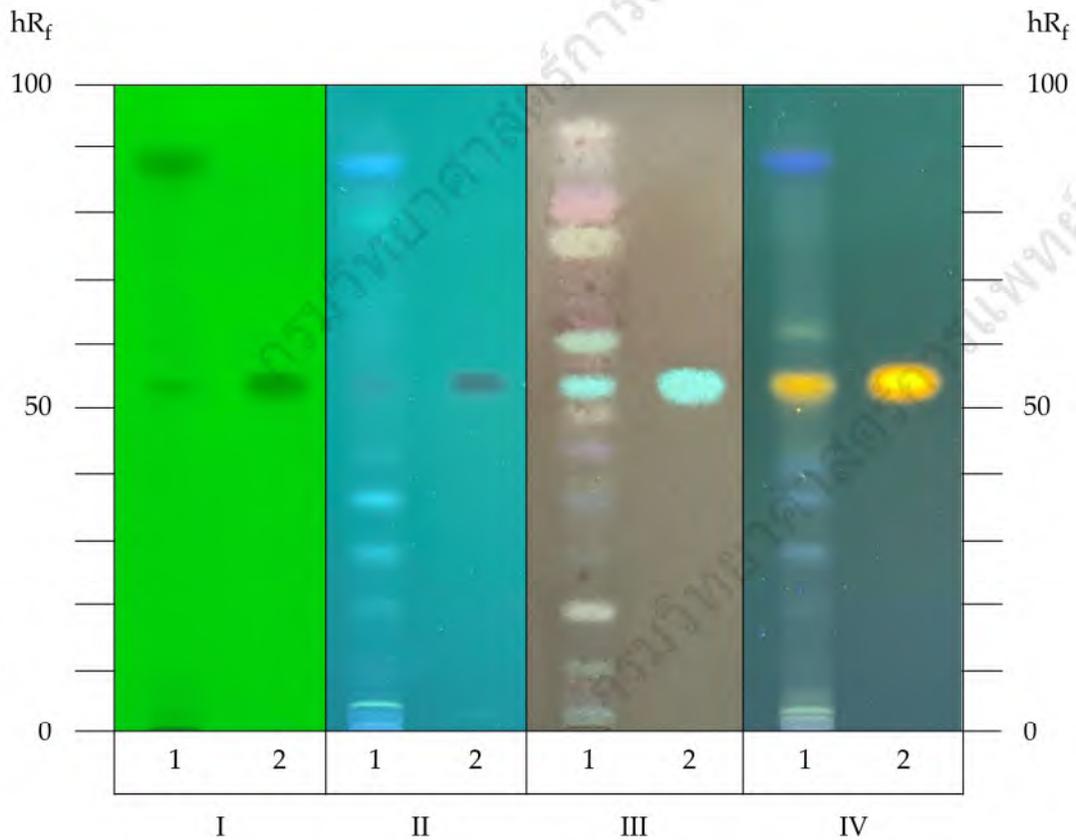


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Rhizomes of *Enhalus acoroides* (L. f.) Royle

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 *anisaldehyde TS*

IV = detection under UV light (366 nm) after spraying with *NP/PEG TS*

มะกา, ใบ (MAKA, BAI)

มัดกา, ใบ (MAT KA, BAI)

Brideliae Ovatae Folium

Bridelia Ovata Leaf

Category Mild laxative.

Bridelia Ovata Leaf is the dried leaf of *Bridelia ovata* Decne. (*B. ovata* Decne. var. *genuina* Müll. Arg.) (Family Phyllanthaceae), Herbarium Specimen Number: DMSC 5331, Crude Drug Number: DMSc 1152.

Constituents Bridelia Ovata Leaf contains triterpenoids such as friedelin. It also contains sterols, etc.

Description of the plant (Fig. 1) Scrambling shrub to tree, up to 8 m tall, monoecious; branchlets glabrous, with scattered lenticels. Leaves simple, alternate, elliptic, oblong to ovate, 5 to 18 cm long, 2 to 8(-10) cm wide, apex obtuse, rounded to bluntly acute, base slightly cordate to obtuse, margin entire or undulate, chartaceous, glabrous, venation prominent on both sides, nerves in 13 to 17 pairs, joining into marginal vein, tertiary veins reticulate; petiole terete, 3 to 6 mm long, glabrous; stipule narrowly triangular or subulate, up to 1 cm long and 1.2 mm wide, glabrous, caducous. Inflorescence glomerule, axillary; bract ovate-triangular, up to 2 mm long, 1 to 1.5 mm wide. Flowers unisexual, 1 to 20 or more per glomerule, subsessile; pedicel 1.5 to 2.5 mm long; sepals 5, triangular, up to 2 mm long and 1.5 mm wide, glabrous, greenish cream tinged with red; petals 5, elliptic, 0.5 to 1.2 mm long, 0.7 to 1 mm wide, whitish yellow, apex notched or sometimes rounded. Male flower 3 to 5 mm in diameter, disc about 2 mm in diameter; stamens 5, staminal column about 1 mm long, free part of filament up to 0.8 mm long, anther shortly ellipsoid, about 0.5 mm long, 0.3 to 0.4 mm wide; pistillode conical-ovoid, up to 0.7 mm long and 0.4 mm wide, apex bifid. Female flower 4 to 6 mm in diameter, flat disc about 2.5 mm in diameter, tubular disc up to 1 mm long, fully covering ovary; ovary superior, globose, 0.6 to 1 mm in diameter, 2-loculed, each locule with 2 ovules, styles 2, up to 1.2 mm long, basally united, stigma deeply bifid; pedicel often shorter and stouter than that of male flower. Fruit drupaceous, tardily dehiscent, up to 9 per glomerule, depressed-ellipsoid to globose, bilobed, apically emarginate, 5 to 7 mm long, 6 to 7.5 mm wide, pale greenish when young, becoming purple to black when aged; endocarps woody, subglobose, brown. Seed subglobose, 3.5 to 5 mm long, 4.5 to 5 mm wide, laterally furrowed, reddish black, shiny.

Description Odour, mild, characteristic; taste, bitter.

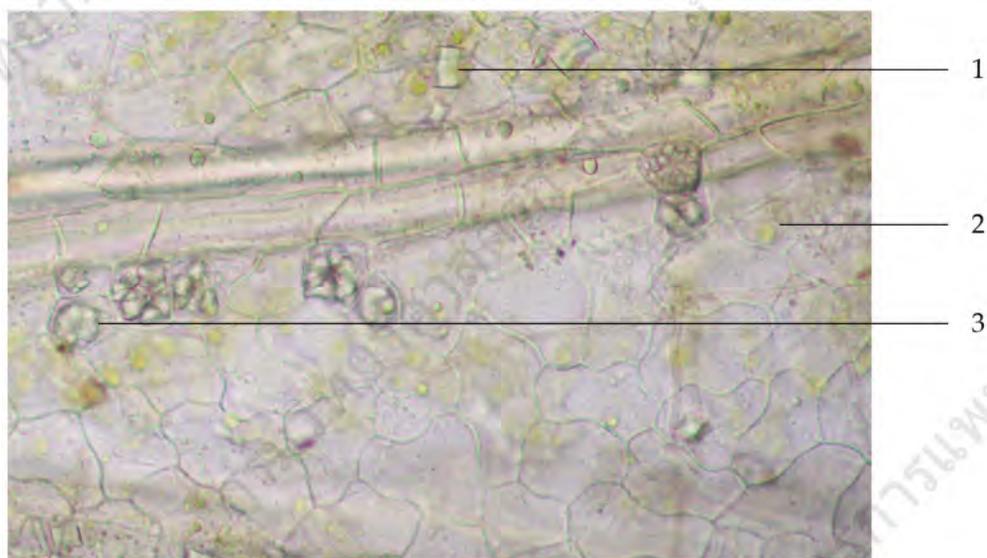
Macroscopical (Fig. 1) Dried entire or broken leaves, shortly petiolate, blade chartaceous, greenish brown, upper surface slightly shiny, lower surface with some farina; entire leaves elliptic, oblong to ovate, apex obtuse, rounded to bluntly acute, base slightly cordate to obtuse, margin entire or undulate.

Microscopical (Figs. 2a-2d) Transverse section of the leaf through the midrib shows upper epidermis, mesophyll, vascular tissue, and lower epidermis. Upper epidermis: 1 to 2 layers of polygonal cells, some containing rosette aggregate or prismatic crystals, or microcrystals. Mesophyll: 1 to 2 layers of cylindrical palisade cells, some containing prismatic or rosette aggregate crystals or brown substances; spongy cells, round-shaped, some containing prismatic or rosette aggregate crystals or microcrystals; collenchyma and parenchyma, some containing brown substances and/or rosette aggregate or prismatic crystals or microcrystals, in the upper and lower parts of the midrib. Vascular tissue: phloem and xylem. Lower epidermis: a layer of subrounded cells, some containing rosette aggregate crystals or brown substances, and stomata.

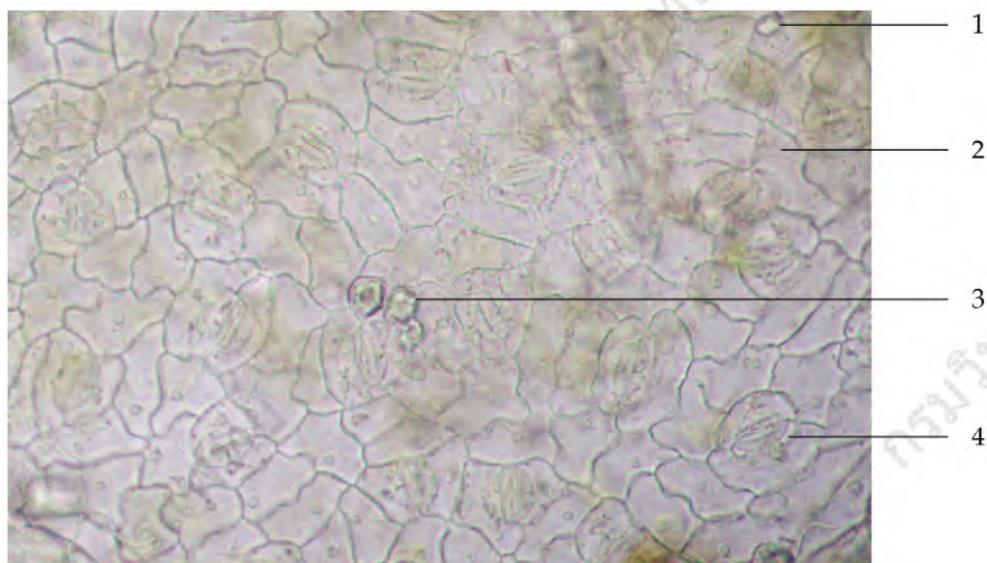


Fig. 1 *Bridelia ovata* Decne.

1. habit 2. leaves 3. flowering twig 4. female inflorescences 5. female flowers
 6. infructescences 7. mature fruits 8. crude drug



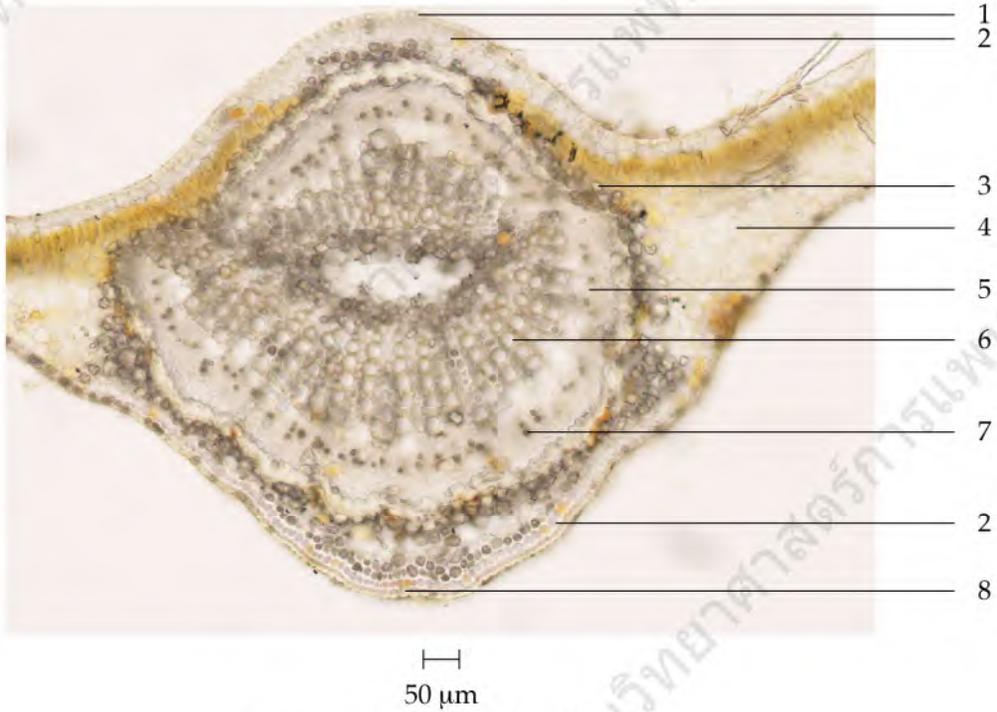
Upper Epidermis of the Lamina



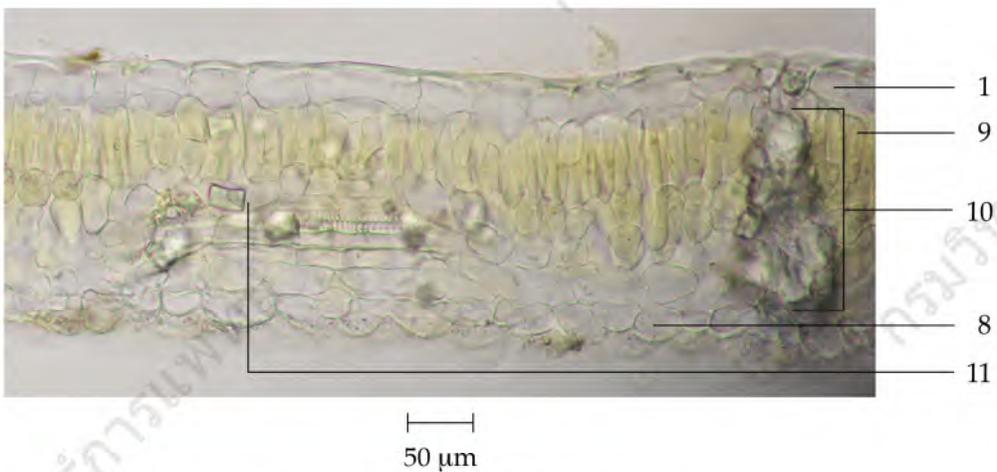
Lower Epidermis of the Lamina

Fig. 2a Photomicrographs of Epidermises of the Leaf of *Bridelia ovata* Decne.

- | | |
|----------------------|------------------------------|
| 1. prismatic crystal | 3. rosette aggregate crystal |
| 2. epidermal cell | 4. paracytic stoma |



Transverse Section of the Midrib



Transverse Section of the Lamina

Fig. 2b Photomicrographs of Transverse Sections of the Leaf of *Bridelia ovata* Decne.

- | | |
|----------------------|---|
| 1. upper epidermis | 7. rosette aggregate crystal |
| 2. collenchyma | 8. lower epidermis |
| 3. prismatic crystal | 9. palisade cell |
| 4. parenchyma | 10. vascular tissue |
| 5. phloem | 11. spongy cell, some containing
prismatic crystal |
| 6. vessel | |

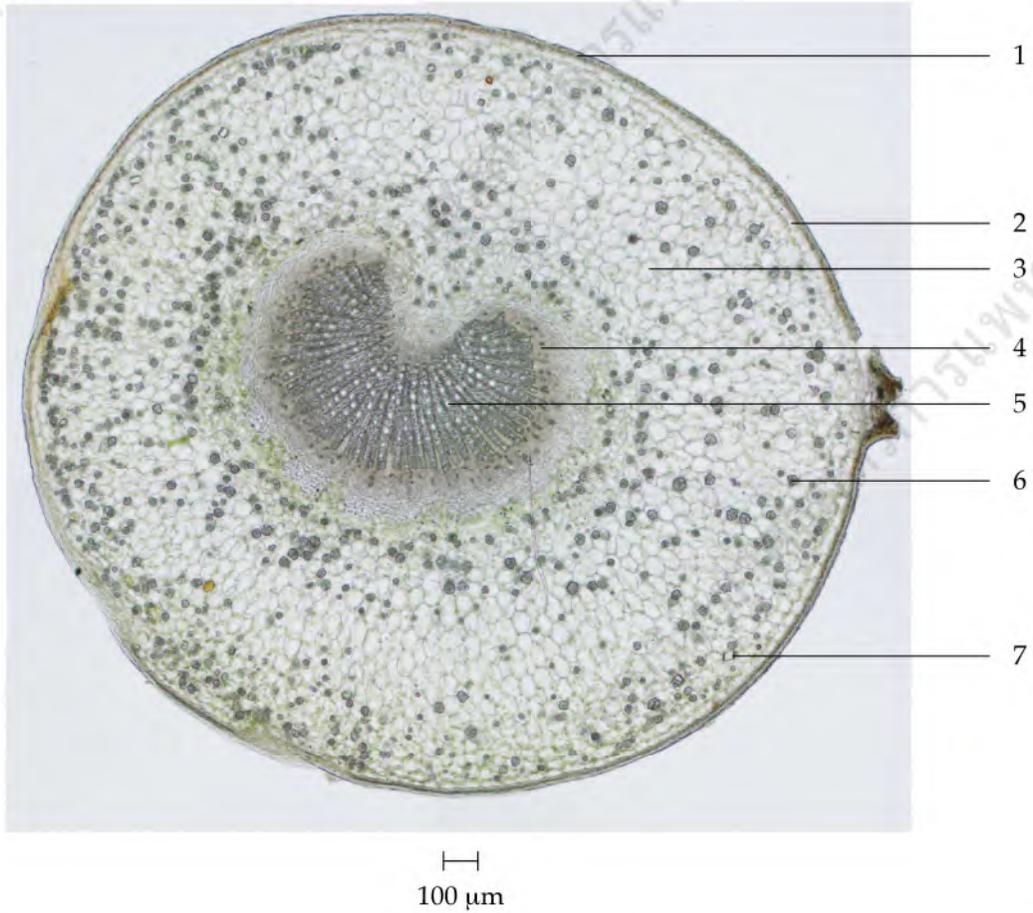


Fig. 2c Photomicrograph of Transverse Section of the Petiole of *Bridelia ovata* Decne.

- | | |
|----------------|------------------------------|
| 1. epidermis | 5. vessel |
| 2. collenchyma | 6. rosette aggregate crystal |
| 3. parenchyma | 7. prismatic crystal |
| 4. phloem | |

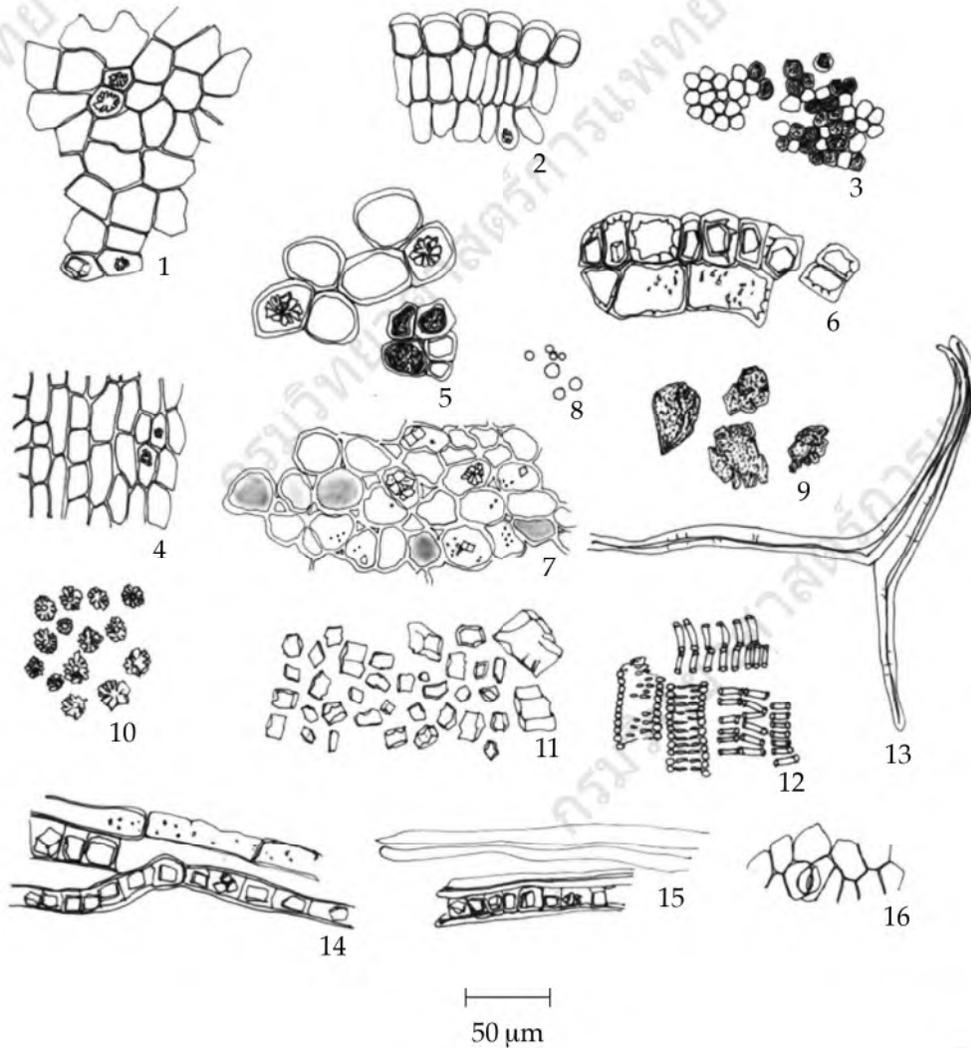


Fig. 2d Line Drawings of Powdered Drugs of the Leaves of *Bridelia ovata* Decne.

1. epidermis, in surface view, some containing rosette aggregate or prismatic crystals
2. upper epidermis and palisade cells, some containing rosette aggregate crystal, in sectional view
3. palisade cells, in top view, some containing brown substances
4. epidermis, in surface view, some containing rosette aggregate crystals
5. parenchyma, some containing rosette aggregate crystals and brown substances
6. sclereids, some containing prismatic crystals
7. collenchyma, some containing yellowish substances, microcrystals, rosette aggregate crystals, or prismatic crystals
8. oil droplets
9. dark brown substances
10. rosette aggregate crystals
11. prismatic crystals
12. pitted, reticulate, and spiral vessels
13. fibres
14. parenchyma and fibre with prismatic sheaths
15. fibres and fibres associated with prismatic sheath
16. lower epidermis with paracytic stoma

Transverse section of the petiole shows epidermis, cortex, and vascular tissue. Epidermis: a layer of subrounded cells containing brown substances. Cortex: 1 to 2 layers of collenchyma, some containing rosette aggregate crystals; parenchyma, numerous round-shaped cells, some containing rosette aggregate or prismatic crystals or microcrystals or brown substances, and sclereids. Vascular tissue: slight secondary growth, phloem and xylem; phloem, several layers of fibres, phloem ray, some containing rosette aggregate crystals, sieve tube cells, and companion cells; xylem, vessels, xylem rays, xylem fibres, and xylem parenchyma, some containing brown substances.

Bridelia Ovata Leaf in powder possesses the diagnostic microscopical of the unground drug. Microcrystals, rosette aggregate and prismatic crystals can be seen in abundance in almost all tissues, particularly in epidermis and palisade cells. Sclereids containing prismatic and rosette aggregate crystals are characteristic.

Packaging and storage Bridelia Ovata Leaf 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 10 mL of *methanol*, shake, allow to stand for 20 minutes, and filter. Evaporate 2 mL of the filtrate to dry and dissolve the residue in 1 mL of *acetic anhydride*. Slowly add 1 mL of *sulfuric acid* to form two layers: the upper layer changes to a green colour and a brownish red ring forms at the zone of contact.

B. Carry out the test as described in the “Thin-Layer Chromatography” (Appendix 3.1), using a high-performance plate with *silica gel GF254* as the coating substance and *chloroform* 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 10 mm, 15 μ L of the test solution prepared by adding 10 mL of *methanol* to 500 mg of the sample, in *fine powder*, shaking, allowing to stand for 20 minutes, and filtering. After removal of the plate, allow it to dry in air. Spray the plate with *anisaldehyde TS*, heat at 105° for about 5 minutes, and examine under ultraviolet light (366 nm). Six grey and nine red fluorescent bands are observed (Fig. 3).

Loss on drying Not more than 7.0 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 1.0 per cent w/w (Appendix 7.6).

Total ash Not more than 12.0 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 13.0 per cent w/w (Appendix 7.12).

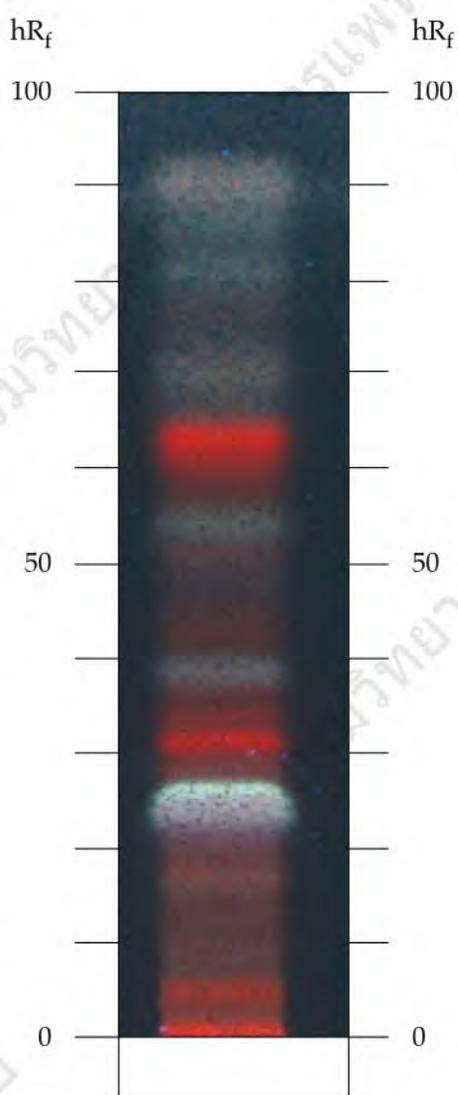


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Leaves of *Bridelia ovata* Decne., Detected Under UV Light (366 nm) After Spraying With *Anisaldehyde* TS

มะขาม, เนื้อในเมล็ด (MAKHAM, NUEA NAI MALET)

บักขาม, เนื้อในเมล็ด (BAKKHAM, NUEA NAI MALET)

Tamarindi Indicae Kernel

Tamarind Kernel

Category Antidiarrheal, anthelmintic.

Tamarind Kernel is the dried kernel of *Tamarindus indica* L. (Family Leguminosae-Caesalpinioideae), Herbarium Specimen Number: DMSC 5303, Crude Drug Number: DMSc 1264.

Constituents Tamarind Kernel contains proteins, fatty acids, and polysaccharides.

Description of the plant (Fig. 1) Tree, up to 30 m tall; bark thick, rough, dark ash or brown, longitudinally fissured; crown rounded, dense; branchlets spreading, pubescent when young, becoming glabrous when aged. Leaves paripinnate, alternate or spiral; stipule minute, caducous; leaflets sessile, opposite, 6 to 20 pairs, oblong or oblong-linear, 0.8 to 3 cm long, 3 to 9 mm wide, apex rounded, mucronate, or emarginate, base oblique, margin entire, chartaceous, glabrous. Inflorescence raceme, lax, terminal or axillary, 2 to 16 cm long, drooping; peduncle up to 1 cm long; bract caducous. Flower: flower bud turbinate; sepals 4, petal-like, creamy yellow, elliptic-lanceolate, 0.6 to 1.2 cm long, about 5 mm wide, imbricate; petals 3, unequal, yellowish orange or yellow tinged with purplish red stripes, obovate, 0.8 to 1.3 cm long, 2 to 6 mm wide, apex acute, base attenuate, margin repand, curled, median lobe smaller, lateral lobes fairly larger; fertile stamens 3(-4), about 1 cm long, monadelphous; ovary superior, linear, about 7 mm long, slightly incurved, 1-loculed, pubescent, with numerous ovules; stigma nearly capitate. Fruit a pod, indehiscent, brown, oblong or terete-oblong, 5 to 20 cm long, 1 to 3 cm wide, straight or incurved, often irregularly constricted. Seeds 3 to 14, obovate-orbicular or rhomboid, compressed, 1 to 2 cm long, about 1 cm wide, dark brown, glossy, embedded in soft and sticky, sweet or sour, blackish brown pulp.

Description Odour mild; taste, bland.

Macroscopical (Fig. 1) Mostly half-kernels, flat, ovate, elliptic, obovate, or oblong in shape; base cordate, apex rounded; about 1.2 cm long and 0.8 to 1 cm wide. Outer surface smooth, matte or glossy, occasionally exhibiting alternating light and dark concentric rings. Inner surface smooth with a distinct raised margin; cream to pale yellow or light brown, sometimes with concentric ring patterns of varying intensity.

Microscopical (Figs. 2a, 2b) Transverse section of the kernel shows embryo. Embryo: cotyledon, an epidermal layer, numerous thick-walled parenchyma containing starch grains; parts of epicotyl and hypocotyl.

Tamarind Kernel in powder possesses the diagnostic microscopical characters of the unground drug. Thick-walled parenchyma containing starch grains is characteristic.



1



2



3



4



5



6

Fig. 1 *Tamarindus indica* L.

1. habit 2. flowering twig 3. flower 4. fruiting branches showing pods
5. pods showing part of shells, fresh pulp, fibrous strands, and seeds 6. crude drug



Fig. 2a Photomicrographs of Transverse Section of the Kernel of *Tamarindus indica* L.

- | | |
|--|--|
| 1. epidermis of cotyledon | 4. vascular tissue |
| 2. thick-walled polygonal parenchyma | 5. cotyledon |
| 3. parenchyma containing starch grains | 6. part of embryo showing epicotyl and hypocotyl |

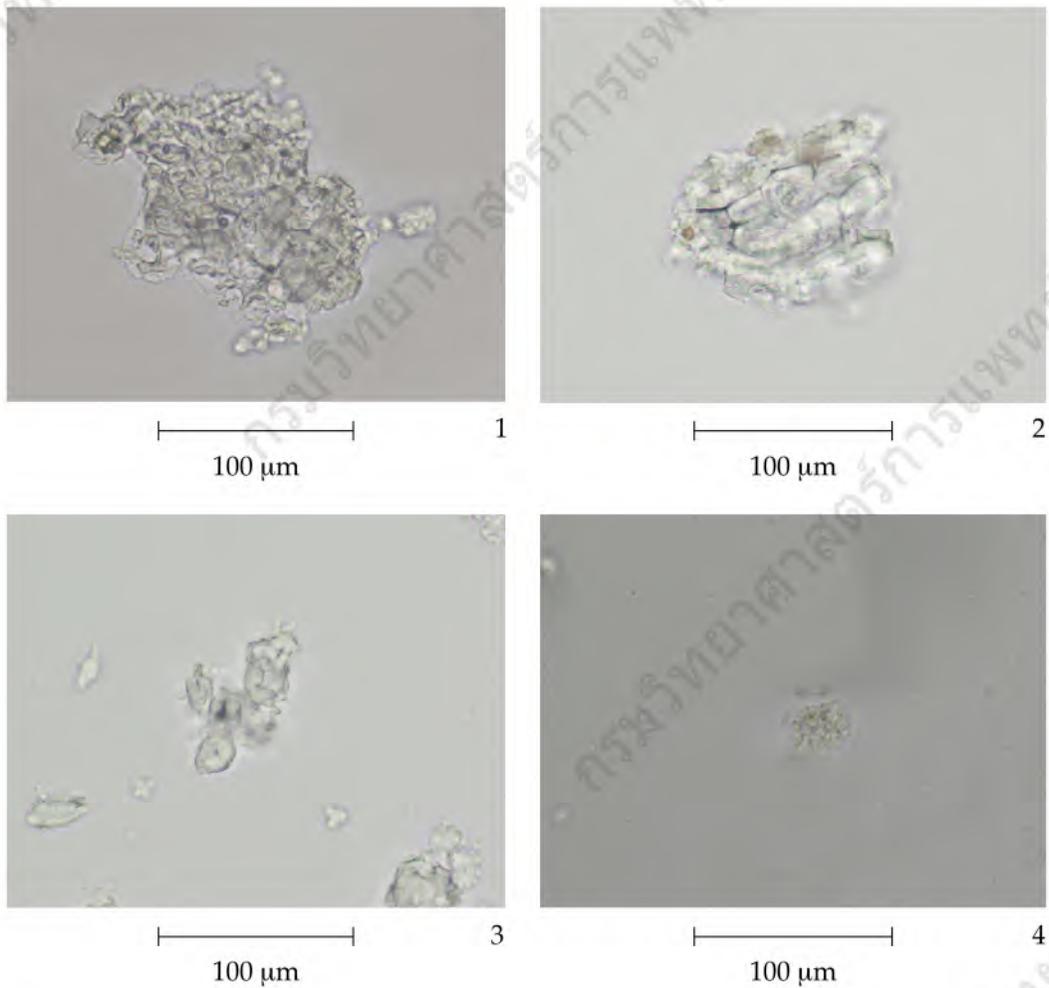


Fig. 2b Photomicrographs of Powdered Drug of the Kernels of *Tamarindus indica* L.
 1. parenchyma of epicotyl
 2. parenchyma of cotyledon containing starch grains
 3. part of thick-walled parenchyma of cotyledon
 4. parenchyma containing starch grains

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

Before carrying out the physico-chemical tests, Tamarind Kernel shall be treated by stir-frying, cracking, and removing their shells in order to obtain their kernels.

