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PHYTOTHERAPIES—PAST, PRESENT, AND FUTURE

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1.1 OVERVIEW OF PHYTOTHERAPY

1.1.1 Definition

Phytotherapy, or the use of herbal medicines to prevent or treat a disease, is a traditional medical practice based on medicinal plants. It is a branch of complementary and alternative medicine (CAM) or traditional medicine, which refers to traditional medicine systems and various forms of Indigenous medicine [1]. Many different cultures have developed herbal medicine systems, for example, Western herbal medicines, Chinese herbal medicines, Ayurvedic and Unani medicines, and Australian Indigenous medicines [2]. Phytotherapy is the basis of modern pharmaceutical science, with about 25% of the drugs prescribed today, such as digoxin, aspirin, and paclitaxel being derived from plants [3].

Western herbal medicine and orthodox medicine share to a large degree a common physiologic and diagnostic system, but they are different in many important ways as well. Herbs are complex mixtures of chemicals, which may have several distinct and concurrent pharmacological activities, while pharmaceutical drugs are mostly single chemical entities. Modern herbal medicines are becoming part of integrative clinical management in medical textbooks as exemplified in Natural Standard Herbal Pharmacotherapy [4].

Traditional Chinese Medicine (TCM) is another popular traditional medical system in China and worldwide. It includes various practices including Chinese
herbal medicine, acupuncture, and massage, sharing a fundamental principle that the human body is part of the whole universe. The treatment goals are harmonization and balance using a holistic approach. The basic theories of TCM are Yin and Yang theory, Five-Element theory, Zang Fu (viscera and bowels) theory, Meridian, Qi, Blood and Fluid theory, Syndrome Differentiation, and Treatment theory. Detailed information on TCM can be found in textbooks on Chinese medicine [5–8]. For example, the blockage by Phlegm is closely related to excessive fat retention in metabolic syndrome and the management with herbal formulations and other modalities is to eliminate the Phlegm [9]. Treatment of diabetes with TCM focuses on nourishing Yin, clearing Heat, producing Body Fluid, and moistening Dryness using herbal formulae composed of herbs such as Rehmannia (Rehmannia glutinosa) and yam (Dioscorea opposita) [10].

Modernization of TCM and integration with orthodox medicine and science is a model accepted in China, covering education, clinical practice, and research. Modern pharmacologic and clinical studies have been used to examine claims of traditional practice; chemistry and chemical analysis are used for quality control of Chinese herbal medicines. Pharmacological and chemical studies have revealed connections between nature of herbal medicines and pharmacological activities, herbal tastes, and chemical components. For example, ephedra is warm as it contains ephedrine, a sympathomimetic amine; pungent herbs contain essential oils; sour herbs contain acid and tannins; sweet herbs contain sugars, proteins, and amino acids; bitter herbs contain alkaloids and glycosides; and salty herbs contain inorganic salts. Pharmacokinetic studies demonstrate a link between the tissue distribution of active chemical constituents and the attributive meridians of Chinese herbal medicines.

The World Health Organization (WHO) has a long-term interest in promoting traditional medicines and has produced a series of publications on global atlas [11], good agricultural practices [12], and monographs on selected medicinal plants [13], providing scientific information on the safety, efficacy, and quality control of widely used medicinal plants. The latest version of WHO Traditional Medicine Strategy (2014–2023) was developed to support Member States in harnessing the potential contribution of traditional medicine to health, wellness, and health care; and promoting the safe and effective use of traditional medicines by regulating, researching, and integrating traditional medicine products, practitioners, and practice into health systems [14].

1.1.2 International Trend in the Usage of Complementary Medicines

Complementary medicines have maintained their popularity in all regions of the world. The global market for herbal medicines is significant and growing rapidly. In China, traditional herbal preparations account for approximately 40% of the total health care delivered [1]. In the United States, over 42% of the population have used complementary or alternative medicine at least once. Total out-of-pocket expenditure relating to alternative therapies in 1997 was conservatively estimated at $27.0 billion, which is comparable with the projected 1997 out-of-pocket expenditure for all US
physician services [15]. In the United Kingdom, estimate of annual out-of-pocket expenditure on practitioner visits in 1998 was £450 million [16].

