

Ethnopharmacology,  
Phytochemistry and Pharmacology  
Review of  
Traditional Chinese Medicine-I

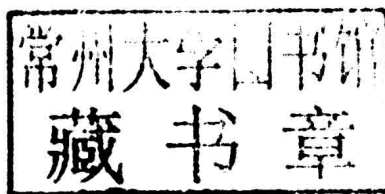
Maoxing Li



Science Press

**Ethnopharmacology, Phytochemistry and Pharmacology**  
**Review of Traditional Chinese Medicine-I**

Maoxing Li



Science Press  
Beijing

Responsible Editors: Litao Kang

Copyright © 2015 by Science Press  
Published by Science Press  
16 Donghuangchenggen North Street  
Beijing 100717, P. R. China

Printed in Beijing

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior written permission of the copyright owner.

ISBN 978-7-03-045639-7

# Editorial Board

## Editor-in-Chief

**Maoxing Li**

Department of Pharmacy

General Hospital of Lanzhou Command, PLA, Gansu, Lanzhou, China

## Associate Editor

**Jinhui Wang**

Department of Pharmacy

Affiliated Hospital of Gansu University of Chinese Medicine, Gansu, Lanzhou, China

**Zhengping Jia**

Department of Pharmacy

General Hospital of Lanzhou Command, PLA, Gansu, Lanzhou, China

## Editorial Board

**Hu Pan**

Institute of Husbandry and Pharmaceutical Sciences, Chinese Academy of Agricultural Sciences,  
Gansu, Lanzhou, China

**Linhong Huang**

Xi'an Hong-Hui Hospital

Xi'an Jiaotong University Medical College, Shanxi, Xi'an, China

**Ruxue Zhang**

Department of Pharmacy

General Hospital of Lanzhou Command, PLA, Gansu, Lanzhou, China

**Xiaofei Shang**

Institute of Husbandry and Pharmaceutical Sciences, Chinese Academy of Agricultural Sciences,  
Gansu, Lanzhou, China

**Xirui He**

Xi'an Hong-Hui Hospital

Xi'an Jiaotong University Medical College, Shanxi, Xi'an, China

**Yinqian Liu**

Pharmacy College

Lanzhou University, Gansu, Lanzhou, China



# Preface

Medicinal plants are - of course - an integral part of our common human history. There can be no doubt that they are an important part of all cultures past and modern. At the same time we now have scientific tools available to us which allow a study of these resources from a multitude of angles - including, for example, pharmacology, clinical research, phytochemistry, toxicology, anthropology, public health and history, to name just a few.

Why do we do all these studies? In part it is in order to understand our own culture and history, but many, including the author of these lines, also think that such research must contribute to a more evidence - based and safer use of such herbal medicines. There are many challenges to overcome and this book offers an overview of key evidence which is available for some of the most important species used in Traditional Chinese Medicine. As always, such research uncovers exciting new pharmacological effects of interesting chemical compounds, but it also highlights potential risks including toxic effects. So, a critical appraisal and review of the available evidence on these species is very welcome indeed. And I want to congratulate Prof. Moaxing Li from the Lanzhou General Hospital of PLA, and his team / collaborators for developing these monographs and for bringing them together in this book. The vast majority of the monographs were published in the Journal of Ethnopharmacology - without doubt today the leading journal in the area of ethnopharmacology / medicinal plant research.

These reviews provide a careful assessment of the scientific evidence on these medicinal plants, and now such research needs to be translated into better products. While the philosophy and many elements of the practice of TCM are unique to the Chinese tradition and philosophy, the fundamental requirements in terms of sustainability, quality and safety are now universal. We want and must make sure that we use safe products, which do not harm patients and ideally, ones for which a good evidence basis exists. Safety is based on two key aspects - the use of species which are general considered to be of low risk (i. e. safe) and good manufacturing along the value chains of these products. Only if both are fulfilled will we get high quality products.

In recent years concerns about adulterations and poor quality have increased tremendously and yes, we have to acknowledge that many products sold with health claims are of poor or inadequate quality. This is also linked to problems with regards to ascertaining a sustainable supply and the overexploitation of resources, is a key problem faced by practitioners of TCM and other medical traditions, So, the review of the evidence provided by Prof Moaxing Li and collaborators is an important but just a *first step* in order secure high

quality products for consumers in China and beyond.

Not only is it a pleasure to congratulate Prof Moaxing Li and collaborators for this exciting initiative, but we all should hope that it leads to such better products and thus a better use of Chinese herbal medicine.