Identification

A. Heat 1 g of the sample, in powder, with 25 mL of methanol in a water-bath for 15 minutes and filter. To 2 mL of the filtrate, add a few drops of *ninhydrin TS* and warm on a water-bath for a few minutes: a violet colour develops.

B. Heat 500 mg of the sample, in powder, with 25 mL of *water* in a water-bath for 15 minutes and filter. To 2 mL of the filtrate, add 4 to 5 drops of a 1 per cent w/v solution of *iodine*: a blue 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 35 volumes of *n-butanol*, 35 volumes of *acetone*, 20 volumes of *water*, 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 as a band of 7 mm, 15 µL of the test solution prepared by heating 1 g of the sample, in powder, with 25 mL of *methanol* in a water-bath for 15 minutes and filtering. After removal of the plate, allow it to dry in air. Examine the plate under ultraviolet light (254 nm), marking the quenching bands. Subsequently examine the plate under ultraviolet light (366 nm); one blue fluorescent band is observed. Spray the plate with *ninhydrin TS* and heat at 110° for 5 minutes; one purple and three brown bands are observed (Fig. 3).

Loss on drying Not more than 8.0 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 3.0 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 33.0 per cent w/w (Appendix 7.12); use 1.0 g.

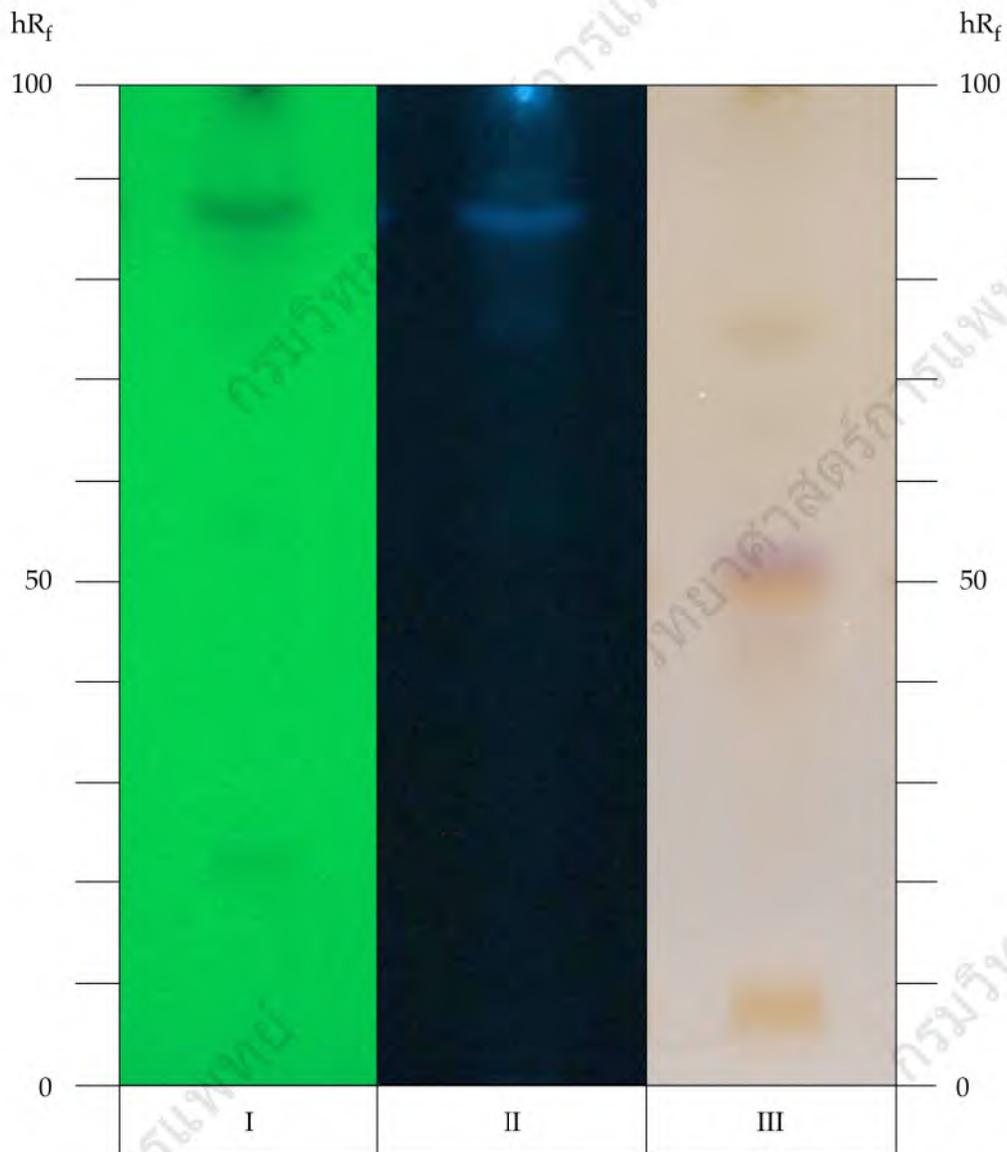


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Kernels of *Tamarindus indica* L.

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

มะนาว, ฝิว (MANAO, PHIO)

บักนาว, ฝิว (BAK NAO, PHIO), ส้มนาว, ฝิว (SOM NAO, PHIO)

Citri Aurantiifoliae Exocarpium et Mesocarpium

Lime Peel

Synonyms Common Lime Peel, Sour Lime Peel

Category Carminative, antifatulent.

Lime Peel is the dried exocarp with unremovable mesocarp of *Citrus × aurantiifolia* (Christm.) Swingle [*C. × javanica* Blume, *C. × medica* f. *aurantiifolium* (Christm.) M. Hiroe, *Limonia × aurantiifolia* Christm.] (Family Rutaceae), Herbarium Specimen Number: DMSC 5329, Crude Drug Number: DMSc 1261.

Constituents Lime Peel contains volatile oils consisting of limonene, β -pinene, and α -terpineol. It also contains limonoids and flavonoids, i.e., hesperidin. Other compounds are coumarins, phenolic acids, carotenoids, etc.

Description of the plant (Fig. 1) Shrub or small tree, 0.5 to 5(–8) m tall, much branched; stem glabrous; branchlets compressed-angular when young, spiny; spines numerous. Leaves unifoliolate, alternate or spirally arranged, elliptic, elliptic-oblong, oblong-ovate, or ovate, 2 to 8(–11) cm long, 1 to 5.5 cm wide, apex acute, obtuse to cuneate, base cuneate or obtuse to rounded, margin entire to crenulate, subcoriaceous, shiny, with scattered pellucid dots; petiole broadly winged, triangular, obovate, or oblanceolate, 2 to 3 cm long, 2 to 9 mm wide. Inflorescence axillary or terminal, raceme, cyme, or solitary, 7(–15)-flowered in fascicled, fragrant; peduncle 3 to 5 mm long. Flower white to yellowish white; pedicel 2 to 5 mm long; calyx cupular, 2 to 3 mm long, 4- to 5-lobed, lobe broadly triangular or ovate, about 1 mm long, fleshy, glabrous or puberulent; petals 4 to 5, oblanceolate, oblong-lanceolate, oblong, or ovate, 0.7 to 1.5 cm long, 2.5 to 5 cm wide, apex acute, fleshy, reflexed at anthesis; stamens white, numerous, filament 2 to 6 mm long, polyadelphous, anther bright yellow, oblong, linear, to linear-sagittate, 2 to 3 mm long, intrastaminal disc about 1 mm high; ovary superior, style white, 2 to 3 mm long, glabrous, caducous, stigma capitate, bright yellow. Fruit a hesperidium, ellipsoid, obovoid to globose, 2.5 to 6 cm in diameter, sometimes with apical papilla; exocarp thin, glabrous, glossy, greenish when young, turning greenish yellow to yellowish when ripe; mesocarp white, spongy; segments 9 to 12; fruit-pulp pale greenish, juicy, sour, aromatic. Seeds whitish, few to numerous, elliptic-oblong to ovoid, about 5 mm long.

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

Macroscopical (Fig. 1) Dried external peels with some unremovable mesocarp, varied in shape and size; outer surface, yellowish green to brownish green, slightly rough, hard, brittle; inner surface whitish to pale yellowish.

Microscopical (Figs. 2a–2c) Transverse section of the peel shows exocarp with some unremovable mesocarp. Exocarp: a layer of rectangular epidermal cells containing yellowish green substances and some containing prismatic crystals or oil droplets, and stomata, covered with thick cuticle layer. Mesocarp: parenchyma, several layers of slightly thick-walled cells, some containing yellowish green substances, oil droplets or prismatic crystals; schizolysigenous oil cavities; vascular tissue, phloem and xylem.

Lime Peel in powder possesses the diagnostic microscopical of the unground drug. Epidermal layer with stomata, oil droplets, and prismatic crystals can be seen in abundance. Part of oil cavity and thick-walled parenchyma of mesocarp can also be seen.



Fig. 1a *Citrus × aurantiifolia* (Christm.) Swingle

1. habit 2. inflorescence 3. flowers 4. leaves and fruits 5. fruits 6. halved fruit 7. crude drug

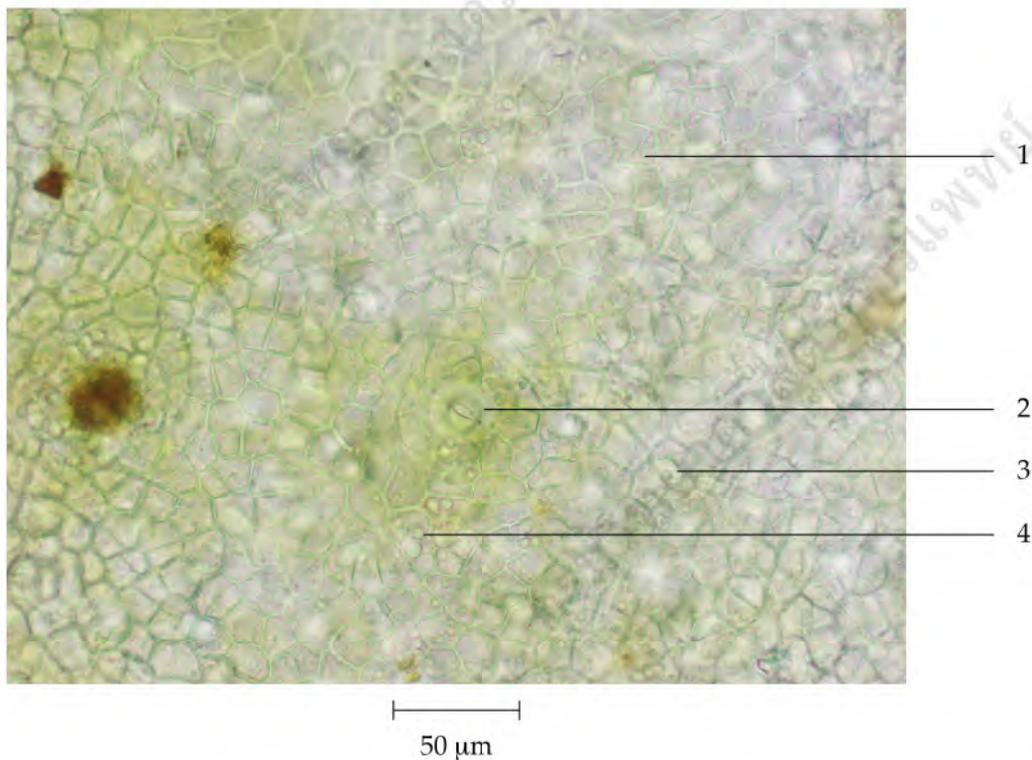


Fig. 2a Photomicrograph of Surface View of the Exocarp of *Citrus x aurantiifolia* (Christm.) Swingl
 1. epidermal cell
 2. paracytic stoma
 3. prismatic crystal
 4. oil droplet

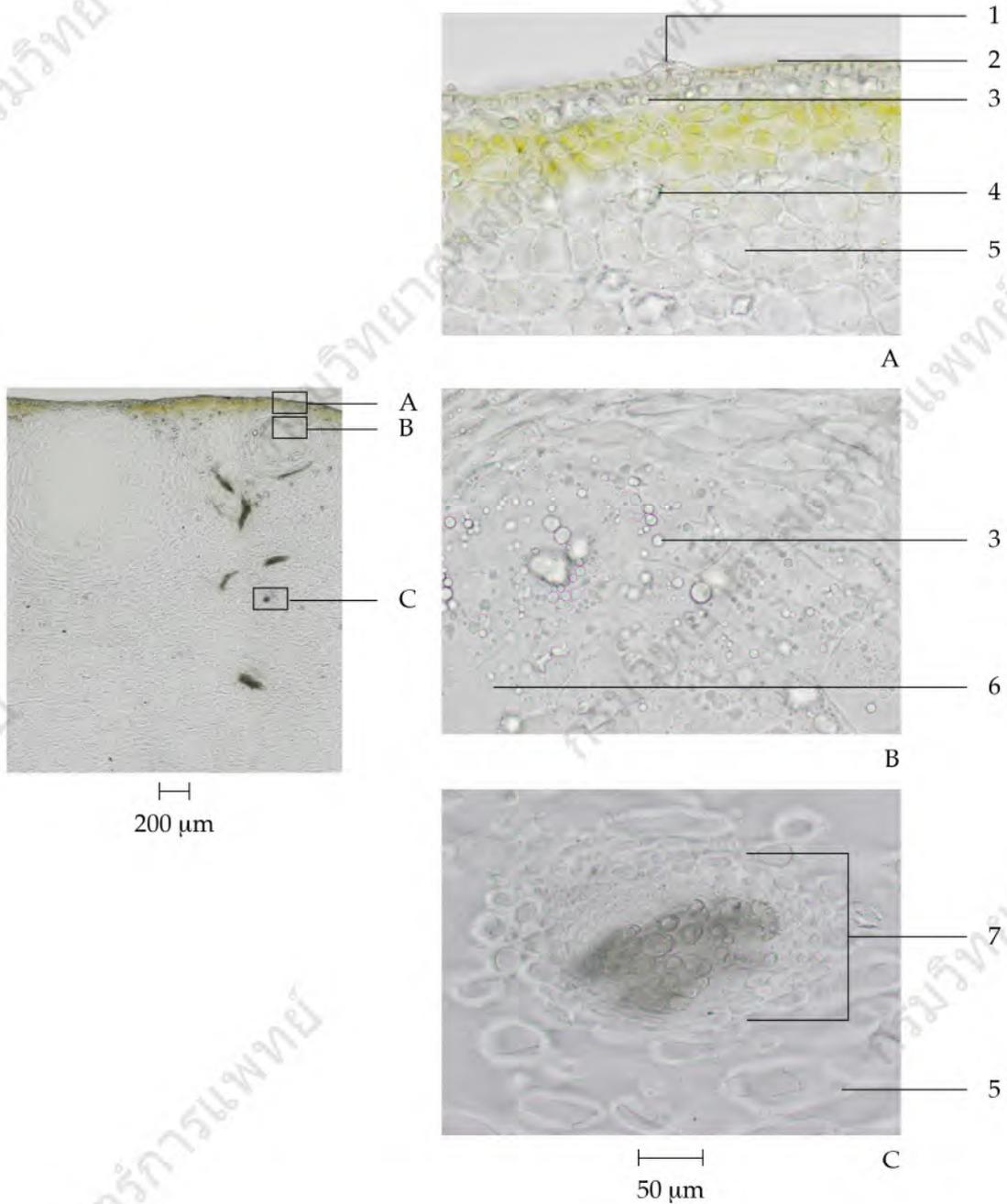


Fig. 2b Photomicrographs of Transverse Sections of the Exocarp and Mesocarp of *Citrus × aurantiifolia* (Christm.) Swingle

A. Exocarp and Mesocarp

B. and C. Mesocarp

1. stoma

2. epidermis with cuticle layer

3. oil droplet

4. prismatic crystal

5. parenchyma

6. schizolysigenous oil cavity

7. vascular tissue

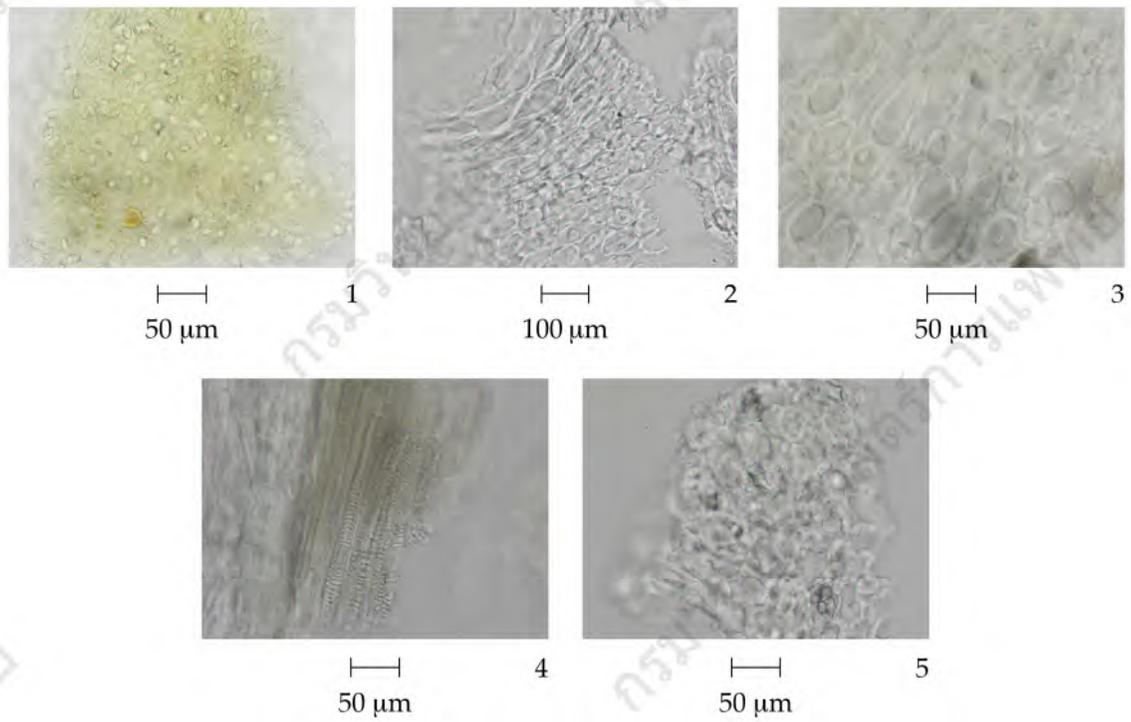


Fig. 2c Photomicrographs of Powdered Drug of the Exocarps and Mesocarps of *Citrus × aurantiifolia* (Christm.) Swingle

1. epidermis, some containing prismatic crystals, and stomata, in surface view
2. part of schizolysigenous oil cavity and mesocarp parenchyma
3. parenchyma, some containing prismatic crystals
4. spiral, reticulate vessels, parenchyma, and fibres
5. parenchyma of mesocarp, some containing prismatic crystals

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

Identification

A. To 500 mg of the sample, in powder, add 15 mL of *ethanol*, shake, allow to stand for 30 minutes, and filter (solution 1). To 2 mL of solution 1, add 2 or 3 pieces of *magnesium ribbon*, shake well, mix with a few drops of *hydrochloric acid*, and warm on a water-bath for 5 to 10 minutes: a red-pink colour develops.

B. To 2 mL of solution 1, add a few drops of a 10 per cent w/v solution of *phosphomolybdic acid*, mix well, and warm on a water-bath for 5 to 10 minutes: a blue-green 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 GF254* as the coating substance and a mixture of 75 volumes of *ethyl acetate*, 15 volumes of *methanol*, and 10 volumes 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, 20 µL of solution (A) and 10 µL of solution (B). Prepare solution (A) by adding 5 mL of *ethanol* to 500 mg of the sample, in *fine powder*, shaking, allowing to stand for 30 minutes, and filtering. For solution (B), dissolve 1 mg of *hesperidin* in 2 mL of *ethanol*. After removal of the plate, allow it to dry in air, spray the plate with a 1 per cent w/v solution of *aluminium chloride* in *ethanol*, and examine under ultraviolet light (366 nm). The chromatogram obtained from solution (A) shows a green fluorescent band (hR_f value 54 to 57), corresponding to the hesperidin band obtained from solution (B). Six blue fluorescent bands are also observed (Fig. 3).

Water Not more than 7.0 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 10.0 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 19.0 per cent w/w (Appendix 7.12).

Volatile oil Not less than 2.0 per cent v/w, calculated on the anhydrous basis (Appendix 7.3H). Use 20 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.

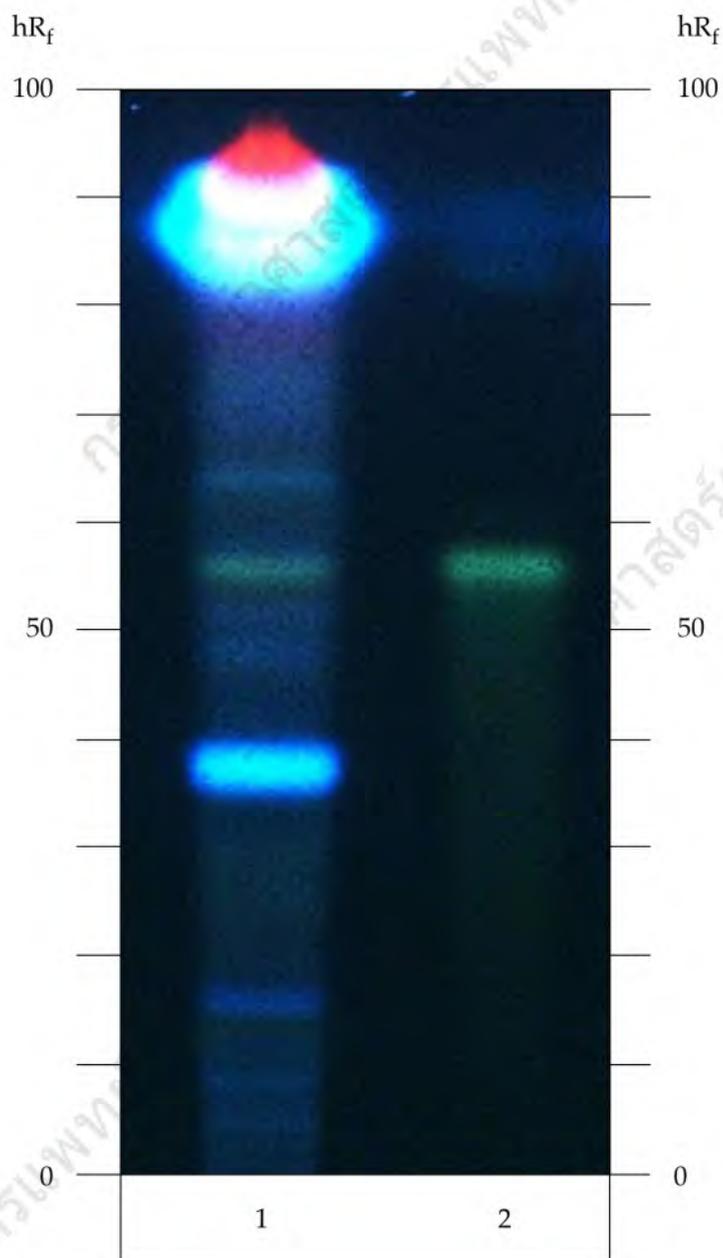


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Exocarps and Mesocarps of *Citrus × aurantiifolia* (Christm.) Swingle, Detected Under UV light (366 nm) After Spraying With a 1 Per Cent W/V Solution of *Aluminium Chloride* in *Ethanol*
1 = solution (A)
2 = solution (B)

มังคุด, เปลือกผล (MANGKHUT, PLUEAK PHON)

แมงคุด, เปลือกผล (MAENGHUT, PLUEAK PHON)

Garcinia mangostanae Pericarpium

Mangosteen Rind

Category Antidiarrheal, wound healing, anti-inflammatory.

Mangosteen Rind is the dried pericarp, without persistent calyx, of *Garcinia mangostana* L. (*Mangostana garcinia* Gaertn.) (Family Guttiferae), Herbarium Specimen Number: DMSC 5359, Crude Drug Number: DMSc 1242.

Constituents Mangosteen Rind contains xanthenes (e.g., garcinone B, α -, β -, and γ -mangostins). It also contains tannins, procyanidin, pectin, etc.

Description of the plant (Fig. 1) Tree up to 25 m tall, with orangish yellow latex. Leaves simple, opposite, ovate to oblong-ovate, 6.5 to 25 cm long, 3.5 to 13 cm wide, apex acute or acuminate, base obtuse or cuneate, margin entire, blade coriaceous, glabrous, upper surface dark green, shiny, lower surface yellowish green, midrib prominent on both sides, lateral veins 15 to 20 pairs, parallel, curving toward margin, then united into 2 intramarginal veins; petiole 1 to 2 cm long, stout, with basal appendage; stipule absent. Inflorescence cyme, 1- to 5(-7)-flowered, terminal; bracteole caducous. Flower bisexual or unisexual. Male flower absent or usually caducous. Female and/or perfect flowers 3.2 to 5 cm in diameter; pedicel green, stout, terete or slightly 4-angled, 1 to 2.5 cm long, glabrous; sepals 4(-5), concave, free, pale green outside, bright red or yellowish red inside, coriaceous, suborbicular, orbicular or broadly elliptic, 1 to 2.5 cm long, 1 to 2.2 cm wide, apex rounded, persistent; petals 4(-5), yellowish pink, fleshy, suborbicular, broadly elliptic, broadly obovate, or broadly ovate, 1 to 2.5 cm long, 1.2 to 2.8 cm wide, unequal, apex rounded, margin entire and undulate; staminodes 10 to 18, free, filament filiform, about 5 mm long, anther small, pale yellow or brownish yellow, caducous; ovary superior, subglobose, pale green, glabrous, stigma pale yellow, 4- to 8-lobed. Fruit a berry, globose or subglobose, 3.5 to 8 cm in diameter, smooth, reddish purple to blackish purple when ripe; pericarp 0.4 to 1.2 cm thick, fleshy, becoming woody when dry; persistent stigma dark brown or blackish brown, deeply 4- to 8-lobed, lobes wedge-shaped; persistent calyx coriaceous, 1.2 to 2.5 cm long, 1.2 to 2.8 cm wide, green, sometimes tinged with reddish purple. Seeds (1-)4 to 8, large, mostly not fully developed, flattened, embedded in fleshy, whitish pulp.

Description Odour, mild; taste, astringent.

Macroscopical (Fig. 1) Dried rind, varied in shape, size, and length, hard, some with persistent calyx and stigma; externally purplish brown to brown, smooth; internally brown, slightly shiny, with small ridges at the centre and lighter coloured lines radiating from the ridges.

Microscopical (Figs. 2a, 2b) Transverse section of the pericarp shows exocarp and mesocarp. Exocarp: epidermis, a layer of rectangular cells, some containing reddish purple or brown substances, covered with thick cuticle layer. Mesocarp: parenchyma, several layers of oval to round cells, varied in shape and size, some containing rosette aggregate crystals or brown substances; secretory ducts, scattered, some containing brown or yellow substances; sclereids, several layers of cells in various sizes and shapes; vascular bundles, scattered. Endocarp, irregular-shaped parenchyma, cannot be differentiated from mesocarp.

Mangosteen Rind in powder possesses the diagnostic microscopical of the unground drug. Secretory ducts with yellow or brown substances, and various sizes and shapes of grey sclereids can be characteristic.



Fig. 1 *Garcinia mangostana* L.

1. habit 2. flowers 3. branches with flowers 4. young and mature fruits
5. ripe fruits 6. crude drug

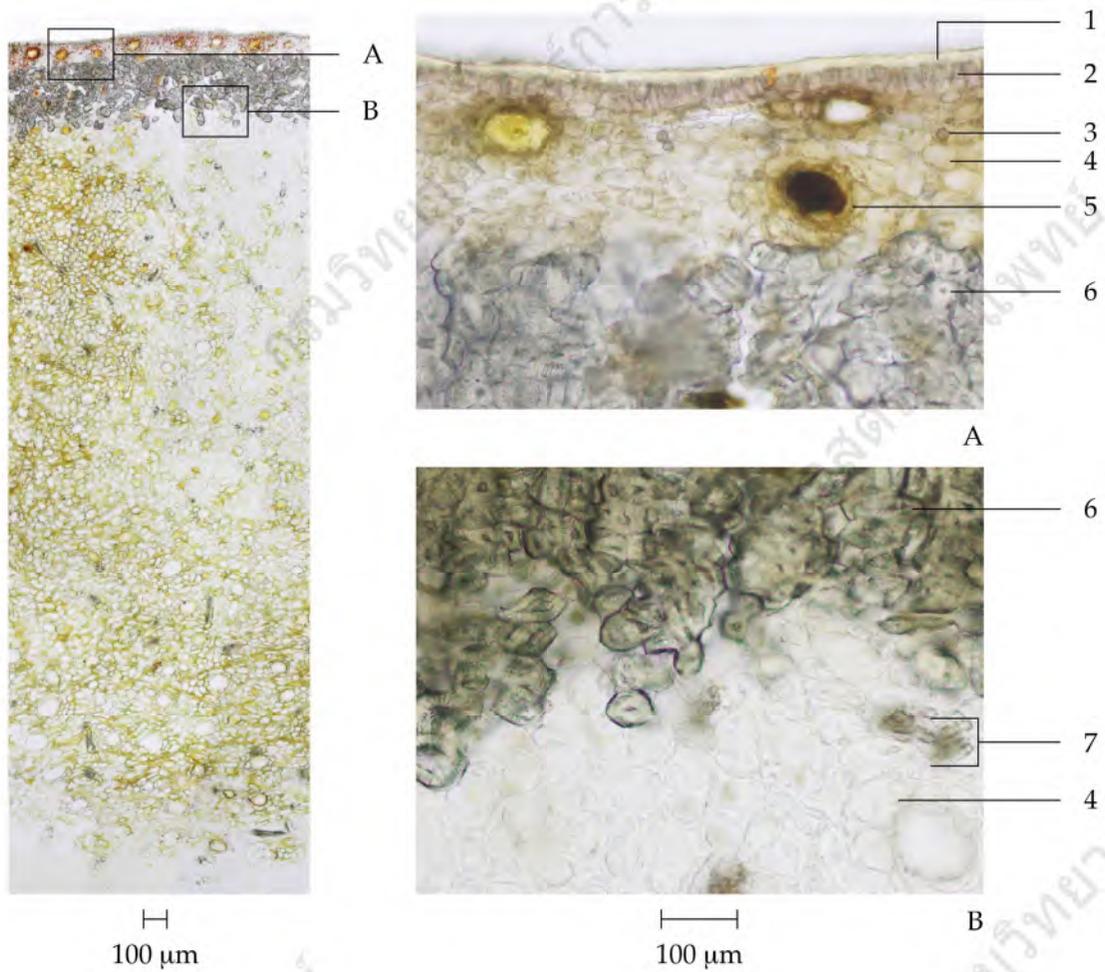


Fig. 2a Photomicrographs of Transverse Section of the Pericarp of *Garcinia mangostana* L.

A. Exocarp and Mesocarp

B. Mesocarp

1. cuticle layer

2. epidermis

3. rosette aggregate crystal

4. parenchyma

5. secretory duct

6. sclereid

7. vascular tissue

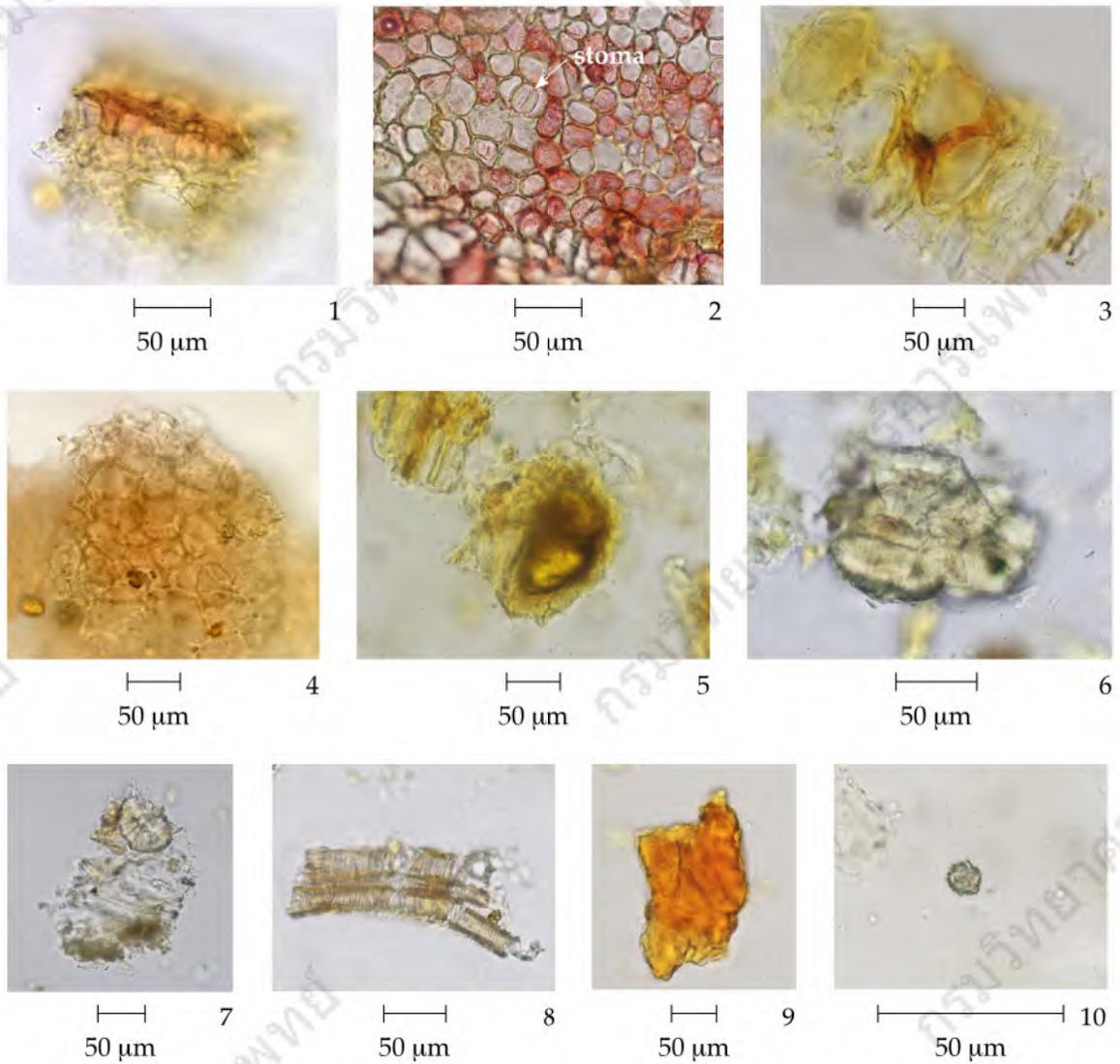


Fig. 2b Photomicrographs of Powdered Drug of the Pericarps of *Garcinia mangostana* L.