In Australia, it has been reported that in 2000, 52% of the population used at least one nonmedically prescribed complementary medicine [17]. The estimated expense on complementary medicines was nearly twice the patient expenditure on pharmaceutical medicines during 1992–1993 [17]. The expenditure on alternative therapies in 2000 was $AUD 2.3 billion [18]. In 2005, the annual out-of-pocket expenditure was estimated to be $AUD 4.13 billion [19]. More recent studies have indicated that complementary medicines are finding a growing preference amongst patients with chronic or serious diseases who are looking for natural options to assist in the ongoing management of these conditions. For instance, St. John’s wort preparations have low rates of side effects and good compliance, comparatively low cost, making it worthy of consideration in the management of mild-to-moderate depression [20]. An overview of complementary medicines use and regulation in Australia is available in the Australian government’s commissioned report, Complementary Medicines in the Australian Health System [21].

1.2 PRECLINICAL RESEARCH ON PHYTOTHERAPIES

1.2.1 Pharmacognosy and Quality Standardization of Phytotherapies

Pharmacognosy is the study of medicinal materials, mainly plants, using theory and methods of modern sciences such as botany, zoology, chemistry, pharmacology, and traditional medicines to study the origin, production, harvesting and processing, identification and evaluation, chemical components, physical and chemical properties, resource development, pharmacology, toxicology, and therapeutic application of herbal medicines to ensure the quality of herbal materials and to develop new herbal resources. Its main focus is on the study of authentication and quality control of herbs [22].

Plant descriptions are used in the identification of herbal materials. They are first classified by the plant parts of origin, such as roots and rhizomes, stems, leaves, flowers, fruits, or whole herbs. Then the macroscopic and microscopic descriptions are included in each monograph. Some microscopic features reflect the secondary metabolites, starch granules, resin ducts, and oil cells. The macroscopic features are still very useful for authentication; for example, the colors of herbs such as yellow coptis, brown rhubarb, and black valerian are related to their alkaloid, anthraquinone, and iridoid contents, respectively.

Pharmacognosy, particularly correct identification and high quality of the herb, is the foundation of safety, clinical efficacy, and research on phytotherapy. It is a subject most relevant to professionals in testing laboratories, herbal dispensing, and regulatory bodies. Pharmacognosy is the principal discipline employed in national and international pharmacopeia in the form of the following topics: species identification using plant taxonomy, macroscopic identification using morphology, microscopic identification using anatomy, and quality control with analytical
methods. The WHO monographs are examples of such comprehensive monographs [13], while *British Pharmacopoeia* used as statutory standards in Europe and Australia focuses on chemical analysis for quality control [23].

Bioequivalence is a useful concept in the quality standardization of herbal medicines. *European Guideline on the Investigation of Bioequivalence* defined bioequivalence as same active substances and similar bioavailability that results in similar clinical effectiveness and safety [24]. To approve two products to be bioequivalent, the following studies need to be carried out: pharmaceutical equivalence (quality standardization), pharmacokinetic equivalence (same bioavailability and time-to-peak concentration), pharmacodynamic equivalence (*in vivo* and *in vitro*), and therapeutic equivalence (clinical study). For example, a study found that the bioavailability of ginkgolide A, ginkgolide B, and bilobalide of two different *Ginkgo biloba* commercial brands were clearly different and did not demonstrate bioequivalence of test and reference products. The slow *in vitro* dissolution of the test product resulted in a large decrease in bioavailability [25]. The bioequivalence concept implies the need for a comprehensive platform for evaluation of herbal products [22].

Kudzu root is an example of a herb requiring a comprehensive quality control platform. Kudzu is one of the most commonly used Chinese herbal medicines for the treatment of diabetes, cardiovascular disease, and many other conditions. It includes two closely related species, *Pueraria lobata* and *Pueraria thomsonii*, which are not well-differentiated in pharmacopoeias. Isoflavonone puerarin is currently used as a marker for quality control of the species [26]. Recent studies indicate that ultra-performance liquid chromatography combined with partial least square discriminant analysis (PLS-DA) was more effective than using puerarin alone in differentiating the two species [27]. HPTLC coupled with multivariate classification analyses has also been used effectively to differentiate the two species [28].

Similarly, multiple markers have been used in the quality control of propolis. High-performance liquid chromatography with UV detection has been used to simultaneously quantify the eight major bioactive phenolic compounds in Chinese propolis [29] and a rapid thin-layer chromatography combined with chemometric fingerprinting has also been used to distinguish Chinese propolis from poplar tree gum [30].

