Eng Soon Teoh

Medicinal Orchids of Asia

Springer

Medicinal Orchids of Asia

Eng Soon Teoh

Medicinal Orchids of Asia

Springer

Eng Soon Teoh, M.D., F.R.C.O.G., F.A.C.S.
Singapore
Singapore

ISBN 978-3-319-24272-9 ISBN 978-3-319-24274-3 (eBook)
DOI 10.1007/978-3-319-24274-3

Library of Congress Control Number: 2016947012

© Springer International Publishing Switzerland 2016
This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.
The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.
The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG Switzerland

Dedicated to my wife Teoh Phaik Khuan

Preface

Rebecca Northern's *Home Orchid Growing* provided recreational reading when I was studying for my professional examination in London in 1968. I continue to enjoy reading about orchids and growing the plants. Noticing that orchids are now receiving attention as possible sources of medicinal compounds, I decided to study this area in depth because, having been privileged to participate in laboratory and clinical research for many years, I could employ my medical background to examine the extensive research that has been conducted on the use of orchids as medicine. There is maximum, continuous usage of orchids as medicine in Asia, for the longest period, and because Asia is my home, and also the area of much of my travel, the coverage of medicinal orchid species will be restricted to this region.

Before the advent of scientific medicine, all civilizations relied on plants and other natural materials to cope with pain, trauma and disease. Dominance and sex being important elements of Man's animal heritage, plants with alleged invigorating or aphrodisiac properties were eagerly sought after. Growth hormone, testosterone, sidenafil and tadalafil are only modern substitutes for much the same need.

Herbal medicine is practised worldwide, and not in Asia alone. In many continents, orchids have been used to nourish or to heal. *Salep* derived from terrestrial Mediterranean orchids and extracts of North American *Cypripediums* featured in European and American pharmacopoeia well into the later nineteenth century. Nevertheless, using orchids as medicine is most entrenched in China, which has a well-documented and the longest history of continuous usage, as well as the longest list of orchids in medicinal use. Worldwide, there are over 25,000 species in approximately 850 genera but only 2 % have a published medicinal usage. It is estimated that approximately 1200 species of orchids belonging to 174 genera occur in China. More than 250 species (or over 20 % of total species) in approximately 100 genera are already recorded in Chinese herbals as having medicinal usage. Four orchids are classical medicinal herbs whose origins can be traced to antiquity. They are still commonly employed in the Orient, from China to Korea, Japan and Southeast Asia, and by Chinese communities in far-flung countries. Chinese herbal soups occasionally contain an orchid.

Orchids also feature in Ayurvedic medicine. They constitute half of the eight items in the famed *Asthvargha* tonic. Nearly two dozen Indian medicinal names are attached to *Dendrobium plicatile*, many of which denote "life". It is one of two candidates that fulfil the description of a mysterious

Himalayan herb that restored life to the *Ramayana* hero, Lakshmana. Truckloads of this orchid are imported into India from neighbouring countries. Tribes in India and the surrounding countries employ orchids in various ways to treat trauma and disease.

Having experienced a shortage of medicines during World War II, after the war scientists embarked on an extensive search for alkaloids in plants. There was some difficulty in studying alkaloids in orchids because rarity or small plant size sometimes made it difficult to collect sufficient materials for the identification of chemical compounds. Nevertheless, this did not deter the Swedish team led by Bjorn Luning and Kurt Leander or the Australian team of Slaytor and Walker from undertaking alkaloid screening programmes. Together, by 1994 they had published the data on 1750 orchid species. Japanese, Chinese and Korean scientists were more interested in studying orchid species employed in traditional Chinese, Japanese and Korean medicine. There are extensive publications on phytochemicals from *Gastrodia elata, Dendrobium* spp. and *Bletilla striata*.

Forced to rely on its own resources to promote the health of its people when the "Bamboo Curtain" descended over the Peoples' Republic of China, the country undertook an extensive in-depth study of ethno-medicine which hitherto had only been provincial or tribal knowledge. In the process, hundreds of orchid species were incorporated into an expanded *Ben Cao* (*Materia Medica*). By unveiling the reproductive biology and pharmacology of important medicinal species, scientists in Guizhou and Yunnan managed to promote the cultivation of such species on an industrial scale and to manufacture specific compounds to meet with demand.

As a consequence of the remarkable economic and scientific advances made by China during the last three decades, traditional Chinese medicine is witnessing an interphase between tradition and science, with science dominating the transition. Concurrently, there has been an explosion of publications, including many on orchids. Several traditional medicinal orchids have since been shown to contain compounds that exert a wide range of pharmacological effects. Some compounds are unique in their actions, some are capable of protecting brain cells, while a few act against malaria parasites or liver flukes. Orchid extracts may protect the skin or liver. There are compounds that kill cancer cells, while others reverse cancer cell resistance to chemotherapeutic agents. *Bletilla striata* starch is employed for embolization to treat inoperable liver cancer and is being developed to assist in the delivery of drugs. Such compounds are being actively studied to determine whether they can be turned into potent drugs.

There are many studies on ethno-medicine in India, but until the advent of the internet knowledge of the subject was mainly confined to the nation. In Calcutta, Majumder and his team of collaborators isolated a long list of compounds from numerous Himalayan orchids. Korean scientists have also investigated the pharmacology of their orchids. However, it is difficult to extract these data because they are either not available in the English language or they are published in journals which are not read by doctors,

nor by orchid enthusiasts with no interest in pharmacology. Research materials originating in China and Japan are mostly recorded in journals which employ their native languages and such data may remain unnoticed by Western readers for decades. I am fortunate to have been helped by medical colleagues who have mastered the Chinese language. They provided me with the necessary support that has enabled me to research the Chinese literature.

This volume thus sets out to compile a list of the medicinal orchids employed in Asia, briefly describe their identification, distribution, habitat and flowering season, how they are used and their pharmacology. Medicinal orchid species are described individually, grouped under genera. An overview sums up and discusses the research findings in each genus. Clinical information is occasionally included when it was necessary to explain the significance of the research data. Findings that hold promise of possible therapeutic application are highlighted.