- | | |
|---|-------------------------------|
| 1. epidermis, parenchyma, and secretory duct, in sectional view | 6. sclereids |
| 2. epidermis and stoma in surface view | 7. sclereids and parenchyma |
| 3. parenchyma with brown substances | 8. reticulate vessels |
| 4. parenchyma and rosette aggregate crystals | 9. brown substance |
| 5. parenchyma and secretory duct, containing brown substances | 10. rosette aggregate crystal |

Packaging and storage Mangosteen Rind 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 *ethanol* on a water-bath for 15 minutes and filter (solution 1). To 2 mL of solution 1, add 1 mL of *iron(III) chloride TS* and mix well: a bluish black colour develops.

B. To 2 mL of solution 1, mix with a few drops of *gelatin TS*: a white precipitate forms.

C. To 2 mL of solution 1, add 1 to 2 pieces of *magnesium ribbon*, shake well, and mix with a few drops of *hydrochloric acid*: a pinkish red colour develops.

D. The chromatogram of the Sample preparation shows several peaks, one of which corresponds to the α -mangostin peak of the standard preparations, as obtained in the α -Mangostin content (Fig. 3).

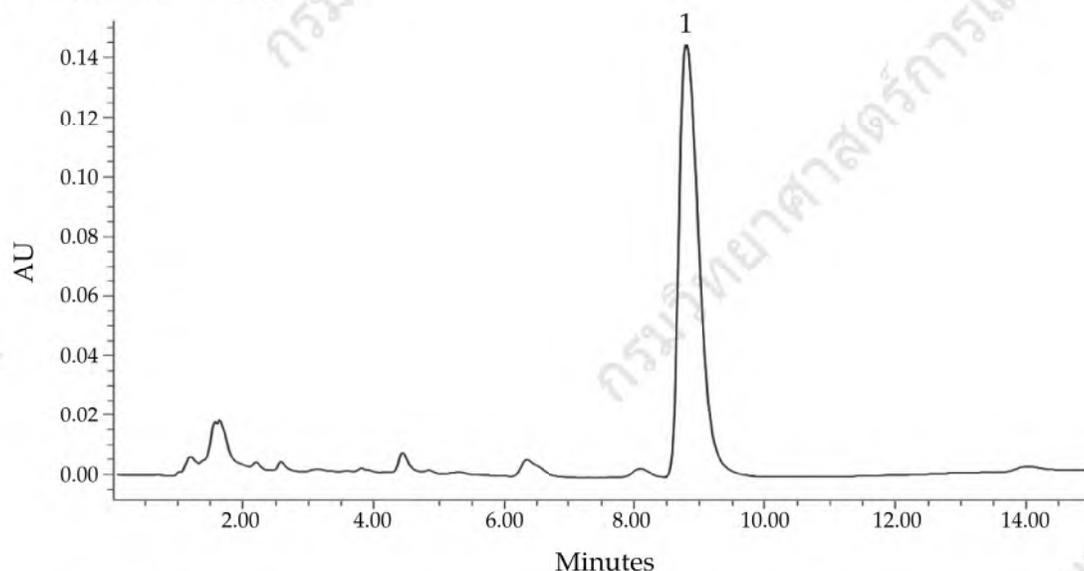


Fig. 3 HPLC Chromatogram of Mangosteen Rind Showing α -Mangostin (1)

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 88 volumes of *chloroform*, 10 volumes of *ethyl acetate*, and 2 volumes of *methanol* as the mobile phase and allowing the solvent front to ascend 10 cm above the line of application. Apply separately to the plate, 5 μ L each of solutions (A) and (B). Prepare solution (A) by refluxing 1 g of the sample, in *fine powder*, with 20 mL of *ethanol* for 15 minutes and filtering. Evaporate the filtrate to dry under reduced pressure at 45°. Dissolve the residue in 2 mL of *ethanol*. For solution (B), dissolve 1 mg of α -mangostin in 2 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 60 to 64), corresponding to the α -mangostin spot obtained from solution (B). Other nine quenching spots are also observed. Subsequently examine the plate under ultraviolet light (366 nm). The spot due to α -mangostin is dark fluorescent. Other two dark and four blue fluorescent spots are also observed. Spray the plate with a 10 per cent v/v solution of *sulfuric acid* in *ethanol*, heat at 110° for about 10 minutes. The spot due to α -mangostin is yellow. One brown and two yellow spots are also observed (Fig. 4).

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 3.0 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 15.0 per cent w/w (Appendix 7.12).

α -Mangostin content Not less than 4.0 per cent w/w of α -mangostin ($C_{24}H_{26}O_6$), calculated on the dried basis. Carry out the determination as described in the "Liquid Chromatography" (Appendix 3.5).

Standard preparations Dissolve a suitable quantity of α -Mangostin RS, accurately weighed, in sufficient *methanol* to obtain a stock solution having a known concentration of about 500 μ g of α -mangostin per mL. Dilute the solution quantitatively and stepwise with *methanol* to obtain six solutions having known concentrations of about 10, 20, 30, 40, 50, and 60 μ g per mL of α -mangostin.

Sample preparation Reflux about 100 mg of Mangosteen Rind, in *fine powder* and accurately weighed, with 25 mL of *methanol* for an hour and filter. Wash the marc with sufficient *methanol*. Combine the washings and the filtrate, transfer quantitatively to a 100-mL volumetric flask, and adjust to volume with *methanol*.

Mobile phase Prepare a mixture of 70 volumes of *water* and 30 volumes of *methanol*. Make adjustments if necessary.

Chromatographic system The chromatographic procedure may be carried out using (a) a stainless steel column (15 cm \times 4.6 mm) packed with octadecylsilane chemically bonded to porous silica or ceramic microparticles (4.6 μ m), equipped with a similarly packed guard column (b) *Mobile phase* at a flow rate of about 1.2 mL per minute, and (c) an ultraviolet photometer set at 243 nm.

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.

Procedure Separately inject about 20 μ L each of *Standard preparations* into the chromatograph, record the chromatograms, and measure the responses for α -mangostin peaks. Plot the readings and draw the standard curve of best fit: the curve shows the correlation coefficient of not less than 0.999. Inject about 20 μ L of *Sample preparation* into the chromatograph, record the chromatogram, and measure the responses for α -mangostin peaks.

Calculation By reference to the standard curve, calculate the content of α -mangostin ($C_{24}H_{26}O_6$) in the portion of the Mangosteen Rind taken.

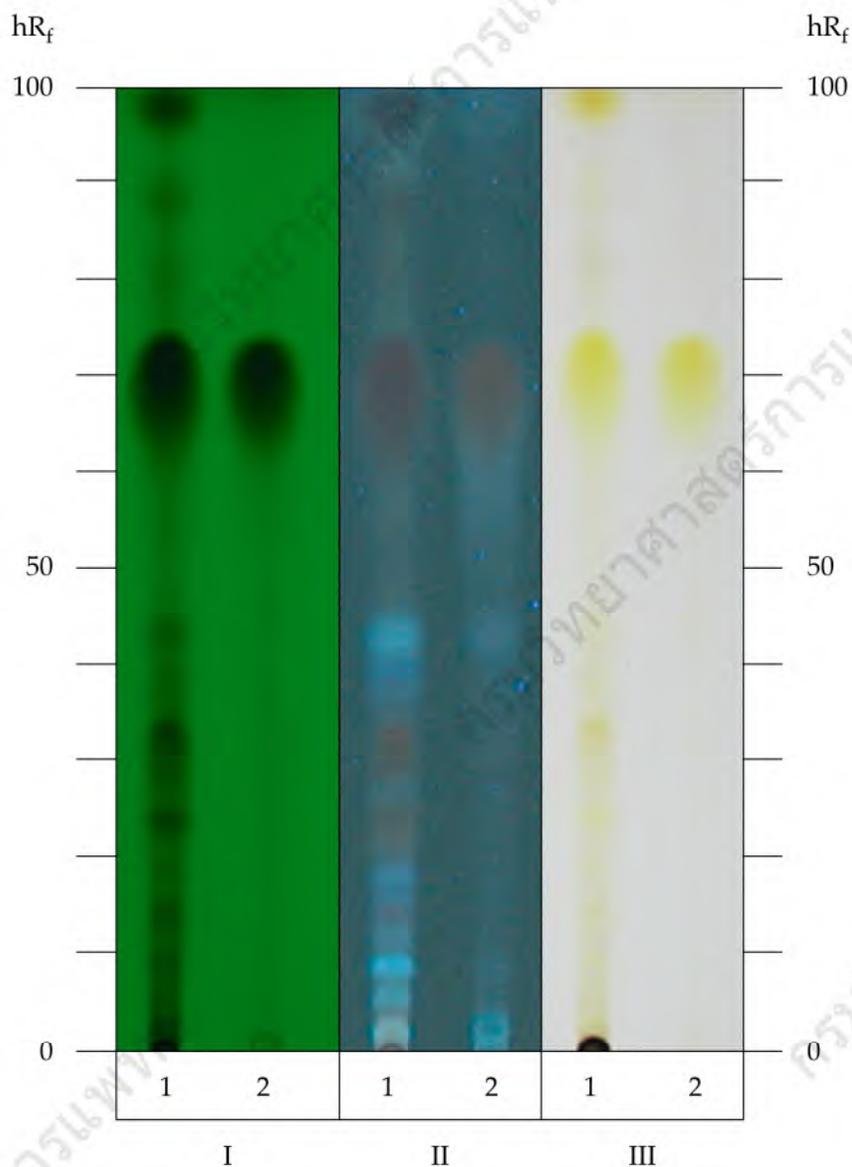


Fig. 4 Thin-Layer Chromatogram of Ethanolic Extract of the Pericarps of *Garcinia mangostana* L.

- 1 = solution (A)
- 2 = solution (B)
- I = detection under UV light (254 nm)
- II = detection under UV light (366 nm)
- III = detection with a 10 per cent v/v solution of sulfuric acid in ethanol

สารสกัดแห้งมังคุด (MANGKHUT DRY EXTRACT)

Mangosteen Rind Dry Extract

Category Antidiarrheal, wound healing, anti-inflammatory.

Mangosteen Rind Dry Extract is prepared from the powdered Mangosteen Rind 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 α -mangostin ($C_{24}H_{26}O_6$); the labelled amount of α -mangostin is not less than 14.0 per cent, calculated on the dried basis.

Description Brownish yellow powder; hygroscopic.

Packaging and storage Mangosteen Rind 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 amount of α -mangostin; (2) the expiration date.

Identification

A. The chromatogram of the Assay preparation shows several peaks, one of which corresponds to that of the Standard preparation, as obtained in the *Assay* (Fig. 1).

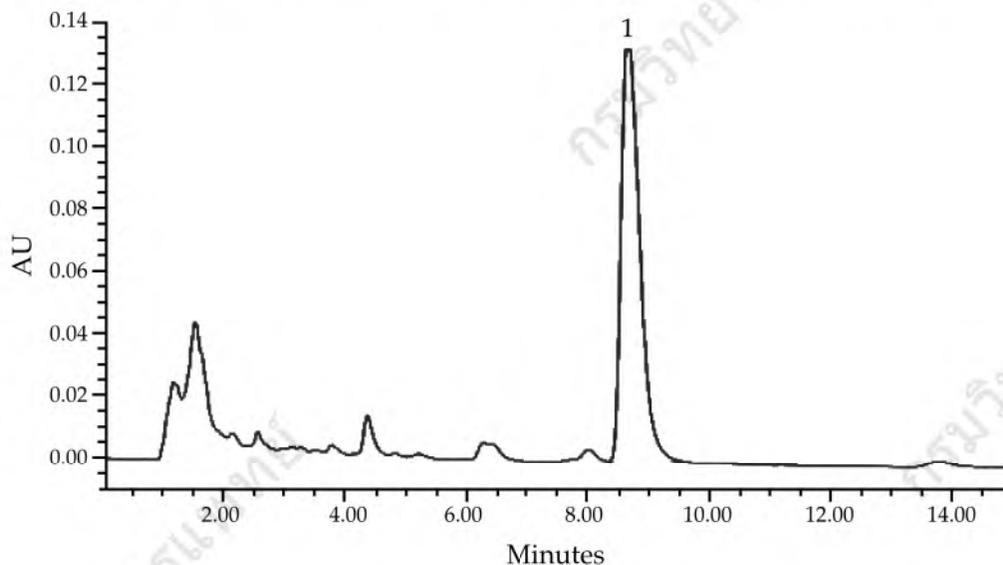


Fig. 1 HPLC Chromatogram of Mangosteen Rind Dry Extract Showing α -Mangostin (1)

B. Carry out the test as described in the “Thin-Layer Chromatography” (Appendix 3.1), using a high-performance plate with *silica gel GF254* as the coating substance and a mixture of 90 volumes of *chloroform* and 5 volumes of *methanol* 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 6 mm, 3 mL each of solutions (A) and (B). Prepare solution (A) by dissolving 10 mg of the sample, in powder, in 1 mL of *methanol*. For solution (B), dissolve 1 mg of α -mangostin 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 bands. The chromatogram obtained from solution (A) shows a quenching band (hR_f value 60 to 64), corresponding to the α -mangostin band obtained from solution (B). Other seven quenching bands are also observed. Subsequently

examine the plate under ultraviolet light (366 nm); the band due to α -mangostin is dark fluorescent. One dark and three blue fluorescent bands are also observed. Spray the plate with *anisaldehyde TS* and heat at 110° for about 10 minutes. The band due to α -mangostin is yellow. One brown and other two yellow bands are also observed (Fig. 2).

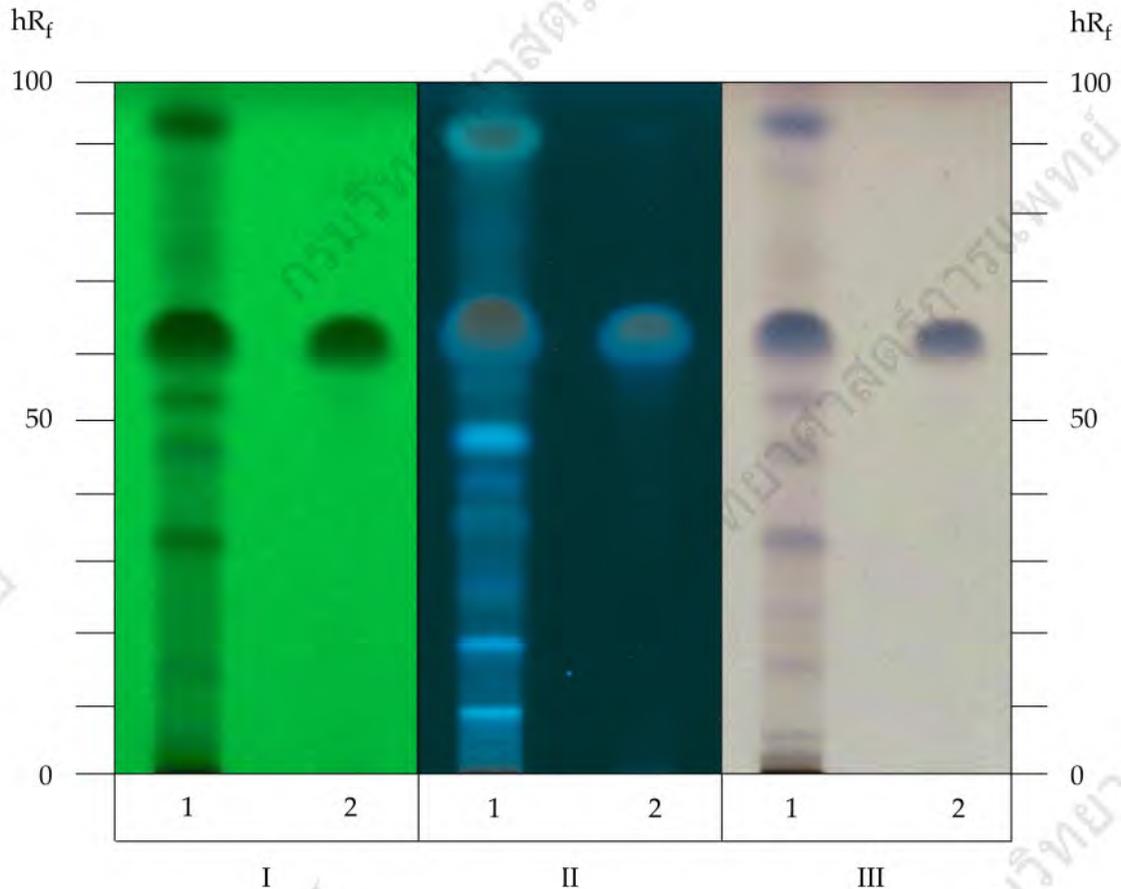


Fig. 2 Thin-Layer Chromatogram of Mangosteen Rind Dry Extract

- 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*

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 Prepare a mixture of 70 volumes of *water* and 30 volumes of *methanol*. Make adjustments if necessary.

Standard preparations Dissolve a suitable quantity of α -Mangostin RS, accurately weighed, in sufficient *methanol* to obtain a stock solution having a known concentration of about 500 μg of α -mangostin per mL. Dilute the solution quantitatively, and stepwise with *methanol* to obtain six solutions having known concentrations of about 10, 20, 30, 40, 50, and 60 μg per mL of α -mangostin.

Assay preparation Transfer about 50 mg of Mangosteen Rind Dry Extract, accurately weighed, to a 100-mL volumetric flask, add 25 mL of *methanol*, sonicate until completely dissolved, and adjust with *methanol* to volume. Mix well and filter through a membrane having a 0.45- μm membrane filter.

Chromatographic system The chromatographic procedure may be carried out using (a) a stainless steel column (15 cm \times 4.6 mm) packed with octadecylsilane chemically bonded to porous silica or ceramic microparticles (4.6 μm), equipped with a similarly packed guard column, (b) *Mobile phase* at a flow rate of about 1.2 mL per minute, and (c) an ultraviolet photometer set at 243 nm. To determine the suitability of the chromatographic system, chromatograph *Standard preparation*, and record the peak response as directed under *Procedure* and *Calculation*: the relative standard deviation for replicate injections is not more than 2.0 per cent.

Procedure Separately inject about 20 μL each of *Standard preparations* into the chromatograph, record the chromatograms and measure the responses for α -mangostin peaks. Plot the readings and draw the standard curve of best fit: the curve shows the correlation coefficient of not less than 0.999. Inject about 20 μL of *Assay preparation* into the chromatograph, record the chromatogram, and measure the response for α -mangostin peak.

Calculation By reference to the standard curve, calculate the content of α -mangostin ($\text{C}_{24}\text{H}_{26}\text{O}_6$) in the portion of the Extract taken.

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

หนาด, ใบ (NAT, BAI)

หนาดหลวง, ใบ (NAT LUANG, BAI), หนาดใหญ่, ใบ (NAT YAI, BAI)

Blumeae Balsamiferae Folium

Blumea Balsamifera Leaf

Category Carminative, muscle relaxant, antidermatitis.

Blumea Balsamifera Leaf is the dried mature leaf of *Blumea balsamifera* (L.) DC [*Conyza balsamifera* L., *Placus balsamifer* (L.) Baill.] (Family Compositae), Herbarium Specimen Number: DMSC 5330, Crude Drug Number: DMSc 1263.

Constituents Blumea Balsamifera Leaf contains flavonoids such as blumeatin and quercetin. It also contains a volatile oil consisting of *l*-borneol and camphor. Other compounds are tannins, phenolics, sterols, etc.

Description of the plant (Fig. 1) Shrub or subshrub, up to 4 m tall; stem erect, bark greyish brown, tomentose, branched. Leave simple, alternate or spirally arranged, lanceolate, oblong-lanceolate, elliptic, or ovate-elliptic, 5 to 30 cm long, 1.5 to 12 cm wide, apex acute to acuminate, base attenuate or obtuse, margin serrulate to serrate, usually with upcurved teeth, rarely dentate or lacerate, coriaceous, bright green, upper surface rugose, pubescent and glandular hairs, lower surface tomentose, rarely woolly; petiole 1 to 4 cm long, with 1 to 6 pairs of appendages, 0.6 to 1.5 cm long. Inflorescence spreading panicle, terminal and/or axillary, 7 to 30 cm long; peduncle 0.2 to 1 cm long; capitula 4 to 7 mm in diameter; involucre campanulate; phyllaries in 3 to 5 series, outer one lanceolate or oblong-lanceolate, 1 to 3 mm long, 0.4 to 0.5 mm wide, apex acute, pilose, inner one linear, 5 to 6 mm long, scarious with ciliate margin, pilose; receptacle 2.5 to 3 mm in diameter, slightly convex, alveolate, glabrous; marginal floret yellow, filiform, 4.5 to 6 mm long, 2- to 4-lobed, glabrous; disc floret yellow, 4 to 7 mm long, glabrous, lobe oblong-lanceolate, minute, pubescent with glandular hairs; anther 0.8 to 2 mm long, apical appendage round, base with branched tails; ovary inferior, style arm about 1 mm long, base swollen. Fruit an achene, brown, oblong, 1 to 2 mm long, about 0.3 mm wide, 5- to 10-ribbed, setuliferous; pappus reddish, bristly, 4 to 6 mm long, persistent. Seed 1.

Description Odour, borneol-like, aromatic; taste, slightly bitter.

Macroscopical (Fig. 1) Whole or broken leaves; whole leaf petiolate, brownish green to brownish, oblong-elliptic, elliptic to lanceolate, apex acute or acuminate, base attenuate or obtuse, margin serrulate to serrate, tomentose on both surfaces with prominent veins, brittle.

Microscopical (Figs. 2a–2d) Transverse section of the leaf through the midrib shows upper epidermis, mesophyll, vascular tissue, and lower epidermis. Upper epidermis: thick cuticle layer, a layer of rectangular cells, multicellular uniseriate trichomes, some with collapsed cells, glandular trichomes, and stomata. Mesophyll: a layer of rectangular palisade cells and loosen round spongy cells, and some containing starch grains; several layers of lamella and a few angular collenchyma cells in midrib. Vascular tissue: phloem and xylem. Lower epidermis: thin cuticle layer, a layer of rectangular cells, multicellular uniseriate trichomes, some with collapsed cells, glandular trichomes, and stomata.

In surface view, the lamina shows wavy-walled epidermal cells, multicellular uniseriate trichomes, some with collapsed cells, glandular trichomes, and paracytic and anomocytic stomata.



1



2



3



4

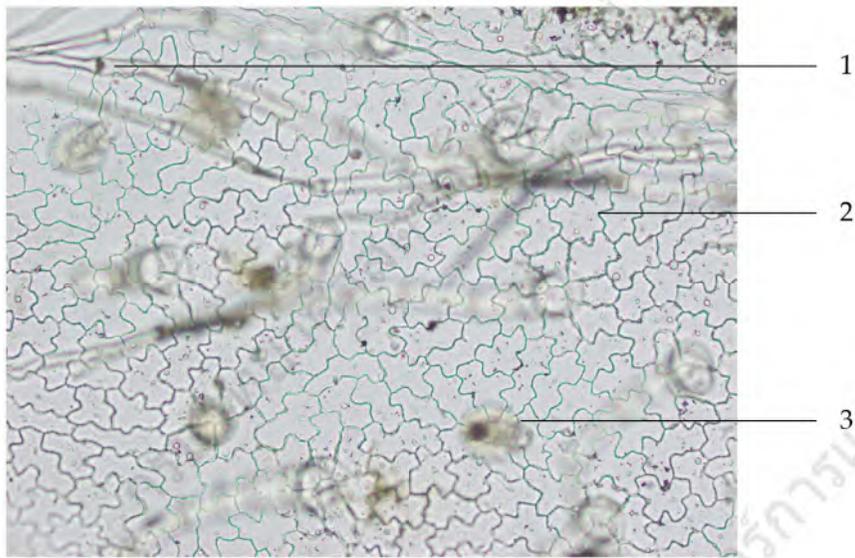


1 cm

5

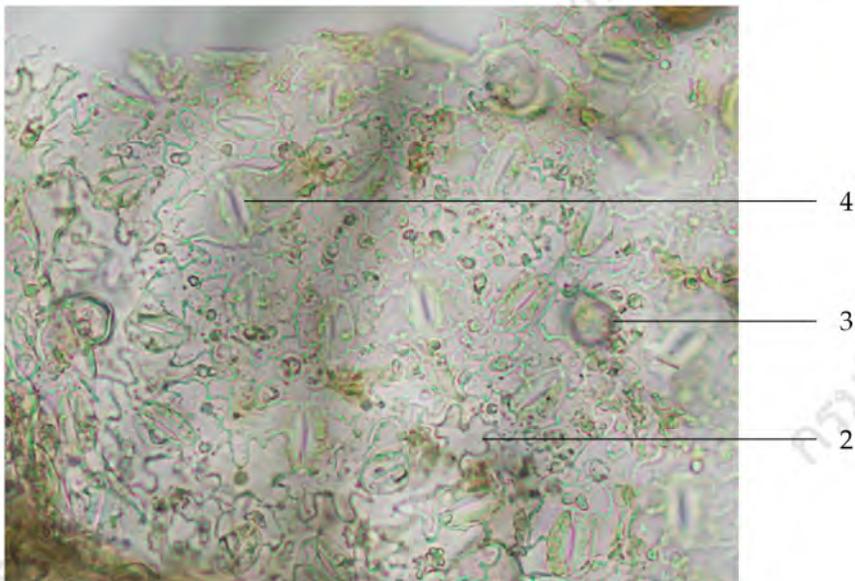
Fig. 1 *Blumea balsamifera* (L.) DC

1. habit 2. flowering branches 3. inflorescences 4. infructescences 5. crude drug



100 μm

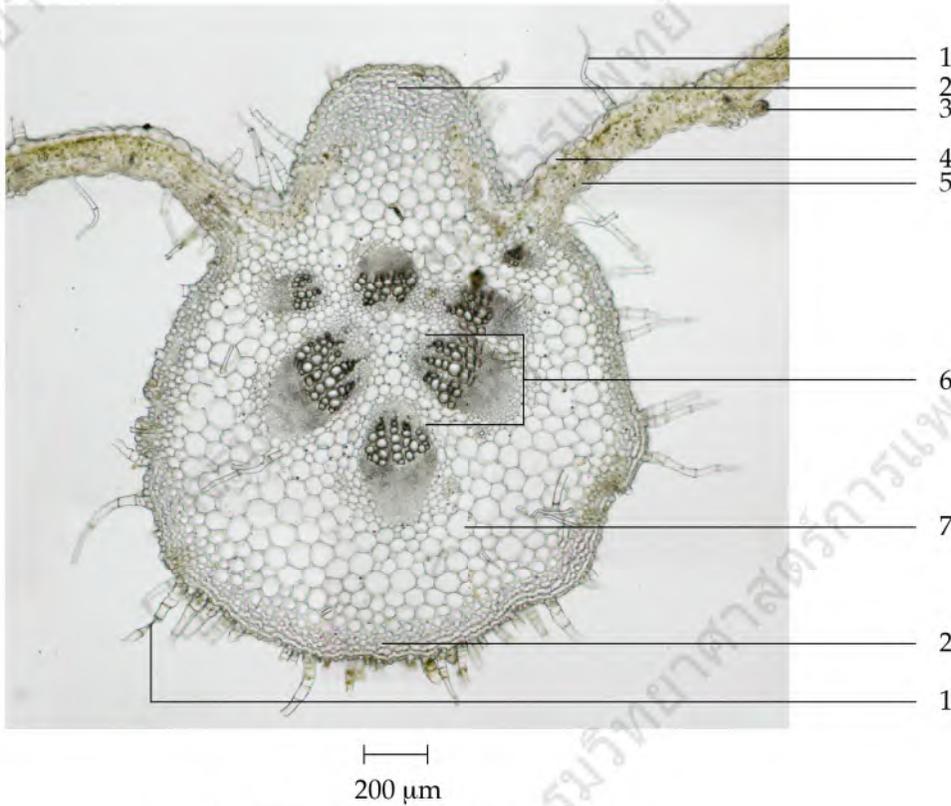
Upper Epidermis of the Lamina



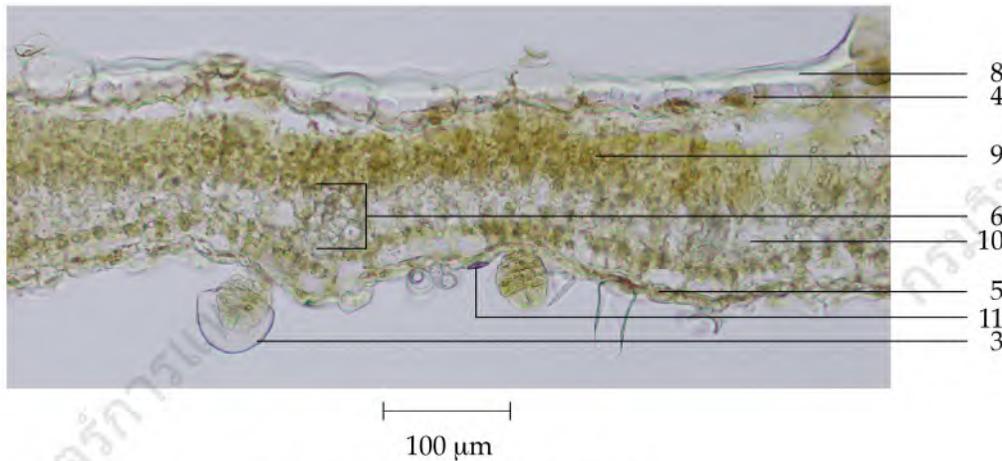
100 μm

Lower Epidermis of the Lamina

Fig. 2a Photomicrographs of Epidermises of the Leaf of *Blumea balsamifera* (L.) DC
 1. multicellular uniseriate trichome with collapsed cells
 2. wavy-walled epidermal cell
 3. glandular trichome
 4. stoma



Transverse Section of the Midrib



Transverse Section of the Lamina

Fig. 2b Photomicrographs of Transverse Sections of the Leaf of *Blumea balsamifera* (L.) DC

- | | |
|---|--------------------|
| 1. multicellular uniseriate trichome with collapsed cells | 6. vascular tissue |
| 2. collenchyma | 7. parenchyma |
| 3. glandular trichome | 8. cuticle |
| 4. upper epidermis | 9. palisade cell |
| 5. lower epidermis | 10. spongy cell |
| | 11. stoma |

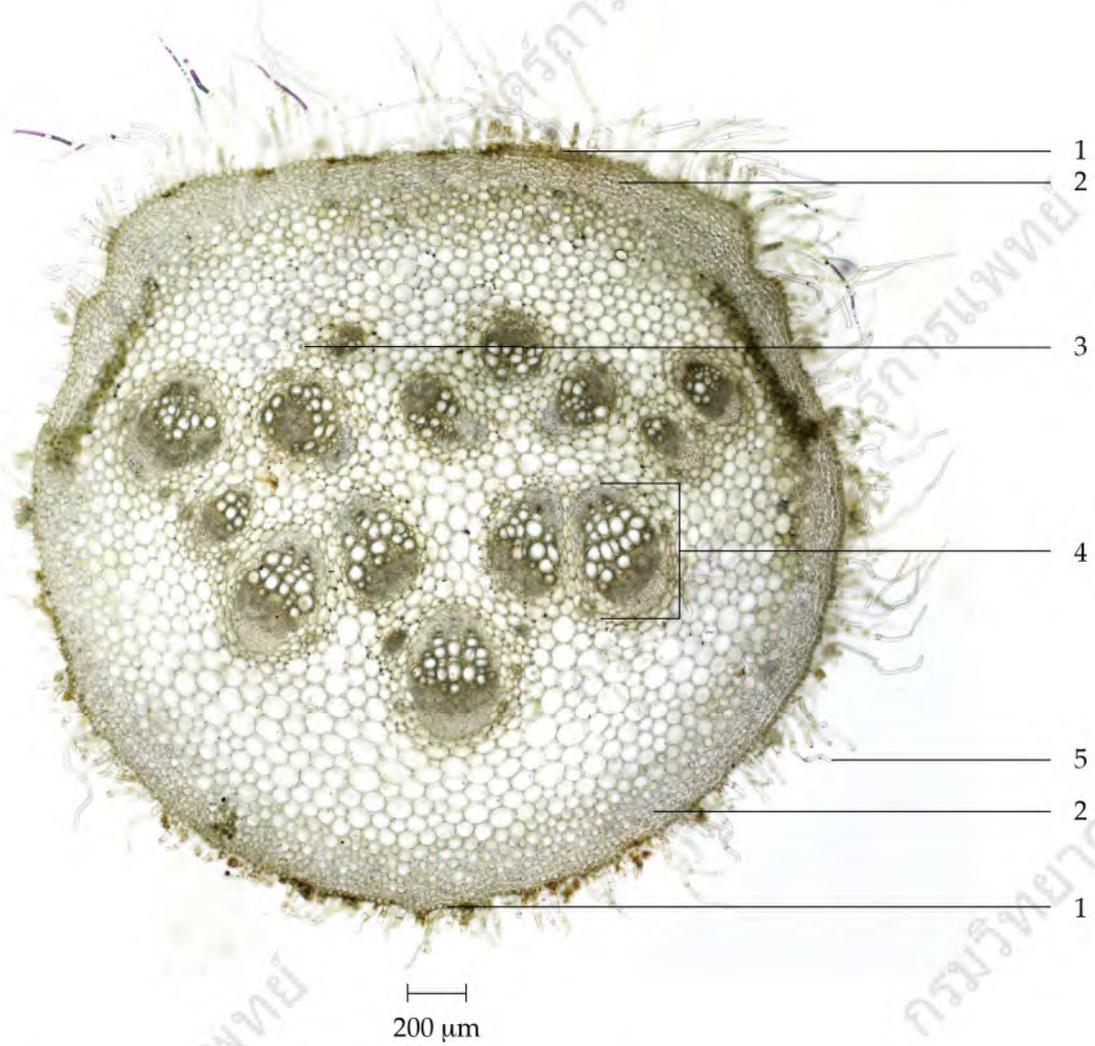


Fig. 2c Photomicrograph of Transverse Section of the Petiole of *Blumea balsamifera* (L.) DC