### 1.2.2 Pharmacological Studies and Identification of Bioactive Compounds

Herbal pharmacology is the study of the function and mechanism of action of herbal medicines in biological systems and the pharmacokinetics of herbal compounds with modern scientific methods to understand the underlying nature of the likely clinical application. Herbal medicines are unique in that they contain multiple components and can act on multiple pharmacologic targets. The major types of herbal pharmacology research are *in vitro* studies at the cellular or tissue level to uncover the mechanism of action of the herbal components at the molecular level, for example, cytotoxicity in cancer cell lines; whole animal models to test preclinical properties of herbal medicines and to determine the pharmacokinetic properties, for example, streptozotocin-induced diabetic rats and human clinical studies to confirm the efficacy and safety of the herbal medicines. For instance, preclinical and limited clinical
evidence have shown pentacyclic triterpenoids including the oleanane, ursane, and lupane groups have multiple biological activities and may contribute to their use in traditional medicine for the treatment of diabetes and diabetic complications [31]. Increasing evidence also has shown common chemical components such as gallic acid, a common phenolic compound, playing some role in the potential health benefits of food and nutraceuticals [32, 33]. Quercetin is clinically used as a nutraceutical for cardiovascular disease [34], and berberine has been used for the management of diabetes [35].

St. John’s wort is an example of a herb with a huge body of research on the chemistry, analysis, and pharmacological actions. The active compounds may include naphthodianthrones (e.g., hypericins), flavonoids (rutin, quercetin), and phloroglucinols (hyperforin) individually or in combination. St. John’s wort extracts have been found to interact with a number of neurotransmitter systems implicated in depression and in psychiatric illness generally, such as uptake of serotonin, noradrenaline, and dopamine and to interact with γ-aminobutyric acid (GABA) receptors, monoamine oxidases, catechol-O-methyltransferase, and dopamine-beta hydroxylase [36]. However, the exact active compound(s) and mechanism(s) are still to be fully defined.

Lavender flower (Lavandula officinalis) is another example of a herb having multiple actions. This herb is used for anxiety, insomnia, antimicrobial activity, dyspepsia, wounds, and sores, and pharmacological studies have focused on anxiety, but cover other actions. Lavender oil showed significant dose-dependent anxiolytic activity in rats and mice, comparable to that of the standard anxiolytic agent lorazepam and also increased pentobarbital-induced sleeping time [37]; lavender oil also lowered the mean heart rate in dogs [38]. Mechanistic studies revealed it inhibited voltage-dependent calcium channels in synaptosomes, primary hippocampal neurons [39], and increased the dopamine D3 receptor subtype in the olfactory bulb of mice [40]. The lavender essential oils are dominated by oxygenated monoterpenes including linalyl acetate, linalool, 1,8-cineole, fenchone, camphor, nerol, and borneol. However, the exact compositions are dependent on the varieties and steaming process [38, 41, 42], which can impact the biological and clinical outcomes. While the current actions are mostly based on the total effects of the essential oils, identification of active ingredients should help future quality standardization of the extracts.

Overall, for most herbal medicines, the mechanism of action and the nature of active constituents are still not well-defined. Furthermore, most research involving herbal medicines concentrates on establishing biological activities of purified single compounds, or crude extracts without a defined fingerprint of the extract or formulation. New research platforms need to be multidisciplinary in nature to cover the research from single constituent activity to multiple biological activities linking to various standardized extracts.

1.2.3 Application of Proteomics and Metabolomics in Phytotherapy Research

To address the multi-ingredient and multitarget nature of herbal medicines and TCM formulae, network pharmacology or systems biology approach has been used in phytotherapy research in the past few years [43, 44]. Protein–protein interaction
network and topological attributes related to the biological targets of the ingredients were integrated to identify active ingredients in herbal medicines [45].

Progress in analytical techniques, such as matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF-MS) combined with bioinformatics, proteomics, and metabolomics have attracted increasing attention. The use of metabolomics has led to the discovery of the metabolite 2-aminoadipic acid as a marker of diabetes risk in humans [46] and two differentiating urinary metabolites involved in key metabolic pathways of sugar have been identified in high-fat-diet-induced type 2 diabetic rats [47].

