

Thai Herbal Pharmacopoeia 2021

SUPPLEMENT 2022



กรมวิทยาศาสตร์การแพทย์
DEPARTMENT OF MEDICAL SCIENCES



กรมวิทยาศาสตร์การแพทย์
DEPARTMENT OF MEDICAL SCIENCES

Thai Herbal Pharmacopoeia 2021 SUPPLEMENT 2022

Department of Medical Sciences, Ministry of Public Health
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PREFACE

Overcoming health problems is a never-ending journey. There are always new challenges to conquer—newly emerging diseases, demand for more effective treatments, drug resistance, etc. Thus, the medical world always calls for research and development, novel technologies and therapeutic enhancement in order to provide better healthcare to every life worldwide.

Although a vast number of options are available in this era of modernization, herbal medicine has never lost its popularity in the realm of healthcare. In fact, advances in knowledge and technologies make it possible to use herbal medicine more safely and effectively. Nowadays, herbal drugs are used for both treatment and preventive purposes, especially with the threats of new pandemic diseases. Several medicinal plants have shown potential in alleviating such illnesses.

As usual, when it comes to herbal drugs, quality control comes into play as the means to ensure their quality, safety and efficacy. The Department of Medical Sciences by the Bureau of Drug and Narcotic, therefore, incorporated monographs of herbal drugs into this Thai Herbal Pharmacopoeia 2021 Supplement 2022 (THP 2021 Suppl. 2022). The publications in the Thai Herbal Pharmacopoeia series are official compendia that set standards for quality control of herbal drugs and herbal preparations. This THP 2022 Suppl. 2022 is published as a supplement to the THP 2021 and contains ten newly established monographs.

The establishment of the THP 2021 Suppl. 2022 would never have accomplished without the collaboration among the six subcommittees under the supervision of the Thai Pharmacopoeia Committee: the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia, the Subcommittee on the Pharmacognostic and Botanic Specifications for the Thai Herbal Monographs, the Subcommittee on the Physico-chemical Specifications and Safety for the Thai Herbal Monographs, the Subcommittee on Standards for Thai Herbal Drug Preparations, the Subcommittee on Standards and Analytical Methods, and the Subcommittee on Editorial Style. Together, they prepare the monographs of herbal drugs and herbal drug preparations, the appendices and other necessary information.

Finally, the Department of Medical Sciences and the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia wish to express their deep gratitude to the contribution and technical support from various contributors, government agencies, academic institutions, and other organizations, including individuals who have provided their time and expertise for invaluable comments.

(Mr. Anutin Charnvirakul)
Deputy Prime Minister
and Minister of Public Health

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INTRODUCTION

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

1. Subcommittee on the 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 the Physico-chemical Specifications and Safety for Thai Herbal Monographs:

2.1 producing drafts of the physico-chemical specifications of the Thai herbal monographs, 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 organizing the information compiled by other subcommittees into a pharmacopoeial form and completing the final draft of the Thai Pharmacopoeia;

1.5 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.

It is to be noted that the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia and its associates see fit to make some changes in order to streamline the content of the monographs; omitting non-essential data (e.g., tables of hR_f values) and replacing most line drawings of microscopical characters of herbal drugs with photomicrographs.

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

For previously established monographs, please refer to THP 2021 Volumes I and II where 109 monographs of herbal drugs and herbal drug preparations are compiled, or visit the BDN website at: <http://bdn.go.th/thp/home>.

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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)

1. SUBCOMMITTEE ON THE ESTABLISHMENT OF THE THAI HERBAL PHARMACOPOEIA (1989-)

Chairpersons: Vichiara A. Jirawongse (deceased), B.Sc. in Pharm., Ph.D., Hon. D.Sc. in Pharm. (CU), Hon. Ph.D. (KKU) (1989-2006)
Rapepol Bavovada, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (2006-)

Advisors: Panida Kanchanapee (deceased), B.Sc. in Pharm. (1998-2008)
Kamol Sawasdimongkol, B.Sc. in Pharm., M.S. (2004-2008)
Thaweephol Dechatiwongse Na Ayudhya, B.Sc. in Pharm. (2008-2013)
Yupadee Payakkapan, B.Sc. in Pharm., M.Sc. in Pharmaceutical Analysis (2008-2013)
Kongkanda Chayamarit, B.Sc., M.Sc., D.Sc. (2008-2013)
Chirayupin Chandraprasong (deceased), B.Sc., M.Sc., Hon. Ph.D., FRI (2008-2013)

Members: Representative, The Government Pharmaceutical Organization, Principal Medical Scientist (1989-1995)
Director, Raw Material Standard Division, The Government Pharmaceutical Organization (1993-2011)
Jiraporn Noppadech, B.Sc. in Pharm., M. Pharm., *Representative*
Weena Sathianpokkasap, B.Sc. in Pharm., *Representative*
Director, Research and Development Institute, The Government Pharmaceutical Organization (1989-)
Chada Phisalaphong, B.Sc. in Pharm., M.Sc., Ph.D., *Representative*
Piyaporn Prayakprom, B.Sc. in Pharm., Ph.D., *Representative*
Director, Medicinal Plant Research Institute, Department of Medical Sciences (1989-)
Amporn Kun-anake, B.Sc. in Pharm.
Pranee Chavalittumrong, B.Sc. in Pharm., M.Sc. in Pharm.
Nalinphat Saktiyasunthorn (deceased), B.Sc. in Pharm., M.Sc. in Pharm.
Nuchattra Chansuvanich, B.Sc., M.S.
Siriwan Chaisomboonpan, B.Sc. in Pharm., M.Sc. in Pharm.
Kalaya Anulukanapakorn, B.Sc., M.Sc., Dr. rer. nat., *Representative*
Jaree Bansiddhi, B.Sc., M.Sc., *Representative*
Pranom Dechwisissakul, B.Sc., M.Sc. in Pharm., *Representative*
Amporn Kun-anake, B.Sc. in Pharm., *Representative*
Narumole Mongkolchaipak, B. Pharm., M.Sc., *Representative*
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.,
Supanee Duangteerapreecha, B.Sc. in Pharm., M.S., Ph.D., *Representative*
Jiranuch Jantaweekul, 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-)
 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. (1989-2021)
 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-)
 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 **Suntornanasat**, 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 **Ittiritthanon**, 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 THE 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)
Kongkanda **Chayamarit**, B.Sc., M.Sc., D.Sc. (2010-2015)

Members: 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*
 Jaree **Bansiddhi**, B.Sc., M.Sc. (2010-)
 Bhanubong **Bongcheewin**, B. Pharm., M.Sc., Ph.D. (2014-)
 Kongkanda **Chayamarit**, B.Sc., M.Sc. D.Sc. (2015-)
 Pranom **Dechwisissakul**, B.Sc., M.Sc. in Pharm. (2010-)
 Jiranuch **Jamtaweekul**, B.Sc. in Pharm., M.Sc. in Pharm. (2010-2015, 2017-)
 Ornusa **Khamsuk**, B.S., M.S., Ph.D. (2014-2019)
 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-)
 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 the Thai herbal monographs, i.e., nomenclature, definitions, plant descriptions, macroscopical and microscopical descriptions, and other related information;
- 2.2 submitting the drafts to the Subcommittee on the Establishment of the Thai Herbal Pharmacopoeia for approval;
- 2.3 attending to all matters related to the preparation of pharmacognostic and botanic specifications.

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

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*
 Apirak **Sakpetch**, B.S. Pharm., *Representative*
 Sununta **Srisopon**, B. Pharm., M. Pharm., Ph.D., *Representative*
 Chitra **Chaiyawat**, B. Pharm. (2010-2014)
 Yupadee **Payakkapan**, B.Sc. in Pharm., M.Sc. in Pharmaceutical
 Analysis (2015-2021)

Chada **Phisalapong**, B.Sc. in Pharm., M.Sc., Ph.D. (2010-)
 Veena **Satitpatipan**, B.S. in Pharm., Ph.D. (2014-)
 Nantana **Sittichai**, B.Sc. in Pharm., M.S. (2015-)
 Uthai **Sotanaphun**, B.Sc. in Pharm., M.Sc. in Pharm., Ph.D. (2014-)
 Taweesak **Suntornanasat**, 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: Sasiyimol **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 the 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 THAI HERBAL DRUG PREPARATIONS (2010-)*

Chairperson: Yupadee **Payakkapan**, B.Sc. in Pharm., M.Sc. in Pharmaceutical Analysis (2010-2021)
 Nantana **Sittichai**, B.Sc. in Pharm., M.S. (2021-)

Members: Kornvika **Charupant**, B.S. Pharm., M.Sc. in Pharm., Ph.D. (2015-)
 Jiranuch **Jamtaweekul**, B.Sc. in Pharm., M.Sc. in Pharm. (2017-)
 Piyaporn **Prayakprom**, B.Sc. in Pharm., Ph.D., (2017-)
 Nidapan **Ruangritinon**, 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: Sasiyimol **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-)

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

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)

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: 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**, 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)

Arune **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.Pharm.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 **Vongsaroj** (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 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 other 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 (2019-)
Suratchanee **Savetsila**, B.Sc. in Pharm., M.Sc. in Pharm.
Somsak **Sunthornphanich**, B.Sc. in Pharm., M. Chem.
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
Puritrat **Rattanasiri**, B.Sc. in Pharm., *Representative*
Head, Physical and Chemical Testing Section, Bureau of Drug and Narcotic (2019-)
Sasida **Yoosuk**, B.Sc. in Pharm., M.Sc. in Pharm.
Jiranuch **Jamtaweekul**, B.Sc. in Pharm., M.Sc. in Pharm.
Wicharanee **Tongsima**, B.Sc. in Pharm., M.Sc. in Pharm. (Pharmaceutics),
Representative
Tharntip **Wachirasakwong**, 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-)
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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GENERAL NOTICES

กรมวิ

กรมวิทยาศาสตร์การแพ

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กรมวิทยาศาสตร์การแพทย์

กรมวิทยาศาสตร์

กรมวิทยาศาสตร์การแพทย์

กรมวิทยาศาสตร์การแพทย์

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GENERAL NOTICES

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

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

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

Monograph Nomenclature

A Thai name is adopted as the main title of each pharmacopoeial substance. It is transcribed to English following the Royal Institute’s official transliteration system¹ and printed with capital letters. Subsidiary titles, where applicable, are other Thai name(s), Latin genitives of plants, English common name(s), and English synonym(s).

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

Reference Substances

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

Authenticated Reference Specimens

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

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.

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

กรมวิ

กรมวิทยาศาสตร์การแพ

าสตร์การแพทย์

กรมวิทยาศาสตร์การแพทย์

กรมวิทยาศาสตร์

กรมวิทยาศาสตร์การแพทย์

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ชิงชี (CHING CHI)

Capparis Micracanthae Radix
Capparis Micracantha Root

Category Antipyretic.

Capparis Micracantha Root is the dried root of *Capparis micracantha* DC. (Family Capparaceae), Herbarium Specimen Number: DMSC 5220, Crude Drug Number: DMSc 1089.

Constituents Capparis Micracantha Root contains alkaloids such as capparine B and terpenoids (e.g., capparisditerpenol), etc.

Description of the plant (Figs. 1a, 1b) Shrub or small tree, sometimes scandent; twig nearly terete, base with subulate scales, glabrous or sparsely pubescent when young; thorn directed upwards, 2 to 4 mm long. Leaves simple, alternate, elliptic-oblong, oblong-lanceolate, or ovate-lanceolate, 10 to 30 cm long, 4 to 10 cm wide, apex obtuse, rounded, acute to shortly acuminate, rarely emarginate, base cuneate, rounded, or slightly cordate, membranous when young, coriaceous when mature, glabrous, shiny, often yellowish green when dry, midrib grooved on the upper surface, slightly raised below, secondary veins 5 to 10 on each side of midrib, reticulate veins obvious on both surfaces; petiole 1 to 2.2 cm long. Flowers arranged in supra-axillary rows, up to 7 flowers in each axil; pedicel 0.6 to 2 cm long, pubescent; sepals 4, bi-seriate, outer pairs boat-shaped, inner pairs more or less flattened, ovate to oblong, 0.6 to 1.2 cm long, 3 to 4 mm wide, apex acute to obtuse, pubescent on both surfaces; petals 4, white with yellow base, turning dark red, obovate, 1 to 2 cm long, 3 to 7 mm wide, apex obtuse or rounded, glabrous, distinctly veined; stamens numerous; filament 1.5 to 2.5 cm long; anther 1 to 1.5 mm long; gynophore 2 to 3.5 cm long, glabrous; ovary superior, ovoid to ellipsoid, 2.5 to 3 mm long, 1-loculed, pubescent when young, ovules numerous, stigma sessile, knob-shaped. Fruit subglobose, ovoid to ellipsoid, 1.5 to 7 cm long, 1.5 to 4 cm wide; pericarp woody, orange-red, brown when dry; stipe 3.5 to 4 cm long, 3 to 6 mm thick. Seeds numerous, reniform, about 7 mm long, 5 to 6 mm wide, dark red.

Description Odour, characteristic; taste, slightly bitter.

Macroscopical (Fig. 1a) Obliquely, longitudinally or transversely sliced roots, varied in shape and size; bark 1 to 4 mm thick, light brown to greyish brown, rough; wood pale brown.

Microscopical (Figs. 2a, 2b, 2c, 2d) Transverse section of the root shows periderm, cortex, secondary vascular tissue, and primary vascular tissue. Periderm: lenticels, several layers of rectangular cork cells, cork cambium, and phelloderm. Cortex: polygonal parenchyma (some containing starch grains), groups of sclereids, and fibres. Secondary vascular tissue: secondary phloem, secondary xylem and vascular cambium; secondary phloem, phloem parenchyma (some containing starch grains), phloem fibres and phloem ray; secondary xylem, vessels, axial parenchyma, xylem fibres (some containing obtuse-triangular shaped starch grains), and xylem ray (some containing round shaped starch grains); vascular cambium, several layers of rectangular vascular cambium. Primary vascular tissue: small vessels and small fibres in the centre.

Radial and tangential longitudinal sections of the woody part of the root show secondary vascular tissue; bordered-pitted vessels, axial parenchyma, ray cells, and fibres.



1



2



3



4



5



2 cm

6

Fig. 1a *Capparis micracantha* DC.

1. habit 2. flowering twig 3. flowers 4. unripe fruits 5. ripe fruits 6. crude drug

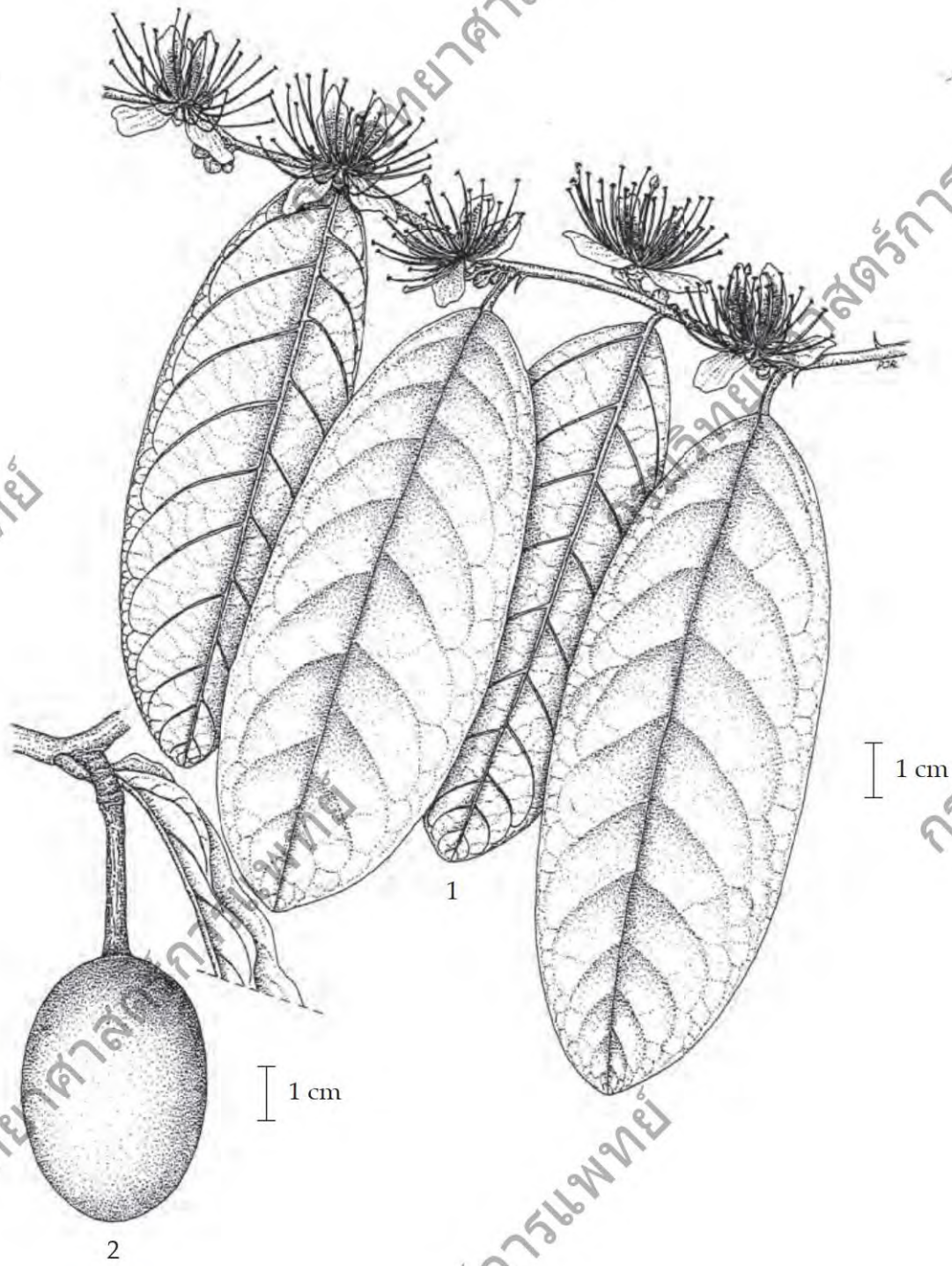


Fig. 1b *Capparis micracantha* DC.
1. flowering twig 2. fruit

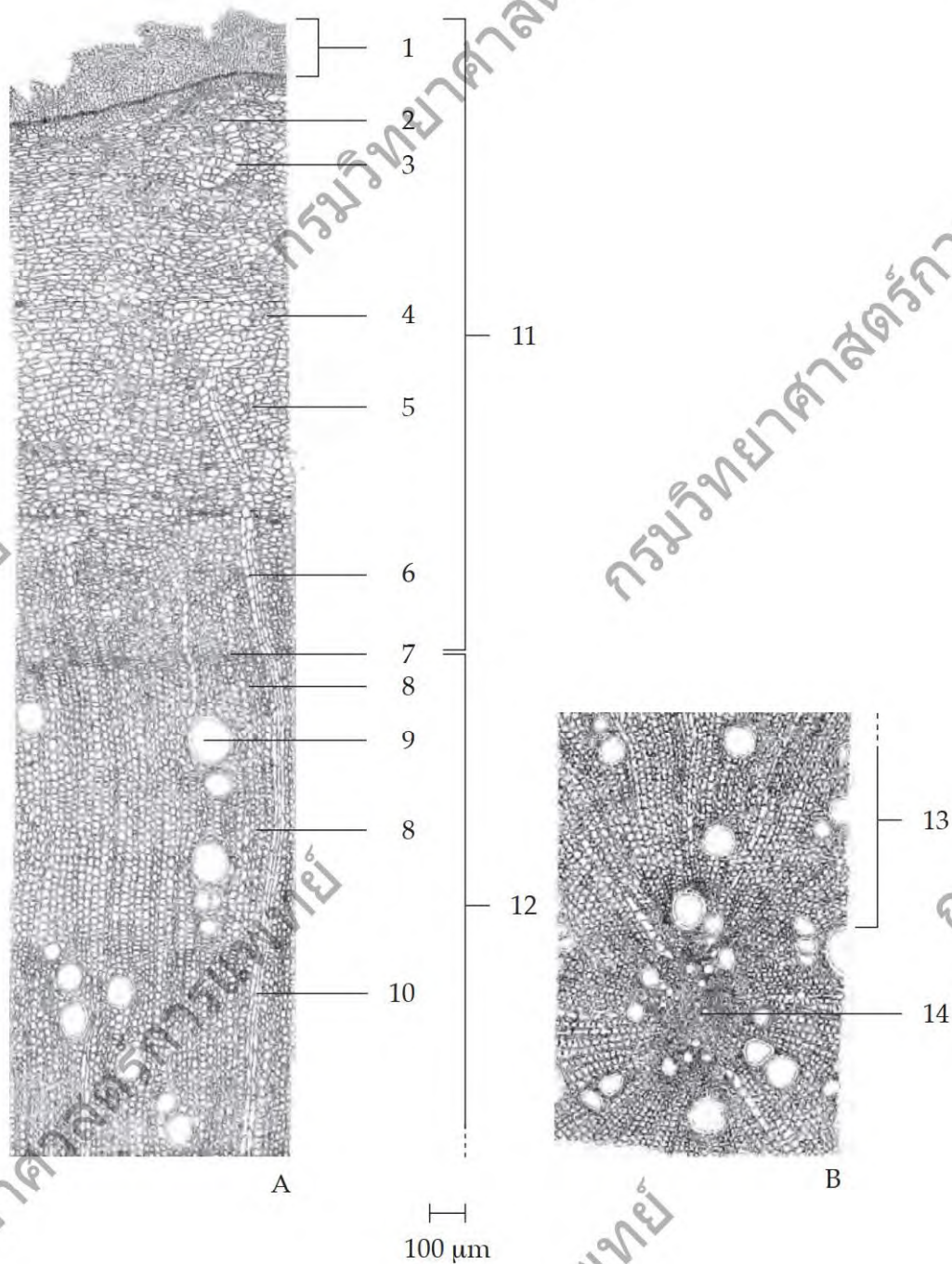


Fig. 2a Line Drawings of Transverse Section of the Root of *Capparis micracantha* DC.

A. Bark and Part of Wood

B. Part of Wood

1. periderm

2. sclereid

3. parenchyma

4. fibre

5. starch grain

6. phloem ray

7. cambium

8. axial parenchyma

9. vessel

10. xylem ray

11. bark

12. wood

13. secondary xylem tissue

14. primary xylem tissue

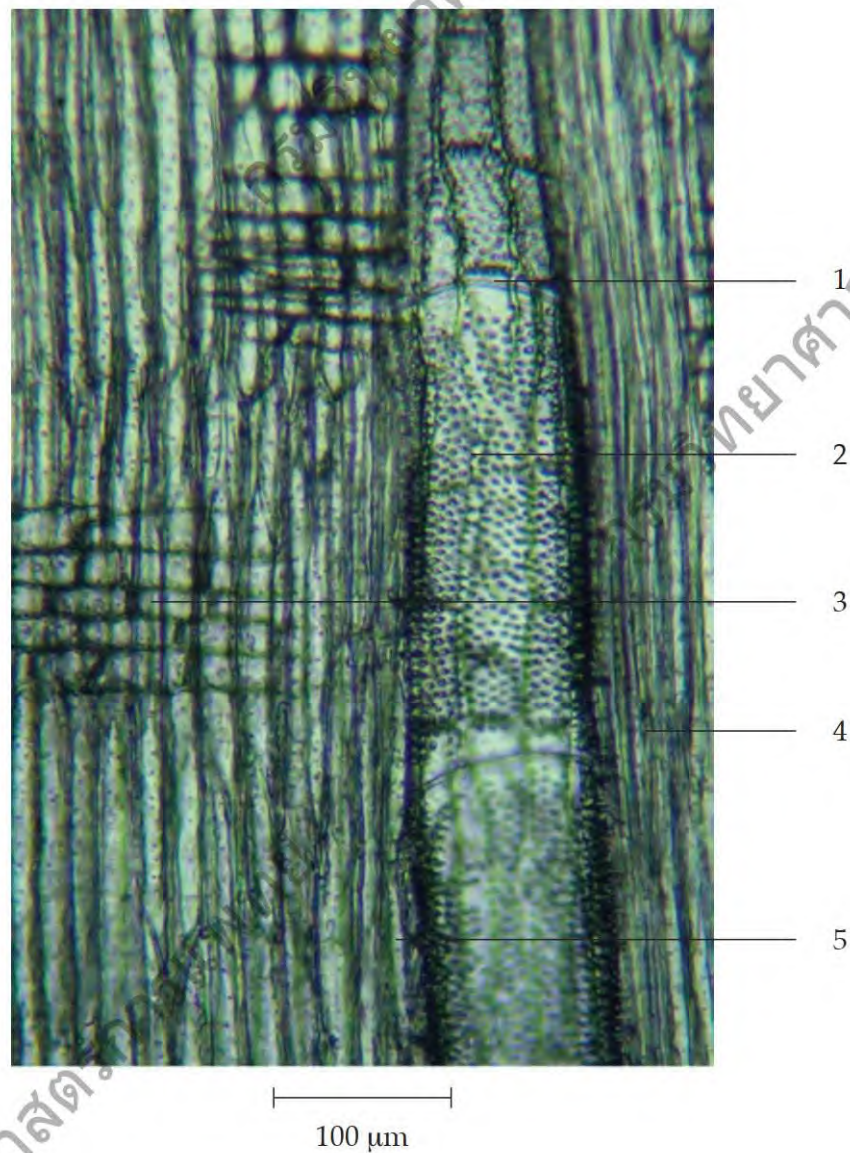


Fig. 2b Photomicrograph of Radial Longitudinal Section of the Woody Part of the Root of *Capparis micracantha* DC.

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



Fig. 2c Photomicrograph of Tangential Longitudinal Section of the Woody Part of the Root of *Capparis micracantha* DC.

- | | |
|---------------------------|-----------------------------|
| 1. perforation plate | 4. fibre |
| 2. bordered-pitted vessel | 5. axial parenchyma |
| 3. xylem ray | 6. fibre with starch grains |

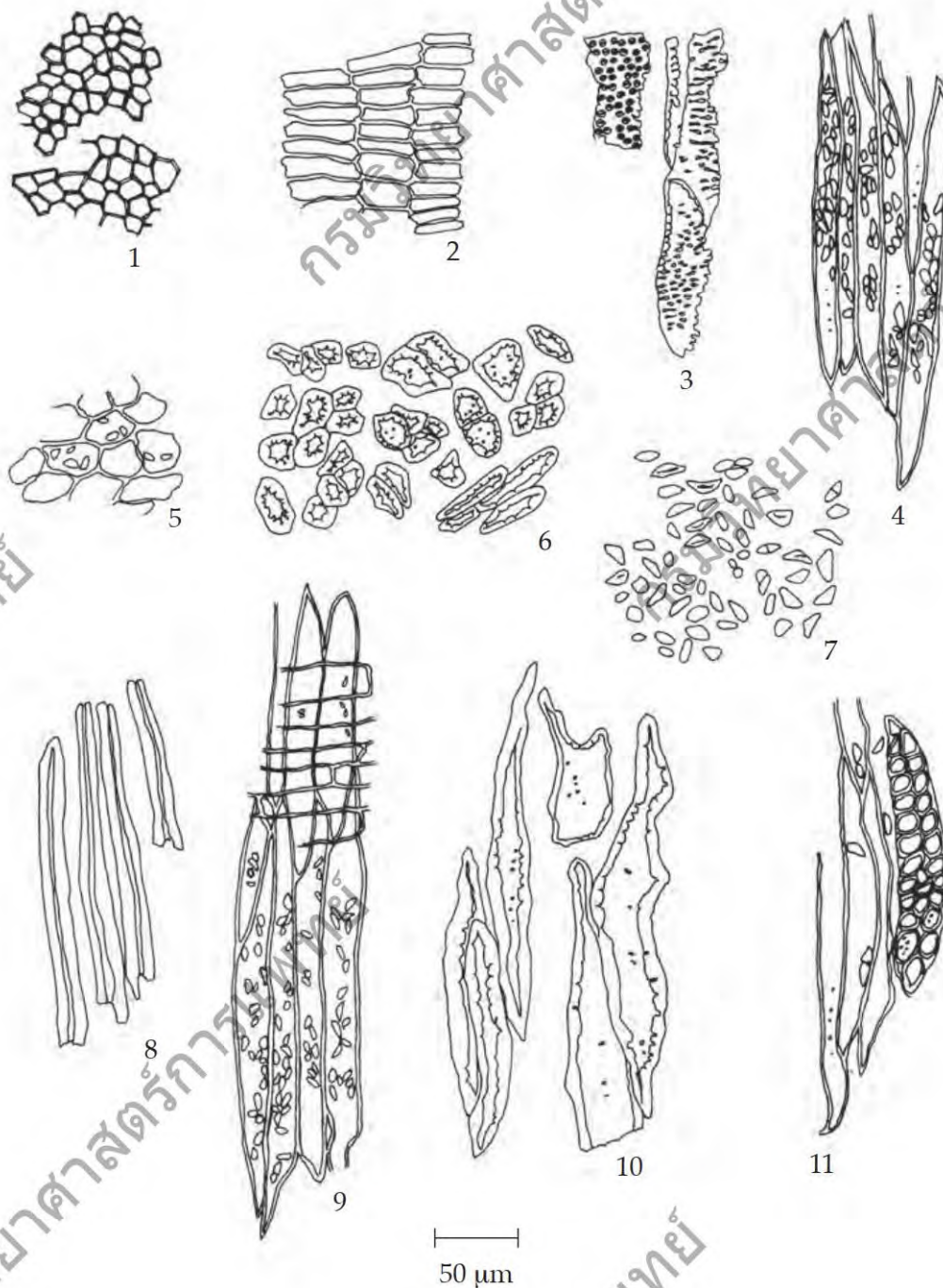


Fig. 2d Line Drawings of Powdered Drug of the Roots of *Capparis micracantha* DC.

- | | |
|--|--|
| 1. cork in surface view | 7. starch grains |
| 2. cork in sectional view | 8. fibres |
| 3. bordered-pitted vessels | 9. xylem rays with underlying xylem fibres in radial longitudinal view |
| 4. xylem fibres containing starch grains | 10. fibrosclereids |
| 5. parenchyma, some containing starch grains | 11. xylem rays associated with xylem fibres, some containing starch grains in tangential longitudinal view |
| 6. sclereids | |

Capparis Micracantha Root in powder possesses the diagnostic microscopical characters of the unground drug. Xylem fibres, with both simple and compound obtuse-triangular shaped starch grains, and xylem ray, with round shaped starch grains, are characteristic features.

Packaging and storage Capparis Micracantha 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 powder, with 10 mL of *methanol* for 30 minutes and filter. To 2 mL of the filtrate, add a few drops of *ninhydrin TS*, shake well and warm in a water-bath for a while: a purple 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 60 volumes of *chloroform*, 30 volumes of *methanol* and 10 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 a band of 8 mm, 15 µL of the test solution, prepared by macerating 1 g of the sample, in *fine powder*, with 10 mL of *methanol* for 30 minutes and filtering. After removal of the plate, allow it to dry in air. Spray the plate with *ninhydrin TS*, heat at 105° for 5 minutes and immediately examine the plate. Several purple bands appear (Fig. 3).

Repeat the same procedure on another plate but spray with *anisaldehyde TS*. One black, one yellowish orange, three violet, and other bands of different colours are 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 2.0 per cent w/w (Appendix 7.6).

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

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

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

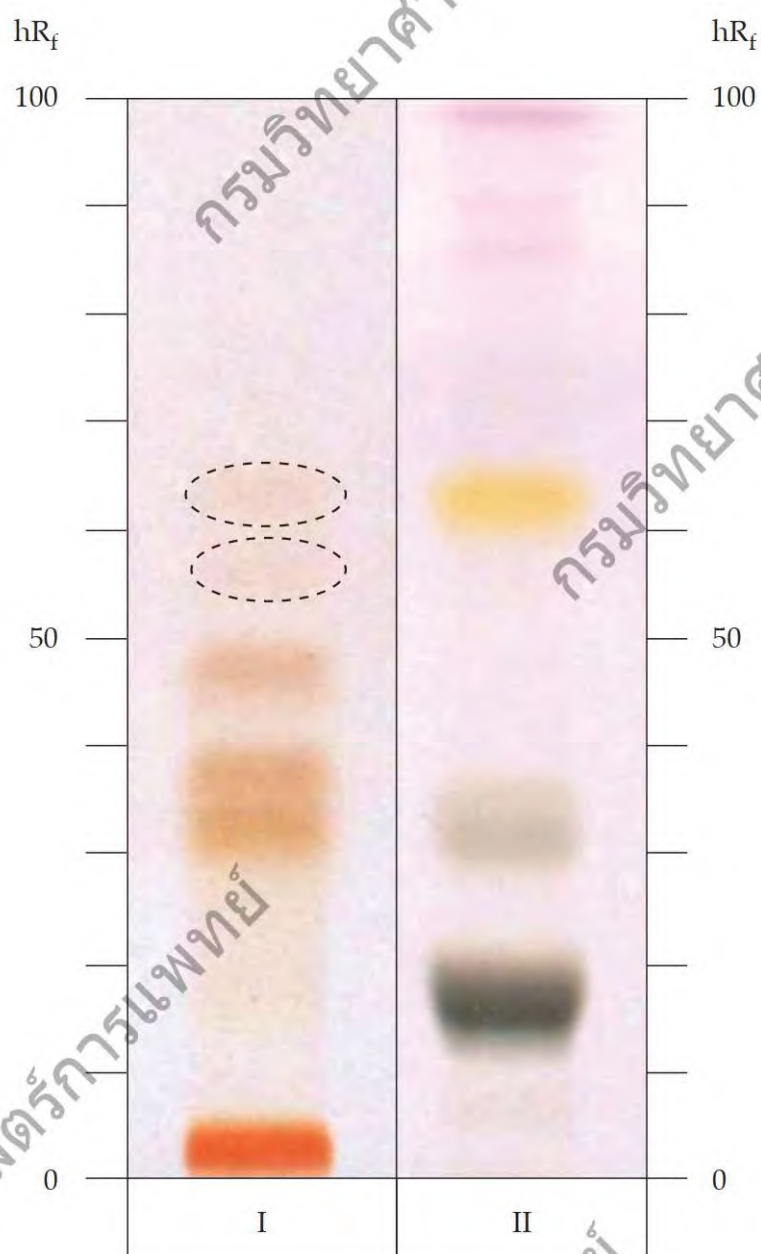


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Roots of *Capparis micracantha* DC.

- I = detection with *ninhydrin* TS
- II = detection with *anisaldehyde* TS
- = band developed in some samples

แฟกหอม (FAEK HOM)

Chrysopogon Zizanioides Radix
Vetiver Root

Category Cardiotonic, carminative, stomachic.

Vetiver Root is the dried root of *Chrysopogon zizanioides* (L.) Roberty [*Andropogon muricatus* Retz., *A. zizanioides* (L.) Urb., *Phalaris zizanioides* L., *Vetiveria zizanioides* (L.) Nash ex Small] (Family Gramineae), Herbarium Specimen Number: BKF 200904, DMSC 5305, Crude Drug Number: DMSc 1200.

Constituents Vetiver Root contains a volatile oil, of which khusimol, khusimone, α - and β -vetivone are its major components.