1. epidermis	4. vascular tissue
2. collenchyma	5. multicellular uniseriate trichome with collapsed cells
3. parenchyma containing rosette aggregate crystal	

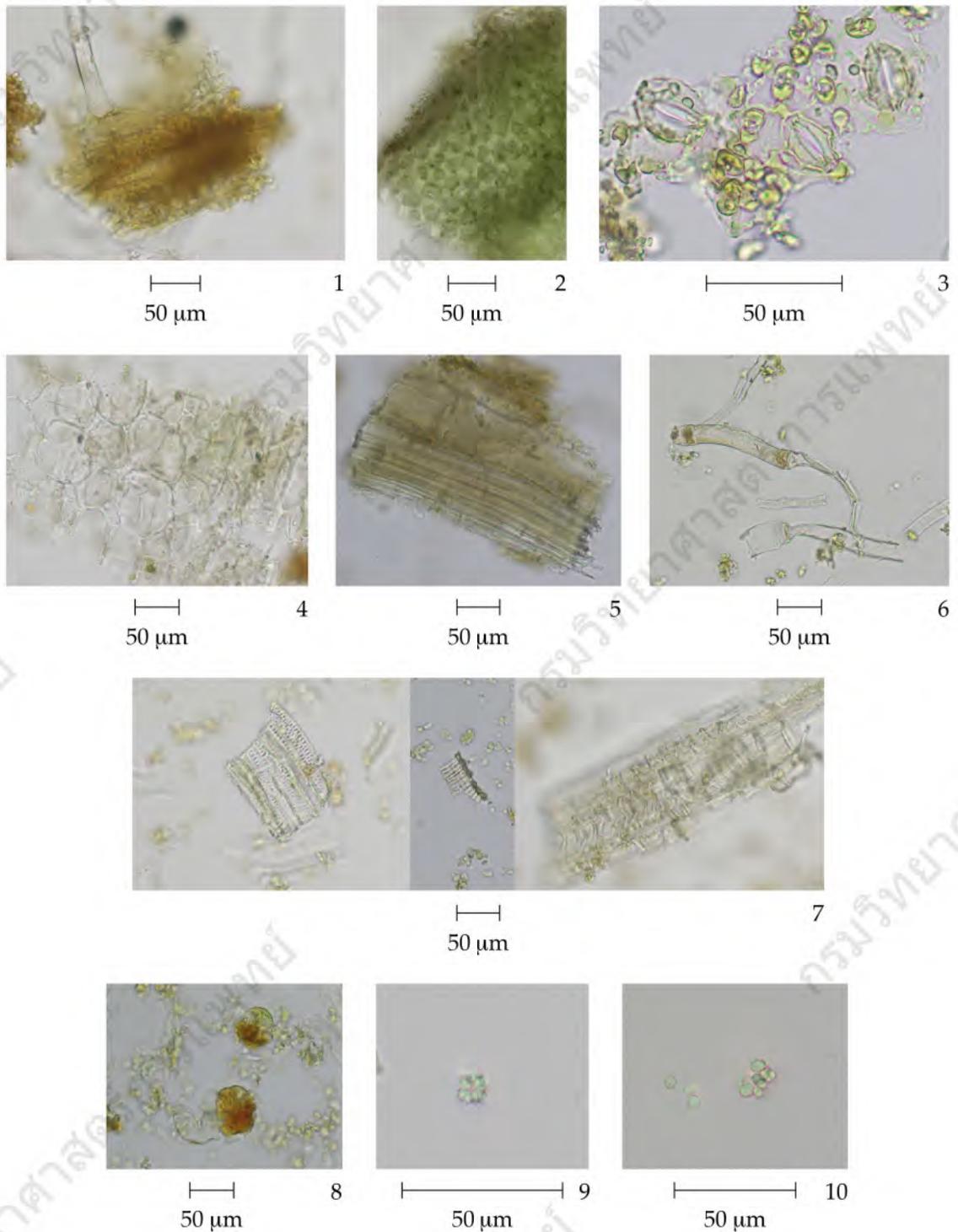


Fig. 2d Photomicrographs of Powdered Drugs of the Leaves of *Blumea balsamifera* (L.) DC

1. lamina showing epidermal cells and trichome, in sectional view	6. fragment of trichome with collapsed cells
2. collenchyma	7. bordered-pitted, reticulate, spiral, and annular vessels
3. lower epidermis showing stomata	8. glandular trichomes
4. parenchyma, some containing rosette aggregate crystals	9. rosette aggregate crystal
5. fibres and parenchyma	10. starch grains

Transverse section of the petiole shows epidermis, cortex, and vascular tissue. Epidermis: a layer of epidermal cells some with rosette aggregate crystals, numerous multicellular uniseriate trichomes, some with collapsed cells, glandular trichomes, and stomata. Cortex: collenchyma, several layers of lamella cells underneath epidermal layer, parenchyma some with rosette aggregate crystals or starch grains, angular collenchyma near vascular tissue, and schizogenous cavities. Vascular tissue: phloem and xylem.

Blumea Balsamifera Leaf in powder possesses the diagnostic microscopical characters of the unground drug. Multicellular uniseriate trichomes, some with collapsed cells, and glandular trichomes are characteristic.

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

Identification

A. To 200 mg of the sample, in powder, add 10 mL of *ethanol*, shake, allow to stand for 10 minutes, and filter. To 2 mL of the filtrate, add 0.5 mL each of a 5 per cent w/v solution of *aluminium chloride*, a 5 per cent w/v solution of *sodium nitrite*, and a 20 per cent w/v solution of *sodium hydroxide* successively. Mix well: a red colour develops.

B. Carry out the test as described in the “Thin-Layer Chromatography” (Appendix 3.1), using a high-performance plate with *silica gel GF254* as the coating substance and a mixture of 94 volumes of *chloroform*, 5 volumes of *methanol*, and 1 volume of *formic acid* 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 μ L of solution (A) and 2 μ L of solution (B). Prepare solution (A) by adding 5 mL of *methanol* to 200 mg of the sample, in *fine powder*, shaking, allowing to stand for 10 minutes, and filtering. For solution (B), dissolve 1 mg of *blumeatin* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine the plate under ultraviolet light (254 nm), marking the quenching bands. The chromatogram obtained from solution (A) shows a quenching band (hR_f value 39 to 41) corresponding to the *blumeatin* band obtained from solution (B); several other quenching bands are observed. Subsequently, spray the plate with a 1 per cent w/v solution of *aluminium chloride* in *ethanol* and examine under ultraviolet light (366 nm). The band due to *blumeatin* shows green fluorescent. One yellow, three green, and three red fluorescent bands are also observed (Fig. 3).

Water Not more than 9.0 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 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 13.0 per cent w/w (Appendix 7.12).

Volatile oil Not less than 0.5 per cent v/w, calculated on the anhydrous basis (Appendix 7.3H). Use 20 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.

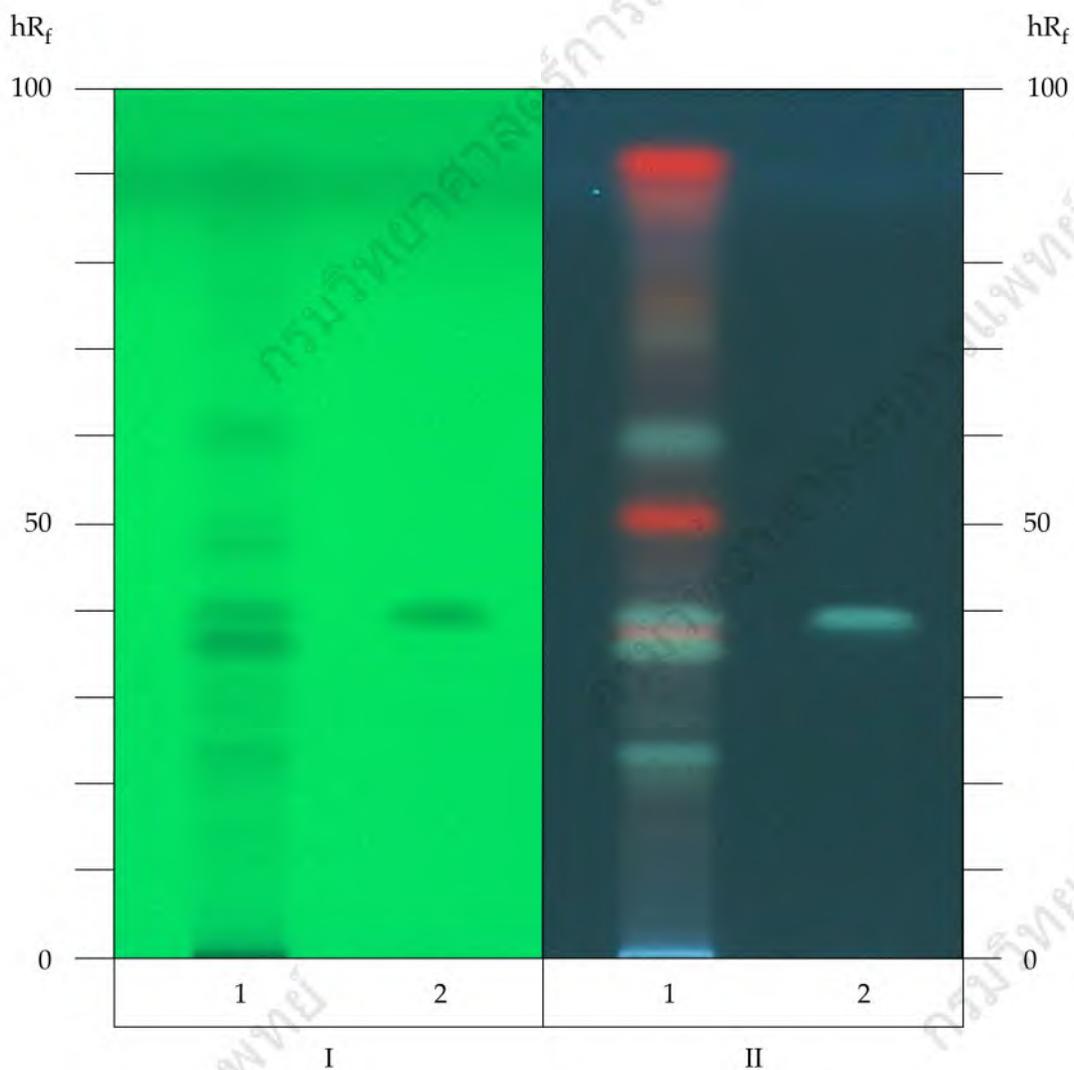


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Leaves of *Blumea balsamifera* (L.) DC.

- 1 = solution (A)
- 2 = solution (B)
- I = detection under UV light (254 nm)
- II = detection under UV light (366 nm) after spraying with a 1 per cent w/v solution of *aluminium chloride* in *ethanol*

ผักไผ่, ส่วนเหนือดิน (PHAK PHAI, SUAN NUEA DIN)

ผักไผ่น้ำ, ส่วนเหนือดิน (PHAK PHAI NAM, SUAN NUEA DIN), ผักแพว, ส่วนเหนือดิน (PHAK PHAEO, SUAN NUEA DIN)

Persicariae Odoratae Herba

Persicaria Odorata Herb

Synonym Asian Mint

Category Anti-inflammatory.

Persicaria Odorata Herb is the dried aerial part of *Persicaria odorata* (Lour.) Soják (*Polygonum odoratum* Lour.) (Family Polygonaceae), Herbarium Specimen Number: DMSC 5343, Crude Drug Number: DMSc 1221.

Constituents *Persicaria Odorata* Herb contains flavonoids and tannins. It also contains a volatile oil consisting of aliphatic aldehydes, amino acids, phenolics, terpenoids, sterols, etc.

Description of the plant (Fig. 1) Perennial herb 15 to 50 cm tall; stem erect, terete, grooved, glabrous, reddish green, branched; ocrea cylindrical, about 1 cm long, membranous, pellucid-dotted, loosely enveloping stem, apex truncate with bristles. Leaves simple, alternate, lanceolate, elliptic, or ovate, 3 to 10 cm long, 1 to 3 cm wide, apex acute or acuminate, base cuneate or attenuate, margin entire with hispid hairs, thin, green with red markings along margin and veinlets, glabrous, pellucid-dotted; petiole 2 to 5 mm long, reddish, glabrous, attached to the base of ocrea. Inflorescence spicate or spicate-paniculate, terminal or axillary, erect, 4.5 to 15 cm long, branched; inflorescence branch glabrous with glandular dots; side branches 2.5 to 8.5 cm long, lax flowers; rachis conspicuous, bract ovate, 1.5 to 5.5 mm long, 0.4 to 1 cm wide, apex acute margin with hispid hairs. Flowers 4 to 8 each enclosed by ocreola; perianth 5-merous, whitish, pinkish, or purplish pink; lobe ovate-orbicular, 1.5 to 3.5 mm long, 1.5 to 2.5 mm wide, apex obtuse, pellucid-dotted, tube 0.8 to 1 mm long; glandular nectaries; ocreola completely enclosing rachis, 3.5 to 6 mm long, pellucid-dotted, apex obtuse or acute, margin entire with hispid hairs; stamens 8, arranged in two whorls, outer ones 1.5 to 2 mm long, inner ones 1.8 to 2.6 mm long, anther elliptic, white; ovary superior, styles 3, 2.5 to 3.2 mm long, stigma capitate, white. Fruit an achene, triangular, about 1.5 mm long, shiny black; with scarious perianth.

Description Odour, aromatic, characteristic; taste, slightly tingling.

Macroscopical (Fig. 1) Whole or broken aerial parts; whole leaves, with or without petioles, brownish green, lanceolate, elliptic, or ovate, apex acute or acuminate, base cuneate or attenuate, margin entire, with hispid hairs, brittle; stem erect, slightly twisted, longitudinally grooved, with ocrea.

Microscopical (Figs. 2a–2f) Transverse section of the leaf through the midrib shows upper epidermis, mesophyll, vascular tissue, and lower epidermis. Upper epidermis: a layer of thin-walled oblong epidermal cells, glandular trichomes, lignified trichomes, stomata, and epithelial cells with secretory cavities. Mesophyll: 1 to 2 layers of palisade cells, spongy cells some containing rosette aggregate crystals, and several layers of angular collenchyma in midrib. Vascular tissue: phloem and xylem. Lower epidermis: small epidermal cells, glandular trichomes, lignified trichomes, epithelial cells with secretory cavities, and stomata.

Transverse section of the petiole shows epidermis, cortex, vascular tissue, and pith. Epidermis: a layer of polygonal epidermal cells, epithelial cells with secretory cavities, glandular trichomes, lignified trichomes, and stomata. Cortex: angular collenchyma and parenchyma, some containing rosette aggregate crystals or starch grains. Vascular tissue: collateral bundles, containing phloem and xylem. Pith: large round parenchyma, some containing rosette aggregate crystals.



1



2



3



4

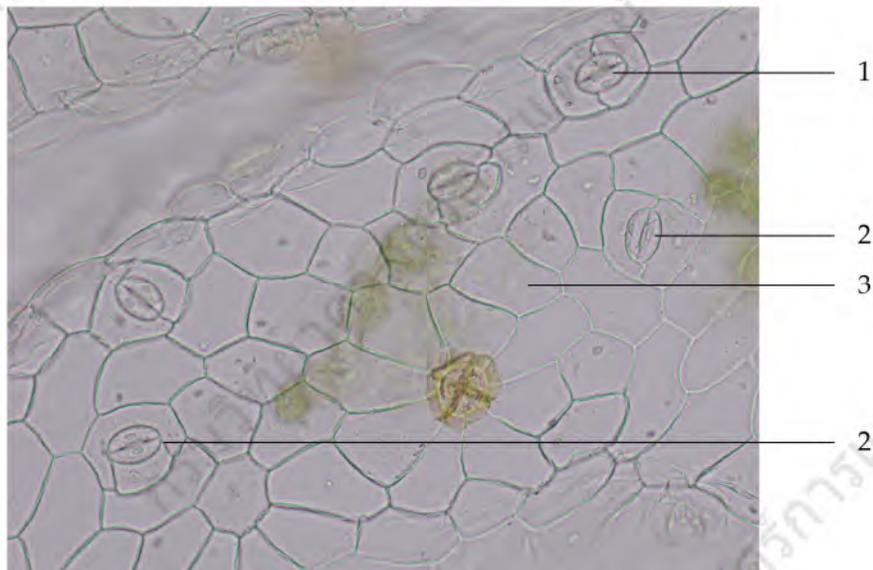


1 cm

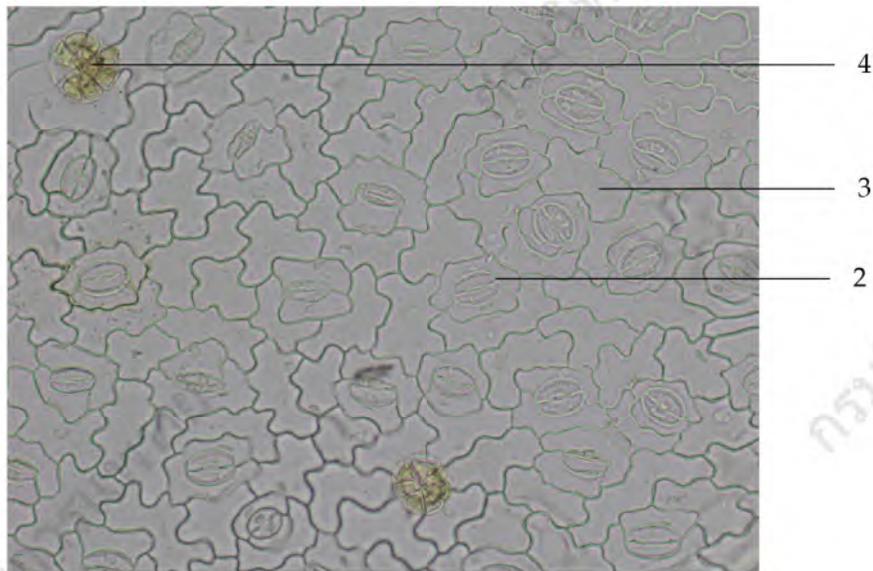
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Fig. 1 *Persicaria odorata* (Lour.) Soják

1. habit 2. stem with ocrea leaf (a), ocrea with truncate apex and bristles (b)
3. inflorescence 4. flowers 5. crude drug

100 μm

Upper Epidermis of the Lamina

100 μm

Lower Epidermis of the Lamina

Fig. 2a Photomicrographs of Epidermises of the Leaf of *Persicaria odorata* (Lour.) Soják

- | | |
|--------------------|-----------------------|
| 1. diacytic stoma | 3. epidermal cell |
| 2. paracytic stoma | 4. glandular trichome |

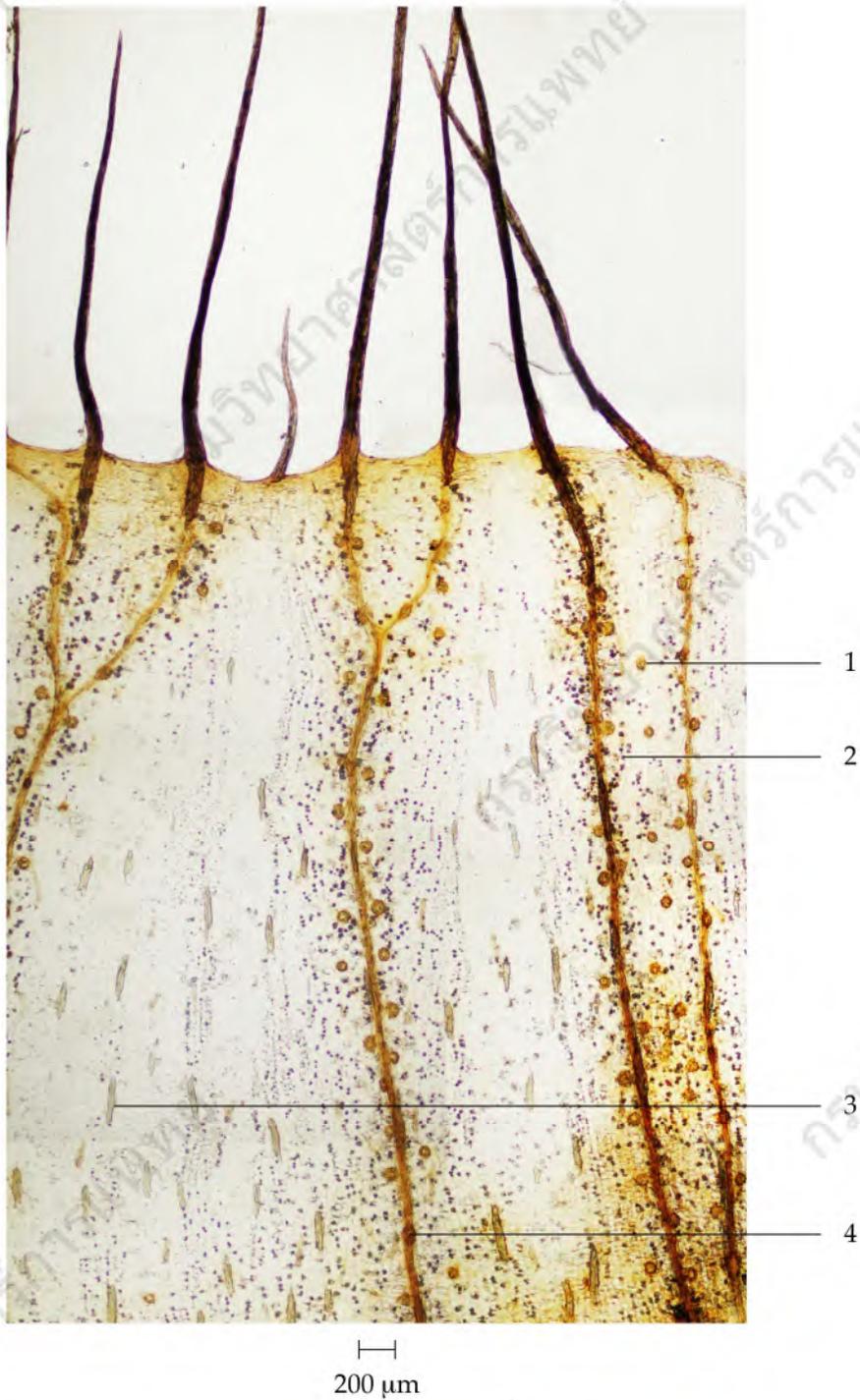
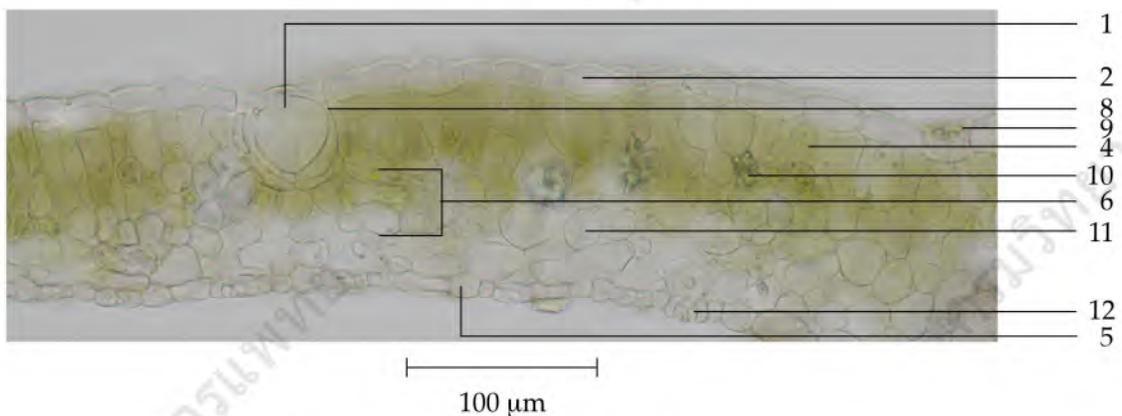


Fig. 2b Photomicrograph of Surface View of the Ocrea of *Persicaria odorata* (Lour.) Soják
 1. epithelial cell with secretory cavity 3. sclerenchymatous bundle
 2. rosette aggregate crystal 4. vascular tissue



Transverse Section of the Midrib



Transverse Section of the Lamina

Fig. 2c Photomicrographs of Transverse Sections of the Leaf of *Persicaria odorata* (Lour.) Soják

- | | |
|--|-------------------------------|
| 1. secretory cavity | 8. epithelial cell |
| 2. upper epidermis | 9. glandular trichome |
| 3. collenchyma | 10. rosette aggregate crystal |
| 4. palisade cell | 11. spongy cell |
| 5. lower epidermis | 12. stoma |
| 6. vascular tissue | |
| 7. parenchyma containing rosette aggregate crystal | |

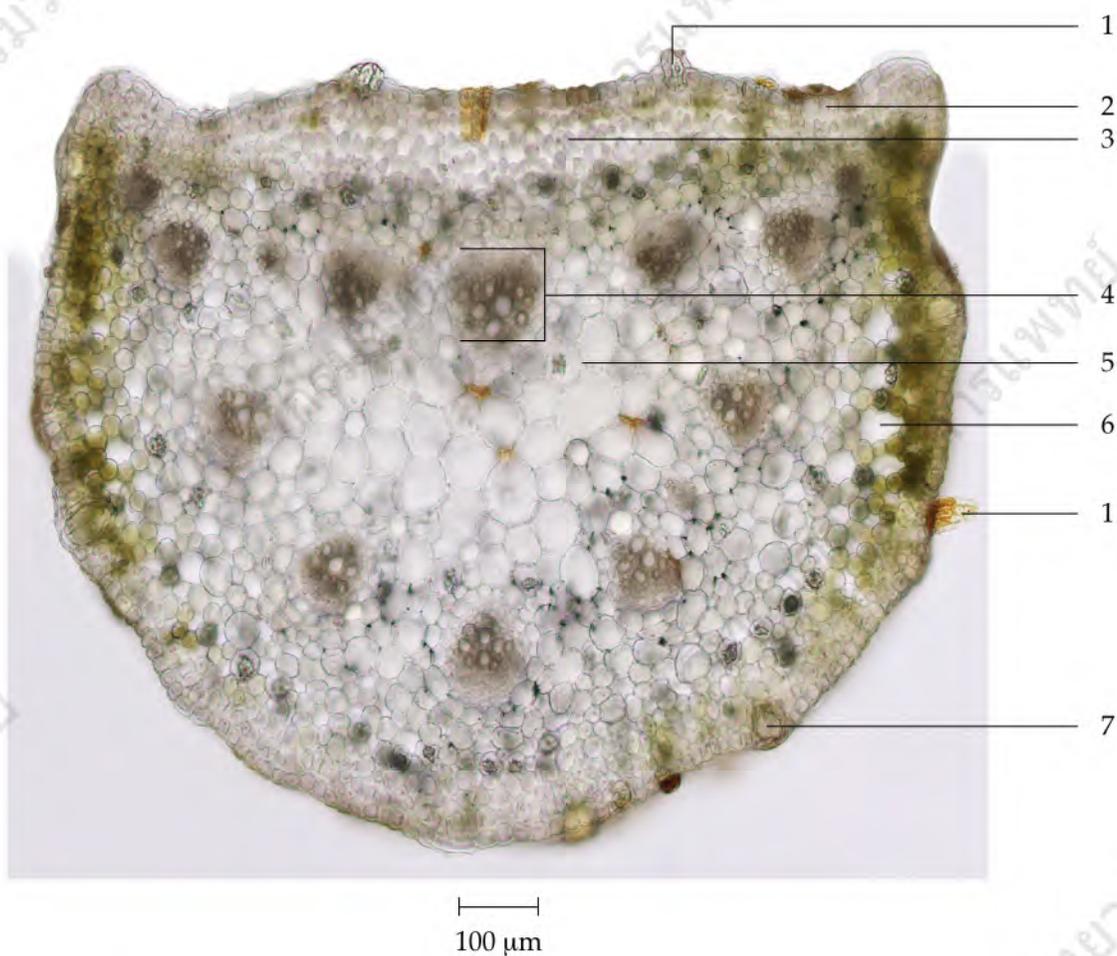


Fig. 2d Photomicrograph of Transverse Section of the Petiole of *Persicaria odorata* (Lour.) Soják

1. multicellular trichome	5. parenchyma containing rosette aggregate crystal
2. epidermis	6. air space
3. collenchyma	7. secretory cavity
4. vascular tissue	

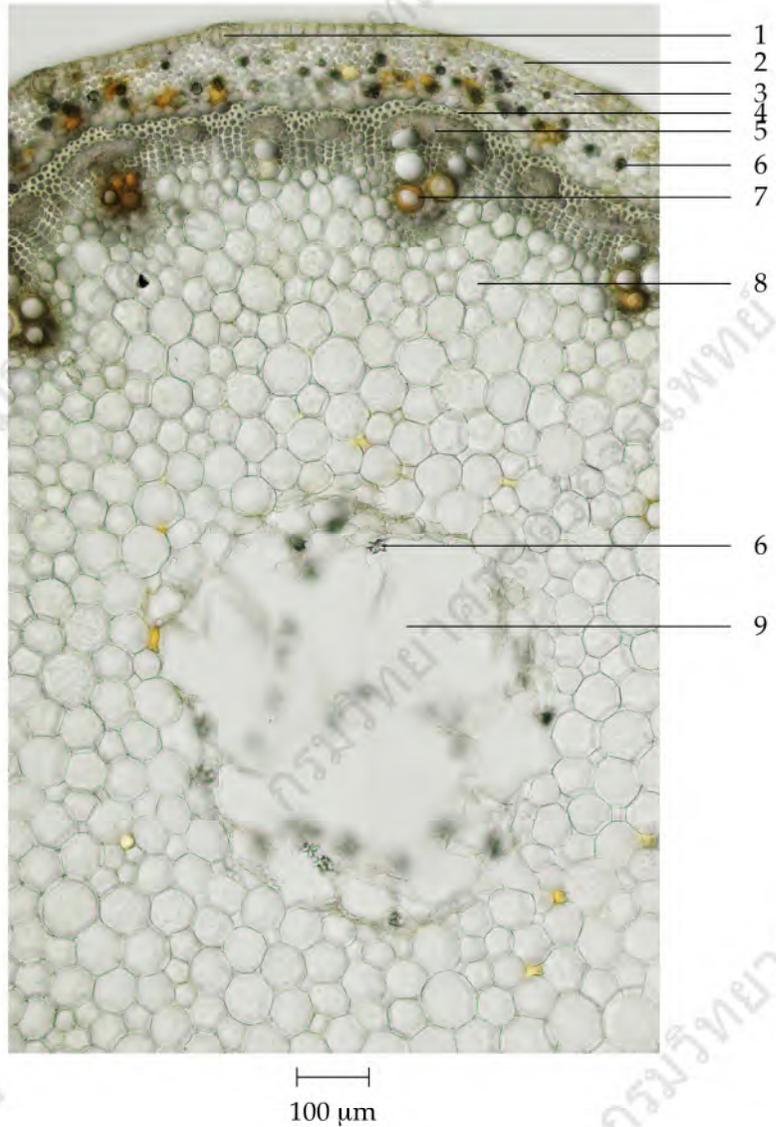


Fig. 2e Photomicrograph of Transverse Section of the Stem of *Persicaria odorata* (Lour.) Soják

- | | |
|---------------------|------------------------------|
| 1. secretory cavity | 6. rosette aggregate crystal |
| 2. epidermis | 7. vessel |
| 3. collenchyma | 8. parenchyma |
| 4. fibre | 9. degenerated pith |
| 5. phloem | |