Proteins and small metabolites are more responsive to disease, environment, and drug treatment and may be more relevant to the holistic approach in traditional medicines [48, 49]. Omic studies may provide answers on epigenetic effects on gene expression and polymorphisms of cytochrome P450 liver enzymes or P-glycoprotein [50]. Herbal medicines have elicited changes in proteins in wound healing in rats [51] and liver HepG2 cells [52]. Treatment with berberine of patients with type 2 diabetes and dyslipidemia led to a highly significant decrease in the concentrations of 13 fatty acids, suggesting that berberine might play a pivotal role in the treatment of type 2 diabetes by downregulating the high level of free fatty acids [35]. In rats, epimedium herb was shown to reverse perturbations in plasma levels of phenylalanine, tryptophan, cholic acid, and other metabolites regulating oxidant–antioxidant balance, amino acid, lipid, and energy metabolism, respectively, and gut microflora [53].

1.3 CLINICAL RESEARCH ON PHYTOTHERAPIES

1.3.1 Efficacy of Popular Phytotherapies

Clinical evidence on herbal medicine comes as case reports and/or clinical data. In the past 5 years, there have been over two hundred systematic reviews on herbal medicines and traditional Chinese medicines published in the Cochrane Library, including reviews on the most popular herbs, such as ginkgo (Ginkgo biloba), St. John’s wort (Hypericum perforatum), ginseng (Panax ginseng), valerian (Valeriana officinalis), hawthorn (Crataegus monogyna), echinacea (Echinacea species), milk thistle (Silybum marianum), bitter melon (Momordica charantia), and black cohosh (Cimicifuga species).

Although a large number of trials report positive outcomes, the reviews reveal no conclusive evidence on the efficacy of the popular herbs, including ginkgo for cognitive impairment and dementia [54], ginseng for cognition [55], echinacea for preventing and treating the common cold [56], milk thistle for alcohol or nonalcohol hepatitis and other liver diseases [57], bitter melon for type 2 diabetes mellitus [58], and black cohosh and phytoestrogens for menopausal symptoms [59, 60]. A positive conclusion has been drawn for St. John’s wort for major depression, as available evidence suggests that the hypericum extracts tested in the relevant trials are superior to placebo in patients with major depression; and are as effective as standard antidepressants [61]. In addition, hawthorn extract is beneficial in symptom control as an adjunct for chronic heart failure treatment [62].
Lavender is another popular phytotherapy with positive effects for the management of anxiety. In a randomized, double-blind, double-dummy trial, 539 adults with generalized anxiety disorder received 160 or 80 mg lavender preparation, Silexan®, 20 mg paroxetine, or placebo once daily for 10 weeks. Silexan was more efficacious than placebo [63]. A systematic review of seven trials concluded Silexan was significantly superior to placebo in patients with subsyndromal anxiety and was comparable to lorazepam [64].

1.3.2 Chinese Herbal Medicines

In TCM, herbal medicines are normally used in formulae that are based on classic prescriptions and subtypes of clinical syndrome. Therefore, clinical trials often involve different formulae, making meta-analysis of trials impossible or difficult.

In the past 5 years, a large proportion of published systematic reviews in the Cochrane library are on TCM, covering common chronic conditions such as osteoporosis [65], hypertriglyceridemia [9], fatty liver [66], acute bronchitis [67], severe acute respiratory syndrome and irritable bowel syndrome [68], premenstrual syndrome [69], and type 2 diabetes mellitus [70]. Many small and less-rigorous trials report positive findings. However, they should be interpreted with caution due to inappropriate methodology, small sample size, and lack of confirmatory data. Similar findings are noted for single-herb preparations, including Danshen (Salvia miltiorrhiza) preparations for acute myocardial infarction [71], puerarin injection (Pueraria lobata) for unstable angina pectoris [72], and Sanchi (Panax notoginseng) for acute ischemic stroke [73]. There is insufficient evidence to support their claims and high-quality trials are needed to support their clinical use.

1.3.3 Food Nutrition and Translational Research

There is no clear border between phytotherapies and foods since many phytotherapies are also used as foods and many foods contain phytochemicals. Recent studies on the impact of nutrition on health and life span have shed some new light on the understanding and the management of metabolic syndrome and cardiovascular disease. In a study with mice fed one of 25 diets ad libitum, longevity and health were optimal when protein was replaced with carbohydrate. High-protein diet intakes were associated with hepatic mammalian target of rapamycin (mTOR) activation and circulating branched-chain amino acids and glucose [74]. A cross-sectional study of 1015 Chinese patients who underwent coronary angiography indicated that high animal-protein diet was positively associated with hyperhomocysteinemia, whereas high plant-protein diet was inversely associated with total homocysteine concentrations [75]. In a prospective study of 1003 patients who underwent coronary angiography, higher concentrations of plasma 5-Adenosyl-L-homocysteine are independently associated with an increased risk of cardiovascular events [76].