*Prof. Michael Heinrich*

Centre for Pharmacognosy and Phytotherapy / Research Cluster Biodiversity and Medicines

UCL School of Pharmacy,

29–39 Brunswick Square,

London WC1N 1AX, United Kingdom

# Introduction

In human history, people have relied on plants in order to survive numerous diseases. After diverse exploration of their observable effects, our ancestors distinguished the medicinal plants from other ones. This knowledge was recorded categorized, and inherited over centuries in oral or in a few cases written traditions. Today, more than 22,000 plants have been used as medicine in different cultures of the world.

Thanks to the geographical and climatic diversity in our enormous country, 27,000 species of plants are known to be distributed in China. Our civilization, one of the longest and most glorious cultures in the world, has developed a unique and the most amazing Traditional medicinal tradition - TCM. People believe TCM not only can be used as medicine to treat diseases, but also as food to nourish and protect our body.

Today more and more researchers find ethnopharmacological clues for developing of new medicine from such local and traditional knowledge. Artemisinin and taxinol were the most famous success in these studies.

In the past decades, the development of chemistry, molecular pharmacology and cell biology has led to a rapid increase in the information available on TCM. At the same time, scientists also showed enthusiasm to study the phytochemistry and pharmacology of samples from the same species or genus coming from different areas. A thorough review of these studies published in different languages and areas is very important and valuable not only for the experts but also for a novice.

The aim of this book is to comprehensively outline the botanical description, ethnopharmacology, phytochemistry, biological activities and toxicology of ten special species or genera: *Leonurus Japonicus* Houtt., *Eucommia ulmoides* Oliv, *Pedicularis*, *Epimedium*, *Lonicera japonica* Thunb, *Scutellaria*, *Rehmannia glutinosa*, *Oxytropis*, *Phlomis*, *Patrinia*, and to discuss the possible trend for the further study. Information on these plants was gathered via the internet (using Pub Med, Elsevier, Baidu Scholar, Google Scholar, Medline Plus, ACS, CNKI and Web of Science) and libraries for some local books.

The common structure of the reviews for every genus includes: Introduction (1), Botanical description (2), ethnopharmacology (3), Phytochemistry (4), Biological activities (5), Toxicity (6), Future perspectives and conclusion (7), and References (8). In the first part, the common knowledge and study were introduced. In the second part, the distribution, botanical description, medicinal material description were summarized according to flora and record. In the third part, the recorded in local and traditional uses as a medicine, nourishment, an invigorator or a roborant, were reviewed. In the fourth part, the isolated



and identified chemical compounds were categorized with their structures and source (the part or species of plants). At the same time, the structures of the major compounds with high contents or high activities are included. In the fifth part, the data about bioactivities of the extracts or compounds, *in vivo* experiments or *in vitro* experiments, and animals or cells, are presented analyzed, and assessed according to different functions. The relationship of these bioactivities and the species' ethnopharmacology was especially presented. In the sixth part, the serious attention was paid to any information about the toxicity of the extracts or compounds. In the seventh part, the data about modern pharmacological and ethnopharmacological, and the species phytochemistry are rivied in order to assess theirpotential as new medicine. At the same time, limitations, methodological problems and new method arediscussed and suggested for further investigation. The references form the last part of each monograh (organized alphabetically).

The tenmedicinally important species or genera reviewed in this book were specially selected, some of them are widely used in TCM, and others are indigenous to China, especially in the Qing-zang Plateau. These plants have a long tradition of use, have therapeutically relevant effects on modern diseases, such as hepatopathy, diabetes, cancer, inflammation, immunodeficiency, ageing, and highlight the chemical diversity of such medicines. We hope this book will be beneficial for the wider public to understand the plant-based medicines and specifically of the ones used in TCM. For a novice it will serve as an outline of their chosen study object, and for researchers it will hopefully spark some ideas for future invention.