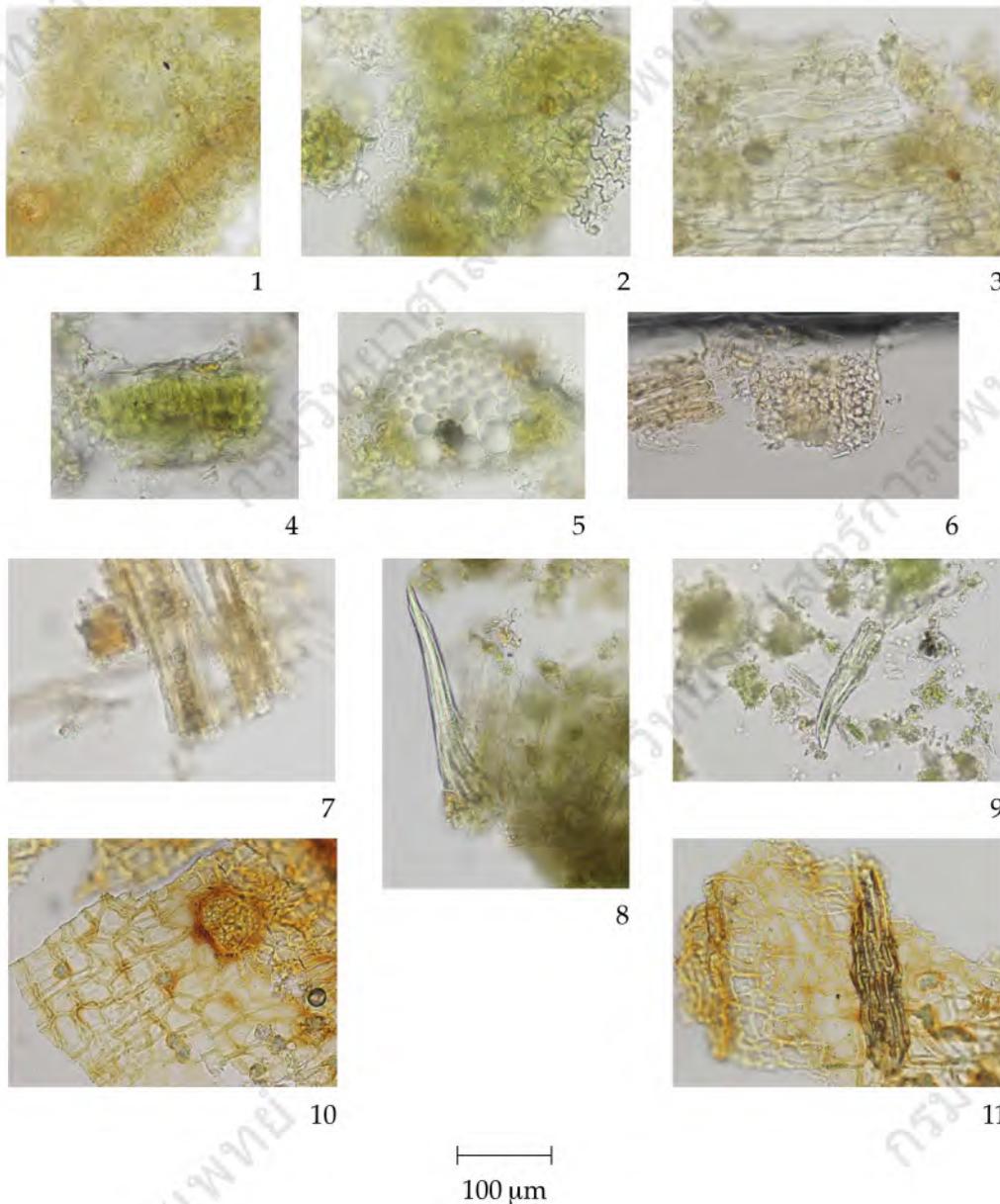


Fig. 2f Photomicrographs of Powdered Drug of the Aerial Parts of *Persicaria odorata* (Lour.) Soják

1. polygonal upper epidermis and paracytic stomata, in surface view
2. wavy-walled lower epidermis, paracytic stomata, and diacytic stomata, in surface view
3. epidermis and secretory cavities with epithelial cells, in surface view
4. lamina showing upper epidermis, palisade cells, and spongy cells, in sectional view
5. epidermis and collenchyma of midrib, some containing rosette aggregate crystals, in sectional view
6. parenchyma containing starch grains
7. fragment of fibres with rosette aggregate crystals
8. epidermis with lignified trichome
9. lignified trichome
10. part of ocrea, in surface view, showing epidermal cells, epithelial cells with secretory cavities, and with underlying parenchyma, some containing rosette aggregate crystals
11. part of ocrea, in surface view, showing epidermal cells and sclerenchymatous bundle

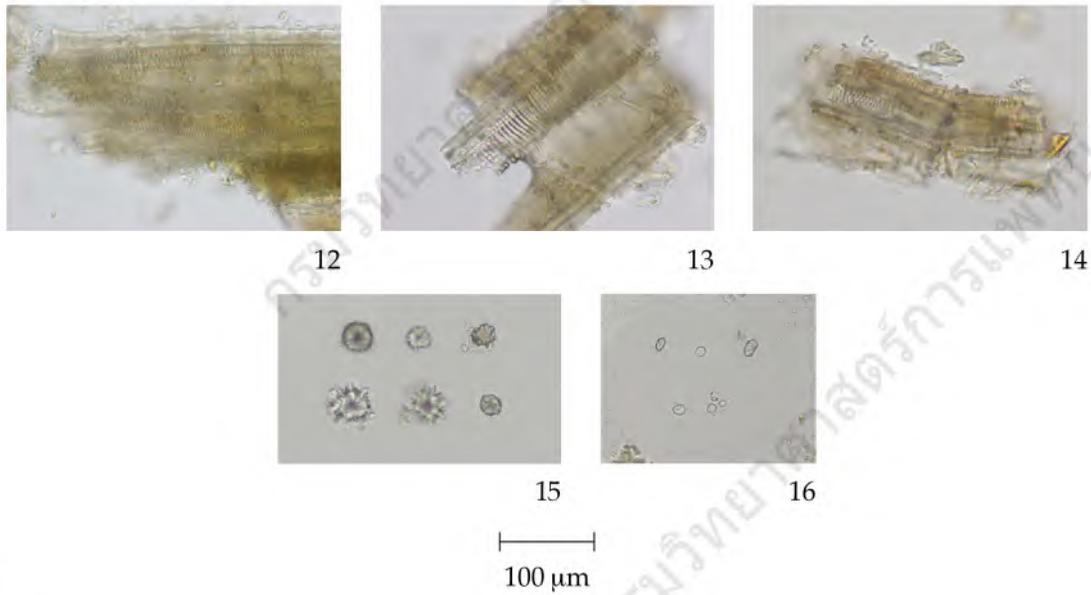


Fig. 2f (continued)

- | | |
|--|--------------------------------|
| 12. reticulate and spiral vessels, fibres,
and parenchyma, in longitudinal view | 14. bordered-pitted vessels |
| 13. reticulate vessels | 15. rosette aggregate crystals |
| | 16. starch grains |

Transverse section of the stem shows epidermis, cortex, vascular tissue, and pith. Epidermis: a layer of oblong cells, epithelial cells with secretory cavities, glandular trichomes, lignified trichomes, and stomata. Cortex: several layers of angular collenchyma and polygonal parenchyma, some containing starch grains or brown substances. Vascular tissue: slightly secondary growth, collateral bundles, containing pericyclic fibres, phloem, vascular cambium, and xylem. Pith: large round parenchyma, some containing starch grains or rosette aggregate crystals and degenerated cells in the centre.

Persicaria Odorata Herb in powder possesses the diagnostic microscopical characters of the unground drug. Epithelial cells with secretory cavities, lignified trichomes, and sclerenchymatous bundles of ocrea are characteristic.

Packaging and storage *Persicaria Odorata* 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 25 mL of *water* for 15 minutes and filter. To 2 mL of the filtrate, add a few drops of a 1 per cent w/v solution of *iron(III) chloride*: a bluish black precipitate appears.

B. Heat 500 mg of the sample, in powder, with 10 mL of *water* on a water-bath for 10 minutes and filter. To 2 mL of the filtrate, add two pieces of *magnesium ribbon*, shake well, mix with a few drops of *hydrochloric acid*, and warm on a water-bath for 5 minutes: a red 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 GF254* as the coating substance and a mixture of 64 volumes of *ethyl acetate*, 10 volumes of *water*, 4 volumes of *formic acid*, and 4 volumes of *glacial acetic 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 6 mm, 2 μ L of the test solution prepared by warming 500 mg of the sample, in powder, with 10 mL of *methanol* in a water-bath at 65° 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. Subsequently examine the plate under ultraviolet light (366 nm); one blue fluorescent band is observed. Heat the plate at 80° for 5 minutes and then spray the plate with *natural products (NP) TS* while the plate is still warm. Subsequently spray the plate with *polyethyleneglycol (PEG) TS* and observe the plate under ultraviolet light (366 nm); one blue, three green, and four yellow fluorescent bands are observed (Fig. 3).

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 17.0 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 13.0 per cent w/w (Appendix 7.12).

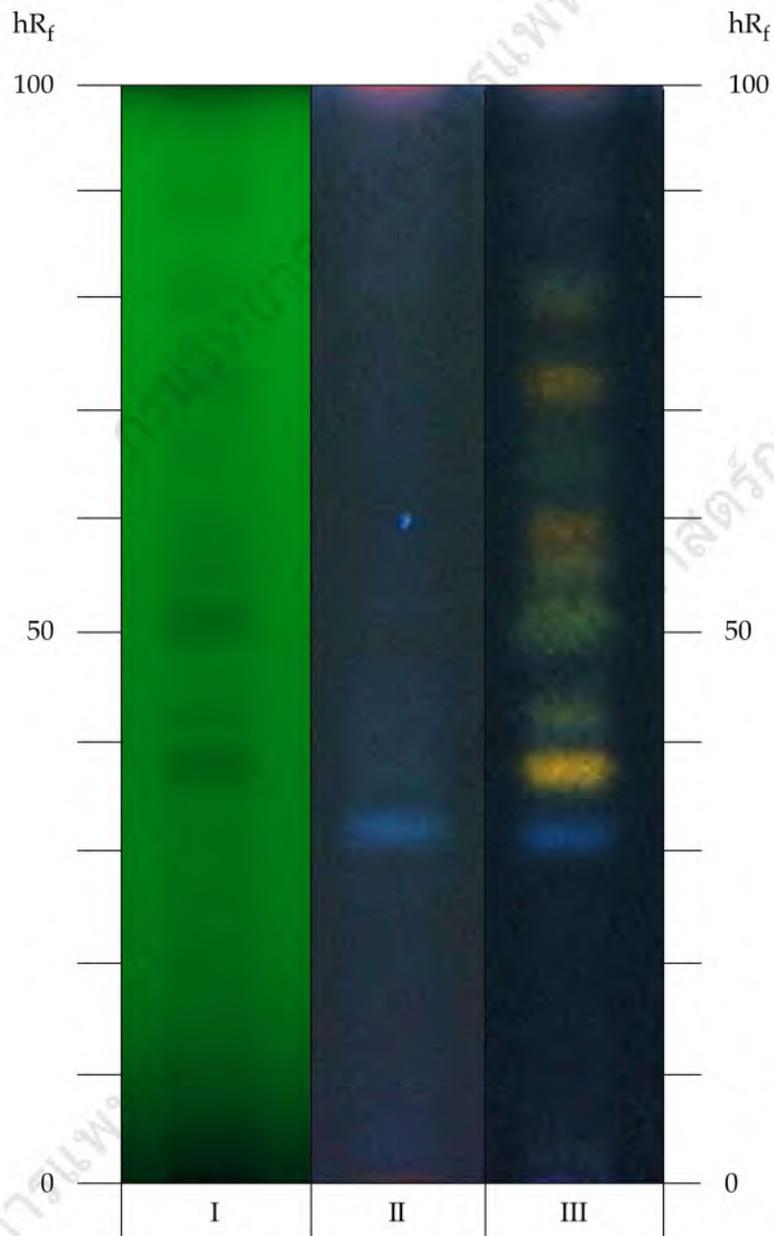


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Aerial Parts of *Persicaria odorata* (Lour.) Soják

- 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

สารสกัดไพล (PHLAI EXTRACT)

Zingiber Montanum Extract

Category Anti-inflammatory, counter-irritant.

Zingiber Montanum Extract is the liquid extract obtained by hydrodistillation from the fresh rhizome of *Zingiber montanum* (J. König) Link ex A. Dietr. (*Z. cassumunar* Roxb.) (Family Zingiberaceae). It contains not less than 90.0 per cent and not more than 110.0 per cent of the labelled amounts of terpinen-4-ol (C₁₀H₁₈O) and sabinene (C₁₀H₁₆); the labelled amounts of terpinen-4-ol and of sabinene are not less than 1.5 per cent.

Description Pale yellow to brownish yellow liquid; odour, strong and characteristic.

Packaging and storage Zingiber Montanum Extract 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°.

Labelling The label on the container states (1) the amounts of terpinen-4-ol and sabinene; (2) the expiration date.

Identification

A. The chromatogram of the Assay preparation shows several peaks, two of which correspond to those of the Standard preparations, as obtained in the Assay (Fig. 1).

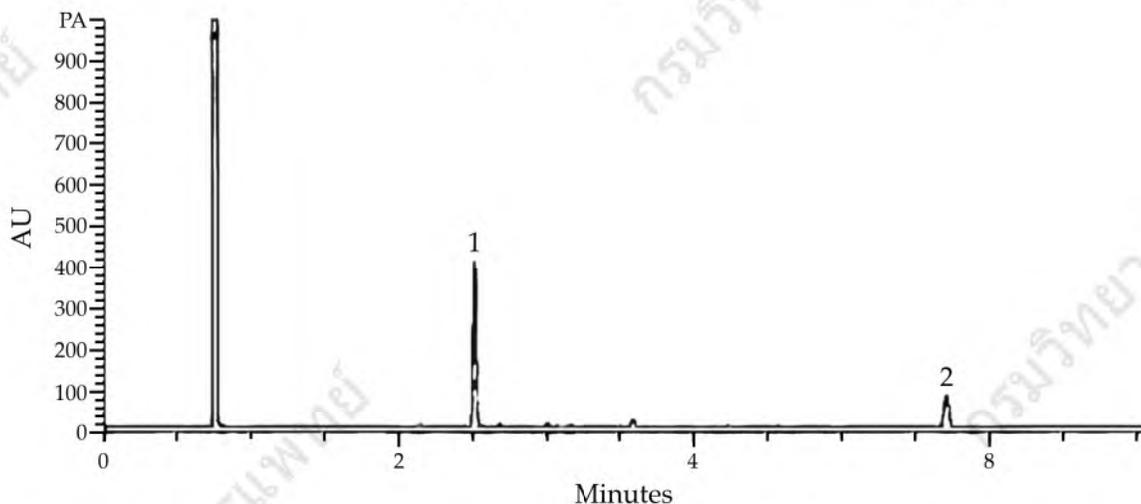


Fig. 1 GC Chromatogram of Zingiber Montanum Extract Showing Sabinene (1) and Terpinen-4-ol (2)

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 98 volumes of *toluene* and 2 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, 5 μ L each of solutions (A), (B), and (C). Prepare solution (A) by diluting 1 mL of the sample with 9 mL of *ethanol*. For solution (B), dilute 1 mL of *terpinen-4-ol* with 9 mL of *ethanol*. For solution (C), dilute 1 mL of (*E*)-1-(3,4-dimethoxyphenyl) butadiene (DMPBD) with 9 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 46 to 50), corresponding to the DMPBD spot from solutions (C). Subsequently spray the plate with *anisaldehyde TS* and heat at 105° for 10 minute. The chromatogram obtained from solution (A) shows a purple spot (hR_f value 28 to 32) due to the terpinen-4-ol spot from solution (B) and a blue spot due to the DMPBD spot from solution (C). Three purple spots are also observed (Fig. 2).

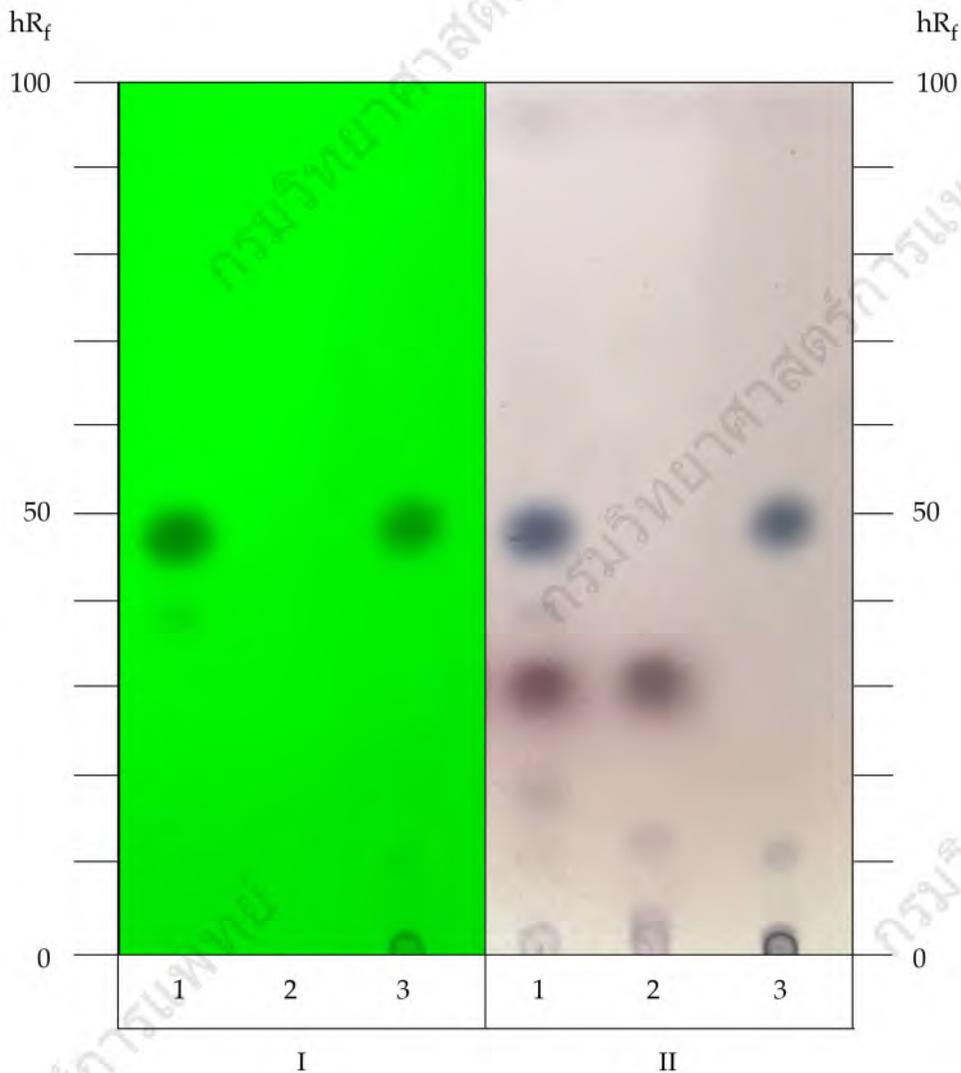


Fig. 2 Thin-Layer Chromatogram of Zingiber Montanum Extract

- 1 = solution (A)
- 2 = solution (B)
- 3 = solution (C)
- I = detection under UV light (254 nm)
- II = detection with *anisaldehyde TS*

Relative density 0.8756 to 0.9836 (Appendix 4.9).

Refractive index 1.4807 to 1.5049, at 20° (Appendix 4.7).

Optical rotation -34.1° to -26.1°, at 20° (Appendix 4.8).

Assay Carry out the determination as described in the “Gas Chromatography” (Appendix 3.4).

Standard preparation A Dissolve an accurately weighed quantity of Terpinen-4-ol RS in sufficient *ethanol*. Dilute quantitatively and stepwise with *ethanol* to obtain five solutions, each having a known concentration of 0.5, 1, 2, 3, and 4 mg per mL of terpinen-4-ol.

Standard preparation B Dissolve an accurately weighed quantity of Sabinene RS in sufficient *ethanol*. Dilute quantitatively and stepwise with *ethanol* to obtain five solutions, each having a known concentration of 0.5, 1.5, 2.5, 3.5, and 4.5 mg per mL of sabinene.

Assay preparation Dissolve an accurately weighed quantity of Zingiber Montanum Extract in sufficient *ethanol* and dilute quantitatively with *ethanol* to obtain a final concentration of about 5 mg per mL.

Chromatographic system The chromatographic procedure may be carried out using (a) a fused silica column (30 m × 0.32 mm) packed with 5 per cent phenyl-95 per cent methylpolysiloxane (0.25 μm) on silanized diatomaceous support, (b) the injection port and the detector block maintained at 150°, (c) split ratio 1:100, (d) helium for chromatography as the carrier gas at a flow rate of about 1.8 mL per minute, and (e) a flame ionization detector at 300°. The step gradient of temperature is as follows:

Time (Minutes)	Temperature (°)
0-1	70
2-17	70→150
18-22	150
23-26	150→230
27-29	230

To determine the suitability of the chromatographic system, chromatograph each of *Standard preparation A* and *Standard preparation B* and record the peak response as directed under *Procedure* and *Calculation*: the relative standard deviation for replicate injections is not more than 2.0 per cent.

Procedure Separately inject about 1 μL each of *Standard preparation A* and *Standard preparation B* into the chromatograph, record the chromatograms and measure the responses for the terpinen-4-ol peak and sabinene peak. Plot the readings and draw the standard curve of best fit: the curves show the correlation coefficient of not less than 0.995. Inject about 1 μL of *Assay preparation* into the chromatograph, record the chromatogram, and measure the responses for terpinen-4-ol peak and sabinene peak.

Calculation By reference to the standard curves, calculate the contents of terpinen-4-ol (C₁₀H₁₈O) and sabinene (C₁₀H₁₆) in the portion of the Extract taken.

สารภี, ดอก (SARAPHI, DOK)

Mammeae Siamensis Flos

Mammea Siamensis Flower

Category Cardiotonic, antipyretic.

Mammea Siamensis Flower is the dried flower of *Mammea siamensis* (Miq.) T. Anderson [*Calysaccion siamense* Miq., *Ochrocarpos siamensis* (Miq.) T. Anderson] (Family Calophyllaceae), Herbarium Specimen Number: DMSC 5362, Crude Drug Number: DMSc 1253.

Constituents *Mammea Siamensis* Flower contains coumarins (e.g., kayeassamins and mammeasins). It also contains terpenoids, xanthenes, sterols, etc.

Description of the plant (Fig. 1) Evergreen tree, up to 20 m tall, dioecious, sometimes polygamo-dioecious; outer bark dark grey, roughly cracked and flaking, sometimes smooth or slightly fissured, inner bark red with pale yellow latex; youngest twigs slightly flat. Leaves simple, opposite, oblanceolate, obovate or oblong to oblong-obovate, 7.5 to 25 cm long, 1.5 to 8 cm wide, apex obtuse to slightly cuspidate, base cuneate, margin entire, coriaceous, veins conspicuous, young leaves purple, dark green above when mature; petiole 0.5 to 1.5 cm long. Inflorescence cymose, mostly in axils of fallen leaves. Flower unisexual or bisexual, mostly male and perfect flowers on separate trees, 1.2 to 2.5 cm in diameter; pedicel up to 2 cm long; sepals 2, white-green, elliptic, 2 to 7 mm long, 4 to 8 mm wide; petals 4, white or pale yellow, oblong, 0.6 to 1 cm long, 5 to 9 mm wide; stamens 60 to 90, filament white, free, anther yellow to orange-yellow, 1 to 2 mm long; ovary superior, 2-loculed, ovary and style light green and turning dark green, style 1, short, stigma 2-lobed. Fruit a drupe, oval to ellipsoid, or rhomboid, 2 to 2.5(-4) cm long, 0.8 to 2.5 cm wide, with short blunt tip, green to yellow-orange. Seed 1, with thin yellow to orange aril.

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

Macroscopical (Fig. 1) Complete or broken flowers, fragment of sepals, petals, filaments, stamens, and pedicels are commonly found. Sepals, petals, and filaments, pale yellow to brown; pedicels, dark brown.

Microscopical (Figs. 2a-2g) Transverse section of the sepal shows upper epidermis, mesophyll, vascular tissue, and lower epidermis. Upper epidermis: a layer of oval cells and stomata. Mesophyll: collenchyma, 1 to 3 layers underneath epidermises; slightly thick-walled parenchyma, some containing rosette aggregate crystals and/or microcrystals, and schizogenous secretory ducts. Vascular tissue: phloem and xylem. Lower epidermis: a layer of rectangular epidermal cells and stomata.

Transverse section of the petal shows upper epidermis, mesophyll, vascular tissue, and lower epidermis. Upper epidermis: a cuticle layer and a layer of oval cells. Mesophyll: collenchyma, 1 to 3 layers of small cells; parenchyma, some containing rosette aggregate crystals and/or microcrystals or brown substances, and schizogenous secretory ducts. Vascular tissue: phloem and xylem. Lower epidermis: a cuticle layer, layer of small rectangular epidermal cells, and stomata.

Transverse section of the filament shows a layer of epidermis with papillae covered with cuticle layer, loosen parenchyma cells, and one strand of vascular tissue.

Transverse section of the anther shows 4 pollen sacs containing a layer of round epidermal cells with papillae, a layer of endothecium, parenchyma, pollen grains, and vascular tissue.



Fig. 1 *Mammea siamensis* (Miq.) T. Anderson

1. habit 2. male flower 3. perfect flower 4. flowering branches with perfect flowers
5. branch of ripe fruits 6. crude drug

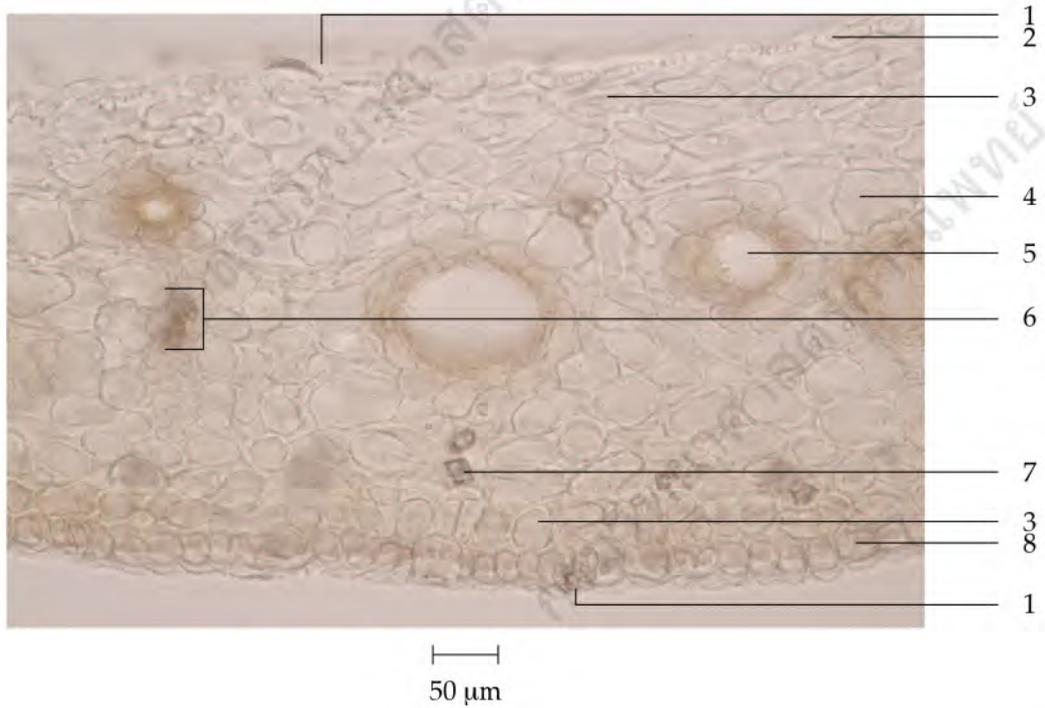


Fig. 2a Photomicrograph of Transverse Section of the Sepal of *Mammea siamensis* (Miq.) T. Anderson

- | | |
|--------------------|------------------------------|
| 1. stoma | 5. secretory duct |
| 2. upper epidermis | 6. vascular tissue |
| 3. collenchyma | 7. rosette aggregate crystal |
| 4. parenchyma | 8. lower epidermis |

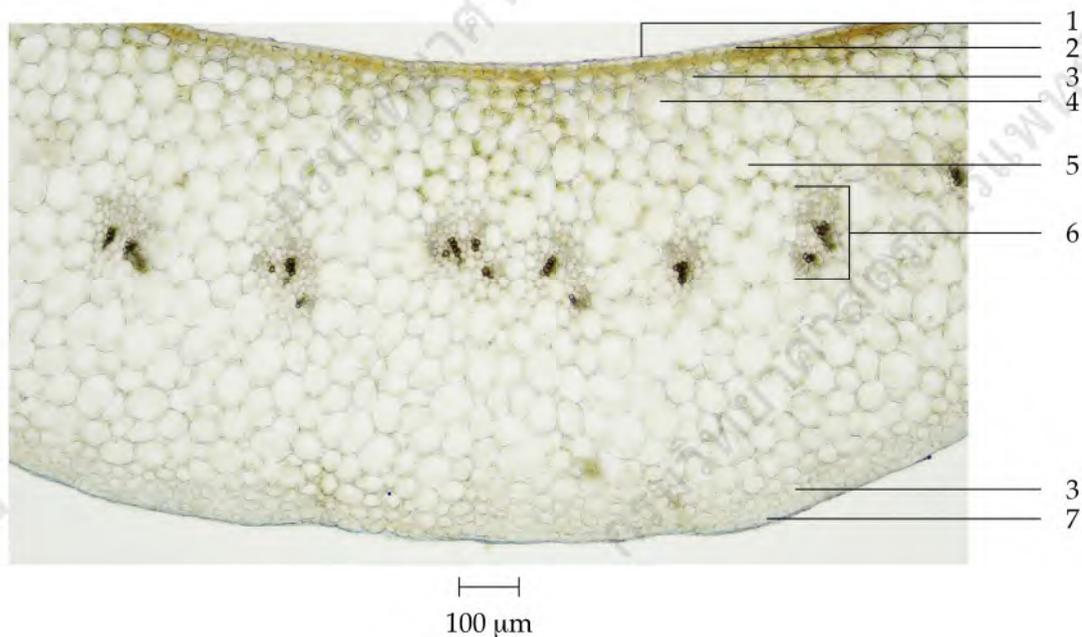


Fig. 2b Photomicrograph of Transverse Section of the Petal of *Mammea siamensis* (Miq.) T. Anderson

1. cuticle	5. parenchyma
2. upper epidermis	6. vascular tissue
3. collenchyma	7. lower epidermis
4. secretory duct	

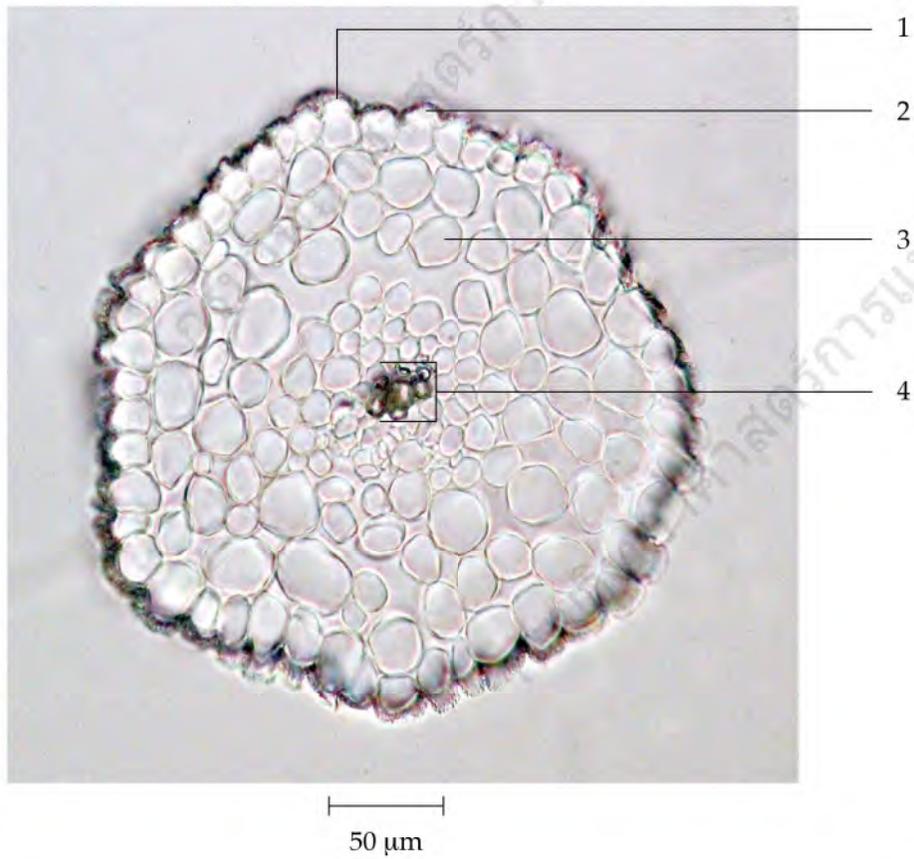


Fig. 2c Photomicrograph of Transverse Section of the Filament of *Mammea siamensis* (Miq.) T. Anderson

1. cuticle

2. epidermal cell with papilla

3. parenchyma

4. vascular tissue

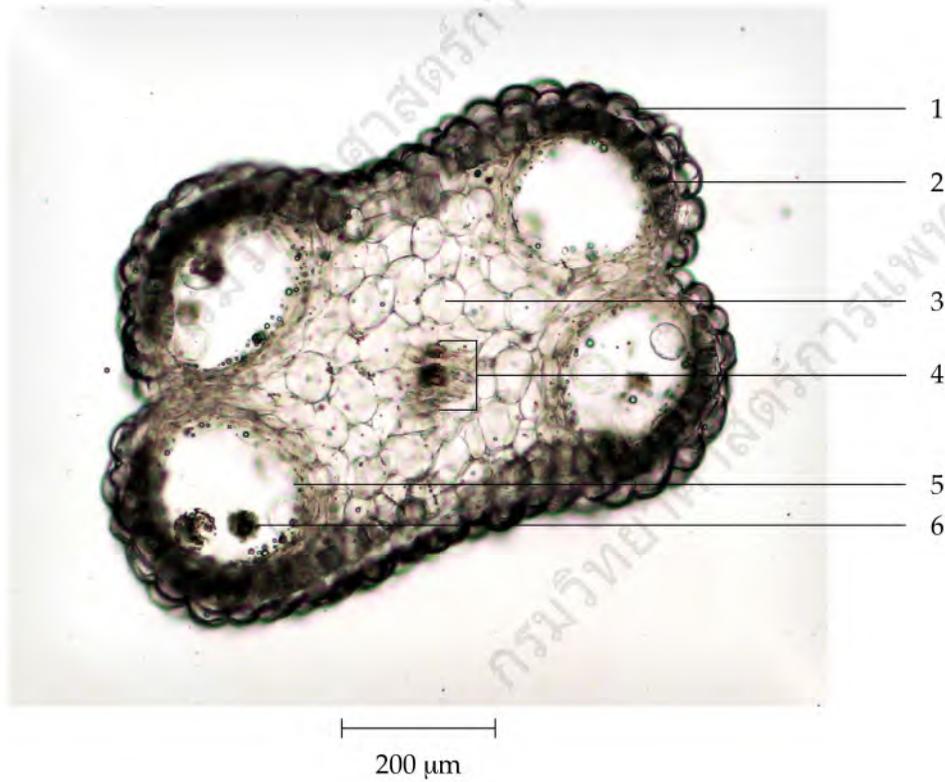


Fig. 2d Photomicrograph of Transverse Section of the Anther of *Mammea siamensis* (Miq.) T. Anderson