Description of the plant (Figs. 1a, 1b) Perennial herb, tufted; culm stout, up to 2.5 m tall, about 5 mm in diameter; root stout, aromatic. Leaves simple, stiff, linear to oblong, 30 to 90 cm long, 0.5 to 1 cm wide, apex acute, base obtuse, margin scabrous, upper surface pale green, pilose towards base, lower surface glabrous; leaf sheaths glabrous, lower ones sharply keeled and imbricate in fanlike clusters; ligule about 0.5 mm long, margin scarious, upper margin ciliate. Inflorescence paniculate, large, erect, 13 to 30 cm long, central axis with whorls of racemes, 5 to 7.5 cm long, purplish, silver, or greyish. Spikelets in pairs, one pedicelled, one sessile, with 5 to 13 pairs; lower spikelet sessile, fertile, glabrous; glumes with minute spines on outer surface; lower glume 3-nerved, upper glume 1-nerved; lower floret with lemma only, upper floret with membranous lemma and palea; lodicules 2, truncate; pedicelled spikelet sterile, lower glume with minute spines on outer surface; stamens 3, anther orange, linear, about 2 mm long; ovary with 2 feather-like styles, purple. Fruit a caryopsis, 4 to 5 mm long, with short spine. Seed oblong.

Description Odour, strongly aromatic, sandal wood-like; taste, bitter.

Macroscopical (Figs. 1a, 1b) Clusters of wiry roots, minute, 0.5 to 1.5 mm in diameter, longitudinally grooved, varied in colour from cream, grey or light yellow to brown; fracture, short and splintery.

Microscopical (Figs. 2a, 2b, 2c) Transverse section of the root shows epidermis, cortex, vascular tissue, and pith. Epidermis: a layer of polygonal cells, with unicellular root hairs. Cortex: lamellar collenchyma, 1 to 4 layers of fibres, polygonal parenchyma, some containing starch grains and/or crystals, aerenchyma, large air spaces, oil cells, and a layer of endodermis. Vascular tissue: polyarch bundles, a layer of pericycle, with some modified lateral roots primordial, xylem and phloem. Pith: polygonal parenchyma, some containing starch grains, crystals or oil droplets and horseshoe-shaped cells.

Vetiver Root in powder possesses the diagnostic microscopical characters of the unground drug. Reticulate-pitted and bordered-pitted vessels are frequently observed; simple and compound starch grains are also observed.



1



2



3



4



5

5 mm



6

2 cm

Fig. 1a *Chrysopogon zizanioides* (L.) Roberty

1. habit 2. inflorescence 3. perfect flowers 4. female flowers (a) and male flowers (b)
5. infructescence 6. crude drug

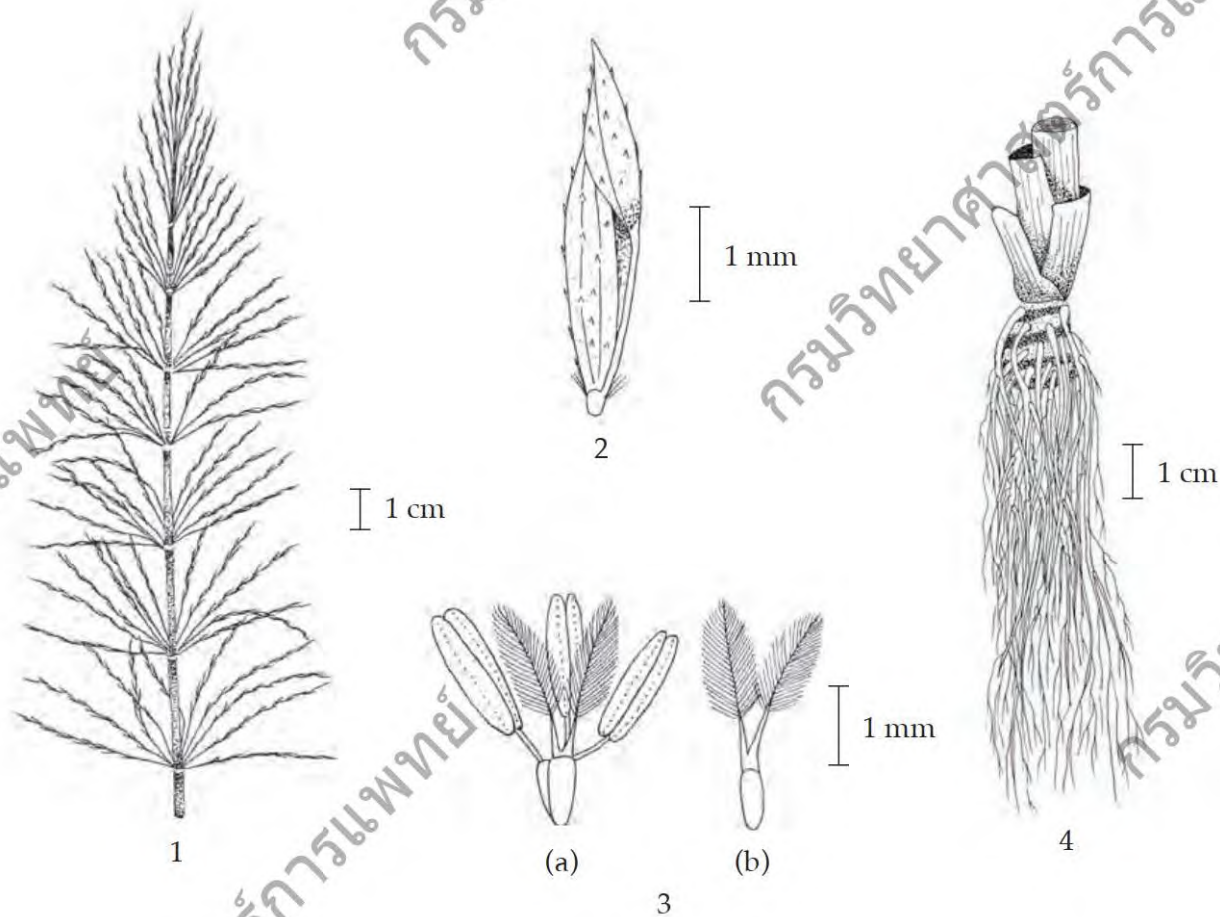


Fig. 1b *Chrysopogon zizanioides* (L.) Roberty

1. inflorescence 2. spikelets 3. perfect flower (a) and female flower (b)
4. culm and fibrous roots

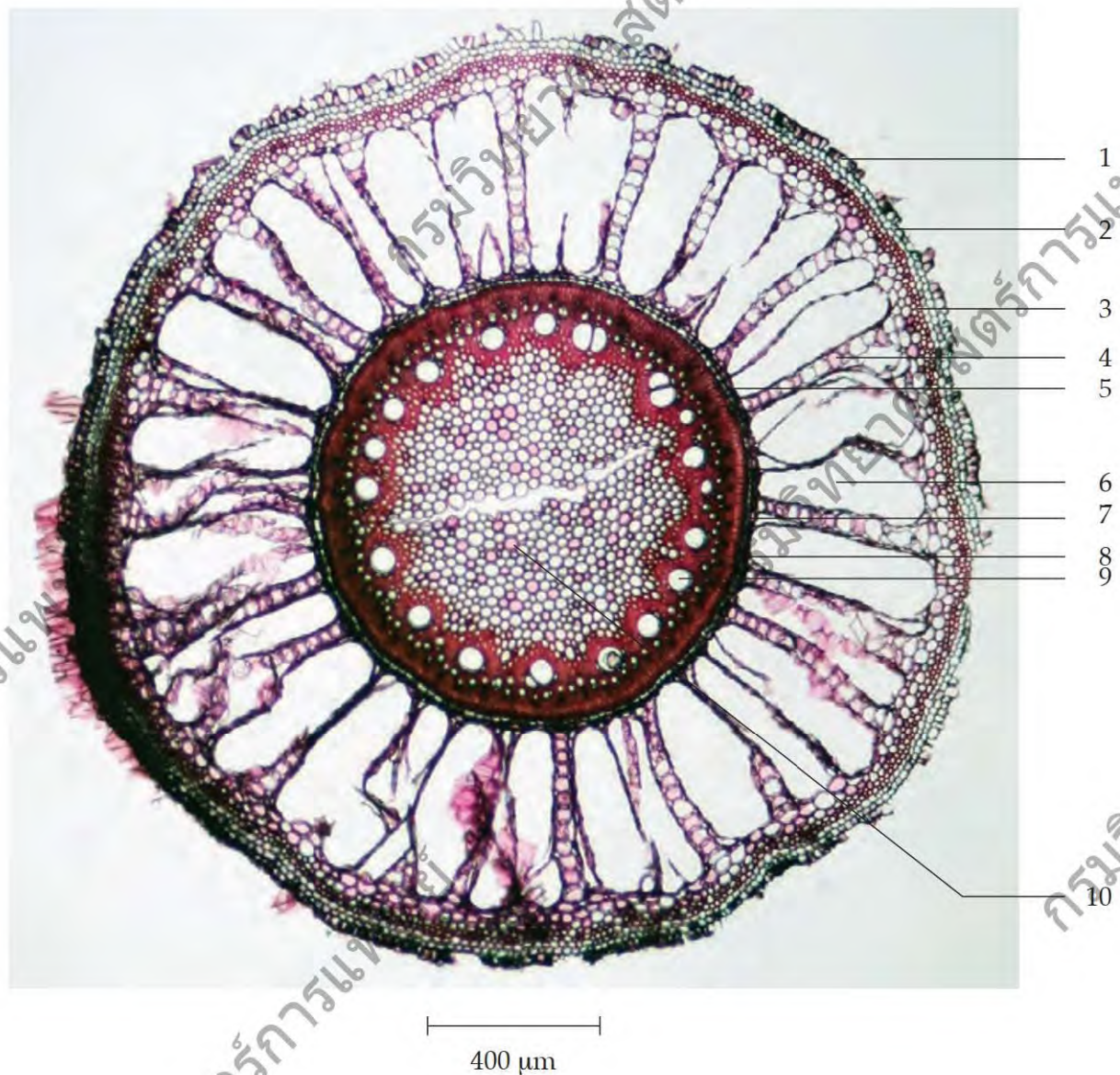


Fig. 2a Photomicrograph of Transverse Section of the Root of *Chrysopogon zizanioides* (L.) Roberty, Stained With Safranin-Fast Green

- | | |
|----------------|--------------------|
| 1. epidermis | 6. large air space |
| 2. collenchyma | 7. pericycle |
| 3. fibre | 8. phloem |
| 4. aerenchyma | 9. vessel |
| 5. endodermis | 10. pith |



Fig. 2b Photomicrographs of Powdered Drug of the Roots of *Chrysopogon zizanioides* (L.) Roberty

1. epidermis in surface view
2. parenchyma
3. parenchyma containing starch grains, in longitudinal view
4. simple and compound starch grains
5. reticulate-pitted and bordered-pitted vessels, unstained and stained with safranin

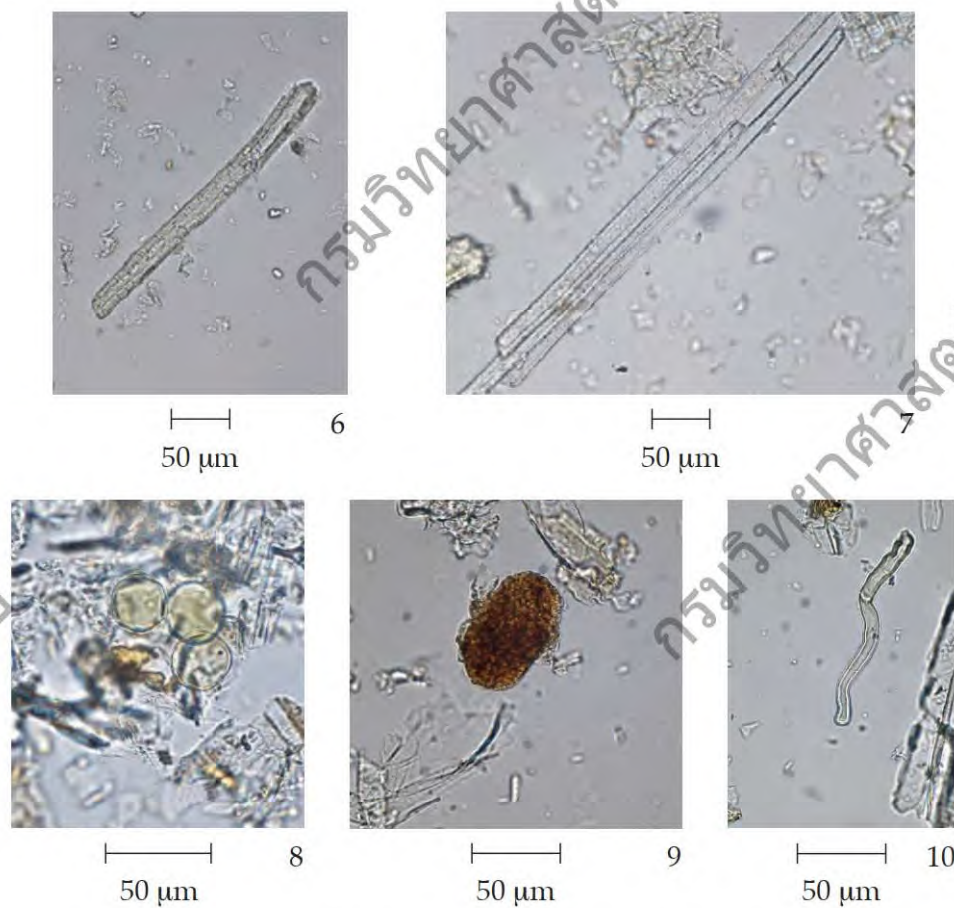


Fig. 2b (continued)
6. elongated sclereids
7. fibre
8. oil droplets

9. brown substance
10. root hair

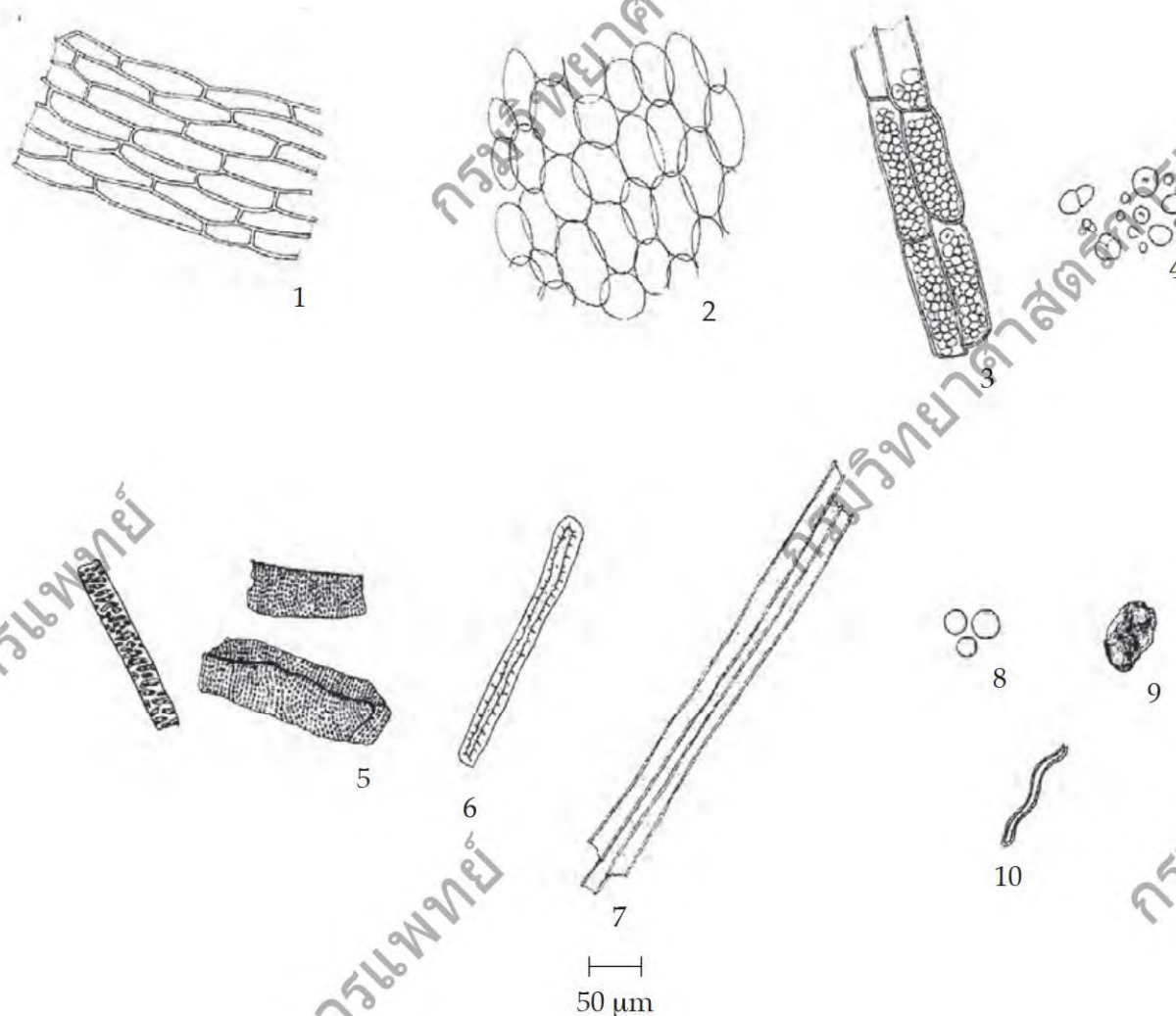


Fig. 2c Line Drawings of Powdered Drug of the Roots of *Chrysopogon zizanioides* (L.)

Roberty

- | | |
|--|-----------------------|
| 1. epidermis in surface view | 6. elongated sclereid |
| 2. parenchyma | 7. fibres |
| 3. parenchyma containing starch grains, in longitudinal view | 8. oil droplets |
| 4. simple and compound starch grains | 9. brown substance |
| 5. reticulate-pitted and bordered-pitted vessels | 10. root hair |

Packaging and storage Vetiver Root 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 heat on a water-bath: a violet colour is produced.

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 pinkish orange colour develops.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel 60 F254* as the coating substance and a mixture of 76 volumes of *n-hexane*, 4 volumes of *ethanol* and 2 volumes of *glacial acetic acid* as the mobile phase. Apply to the plate as a band of 8 mm, 15 µL of the test solution prepared by sonicating 1 g of the sample, in powder, with 10 mL of *methanol* for 30 minutes and filtering. Evaporate the filtrate to dryness 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. Subsequently spray the plate with *anisaldehyde TS* and heat at 110° for 10 minutes. Two brown and five purple bands are observed. Examine the plate under ultraviolet light (366 nm); one blue, one green, one red, one yellow, and four purple fluorescent bands are 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).

Acid-insoluble ash Not more than 8.0 per cent w/w (Appendix 7.6).

Total ash Not more than 11.0 per cent w/w (Appendix 7.7).

Ethanol-soluble extractive Not less than 2.0 per cent w/w (Appendix 7.12).

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

Volatile oil Not less than 0.5 per cent v/w, calculated on the anhydrous basis (Appendix 7.3H). Use 30 g, in *coarse powder*, freshly prepared and accurately weighed. Use 500 mL of *water* as the distillation liquid and a 1000-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 3 hours. Use 2.0 mL of *xylene* in the graduated tube.

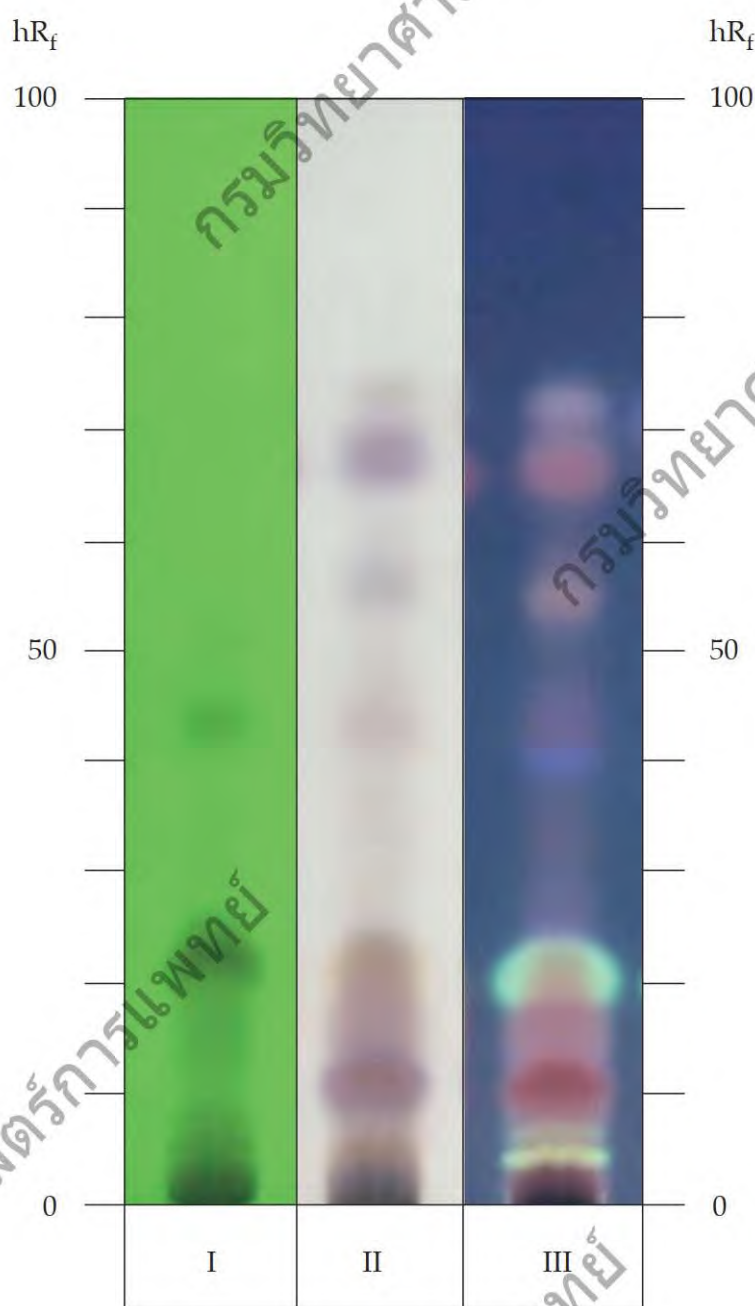


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Roots of *Chrysopogon zizanioides* (L.) Roberty

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

แห้วหมู (HAEO MU)

หัวแห้วหมู (HUA HAEO MU)

Cyperi Rotundi Cormus

Cyperus Rotundus Corm

Category Carminative, diuretic, stomachic.

Cyperus Rotundus Corm is the dried corm of *Cyperus rotundus* L. (Family Cyperaceae),
Herbarium Specimen Number: DMSC 5306, **Crude Drug Number:** DMSc 1201.

Constituents *Cyperus Rotundus* Corm contains a volatile oil, of which cyperotundone and cyperene are its major components. It also contains flavonoids, etc.

Description of the plant (Fig. 1) Perennial herb, 10 to 60 cm tall, stoloniferous; culm trigonous, glabrous, tuberous at base; corm fusiform, ovoid or ellipsoid, 0.7 to 2.3 cm long, 0.5 to 1 cm in diameter, blackish brown, woody; stolons long creeping. Leaves basal, 3-ranked, blade linear, up to 60 cm long, 2 to 6 mm wide, apex acuminate, margin entire, greyish green to dark green, scabrous, flattish, longitudinally grooved in the middle; leaf sheath pale brown, sometimes with reddish tint, becoming fibrous. Inflorescence terminal, usually compound umbel-like spike; involucre bracts 2 to 5, leaf-like, 2 to 35 cm long, 0.5 to 4 mm wide; primary branch 2 to 12 cm long, secondary branch (if present), 0.7 to 2 cm long; spike 1.5 to 5 cm long, axis 2 to 8 mm long; spikelets 3 to 10 per spike, suberect to patent, narrowly oblong to linear, 1 to 3 cm long, 1.5 to 3 mm wide, flattened, axis more or less straight, winged; glumes 2-ranked, 9 or more on the longest spikelet, ovate to ovate-elliptic, 3 to 3.5 mm long, about 2 mm wide, obtuse, mucronate, 5- to 7-nerved, reddish or purplish brown with pale narrow hyaline margin, keel greenish; stamens 3, anther about 1 mm long; ovary superior, unilocular, 1-ovuled; style 1.3 to 3.5 mm long, stigmas 3, 1.8 to 3.3 mm long, exserted from glume. Nutlet cylindric to obovoid-cylindric, trigonous, 1.3 to 1.5 mm long, 0.5 to 0.7 mm wide, brown to blackish brown, minutely punctate.

Description Odour, mildly aromatic, spicy; taste, slightly spicy and bitter.

Macroscopical (Fig. 1) Subglobose, fusiform, ovoid or ellipsoid, 0.7 to 2.3 cm long, 0.5 to 1 cm in diameter, some slightly curved; externally dark brown or black with several distinctive annular rings, with remnants of fibrous root scars, or sometimes somewhat glabrous with indistinctive roots scars; texture hard and tough.

Microscopical (Figs. 2a, 2b, 2c) Transverse section of the corm shows epidermis, cortex and vascular tissue. Epidermis: a single layer of yellow to brownish yellow polygonal cells. Cortex: groups of reddish brown fibres, storied cork, sclerenchyma, thin-walled ovate to round parenchyma, some containing starch grains and/or reddish brown oleoresins, secretory cells containing reddish brown substance and enclosed by 5 to 8 parenchyma cells; pseudoendodermis, 1 to 2 layers of thick-walled subrectangular or subround cells. Vascular tissue: scattering collateral vascular bundles in the outer pseudoendodermis region and amphivasal vascular bundles in the inner pseudoendodermis region, both of which enclosed by 1 to 3 layers of lignified fibres.

Cyperus Rotundus Corm in powder possesses the diagnostic microscopical of the unground drug. Secretory cells enclosed by parenchyma and groups of reddish brown fibres are characteristic.

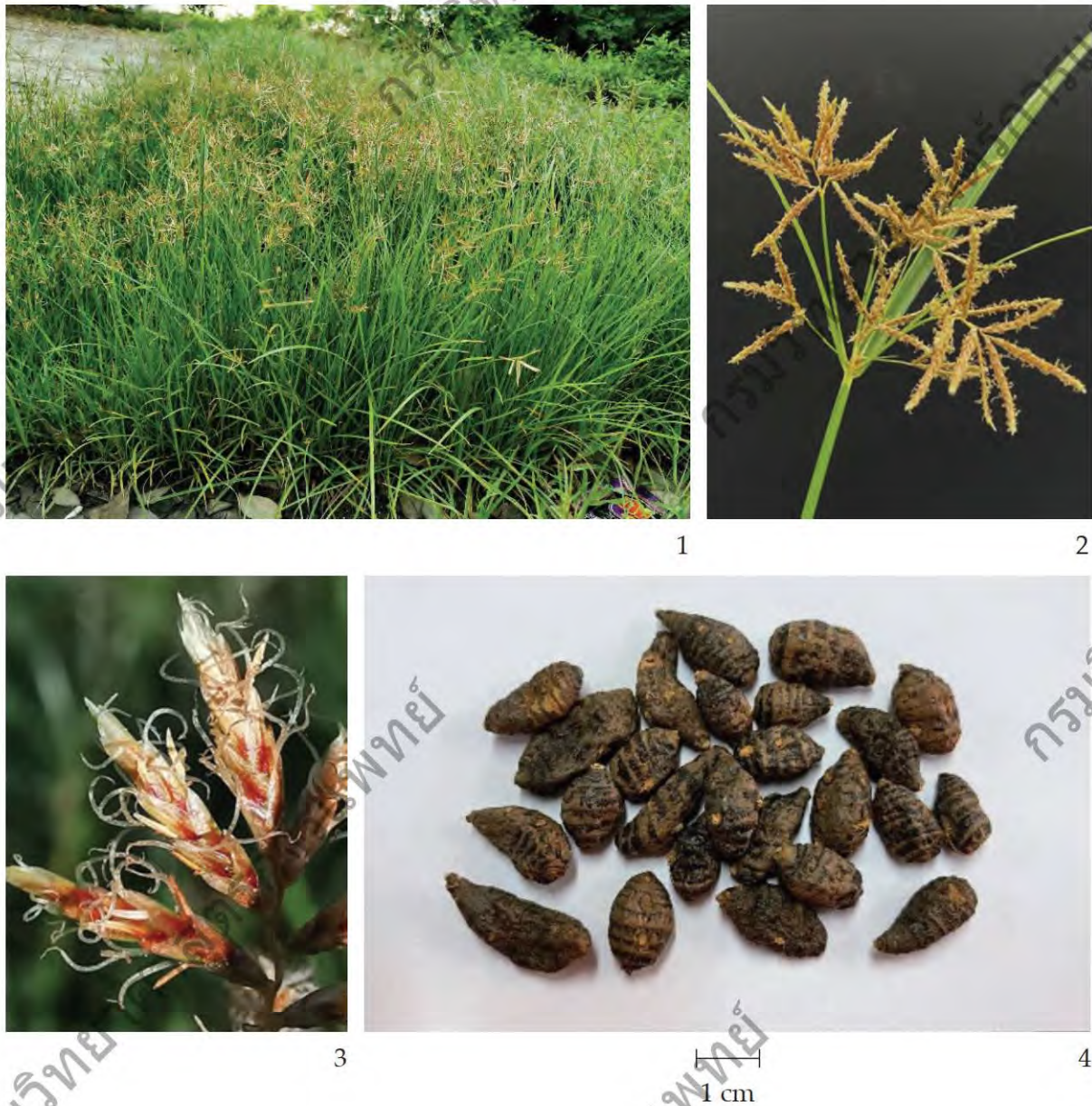


Fig. 1 *Cyperus rotundus* L.

1. habit 2. inflorescences 3. spikelets 4. crude drug

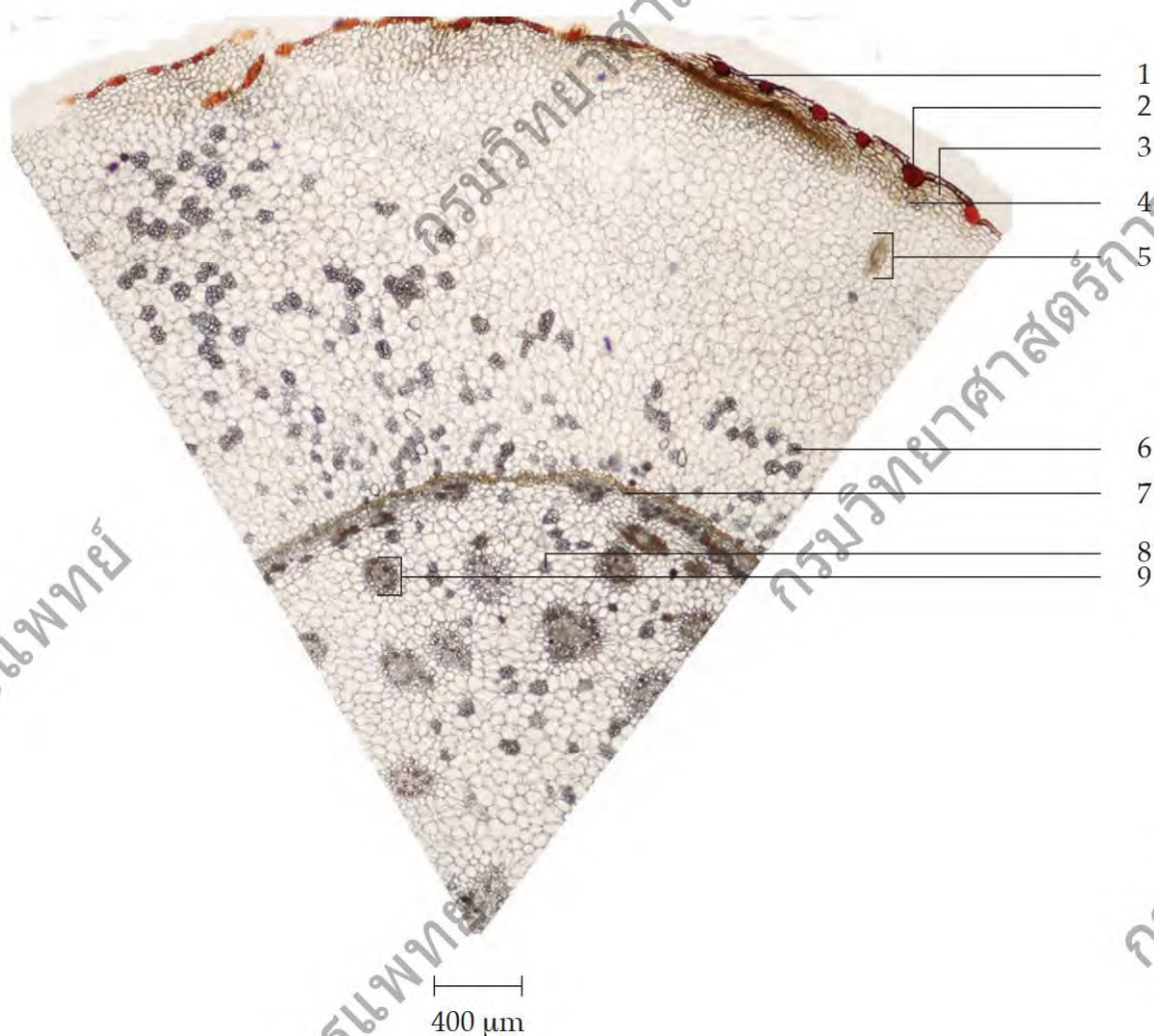


Fig. 2a Photomicrograph of Transverse Section of the Corm of *Cyperus rotundus* L.

- | | |
|----------------------------------|--|
| 1. epidermis | 6. parenchyma containing starch grains |
| 2. group of reddish brown fibres | 7. pseudoendodermis |
| 3. storied cork | 8. secretory cell |
| 4. sclerenchyma | 9. amphivasal vascular bundle |
| 5. collateral vascular bundle | |

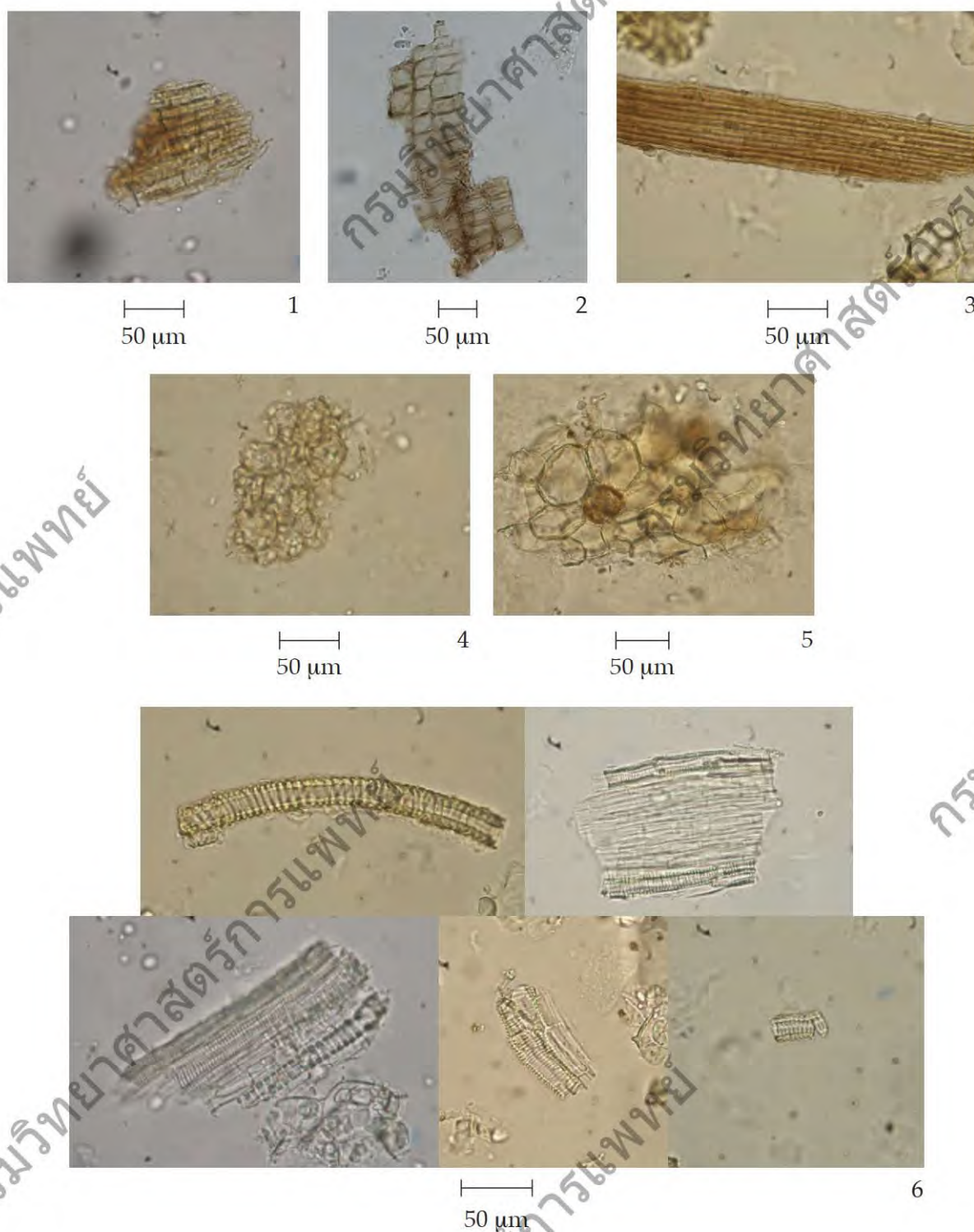


Fig. 2b Photomicrographs of Powdered Drug of the Corms of *Cyperus rotundus* L.