# Contents

## Preface

## Introduction

### Chapter 1 Ethnopharmacology, phytochemistry and pharmacology of

<i>Leonurus japonicus</i> Houtt .....	(1)
1.1 Introduction .....	(1)
1.2 Botany and ethnopharmacology .....	(2)
1.2.1 Botany .....	(2)
1.2.2 Ethnopharmacology .....	(2)
1.3 Phytochemistry .....	(5)
1.3.1 Alkaloids .....	(6)
1.3.2 Diterpenes .....	(6)
1.3.3 Flavones .....	(7)
1.3.4 Spirocyclic nortriterpenoids .....	(7)
1.3.5 Sesquiterpene glycosides .....	(7)
1.3.6 Megastigma .....	(7)
1.3.7 Phenylethanoid glycosides .....	(8)
1.3.8 Nonapeptides .....	(8)
1.3.9 Essential oils .....	(8)
1.3.10 Others .....	(9)
1.4 Pharmacology .....	(15)
1.4.1 Effects of chemical compounds .....	(15)
1.4.2 Effects of crude extract .....	(18)
1.5 Analysis of active constituents and quality control .....	(31)
1.6 Toxicity .....	(33)
1.7 Conclusion .....	(34)
1.8 Acknowledgements .....	(36)
1.9 References .....	(36)

### Chapter 2 Ethnopharmacology, phytochemistry and pharmacology of

<i>Eucommia ulmoides</i> Oliv .....	(41)
2.1 Introduction .....	(41)
2.2 Botanical description and ethnopharmacology .....	(41)
2.3 Phytochemistry .....	(43)
2.3.1 Lignans .....	(52)

2.3.2	Iridoids	(52)
2.3.3	Phenolics	(53)
2.3.4	Steroid and terpenoids	(53)
2.3.5	Flavonoids	(53)
2.3.6	Other compounds	(53)
2.3.7	Variance of major components	(54)
2.4	Biological activities	(54)
2.4.1	Anti-hypertensive activity	(56)
2.4.2	Hypolipidemic activity	(57)
2.4.3	Anti-obesity activity	(58)
2.4.4	Anti-diabetic activity	(58)
2.4.5	Effect on bone metabolism	(59)
2.4.6	Anti-inflammatory, anti-viral and anti-bacterial activities	(60)
2.4.7	Neuroprotective activity	(61)
2.4.8	Antioxidative activity	(61)
2.4.9	Improving erectile function	(63)
2.4.10	Anti-fatigue activity	(63)
2.4.11	Anti-aging activity	(63)
2.4.12	Anti-tumor activity	(64)
2.4.13	Hepatoprotective activity	(64)
2.4.14	Enhancing immune-function	(65)
2.5	Toxicity	(65)
2.6	Future perspectives and conclusion	(65)
2.7	Acknowledgements	(66)
2.8	Reference	(66)
<b>Chapter 3 Phytochemistry and pharmacology of the genus <i>Pedicularis</i></b>		
		(73)
3.1	Introduction	(73)
3.2	Chemical constituents	(73)
3.3	Iridoid glycosides	(77)
3.4	Phenylpropanoid glycosides	(77)
3.5	Lignan glycosides	(77)
3.6	Flavonoids	(78)
3.7	Alkaloids	(78)
3.8	Other compounds	(78)
3.9	Biological activity	(92)
3.10	Anti-tumor activity	(92)
3.11	Antioxidative activity	(93)

---

3.12	Antihemolysis activity	(94)
3.13	Repair effects on DNA damage	(94)
3.14	Hepatoprotective activity	(95)
3.15	Improving the spleen asthenia symptoms	(95)
3.16	Anti-fatigue activity	(95)
3.17	Improving learning and memory	(95)
3.18	Antibacterial activity	(96)
3.19	Other activities	(96)
3.20	Conclusions	(96)
3.21	Acknowledgement	(97)
3.22	References	(97)
<b>Chapter 4 Ethnopharmacological and phytochemical review of genus</b>		
	<b><i>Epimedium</i></b>	<b>(102)</b>
4.1	Introduction	(102)
4.2	Botanical description and distribution	(102)
4.3	Ethnopharmacological use	(106)
4.4	Chemical constituents	(108)
4.4.1	Flavonoids	(120)
4.4.2	Lignans	(121)
4.4.3	Ionones	(121)
4.4.4	Phenol glycosides	(122)
4.4.5	Phenethyl alcohol glycosides	(122)
4.4.6	Sesquiterpenes	(122)
4.4.7	Other compounds	(122)
4.5	Methods of quality control	(123)
4.6	Biological activity	(125)
4.6.1	Treatment of sexual dysfunction (aphrodisiac, kidney tonic)	(125)
4.6.2	Effect on bone metabolism	(127)
4.6.3	Effect on the immune system	(130)
4.6.4	Effect on the cardiovascular system	(132)
4.6.5	Anti-tumor effects	(134)
4.6.6	Anti-aging and anti-oxidation effects	(135)
4.6.7	Anti-hypoxia and anti-fatigue effects	(136)
4.6.8	Anti-inflammatory, anti-virus and anti-bacterial activities	(136)
4.6.9	Hepatoprotective	(137)
4.7	Clinical studies	(137)
4.8	Processing	(137)
4.9	Side effects and acute toxicity	(138)