The Introduction gives an overview of herbal medicine, its role, the extent of its usage and the risks involved. Since many Western readers may be unfamiliar with Asian medicinal tradition, the various traditions are described, followed by a discussion of the way herbs are collected and prepared. A brief survey of plant metabolites is intended as an introduction for the general reader to the types of bioactive chemical compounds isolated from orchids in which scientists are interested. Currently, the effects of medicinal orchid species are being proven by laboratory research on tissues or laboratory animals, but there is a paucity of data on human subjects. Nevertheless, this is a beginning. A placebo-controlled randomized clinical trial being the gold standard to prove efficacy of any new drug, a chapter is included to emphasize that it would be difficult, today, to endorse a herbal remedy without such experimental proof. A short final chapter explains the difference between anecdotal evidence and data which are statistically significant.

The use of orchids as aphrodisiacs in India, and the high Chinese demand for some medicinal orchids, worry conservationists who are concerned about the status of wild orchids in India (especially in the Himalayan region), China and continental Southeast Asia. Conservation, the preservation of biodiversity and problems in the enforcement are discussed in detail.

I wish to stress that this book was not written to endorse the use of orchids as medicinal herbs. I do not practise Chinese herbal medicine. Scientific research on medicinal orchids, although extensive and exciting, is still at an early stage, and it is inappropriate to draw clinical inferences or conclusions from in vitro studies and animal experiments. Much remains to be done to see that proper clinical trials are conducted to substantiate or disprove the claims for specific therapeutic uses of individual orchids or their compounds. I have kept an open mind on the subject, and I have tried to be impartial in my assessments of published articles. The claims that are made in the quoted publications are reported as they appear and no attempt was made to check their validity. On the issue of tribal and folk medicine, it seems unlikely that the authors actually witnessed the orchids they described being used to treat disease and the results, as ethnomedicinal botany is basically constituted from statements of folk practitioners. This being so, the portion of the present

book which deals with herbal usage should be viewed as just a historical record and not as recommendations for use.

Scientists recognize that, when dealing with herbal products, there is the problem of dosage standardisation. Pharmacological potency of biological products vary from batch to batch and the potency of a herb cannot be accurately determined by weight. Only highly purified, single compounds can be standardised by weight. Recommendations for the use of chromatographic analyses to be employed for quality control have been made, but this is not universally practised. Furthermore, since chromatograms of batches will certainly vary, every batch requires bioassay and that is hardly possible to put into practice. There is also the problem of the proper identification of species. The best way to handle this last problem is for medicinal orchids to be commercially cultivated. Clonal propagation might bring herbs closer to a uniform standard, albeit the environment will produce differences.

Readers will notice that a good percentage of the references are made up of material published in Chinese. For their translation, I wish to thank my colleagues and friends, Ong Siew Chey, MD (Chicago), FACS, and Wu Dong Yin, MD (Shanghai), who devoted a great deal of time to this effort. I am grateful to Wibowo Sutjahto, MD, who translated the Dutch texts for me, and especially to Joseph Arditti, who spent many days going over the text with me, for his advice on how botanical data should be presented and for access to his treasure house of references. The Library of the Singapore Botanic Gardens and the National Library of Singapore were valuable sources of reference materials, and I thank their staff for their kind assistance. I also wish to record my thanks to Hong Hai, PhD, for reading through my text and making valuable suggestions. For colour photographs, I am indebted to Bhaktar Bhadhar Raskoti for his numerous images of Himalayan orchids, the Plant Photo Bank of China and Luo Yibo, PhD, for photographs of Chinese orchids, as well as Henry Oakley, Peter O'Byrne, Nima Gyeltshen, Liu Ming, Hubert Kurzweil, Tim Yam, Sathish Kumar, Suranjan Fernando, Jagdeep Varma and Ang Wee Foong for additional photographs of medicinal orchids. I thank the Orchid Society of Southeast Asia for giving me the privilege to photograph orchid plants exhibited at their meetings and shows, and my many friends in Singapore, Thailand, India, Bhutan and China who helped to provide access to orchid species: in particular, Mak Chin On, John Elliott, Rapee Sagarik, Apichart Jitnuyanond, Michael Ooi, Robert Ang, Udai C. Pradhan and Ganesh Pradhan, Ngawang Gyeltshen, Nima Gyeltshen and Rajendra Yonzone.

To complement the short descriptions of the plants, black and white drawings are featured to illustrate the general appearance of the plants in various genera. These were originally planned to be line drawings borrowed from old, classic publications. As it turned out, it was not possible to provide a comprehensive coverage through this avenue. However, I did manage to borrow some excellent line drawings from Abraham and Vatsala's *Introduction to Orchids* and I wish to thank the Director of Jawaharlal Nehru Tropical Garden and the Botanical Research Institute, Parlode, for permission to reproduce the drawings. For the remaining black and white illustrations, I am grateful to the Plant Illustrations Organization and the Missouri Botanical

Gardens for access to their vast collection of old publications whose material is now in the public domain. I also wish to thank the other libraries for the materials which are reproduced with their named source.

Singapore
January 2016

Eng Soon Teoh, MD

Contents

Part I General Information

1 Introduction 3
Orchids as Medicine or Food 7
Orchids as Aphrodisiacs 11
Chemical Compounds in Orchids 12
Are Orchids the Real Source of the Chemical Constituents? 14
Orchids as Talismans 15
References 15

2 Traditional Chinese Medicine, Korean Traditional Herbal Medicine, and Japanese Kanpo Medicine 19
Origins 19
Using Chinese Herbs 23
Herbal Names 24
Specificity of Herbal Names 27
Classification of Herbs 27
Foreign Influences 28
Korean Traditional Herbal Medicine 29
Ethnic Traditional Medicine in Japan 30
References 31

3 Indian Traditional Medicine and Other Asian Traditions . . . 33
Ayurveda 33
Siddha Medicine *(Siddha vaidyam)* 38
Unnani tibb 39
Tibetan Medicine 39
Indian Tribal Medicine 40
Arab Medicine 42
Iranian Medicine 45
Malay and Indonesian Medicine 46
Thai Herbal Medicine 46
References 47