- | | |
|--|---|
| 1. epidermis | 5. secretory cell enclosed by parenchyma |
| 2. storied cork | |
| 3. group of fibres | 6. spiral, scalariform and reticulate vessels |
| 4. parenchyma containing starch grains | |

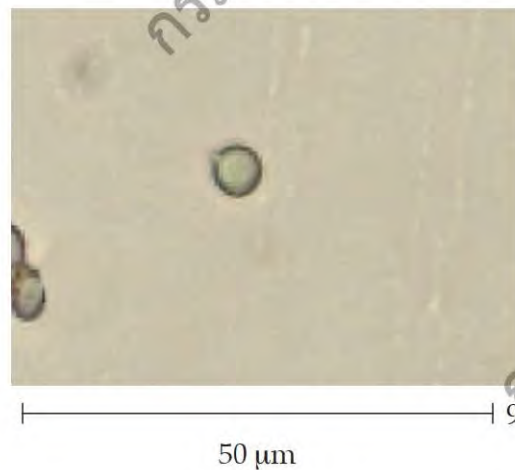
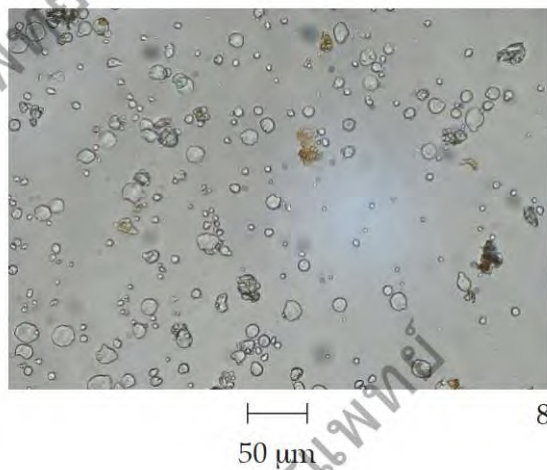


Fig. 2b (continued)

7. sclereids

8. starch grains, oil droplets and
brown substance

9. oil droplet

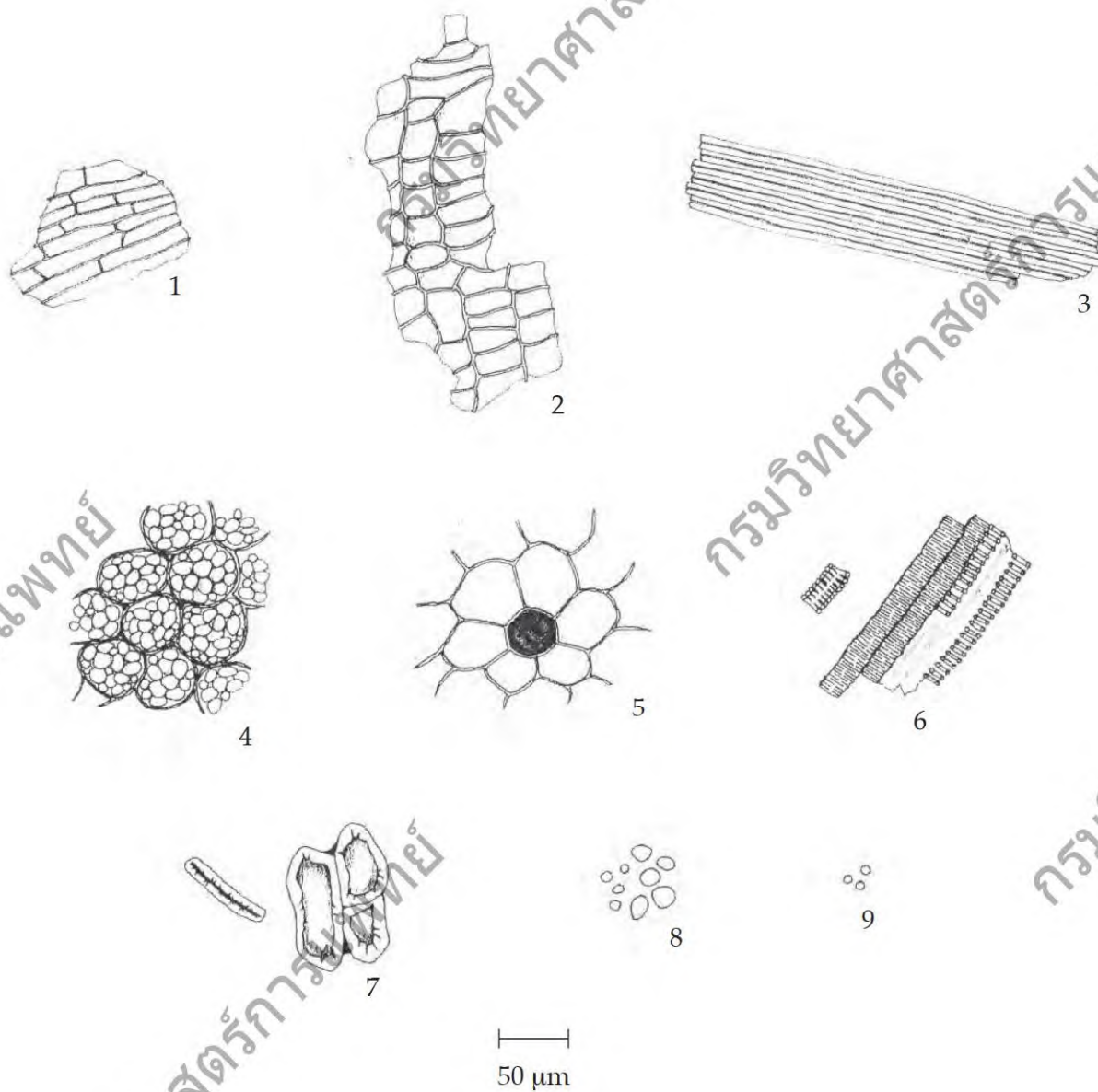


Fig. 2c Line Drawings of Powdered Drug of the Corms of *Cyperus rotundus* L.

- | | |
|--|---|
| 1. epidermis | 6. spiral, scalariform and reticulate vessels |
| 2. storied cork | 7. sclereids |
| 3. group of fibres | 8. starch grains |
| 4. parenchyma containing starch grains | 9. oil droplets |
| 5. secretory cell enclosed by parenchyma | |

Additional information When the *Cyperus rotundus* corms are pre-processed by steaming, fractures of the unsteamed corms are white and starchy with prominent endodermis ring, dark stele and scattering dotted vascular bundles, while the steamed ones are yellowish brown to reddish brown in colour.

Packaging and storage *Cyperus Rotundus* Corm shall be kept in well-closed containers, protected from light, and stored in a cool and dry place.

Identification

A. Boil 1 g of the sample, in powder, with 10 mL of *water* for 15 minutes and filter. To 2 mL of the filtrate, add a few drops of *ninhydrin TS* and warm on a water-bath: a violet colour is produced.

B. Sonicate 1 g of the sample, in powder, with 10 mL of *methanol* for 30 minutes and filter. To 2 mL of the filtrate, add 2 or 3 pieces of *magnesium ribbon*, shake well and mix with a few drops of *hydrochloric acid*: a reddish pink colour develops.

C. Carry out the test as described in the “Thin-Layer Chromatography” (Appendix 3.1), using *silica gel 60 F254* as the coating substance and a mixture of 80 volumes of *n-hexane* and 20 volumes of *acetone* as the mobile phase. Apply separately to the plate as bands of 8 mm, 10 µL each of the following solutions. Prepare solution (A) by sonicating 2 g of the sample, in powder, with 10 mL of *methanol* for 10 minutes and filtering. Evaporate the filtrate to dryness under reduced pressure at 50°. Dissolve the residue in 1 mL of *methanol*. For solution (B), dissolve 2 mg of *cyperotundone* 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 (R_f value 51 to 57) corresponding to the cyperotundone band obtained from solution (B) (Fig. 3).

Water Not more than 8.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

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

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

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

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

Water-soluble extractive Not less than 11.0 per cent w/w (Appendix 7.12).

Volatile oil Not less than 1.0 per cent v/w, calculated on the anhydrous basis (Appendix 7.3H). Use 15 g, in *moderately coarse powder*, freshly prepared and accurately weighed. Use 200 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 3 hours. Use 2.0 mL of *xylene* in the graduated tube.

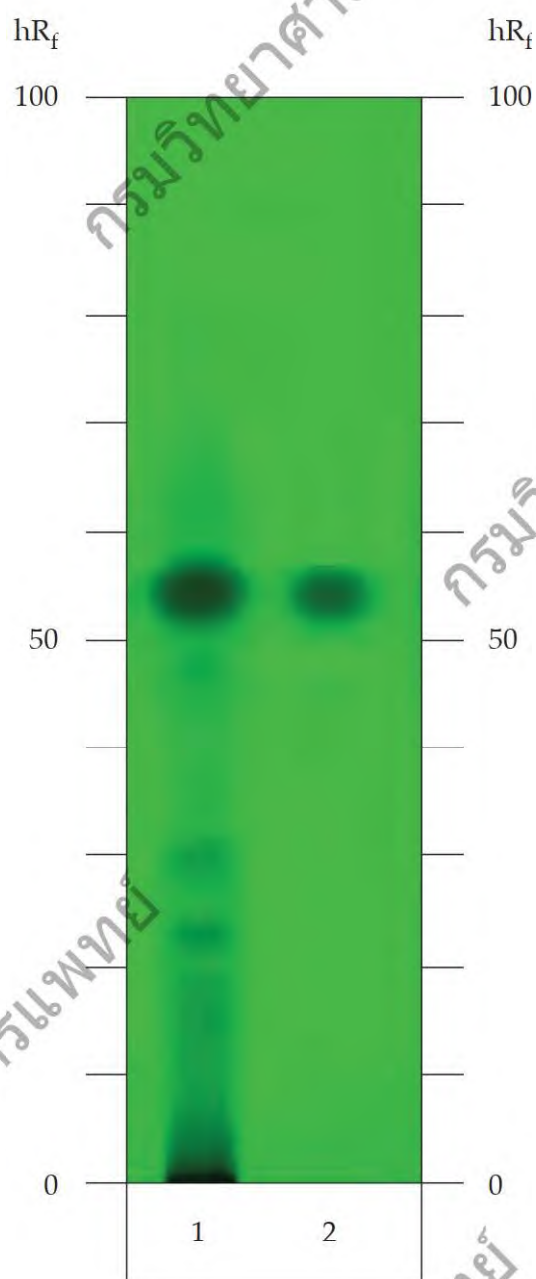


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Corms of *Cyperus rotundus* L., Detected Under UV light (254 nm)

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

กัญชา, ใบ (KANCHA, BAI)

Cannabis Sativae Folium

Cannabis Sativa Leaf

Synonym *Cannabis* Leaf

Category Appetite enhancer, sleep aid.

Cannabis Sativa Leaf is the dried mature cauline leaf of *Cannabis sativa* L. [*C. indica* Lam., *C. ruderalis* Janisch., *C. ruderalis* (Janisch.) S. Z. Liou, *C. sativa* subsp. *indica* (Lam.) E. Small & Cronquist, *C. sativa* var. *indica* (Lam.) Wehmer] (Family Cannabaceae), Herbarium Specimen Number: DMSC 5268, Crude Drug Number: DMSc 1193.

Constituents *Cannabis Sativa* Leaf contains cannabinoids (e.g., cannabidiol or CBD, Δ^9 -tetrahydrocannabinol or Δ^9 -THC or THC). It also contains terpenoids, flavonoids, etc.

Description of the plant (Fig. 1) Herbaceous plant, dioecious, occasionally monoecious, 0.2 to 6 m tall; stem and branches angular, erect, covered with rather short stiff hairs. Leaves palmately compound, opposite near base, spirally arranged upwards; petiole up to 10 cm long, pubescent; stipule erect, linear or narrowly subulate, 4 to 6 mm long, persistent; leaflets (3–)5 to 11, narrowly lanceolate, linear to linear-lanceolate, 2 to 15 cm long, 0.2 to 2 cm wide, apex acuminate-caudate, base narrowly cuneate, margin coarsely serrate, upper surface dark green, scabrous, lower surface whitish green with scattered brownish resinous dots, densely pubescent with appressed hairs, nerves 8 to 20 pairs; sessile. Flowering top numerous inflorescences, terminal or axillary; male inflorescence diffused and paniculate, bracts small; female inflorescence crowded among foliaceous bracts, 1 to 5 cm long. Flower small, unisexual; male flower yellowish green, tepals 5, free, elliptic or oblong, 3 to 5 mm long, 1.5 to 2 mm wide, apex acute, margin entire, finely pubescent; stamens 5, opposite tepals, filament slender, 0.5 to 1 mm long, anther basifixed, oblong, 2-celled, dehiscing by apical pore; female flower greenish, subsessile, enveloped by perigonal bract, membranous spathe-like, dark green, with glandular hairs; tepals fused into thin-textured tube adnate to ovary, in some cultivars, merely a ring at base of ovary; ovary superior, subglobose, 1 to 2 mm in diameter, 1-loculed, style short divided into 2 stigmatic slender arms, brown, pubescent, caducous. Fruit an achene, ovoid or ellipsoid, 2 to 5 mm long, 3 to 4 mm wide, somewhat compressed, minutely pilose to glabrous, shiny, yellowish brown to white or greenish, mottled with purple pericarp crustaceous, finely reticulate. Seed 1.

Description Odour, aromatic, characteristic; taste, bland.

Macroscopical (Fig. 1) *Cannabis Sativa* Leaf occurs as a mixture of entire and broken, greenish brown leaves. Entire leaves palmately compound with up to 10 cm long stalk, leaflets 5 to 9, linear to lanceolate, apex acuminate, base acute, margin toothed.

Microscopical (Figs. 2a, 2b, 2c, 2d, 2e) Transverse section of the cauline leaf through the midrib shows upper epidermis, mesophyll, vascular tissue, and lower epidermis. Upper epidermis: a layer of rectangular cells, covered with cuticle layer; stomata; short unicellular trichomes with or without cystolith. Mesophyll: a layer of cylindrical palisade cells, some containing rosette aggregate crystals; spongy cells, irregularly shaped, loosely arranged, some containing rosette aggregate crystals or starch grains; angular collenchyma; and parenchyma, some containing rosette aggregate crystals, occurring in the upper and lower parts of the midrib. Vascular tissue: phloem and xylem. Lower epidermis: a layer of small rectangular cells, covered with cuticle layer; raised stomata; long unicellular trichomes with or without cystolith; glandular trichomes with short stalk; clear or cloudy multicellular glandular trichomes.



1



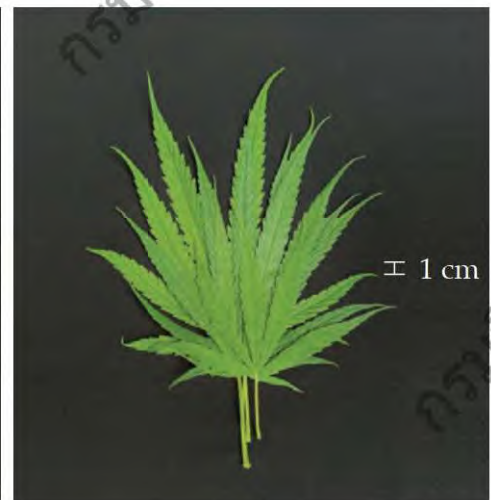
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3



4



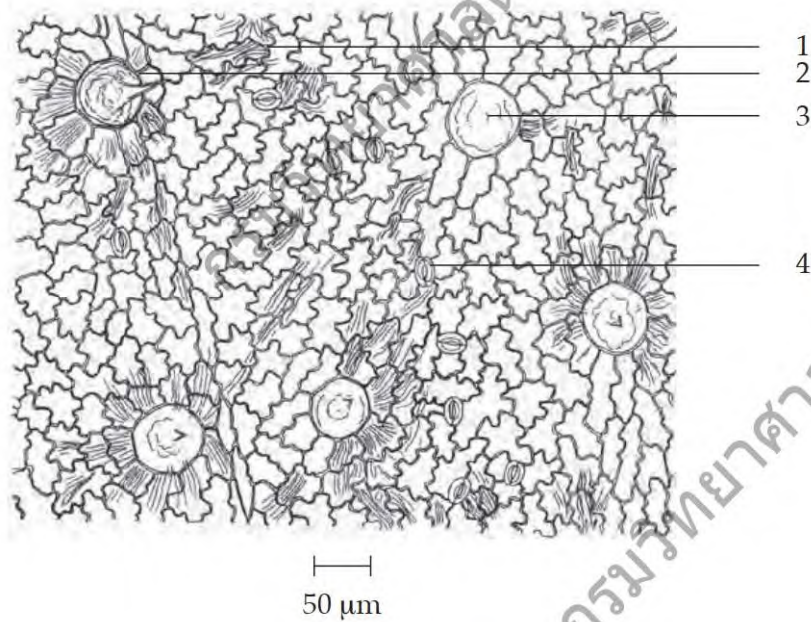
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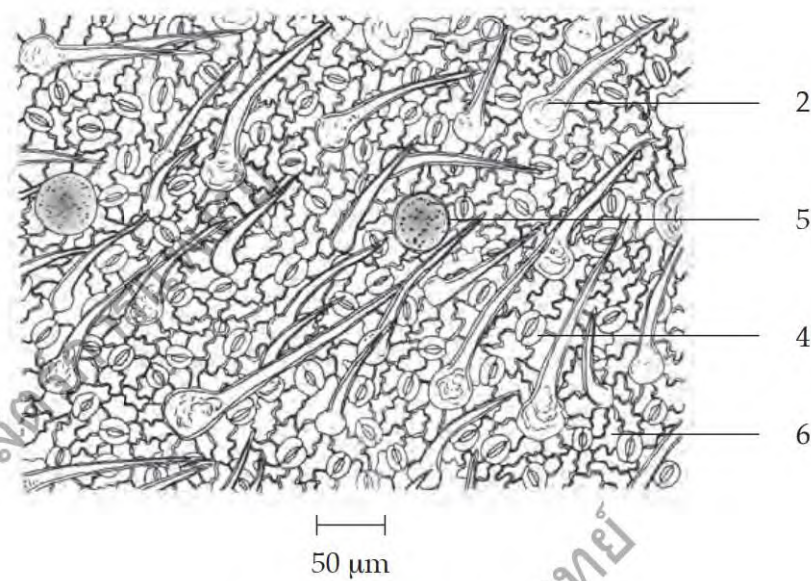
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Fig. 1 *Cannabis sativa* L.

1. habit 2. male inflorescence 3. female inflorescence 4. and 5. leaves 6. crude drug

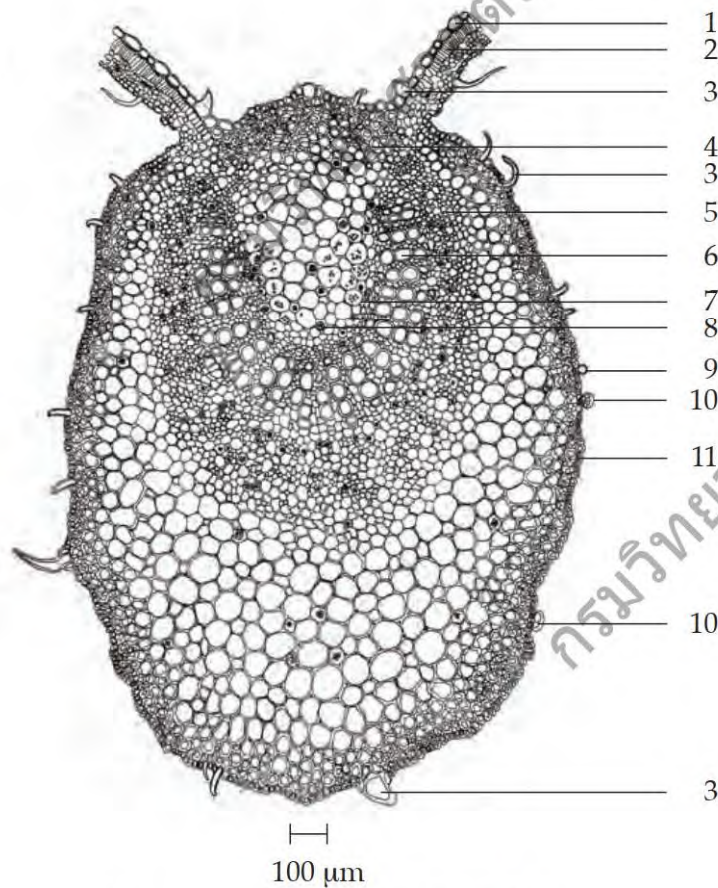


Upper Epidermis of the Lamina

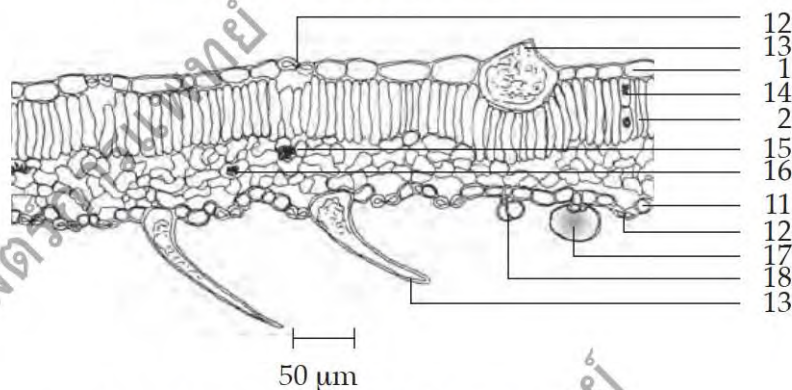


Lower Epidermis of the Lamina

Fig. 2a Line Drawings of Epidermises of the Cauline Leaf of *Cannabis sativa* L.
 1. upper epidermis, some with striation
 2. unicellular trichome with cystolith
 3. cystolith
 4. anomocytic stoma
 5. cloudy glandular head
 6. lower epidermis



Transverse Section of the Midrib



Transverse Section of the Lamina

Fig. 2b Line Drawings of Transverse Sections of the Cauline Leaf of *Cannabis sativa* L.

- | | |
|--|--|
| 1. upper epidermis | 11. lower epidermis |
| 2. palisade cell | 12. stoma |
| 3. unicellular trichome | 13. unicellular trichome with cystolith |
| 4. collenchyma | 14. palisade cell containing rosette aggregate crystal |
| 5. phloem | 15. vascular bundle |
| 6. vessel | 16. spongy cell containing rosette aggregate crystal |
| 7. parenchyma containing starch grain | 17. cloudy multicellular glandular trichome |
| 8. parenchyma containing rosette aggregate crystal | 18. glandular trichome with short stalk |
| 9. glandular trichome | |
| 10. clear multicellular glandular trichome | |

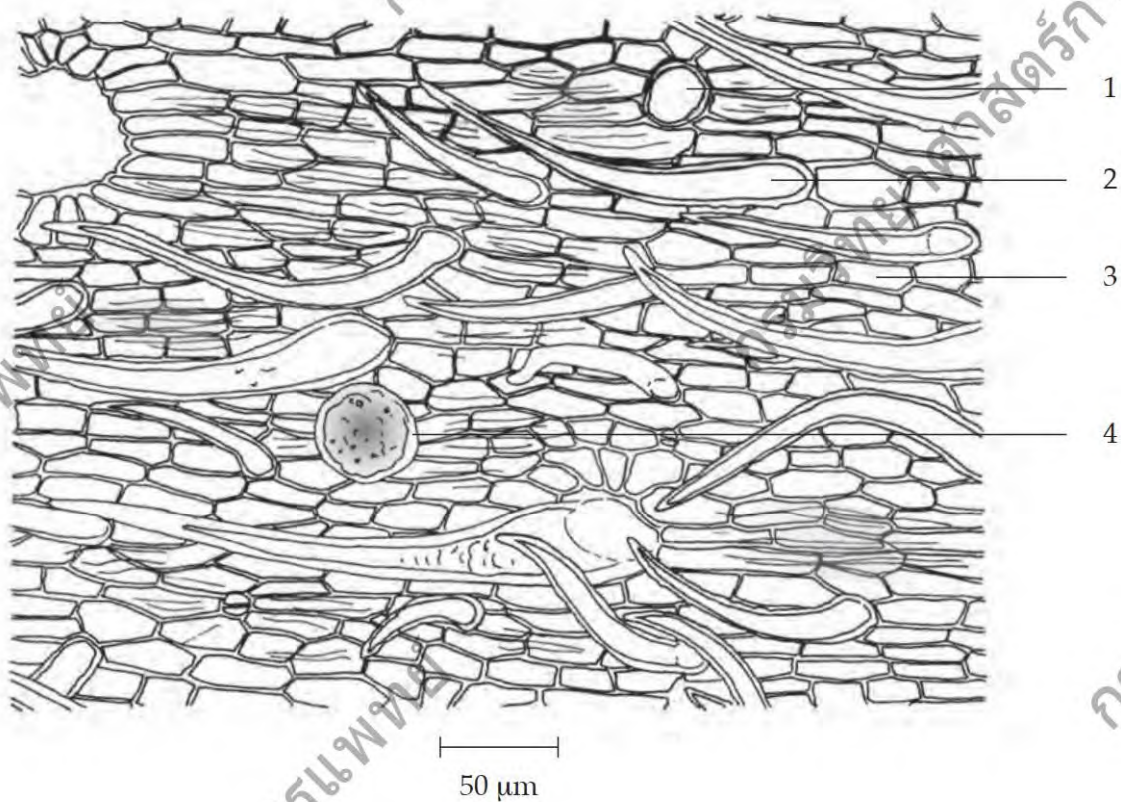


Fig. 2c Line Drawing of Epidermis of the Petiole of *Cannabis sativa* L.

1. cicatrix

3. epidermal cell

2. unicellular trichome

4. cloudy glandular head

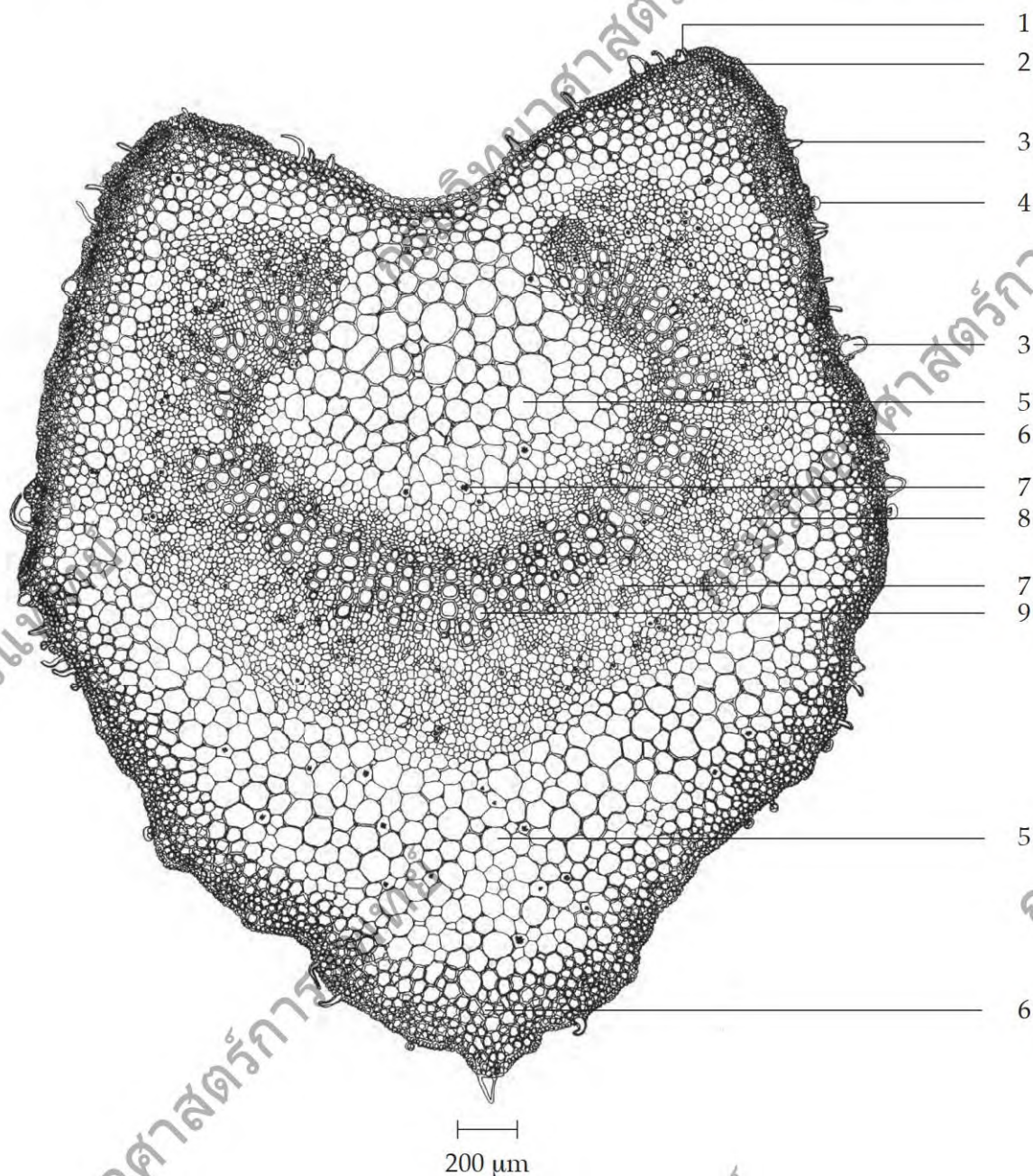


Fig. 2d Line Drawing of Transverse Section of the Petiole of *Cannabis sativa* L.

- | | |
|--|---|
| 1. raised stoma | 6. collenchyma |
| 2. epidermis | 7. parenchyma containing
rosette aggregate crystal |
| 3. unicellular trichome | 8. phloem |
| 4. clear multicellular glandular
trichome | 9. vessel |
| 5. parenchyma | |

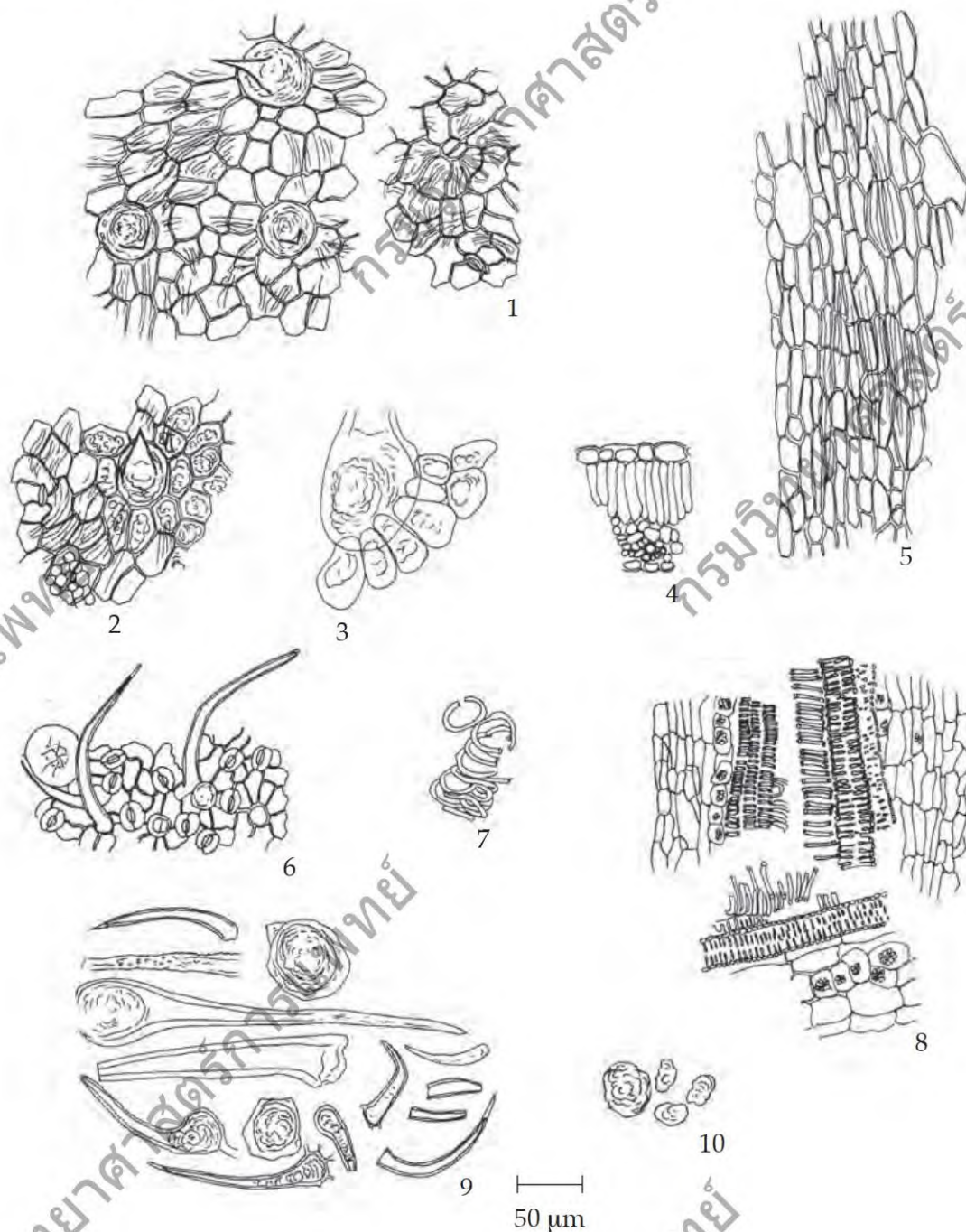


Fig. 2e Line Drawings of Powdered Drug of the Cauline Leaves of *Cannabis sativa* L.