- | | |
|--------------------------------|--------------------|
| 1. epidermal cell with papilla | 4. vascular tissue |
| 2. endothecium | 5. pollen sac |
| 3. parenchyma | 6. pollen grain |

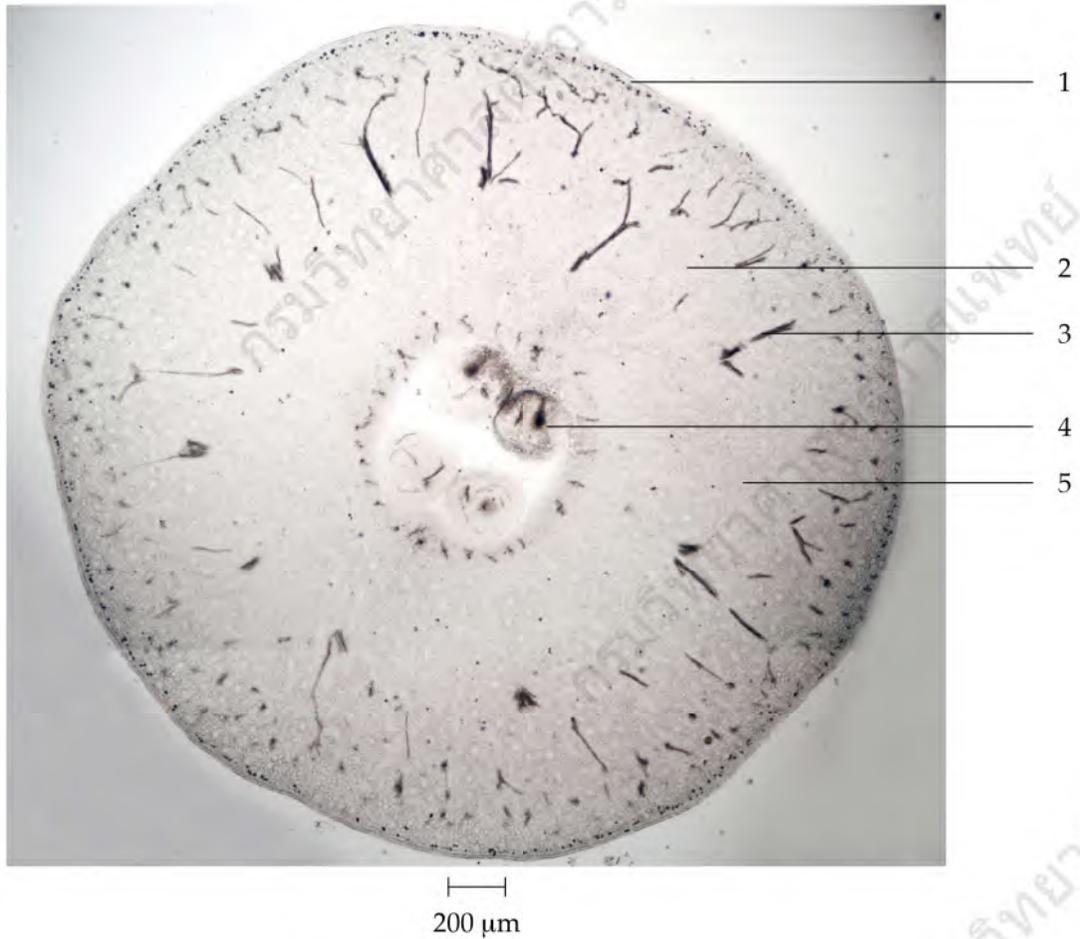


Fig. 2e Photomicrograph of Transverse Section of the Ovary of *Mammea siamensis* (Miq.) T. Anderson

- | | |
|--------------------|-------------------|
| 1. epidermis | 4. ovule |
| 2. parenchyma | 5. secretory duct |
| 3. vascular tissue | |

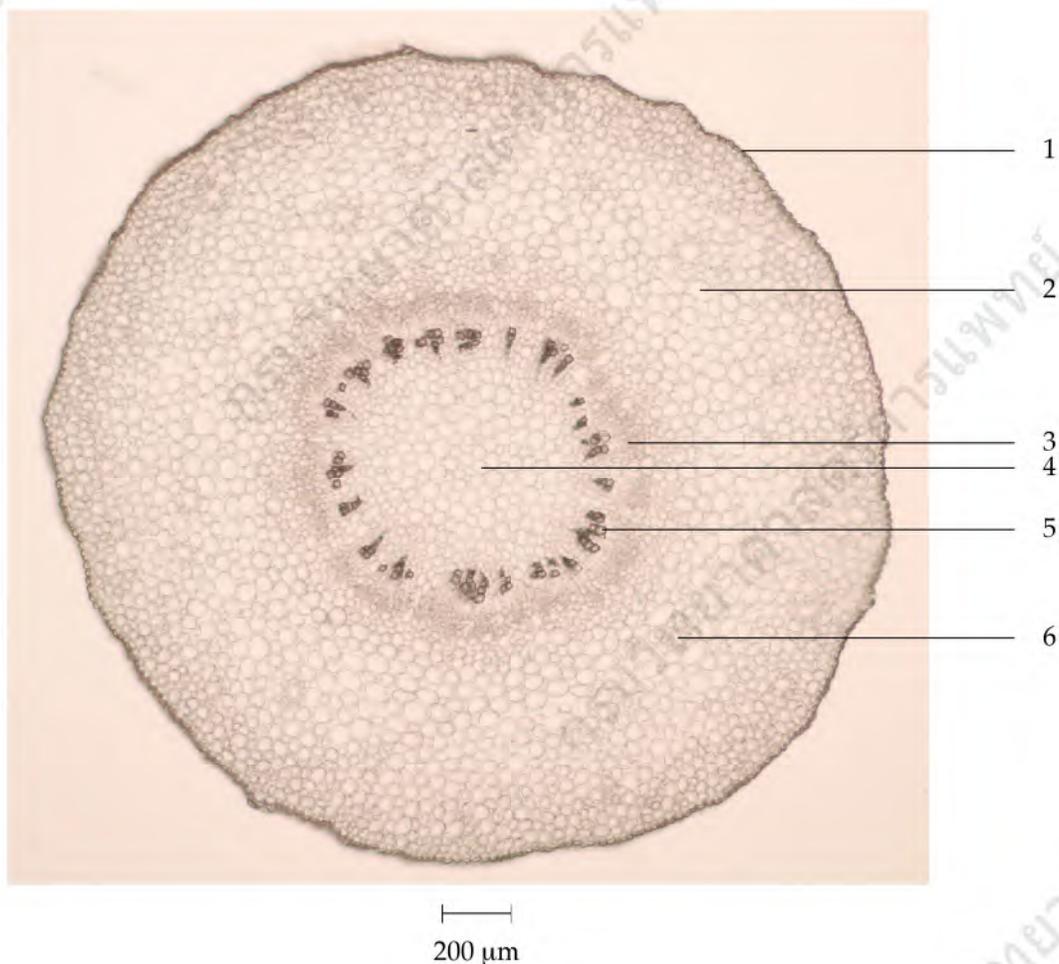


Fig. 2f Photomicrograph of Transverse Section of the Pedicel of *Mammea siamensis* (Miq.) T. Anderson

- | | |
|---------------|--------------------|
| 1. epidermis | 4. pith parenchyma |
| 2. parenchyma | 5. vessel |
| 3. phloem | 6. secretory duct |

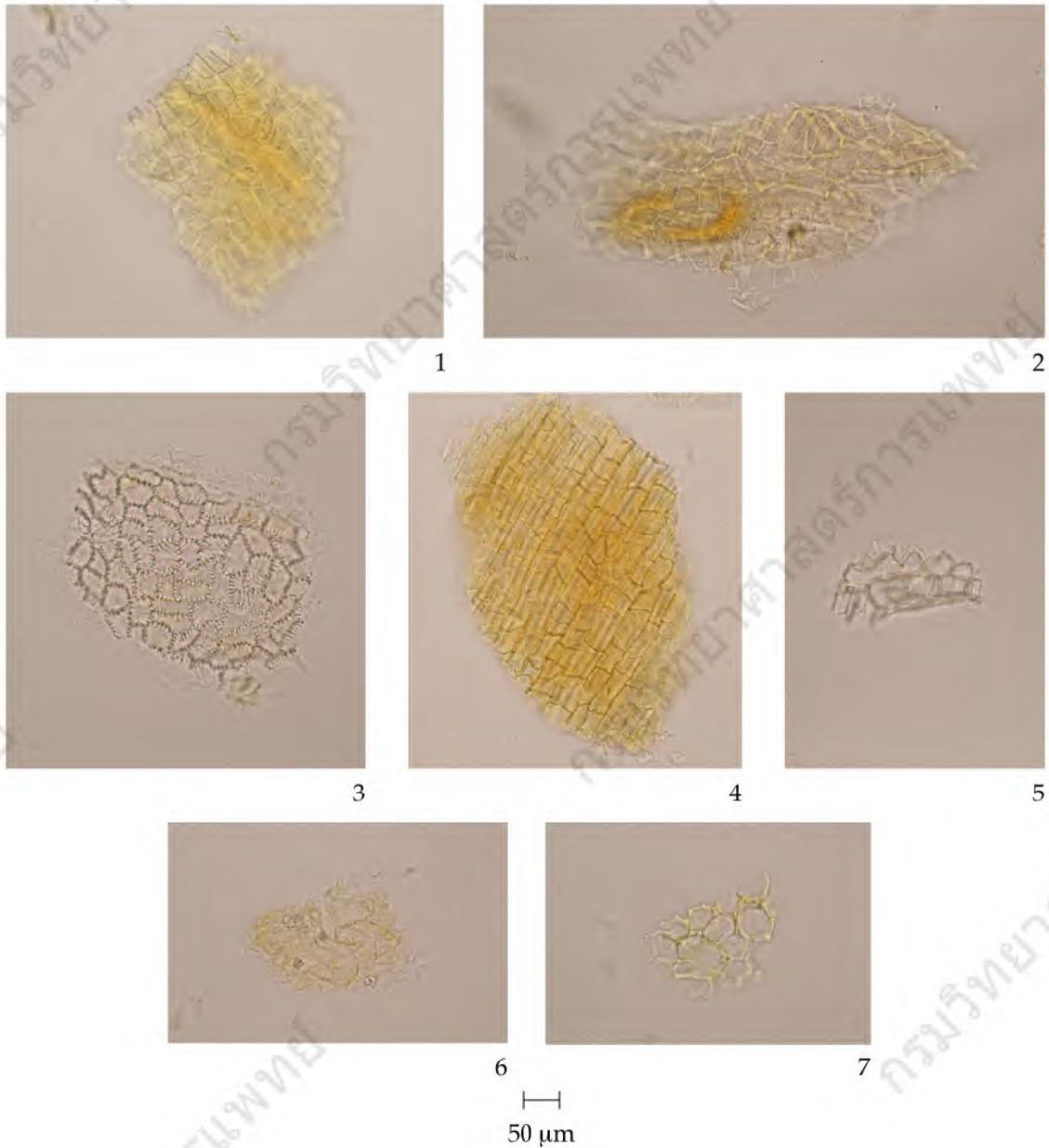


Fig. 2g Photomicrographs of Powdered Drug of the Flowers of *Mammea siamensis* (Miq.) T. Anderson

1. fragment of sepal, in surface view, showing epidermis and stomata
2. fragment of petal in surface view
3. endothecium in surface view
4. epidermis in surface view
5. epidermis with papillae and endothecium of anther, in sectional view
6. parenchyma containing rosette aggregate crystals
7. slightly thick-walled parenchyma

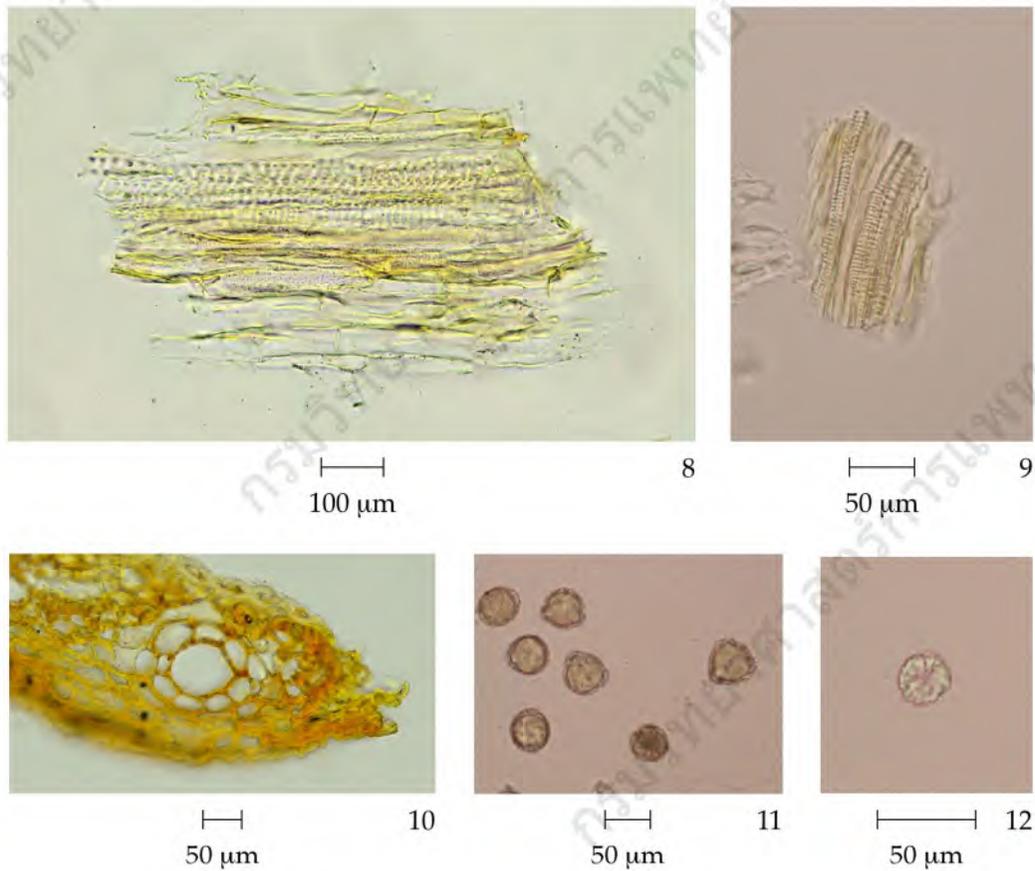


Fig. 2g (continued)

- 8. fragment of vascular tissue, in longitudinal view showing reticulate and spiral vessels, and parenchyma
- 9. fragment of vascular tissue, showing vessels, parenchyma, and fibres

- 10. epidermis, secretory duct, parenchyma, and collenchyma, in sectional view
- 11. pollen grains
- 12. rosette aggregate crystal

Transverse section of the ovary shows epidermis, cortex, vascular tissue, and ovules. Epidermis: a layer of small epidermal cells. Cortex: numerous parenchyma cells, some containing rosette aggregate crystals, secretory ducts. Vascular tissue: phloem and xylem. Ovule: 4.

Transverse section of the pedicel shows epidermis, cortex, vascular tissue, and pith. Epidermis: a layer of small epidermal cells. Cortex: numerous parenchyma cells, some containing rosette aggregate crystals, and secretory ducts. Vascular tissue: phloem and xylem. Pith: parenchyma.

Mammea Siamensis Flower in powder possesses the diagnostic microscopical of the unground drug. Secretory duct, endothecium, slightly thick-walled parenchyma of sepal, fragment of filament, and triporate pollen grains are characteristic.

Packaging and storage Mammea Siamensis Flower 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 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. Heat 1 g of the sample, in powder, with 20 mL of water in a water-bath for 10 minutes, allow to cool, and filter. To 2 mL of the filtrate, add a few drops of *iron(III) chloride TS* and mix well: a dark 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 80 volumes of *n-hexane* and 20 volumes of *ethyl acetate* as the mobile phase and allowing the solvent front to ascend 12 cm above the line of application. Apply to the plate as a band of 8 mm, 20 µL of the test solution prepared by sonicating 1 g of the sample, in coarse powder, with 10 mL of *methanol* for 20 minutes and filtering. Evaporate the filtrate to dry under reduced pressure at 50°. Dissolve the residue in 1 mL of *methanol*. 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; two green, two red, two orange, and six blue fluorescent bands are observed. Subsequently spray the plate with *anisaldehyde TS* and heat at 105° for 10 minutes; four violet and four purple bands are observed.

Repeat the same procedure on another plate but spray with a 3 per cent w/v solution of *potassium hydroxide*, allow it to dry in air, and then examine under ultraviolet light (366 nm); one green and eight blue fluorescent bands are observed (Fig. 3).

Loss on drying Not more than 7.0 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 9.0 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 21.0 per cent w/w (Appendix 7.12).

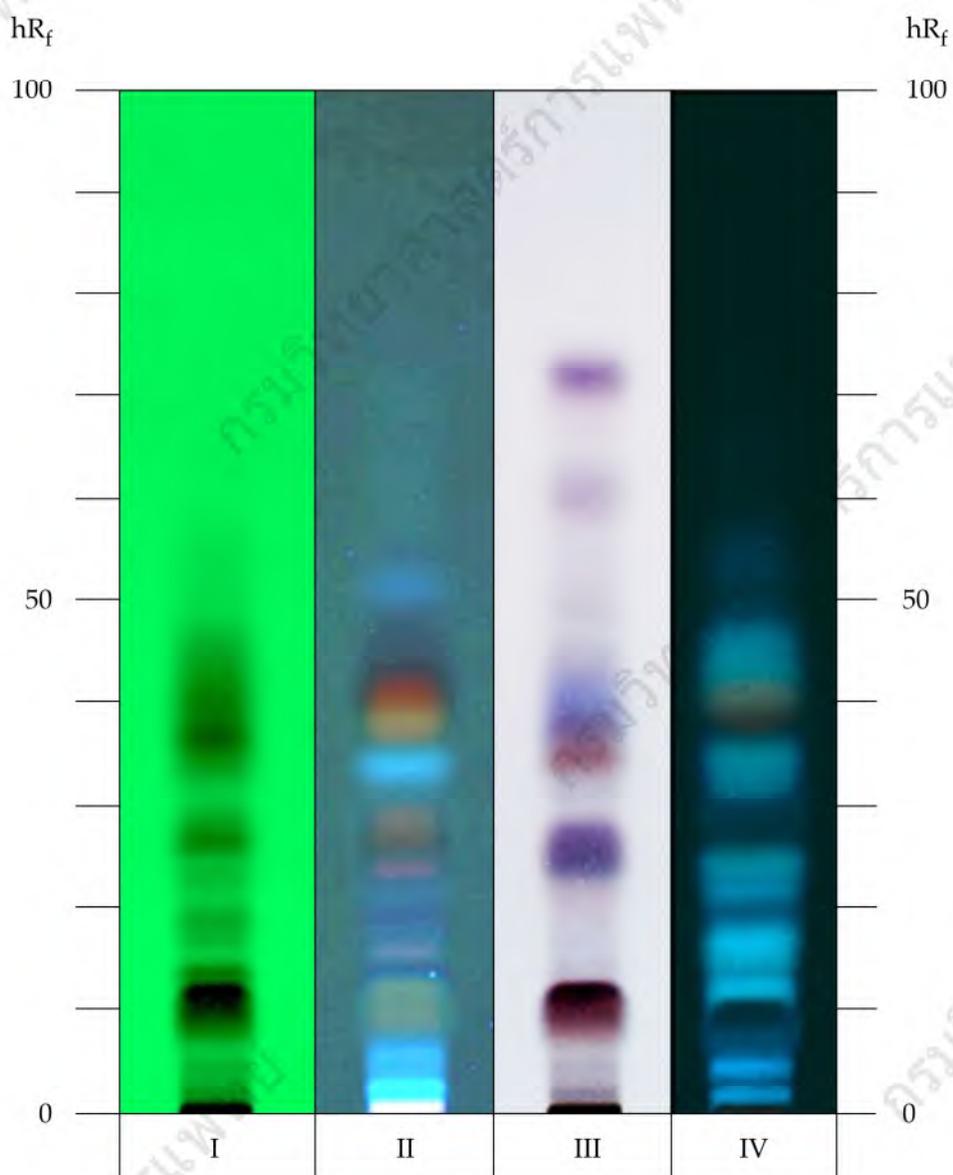


Fig. 3 Thin-Layer Chromatogram of the Methanolic Extract of the Flowers of *Mammea siamensis* (Miq.) T. Anderson

- I = detection under UV light (254 nm)
- II = detection under UV light (366 nm)
- III = detection with *anisaldehyde TS*
- IV = detection under UV light (366 nm) after spraying with a 3 per cent w/v solution of *potassium hydroxide*

ส้มโอ, ผิว (SOM O, PHIO)

มะโอ, ผิว (MA O, PHIO)

Citri Maximae Exocarpium et Mesocarpium

Pomelo Rind

Synonym Pummelo Rind

Category Anti-cough, mild cardiotoxic.

Pomelo Rind is the dried exocarp with some unremovable mesocarp of *Citrus maxima* (Burm.) Merr. [*Aurantium maximum* Burm., *Citrus grandis* (L.) Osbeck] (Family Rutaceae), Herbarium Specimen Number: DMSC 5319, Crude Drug Number: DMSc 1224.

Constituents Pomelo Rind contains flavonoids (e.g., apigenin, hesperidin, and naringin). It also contains volatile oils, coumarins, limonoids, sterols, pectins, etc.

Description of the plant (Fig. 1) Tree, up to 15 m tall; stem thorny, irregular branches; young branch usually angular, purplish, pilose. Leaves unifoliolate, alternate, obovate, broadly ovate to elliptic, 5 to 20 cm long, 2 to 12 cm wide, apex obtuse, mucronate, or rounded, base rounded or subcordate, margin entire or crenate, upper surface dark green, coriaceous, with aromatic pellucid dots, lower surface prominently veins, pubescent; petiole articulated, 2 to 7 cm long, broadly winged to nearly wingless. Inflorescence terminal or axillary, racemose, sometimes flowers solitary or clustered, (1-)2- to 15-flowered, 10 to 30 cm long; rachis hairy; pedicel 1 to 1.5 cm long. Flowering bud purplish, rarely whitish; flower white, calyx green, 4- to 5-lobed, 0.5 to 1 mm long; petals 4 to 5, whitish, ovate or oblong-ovate, 1.5 to 3 cm long, 0.7 to 1.5 cm wide; stamens 20-35, filament 1 to 3 cm long, anther oblong, about 5 mm long; ovary superior, pubescent, 10-to 16-loculed, 4- to 8-ovuled per locule, style about 1.5 cm long, thick, stigma verrucose. Fruit a hesperidium, globose, oblate, or pyriform, 10 to 20 cm in diameter; exocarp and mesocarp 1 to 4 cm thick, exocarp greenish yellow to golden yellow with large prominent pellucid dots, tough, mesocarp white or pale pink, spongy, 1 to 3 cm thick; segments 11 to 18; fruit-pulp numerous, elliptic or ovate, elongate. Seeds numerous, somewhat flattened, ridged, hard.

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

Macroscopical (Fig. 1) Dried external rinds with some unremovable mesocarp, roughly cut, easily broken, varied in shape and size; externally yellowish to pale brown and brown bulges; internally whitish, rough.

Microscopical (Figs. 2a-2c) Transverse section of the rinds shows exocarp with some unremovable mesocarp. Exocarp: 1 to 2 layers of yellow greenish epidermal cells, some containing prismatic crystals or oil droplets, covered with thick cuticle layer and stomata. Mesocarp: numerous and various shapes of nonlignified unevenly thick-walled parenchyma, round shape in the outer and loosen elliptic shape in the inner, some containing prismatic crystals or oil droplets; schizolysigenous oil cavities, containing oil droplets; vascular tissue, phloem and xylem.

Pomelo Rind in powder possesses the diagnostic microscopical of the unground drug. Epidermal layer with stomata, oil droplets, and prismatic crystals can be seen in abundance. Part of oil cavity and thick-walled parenchyma of mesocarp can also be seen.



1



2



3



4



5



6

1 cm

Fig. 1 *Citrus maxima* (Burm.) Merr.
1. habit 2. flowers 3. fruit set 4. fruits 5. halved fruit 6. crude drug

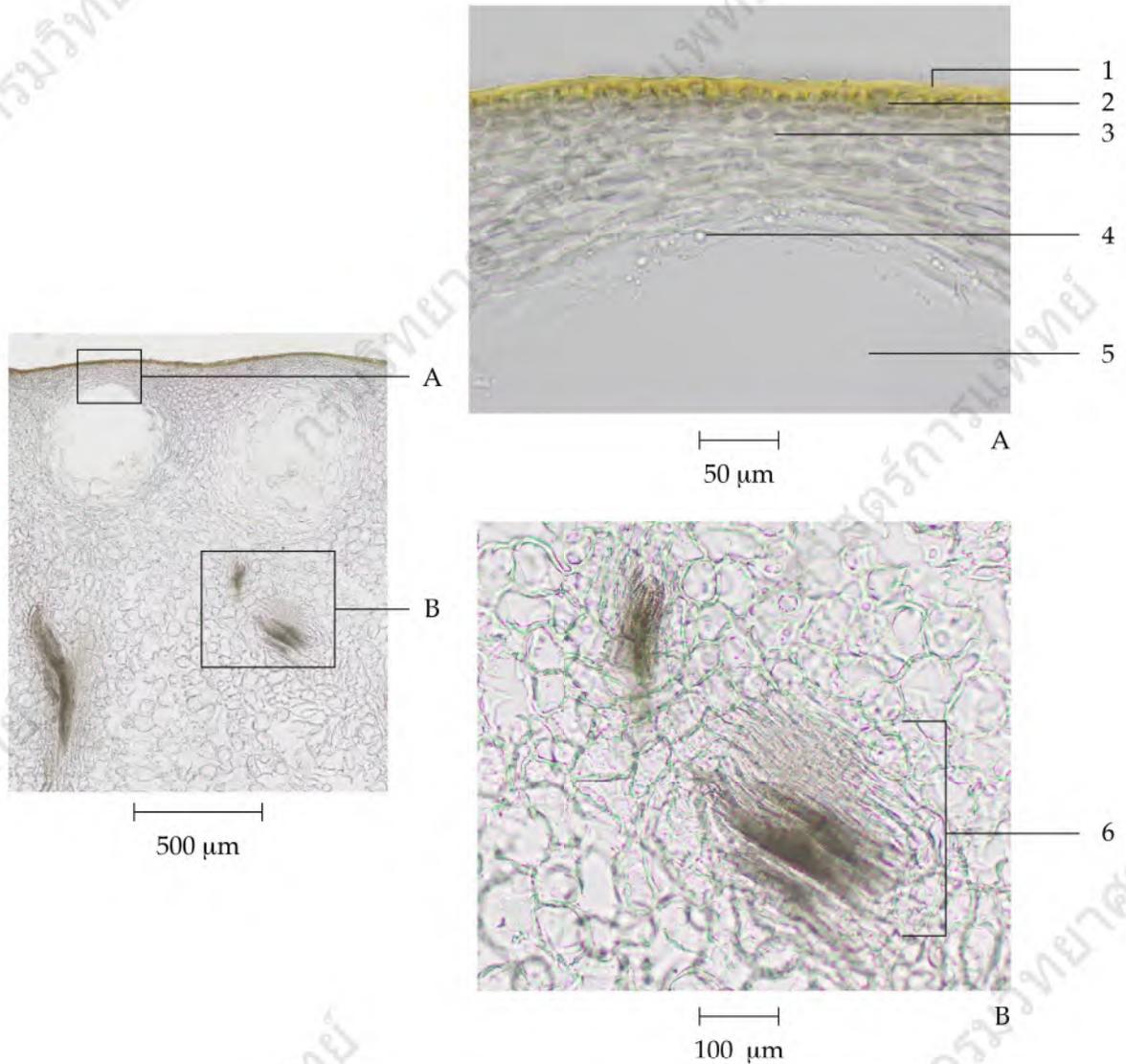


Fig. 2b Photomicrographs of Transverse Sections of the Exocarp and Mesocarp of *Citrus maxima* (Burm.) Merr.

A. Exocarp

B. Mesocarp

1. cuticle

2. epidermis

3. parenchyma

4. oil droplet

5. schizolysigenous oil cavity

6. vascular tissue

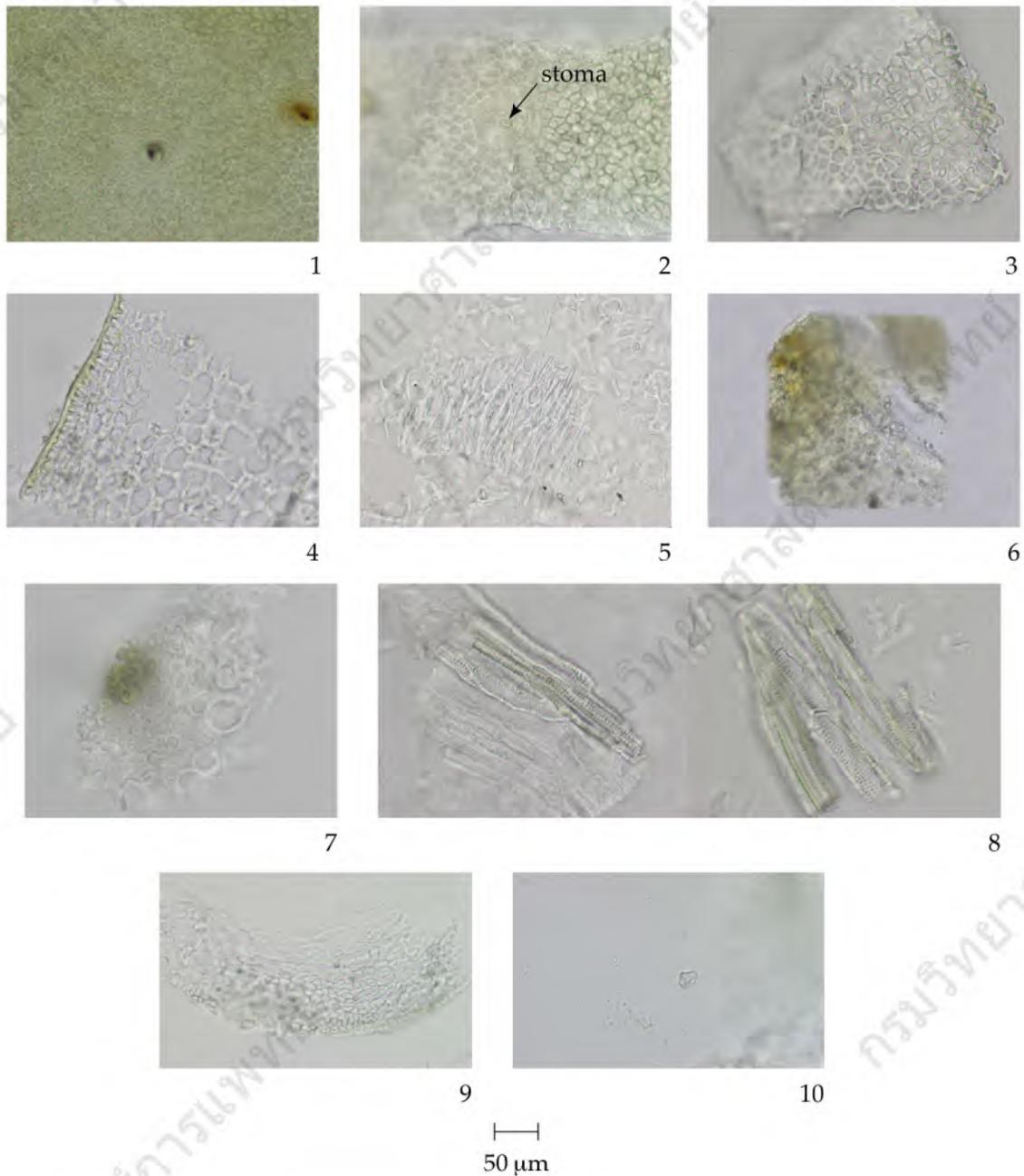


Fig. 2c Photomicrographs of Powdered Drug of the Exocarps and Mesocarps of *Citrus maxima* (Burm.) Merr.

1. epidermis in surface view with stomata
2. epidermis, some containing prismatic crystals, and stoma in surface view
3. exocarp in surface view
4. exocarp and mesocarp, showing epidermis and parenchyma, some containing prismatic crystal, in sectional view
5. parenchyma of mesocarp
6. parenchyma in pericarp, some containing oil droplets
7. fragment of vascular tissue and parenchyma
8. reticulate and pitted vessels
9. exocarp, mesocarp, and part of oil cavity, in sectional view
10. prismatic crystal

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

Before carrying out the physico-chemical tests, Pomelo Rind shall be treated by drying at about 45° for 24 hours.

Identification

A. Heat 500 mg of the sample, in powder, with 10 mL of *methanol* in a water-bath for 15 minutes and filter. To 2 mL of the filtrate, add 1 to 2 pieces of *magnesium ribbon*, shake well, mix with a few drops of *hydrochloric acid*, and warm on a water-bath for 5 to 10 minutes: a red precipitate forms.

B. Heat 1 g of the sample, in powder, with 20 mL of *water* in a water-bath for 15 minutes and filter. To 2 mL of the filtrate, add a few drops of *iron(III) chloride TS* and shake well: a blue precipitate forms.