4. 10	Conclusion .....	(138)
4. 11	References .....	(139)
<b>Chapter 5 Ethnopharmacology, phytochemistry and pharmacology of</b>		
	<b><i>Lonicera japonica</i> Thunb .....</b>	<b>(152)</b>
5. 1	Introduction .....	(152)
5. 2	Botany and ethnopharmacology .....	(153)
5. 2. 1	Botany .....	(153)
5. 2. 2	Ethnopharmacology .....	(154)
5. 3	Phytochemistry .....	(159)
5. 3. 1	Essential oils .....	(173)
5. 3. 2	Organic acids .....	(175)
5. 3. 3	Flavones .....	(175)
5. 3. 4	Iridoids .....	(176)
5. 3. 5	Saponins .....	(177)
5. 3. 6	Other compounds .....	(178)
5. 4	Effects of crude extract .....	(178)
5. 4. 1	Anti-inflammatory activity .....	(178)
5. 4. 2	Antiviral activity .....	(179)
5. 4. 3	Antibacterial activity .....	(181)
5. 4. 4	Antioxidant activity .....	(182)
5. 4. 5	Hepatoprotective .....	(183)
5. 4. 6	Anti-tumor activity .....	(183)
5. 4. 7	Insecticidal and acaricidal activities .....	(184)
5. 4. 8	Anti-pregnant activity .....	(184)
5. 4. 9	Antihyperlipidemic and antithrombotic activities .....	(184)
5. 4. 10	Anti-lipase activity .....	(185)
5. 5	Application on veterinary and agriculture .....	(185)
5. 5. 1	Application on veterinary .....	(185)
5. 5. 2	Cadmium-hyperaccumulator .....	(185)
5. 6	Preparations, the qualitative and quantitative analysis .....	(186)
5. 7	Acute and subacute toxicity .....	(187)
5. 8	Conclusion .....	(188)
5. 9	Acknowledgements .....	(189)
5. 10	Reference .....	(189)
<b>Chapter 6 Ethnopharmacological and phytochemical review of genus</b>		
	<b><i>Scutellaria</i> .....</b>	<b>(196)</b>
6. 1	Introduction .....	(196)
6. 2	Biology and ethnopharmacology .....	(196)

---

6.3	Phytochemistry .....	(203)
6.3.1	Flavonoids .....	(216)
6.3.2	Phenylethanoid glycosides .....	(234)
6.3.3	Iridoid glycosides .....	(234)
6.3.4	Diterpenes .....	(235)
6.3.5	Triterpenoids .....	(235)
6.3.6	Neo-Clerodane diterpenoid alkaloids .....	(235)
6.3.7	Alkaloids .....	(235)
6.3.8	Essential oils .....	(235)
6.3.9	Other compounds .....	(236)
6.4	Qualitative and quantitative analysis .....	(236)
6.5	Effects of crude extract .....	(237)
6.5.1	Antitumor .....	(237)
6.5.2	Anti-angiogenesis .....	(238)
6.5.3	Hepatoprotective .....	(239)
6.5.4	Antioxidant .....	(239)
6.5.5	Anticonvulsant .....	(239)
6.5.6	Antibacterial and antiviral .....	(240)
6.5.7	Neuroprotective effects and memory improvement .....	(240)
6.6	Conclusion .....	(241)
6.7	References .....	(241)
<b>Chapter 7 Botany, chemistry and pharmacology review of <i>Rehmannia glutinosa</i></b> .....		
7.1	Introduction .....	(250)
7.2	Botany of <i>Rehmannia glutinosa</i> .....	(258)
7.3	Chemical components .....	(259)
7.3.1	Iridoids, monoterpenes and glycosides .....	(259)
7.3.2	Other glycosides .....	(261)
7.3.3	Saccharides .....	(261)
7.3.4	Amino acids and microelements .....	(261)
7.3.5	Organic acids .....	(262)
7.3.6	The chemical composition changes before and after the processing ...	(262)
7.4	Pharmacological properties .....	(262)
7.4.1	Effects on blood system .....	(262)
7.4.2	Anti-tumor effects .....	(264)
7.4.3	Effects on immune system .....	(264)
7.4.4	Effects on cardiovascular system .....	(265)
7.4.5	Effects on center nervous system .....	(265)