1. upper epidermis of the lamina, showing faint cuticular striation, unicellular trichome with cystolith, cicatrix, and anomocytic stoma
2. upper epidermis of the lamina, showing faint cuticular striation, unicellular trichome with cystolith, with underlying palisade cells
3. unicellular trichome with cystolith and epidermal cells
4. lamina in sectional view
5. epidermis of the midrib, showing faint cuticular striation and cicatrix
6. lower epidermis of the lamina, showing raised stomata, unicellular trichomes and multicellular glandular trichome with brown substance
7. spiral vessel
8. parenchyma, some containing rosette aggregate crystals, associated with spiral, reticulate and pitted vessels
9. unicellular trichomes with or without cystolith
10. cystolith

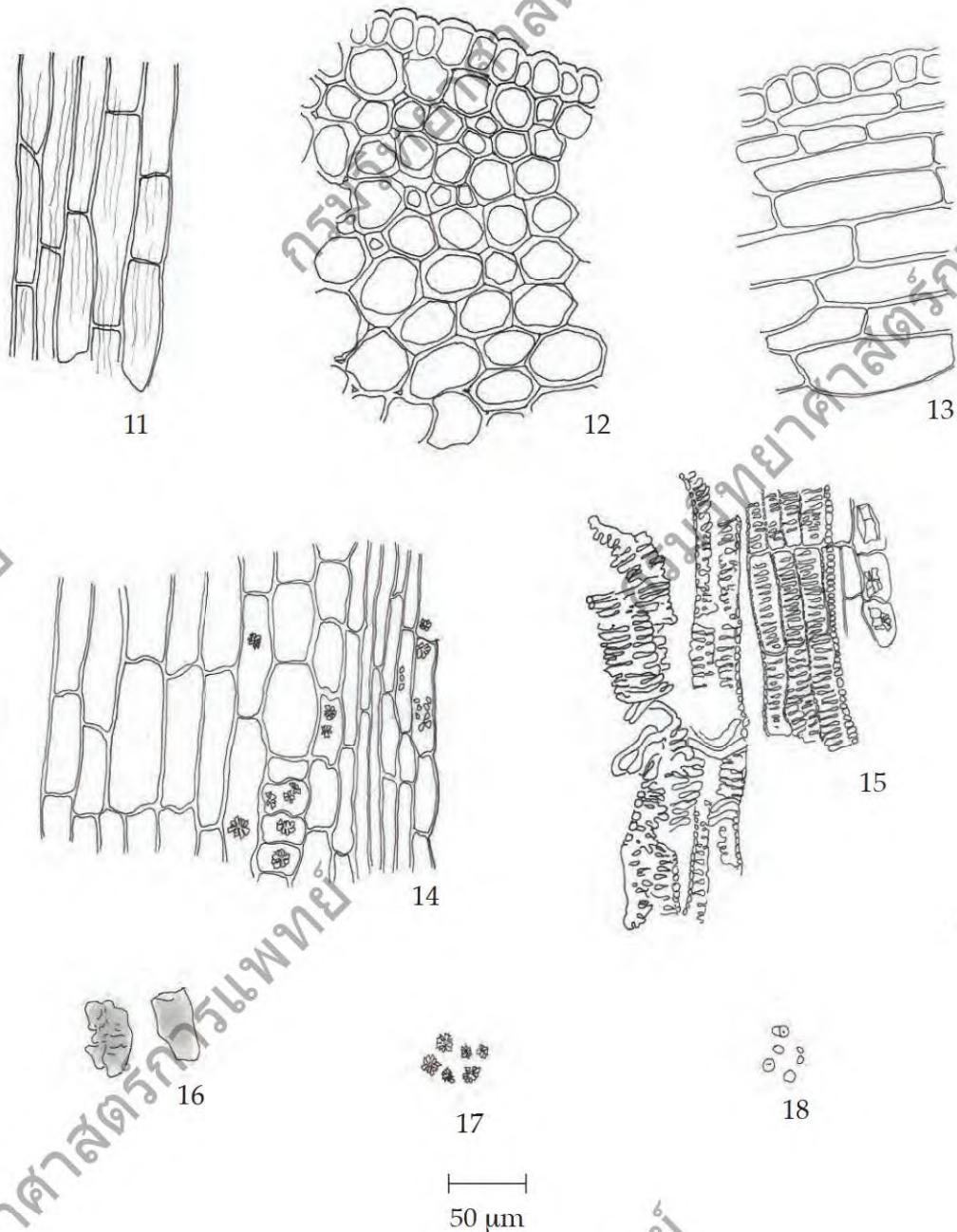


Fig. 2e (continued)

- | | |
|---|--|
| 11. upper epidermis of the petiole, showing faint cuticular striation | 15. reticulate vessel and parenchyma, some containing rosette aggregate and prismatic crystals |
| 12. epidermis associated with collenchyma in sectional view | 16. brown substance |
| 13. epidermis associated with collenchyma in longitudinal view | 17. rosette aggregate crystals |
| 14. parenchyma, some containing starch grains, rosette aggregate crystals and brown substance, in longitudinal view | 18. starch grains |

In surface view, the lamina shows upper epidermis and lower epidermis. Upper epidermis: wavy epidermal cells, some with cuticular striation; stomata; short unicellular trichomes with cystolith. Lower epidermis: wavy epidermal cells, raised stomata; long unicellular trichomes with or without cystolith; and cloudy multicellular glandular trichomes.

Transverse section of the petiole of the cauline leaf shows epidermis, cortex and vascular tissue. Epidermis: a layer of small polygonal cells, covered with cuticle layer; raised stomata; unicellular trichomes; clear multicellular glandular trichome. Cortex: angular and lacunar collenchyma; thin-walled parenchyma, some containing rosette aggregate crystals or starch grains. Vascular tissue: U-shaped collateral vascular bundles, phloem and xylem.

In surface view, the petiole of the cauline leaf shows rectangular epidermal cells, cicatrices; unicellular trichomes with or without cystolith; multicellular glandular trichomes.

Cannabis Sativa Leaf in powder possesses the diagnostic microscopical characters of the unground drug. Epidermis with cuticular striation, multicellular glandular trichomes, cystolith trichomes, cloud and clear glandular trichomes, and short cystolith trichomes are characteristic and frequently observed.

Additional information

1. It is commonly used with other herbal drugs in Thai traditional herbal preparations.
2. Under the Notifications of the Ministry of Public Health B.E. 2564 (2021), cannabis sativa leaf, without female inflorescences or flowering tops, can be used in preparing cosmetics or specially controlled foods.
3. It is to be noted that the TLC patterns may vary due to variation in the CBD and THC contents in different cultivars of the cannabis samples.

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

Identification

A. Macerate 100 mg of the sample, in *fine powder*, with 10 mL of *petroleum ether* (boiling range, 60° to 80°) for 10 minutes and filter. Evaporate 1 mL of the filtrate to dryness. Dissolve the residue in 1 mL of *methanol*. Add 1 drop of *Fast Blue B salt TS* and 1 drop of a 10 per cent w/v solution of *sodium hydrogen carbonate*: an orange-red colour is produced.

B. The chromatogram of the Sample preparation shows several peaks, one of which corresponds to the tetrahydrocannabinol peak of the Standard preparations, as obtained in the *Tetrahydrocannabinol content* (Fig. 3).

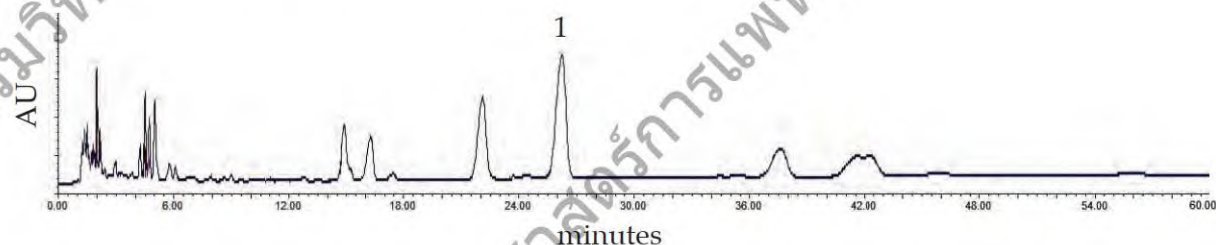


Fig. 3 HPLC Chromatogram of *Cannabis Sativa* Leaf Showing Tetrahydrocannabinol (1)

C. Carry out the test as described in the “Thin-Layer Chromatography” (Appendix 3.1), using a high-performance plate with *silica gel F254* as the coating substance and a mixture of 80 volumes of *petroleum ether* (boiling range, 60° to 80°) and 20 volumes of *ether* as the

mobile phase and allowing the solvent front to ascend 8 cm above the line of application. Apply separately to the plate, as bands of 7 mm, 10 μ L of solution (A) and 5 μ L each of solutions (B) and (C). For solution (A), macerate 100 mg of the sample, in *fine powder*, with 5 mL of *methanol*, shake for 10 minutes and filter. Solution (B) contains 1 mg per mL of Tetrahydrocannabinol RS in *ethanol* (Lipomed® or equivalent is suitable.). For solution (C), dissolve 1 mg of Cannabidiol RS in 1 mL of *methanol*. After removal of the plate, allow it to dry in air and spray the plate with *Fast Blue B salt TS*. The chromatogram obtained from solution (A) shows a pale red band and a pale orange band due to tetrahydrocannabinol and cannabidiol (R_f values 58 to 60 and 64 to 66), respectively. Two orange and four brown bands are also observed (Fig. 4).

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 4.0 per cent w/w (Appendix 7.6).

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

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

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

Tetrahydrocannabinol content Not less than 0.2 per cent w/w of tetrahydrocannabinol ($C_{21}H_{30}O_2$). Carry out the determination as described in the "Liquid Chromatography" (Appendix 3.5).

Mobile phase A Use *acetonitrile*.

Mobile phase B Prepare a 0.1 per cent v/v solution of *trifluoroacetic acid*.

Standard stock preparation Use a solution containing 1 mg per mL of Tetrahydrocannabinol RS in *ethanol* (Lipomed® or equivalent is suitable.).

Standard preparations Transfer 1.0 mL of *Standard stock preparation* to a 50-mL volumetric flask, dilute with *acetonitrile* to volume and mix. Dilute the solution quantitatively and stepwise with the same solvent to obtain five solutions having known concentrations of 2, 4, 6, 8, and 10 μ g per mL.

Sample preparation Sonicate about 400 mg of Cannabis Sativa Leaf, in *fine powder* and accurately weighed, in 20.0 mL of *acetonitrile* for 20 minutes and filter. Transfer 1.0 mL of the filtrate to a 20-mL volumetric flask, dilute to volume with *acetonitrile* and mix. Filter through a nylon membrane having a 0.45- μ m porosity.

(**Note** In case the concentration of tetrahydrocannabinol in the Sample preparation is not in the concentration range of standard curve, allow to adjust the volume of the filtrate taken.)

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	55	45
1	55	45
9	100	0
11	100	0
13	55	45

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 (5 mm × 3.9 mm) and maintained at a temperature of $35^{\circ} \pm 1^{\circ}$, (b) *Mobile phase* at a flow rate of about 1.8 mL per minute, and (c) an ultraviolet photometer set at 228 nm.

To determine the suitability of the chromatographic system, chromatograph *Standard preparation* having a known concentration of 6 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.

Procedure and Calculation Separately inject about 25 µL each of *Standard preparations* into the chromatograph, record the chromatograms and measure the responses for tetrahydrocannabinol 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 25 µL of *Sample preparation* into the chromatograph, record the chromatogram and measure the response for tetrahydrocannabinol peak. By reference to the standard curve, calculate the content of tetrahydrocannabinol ($C_{21}H_{30}O_2$) in the portion of the Cannabis Sativa Leaf taken.

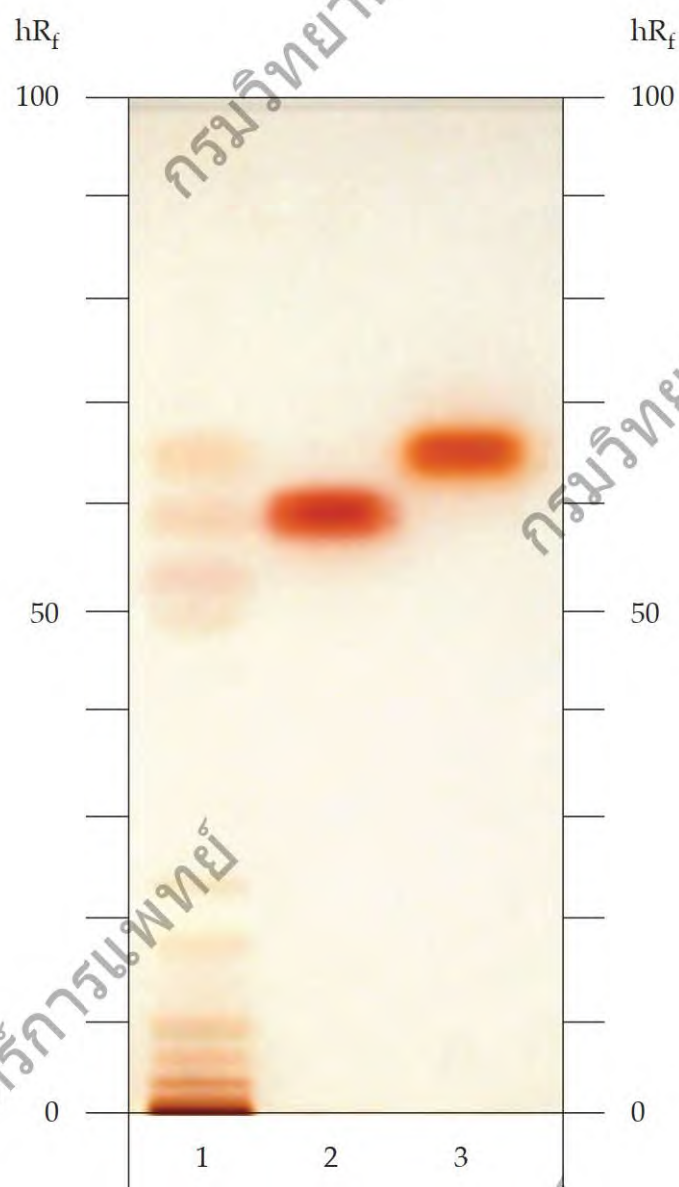


Fig. 4 Thin-Layer Chromatogram of Methanolic Extract of the Leaves of *Cannabis sativa* L., Detected With Fast Blue B salt TS

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

กานพลู (KANPHLU)

กรานพลู (KRANPHUN), จันจี (CHAN CHI)

Syzygii Aromatici Flos

Clove

Category Antiseptic, carminative, dental analgesic.

Clove is the dried mature flowering bud of *Syzygium aromaticum* (L.) Merr. & L. M. Perry [*Caryophyllus aromaticus* L., *C. hortensis* Noronha, *C. silvestris* Teijsm. ex Hassk., *Eugenia caryophyllata* Thunb., *E. caryophyllus* (Spreng.) Bullock & S. G. Harrison, *Jambosa caryophyllus* (Thunb.) Nied., *Myrtus caryophyllus* Spreng.] (Family Myrtaceae), Herbarium Specimen Number: DMSC 5201, Crude Drug Number: DMSc 1195.

Constituents Clove contains a volatile oil, of which eugenol is its major component. It also contains tannins, flavonoids, triterpenes, sterols, etc.

Description of the plant (Fig. 1) Evergreen tree 9 to 20 m tall; stem erect, twig terete; bark smooth, whitish grey or pale brown. Leaves simple, opposite, lanceolate, narrowly elliptic or narrowly obovate, 6 to 14 cm long, 2.5 to 6 cm wide, apex acute or acuminate, base narrowly cuneate, margin entire, coriaceous, shiny, oil glands abundant, midrib impressed on upper surface, secondary veins 15 to 20 pairs, intramarginal vein 1; petiole slender, 1 to 2.5 cm long. Inflorescence terminal corymbose, trichotomous, up to 5 cm long; peduncle up to 1 cm long or absent; bract and bracteole triangular, 2 to 3 mm long. Flower pale yellow, greenish yellow or greenish white; pedicel 3 to 7 mm long; hypanthial cup cylindric, 1 to 1.5 cm long, angled, slightly narrow at base; sepals 4, free, narrowly ovate, 3.5 to 4.2 mm long, apex acute, margin entire and hyaline, red at anthesis; petals 4, free, oblong or orbicular, 7 to 8.4 mm long, margin hyaline with numerous gland dots, caducous; stamens numerous, caducous, filament about 7 mm long, anther ovoid or oblong-ovoid, about 0.5 mm long; ovary inferior, 2-loculed, ovules many per locule, style stout, about 4 mm long. Fruit a berry, obovoid or oblong-ovoid, 2 to 2.5 cm long, 3 to 6 mm in diameter, reddish to dark brown. Seeds 1 or more.

Description Odour, strongly aromatic, characteristic; taste, pungent, spicy and numb.

Macroscopical (Fig. 1) Pestle-shaped, 1.5 to 2 cm long; crown 3 to 5 mm in diameter, petals 4, imbricated, dark brown to brownish yellow, enclosing stamens and style, numerous yellow and granular anthers visible after rubbing into pieces. Calyx attached to hypanthium, apex slightly curved. Hypanthium cylinder, 0.7 to 1.4 cm long, 3 to 6 mm in diameter, reddish brown or dark brown, sepals 4, triangular, occurring at the upper part, separating in cruciform. Texture hard, oily.

Microscopical (Figs. 2a, 2b, 2c, 2d, 2e, 2f, 2g) Transverse section of the petal shows upper epidermis, mesophyll, vascular tissue, and lower epidermis. Upper epidermis: a layer of thick-walled rectangular cells, a few slightly raised stomata and covered with thick cuticle layer. Mesophyll: thick- and wavy-walled parenchyma, some containing oil droplets, starch grains and rosette aggregate crystals; 1 to 2 rows of ovoid schizogenous oil glands near epidermal layer and angular collenchyma. Vascular tissue: bicollateral bundles and pericyclic fibres. Lower epidermis: a layer of thick-walled rectangular cells, and covered with thick cuticle layer.



1



2

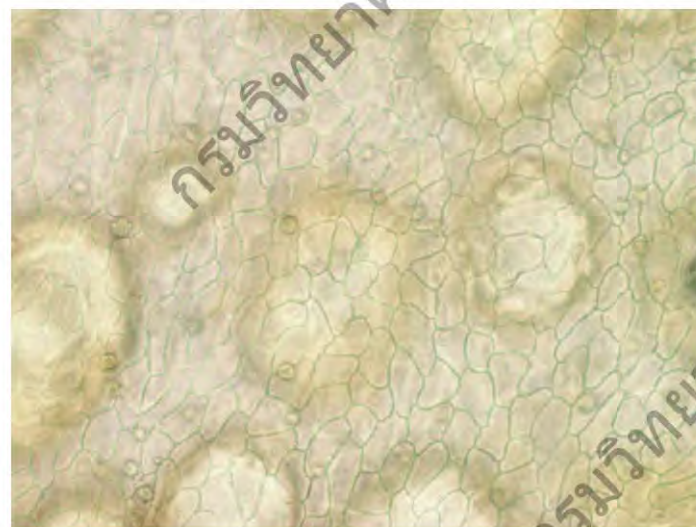


3



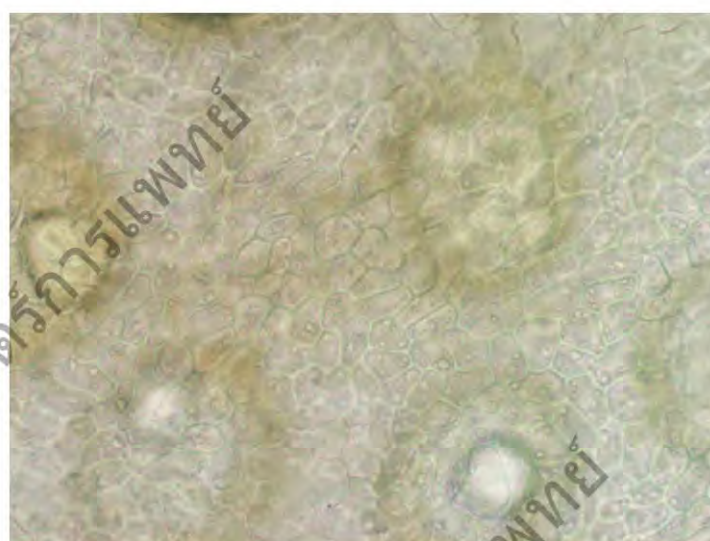
4

Fig. 1 *Syzygium aromaticum* (L.) Merr. & L. M. Perry
1. habit 2. various stages of flowers 3. fruits 4. crude drug



100 μm

Upper Epidermis of the Petal



100 μm

Lower Epidermis of the Petal

Fig. 2a Photomicrographs of Epidermises of the Petal of *Syzygium aromaticum* (L.) Merr. & L. M. Perry

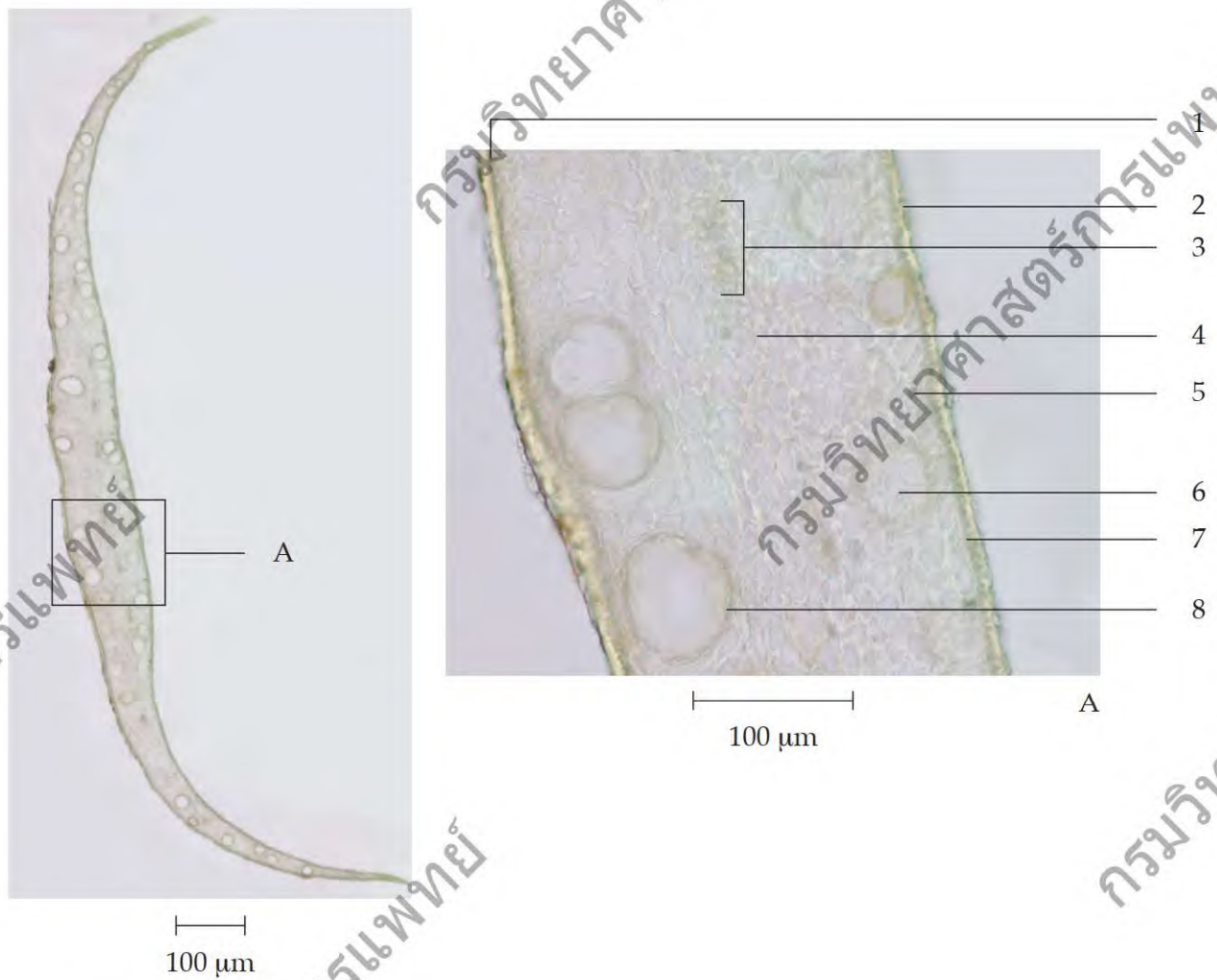
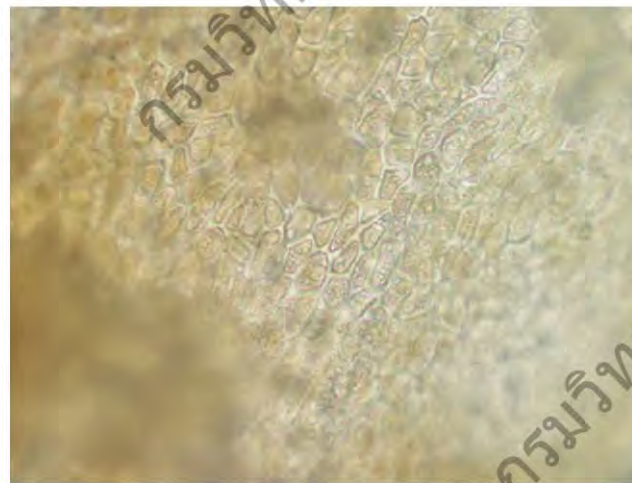


Diagram of the Petal

Fig. 2b Photomicrographs of Transverse Section of the Petal of *Syzygium aromaticum* (L.)
Merr. & L. M. Perry

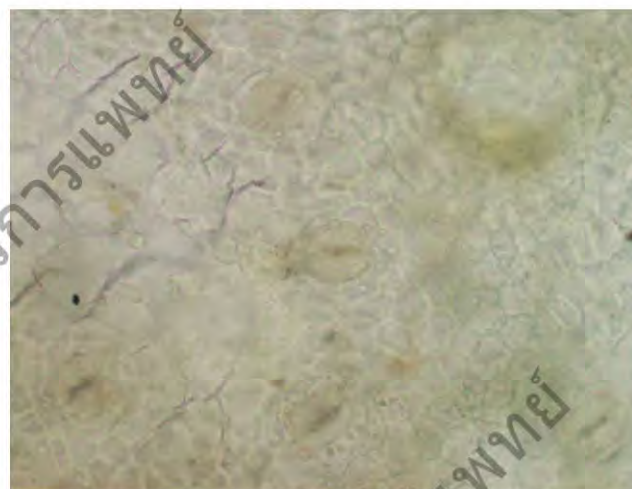
A. Part of Transverse Section

- | | |
|--------------------|------------------------------|
| 1. lower epidermis | 5. rosette aggregate crystal |
| 2. cuticle layer | 6. oil droplet |
| 3. vascular bundle | 7. upper epidermis |
| 4. parenchyma | 8. schizogenous oil gland |



100 μm

Upper Epidermis of the Sepal



100 μm

Lower Epidermis of the Sepal

Fig. 2c Photomicrographs of Epidermises of the Sepal of *Syzygium aromaticum* (L.) Merr. & L. M. Perry

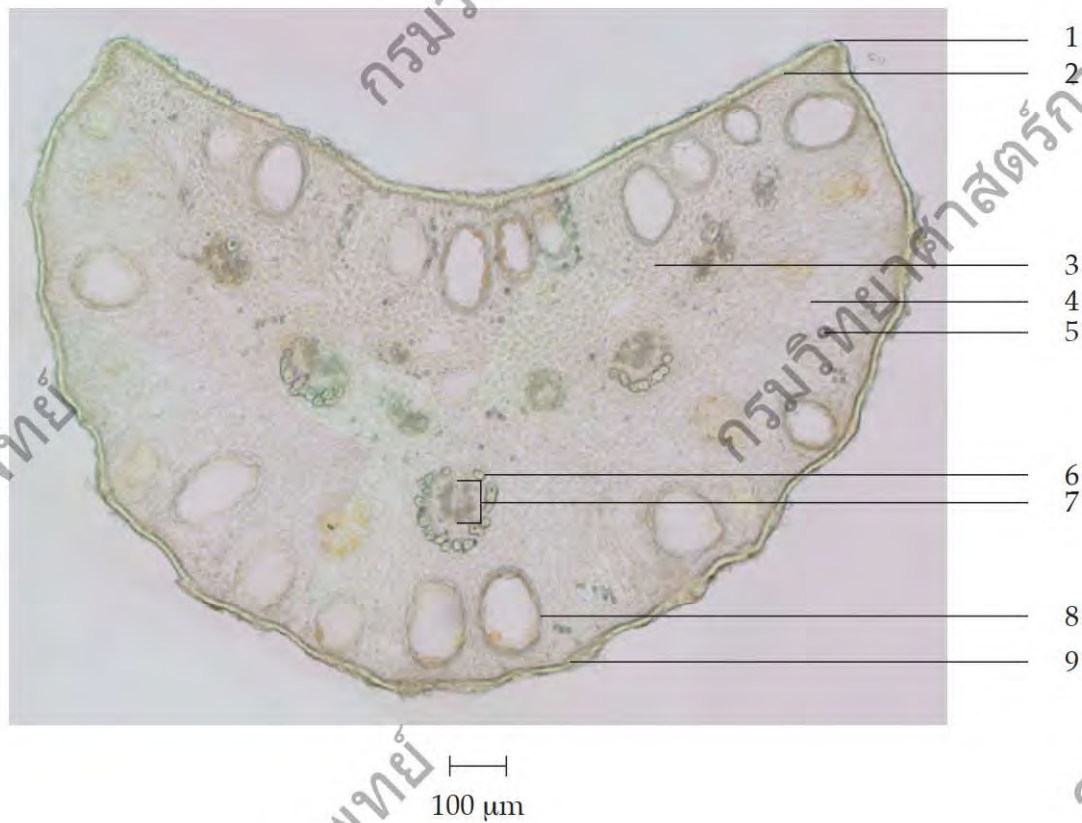


Fig. 2d Photomicrograph of Transverse Section of the Sepal of *Syzygium aromaticum* (L.)

Merr. & L. M. Perry

- | | |
|------------------------------|---------------------------|
| 1. cuticle layer | 6. fibre |
| 2. upper epidermis | 7. vascular bundle |
| 3. collenchyma | 8. schizogenous oil gland |
| 4. parenchyma | 9. lower epidermis |
| 5. rosette aggregate crystal | |

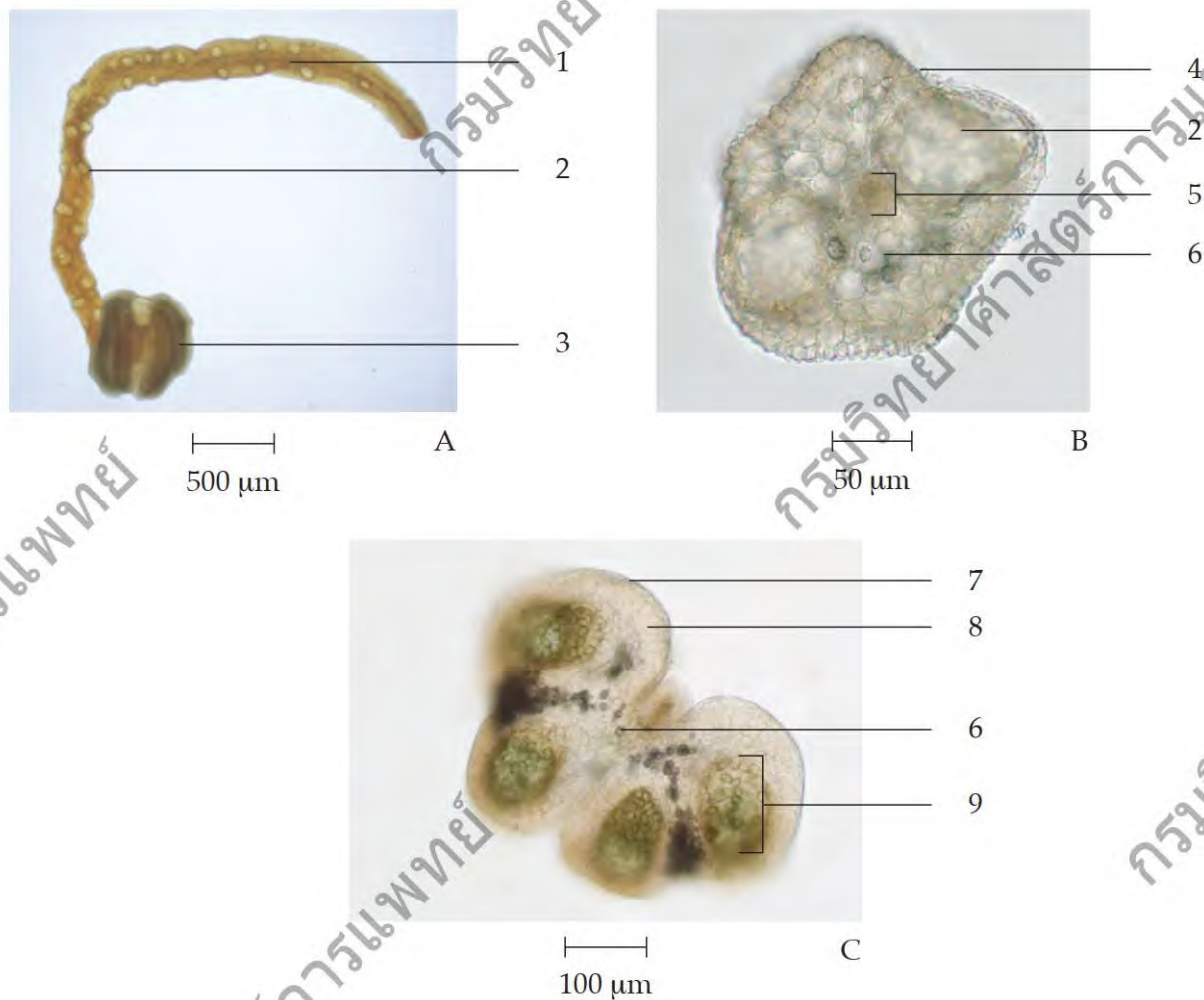


Fig. 2e Photomicrographs of the Stamen of *Syzygium aromaticum* (L.) Merr. & L. M. Perry

- A. Diagram of the Stamen
 B. Filament in Sectional View
 C. Anther in Sectional View

- | | |
|---------------------------|--|
| 1. filament | 6. parenchyma containing rosette aggregate crystal |
| 2. schizogenous oil gland | 7. epidermis |
| 3. anther | 8. endothecium |
| 4. papilla | 9. pollen sac containing pollen grains |
| 5. vascular tissue | |