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*, 10 volumes of *methanol*, 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 separately to the plate as bands of 8 mm, 15 µL of solution(A) and 5 µL of solution(B). Prepare solution (A) by sonicating 1 g of the sample, in *fine powder*, with 15 mL of *methanol*, for 15 minutes and filtering. For solution (B), dissolve 2 mg of *naringin* 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 bands. The chromatogram obtained from solution (A) shows a quenching band (hR_f value 34 to 36), corresponding to the naringin band obtained from solution (B). Other four quenching bands are also observed. Subsequently examine the plate under ultraviolet light (366 nm); three blue fluorescent bands are observed. Spray the plate with *anisaldehyde TS*, heat at 105° for about 10 minutes, and examine under visible light. The band due to naringin is brown. One brown, two green, and six violet bands are also observed (Fig. 3).

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 (50 per cent)-soluble extractive Not less than 28.0 per cent w/w (Appendix 7.12).

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

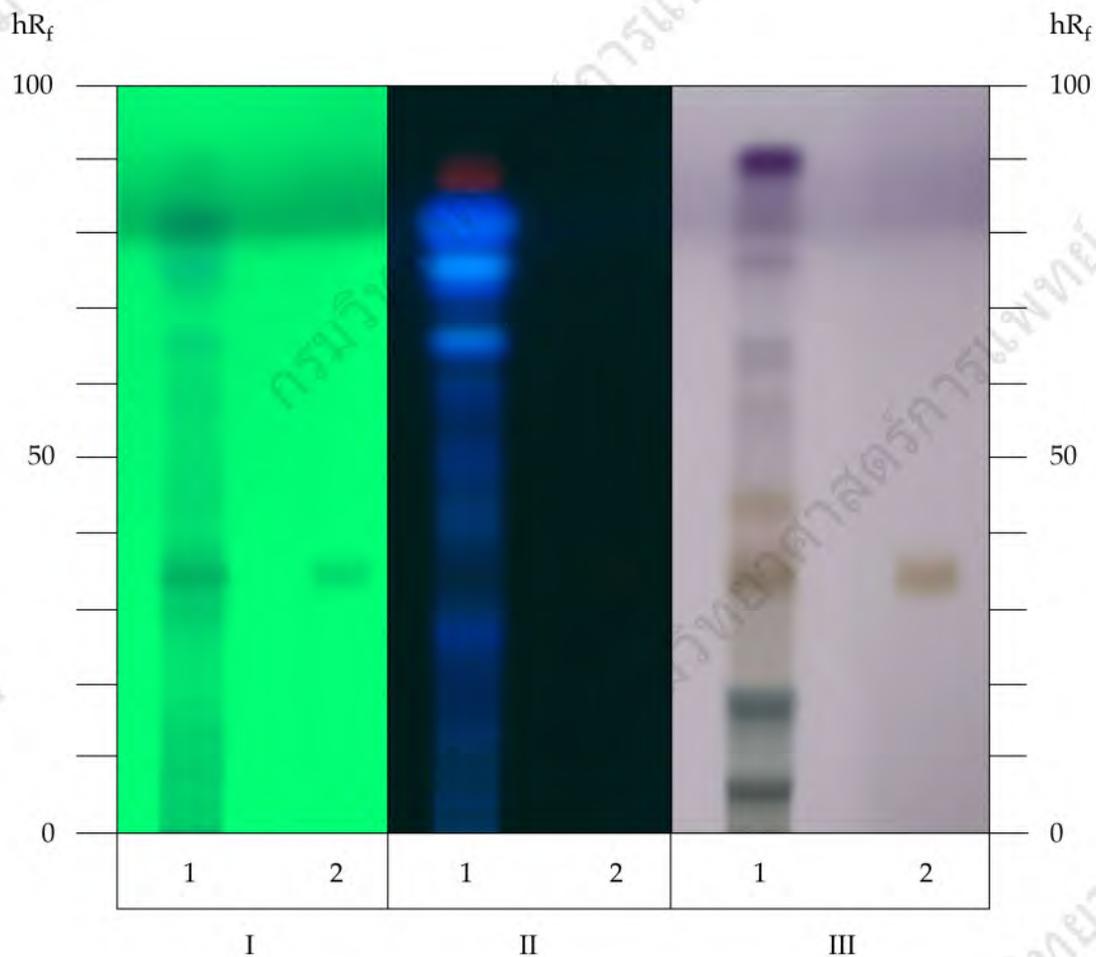


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Exocarps and Mesocarps of *Citrus maxima* (Burm.) Merr.

- 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*

ส้มซ่า, ผิว (SOM SA, PHIO)

Citri × Aurantii Exocarpium et Mesocarpium
Som Sa Peel

Category Carminative, stomachic.

Som Sa Peel is the dried exocarp with some unremovable mesocarp of *Citrus × aurantium* L. 'Som Sa' (Family Rutaceae), Herbarium Specimen Number: DMSC 5384, Crude Drug Number: DMSc 1268.

Constituents Som Sa Peel contains flavonoids (e.g., hesperidin and naringenin) and volatile oils rich in limonene. It also contains phenolic acids, coumarins, limonoids, phenylethylamine alkaloids such as *p*-synephrine, etc.

Description of the plant (Fig. 1) Shrub or small tree, 7 to 10 m tall; bark brown to dark brown; branchlet compressed-angular when young; spine axillary, 1 to 4 cm long, straight; leaf, flower, and peel contain pellucid dots. Leaves unifoliolately compound, alternate; winged petiole obovate, 0.8 to 2 cm long, 0.5 to 1 cm wide; lamina ovate-oblong, 7.5 to 10 cm long, 5.5 to 7 cm wide, apex obtusely acuminate, base cuneate or rounded, margin crenate, with scattered pellucid dots. Inflorescence racemose, axillary or terminal, 1- to 8-flowered, fragrant. Flower with pedicel up to 6 mm long; calyx cupular, 2 to 3 mm long, 5-lobed, greenish white; petals 4 to 5, oblong, 1.2 to 1.6 cm long, 5 to 6 mm wide, obtusely acuminate, white; stamens 20 to 28, polyadelphous, 0.7 to 1 cm long, white; ovary superior, style 0.9 to 1 cm long, stigma capitate. Fruit a hesperidium, globose, 6 to 7 cm in diameter; exocarp slightly bumpy, coriaceous, green, strongly aromatic; mesocarp spongy, white; segments 11 to 13; fruit-pulp yellowish green to greenish white. Seeds numerous, ovoid-oblong, 0.5 to 1.2 cm long, 3 to 5 mm wide.

Description Odour, characteristic and aromatic; taste, tingling and bitter.

Macroscopical (Fig. 1) Dried external peels, with some unremovable mesocarp, varied in shape and size depending on sources and methods of preparation; outer surface, olive green to brownish, slightly rough; inner surface whitish to pale yellowish, spongy.

Microscopical (Figs. 2a–2c) Transverse section of the peel shows exocarp with some unremovable mesocarp. Exocarp: a layer of rectangular epidermal cells covered with thick cuticles and stomata. Mesocarp: numerous parenchyma with thick-walled, containing chloroplasts and some containing prismatic crystals; schizolysigenous oil cavities, relatively large; vascular bundle, small, containing vessels, parenchyma, fibres, and prismatic crystals.

Som Sa Peel in powder possesses the diagnostic microscopical of the unground drug. Epidermal layer with stomata, oil droplets, and prismatic crystals can be seen in abundance. Part of oil cavity and thick-walled parenchyma of mesocarp can also be seen.



1



2



3



4



1 cm

5

Fig. 1 *Citrus × aurantium* L.

1. habit 2. flowering twig showing flowers, and leaves with winged petioles 3. fruits
4. section of fruit and seeds 5. crude drug

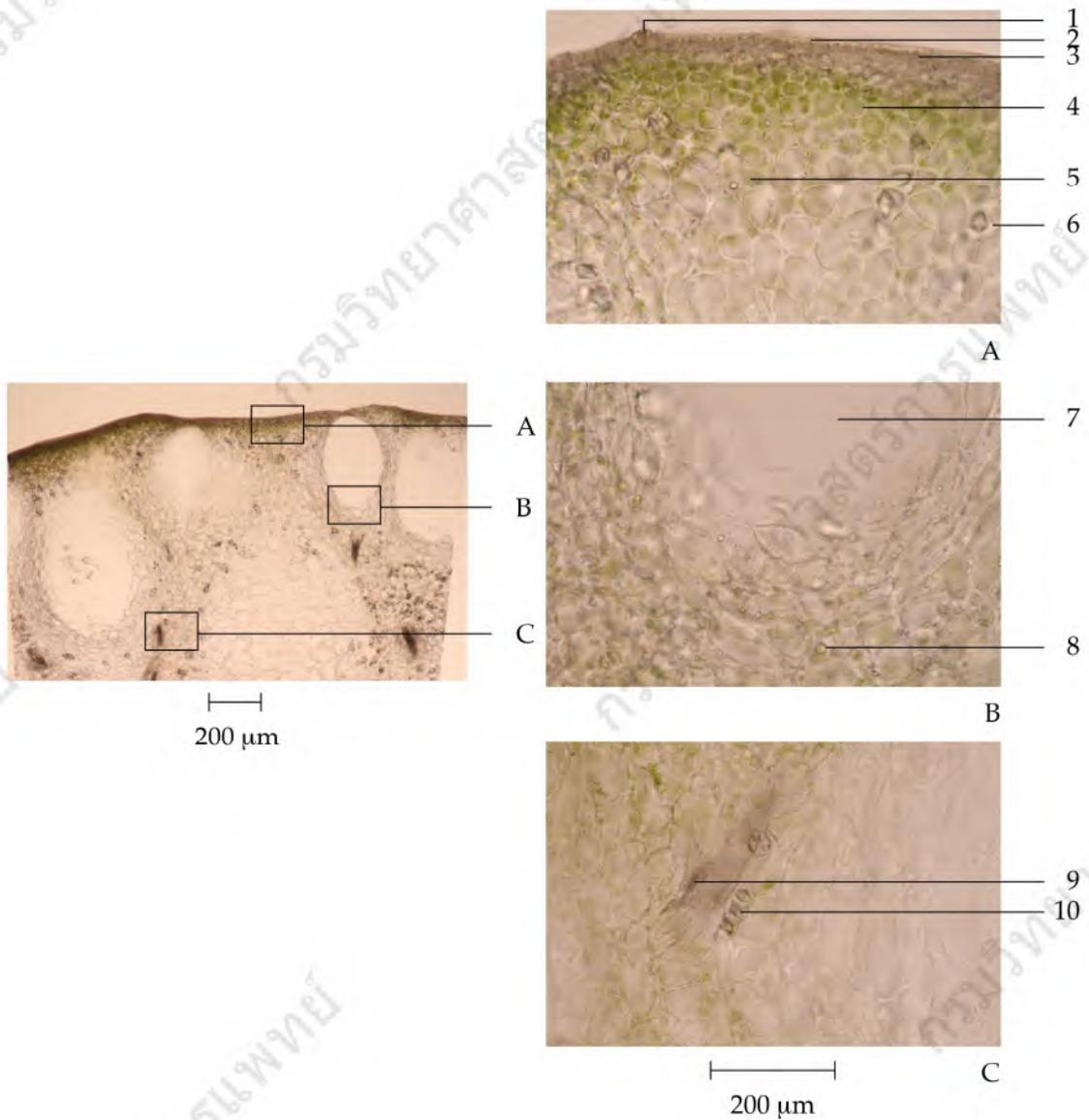


Fig. 2b Photomicrographs of Transverse Sections of the Exocarp and Mesocarp of *Citrus x aurantium* L.

A. Exocarp

B. and C. Mesocarp

1. stoma

2. cuticle

3. epidermis

4. parenchyma containing chloroplast

5. parenchyma containing oil droplet

6. parenchyma containing prismatic crystal

7. schizolysigenous oil cavity

8. oil droplet

9. vessel

10. prismatic crystal

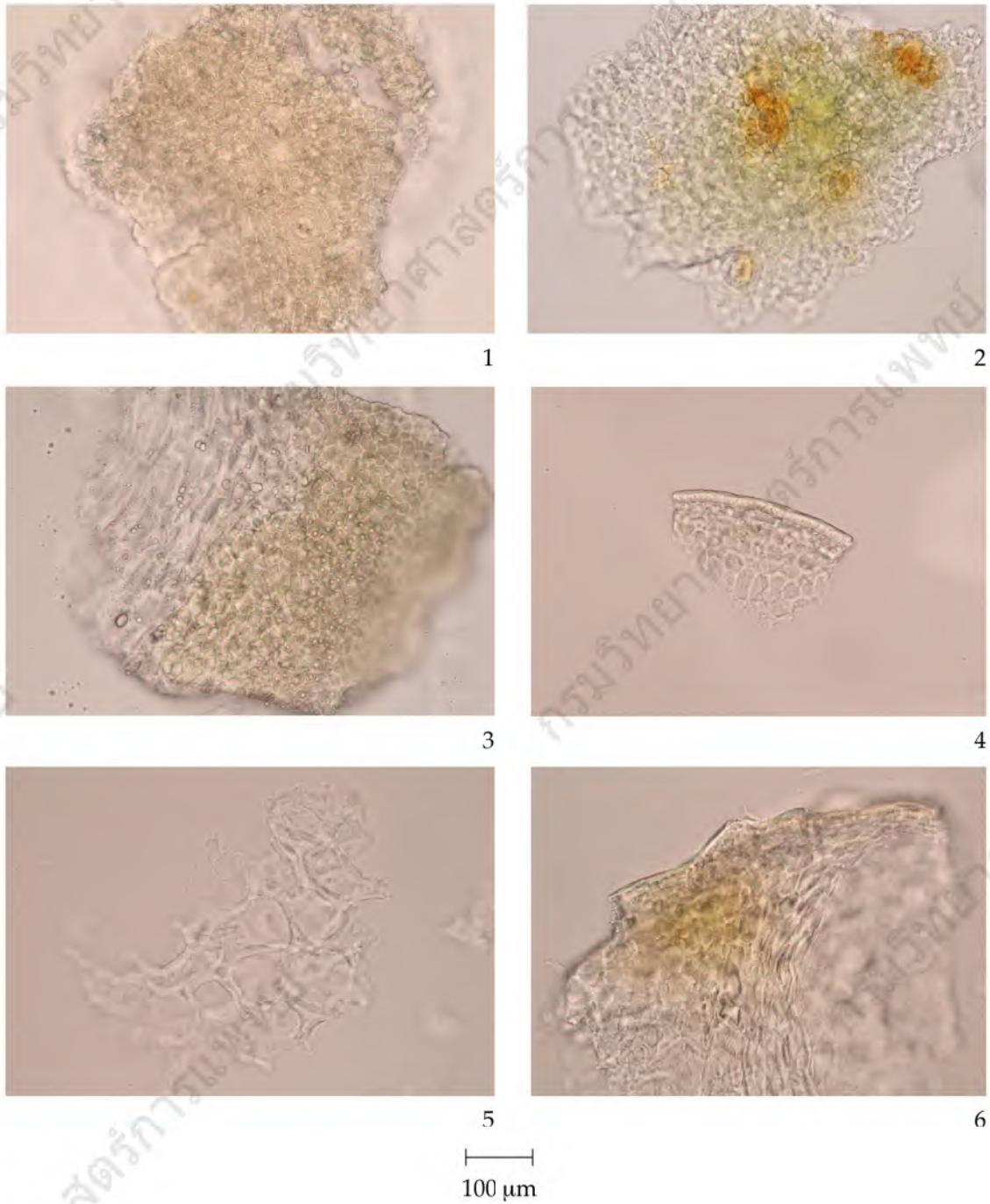


Fig. 2c Photomicrographs of Powdered Drug of the Exocarps and Mesocarps of *Citrus × aurantium* L.

1. epidermis in surface view, showing oil droplets, prismatic crystals, and stomata
2. epidermis in surface view, showing stomata and prismatic crystals
3. epidermis in surface view, showing oil droplets and prismatic crystals
4. epidermis and cuticle layer in sectional view, with underlying parenchyma, some containing prismatic crystals
5. parenchyma of mesocarp
6. fragment of mesocarp showing oil cavity

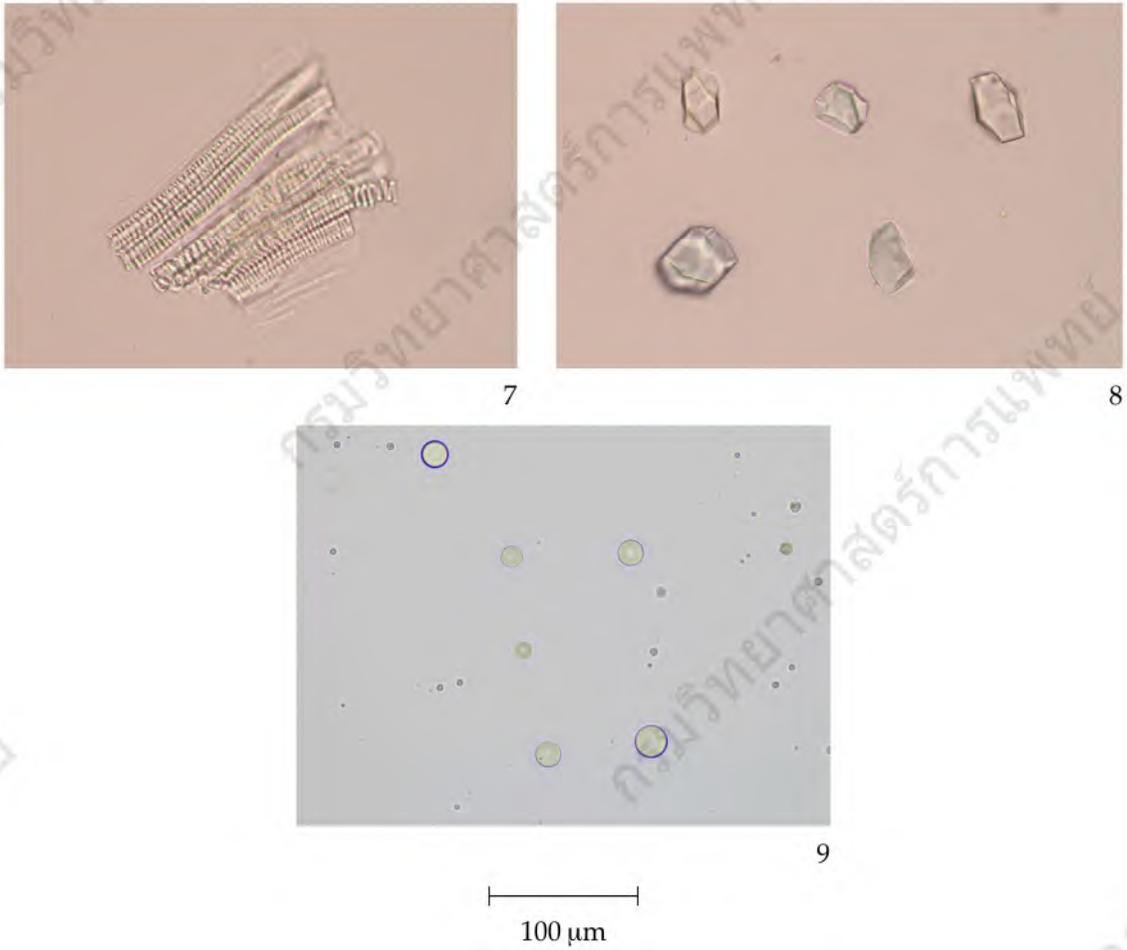


Fig. 2c (continued)

7. vessels

8. prismatic crystals

9. oil droplets

Packaging and storage Som Sa Peel 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. Sonicate 1 g of the sample, in powder, with 10 mL of *methanol* for 30 minutes and filter (solution 1). To 2 mL of solution 1, add a few drops of *ninhydrin TS* and warm on a water-bath: a deep blue or purple colour develops.

B. To 2 mL of solution 1, add 2 or 3 pieces of *magnesium ribbon*, shake well, and mix with a few drops of *hydrochloric acid*: a pink to red 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 70 volumes of *ethyl acetate*, 30 volumes of *toluene*, and 10 volumes 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 as bands of 8 mm, 10 μ L of solution (A) and 5 μ L of solution (B). Prepare solution (A) by sonicating 1 g of the sample, in powder, with 10 μ L of *methanol* for 30 minutes and filtering. Evaporate the filtrate to dry under reduced pressure at 50° and dissolve the residue in 1 mL of *methanol*. For solution (B), dissolve 1 mg of *hesperidin* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and examine the plate under ultraviolet light (254 nm), marking the quenching bands. The chromatogram obtained from solution (A) shows a quenching band (hR_f value 6 to 8) corresponding to the hesperidin band from solution (B); other eight quenching bands are also observed. Subsequently, spray the plate with *anisaldehyde TS* and heat at 105° for 5 minutes; the band due to hesperidin is brown. One yellow, two brown, and two purple bands are also observed.

Repeat the same procedure on another plate. After removal of the plate, allow it to dry in air. Spray the plate with a 1 per cent w/v solution of *aluminium chloride* in *methanol* and examine under ultraviolet light (366 nm). The chromatogram obtained from solution (A) shows a green fluorescent band (hR_f value 6 to 8) corresponding to the hesperidin band from solution (B); one red, five blue, and five green fluorescent bands are also observed (Fig. 3).

Water Not more than 9.0 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 0.5 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 21.0 per cent w/w (Appendix 7.12).

Volatile oil Not less than 3.5 per cent v/w, calculated on the anhydrous basis (Appendix 7.3H). Use 10 g, in *fine 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.

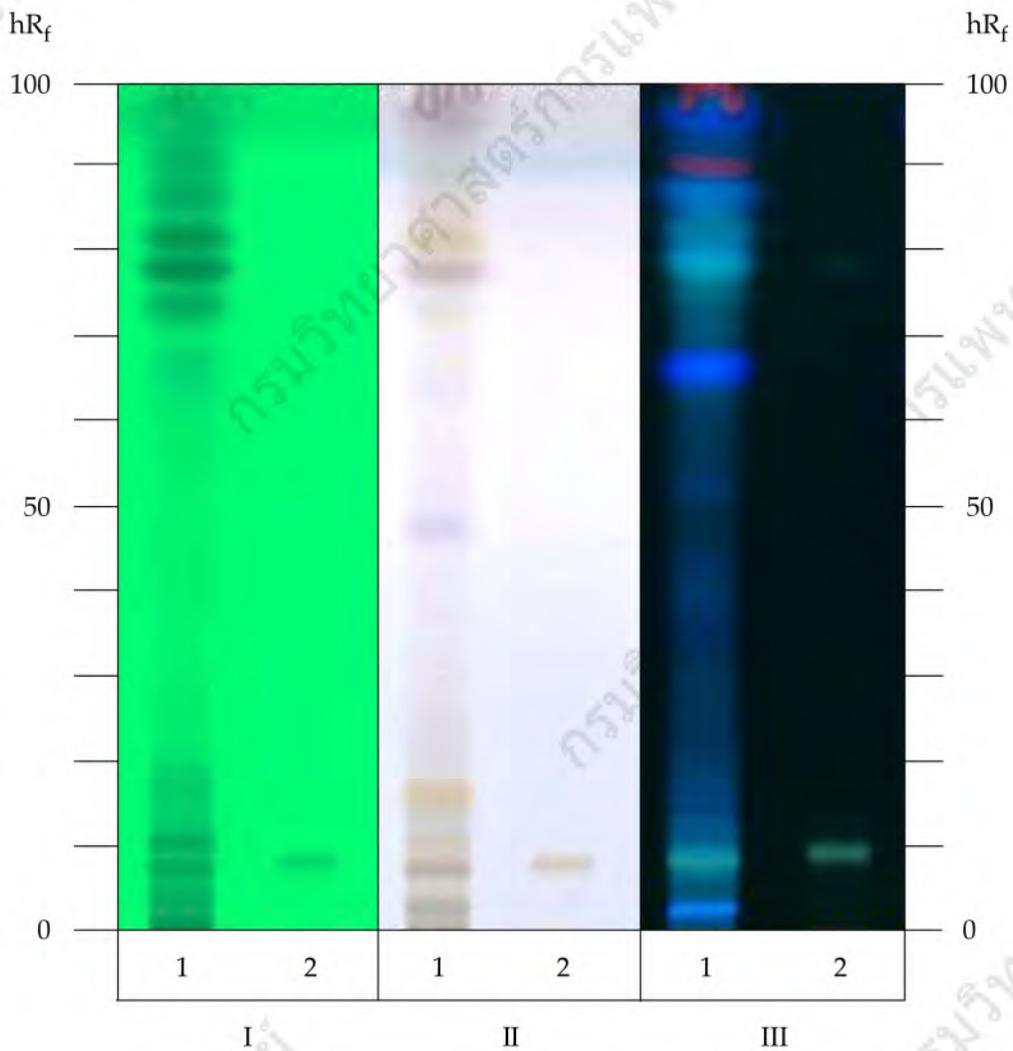


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Exocarps and Mesocarps of *Citrus × aurantium* L.

1 = solution (A)

2 = solution (B)

I = detection under UV light (254 nm)

II = detection with *anisaldehyde* TS

III = detection under UV light (366 nm) after spraying with a 1 per cent w/v solution of *aluminium chloride* in *methanol*

ทับทิม, ใบ (THAPTHIM, BAI)

มะเกี๊ยะ, ใบ (MAKO, BAI); พิล่า, ใบ (PHILA, BAI)

Punicae Granati Folium

Pomegranate Leaf

Category Antidiarrheal, antidyentery.

Pomegranate Leaf is the dried leaf of *Punica granatum* L. (*P. nana* L.) (Family Lythraceae), Herbarium Specimen Number: DMSC 5361, Crude Drug Number: DMSc 1252.

Constituents Pomegranate Leaf contains tannins, sterols (e.g., β -sitosterol and stigmasterol), and phenolic acids. It also contains flavonoids, terpenoids, etc.

Description of the plant (Fig. 1) Deciduous tree or shrub, 1.5 to 7(–10) m tall, much-branched, especially near base; bark dark grey, glabrous; branches opposite, slender, 4-angled when young, becoming terete with age; branchlet usually ending in spine or sometimes leaf-bearing. Leaves simple, opposite or subopposite, lanceolate, elliptic-oblong or oblong, 1 to 9 cm long, 0.5 to 2.5 cm wide, apex acute, obtuse or emarginate, base cuneate or attenuate, margin entire, slightly wavy, or serrulate, upper surface glabrous, shiny, lower surface with prominent midrib; petiole 0.2 to 1 cm long. Flowers solitary or in terminal and axillary cluster of 1 to 6; sessile or subsessile; calyx tube orange-red or pale yellow, campanulate to urceolate, 2 to 3 cm long, 1 to 1.5 cm wide, lobes 5 to 9, triangular; petals 5 to 9, obovate, apex obtuse, thin and crinkled, red, white or variegated; stamens numerous, included or exerted, filaments unequal, anther yellow; ovary inferior, glabrous, 8- to 13-loculed, each locule with numerous ovules. Fruit a berry, globose with persistent calyx at apex, 5 to 13 cm in diameter, varied in colour, from yellow green, red, to black-violet. Seeds numerous, obpyramidal, juicy, red, pink, or yellowish sarcotesta.

Description Odour, characteristic; taste, slightly astringent.

Macroscopical (Fig. 1) A mixture of entire and broken leaves. Entire leaf, lanceolate, elliptic-oblong, or oblong, 1 to 9 cm long, 0.5 to 2.5 cm wide; apex, acute, obtuse, or emarginate, base, cuneate or attenuate, upper surface glabrous, green to brownish green, lower surface green to greyish green, with prominent midrib; petiole brown, 1 to 7 mm long.

Microscopical (Figs. 2a–2d) Transverse section of the leaf through the midrib shows upper epidermis, mesophyll, vascular tissue, and lower epidermis. Upper epidermis: a layer of thin-walled oblong cells, covered with cuticle layer. Mesophyll: palisade, 1 to 2 layers of cylindrical cells; spongy cells, irregularly shaped, loosely arranged; parenchyma, some containing prismatic or rosette aggregate crystals; and angular collenchyma in the midrib. Vascular tissue: bicollateral vascular bundle, phloem, and xylem. Lower epidermis: a layer of small epidermal cells, covered with cuticle layer, and stomata.

In surface view, the lamina shows upper epidermis and lower epidermis. Upper epidermis: polygonal or rectangular cells with cuticular striation. Lower epidermis: wavy-walled cells, and mostly anomocytic and a few anisocytic stomata with cuticular striation.

Transverse section of the petiole shows epidermis, cortex, and vascular tissue. Epidermis: a layer of elongated epidermal cells, covered with cuticle layer. Cortex: polygonal parenchyma, some containing prismatic or rosette aggregate crystals, and lamella and angular collenchyma beneath epidermal layer. Vascular tissue: bicollateral vascular bundle, phloem and xylem.

In surface view, the petiole shows rectangular epidermal cells with cuticular striation.



1



2



3



4

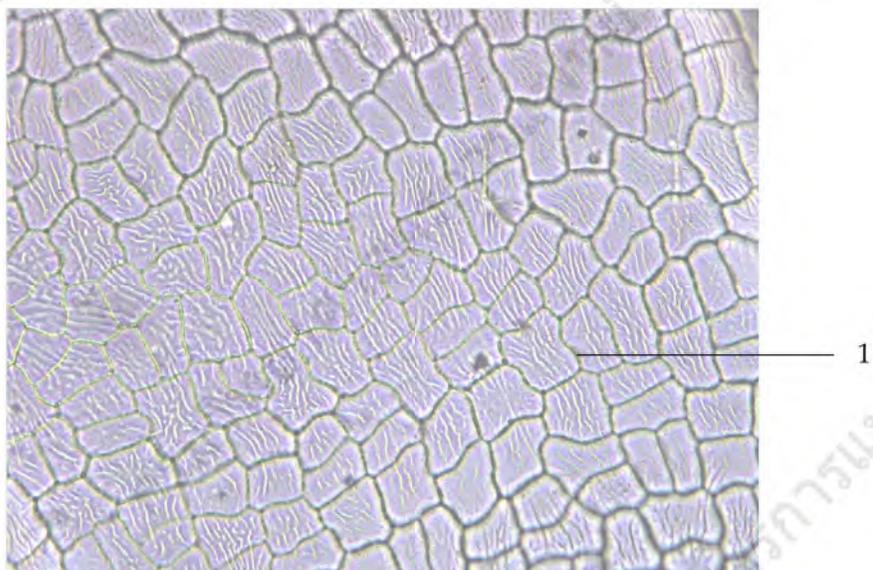


1 cm

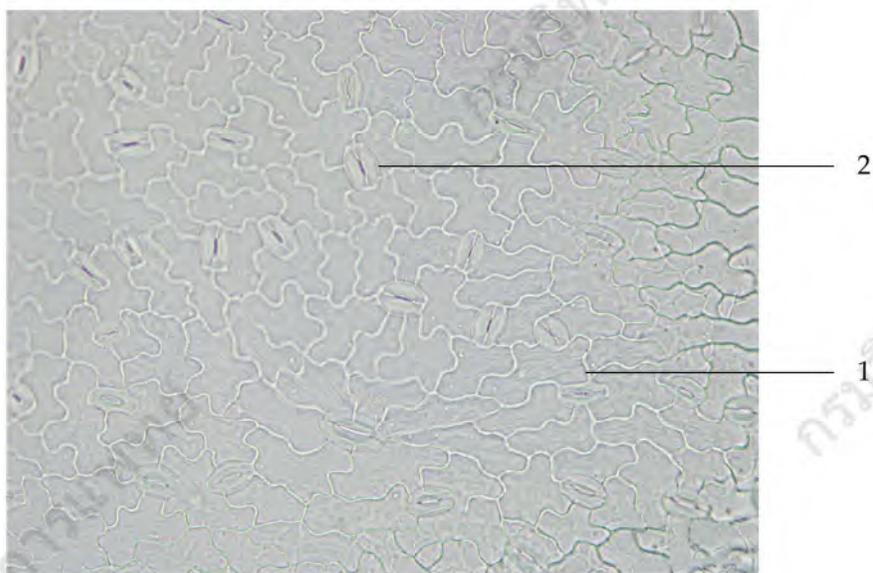
5

Fig. 1 *Punica granatum* L.

1. habit 2. leafy twig 3. flowers 4. fruits 5. crude drug



Upper Epidermis of the Lamina



Lower Epidermis of the Lamina

Fig. 2a Photomicrographs of Epidermises of the Leaf of *Punica granatum* L.
1. epidermis with striation 2. anomocytic stoma

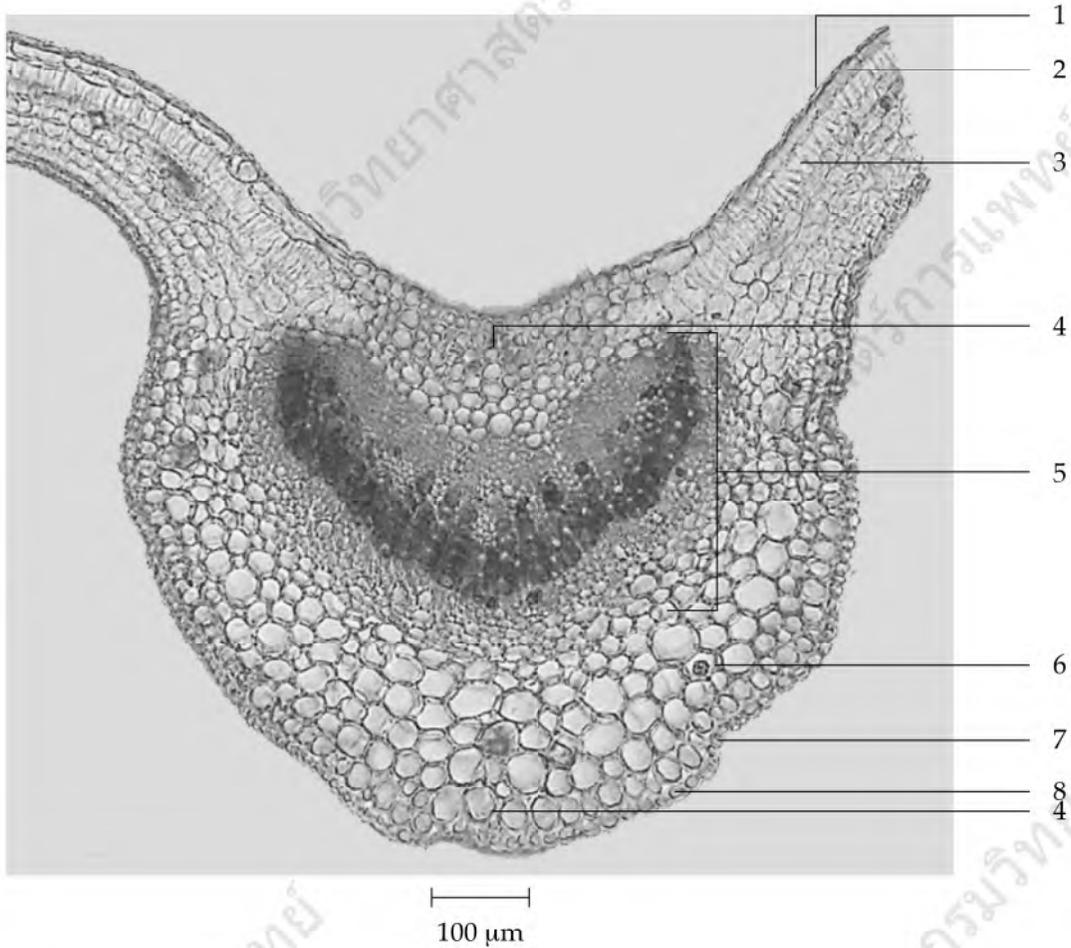


Fig. 2b Photomicrograph of Transverse Section of the Leaf Through the Midrib of *Punica granatum* L.