4 Processing of Medicinal Herbs 51
Washing and Cleaning 51
Heat Treatment 52
Fermentation 52

Contemporary Methods for Extracting Chemicals from Medicinal Herbs 55
Dosage of a Medicinal Compound 56
Expiry Date 56
Administration of a Herbal Product 56
References 57

5 Secondary Metabolites of Plants 59
Phytoalexins 59
Hydrocarbons 60
Terpenes (Terpenoids and Steroids) 61
Triterpenes and Steroids 62
Stilbenoids and Bibenzyls 62
Phenanthrenes 62
Alkaloids 64
Phenols 67
Flavonoids 67
Polysaccharides 69
The Orchids 69
Comment 69
References 69

6 Discovery, Testing and Improving the Production of Herbs and New Drugs 75
Screening Plant Extracts for Possible Medicinal Properties 76
References 80

Part II Medicinal Orchids in Asia by Genus and Species
Introduction to Part II

7 Genus: *Acampe* to *Arundina* 85
Genus: *Acampe* Lindl. 85
Genus: *Acriopsis* Reinw. ex Bl. 89
Genus: *Aerides* Lour. 90
Genus: *Agrostophyllum* Bl. 94
Genus: *Amitostigma* Schltr. 95
Genus: *Anacamptis* Rich. 98
Genus: *Anoectochilus* Blume 103
Genus: *Anthogonium* Lindl. 113
Genus: *Apostasia,* Blume 115
Genus: *Appendicula* Blume 118
Genus: *Arachnis* Blume 118
Genus: *Arundina* Blume 120
References 124

8 Genus: *Bletilla* to *Bulbophyllum* 131
Genus: *Bletilla* Rchb. f. 131
Genus: *Brachycorythis* Lindl. 146
Genus: *Bromheadia* Lindl. 147

Genus: *Bulbophyllum* Thouars 148
References 164

9 Genus: *Calanthe* to *Cyrtosia* 171
Genus: *Calanthe* Brown 171
Genus: *Callostylis* Blume 183
Genus: *Cephalanthera* Rich. 185
Genus: *Changnienia* Chien 187
Genus: *Cleisostoma* Blume 188
Genus: *Coelogyne* Lindl. 193
Genus: *Conchidium* Griff. 203
Genus: *Corymborkis* Thouars. 204
Genus: *Cremastra* Lindl. 206
Genus: *Crepidium* 211
Genus: *Cymbidium* Sw. 214
Genus: *Cypripedium* Linn. 231
Genus: *Cyrtosia* Blume 240
References 242

10 Genus: *Dactylorhiza* to *Dipodium* 251
Genus: *Dactylorhizia,* Necker 251
Genus: *Dendrobium* Sw 257
Genus: *Dienia*, Lindl. 330
Genus: *Diploprora* Hook. f. 333
Genus: *Dipodium* R. Br. 333
References 335

11 *Epipactis* to *Eulophia* 351
Genus: *Epipactis* Zinn. 351
Genus: *Eria* Lindl. 356
Genus: *Eulophia* R. Br. 359
References 370

12 *Galeola* to *Gymadenia* 375
Genus: *Galeola* Lour. 375
Genus: *Gastrochilus* D. Don. 378
Genus: *Gastrodia* R. Br. 379
Genus: *Geodorum* Jacks. 409
Genus: *Goodyera* R. Br. 412
Genus: *Grammatophyllum* Blume 420
Genus: *Gymnadenia* R.Br. 424
References 430

13 Genus: *Habenaria* to *Ischnogyne* 441
Genus: *Habenaria* Willd. 441
Genus: *Hemipilia* Lindl. 454
Genus: *Hemipiliopsis* Y.B. Luo & S.C. Chen 457
Genus: *Herminium* L. 457
Genus: *Hetaeria* Blume 460
Genus: *Hippeophyllum* Schltr. 462

Genus: *Holcoglossum* Schltr. 1 462
Genus: *Ipsea* Lindl. 464
Genus: *Ischnogyne* Schltr. 467
References 467

14 Genus: *Liparis–Luisia* 471
Genus: *Liparis,* Rich. 471
Genus: *Ludisia* A. Rich. 492
Genus: *Luisia* Gaudich. 494
References 501

15 Genus: *Macodes* to *Mycaranthes* 505
Genus: *Macodes* Lindl. 505
Genus: *Malaxis* Sol. ex Sw. 506
Genus: *Microtis* R. Br. 513
Genus: *Mycaranthes* Blume 513
References 517

16 Genus: *Neottia* to *Neuwiedia* 519
Genus: *Neottia* Guett. 519
Genus: *Neottianthe* (Rchb. f.) Schltr. 519
Genus: *Nephelaphyllum* Blume 522
Genus: *Nervilia* Comm. ex Gaudich. 523
Genus: *Neuwiedia* Bl. 530
References 532

17 Genus: *Oberonia* to *Otochilus* 535
Genus: *Oberonia*, Lindl. 535
Genus: *Ophrys* L. 539
Genus: *Orchis* Linn. 542
Genus: *Oreorchis* Lindl. 550
Genus: *Ornithochilus* (Lindl.) Wall ex Benth. 551
Genus: *Otochilus* Lindl. 554
References 557

18 Genus: *Paphiopedilum* to *Ponerorchis* 561
Genus: *Paphiopedilum* Pfitzer 561
Genus: *Papilionanthe* Schltr. 566
Genus: *Pecteilis* Raf. 569
Genus: *Pelatantheria* Ridl. 571
Genus: *Peristylus* Blume 572
Genus: *Phaius* Lour. 576
Genus: *Phalaenopsis* Blume 579
Genus: *Pholidota* Lindl. 587
Genus *Pinalia* 600
Genus: *Platanthera* L.C. Rich. 602
Genus: *Pleione* D. Don 609
Genus: *Plocoglottis* Bl. 616
Genus: *Pogonia* Juss. 618
Genus: *Polystachya* Hook. 619

Genus: *Pomatocalpa* Breda, Kuhl & Hasselt. 621
Genus: *Ponerorchis* Rchb. f. 623
References 624