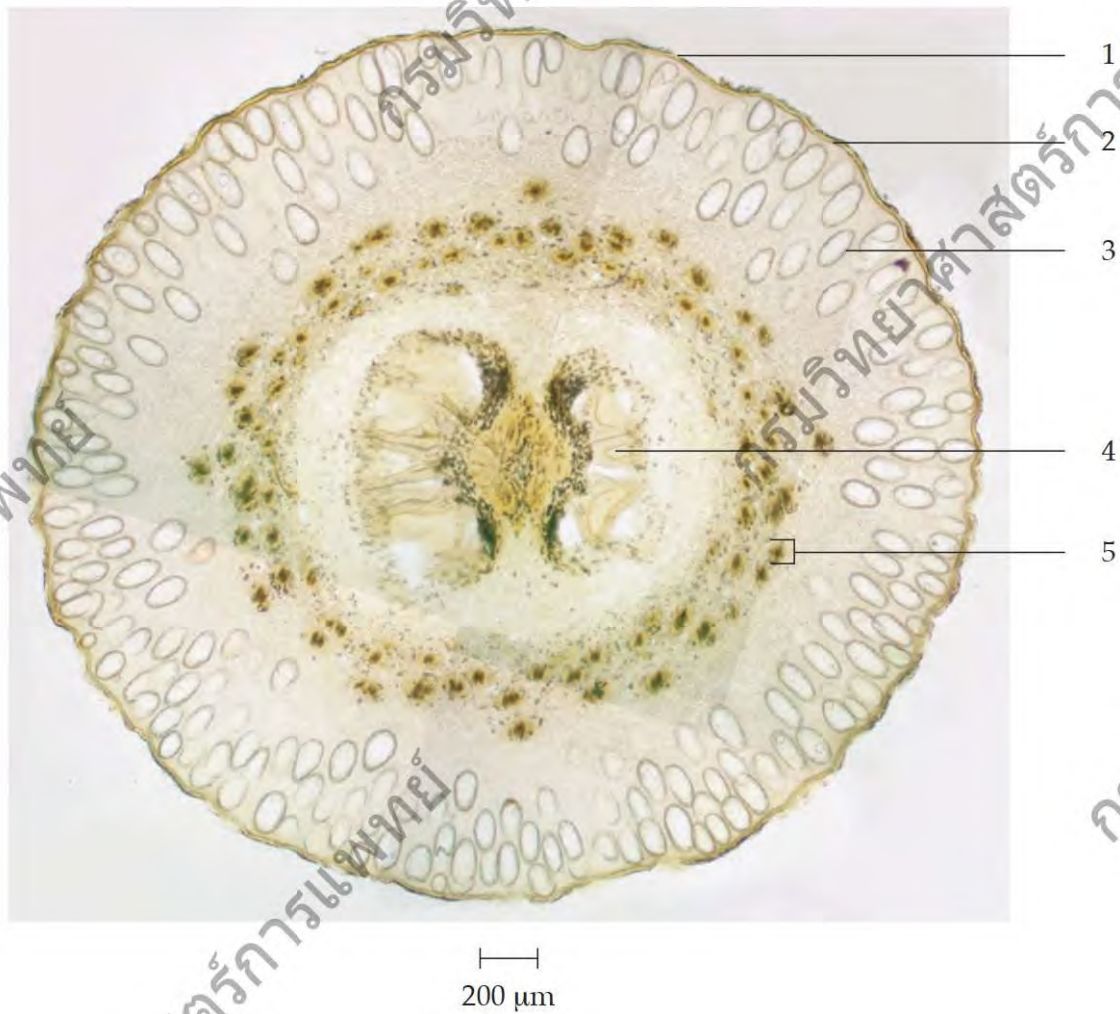


Fig. 2f Photomicrograph of Transverse Section of the Hypanthium of *Syzygium aromaticum* (L.) Merr. & L. M. Perry

- | | |
|---------------------------|--------------------|
| 1. cuticle layer | 4. ovule |
| 2. epidermis | 5. vascular bundle |
| 3. schizogenous oil gland | |

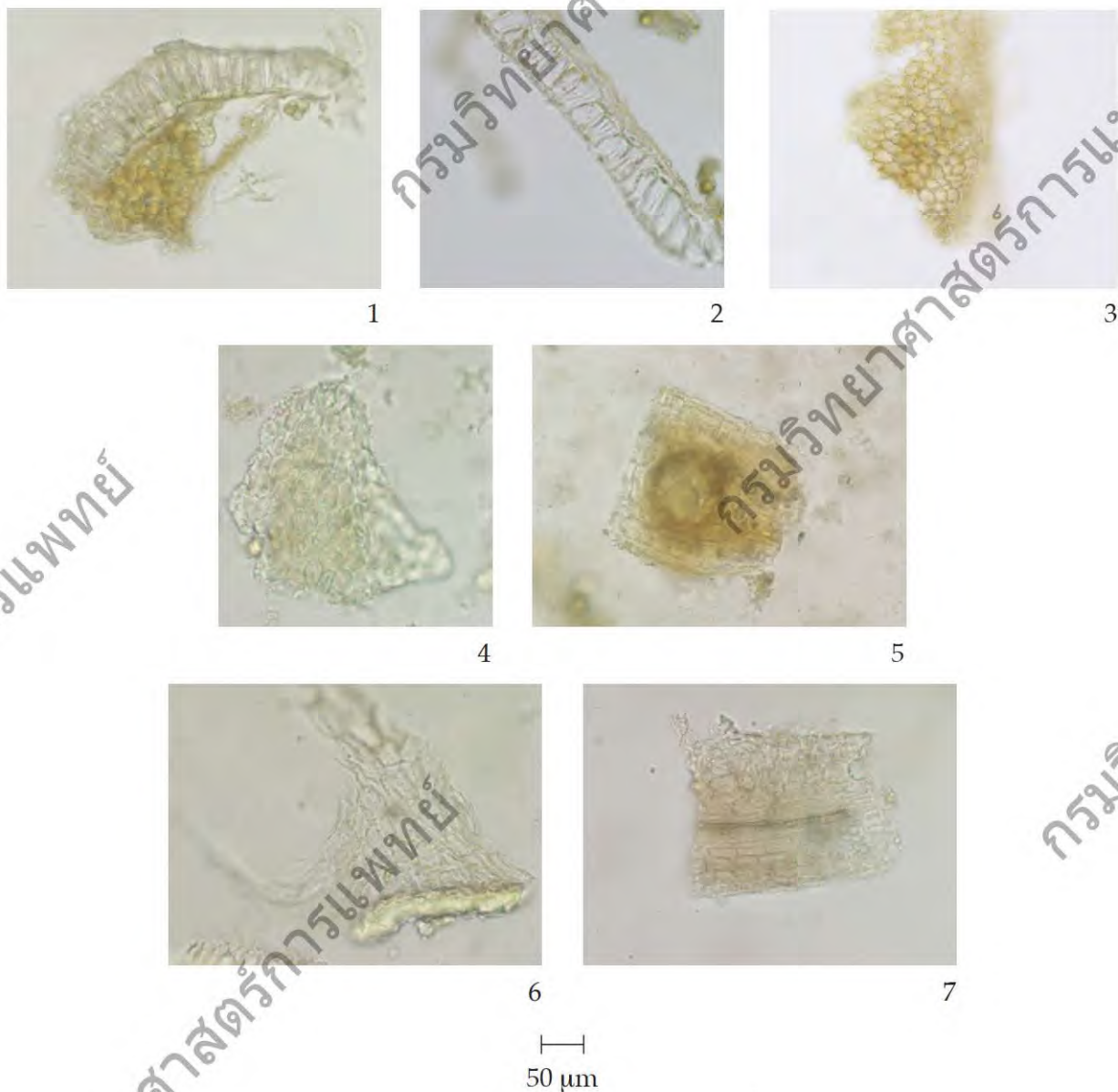
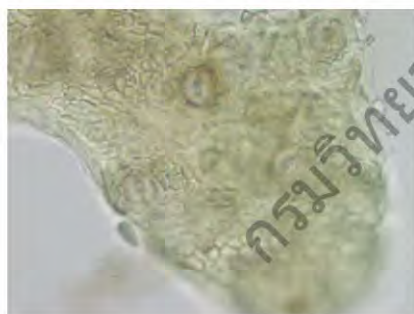


Fig. 2g Photomicrographs of Powdered Drug of Flowering Buds of *Syzygium aromaticum* (L.) Merr. & L. M. Perry

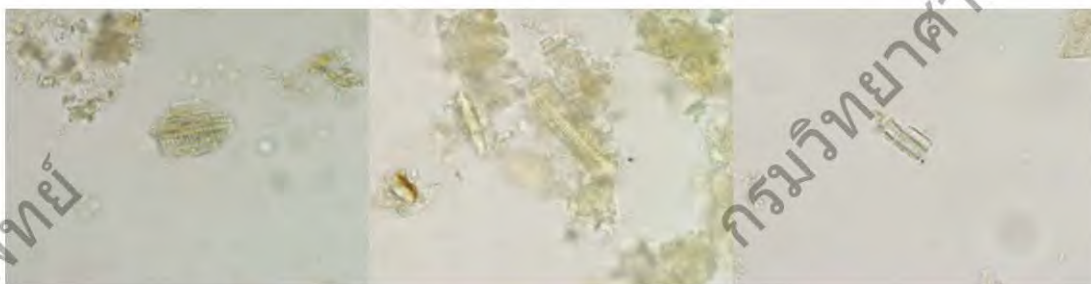
1. part of pollen sac, in sectional view showing endothecium and pollen grains
2. endothecium in sectional view
3. endothecium in surface view
4. upper epidermis of petal
5. epidermis, parenchyma, some containing rosette aggregate crystals, and schizogenous oil gland
6. fragment of hypanthium, in sectional view showing epidermis covered with thick cuticle layer, parenchyma cells and oil gland
7. fragment of filament showing epidermis, parenchyma, oil gland, vascular bundle, and rosette aggregate crystal



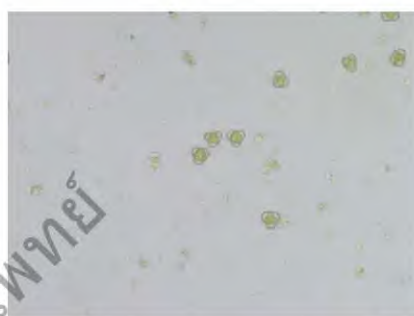
8



9



10



11

50 μ m**Fig. 2g** (continued)

8. epidermis of hypanthium, in surface view showing stomata

10. spiral and reticulate vessels

9. thick-walled fibre containing brown substance and parenchyma cells, in longitudinal view

11. pollen grains

In surface view, the petal shows both upper and lower polygonal epidermal cells, with underlying oil droplets, rosette aggregate crystals and schizogenous oil glands.

Transverse section of the sepal shows upper epidermis, mesophyll, vascular tissue, and lower epidermis. Upper epidermis: a layer of thick-walled rectangular cells, covered with thick cuticle layer. Mesophyll: thick-walled parenchyma, some containing oil droplets, starch grains and rosette aggregate crystals; 1 to 2 rows of large schizogenous oil glands. Vascular tissue: bicollateral bundles and semi-pericyclic fibres. Lower epidermis: a layer of thick-walled rectangular cells, slightly raised stomata and covered with thick cuticle layer.

In surface view, the sepal shows both upper and lower rectangular epidermal cells, with numerous oil droplets, prismatic crystals, slightly raised stomata, and underlying schizogenous oil glands.

Transverse section of the filament shows epidermis with papillae and thin cuticle layer, large schizogenous oil glands, slightly thick-walled round parenchyma cells, some containing rosette aggregate crystals and a strand of vascular tissue in the centre. However, transverse section of the anther shows 4-lobed pollen sac with pollen grains, a layer of small rectangular epidermis covered with thin cuticle layer, a layer of endothecium cells, thin-walled parenchyma and a strand vascular tissue in the centre.

Transverse section of the hypanthium through the ovary shows epidermis, mesophyll, vascular tissue, and ovary. Epidermis: a layer of rectangular cells and slightly raised stomata, covered with thick cuticle layer. Mesophyll: numerous schizogenous oil glands; slightly thick-walled parenchyma, some containing rosette aggregate crystals, loosen small parenchyma near the centre; angular collenchyma. Vascular tissue: bicollateral vascular bundles. Ovary: 2-loculed, and axile placentation.

Clove in powder possesses the microscopic diagnostic of the unground drug. Fragment of hypanthium covered with thick cuticle and numerous oil glands, fragment of filament with oil glands, and endothecium are characteristic. Parenchyma cells containing rosette aggregate crystals are frequently found.

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

Identification

A. Reflux 1 g of the sample, in No. 250 powder, with 10 mL of *methanol* for 10 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 dark blue colour develops.

B. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 100 volumes of *hexane* and 10 volumes of *acetone* as the mobile phase. Apply separately to the plate, 15 µL of solution (A) and 3 µL of solution (B). For solution (A), macerate 1 g of the sample, in No. 250 powder, with 10 mL of *dichloromethane* for 30 minutes and filter. For solution (B), dilute 200 µL of *eugenol* with *methanol* to 2 mL and mix. After removal of the plate, allow it to dry in air. Examine the plate under ultraviolet light (254 nm), marking the quenching spots. The chromatogram obtained from solution (A) shows a quenching spot (R_f value 38 to 48), corresponding to the *eugenol* spot obtained from solution (B). Subsequently spray the plate with *anisaldehyde TS* and heat at 105° for 5 minutes; the spot corresponding to *eugenol* is purple. One pink, two purple and three violet spots are also observed (Fig. 3).

Water Not more than 8.0 per cent v/w (Azeotropic Distillation Method, Appendix 4.12).

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

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

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

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

Volatile oil Not less than 20.0 per cent v/w, calculated on the anhydrous basis (Appendix 7.3H). Use 5 g, in *No. 250 powder*, freshly prepared and accurately weighed. Use 100 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube.

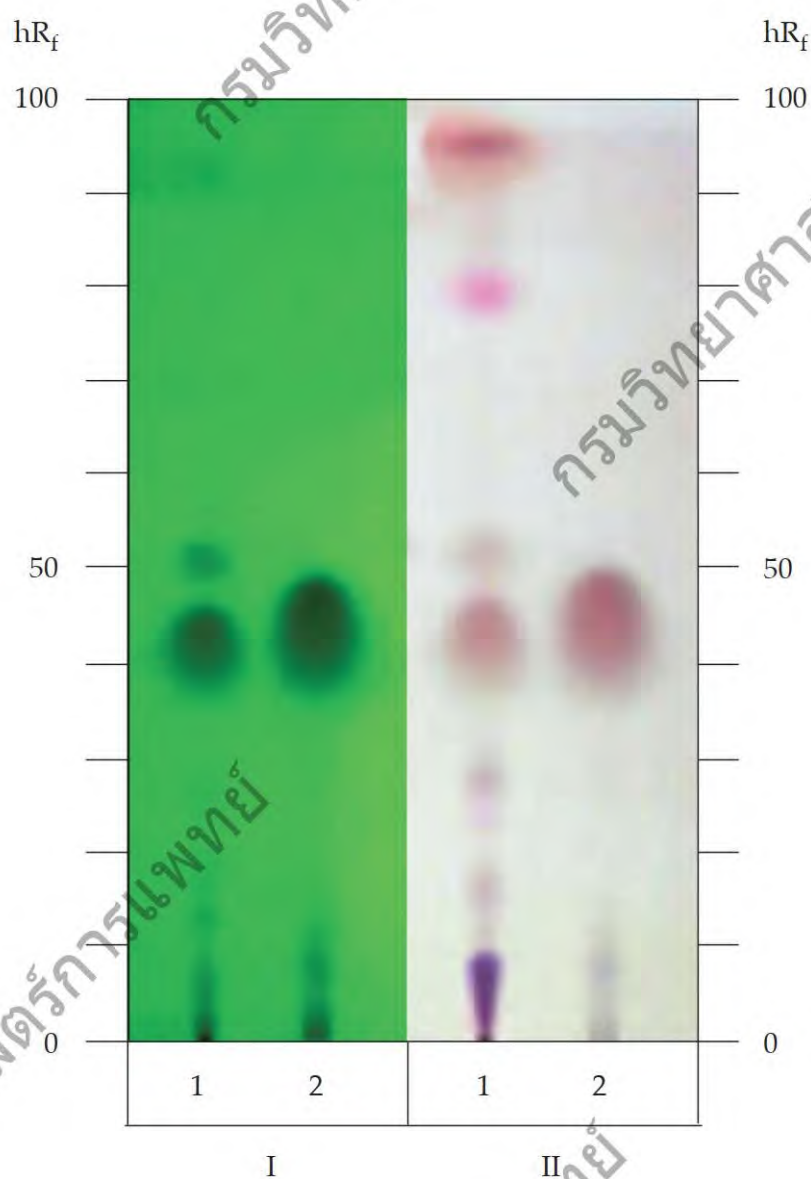


Fig. 3 Thin-Layer Chromatogram of Dichloromethane Extract of the Flowering Buds of *Syzygium aromaticum* (L.) Merr. & L. M. Perry

1 = solution (A)

2 = solution (B)

I = detection under UV light (254 nm)

II = detection with anisaldehyde TS

กระชาย (KRACHAI)

กระชาย (KACHAI), ขิงชาย (KHING SAI), ขิงแคง (KHING KHAENG), ละแ่น (LA AEN),
หัวชาย (HUA CHAI)

Boesenbergia rotunda Radix et Rhizoma
Fingerroot

Category Carminative, antifatulent, tonic.

Fingerroot is the dried root and rhizome of *Boesenbergia rotunda* (L.) Mansf. [*B. cochinchinensis* (Gagnep.) Loes., *B. pandurata* (Roxb.) Schltr., *Curcuma rotunda* L., *Gastrochilus panduratus* (Roxb.) Ridl., *G. rotundus* (L.) Alston, *Kaempferia cochinchinensis* Gagnep., *K. ovata* Roscoe, *K. pandurata* Roxb.] (Family Zingiberaceae), Herbarium Specimen Number: DMSC 5205, Crude Drug Number: DMSc 7493.

Constituents Fingerroot contains chalcones (e.g., boesenbergin A, panduratin A) and other flavonoids (e.g., pinocembrin, pinostrobin). It also contains polyphenols and a volatile oil, of which camphor, 1,8-cineole and geraniol are its major constituents, etc.

Description of the plant (Fig. 1) Perennial herb; pseudostem 30 to 80 cm tall; rhizome stout, dark-brown outside, yellow inside, ovoid to globose, bearing fascicle of storage roots; root stout, cylindrical to oblong-ovoid, up to 15 cm long, up to 2 cm in diameter, apex acute, pale brown outside, yellowish inside. Leaves simple, alternate, 2 to 7, ovate-oblong or elliptic-lanceolate, 12 to 50 cm long, 5 to 12 cm wide, apex acute or apiculate, base obtuse or attenuate, margin entire or slightly wavy, upper surface glabrous with slightly hairy on midrib, several grooved parallel veins, lower surface with raised midrib and veins, glabrous to arachnoid-pubescent; petiole 7 to 30 cm long, glabrous; leaf sheath pinkish to reddish, 7 to 25 cm long; ligule broadly triangular, about 5 mm long, apex emarginate. Inflorescence terminal on pseudostem, spike-like, 3 to 15 cm long, bearing about 10 flowers; almost completely hidden by upper leaf sheaths; peduncle 1 to 2 cm long; rachis short, crowded with distichous, equitant bracts, with 1 flower per bract; bract lanceolate, 4 to 5 cm long. Flower: calyx white or pinkish white, calyx tube 1.5 to 2 cm long, 2-lobed; corolla white, pinkish white to pink, corolla tube 4.5 to 5.5 cm long, 3-lobed, unequal; lateral staminodes 2, light pink, petaloid, obovate, about 1.5 cm long, erect; labellum white or pink with purple stripes, oblong-obovate or panduriform, 2.5 to 3.5 cm long, 1.5 to 2.5 cm in diameter, concave, apex crenate, margin slightly crisped; stamen 1, filament white, short, hairy, anther yellow-white with narrow crest, dehiscing longitudinally; ovary inferior, oblong, about 5.5 mm long, 3-loculed, each locule with numerous ovules, stylode slender, style filiform, stigma yellow-white, funnel-shaped, protruding beyond anther. Fruit a capsule, ellipsoid. Seeds numerous, black.

Description Odour, characteristic and aromatic; taste, spicy.

Macroscopical (Fig. 1) Transverse slices of roots and rhizomes. Transverse slices of roots, rod shape of various lengths and sizes, surface brownish to dark brown, irregularly longitudinally wrinkled. Transverse slices of rhizomes, light yellowish to light brown surface, 2 to 5 mm thick, 0.8 to 1.5 cm in diameter, margin of slices, brown to dark brown, wrinkled.

Microscopical (Figs. 2a, 2b, 2c) Transverse section of the rhizome shows epidermis, cortex, storeid cork, and vascular tissue. Epidermis: collapsed cells, containing yellowish brown substance in cell wall. Cortex: several layers of polygonal parenchyma cells, some



1



2



3



4



5

Fig. 1 *Boesenbergia rotunda* (L.) Mansf.

1. habit
2. plant showing leaves, rhizome and roots
3. inflorescence (a), flower in front view (b)
4. rhizomes with roots and root nodules
5. crude drug

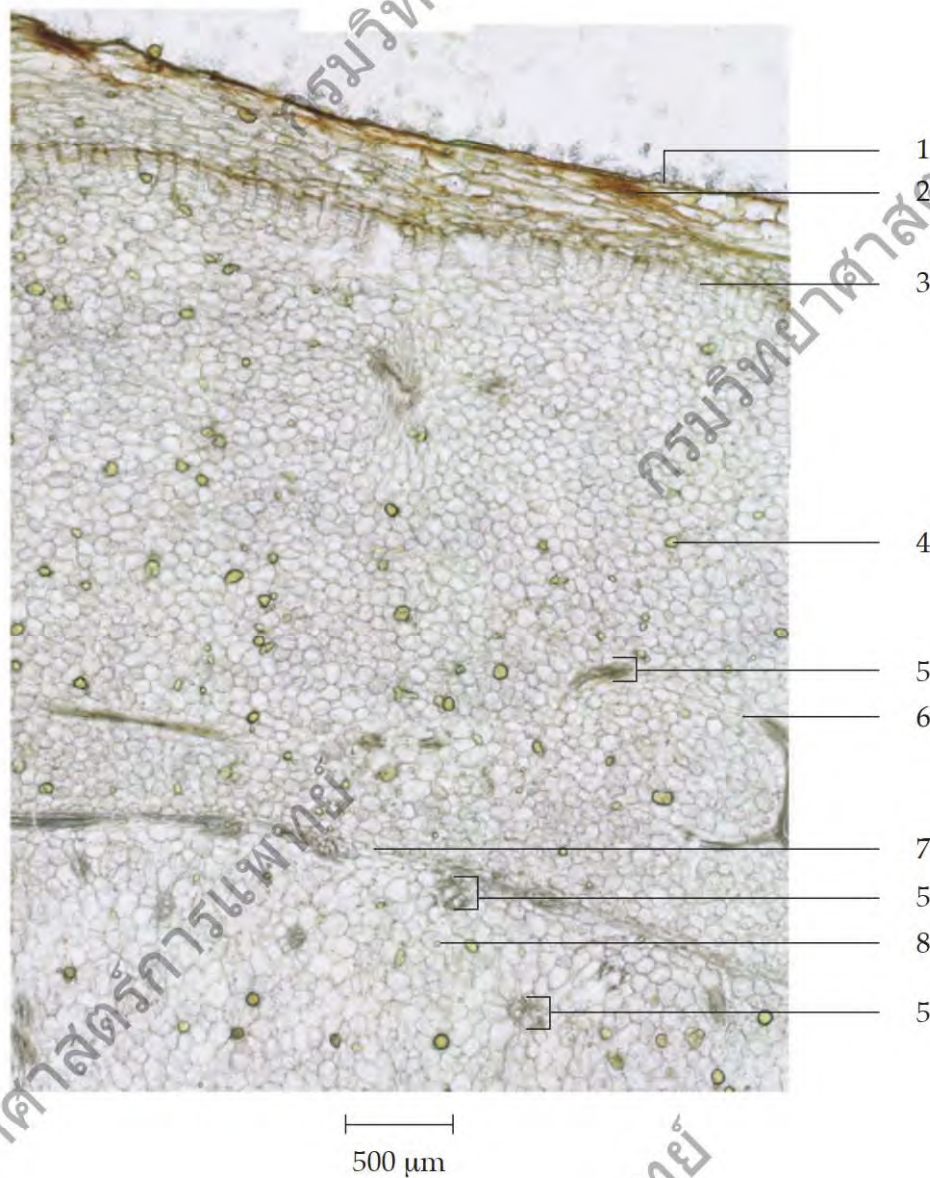


Fig. 2a Photomicrograph of Transverse Section of the Rhizome of *Boesenbergia rotunda* (L.) Mansf.

- | | |
|--|--|
| 1. epidermis | 5. vascular bundle |
| 2. parenchyma containing brown substance | 6. parenchyma containing starch grains |
| 3. storied cork | 7. pseudoendodermis |
| 4. yellow oleoresin | 8. oil droplet |

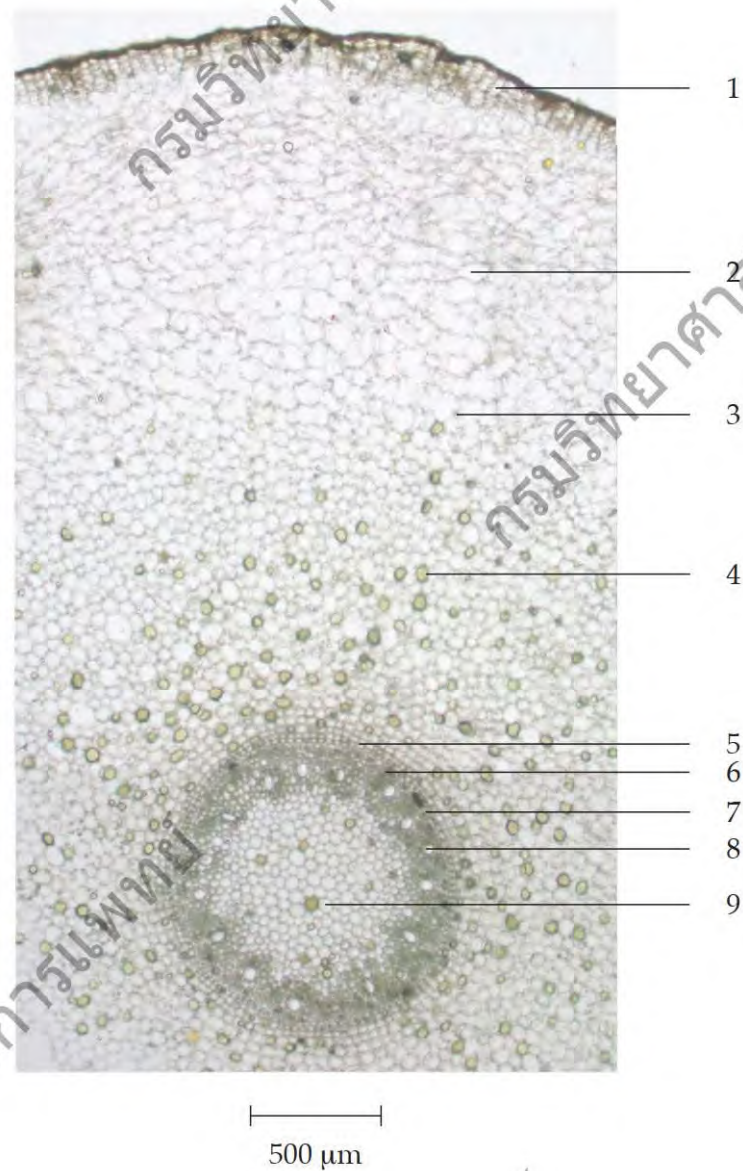


Fig. 2b Photomicrograph of Transverse Section of the Root of *Boesenbergia rotunda* (L.) Mansf.

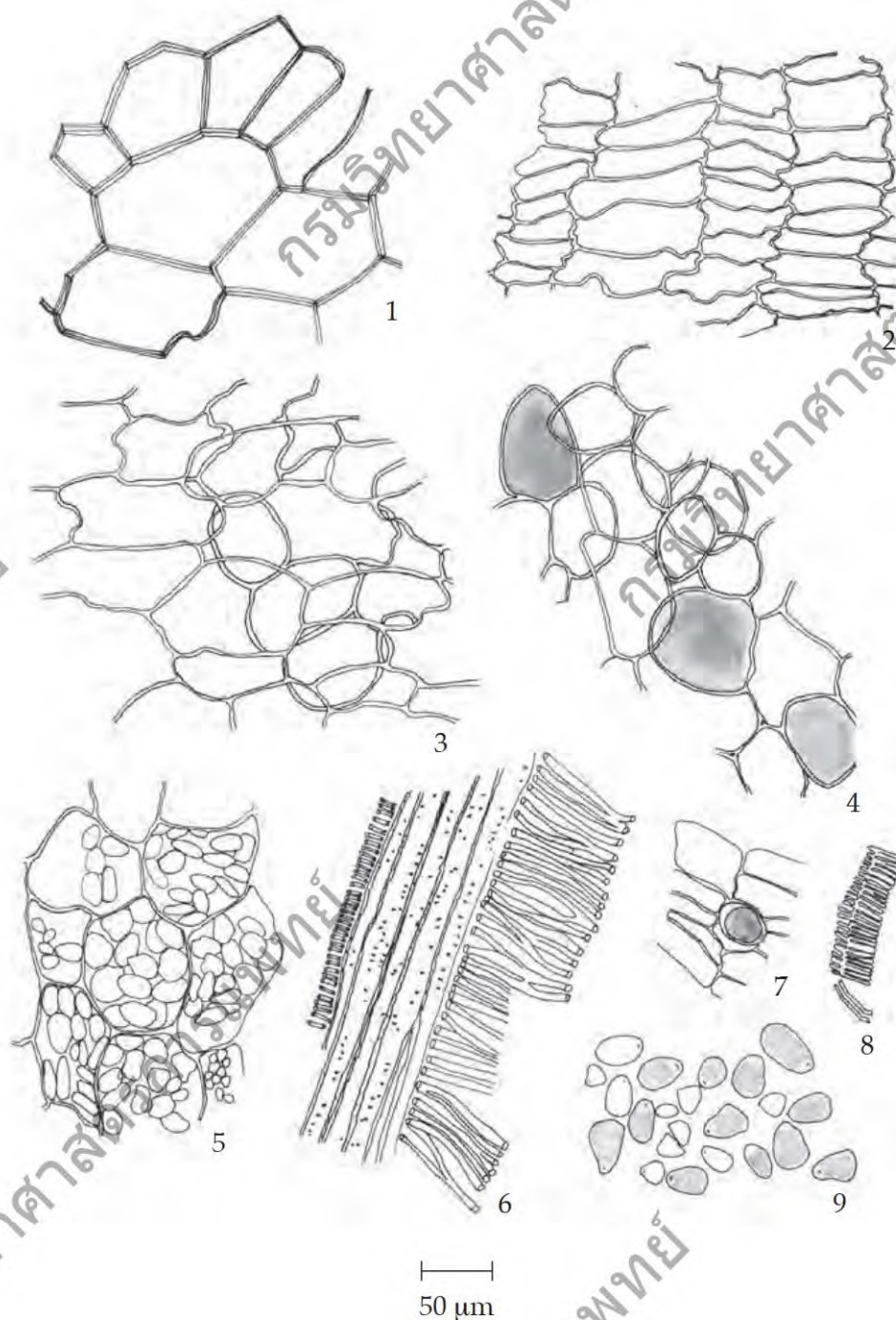


Fig. 2c Line Drawings of Powdered Drug of the Roots and Rhizomes of *Boesenbergia rotunda* (L.) Mansf.

- | | |
|--|---|
| 1. storied cork in surface view | 6. reticulate and spiral vessels associated with fibres |
| 2. storied cork in sectional view | 7. parenchyma, some containing oleoresin |
| 3. parenchyma | 8. scalariform vessel |
| 4. parenchyma, some containing brown substance | 9. starch grains |
| 5. parenchyma containing starch grains | |

containing starch grains, brown substance, oil droplets, and yellow oleoresins; storeid cork, several layers of slightly suberized thin-walled cells; pseudoendodermis, 1 to 3 layers of rectangular cells, some with casparian strip. Vascular tissue: scattered and collateral vascular bundles, containing phloem and xylem.

Transverse section of the root shows storeid cork, cortex, vascular tissue, and pith. Storeid cork, several layers of suberized thin-walled rectangular cells. Cortex: numerous polygonal parenchyma cells, containing minute starch grains, oil droplets, yellow oleoresins, and brown substance; endodermis, a layer of rectangular cells. Vascular tissue: a layer of pericycle cells; polyarch of vascular bundles, containing phloem and xylem. Pith: numerous polygonal parenchyma cells, containing oil droplets, yellow oleoresins, and starch grains.

Fingerroot in powder possesses the diagnostic microscopical characters of the unground drug. Large reticulate vessels, beaked starch grains, and parenchyma containing oleoresin are commonly observed.

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

Identification

A. Reflux 1 g of the sample, in *fine powder*, with 10 mL of *methanol* for 5 minutes and filter. To 2 mL of the filtrate, add a few drops of *hydrochloric acid*, 3 to 5 pieces of *magnesium ribbon* and stand for 5 to 10 minutes: an orange-red colour develops.

B. The chromatogram of the Sample preparation shows several peaks, one of which corresponds to the pinostrobin peak of the Standard preparations, as obtained in the *Pinostrobin content*.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel G* as the coating substance and a mixture of 70 volumes of *dichloromethane* and 1 volume of *methanol* as the mobile phase. Apply separately to the plate, 15 μL of solution (A) and 5 μL of solution (B). For solution (A), reflux 1 g of the sample, in *fine powder*, with 10 mL of *methanol* for 5 minutes and filter. For solution (B), dissolve 1 mg of *pinostrobin* in 1 mL of *methanol*. After removal of the plate, allow it to dry in air. Heat the plate at 80° for at least 10 minutes and then spray with *natural products (NP) TS* while the plate is still warm. Subsequently spray the plate with *polyethyleneglycol (PEG) TS* and observe the colours of the spots under ultraviolet light (366 nm). The chromatogram obtained from solution (A) shows an orange fluorescent spot (hR_f value 92 to 96), corresponding to the pinostrobin spot from solution (B). One greenish yellow and other fluorescent spots of different colours 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 2.0 per cent w/w (Appendix 7.6).

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

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

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

Volatile oil Not less than 1.5 per cent v/w, calculated on the anhydrous basis (Appendix 7.3H). Use 10 g, in *fine powder*, freshly prepared and accurately weighed. Use 100 mL of *water* as the distillation liquid and a 500-mL round-bottomed flask. Distil at a rate of 2 to 3 mL per minute for 5 hours. Use 2.0 mL of *xylene* in the graduated tube.

Pinostrobin content Not less than 2.0 per cent w/w of pinostrobin ($C_{16}H_{14}O_4$), calculated on the anhydrous basis. Carry out the determination as described in the "Liquid Chromatography" (Appendix 3.5).

Mobile phase A Prepare a mixture of equal volumes of *methanol* and *acetonitrile*.

Mobile phase B Use *water*.

Standard preparations Dissolve a suitable quantity of *pinostrobin*, accurately weighed, in sufficient *methanol* to obtain a stock solution having a known concentration. Dilute the solution quantitatively and stepwise with the same solvent to obtain five solutions having known concentrations ranging from 40 to 240 µg per mL.

Sample preparation Macerate about 100 mg of Fingerroot, in *fine powder* and accurately weighed, in 20.0 mL of *methanol* for 24 hours. Pass a portion of the supernatant through a 0.22-µm polyvinylidene fluoride filter.

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	60	40
1.2	60	40
1.5	85	15
2.0	85	15
2.2	60	40

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 290 nm.

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* and *Calculation*: the relative standard deviation for replicate injections is not more than 2.0 per cent.

Procedure and Calculation Separately inject about 2 µL each of *Standard preparations* into the chromatograph, record the chromatograms and measure the responses for pinostrobin 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 2 µL of *Sample preparation* into the chromatograph, record the chromatogram and measure the response for pinostrobin peak. By reference to the standard curve, calculate the content of pinostrobin ($C_{16}H_{14}O_4$) in the portion of the Fingerroot taken.