7.4.6	Effects on bone metabolism	(266)
7.4.7	Effects on endocrine system and glucose metabolism	(267)
7.4.8	Other pharmacological effects	(267)
7.5	Conclusion	(268)
7.6	Acknowledgements	(270)
7.7	References	(270)
<b>Chapter 8 Phytochemical and biological studies of plants from the</b>		
	<b>Genus <i>Oxytropis</i></b>	(275)
8.1	Introduction	(275)
8.2	Chemical constituents	(284)
8.2.1	Flavones	(284)
8.2.2	Alkaloids	(285)
8.2.3	Triterpenoids	(285)
8.2.4	Other compounds	(285)
8.3	Biological activities	(285)
8.3.1	Anti-tumor activity	(285)
8.3.2	Clearing and inducing free radicals activities	(286)
8.3.3	Bacteriostatic activity	(286)
8.3.4	Eliminating phlegm and anti-inflammatory effect	(287)
8.3.5	Hemostasis	(287)
8.3.6	Other activities	(288)
8.4	Toxicity	(288)
8.4.1	Enzyme inhibition	(288)
8.4.2	Effect on embryonic development	(288)
8.4.3	Immune suppression activity	(289)
8.4.4	Effect on tissue and cell	(289)
8.5	Conclusion	(289)
8.6	References	(289)
<b>Chapter 9 Phytochemical and biological studies of plants from the</b>		
	<b>Genus <i>Phlomis</i></b>	(295)
9.1	Introduction	(295)
9.2	Chemical constituents	(302)
9.2.1	Terpenoids	(302)
9.2.2	2-Phenylethanoid and benzyl glycosides	(302)
9.2.3	Flavonoids	(303)
9.2.4	Lignans	(303)
9.2.5	Essential oil	(303)
9.2.6	Other compounds	(303)

---

9.3	Biological activity	(308)
9.3.1	Antinociceptive and anti-inflammatory activities	(308)
9.3.2	Cytotoxic and cytostatic activities	(308)
9.3.3	Antidiabetic activity	(309)
9.3.4	Anti-ulcerogenic activity	(309)
9.3.5	Antioxidant activity	(309)
9.3.6	Antiprotozoal activity	(309)
9.3.7	Antimutagenic activity	(310)
9.3.8	Antimicrobial and antifungal activities	(310)
9.4	Conclusions	(310)
9.5	References	(311)
<b>Chapter 10</b>	<b>The genus <i>Patrinia</i>: Ethnopharmacology, phytochemistry, and pharmacology of an important traditional Chinese medicine</b>	<b>(314)</b>
10.1	Introduction	(314)
10.2	Botanical description and ethnopharmacology	(315)
10.2.1	Botanical description	(315)
10.2.2	Ethnopharmacology	(316)
10.3	Phytochemistry	(317)
10.3.1	Triterpenoids and triterpenoids saponins	(317)
10.3.2	Iridoids	(354)
10.3.3	Flavonoids	(354)
10.3.4	Essential oils	(355)
10.3.5	Organic acids	(355)
10.3.6	Lignans	(356)
10.3.7	Anthraquinones	(356)
10.3.8	Coumarins	(356)
10.3.9	Steroids	(356)
10.3.10	Others compounds	(356)
10.4	Pharmacology	(357)
10.4.1	Anti-tumor activity	(357)
10.4.2	Sedative and hypnotic activities	(361)
10.4.3	Anti-inflammatory and anti-nociceptive activities	(362)
10.4.4	Anti-bacterial and anti-viral activities	(363)
10.4.5	Anti-oxidant activity	(364)
10.4.6	Hepatoprotective activity	(365)
10.4.7	Anti-hypoxia activity	(365)
10.4.8	Hypolipidemic activity	(365)



10. 4. 9	Cytotoxic activity .....	(366)
10. 4. 10	Effect on the immune system .....	(367)
10. 4. 11	Effect on the blood system .....	(368)
10. 4. 12	Effect on central nervous system .....	(369)
10. 5	Modern clinical application .....	(369)
10. 5. 1	Treatment of cancers .....	(369)
10. 5. 2	Treatment of neurasthenia .....	(370)
10. 5. 3	Treatment of epidemic parotitis .....	(370)
10. 5. 4	Treatment of acute bacterial inflammation .....	(370)
10. 5. 5	Treatment of cold .....	(370)
10. 5. 6	Adverse reactions .....	(370)
10. 6	Toxicity .....	(371)
10. 7	Future perspectives and conclusion .....	(371)
10. 8	Acknowledgements .....	(372)
10. 9	References .....	(372)