19 Genus: *Renanathera* to *Robequetia* 631
Genus: *Renanthera* Lour. 631
Genus: *Rhynchostylis* Blume 632
Genus: *Robiquetia* Guadich 635
References 636

20 Genus: *Satyrium* to *Sunipia* 639
Genus: *Satyrium* Sw. 639
Genus: *Sedirea* Garay and H. R. Sweet 642
Genus: *Smitinandia* Holtt. 643
Genus: *Spathoglottis* Blume 644
Genus: *Spiranthes* Rich. 647
Genus: *Steveniella* Schltr. 655
Genus: *Sunipia* Lindl. 655
References 655

21 Genus: *Taprobanea* to *Tropidia* 659
Genus: *Taprobanea* Christenson 659
Genus: *Thrixspermum* Lour. 660
Genus: *Thunia* Rchb. f. 662
Genus: *Trias* Lindl. 663
Genus: *Tropidia* Lindl. 664
References 665

22 Genus: *Vanda* to *Zeuxine* 667
Genus: *Vanda* R. Br. 667
Genus: *Vanilla* Plum. ex Mill. 679
Genus: *Zeuxine* Lindl. 683
References 685

Part III Future Directions

23 Sources of Medicinal Orchids and Conservation 691
Sources of Herbs Influence the Quality 691
Identification of Source 694
Life Span of Above-Ground and Underground Organs of Orchids 694
Indispensable Mycorrhiza 694
Bacteria 699
Light and Moisture 699
Protecting the Sources: Conservation 700
Medicinal Orchids from the Cool Temperate Regions 710
Artificial Pollination 711
Micropropagation and Improved Culture Techniques 711
Cryopreservation and Vitrification 712
Orchid Seed Banking 712
Genetic Diversity 713

Medicinal Orchids and Cites 714
Farming of Medicinal Orchids 717
Hybridization for Improvement 719
Genetic Manipulation 719
Good Agricultural Practice 720
Intercropping 721
Conclusion 721
References 722

24 The Randomized Clinical Trial and the Documentation of Side Effects 729
Side Effects 730
References 732

Glossary 735

Index 743

Part I

General Information

Introduction 1

Once, when the author expressed his concern over the breadth and depth of knowledge required of him as a doctor staying abreast with science, a learned colleague commented that, whereas it was difficult to pass a medical college examination, the actual practice of medicine was relatively easy. The reason stated was that, given rest and time, the body usually heals itself—a phenomenon that was well understood by ancient physicians. Hippocrates referred to this healing power of the body as "the vital force", almost an equivalent to the *qi* of the Yellow Emperor, father of Chinese medicine.

The body's capacity to heal itself supports many forms of complementary and alternative medical practices, with placebo effectively relieving pain and anxiety in up to a third of instances. Although complementary and alternative medicine (CAM) is no match for modern scientific medicine, which is now armed with sophisticated modalities for diagnosis and effective remedies for acute conditions, CAM is on the rise, even in developed countries, because of the growth of their elderly populations causing a concomitant increase in degenerative lesions which are accompanied by discomfort, pain, handicap, depression and dementia, conditions for which modern medicine is still lacking fully effective, safe and affordable remedies. Medical science is still struggling to achieve a better understanding of senescence so that it can either slow down the process or temper its consequences. Meanwhile, effective treatments for sustained pain relief, loss of flexibility, strength, drive, mobility and confidence are all lacking. Consequently, many people turn to CAM for symptom relief, sometimes even with the overly optimistic hope of a cure. The Center for Disease Control of the United States of America (USCDC) reported that in 2004 slightly over a third of Americans had used at least one form of CAM in the previous year, expending billions of dollars from their own pockets (such expenses not being covered by medical insurance). In their search for new compounds to help people cope with old age and its attendant illnesses, scientists have looked again at orchids, and here indeed there seem to be compounds that might prove to be useful (Institute of Medicine (US), Committee on the Use of Complementary and Alternative Medicine in the United States 2005).

Before the nineteenth century, all forms of traditional medicine were pre-scientific, be they Western, Indian, Chinese or tribal (French 2003). They had their own systems of classifying disease, reasoning which stood apart from logic, and treatments that often baffle modern science. Nevertheless, many ancient observations on the history and prognosis of several diseases were accurate, and within each tradition numerous remarkable cures were achieved (Huard and Wong 1968; Horner 1982). Each tradition had its own array of medicinal plants alleged to possess properties relevant to the illness for which

© Springer International Publishing Switzerland 2016

E.S. Teoh, *Medicinal Orchids of Asia*, DOI 10.1007/978-3-319-24274-3_1

they were intended. During the past 100 years or so, advances in chemical, biochemical, pharmacologic and pharmaceutical research have enabled scientists to identify the key constituents of potent medicinal plants and poisons. Numerous compounds have been isolated, studied, purified, modified and improved upon to give us many of the therapeutic weapons that we use today against fever, pain, hypertension, infections and cancer.

The concerted search for new remedies from plants during the period of colonial exploration and expansion led to the discovery of such useful drugs as morphine (from Poppy) for pain relief; ephedrine (from the Chinese *ma hung*, or *Ephedra*) for treating asthma; quinine (from the Indonesian *Cinchona* bark) for malaria; reserpine (from the Indian herb, *Rauwolfia serpentina*) to lower blood pressure; curare (from the Amazonian arrow poison) which paralyses muscles so that safe surgery can be performed; and vincristine (from the Madagascan periwinkle), a cytotoxic agent that is effective against some forms of cancer. There are many others. The search continues and new compounds are constantly being added to the list. For instance, artemisinin (*qinghaosu*) from *Artemisia annua* for chloroquine-resistant cerebral malaria, and taxol from the Pacific Yew, which destroys ovarian and breast cancers, were only added to the medical armamentarium during the last 30 years.

Nevertheless, much of the ancient *Materia Medica* was non-specific, and often did not work. Proficient ancient healers were adept at separating minor discomforts and disabilities from serious illnesses, and non-fatal illnesses from fatal conditions. Reputable physicians did not arrive at diagnosis by guesswork. They honed their skills at clinical diagnosis by long, painstaking study, and by making careful observations on the background and living conditions of the patient, the history of the illness, its symptoms and signs and the patient's personality. This holistic approach determined the remedy that the physician recommended.