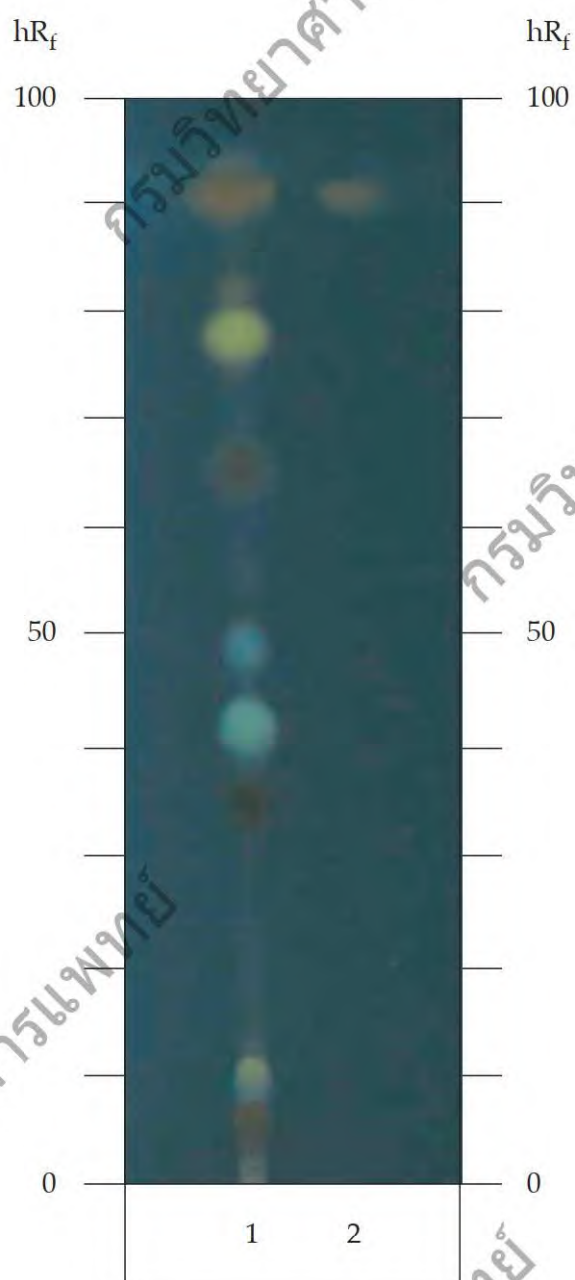


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Roots and Rhizomes of *Boesenbergia rotunda* (L.) Mansf. Detected Under UV Light (366 nm) After Spraying With NP/PEG TS

1 = solution (A)

2 = solution (B)

เหืองปลาหมอ ชนิดดอกขาว (NGUEAK PLA MO CHANIT DOK KHAO)

จะเกร็ง (CHA KRENG), หนามหมอ (NAM MO)

Acanthi Ebracteati Herba

Acanthus Ebracteatus Herb

Synonym Holly-leaved Mangrove

Category Anti-inflammatory (topical), antipruritic.

Acanthus Ebracteatus Herb is the dried whole plants of *Acanthus ebracteatus* Vahl (Family Acanthaceae), Herbarium Specimen Number: DMSC 5252, Crude Drug Number: DMSc 1202.

Constituents *Acanthus Ebracteatus Herb* contains phenolic glycosides (e.g., verbascoside), flavone glycosides, heteropolysaccharides, etc.

Description of the plant (Figs. 1a, 1b) Shrub-up to 2.5 m tall; stem terete, lenticellate, glabrous and glossy, succulent, purplish brown to brown, frequently with stipule-like spines at nodes; prop roots usually present; bark thin, thick at lower part. Leaves simple, opposite, oblong to obovate-oblong, 5 to 13 cm long, 3 to 5 cm wide, apex truncate to obtuse, slightly mucronate, base cuneate, margin 3- or 4-toothed or irregularly pinnatifid, subcoriaceous to coriaceous, upper surface green to dark green, glossy, lower surface pale green, glabrous, secondary veins 3 to 8 on each side of midvein, spreading to spinose teeth margin; petiole 1 to 4 cm long. Inflorescence terminal, up to 20 cm long; bract brown, broadly ovate, 6 to 7 mm long, 4 to 5 mm wide, sometimes caducous; bracteole caducous; calyx light green, 4-lobed, broadly ovate, 0.8 to 1.2 cm long, 5 to 9 mm wide, lateral lobes elliptic, about 1 cm long, about 4 mm wide; corolla white, rarely with purplish tint, 1.5 to 2 cm long, tube 5 to 8 mm long, about 4 mm wide, lip oblong, 1 to 1.5 cm long, 0.5 to 1 cm wide, apex emarginate, pubescent inside; stamens 4, subequal, epipetalous; filament cream or pale brown, about 8 mm long; anther theca oblong, 3 to 5 mm long, with a line of trichomes on both sides of suture; ovary superior, ovate, about 2 mm long, 2-loculed, each locule with 2 ovules, style white, about 1 cm long, bifid. Fruit a capsule, elliptic or oblong, 1 to 1.7 cm long, 0.5 to 1.2 cm wide, glabrous. Seeds whitish to pale brown, 2(-4), orbicular to elliptic, about 8 mm long, about 6 mm wide, flattened, rugulose.

Description Odour, characteristic; taste, slightly salty-astringent.

Macroscopical (Fig. 1a) Whole plant occurs as a mixture of broken, crisp, mainly greenish brown leaves with spinose teeth margin; terete and lenticellate stems with spines at node; elliptic to oblong capsules; some with roots and inflorescences. Unbroken leaves may also be included.

Microscopical (Figs. 2a, 2b, 2c, 2d, 2e, 2f) Transverse sections of the leaf through midrib and lamina show upper epidermis, hypodermis, mesophyll, vascular bundle, and lower epidermis. Upper epidermis: a layer of small rectangular cells covered with thick cuticle; salt glands with 6- to 8-celled head and unicellular stalk. Hypodermis: 1 to 2 layers of large and thin-walled cells. Mesophyll: palisade cells, 2 or 3 layers and cylindrical; spongy cells, irregular-shaped and loosely arranged; collenchyma, angular and several layers; parenchyma, thin-walled and round; both collenchyma and parenchyma found in the upper and lower parts of midrib. Vascular bundle: xylem in the upper part; and phloem in the lower part. Lower epidermis: a layer of small rectangular cells covered with thick cuticle; salt glands with 6- to 8-celled head and unicellular stalk; non-glandular trichome, multicellular uniseriate, rarely.



1



2



3



4



1 cm

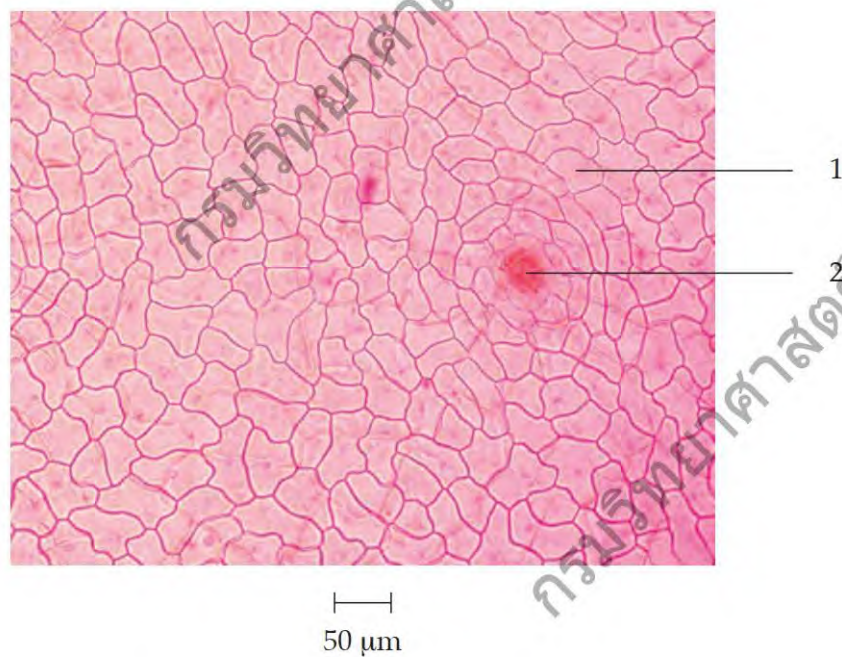
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Fig. 1a *Acanthus ebracteatus* Vahl

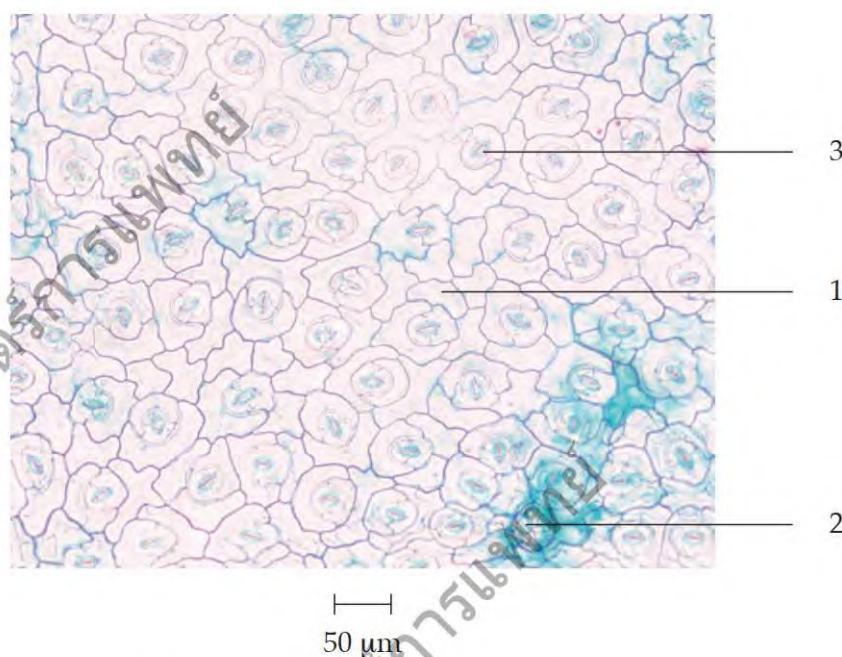
1. habit 2. inflorescence 3. flowers 4. seed 5. crude drug



Fig. 1b *Acanthus ebracteatus* Vahl
 1. flowering twig 2. leaves 3. flowers 4. fruits



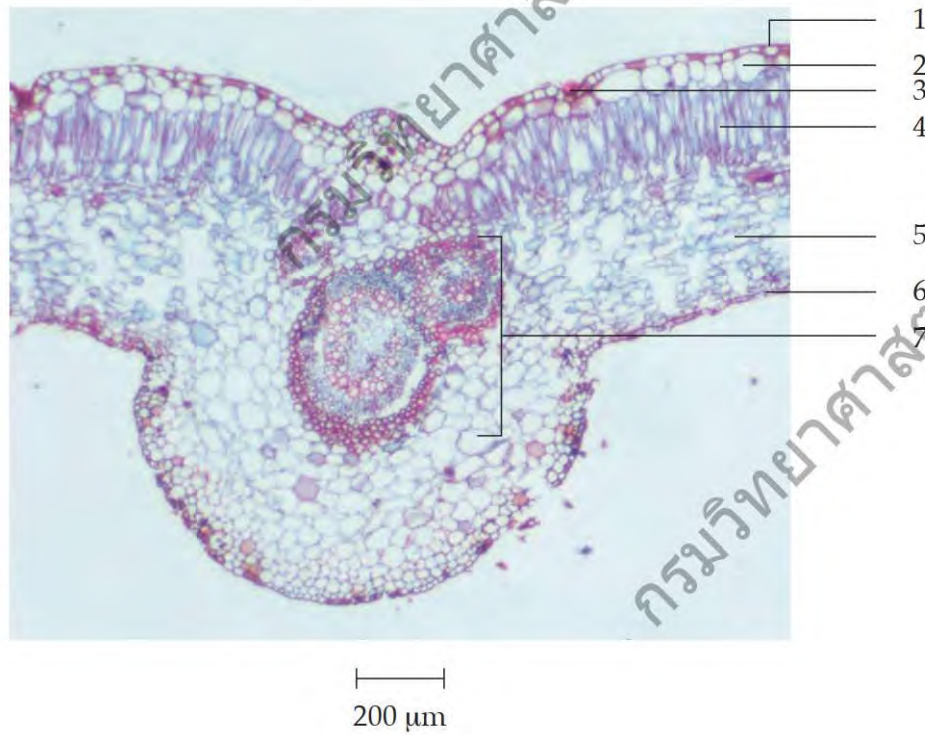
Upper Epidermis of the Lamina



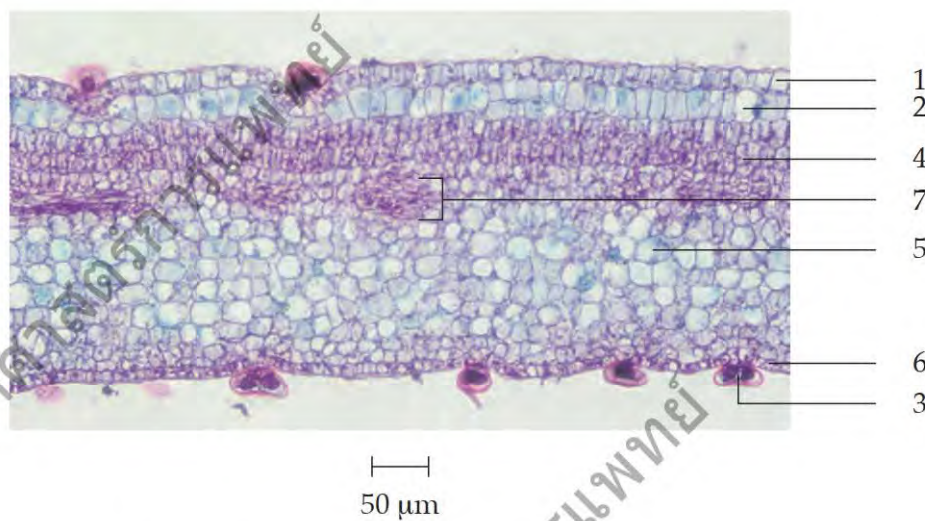
Lower Epidermis of the Lamina

Fig. 2a Photomicrographs of Epidermises of the Leaf of *Acanthus ebracteatus* Vahl, Stained With Safranin-Fast Green

- | | |
|-------------------|-------------------|
| 1. epidermal cell | 3. diacytic stoma |
| 2. salt gland | |



Transverse Section of the Midrib



Transverse Section of the Young Lamina

Fig. 2b Photomicrographs of Transverse Sections of the Leaf of *Acanthus ebracteatus* Vahl, Stained With Safranin-Fast Green

- | | |
|--------------------|---------------------|
| 1. upper epidermis | 5. spongy cell |
| 2. hypodermis | 6. lower epidermis |
| 3. salt gland | 7. vascular bundles |
| 4. palisade cell | |

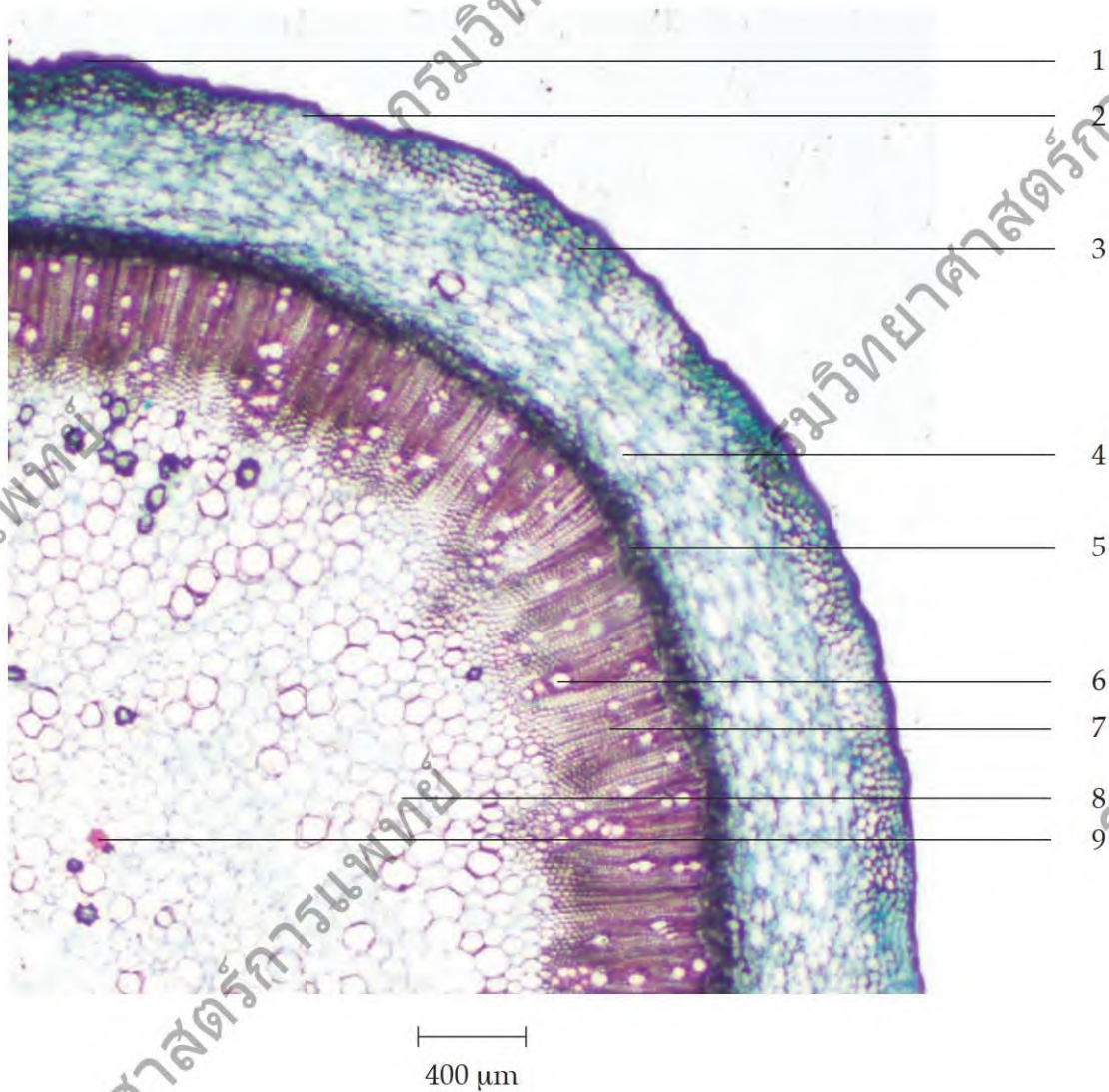


Fig. 2c Photomicrograph of Transverse Section of the Stem of *Acanthus ebracteatus* Vahl, Stained With Safranin-Fast Green

- | | |
|------------------|--------------------|
| 1. cuticle layer | 6. vessel |
| 2. epidermis | 7. xylem ray |
| 3. cork | 8. pith parenchyma |
| 4. air space | 9. sclereid |
| 5. phloem | |

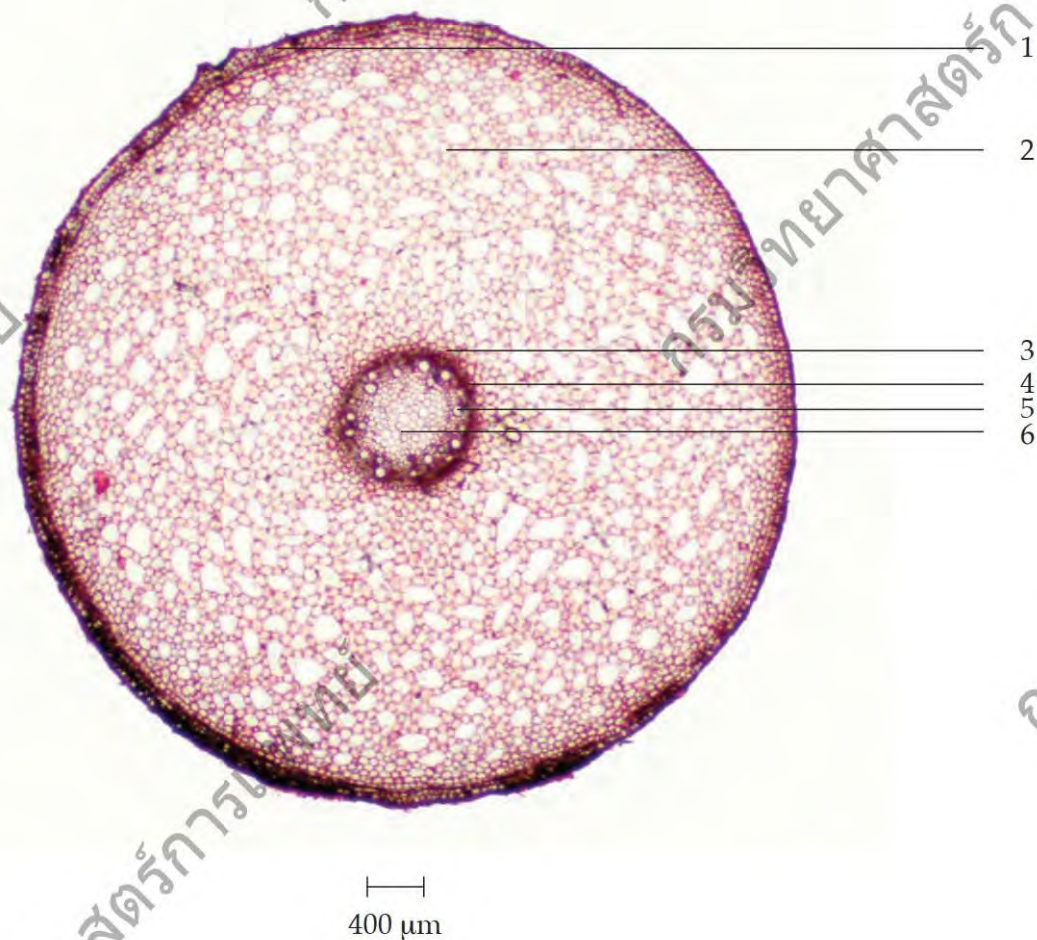


Fig. 2d Photomicrograph of Transverse Section of the Root of *Acanthus ebracteatus* Vahl, Stained With Safranin

- | | |
|---------------|-----------|
| 1. cork layer | 4. phloem |
| 2. aerenchyma | 5. vessel |
| 3. endodermis | 6. pith |



Fig. 2e Photomicrograph of Transverse Section of the Flower of *Acanthus ebracteatus* Vahl, Stained With Safranin-Fast Green

- 1. calyx
- 2. corolla tube
- 3. ovary

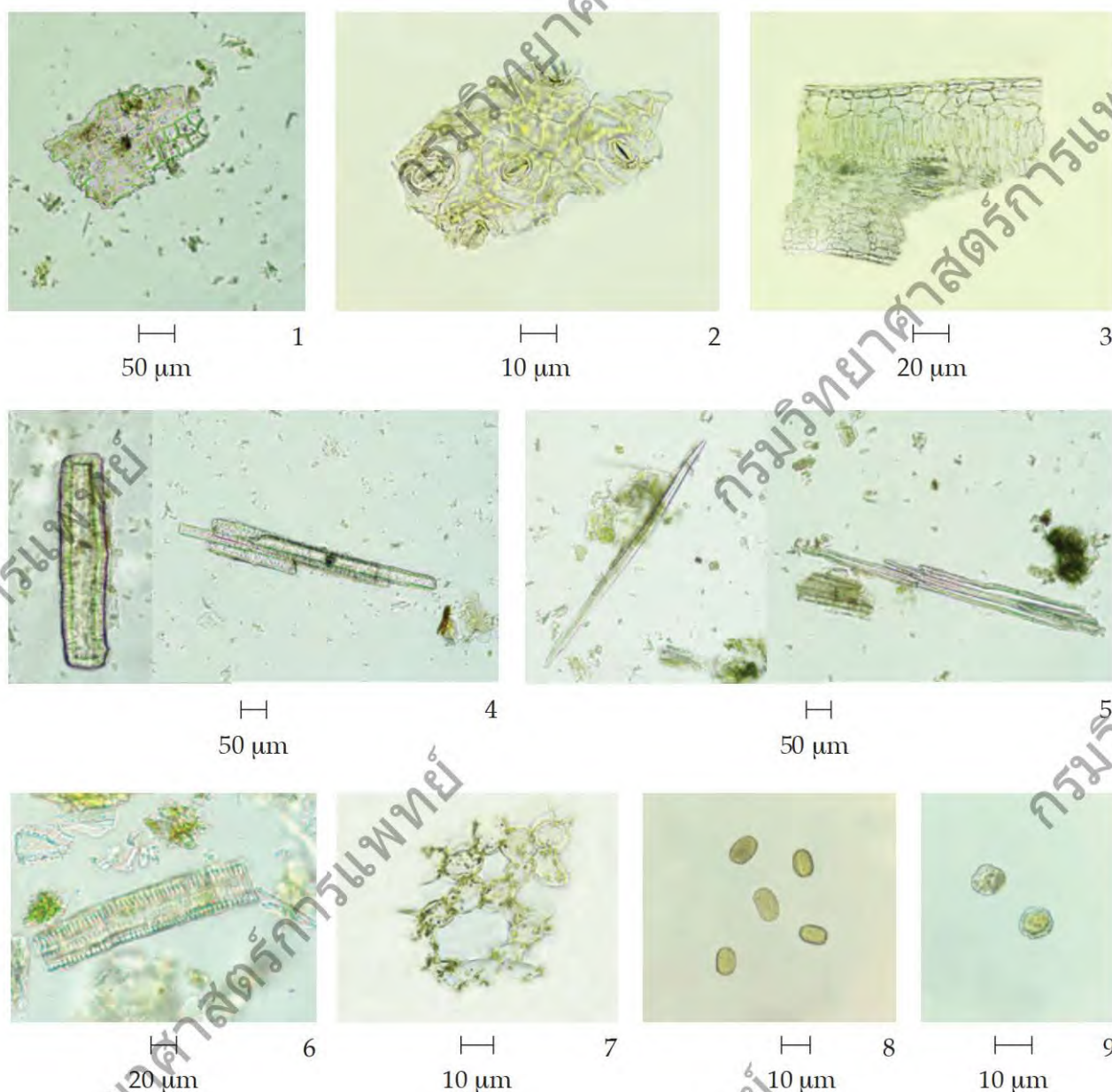


Fig. 2f Photomicrographs of Powdered Drug of the Whole Plants of *Acanthus ebracteatus* Vahl

- | | |
|---|------------------------|
| 1. epidermis in surface view | 4. sclereids |
| 2. epidermis with diacytic stomata in surface view | 5. fibres |
| 3. fragment of lamina in sectional view, showing epidermis, palisade cells, spongy cells, and vascular bundle | 6. reticulate vessel |
| | 7. aerenchyma |
| | 8. pollen grains |
| | 9. head of salt glands |

In surface view, upper epidermis of the lamina shows slightly wavy-walled cells and salt gland; lower epidermis illustrates wavy-walled cells, diacytic stomata, salt gland, and rarely non-glandular trichomes.

Transverse section of the stem shows cork layer, cortex, vascular tissue, and pith. Cork: several layers of rectangular cells. Cortex: several layers of thin-walled parenchyma cells with air space. Vascular tissue: phloem and xylem. Pith: various sizes and shapes of parenchyma cells, some containing sclereids.

Transverse section of the root shows periderm, cortex, vascular tissue, and pith. Periderm: several layers of small rectangular cork cells. Cortex: several layers of thin-walled aerenchyma cells with air space. Vascular tissue: phloem and xylem; phloem, thin-walled parenchyma cells; xylem, vessels, xylem parenchyma, fibres, and xylem rays. Pith: parenchyma cells.

Transverse section of the flower exhibits calyx, corolla tube and ovary.

Acanthus Ebracteatus Herb in powder possesses the diagnostic microscopic characters of the unground drug. Elongated sclereids, salt glands and diacytic stomata are characteristic.

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

Identification

A. Warm 1 g of the sample, in *fine powder*, with 20 mL of *water* on a water-bath for 30 minutes and filter (solution 1). To 2 mL of solution 1, examine under ultraviolet light (366 nm): a blue fluorescence is observed.

B. To 2 mL of solution 1, add 1 drop of *iron(III) chloride TS*: a dark brown flocculent precipitate is produced.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel GF254* as the coating substance and a mixture of 70 volumes of *ethyl acetate*, 10 volumes of *methanol*, 10 volumes of *water*, and 10 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 10 mm, 5 μ L of solution (A) and 2 μ L of solution (B). Prepare solution (A) by sonicating 2 g of the sample, in *fine powder*, with 20 mL of *methanol* for 10 minutes and filter. Evaporate the filtrate under reduced pressure to dryness and dissolve the residue in 5 mL of *methanol*. For solution (B) dissolve 1 mg of *verbascoside* in 5 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 (R_f value 74 to 76) corresponding to the verbascoside band from solution (B); several other quenching bands are also observed. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter, the band corresponding to verbascoside shows blue fluorescence. Several other blue fluorescent bands are also observed. Spray the plate with *anisaldehyde TS* and heat at 105° for 5 minutes; the band due to verbascoside is greenish brown. Other two brown, two grey and two purple bands are 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 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 2.5 per cent w/w (Appendix 7.12).

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

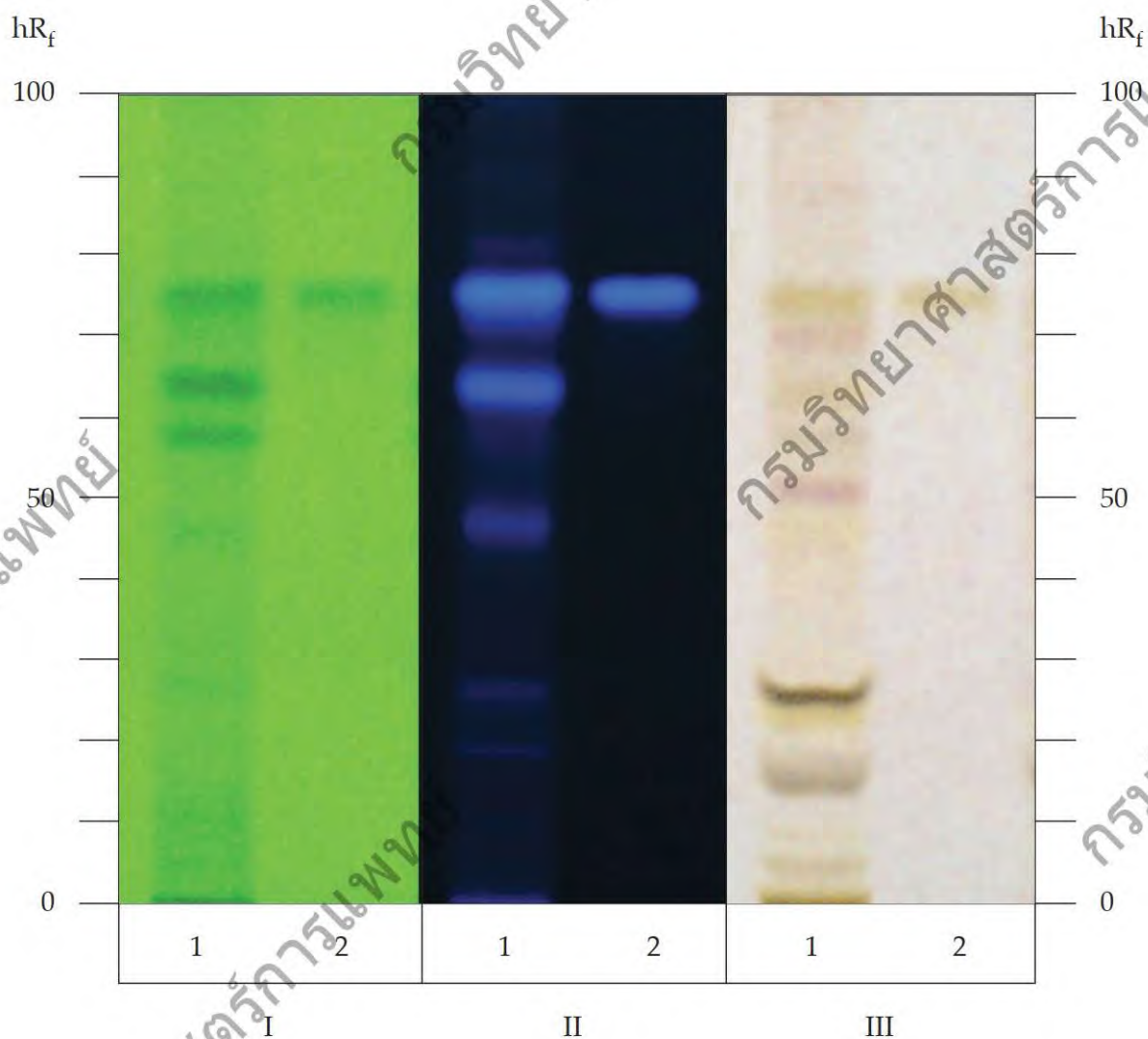


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Whole Plants of *Acanthus ebracteatus* Vahl

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

เหืองปลาหมอ ชนิดดอกม่วง (NGUEAK PLA MO CHANIT DOK MUANG)

อีเกร็ง (I KRENG), แก้มหมอเล (KAEM MO LE)

Acanthi Ilicifolii Herba

Acanthus Ilicifolius Herb

Synonyms Holly Mangrove, Mangrove Holly

Category Anti-inflammatory (topical).

Acanthus Ilicifolius Herb is the dried whole plant of *Acanthus ilicifolius* L. [A. doloarin Blanco, A. neoguineensis Engl., Dilivaria ilicifolia (L.) Juss.] (Family Acanthaceae), Herbarium Specimen Number: DMSC 5253, Crude Drug Number: DMSc 1203.

Constituents *Acanthus Ilicifolius* Herb contains phenolic glycosides (e.g., acteoside or verbascoside) and flavone glycosides.

Description of plant (Fig. 1) Shrub, up to 2.5 m tall; stem erect, terete, stout, branched, slightly lenticellate, glabrous and glossy, succulent, green to brownish green; sometimes with stipule-like spines at node, caducous; prop root usually abundant. Leaves simple, opposite decussate, oblong to oblong-lanceolate, 6 to 14 cm long, 2 to 5 cm wide, apex acute and slightly mucronate, base cuneate, margin 3- to 7-toothed, serrate, subentire or rarely entire, subcoriaceous to coriaceous, upper surface green to dark green, glossy, lower surface pale green, glabrous on both surfaces, secondary veins 5 to 7 on each side of midrib, spreading to spinose teeth margin; petiole 0.3 to 1.5 cm long, thick, glabrous, continued into prominent midrib. Inflorescence spike, terminal or axillary, erect, up to 16.5 cm long; bract broadly ovate to lanceolate, 0.7 to 1 cm long, about 5 mm wide; bracteoles 2, oblong-lanceolate, 3 to 8 mm long, 2 to 5 mm wide; calyx 4-lobed, light green, obovate-oblong, 2 outer ones larger, about 2 cm long, about 1 cm wide, 2 inner ones up to 1.8 cm long, up to 8 mm wide, apex mucronate, margin scarious, ciliolate; corolla usually purplish with yellow band, 3 to 4 cm long, tube about 6 mm long, lip obovate, 2.2 to 3 cm long, thin-leathery, outside soft hairy, apex obtusely 2-lobed, with small lobe in the middle; stamens 4, unequal, attached to corolla throat, filament about 1.5 cm long, stiff, anther theca linear-oblong, densely hairy; disc annular and penicillate; ovary superior, 2-loculed, each locule with 2 ovules, style about 2.2 cm long, glabrous, stigma bifid. Fruit a capsule, ovoid, 1.6 to 3.4 cm long, green and glossy. Seeds 4, orbicular or reniform, up to 1.5 cm in diameter, light yellow, flattened, rugulose or corrugate.

Description Odour, characteristic; taste, slightly salty-astringent.

Macroscopical (Fig. 1) Whole plant occurs as a mixture of unbroken or broken, crisp, mainly brownish leaves with spinose teeth margin; terete and lenticellate stems with spines at node; elliptic to oblong capsules; some with roots and part of inflorescences.

Microscopical (Figs. 2a, 2b, 2c, 2d, 2e, 2f) Transverse section of the leaf shows upper epidermis, hypodermis, mesophyll, vascular bundle, and lower epidermis. Upper epidermis: a layer of small rectangular cells covered with cuticle, sunken salt glands with 8- to 12-celled head and short stalk. Hypodermis: 2 to 4 layers of large- and thin-walled cells. Mesophyll: palisade cells, 2 to 3 layers and cylindrical; spongy cells, polygonal-shaped and loosely arranged; collenchyma, angular and several layers; parenchyma, thin-walled and round; both collenchyma and parenchyma found in the upper and lower parts of midrib. Lower epidermis: 1 to 3 layers of small rectangular cells covered with cuticle, sunken salt glands with 8- to 12-celled head and short stalk.