At the same time, great interest has been placed on the function of micronutrients in food. One such example is the anthocyanins in rice and fruits. Anthocyanins
may play an important role in atherosclerosis prevention, by suppressing oxidative stress-induced endothelial injury in endothelial cells [77, 78], mouse peritoneal macrophages [79], apolipoprotein E-deficient mice [80], and dyslipidemic subjects [81]. The consumption of bayberry juice containing polyphenols for a period of 4 weeks protects against nonalcoholic fatty liver disease in young adults by antioxidant and anti-inflammatory effects [82]. Since food and nutrition are consumed by the public on a daily basis, this research finding will directly impact on an individual’s lifestyle.

1.4 SAFETY OF PHYTOTHERAPIES

Phytotherapies are generally shown to be well-tolerated in clinical studies. According to Cochrane reviews, clinical studies often report no additional side effects compared with placebo, as shown with echinacea [56], ginkgo [54], St. John's wort [61], and Chinese herbal medicines [70]. However, some herbal medicines exhibit toxicity and serious adverse effects. For instance, ephedra causes hypertension, heart attacks, and strokes due to the alkaloid ephedrine, and aristolochia leads to kidney toxicity [83].

Kava (Piper methysticum) has been shown to be more effective in a placebo-controlled trial in the treatment of generalized anxiety disorder (GAD) [84]. However, it is associated with over 100 reports of spontaneous adverse hepatic effects. The unexpected toxicity may be related to pharmacokinetic interactions between kavalactones and coadministered drugs or alcohol involving cytochrome P450 enzyme system [85], or inflammation [86] and involvement of liver macrophages [87]. Some authors propose that contaminant hepatotoxins including molds might have caused rare kava hepatotoxicity in humans [88]. Understanding the underlying mechanisms and quality standardization will help to reduce or prevent future toxicity.

While there are many reports and studies on the toxicity of herbal medicines, the standard and ranking criteria of toxicity used for scheduling of herbal medicines remain unclear. Scientific evidence on toxicity comes from systematic reviews, randomized clinical trials, case reports, animal studies, cellular studies, and chemical studies. A scheduling platform has been proposed based on analysis of all available data. Herbs with high toxicity leading to injury or death, for example, aristolochia should be prohibited for medicinal use, while some toxic herbs should be restricted for medicinal use prescribed by qualified practitioners [83]. This will improve regulation and scheduling of Chinese herbal medicines internationally.

Drug–herb interactions pose major concerns for health practitioners. While many interactions are theoretically possible and predicted from preclinical studies, the interactions of St. John’s wort with pharmaceuticals have been confirmed in clinical studies. Combining St. John’s wort with other antidepressants is strongly discouraged due to potentiation of pharmacodynamic effects. Because St. John’s wort can induce CYP3A4 and 2C19, its concurrent use with conventional drugs can increase the blood concentration of antidepressants, anticonvulsants, antineoplastic drugs, cyclosporin, digoxin, oral contraceptives, and warfarin [89–91]. The popular Chinese
herb rhubarb may either induce or inhibit activities of CYP1A2, CYP2C6, CYP2E1, and CYP3A1 and modify the metabolism of antidiabetic drug saxagliptin in rats [92]. As drug–herb combinations are common practice in China, clinical evaluation of safety and efficacy of drug–Chinese herb interactions are required.

1.5 PROFILE OF RESEARCH IN COMPLEMENTARY MEDICINE

1.5.1 International Profile

To obtain an overall profile of phytotherapy research internationally, we have searched major databases for publication counts up to May 2014 using “phytotherapy” as the key word in All Fields in Scopus and retrieved 87,636 publication counts. The publication number increased 10 times from 326 to 3779 from 1994 to 2004, but increased less than 3 times from 2004 to 9698 in 2013 and remained steady in the last 3 years (Fig. 1.1). Although the data did not include publications not using phytotherapy as a key word, this trend indicates that recent progress on phytotherapy research has been slower in quantity. The top countries with highest publication counts during the past two decades in Scopus were India, the United States, and China (Fig. 1.2). The publication counts reflect not only research output but also public interest and scope of phytotherapy industry in these countries. Phytotherapies are part of traditional medicine systems in India and China, and are widely accepted in the United States. They are regulated as dietary supplements in the United States, but as medicines in China.