Famous physicians in China such as Hua Tuo (died 208 CE) of the Three Kingdoms Period and Sun Simiao (581–682 CE) of the Tang Dynasty recognised the greater prevalence of disease among the underprivileged, and they devoted their lives to the treatment of this group. Hua Tuo and Sun Simiao declined imperial appointments and often gave away their earnings to poor patients whose "illness" was principally lack of food. Sun Simiao exploited the Chinese concern for progeny to emphasize rest and good nutrition for pregnant or lactating women. Pregnancy was a special time when an ancient daughter-in-law might be treated as someone who was extra-special in the family (Teoh and Lam 1985). Sun Simiao's ideas on a healthy lifestyle and proper nutrition are incorporated in his *Qian Jin Yao Fang* (*A Thousand Golden Remedies*) and *Supplement to A Thousand Golden Remedies*, two works that summed up Chinese medical achievements up to the seventh century (Xie and Huang undated). Herbs were not considered to be a first-line treatment: they would be used only when simple measures did not work or if the illness worsened or was serious. Sun Simiao stressed that there was a proper time for the gathering of individual herbs which should thereafter be properly handled and processed; otherwise, 50–60 % of patients would experience no improvement when the herbs were administered. In other words, he appreciated that there is an appreciable placebo effect of perhaps 50 % with any treatment. Sun Simiao is revered as a god of medicine and is commonly shown in control of both *yin* (riding a tiger) and *yang* (holding a dragon) influences (Figs. 1.1 and 1.2).

Such physicians showed great wisdom, for, in the absence of really potent remedies such as antibacterial, antihypertensive and cardiotrophic drugs, and denied the ability to perform safe surgery for most conditions, the best part of a physician's remedy was the provision of an optimal setting for the body to heal itself. Hans Agren (1975), in his assessment of Chinese traditional medicine (TCM), reiterated that a good doctor often cures his patient without the aid of drugs with verified pharmacological properties. What in effect constitutes a good doctor is, among other things, trustworthiness and the power to fulfil the patient's needs for comfort and hope (Figs. 1.3 and 1.4).

Fig. 1.1 Sun Simiao depicted as a god of medicine at White Cloud Temple, Beijing. A Chinese Hippocrates, he placed great stress on medical ethics, described 4500 prescriptions, the proper gathering and handling of herbs and reverence for all forms of life (Photo: E.S. Teoh)

Fig. 1.2 Portrait of Sun Simiao on Chinese postage stamp

Fig. 1.3 White Cloud Temple in Beijing dating from the Yuan Dynasty (1271–1368) is dedicated to famous physicians (or gods of medicine). Main shrine in the background houses images of the Yellow Emperor and Shen Nong. A five-clawed dragon decorating the incense urn in the foreground denotes the imperial status of the shrine's occupants (Photo: E.S. Teoh)

Historical records state that ancient Indian and Chinese physicians gave a prognosis right at the start, and directed a patient to seek the expertise of other practitioners if they were unable to cope with the problem at hand. Nevertheless, if the physician was practising in an isolated area, there was no recourse to higher talent. He was required to rely on his own skills, and his own, few, medicinal resources.

The account of the life of Jivaka Komarabhacca who lived in Rajagriha (in modern Bihar) around 600 BC illustrates how a resourceful Indian physician dealt with medicinal herbs. Jivaka was the royal physician of King Bimbisara, and his duties involved looking after

Fig. 1.4 Shrine at Beijing's White Cloud Temple dedicated to Sun Si Miao also houses an image of Hua Tuo. This reverence for famous physicians characterizes the high regard accorded to Traditional Chinese Medicine in Chinese culture (Photo: E.S. Teoh)

the Buddha and the order of monks. In his youth, he went to study under a famous Master in the city of Taxila (now in Pakistan). After 7 years of study, Jivaka enquired from his Master when his studies would be complete. The Master gave him a basket and asked him to go round the city to collect all the plants with unknown medicinal properties so that the Master could explain their usage to round off his knowledge. At nightfall, Jivaka came back empty-handed. He told the Master that within one *yojana* (13 km) of Taxila, he did not find a single plant whose usage he did not comprehend. Thereupon, the Master announced that his training was complete and he gave Jivaka some money to help with his journey home.

Jivaka proved to be an excellent physician and surgeon. The record of the cures that he achieved showed that his skills far surpassed those of the leading physicians throughout all of northern India (Horner 1982).

On the question of the herbs, young Jivaka understood that it was not always possible to find the plants that contained the specific medicinal properties required to treat the disease on hand. However, as a physician, he could not tell his patient that he did not have the correct remedy, so he would need to use a placebo. For that purpose, almost any non-poisonous plant could be used. In the event, should someone be on hand to record the identity of the placebo plant used by such a distinguished physician, it is conceivable that plant might eventually be incorporated into the local *Materia Medica*.

In the High Chinese Medical Tradition, the *Ben Cao* (*Materia Medica*) forms a major component of the physician's therapeutics. It lists the officially recognised herbs (*Guan Yao*, official medicines). Chinese physicians additionally employ physical methods to treat disease, such as acupuncture, manipulation, moxibation (applying external heat) and cupping. Shamanistic therapists employ apotropaics (incantations, amulets, charms) as well as local herbs. They belong to the Small or Low Tradition that is also practised by lay men and lay women. In the old days, grandmothers in Indonesia and Malaysia (mine among them) would utter a mantra over the lesion when they applied herbal poultices on painful insect and snake bites. From my childhood recollection, oftentimes the patient was instantly relieved. Within this Low Tradition, there is a folkloric *Materia Medica* which is derived by extracting popular remedies from classical pharmacopeias and adding to them simple folk remedies based on locally available plants, referred to by Chinese writers as "uncured or wild herbs" (Hu 1971).