1



2



3



4

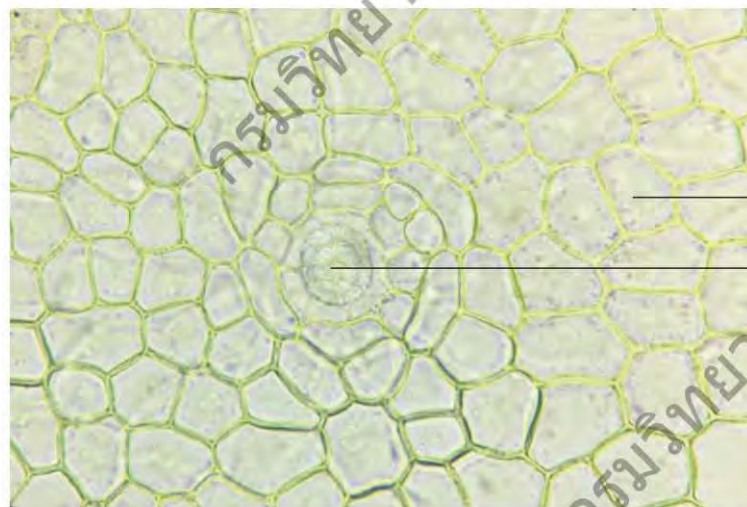


—|—
2 cm

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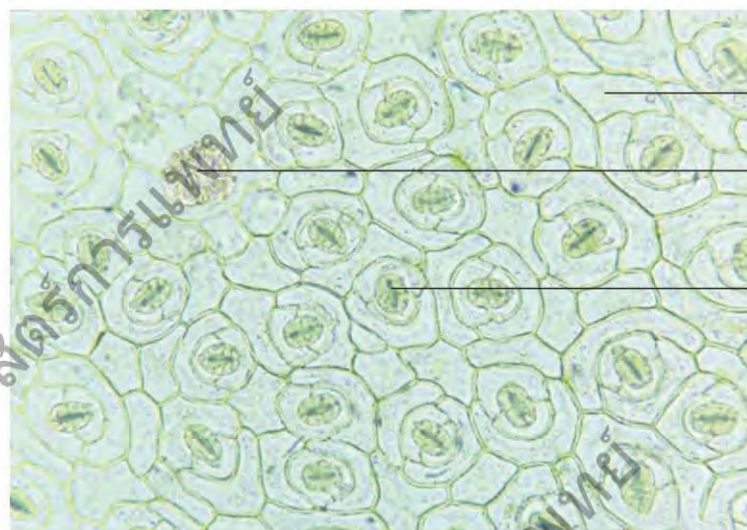
Fig. 1 *Acanthus ilicifolius* L.

1. habit 2. inflorescence 3. flower 4. infructescence 5. crude drug



10 μm

Upper Epidermis of the Lamina



10 μm

Lower Epidermis of the Lamina

Fig. 2a Photomicrographs of Epidermises of the Leaf of *Acanthus ilicifolius* L.

- | | |
|-------------------|-------------------|
| 1. epidermal cell | 3. diacytic stoma |
| 2. salt gland | |

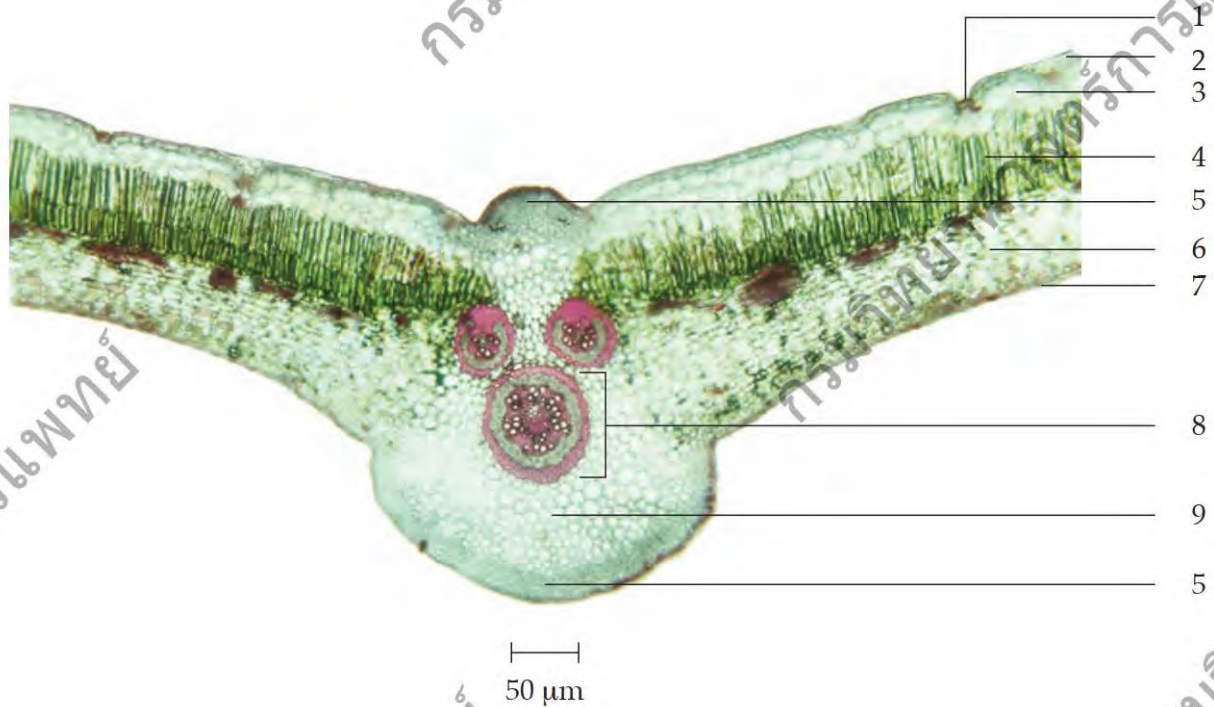


Fig. 2b Photomicrograph of Transverse Section of the Leaf of *Acanthus ilicifolius* L., Stained With Safranin

- | | |
|--------------------|--------------------|
| 1. salt gland | 6. spongy cell |
| 2. upper epidermis | 7. lower epidermis |
| 3. hypodermis | 8. vascular bundle |
| 4. palisade cell | 9. parenchyma |
| 5. collenchyma | |

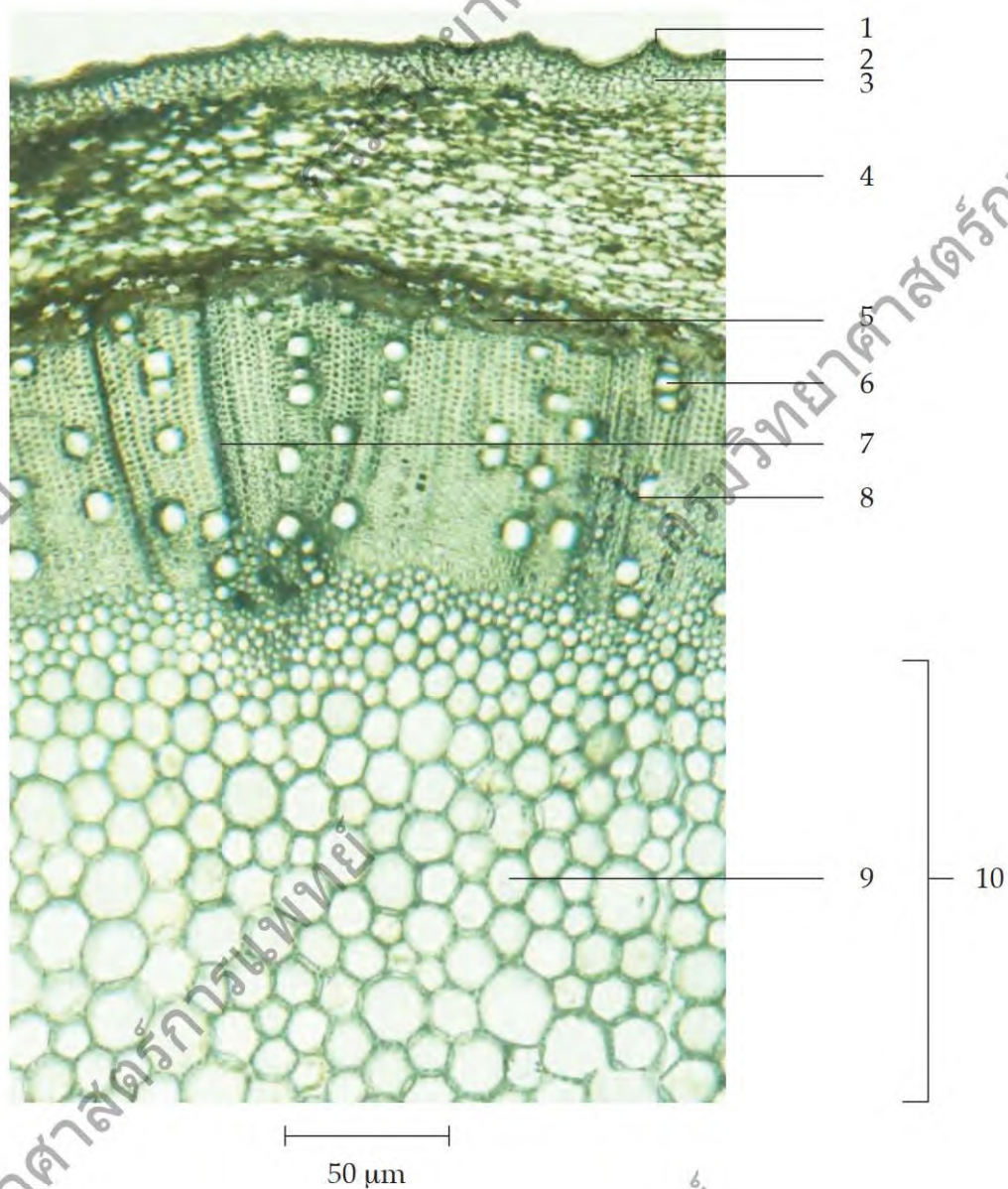


Fig. 2c Photomicrograph of Transverse Section of the Stem of *Acanthus ilicifolius* L.

- | | |
|------------------------|----------------|
| 1. cuticle layer | 6. vessel |
| 2. epidermis | 7. xylem ray |
| 3. angular collenchyma | 8. xylem fibre |
| 4. aerenchyma | 9. parenchyma |
| 5. phloem | 10. pith |

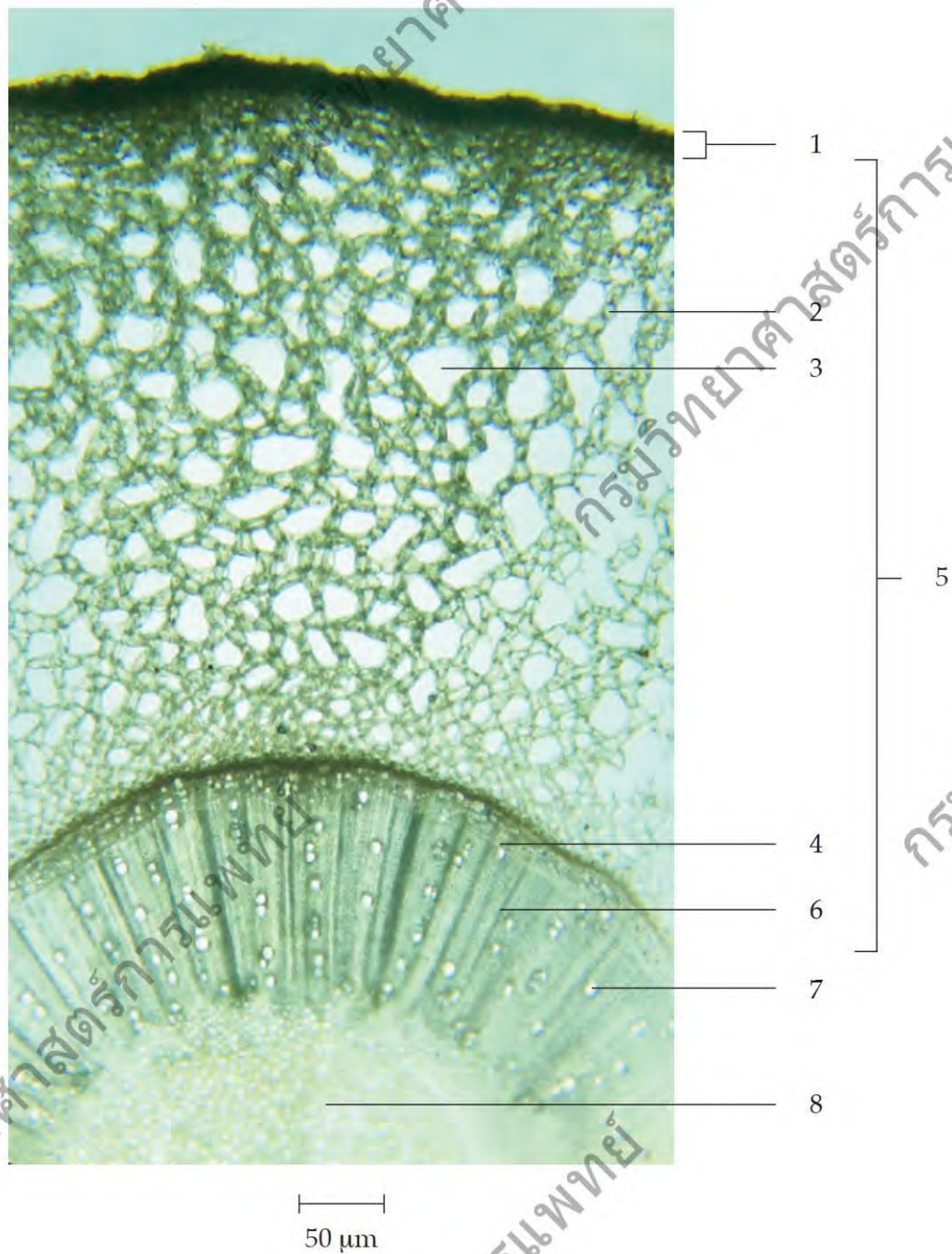


Fig. 2d Photomicrograph of Transverse Section of the Root of *Acanthus ilicifolius* L.

- | | |
|---------------|---------------|
| 1. periderm | 5. cortex |
| 2. aerenchyma | 6. xylem ray |
| 3. air space | 7. vessel |
| 4. phloem | 8. parenchyma |



Fig. 2e Photomicrographs of Powdered Drug of the Whole Plants of *Acanthus ilicifolius* L.

1. upper epidermis
2. lower epidermis
3. groups of fibres
4. bordered-pitted vessel
5. reticulate vessel
6. epidermis, palisade cells and spongy cells, in sectional view
7. pitted-walled parenchyma
8. elongated sclereid
9. fragment of aerenchyma
10. pollen grains
11. salt glands in surface view
12. acicular crystals

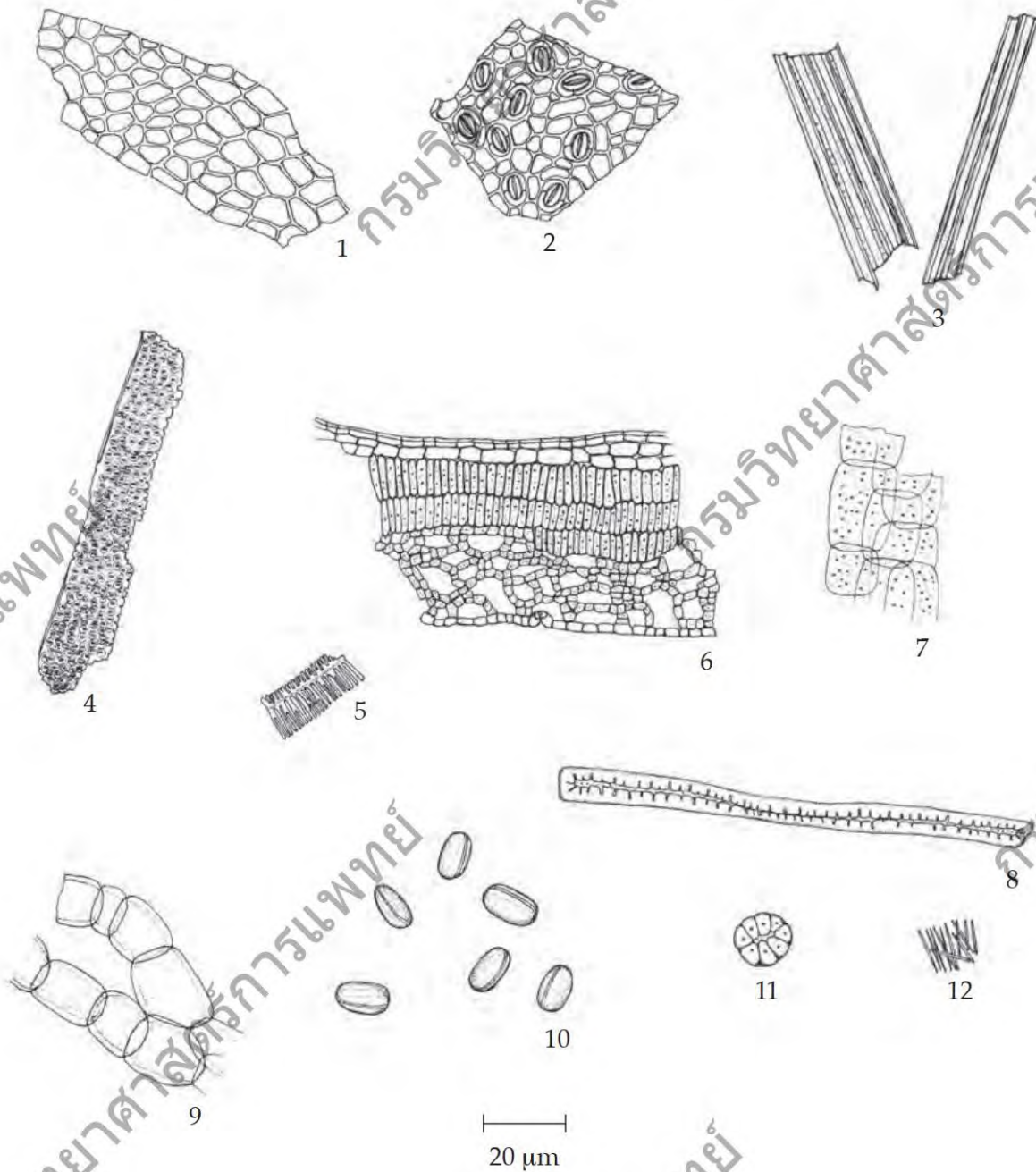


Fig. 2f Line Drawings of Powdered Drug of the Whole Plants of *Acanthus ilicifolius* L.

- | | |
|--|--------------------------------|
| 1. upper epidermis | 7. pitted-walled parenchyma |
| 2. lower epidermis | 8. elongated sclereid |
| 3. groups of fibres | 9. fragment of aerenchyma |
| 4. bordered-pitted vessel | 10. pollen grains |
| 5. reticulate vessel | 11. salt gland in surface view |
| 6. epidermis, palisade cells and spongy cells, in sectional view | 12. acicular crystals |

In surface view, upper epidermis of the lamina shows polygonal cells and salt glands with 8- to 12-celled head; lower epidermis, slightly wavy-walled polygonal cells, numerous diacytic stomata and salt glands with 8- to 12-celled head.

Transverse section of the stem shows epidermis, cortex, vascular tissue, and pith. Epidermis: a layer of various-shaped epidermal cells, with thick cuticle. Cortex: several layers of angular collenchyma, sclereid and several layers of thin-walled aerenchyma. Vascular tissue: phloem and xylem. Pith: various sizes of polygonal pitted parenchyma, slightly thick-walled.

Transverse section of the root shows periderm, cortex, vascular tissue, and pith. Periderm: several layers of small rectangular cork cells. Cortex: broad zone of thin-walled aerenchyma. Vascular tissue: phloem and xylem; phloem, thin-walled parenchyma; xylem, vessels, xylem parenchyma, fibres, and xylem rays. Pith: pitted parenchyma.

Acanthi Ilicifolii Herba in powder possesses the diagnostic microscopical characters of the unground drug. Fibres, bordered-pitted vessels, and epidermal cells of lamina are frequently observed. Pollen grains and acicular crystals may also be seen. However, elongated sclereids from stem, salt glands with 8- to 12-celled head and diacytic stomata are characteristic.

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

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

Identification

A. Heat 5 g of the sample, in powder, with 15 mL of water in a water-bath for 5 minutes and filter. To 1 mL of the filtrate, add a few drops of iron(III) chloride TS and mix well: a dark blue 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 70 volumes of ethyl acetate, 10 volumes of methanol, 10 volumes of water, and 10 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 10 mm, 6 µL each of the following two solutions. Prepare solution (A) by sonicating 2 g of the sample, in No. 250 powder, with 20 mL of methanol for 10 minutes and filtering. Evaporate the filtrate under reduced pressure to dryness and dissolve the residue in 5 mL of methanol. For solution (B), dissolve 1 mg of verbascoside in 5 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 (R_f value 55 to 59) corresponding to the verbascoside band from solution (B); several other quenching bands are also observed. Subsequently examine the plate under ultraviolet light (366 nm) through the cut-off filter, the band corresponding to verbascoside shows a blue fluorescence. Spray the plate with anisaldehyde TS and heat at 105° for 5 minutes; the band due to verbascoside is brown. The other two brown bands are observed (Fig. 3).

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

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

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

Total ash Not more than 13.0 per cent w/w (Appendix 7.7).

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

Water-soluble extractive Not less than 11.0 per cent w/w (Appendix 7.12).

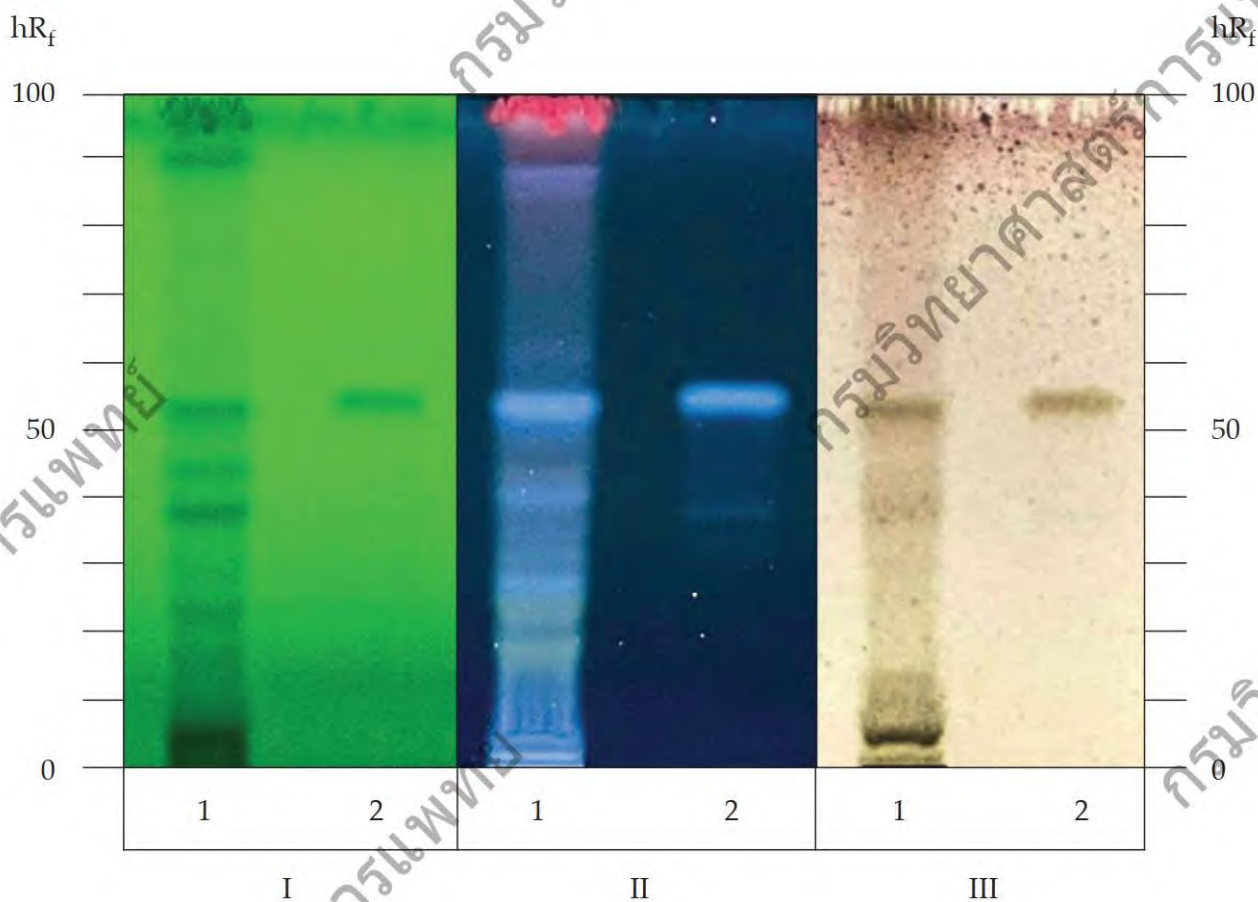


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Whole Plants of *Acanthus ilicifolius* L.

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

เปราะหอม (PRO HOM)

เปราะบ้าน (PRO BAN), เปราะหอมขาว (PRO HOM KHAO), ว่านหอม (WAN HOM)

Kaempferiae Galangae Rhizoma

Kaempferia Galanga Rhizome

Category Carminative, stomachic.

Kaempferia Galanga Rhizome is the dried rhizome of *Kaempferia galanga* L. (*K. humilis* Salisb., *K. latifolia* Donn, *K. plantaginifolia* Salisb., *K. procumbens* Noronha) (Family Zingiberaceae), Herbarium Specimen Number: BKF 200905, DMSC 5307, Crude Drug Number: DMSc 1204.

Constituents *Kaempferia Galanga Rhizome* contains volatile oil, of which carvone, ethyl cinnamate, ethyl *trans*-4-methoxycinnamate, methyl cinnamate, and pentadecane are its major components. It also contains flavonoids (e.g., kaempferol).

Description of the plant (Figs. 1a, 1b) Perennial herb, up to 10 cm tall; pseudostem short, glabrous; rhizome pale green or greenish white inside, irregularly shaped, 2 to 3.5 cm long, 1 to 2.5 cm wide, with several tuberous roots, fragrant. Leaves simple, mostly 2, sessile or shortly petiolate, arising from pseudostem, spreading flat on ground, obliquely ovate or suborbicular, 6 to 14 cm long, 5 to 10 cm wide, apex mucronate or acute, base obtuse to cuneate, margin entire, chartaceous, deep green, upper surface glabrous, lower surface pubescent, veins prominent; leaf-sheath broad, thick and keeled, about 5 cm long, about 1 cm wide; ligule triangular, about 3 mm long, apex rounded, membranous, hairy. Inflorescence terminal on pseudostem, enclosed by imbricate leaf-sheaths, sessile; bract lanceolate, acuminate, 2 to 3 cm long, 0.7 to 1.3 cm wide, glabrous; bracteole tubular, 2 to 3 cm long, split to the base. Flowers 4 or more, irregular, bisexual; calyx 2 to 2.5 cm long, apex bifid, glabrous; corolla tube 3 to 4 cm long; lobes white, lanceolate; dorsal lobe 1.5 to 2 cm long, about 4 mm wide, hood-like, aristate; lateral lobes 1.4 to 1.8 cm long, about 4 mm wide, blunt; lateral staminodes petaloid, obovate-cuneate or oblanceolate, 1.5 to 2 cm long, 0.7 to 1.2 cm wide; labellum white with purple blotch at base, bilobed, each lobe obovate, about 1.8 cm long, about 1.3 cm wide, apex irregularly crenate; anther sessile, 3 to 4 mm long, anther crest 2 to 3 mm long, 4 to 5 mm wide, deeply bilobed, each lobe rounded or unequally toothed; ovary inferior, 3 to 4 mm long, about 2.5 mm wide, glabrous, 3-loculed, ovules many in each locule. Fruit a capsule, oblong, pericarp thin. Seed subglobose; aril lacerate.

Description Odour, characteristic; taste, spicy.

Macroscopical (Fig. 1a) Transverse and longitudinal slices, occasionally with whole rhizomes, varied in shape and size. Slices irregularly shaped, externally brownish to dark brown, some with rootlets or rootlet scars, fragile. Surface creamy to light brownish, starchy.

Microscopical (Figs. 2a, 2b, 2c) Transverse section of the rhizome shows scale leaf, periderm, cortex, and vascular tissue. Scale leaf: dark-brown thin sheet. Periderm: several layers of thin-walled rectangular storied corks. Cortex: collapsed parenchyma cells, lysigenous cavities, thin-walled polygonal parenchyma cells, some containing starch grains and/or oleoresin, and oil cells; pseudoendodermis, a layer of small rectangular cells with casparian strip, oil cells and thin-walled polygonal parenchyma cells, some with numerous starch grains and/or oleoresin. Vascular tissue: collateral bundles, scattered.

Kaempferia Galanga Rhizome in powder possesses the diagnostic microscopical characters of the underground drug. Storied cork in surface view and in sectional view, parenchyma containing starch grains, spiral and reticulate vessels are commonly observed. Parenchyma containing oleoresin and fragments of scale leaf are characteristic.



1



2



3



4

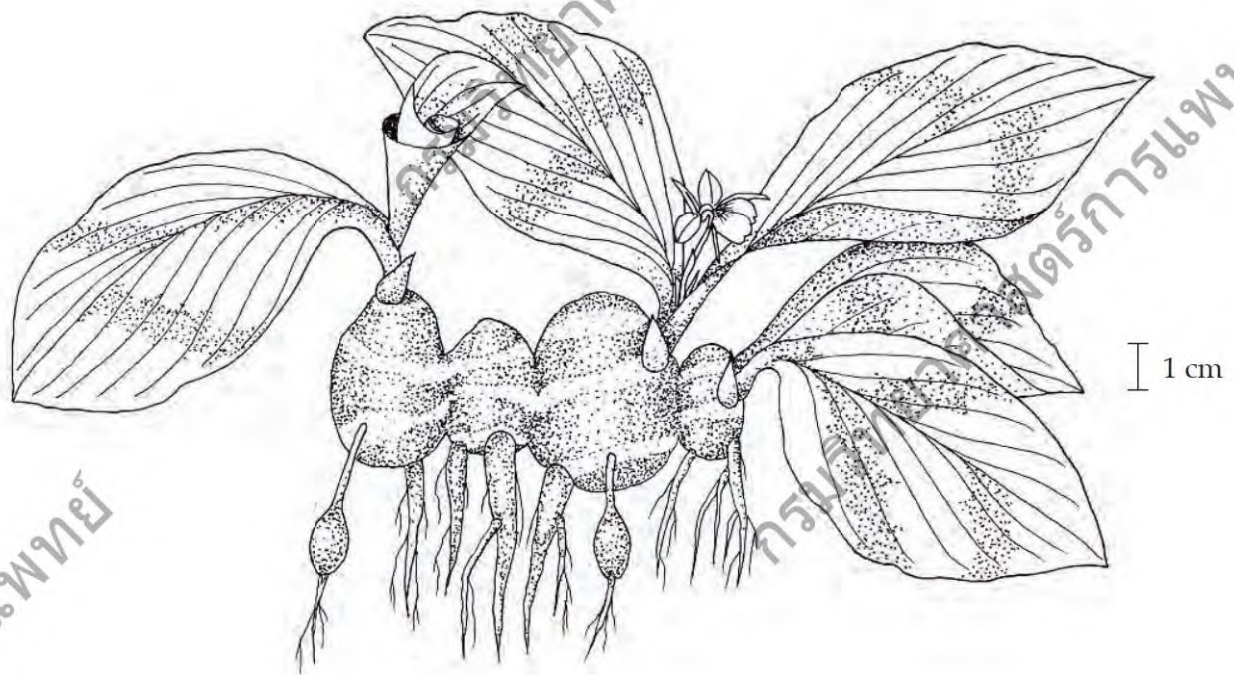


5

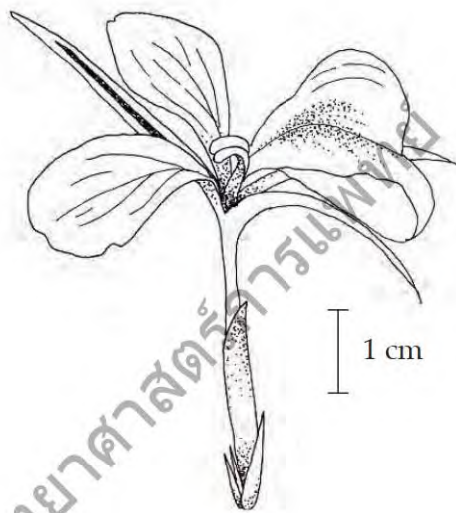
1 cm

Fig. 1a *Kaempferia galanga* L.

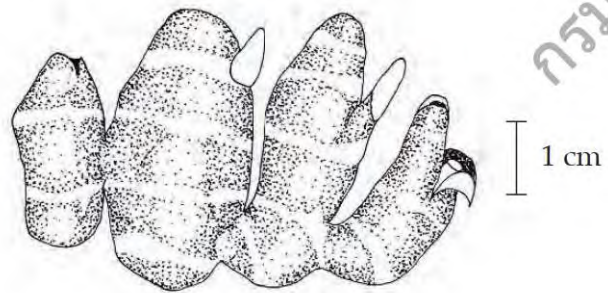
1. habit 2. leaves and fresh rhizomes 3. flower with part of leaves 4. flower, showing dorsal corolla lobe, lateral corolla lobes, staminodes, labellum, and anther crest 5. crude drug



1



2



3

Fig. 1b *Kaempferia galanga* L.
1. habit 2. flower 3. rhizomes

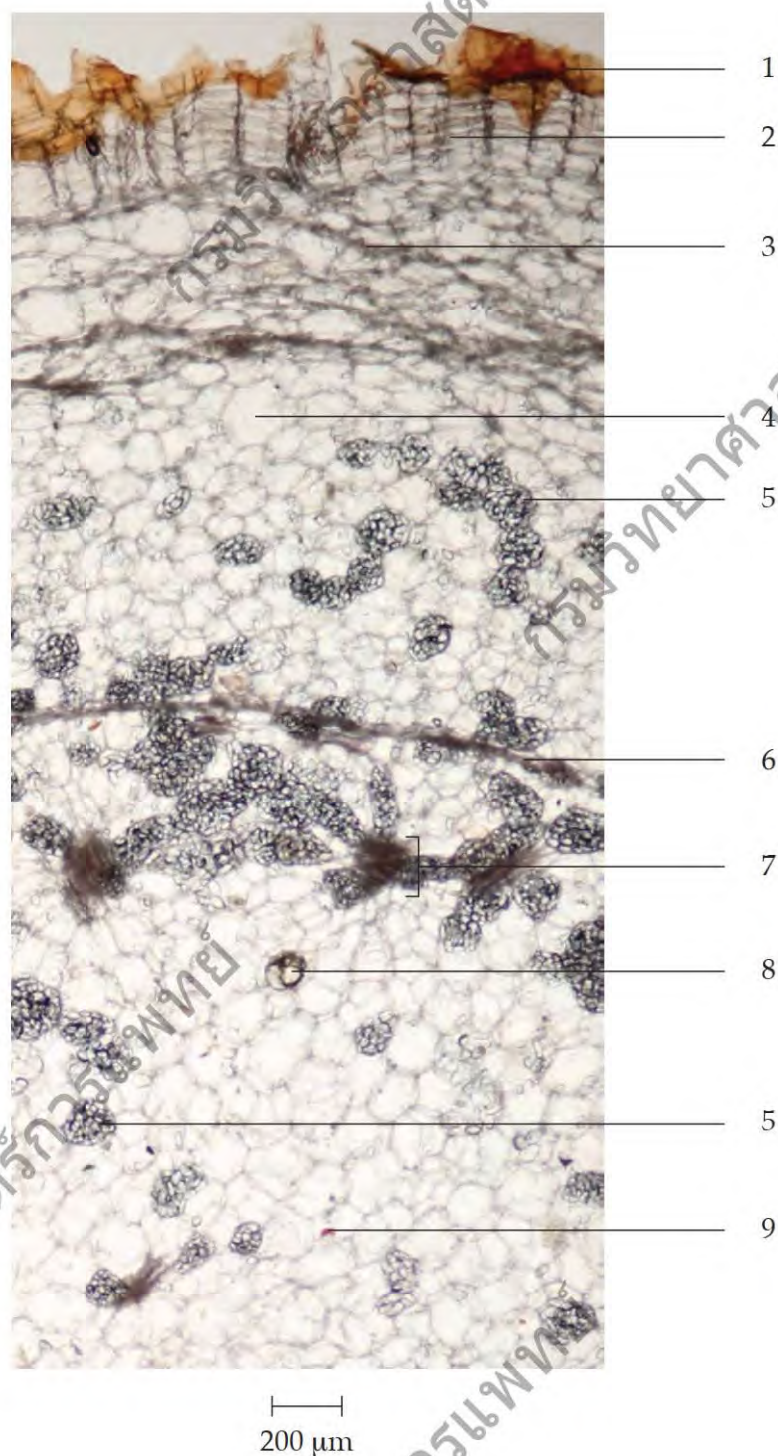


Fig. 2a Photomicrograph of Transverse Section of the Rhizome of *Kaempferia galanga* L.