- | | |
|------------------------|---|
| 1. cuticle | 6. parenchyma containing rosette aggregate crystals |
| 2. upper epidermis | 7. stoma |
| 3. palisade cell | 8. lower epidermis |
| 4. angular collenchyma | |
| 5. vascular tissue | |

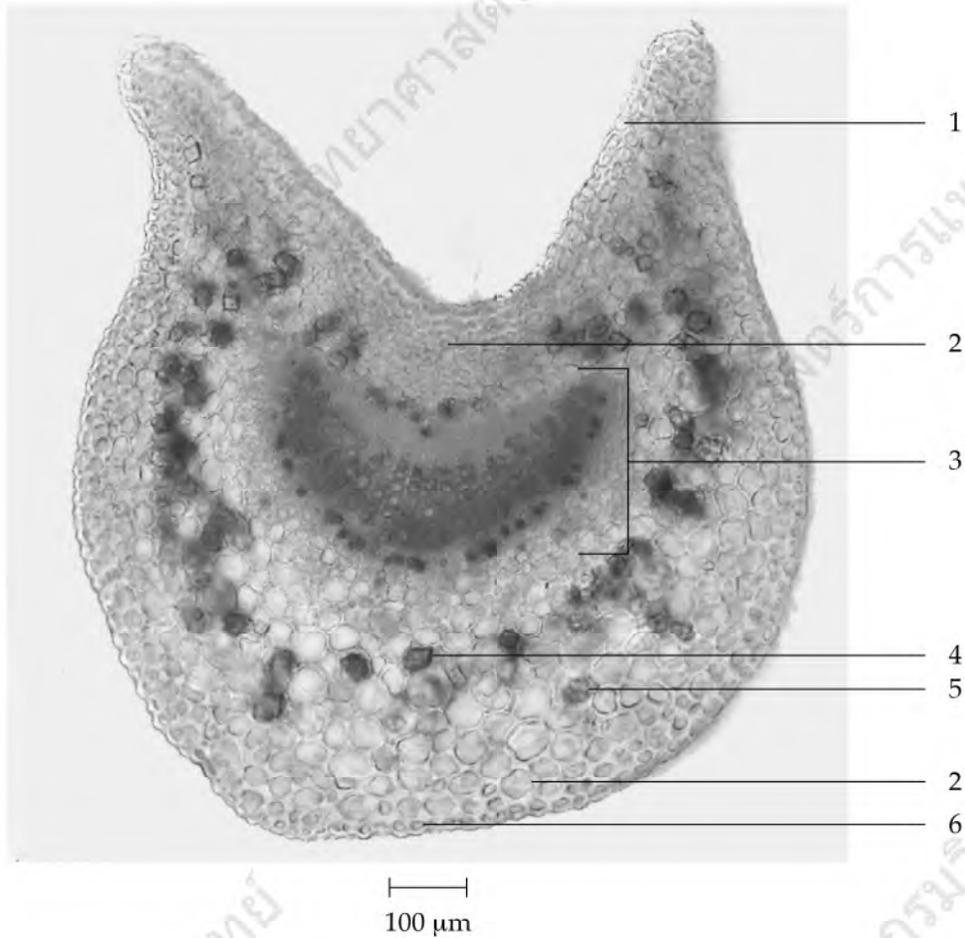


Fig. 2c Photomicrograph of Transverse Section of the Petiole of *Punica granatum* L.

- | | |
|--|--|
| 1. upper epidermis | 5. parenchyma containing rosette aggregate crystal |
| 2. collenchyma | 6. lower epidermis |
| 3. vascular tissue | |
| 4. parenchyma containing prismatic crystal | |

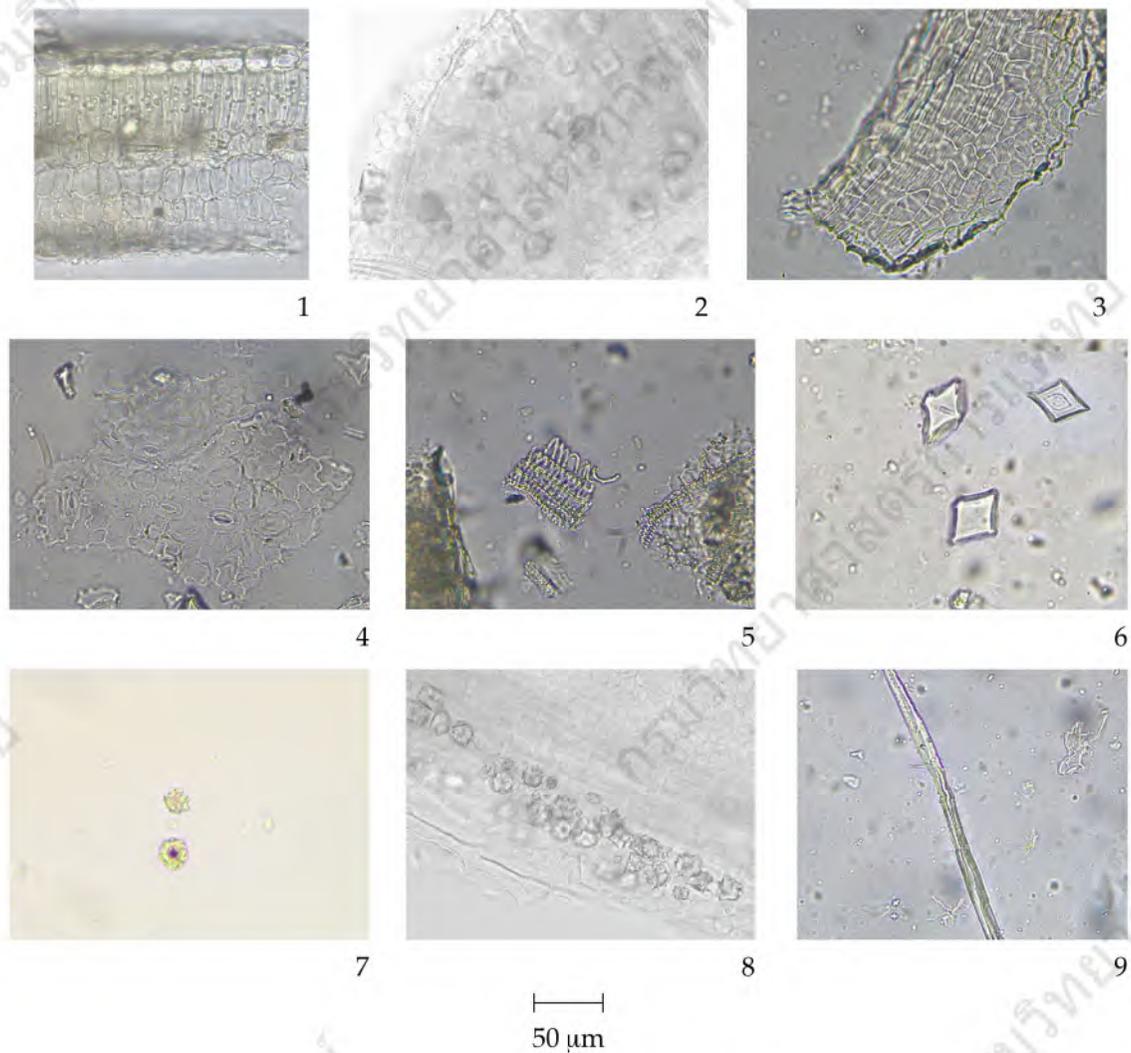


Fig. 2d Photomicrographs of Powdered Drug of the Leaves of *Punica granatum* L.

1. lamina in sectional view
2. part of mesophyll, in surface view, containing palisade cells, fibres, vessels, and prismatic and rosette aggregate crystals
3. upper epidermis of the lamina, in surface view, showing cuticular striations and stomata
4. lower epidermis of the lamina, in surface view, showing stomata
5. reticulate and spiral vessels associated with parenchyma
6. prismatic crystals
7. rosette aggregate crystals
8. parenchyma containing rosette aggregate crystals
9. fibre

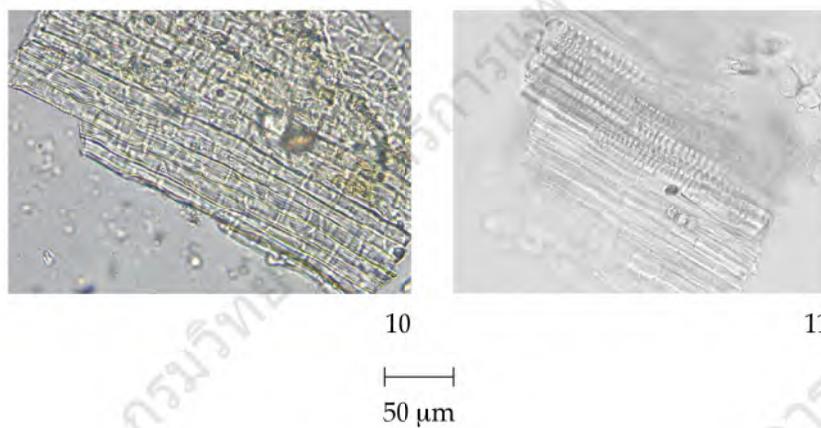


Fig. 2d (continued)

10. epidermis of the petiole, in surface view, showing cuticular striation

11. petiole, in longitudinal view, showing reticulate and spiral vessels, and parenchyma, some containing rosette aggregate crystals

Pomegranate Leaf in powder possesses the diagnostic microscopical characters of the unground drug. Vascular tissue, particularly reticulate and spiral vessels, and prismatic and rosette aggregate crystals, can be found in abundance. Thick cuticle layer of epidermis with prominent striation can be distinctive.

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

Identification

A. Heat 1 g of the sample, in powder, with 10 mL of *water* on a water-bath for 20 minutes and filter (solution 1). To 1 mL of solution 1, add a few drops of a 1 per cent w/v solution of *gelatin*: an off-white precipitate is produced.

B. To 1 mL of solution 1, add a few drops of a 1 per cent w/v solution of *iron (III) chloride*: a blue precipitate 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 80 volumes of *n-hexane* and 20 volumes of *ethyl acetate* 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 10 mm, 10 μ L of the test solution prepared by sonicating 1 g of the sample, in *No. 250 powder*, with 10 mL of *ethanol* for 30 minutes, centrifuging at $9200 \times g$ (10,000 rpm) for 5 minutes, and using the supernatant. After removal of the plate, allow it to dry in air. Spray the plate with *anisaldehyde TS* and heat at 105° for 10 minutes; the chromatogram obtained from the test solution shows nine violet bands (Fig. 3).

Alternatively, using *silica gel G* as the coating substance and a mixture of 80 volumes of *dichloromethane* and 20 volumes of *ethanol* 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 10 mm, 10 μ L of the test solution prepared by sonicating 1 g of the sample, in *No. 250 powder*, with 10 mL of *ethanol* for 30 minutes, centrifuging at $9200 \times g$ (10,000 rpm) for 5 minutes, and using the supernatant. After removal of the plate, allow it to dry in air. Spray the plate with *anisaldehyde TS* and heat at 105° for 10 minutes; the chromatogram obtained from the test solution shows two brown and five violet bands (Fig. 3).

Loss on drying Not more than 8.0 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 9.0 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 27.0 per cent w/w (Appendix 7.12).

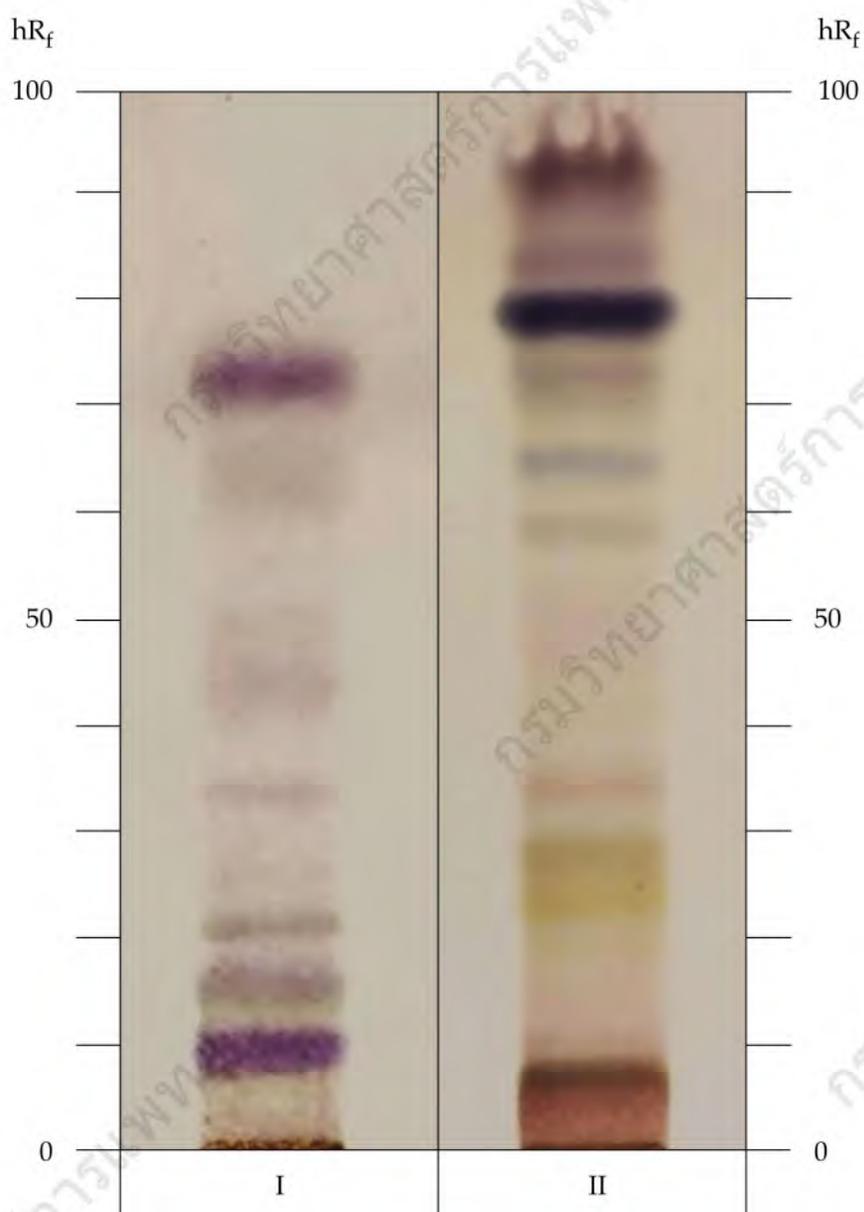


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Leaves of *Punica granatum* L., Detected With *Anisaldehyde* TS

- I = a mixture of 80 volumes of *n-hexane* and 20 volumes of *ethyl acetate* as the mobile phase
- II = a mixture of 80 volumes of *dichloromethane* and 20 volumes of *ethanol* as the mobile phase

ทองพันชั่ง, ใบ (THONG PHAN CHANG, BAI)

ทองคันทั่ง, ใบ (THONG KHAN CHANG, BAI), หญ้ามันไก่, ใบ (YA MAN KAI, BAI)

Rhinacanthi Nasuti Folium

Snake Jasmine Leaf

Synonyms Dainty Spur Root, White Crane Flower Root

Category Antipyretic, antifungal (topical), antibacterial (topical).

Snake Jasmine Leaf is the dried leaf of *Rhinacanthus nasutus* (L.) Kurz (*Justicia nasuta* L., *Rhinacanthus communis* Nees) (Family Acanthaceae), Herbarium Specimen Number: DMSC 5372, Crude Drug Number: DMSc 1274.

Constituents Snake Jasmine Leaf contains naphthoquinones (e.g., rhinacanthins and rhinacanthone). It also contains polyphenols, flavonoids, etc.

Description of the plant (Fig. 1) Subshrub, up to 2 m tall; stem erect, stout, quadrangular, much branched, finely striated, densely pubescent when young, becoming glabrescent with age; young branch hairy. Leaves simple, opposite decussate, ovate-elliptic, elliptic to lanceolate, 6 to 12 cm long, 2 to 5 cm wide, apex acute to shortly acuminate, base cuneate or attenuate, margin entire or slightly undulate, abaxially densely pubescent, adaxially sparsely pubescent to subglabrous, secondary veins 5 or 6 pairs; petiole 1 to 1.5 cm long. Inflorescence paniculate, terminal or axillary, up to 50 cm long; rachis densely pubescent; bract lanceolate, about 2 mm long, about 0.5 mm wide; bracteole minute. Flower white to greenish white, bilabiate, sessile to subsessile; calyx 5 to 6 mm long, deeply 5-lobed, lobe lanceolate, up to 4 mm long, about 0.7 mm wide, both surfaces pubescent, outer surface with glandular trichome; corolla tube 1.5 to 2.5 cm long, upper lip upright, oblong, 8 to 9 mm long, 2 to 3 mm wide, revolute, lower lip obovate, 3-lobed, with red marking at base, 1 to 1.5 mm long, 1 to 1.3 mm wide; stamens 2, attached to apex of corolla tube, filament short, glabrous; ovary superior, elliptic, 2-loculed, each locule with 2 ovules, style slender, sparsely pubescent, stigma 2-lobed. Fruit a capsule, oblong-elliptic, 1.5 to 2 cm long, about 2 mm wide. Seeds 4, subglobose, about 2.5 mm in diameter, papillose.

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

Macroscopical (Fig. 1) Dried whole or broken leaves, with or without petioles; whole leaves apex acute or shortly acuminate, base cuneate or attenuate, margin entire or slightly undulate, blade thin, wrinkled, slightly curled, brownish green to brown.

Microscopical (Figs. 2a–2d) Transverse section of the leaf through the midrib shows upper epidermis, mesophyll, vascular bundle, and lower epidermis. Upper epidermis: a layer of epidermal cells, stomata, glandular and multicellular uniseriate trichomes, and lithocysts. Mesophyll: palisade cell, a layer of columnar cells; spongy cell, loosely parenchyma; several layers of angular collenchyma in midrib. Vascular bundle: phloem and xylem. Lower epidermis: a layer of epidermal cells, stomata, glandular and multicellular uniseriate trichomes, and lithocysts.

Transverse section of the petiole shows epidermis, cortex, and vascular tissue. Epidermis: a layer of subrounded cells, stomata, glandular and multicellular uniseriate trichomes, and lithocysts. Cortex: several layers of angular collenchyma, chlorenchyma, numerous round-shaped parenchyma. Vascular tissue: U-shaped collateral vascular bundles; phloem and xylem.

Snake Jasmine Leaf in powder possesses the diagnostic microscopical of the unground drug. The combination of lithocyst, glandular and multicellular uniseriate trichomes, are characteristic and can be seen in abundance.

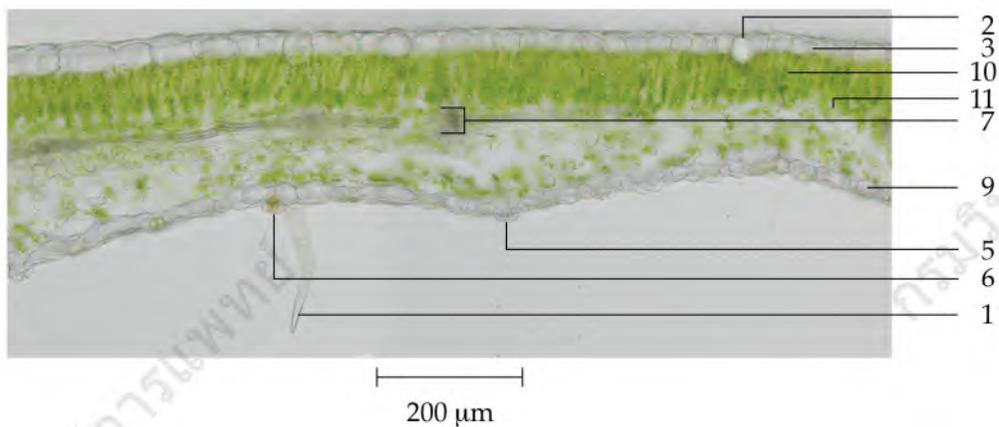


Fig. 1 *Rhinacanthus nasutus* (L.) Kurz

1. habit 2. leaves and flowers 3. part of inflorescences 4. partially bloomed flower
5. flowers (top view) 6. crude drug



Transverse Section of the Midrib



Transverse Section of the Lamina

Fig. 2b Photomicrographs of Transverse Sections of the Leaf of *Rhinacanthus nasutus* (L.) Kurz

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

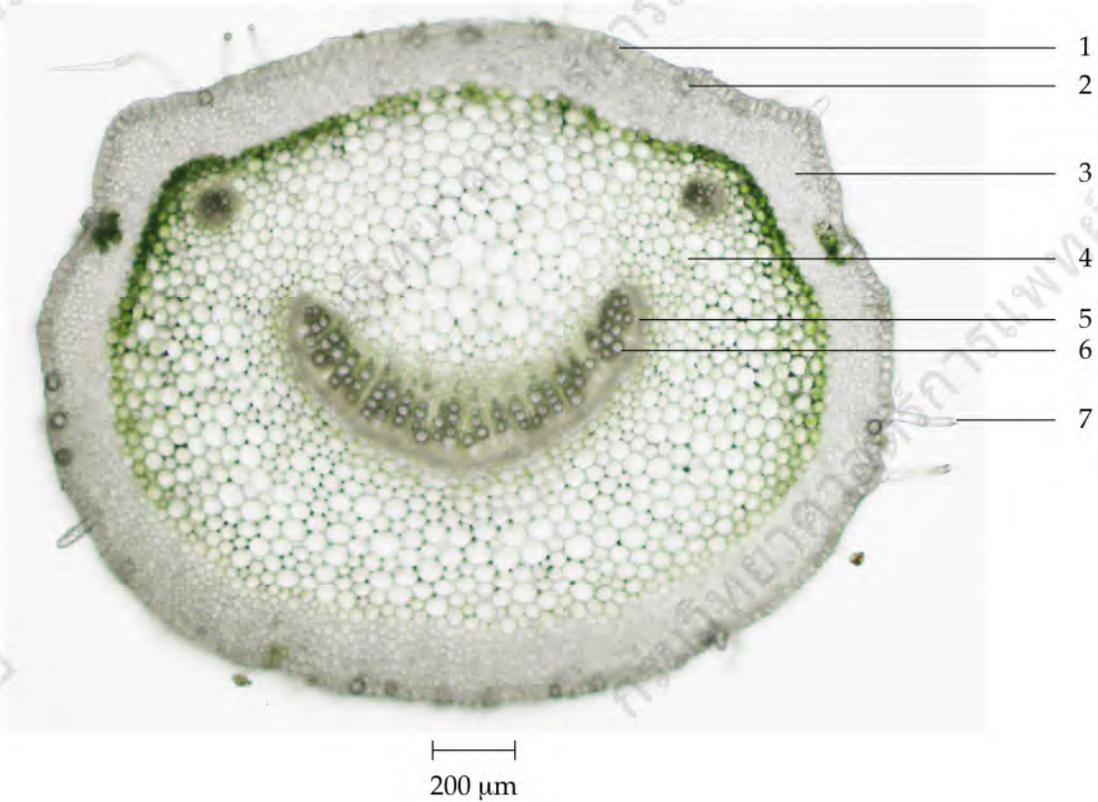


Fig. 2c Photomicrograph of Transverse Section of the Petiole of *Rhinacanthus nasutus* (L.) Kurz

- | | |
|----------------|---------------------------|
| 1. epidermis | 5. phloem |
| 2. lithocyst | 6. vessel |
| 3. collenchyma | 7. multicellular trichome |
| 4. parenchyma | |



Fig. 2d Photomicrographs of Powdered Drug of the Leaves of *Rhinacanthus nasutus* (L.) Kurz

1. upper epidermis and lithocyst, in surface view
2. epidermis, glandular trichome, cystolith, and diacytic stomata
3. lamina in sectional view, showing epidermis, palisade cells, spongy cells, and lower epidermis
4. lamina, in surface view, showing spongy cells and veinlets
5. parenchyma containing acicular crystals
6. collenchyma in sectional and longitudinal views
7. spiral vessels
8. reticulate vessels, fibres, and parenchyma, in longitudinal view
9. glandular trichomes



Fig. 2d (continued)

10. multicellular uniseriate trichomes

11. cystoliths

Packaging and storage Snake Jasmine Leaf 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 *chloroform* for 15 minutes and filter. To 2 mL of the filtrate, add 1 mL of *strong ammonia solution*: a pink colour develops.

B. Reflux 500 mg of the sample, in powder, with 10 mL of *ethanol* for 15 minutes and filter. Add 200 mg of *activated charcoal* to the filtrate, swirl, allow to stand for 5 minutes, and filter. To the filtrate obtained, add a few drops of a 10 per cent w/v solution of *potassium hydroxide* in *ethanol* and mix. Apply a few drops of this solution to a filter paper and examine under ultraviolet light (366 nm): a greenish blue colour appears.

C. Carry out the test as described in the “Thin-Layer Chromatography” (Appendix 3.1), using a high-performance plate with *silica gel GF254* as the coating substance and a mixture of 65 volumes of *hexane* and 35 volumes of *ethyl acetate* as the mobile phase and allow 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 refluxing 500 mg of the sample, in powder, with 10 mL of *ethanol* for 15 minutes and filtering. Add 100 mg of *activated charcoal* to the filtrate, swirl, allow to stand for 5 minutes, and filter. After removal of the plate, allow it to dry in air. Spray the plate with a 10 per cent w/v solution of *potassium hydroxide* in *ethanol* and examine the plate under ultraviolet light (366 nm); one blue and two bluish green fluorescent bands are observed (Fig. 3).

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 18.0 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).

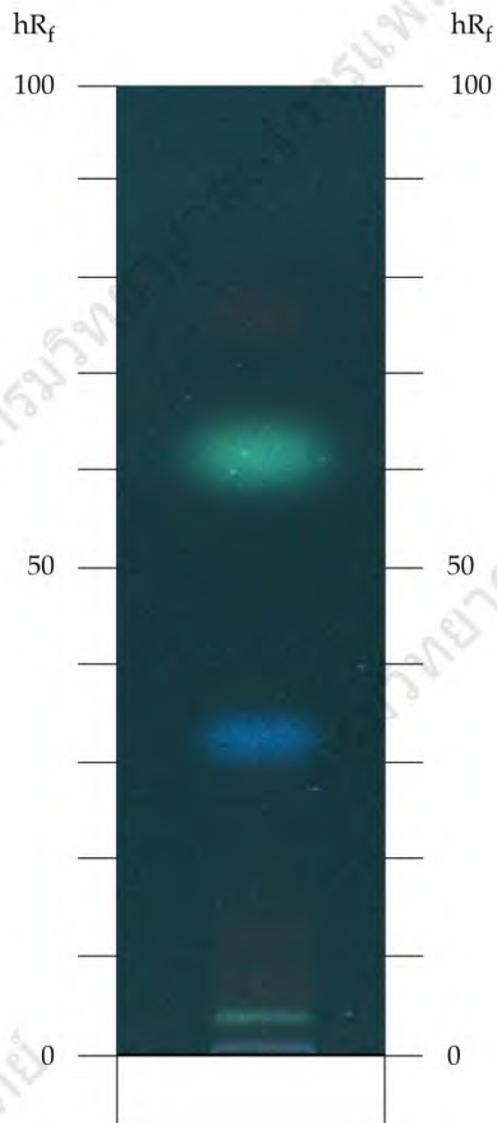


Fig. 3 Thin-Layer Chromatogram of Ethanolic Extract of the Leaves of *Rhinacanthus nasutus* (L.) Kurz, Detected Under UV Light (366 nm) After Spraying With a 10 Per Cent W/V Solution of *Potassium Hydroxide* in *Ethanol*

APPENDIX

APPENDIX

The Thai Herbal Pharmacopoeia 2021 Supplement 2025 is a supplement publication to the Thai Herbal Pharmacopoeia 2021 where complete information on the quality control of herbal drugs and herbal drug preparations are compiled. Thus, it solely lists the reagents used for tests and assays of the herbal drugs contained herein. For information on the relevant appendices, kindly consult the Thai Pharmacopoeia II 2011 Volume I Part 1, the Thai Pharmacopoeia II Volume I Part 1 Supplement 2020, or the Thai Herbal Pharmacopoeia 2021.

Content of the Appendix

APPENDIX 1 GENERAL INFORMATION

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1.1 Reagents

173

APPENDIX 1 GENERAL INFORMATION

The specifications given below are strictly for the use of the materials as reagents. The inclusion of a material in this Appendix does not imply that it is suitable for use in medicines. Exceptionally, a trademark or supplier may be indicated for certain reagents whose availability is limited. It is however acceptable to use reagents from another source provided that they comply with the standards of the Pharmacopoeia.

1.1 REAGENTS

The name of a substance or solution indicates a reagent included in the following list. The specifications given for reagents do not necessarily guarantee their quality for use in medicines.

Some of the reagents included may be injurious to health. Important cautions have been stated for these reagents. They should be handled in accordance with good laboratory practice and any relevant regulations.

Reagents in aqueous solution are prepared using water. Where the name of the solvent is not stated, an aqueous solution is intended.

Unless otherwise specified, the reagents and reagent solutions are to be stored in well containers. The labelling should comply with the relevant national legislation.

Alanine $C_3H_7NO_2 = 89.09$

Use an analytical reagent grade of commerce containing not less than 98.0 per cent w/w of $C_3H_7NO_2$.

DESCRIPTION White, crystalline powder; odourless.

SOLUBILITY Freely soluble in *water*; slightly soluble in *ethanol*.

MELTING TEMPERATURE About 297° , with decomposition (Appendix 4.3).

Store in tightly closed containers.

Aluminium Chloride, Anhydrous $AlCl_3 = 133.34$

DESCRIPTION White, crystalline powder; odour, strong of hydrogen chloride.

SOLUBILITY Freely soluble in many organic solvents such as benzophenone, nitrobenzene; soluble in *benzene*, in *carbon tetrachloride*, and in *chloroform*.

MELTING TEMPERATURE About 193° (Appendix 4.3).

Store in tightly closed containers, protected from moisture.

Betulinic Acid $C_{30}H_{48}O_3 = 456.70$

DESCRIPTION White, crystalline powder.

MELTING RANGE 316° to 318° (Appendix 4.3).

Store in tightly closed containers.

Blumeatin $C_{16}H_{14}O_6 = 302.28$

Use an analytical reagent grade of commerce containing not less than 95.0 per cent w/w of $C_{17}H_{14}O_6$.

DESCRIPTION Yellow, crystalline powder.

SOLUBILITY Soluble in *dimethyl sulfoxide*.

Store in tightly closed containers.

Hesperidin $C_{28}H_{34}O_{15} = 610.56$

DESCRIPTION Light brown, crystalline powder.

MELTING RANGE 250° to 255° (Appendix 4.3).

Store in tightly closed containers.

Luteolin $C_{15}H_{10}O_6 = 286.24$ Use an analytical reagent grade of commerce containing not less than 98.0 per cent w/w of $C_{15}H_{10}O_6$.

DESCRIPTION Yellow, crystalline powder.

MELTING TEMPERATURE About 330° (Appendix 4.3).Store in tightly closed containers at a temperature between 2° and 8° , protected from light. **α -Mangostin** $C_{24}H_{26}O_6 = 410.46$ Use an analytical reagent grade of commerce containing not less than 98.0 per cent w/w of $C_{24}H_{26}O_6$.

DESCRIPTION Yellow, crystalline solid.

SOLUBILITY Soluble in *methanol*.MELTING TEMPERATURE About 182° (Appendix 4.3).Store in tightly closed containers at a temperature between 4° and 8° .**Naringin** $C_{27}H_{32}O_{14} = 580.53$ Use an analytical reagent grade of commerce containing not less than 95.0 per cent w/w of $C_{27}H_{32}O_{14}$.

DESCRIPTION Light brown, crystalline powder.

SOLUBILITY Slightly soluble in *water*.MELTING TEMPERATURE About 83° (Appendix 4.3).

Store in tightly closed containers.

Terpinen-4-ol $C_{10}H_{18}O = 154.25$ Use an analytical reagent grade of commerce containing not less than 95.0 per cent w/w of $C_{10}H_{18}O$.

DESCRIPTION Colourless to pale yellow, oily liquid.

SOLUBILITY Soluble in oils; slightly soluble in *water*.BOILING TEMPERATURE About 209° (Appendix 4.6).Store in tightly closed containers, protected from light, and at a temperature between 2° and 8° .

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