Orchids as Medicine or Food

Apart from three main drugs which happen to be orchids in the *Shen Nong Ban Cao Jing* or the *Materia Medica of Shen Nong*, namely *Tianma* (*Gastrodia elata*) (Fig. 1.5), *Shihu* (various species of lithophytic *Dendrobium*) (Fig. 1.6) and *Baiji* (*Bletillia striata*) (Fig. 1.7), the vast majority of orchids used as medicinal herbs in China fall within this Low Tradition. The same is probably the case with the use of orchids in Indian Ayurvedic and Unnani Medicine (Akarsh 2004; Rao and Sridhar 2007; Trivedi et al. 1980; Dagar and Dagar 2003; Sivakumar et al. 2003; Dash et al. 2008). Medicinal usage of native orchids in Thailand, Malaysia, Indonesia, the Philippines and the rest of tropical Asia is similarly the provenance of provincial herbalists (Burkill and Haniff 1930; Gimlette and Thomson 1939; Beekman 2002; Chuakul 2002).

It is estimated that about 25–50 % of medications used today are derived directly from plants or are modified forms of secondary

Fig. 1.5 *Tianma* (tubers of *Gastrodia elata*) offered in a herbal shop in Lijiang, Yunnan Province, China (Photo: E.S. Teoh)

Fig. 1.6 *Dendrobium catenatum* (syn. *Dendrobium officinale*) is one of two *Dendrobium* species mentioned as *shihu* in *Shen Nong Bencao Jing* (first century CE) (Photo: E.S. Teoh)

Fig. 1.7 *Baiji* are tubers of *Bletilla striata* (as *Cymbidium hyacinthinum* Sm. in Curtis Botanical Magazine, vol. 36: t. 1492 (1812) drawn by S.T. Edwards. Courtesy of Missouri Botanical Gardens, St. Louis, USA

metabolites of plants. Many pharmaceutical firms and research institutes devote a sizable portion of their resources to the investigation of medicinal plants and related species, even though the search is seldom fruitful. Nevertheless, since only a tiny fraction of the botanical world has been examined by chemists and pharmacologists (Kong et al. 2003), there is much scope for new discoveries.

Apart from being decorative plants grown primarily for the sake of their flowers, orchids have other uses. Worldwide, there are 25,000–30,000 species of orchids, and about 600 species (2 %) have recorded medical usage. China is an exception: approximately 20 % of its native orchids enjoy medicinal usage.

Four orchid species have been used in China as herbal remedies since the dawn of history. All four orchids are remarkable in their ecological characteristics. *Dendrobium catenatum* (syn. *D. officinale*) (Fig. 1.6) and *D. moniliforme*, or *shihu* in TCM terminology, were consumed as tonics. In what is possibly the oldest Chinese account of an orchid habitat, Tao Hongjing's *Ming Yi Bie Lu* (*Additional Records of Famous Physicians*) published around 520, reported that *shihu* grew on rocks by the waterside, in the valleys of Lu An (Chen and Tang 1982). This saxicolous (lithophytic) characteristic endowed *shihu* with tonic potential. Exotic *Chi Jian* (red arrow), now universally referred to as *Tianma* (*Gastrodia elata*), was a parasitic orchid which lived underground, only sending out its arrow-shaped red inflorescence when it sought to cross-fertilize. *Tianma* enjoyed a reputation for an ability to promote recovery from strokes and other neurological disorders. *Baiji* (*Bletilla striata*) flourished in extensive colonies by producing potent phytoalexins which kept other plants at bay. It was used to treat tuberculosis and bronchiectasis, two very common and incurable conditions in impoverished ancient China, and as a remedy for chapped skin and bleeding sores. These three orchidaceous herbs are still widely consumed, their usage extending to Korea, Japan and Southeast Asia, countries that long ago experienced an influx of Chinese culture (Han et al. 1998; Zhao et al. 2006). Today, the list of orchid species used in Chinese remedies run into the hundreds, with dozens of saxicolous and epiphytic *Dendrobium* species now classified as *shihu*.

Orchids have also seen medicinal usage for centuries in India, Southeast Asia, the Middle East, Africa, Europe, the Americas and in Oceania. Vanilla comes from an orchid with the same name. Aztecs used *tlilxochitl* (the original name for vanilla) to flavour *choklatl* (de la Cruz and Bandianus 1552; Ossenbach 2009), a delicacy which was introduced by the Spaniards into Europe in the sixteenth century. It was used as appetiser, digestive, tonic and aphrodisiac (Fig. 1.8). Over time, vanilla was put into perfume, food and drinks (Ecott 2004). To meet the demand for vanilla, use was made of slave labour to grow and hand-pollinate *Vanilla planifolia* in Reunion and other islands in the Indian Ocean, far removed from the orchid's homeland in Central America, but in climates similar to the original (Arditti et al. 2009). The chemical

Fig. 1.8 *Vanilla planifolia* Jacks. ex Andrews. Adapted from Blume C.L., *Rumphia*, vol. 1: t.68, Fig. 2 (1835). Courtesy of Missouri Botanical Gardens, St. Louis, USA

constituents of the vanilla spice have been extensively studied. Artificial vanillin is now available and made by hydrolysing lignin.

Vainilla chica (little vanilla) and *vainilla en arbol* (vanilla on a tree) refer to the tall South American slipper orchid, *Selenipedium chica*, the seed capsules of which are sometimes used as a substitute, when vanilla is not available, by the Indians living in the mountains of Panama (Fig. 1.9). In Brazil, fruit capsules of the native species, *Leptotes bicolor*, have been used to flavour ice cream (Hawkes 1943) (Fig. 1.10). However, worldwide, vanilla is a dominant flavour in the dessert.

Faham tea, derived from the leaves of *Jumella fragrans* (syn. *Angraecum fragrans*), an epiphytic orchid endemic to Reunion and Mauritius, was introduced to Paris just before 1866 (Fig. 1.11). It was intended to replace Chinese tea which had not been well received in France "owing to the wakefulness resulting from its use"; Faham did not have this effect. The manufacturer's blurb mentioned that Faham possessed a "most agreeable perfume; after being drunk it leaves a lasting fragrance in the mouth, and in a closed room the fragrance of it can be recognized long after." Spirits, especially rum, in small amounts enhanced its aroma. An English writer commented that the perfume from the teapot was very agreeable; it was an indisputable novelty and, should Faham come to general use, the teapot would serve the additional function of a perfume vaporiser (Jackson 1866).