- | | |
|--|---------------------|
| 1. scale leaf | 6. pseudoendodermis |
| 2. storied cork | 7. vascular tissue |
| 3. collapsed cell | 8. oil cell |
| 4. lysigenous cavity | 9. oleoresin |
| 5. parenchyma containing starch grains | |

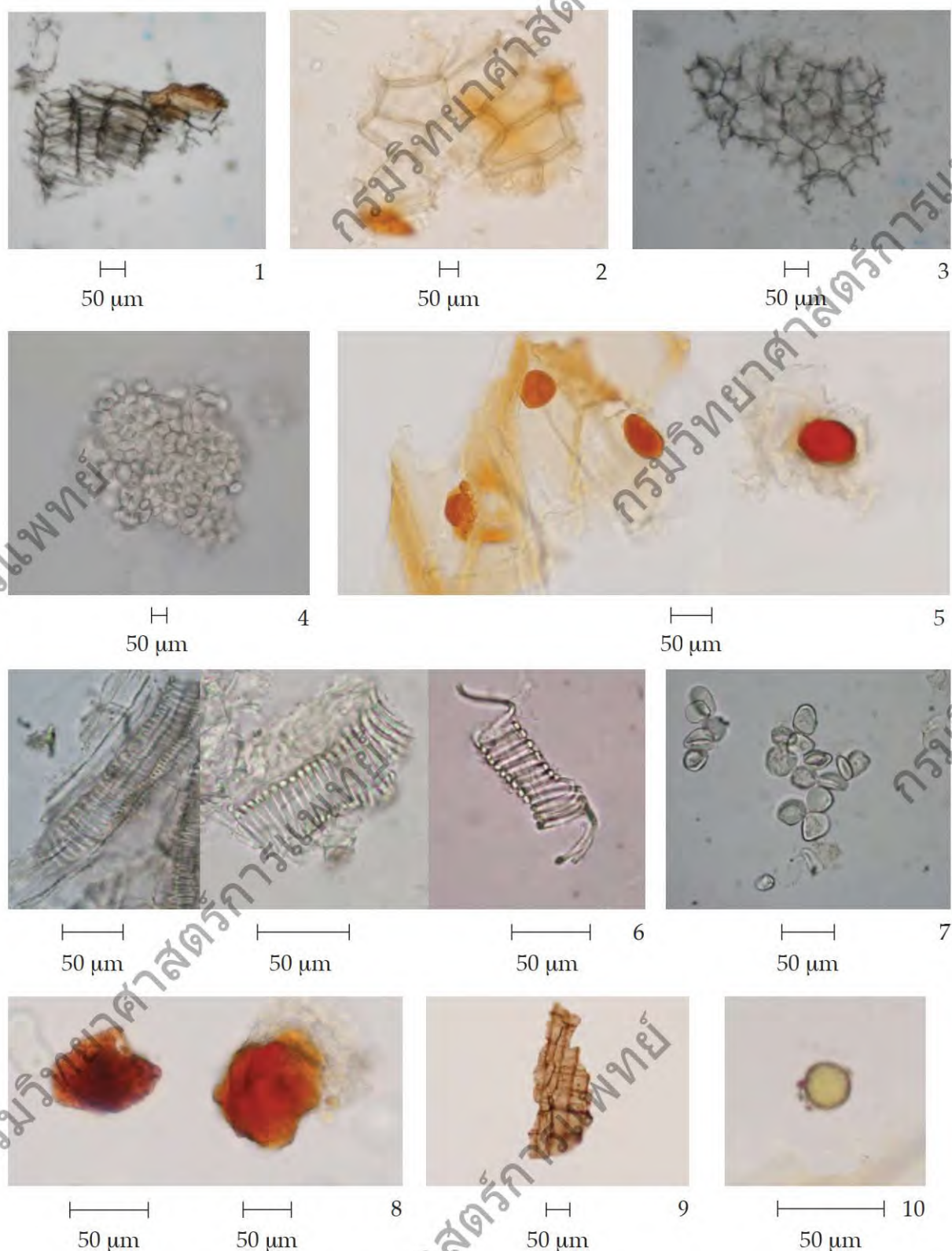


Fig. 2b Photomicrographs of Powdered Drug of the Rhizomes of *Kaempferia galanga* L.

1. storied cork in sectional view
2. storied cork in surface view
3. parenchyma
4. parenchyma containing starch grains
5. parenchyma containing oleoresin
6. reticulate and spiral vessels
7. starch grains
8. oleoresin
9. fragment of scale leaf in surface view
10. oil droplet

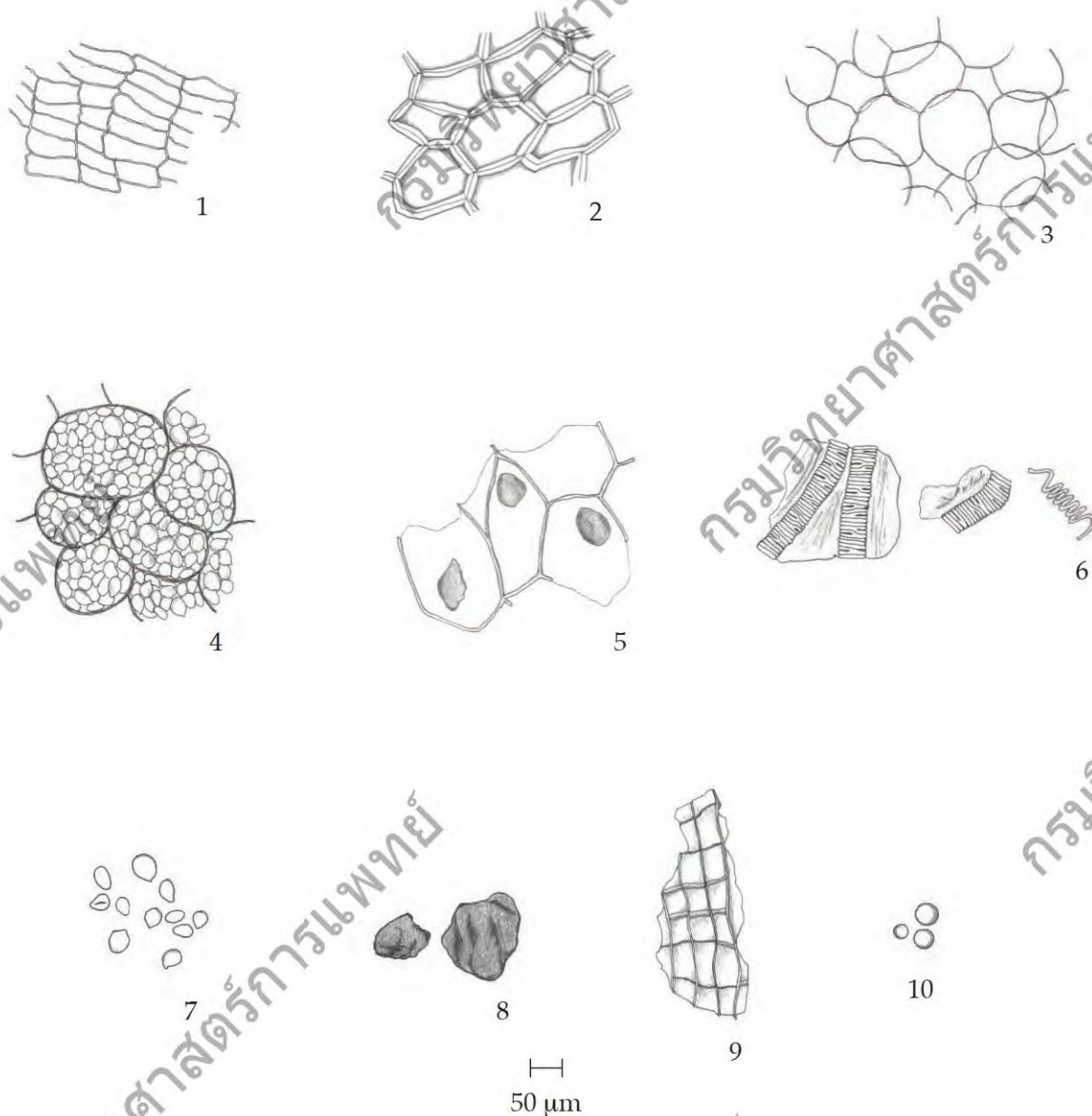


Fig. 2c Line Drawings of Powdered Drug of the Rhizomes of *Kaempferia galanga* L.

- | | |
|--|---|
| 1. storied cork in sectional view | 6. reticulate and spiral vessels |
| 2. storied cork in surface view | 7. starch grains |
| 3. parenchyma | 8. oleoresin |
| 4. parenchyma containing starch grains | 9. fragment of scale leaf in surface view |
| 5. parenchyma containing oleoresin | 10. oil droplets |

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

Identification

A. Sonicate 2 g of the sample, in *moderately fine powder*, with 10 mL of *methanol* for 10 minutes and filter (solution 1). To 2 mL of solution 1, add a few drops of *ninhydrin TS* and heat on a water-bath: a violet colour is produced.

B. To 2 mL of solution 1, add a few drops of *vanillin-sulfuric acid TS2*: a violet colour is produced immediately.

C. Carry out the test as described in the "Thin-Layer Chromatography" (Appendix 3.1), using *silica gel F254* as the coating substance and a mixture of 90 volumes of *toluene* and 10 volumes of *ethyl acetate* as the mobile phase. Apply separately to the plate as bands of 8 mm, 10 µL of solution (A) and 12 µL of solution (B). Prepare solution (A) by sonicating 1 g of the sample, in *moderately fine powder*, with 10 mL of *methanol* for 30 minutes and filtering. Evaporate the filtrate to dryness under reduced pressure at 50°. Dissolve the residue in 1 mL of *methanol*. For solution (B), dissolve 1 mg of *ethyl trans-4-methoxycinnamate* 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 (R_f value 47 to 51) corresponding to the *ethyl trans-4-methoxycinnamate* band from solution (B), and several other quenching bands are also observed. Examine the plate under ultraviolet light (366 nm); the band due to *ethyl trans-4-methoxycinnamate* exhibits a blue fluorescence. One blue fluorescent band is also observed. Subsequently spray the plate with *anisaldehyde TS* and heat at 105° for 10 minutes; the band corresponding to *ethyl trans-4-methoxycinnamate* is purple. One brown, two orange and nine purple bands are also observed (Fig. 3).

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

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

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

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

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

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

Volatile oil Not less than 4.0 per cent v/w, calculated on the anhydrous basis (Appendix 7.3H).

Use 15 g, in *moderately 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 3 hours. Use 2.0 mL of *xylene* in the graduated tube.

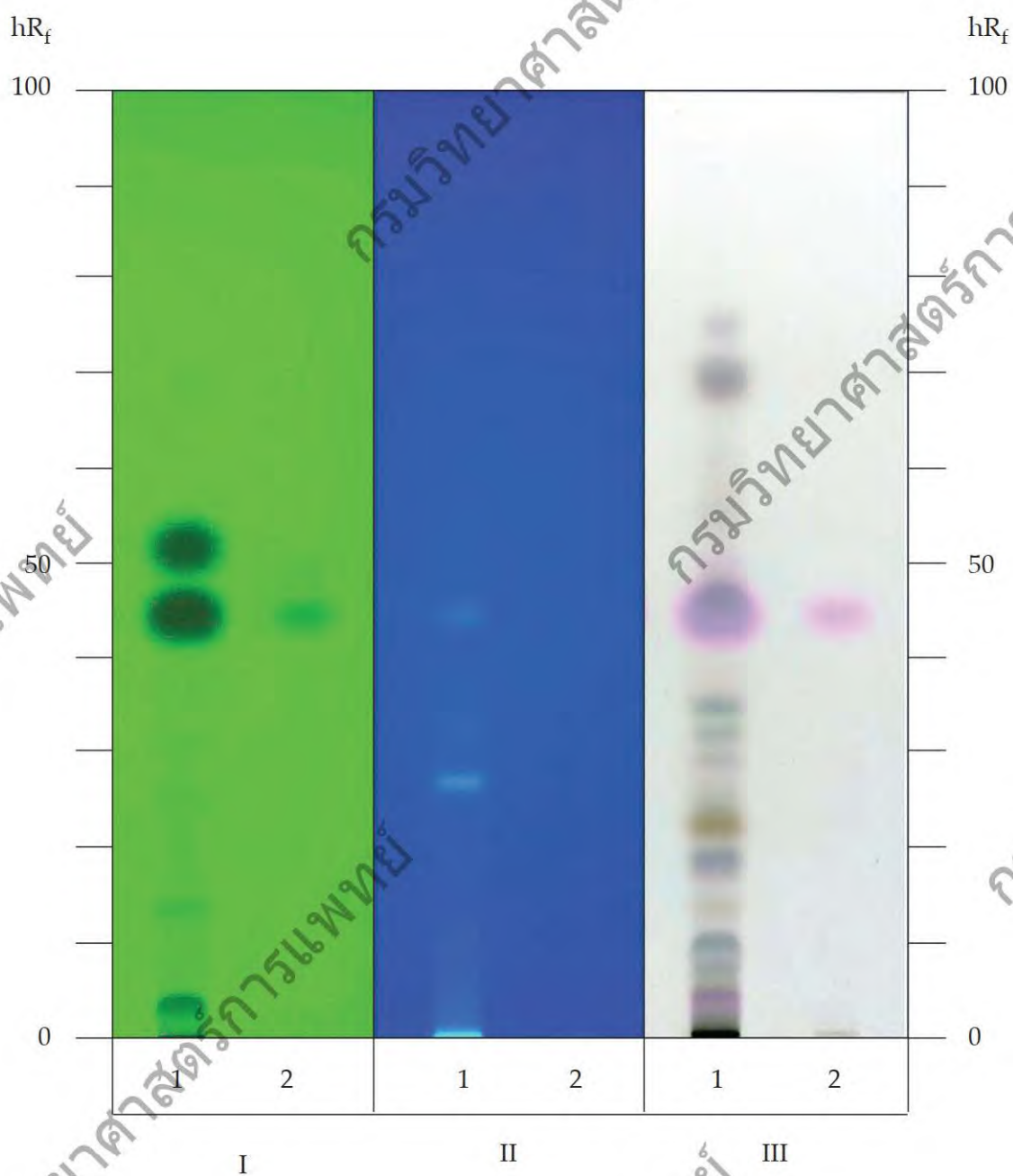


Fig. 3 Thin-Layer Chromatogram of Methanol Extract of the Rhizomes of *Kaempferia galanga* L.

- 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

ว่านชักมดลูก (WAN CHAK MOT LUK)

Curcuma Comosae Rhizoma

Curcuma Comosa Rhizome

Category Phytoestrogenic-like, anti-inflammatory (uterus).

Curcuma Comosa Rhizome is the dried rhizome of *Curcuma comosa* Roxb. (Family Zingiberaceae), Herbarium Specimen Number: DMSC 5308, Crude Drug Number: DMSc 1205.

Constituents Curcuma Comosa Rhizome contains diarylheptanoids (e.g., (6E)-1,7-diphenylhept-6-en-3-ol, (4E,6E)-1,7-diphenylhepta-4,6-dien-3-ol). It also contains sterols, a volatile oil, etc.

Description of the plant (Fig. 1) Perennial herb, pseudostem 60 to 180 cm tall; rhizome pale brown to brown, ellipsoid or ovoid, 8 to 12 cm long, 5 to 10 cm in diameter, with rusty scales; tuberous roots ovate to lanceolate, 4 to 9.5 cm long, 1.5 to 3.5 cm wide. Leaves simple, alternate, tufted at base, oblong, elliptic to lanceolate-elliptic, 20 to 40(-110) cm long, 14 to 17(-24) cm wide, apex acute to acuminate, base obliquely cuneate to attenuate, margin entire, hyaline, glabrous, midrib sometimes red or reddish purple; petiole 5 to 14 cm long, glabrous. Inflorescence thyriform, arising from rhizome before leaves, 10 to 21 cm long, 7 to 10 cm in diameter; peduncle 8 to 11 cm long, glabrous; bract pinkish white or white, distal bract 6 to 7 cm long, 4 to 4.5 cm wide; fertile bract obovate, 2.2 to 4.2 cm long, 3.5 to 4.5 cm wide. Flower exerted from bracts; calyx tube about 8 mm long, 3-toothed, sparsely hairy at apex; corolla tube about 3 cm long, with a ring of densely hair; 3-lobed, dorsal lobe pinkish white to white, triangular, about 1.3 cm long, about 9 mm wide, apex mucronate, hooded, lateral lobe elliptic, about 1 cm long, about 7 mm wide, apex rounded; lateral staminode pale yellow, reddish tinge apically, unequally obovate, 1.3 to 1.5 cm long, about 1 cm wide; labellum pale yellow, with a bright yellow median band and paler lines radiating towards margin, blade broadly obovate, about 2.2 cm long, about 1.9 cm wide, apex bilobed, glabrous; stamen creamy white to pale yellow, about 8 mm long, filament 3 to 3.5 mm long, anther 4 to 5 mm long, spurs narrowly triangular, anther crest creamy white, obtuse; ovary inferior, pale cream to white, subglobose, about 3 mm in diameter, 3-loculed, pubescent, style glabrous, stigma capitate. Fruit a dehiscent capsule, ellipsoid, 3-valved.

Description Odour, characteristic; taste, bitter with astringent aftertaste.

Macroscopical (Fig. 1) Dried slices of rhizome, vary in shape, size and thickness; texture rough; externally brown; internally yellowish brown.

Microscopical (Figs. 2a, 2b) Transverse section of the rhizome shows epidermis, storeid cork, cortex, and vascular tissue. Epidermis: a layer of rectangular cells with unicellular trichomes. Storeid cork: several layers of rectangular cells. Cortex: thin-walled parenchyma containing numerous starch grains and/or oil droplets, some of which containing yellow oleoresin; pseudoendodermis, 2 or 3 layers of thin-walled rectangular cells. Vascular tissue: vascular bundles scattered in ground tissue, consisting of phloem and xylem.

Curcuma Comosa Rhizome in powder possesses the diagnostic microscopical characters of the unground drug. Parenchyma cells containing beaked starch grains, oleoresin and/or oil droplets, are frequently seen. Scalariform, spiral and reticulate vessels are found.



1



2



3



4



5



6

1 cm

Fig. 1 *Curcuma comosa* Roxb.

1. habit (leafy shoot) 2. flowering shoot with rhizome and part of young leafy shoot
3. flower (top view), showing dorsal corolla lobe, lateral corolla lobes, staminodes, labellum, and part of spurs 4. floral part, showing dorsal corolla lobe, lateral corolla lobes, staminodes, labellum, and spurs
5. flower showing ovary, calyx tube, corolla tube, corolla lobes, staminodes, labellum, and spurs 6. crude drug

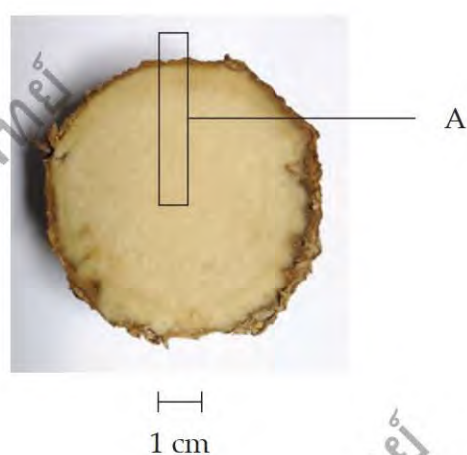


Diagram of the Rhizome

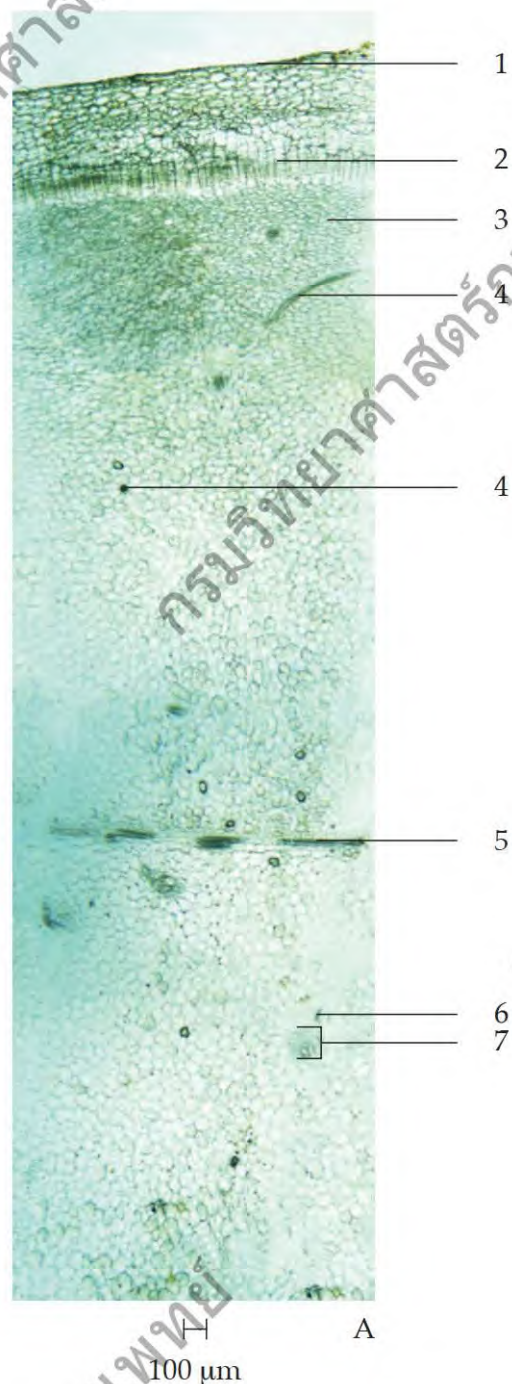


Fig. 2a Photomicrograph of Transverse Section of the Rhizome of *Curcuma comosa* Roxb.

A. Part of Transverse Section

- | | |
|-----------------|--|
| 1. epidermis | 5. pseudoendodermis |
| 2. storied cork | 6. parenchyma containing starch grains |
| 3. parenchyma | 7. vascular bundle |
| 4. oleoresin | |



Fig. 2b Photomicrographs of the Powdered Drug of the Rhizomes of *Curcuma comosa* Roxb.

1. storied cork in surface view
2. storied cork in sectional view
3. parenchyma, some containing prismatic crystals
4. parenchyma, some containing oil droplets
5. parenchyma, some containing starch grains
6. fibres and parenchyma
7. scalariform vessels associated with parenchyma in longitudinal view

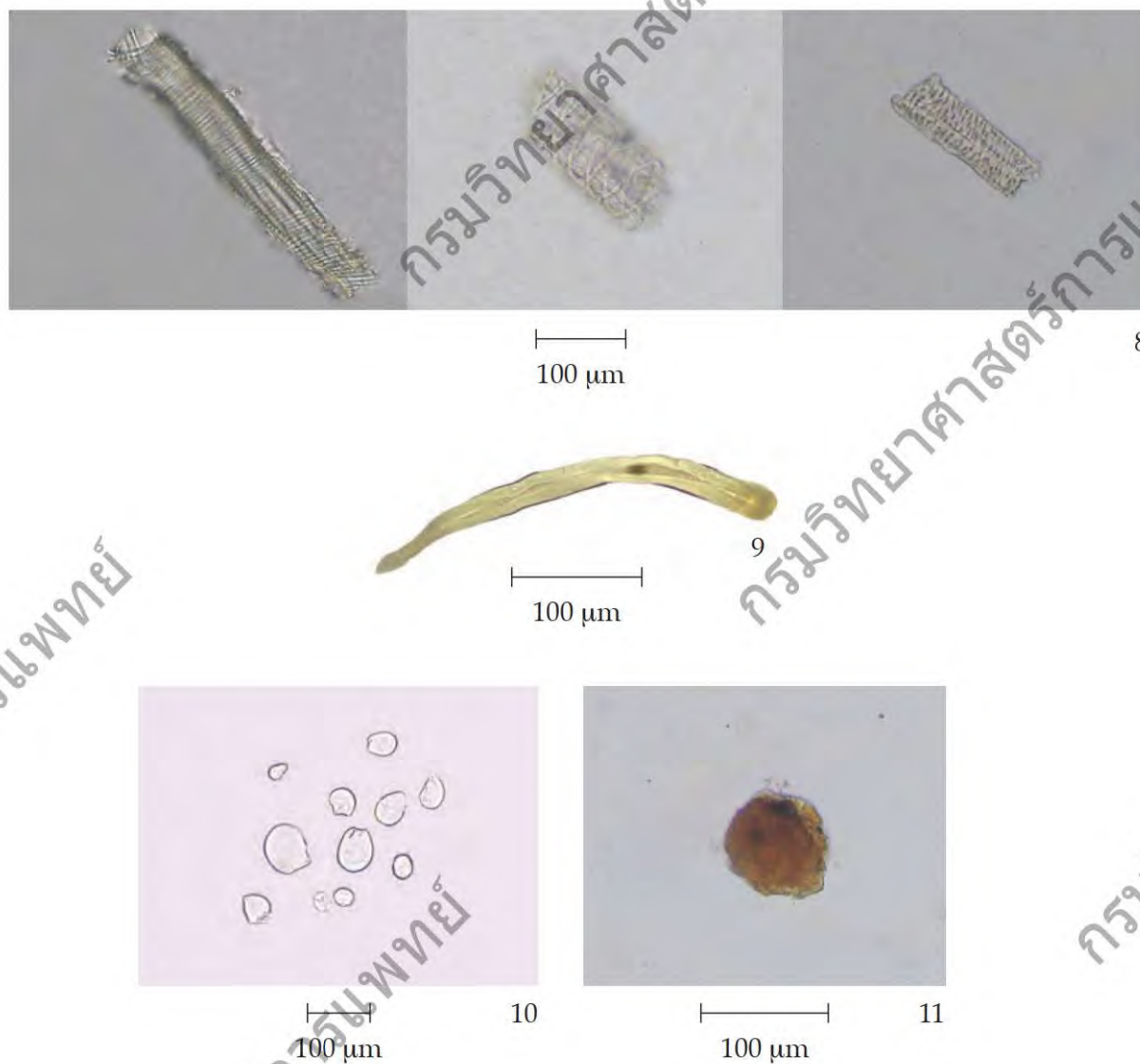


Fig. 2b (continued)

8. scalariform, spiral and reticulate vessels
9. trichome

10. starch grains
11. oleoresin

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

Identification

A. Reflux 500 mg of the sample, in *coarse powder*, with 10 mL of *ethanol* for 10 minutes, allow to cool and filter. Evaporate 3 mL of the filtrate to dryness and dissolve in a few drops of *acetic anhydride*. Slowly add a few drops of *sulfuric acid*: a green to dark green 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 F254* as the coating substance and a mixture of 93 volumes of *dichloromethane*, 7 volumes of *methanol* and 4 volumes of *ethyl acetate* as the mobile phase. Apply to the plate as a band of 10 mm, 15 µL of the test solution prepared by macerating 300 mg of the sample, in *coarse powder*, with 2 mL of *methanol* for 12 hours and filtering. After removal of the plate, allow it to dry in air and spray the plate with *anisaldehyde TS* and heat at 105° for 5 minutes; several bands of different colours are observed. Subsequently examine the plate under ultraviolet light (366 nm); one yellow and three blue fluorescent bands are observed (Fig. 3).

Loss on drying Not more than 11.0 per cent w/w after drying at 105° for 2 hours (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 10.0 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 14.0 per cent w/w (Appendix 7.12).

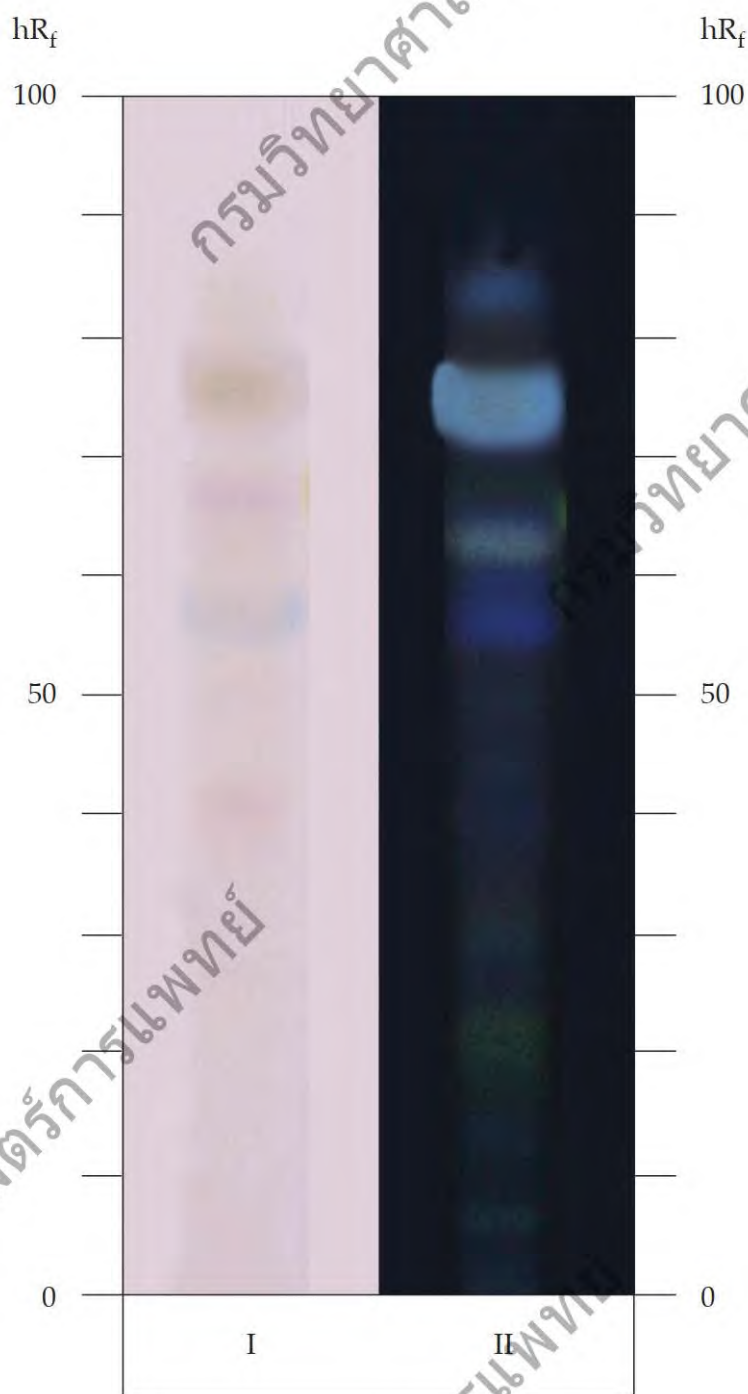


Fig. 3 Thin-Layer Chromatogram of Methanolic Extract of the Rhizomes of *Curcuma comosa* Roxb.

I = detection with *anisaldehyde* TS

II = detection under UV light (366 nm) after spraying with *anisaldehyde* TS

กรมวิ

กรมวิทยาศาสตร์การแพ

าสตร์การแพทย์

กรมวิทยาศาสตร์การแพทย์

กรมวิทยาศาสตร์

กรมวิทยาศาสตร์การแพทย์

กรมวิทยาศาสตร์การแพทย์

าสตร์การแพทย์

APPENDIX

กรมวิ

กรมวิทยาศาสตร์การแพ

าสตร์การแพทย์

กรมวิทยาศาสตร์การแพทย์

กรมวิทยาศาสตร์

กรมวิทยาศาสตร์การแพทย์

กรมวิทยาศาสตร์การแพทย์

าสตร์การแพทย์

APPENDIX

The Thai Herbal Pharmacopoeia 2021 Supplement 2022 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.

กรมวิ

กรมวิทยาศาสตร์การแพ

าสตร์การแพทย์

กรมวิทยาศาสตร์การแพทย์

กรมวิทยาศาสตร์

กรมวิทยาศาสตร์การแพทย์

กรมวิทยาศาสตร์การแพทย์

าสตร์การแพทย์

Content of the Appendix

APPENDIX 1 GENERAL INFORMATION

113

1.1 Reagents

113

กรมวิ

กรมวิทยาศาสตร์การแพ

าสตร์การแพทย์

กรมวิทยาศาสตร์การแพทย์

กรมวิทยาศาสตร์

กรมวิทยาศาสตร์การแพทย์

กรมวิทยาศาสตร์การแพทย์

าสตร์การแพทย์

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-closed containers. The labelling should comply with the relevant national legislation.

Cyperotundone $C_{15}H_{22}O = 218.33$

Use analytical reagent grade of commerce.

DESCRIPTION Yellow liquid.

Store in tightly closed containers, protected from light and at a temperature of -20° .

6-Deacetylnimbin $C_{28}H_{34}O_8 = 498.56$

Use analytical reagent grade of commerce.

DESCRIPTION White to off-white powder.

SOLUBILITY Slightly soluble in *chloroform* and in *methanol*.

MELTING RANGE 204° to 206° (Appendix 4.3).

Store in tightly closed containers, at a temperature between 0° and 4° .

Ethyl trans-4-methoxycinnamate $C_{12}H_{14}O_3 = 206.24$

Use analytical reagent grade of commerce.

DESCRIPTION White, crystalline powder.

MELTING RANGE 49.5° to 51° (Appendix 4.3).

Store in tightly closed containers, protected from light and moisture.

Pinostrobin $C_{16}H_{14}O_4 = 270.28$

Use analytical reagent grade of commerce.

DESCRIPTION White powder.

MELTING RANGE 99° to 101° (Appendix 4.3).

Store in tightly closed containers, in a cool place.

Verbascoside $C_{29}H_{36}O_{15}$ = 624.59

Use analytical reagent grade of commerce.

DESCRIPTION White to yellow powder.

MELTING RANGE 142° to 145° (Appendix 4.3).

Store in tightly closed containers, protected from light and moisture.

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