Faham tea failed and is no longer in fashion. This was possibly due to cost; it was not possible to obtain large amounts of leaves from the *Jumella* plants without unduly stressing them. However, Faham still enjoys a role as a native remedy for childhood eczema and diarrhoea. It possesses antispasmodic properties. The volatile

Fig. 1.9 *Selenipedium chica* Rchb. f. From: Reichenbach, H.G., Arnott G.A.W., *Xenia Orchidacea*, vol. 1: t. 2 (1900). Courtesy of Missouri Botanical Gardens, St. Louis, USA

Fig. 1.10 *Leptotes bicolor* Lindl. (as *Leptotes Serrulato* Lindl.). From: Lindley J., *Sertum Orchidaceum:* t.11 (1838). Courtesy of Missouri Botanical Gardens, St. Louis, USA

Fig. 1.11 *Jumellea fragrans* (Thouars.) Schltr. (as *Angraecum fragrans* Thouars.) *Curtis Botanical Magazine*, vol. 117 (ser. 3, vol. 47): t. 7161 (1891) drawn by Matilda Smith. Courtesy of Missouri Botanical Gardens, St. Louis, USA

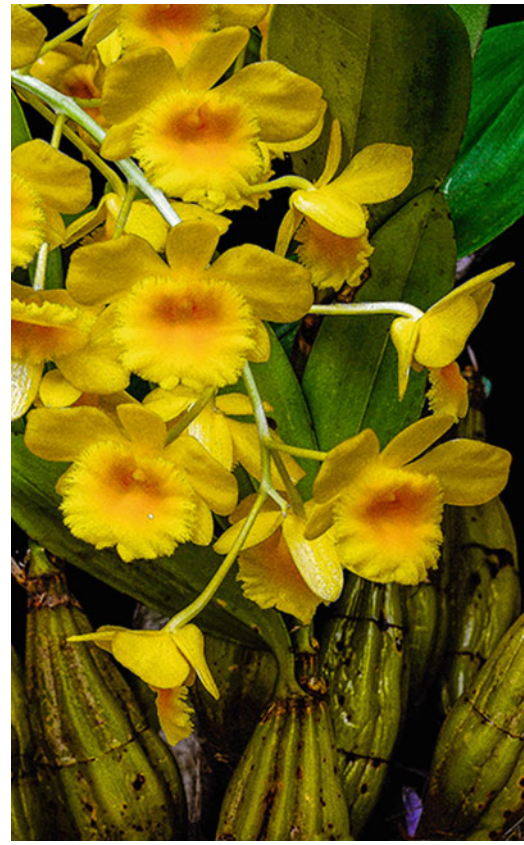

Fig. 1.12 *Dendrobium chrysotoxum* Lindl. is easily distinguished from other yellow flowered, deciduous *Dendrobium* by its fat, ribbed, hard pseudobulbs (Photo: E.S. Teoh)

constituents of faham are made up of coumarin and 99 minor components which include kaurenes and phytadienes (Sing et al. 1999).

Currently, a new tea prepared from dried *Dendrobium chrysotoxum* flowers is popular in Xishuangbana, Yunnan Province in China (Fig. 1.12). Leaves of *D. salaccense* Lindl. (syn. *Grastidium salaccense* Bl.) impart a delicate aroma to rice if added during cooking (Burkill 1936). The orchid is not widely distributed nor cultivated for domestic usage, and thus the practice is not in vogue. Common *pandan* leaves are used instead for that purpose. In Fiji, *Dendrobium tokai* (Fig. 1.13) and *Calanthe hololeuca* are used as tonics, and *Oberonia equitans* (syn. *O. glandulosa*) and *Taeniophyllum fasciola* (syn. *T. parhamiae*) for pain relief (Cambie and Ash 1994).

Australian aborigines resort to eating orchid tubers when there is a desperate food shortage. This is different from the situation in Zambia where, following urbanisation, millions of orchid tubers are brought to the markets for sale. They are mixed with groundnuts to make an African polony known as *chikanda*, which has become so popular that there is even a recipe on Google. Such is the demand that Zambia's orchid supply is rapidly being depleted, and the tubers are now sourced from the Southern Highlands of Tanzania, Angola, the Democratic Republic of Congo and Malawi. The main species in the trade belong to three genera, *Disa*, *Satyrium* and *Habenaria* (Veldman et al. 2014).

Fig. 1.13 *Dendrobium tokai* Rchb. f., a native of Papua New Guinea and some South Pacific Islands. From: Seeman, B, *Flora Vitiensis,* vol. 2: t. 92 (1873) (drawn by W. H. Fitch). Courtesy of Missouri Botanical Gardens, St. Louis, USA

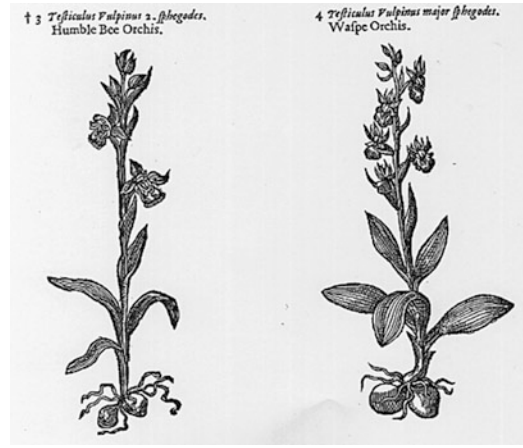

Fig. 1.14 *Ophrys* from Gerarde's *Herball* (1597)

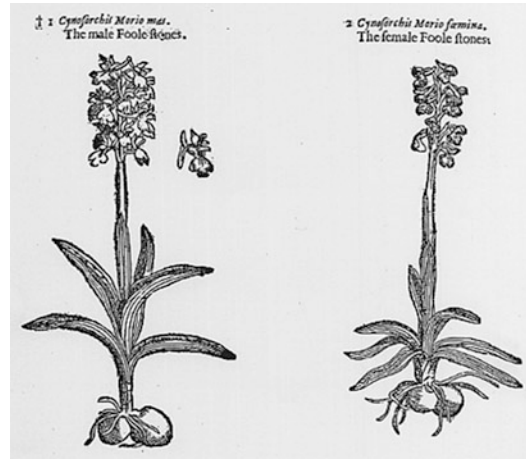

Fig. 1.15 *Orchis* from Gerarde's *Herball* (1597)

Orchids as Aphrodisiacs

In Europe, the Middle East and India, tubers of various terrestrial orchids which resemble a pair of testicles of uneven size were considered to be potent aphrodisiacs. For almost 2000 years, *Ophrys* and *Orchis* tubers (Figs. 1.14 and 1.15) were ground up to make a drink called *salep* (*sahlep*). Lacking these orchids, Indians substituted *Dactylorhiza hatagirea* and various species of *Eulophia* (Dymock 1885; Chopra 1930; Caius 1936; Duggal 1972; Trivedi et al. 1980; Jalal et al. 2008). *Salep* is still available in Turkey where, *inter alia*, it is made into ice cream. Many *salep* orchids became so rare that the Turkish government had to ban the export of *salep*. Nowadays, *salep* usually consists of flour with artificial orchid flavour.

Asthavarga is an Indian tonic which also substitutes as a local aphrodisiac. It is a cocktail of eight herbs, which currently include up to four orchid species, namely: *Malaxis muscifera* (Ayurvedic name: *Jivaka*); *Crepidium acuminatum* (syn. *M. acuminata*) (*Rishbhaka*); *Habenaria intermedia* (*Riddhi*); and *Platanthera edgeworthii* (syn. *H. edgeworthii* (*Vriddhi*) (Singh and Duggal 2009; Dhayani et al. 2011). Nevertheless, Sanskrit works on which this preparation is based carry only casual descriptions of the plants involved, and there are insufficient details for plant taxonomists to be absolutely certain about the identities of the orchids (Van Steenis 1948).

Flickingeria fimbriata (*Dendrobium plicatile*), which has over three dozen Indian names, including 32 in Sanskrit, is shipped by the truckload across borders because it is considered to be an aphrodisiac. It is short-listed as one of the two possible candidates for the role of *Sanjeevani*, the magical Indian herb mentioned in the *Ramayana* that is capable of reviving the dying (Ganeshaiah et al. 2009)!

Chemical Compounds in Orchids

During the 1960s, Japanese and Swedish researchers began to re-examine orchids for alkaloids because many useful drugs such as morphine, quinine and ergometrine were alkaloids derived from plants (Inubushi et al. 1964; Okamoto et al. 1966a, b; Nishikawa and Hirata 1968; Nishikawa et al. 1969; Leander and Luning 1968; Hedman et al. 1971; Leander et al. 1973; Luning 1974). Japanese scientists generally concentrated on *Dendrobium* (*shihu*) (Suzuki et al. 1932; Inubushi et al. 1972; Yamada et al. 1972); some Japanese teams also made important discoveries in other genera (Nishikawa and Hirata 1968; Nishikawa et al. 1969).

Morphine was the first alkaloid to be isolated, but it was obtained from Poppy and not from an orchid. The use of opium for pain relief is ancient, as it was mentioned by Theophrastus (371–287 BC) and Dioscorides (c. 40–90 CE) (Figs. 1.16 and 1.17). However, crude opium was unreliable and dangerous because sometimes the standard dose did not work, and on other occasions the same amount was lethal. To solve this problem, in 1803, Friedrich Wilheim Serturner (1783–1841), a chemist's assistant with no scientific education and working under primitive conditions in the Westphalian town of Pederborn, tried using solvents to see what he could extract from crude opium (Fig. 1.18). Crystals appeared when he poured liquid ammonia over the raw opium. By washing and further treatment with other solvents, Serturner managed

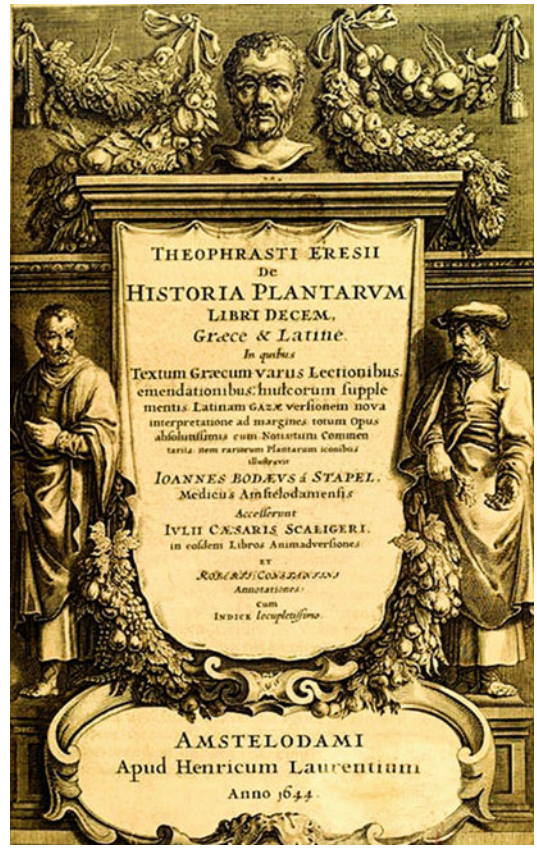

Fig. 1.16 Frontispiece of a seventeenth century edition of *Historia Plantarum* by Theophrastus (371–287 BC)

to isolate a white crystalline residue. He called it the "somniferous principle of opium". In the evenings after work, Serturner fed the crystals to mice and dogs in increasing amounts to observe the effects, ending only when the quantities were sufficient to kill the animals. Serturner thus established the two critical values now required for every drug that is in use: the minimum effective dose, and the lethal dose. He then experimented on himself and his friends. After 14 years of study, he concluded that the white powder from opium was capable of relieving pain and, because of the dreams associated with its use, he changed its name to morphium after the Grecian Morpheus, son of Somnus and god of dreams. The term was later changed to "morphia" and "morphine". Saturner's discovery