![Publication counts during the past two decades in Scopus.](image-url)
1.5.2 Australian Profile of Research in Complementary Medicines

Australia plays a leading role in regulation, education, and research on phytotherapies, particularly TCM. Complementary medicine is a listed medicine that needs to meet the requirements of safety and good manufacturing practice standards under the regulation of Therapeutic Goods Administration. Many universities and private colleges offer diploma and/or undergraduate or even postgraduate degrees in herbal medicines and TCM. While herbalists are regulated by professional associations, TCM practitioners are regulated nationally under Australian Health Practitioner Regulation Agency together with other health professions since 2012. Lectures, workshops, and practicals have been introduced into the undergraduate Bachelor of Pharmacy and postgraduate (Master of Pharmacy) courses at the University of Sydney to equip students with the knowledge and skills to provide clinical advice on herbal products available in pharmacy and supermarkets.

In 2007, the Australian Federal government provided a grant to establish the National Institute of Complementary Medicine (NICM) at the University of Western Sydney and approximately AUD $2 million was used to support three NICM collaborative centers: University of Sydney NICM Collaborative Centre for Traditional Chinese Medicine, University of Queensland NICM Collaborative Centre for Transitional Preclinical and Clinical Research in Nutraceuticals and Herbal...
Medicine, and Swinburne University of Technology NICM Collaborative Centre for the Study of Natural Medicines and Neurocognition in Health and Disease. A further $5.3 million for 13 projects was provided by the National Health and Medical Research Council (NHMRC). The projects covered different disciplines of CAM and included the following research areas on herbal medicines [93]:

1. Alternative medicines from medicinal plants of Aboriginal people of northern NSW
2. Novel probiotics and naturally sourced extracts as treatment strategies for chemotherapy-induced intestinal mucositis
3. Clinical and physiological evaluation of Chinese herbal medicine for constipation predominant irritable bowel syndrome
4. Complementary medicines based on propolis produced by honeybees from Australian flora
5. A randomized placebo-controlled trial of a herbal preparation in functional dyspepsia: cost-effectiveness and mechanisms

Complementary and alternative medicine was a field of research in the 2012 round of Excellence in Research for Australia (ERA), which was carried out to evaluate research excellence in Australia by the Australian Federal Government. The profile of CAM based on the data during 2008–2010 is listed in Table 1.1 [94]. Overall, CAM (four-digit Field of Research Code, FoR 1104) is a very small component of medical and health sciences (FoR 11). In comparison with Pharmacology and Pharmaceutical Sciences (FoR 1115), CAM had 4, 6, 6% in research income, unit of

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<tr>
<th>Complementary and Alternative Medicine (FoR 1104)</th>
<th>Pharmacology and Pharmaceutical Sciences (FoR 1115)</th>
<th>Percentage 1104/1115 (%)</th>
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<tr>
<td>Researcher EFTa</td>
<td>110.7</td>
<td>444.8</td>
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<td>Research outputs</td>
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<td>5,210.3</td>
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<td>Research income</td>
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<tr>
<td>Unit of evaluation assessedb</td>
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<td>Esteem countc</td>
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<td>38.3</td>
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<td>Patents</td>
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<td>23.5</td>
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<td>Research commercialization income</td>
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<td>$15,280,047</td>
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aResearchers EFT, researchers full-time equivalent.
bUnit of evaluation assessed, number of university included in ranking.
cEsteem includes fellowship of learned academy, recipient of a nationally competitive research fellowship, membership of a statutory committee.
evaluation assessed and esteem count, respectively, and no patents and research commercialization income. However, CAM had 25% of researchers and 16% of the publications output in comparison with Pharmacology and Pharmaceutical Sciences, which were very substantial. The data indicate many researchers are publishing in CAM, but they have not attracted similar government funding as Pharmaceutical Sciences. One possible way forward is for governments to establish international joint research centers to bring together different research teams with different areas of technical competency and expertise to form new research platforms, which will lead to multidisciplinary strategies to address the complexity of phytotherapies.

1.6 SUMMARY AND FUTURE DIRECTIONS

Phytotherapy, or the use of herbal medicines to prevent or treat a disease, is a modality of complementary and alternative medicine, or traditional medicine. Its popularity is maintained not only in developing countries but also in Western countries. The long-term traditional knowledge and rich source of medicinal plants have attracted enormous modern scientific research, providing an evidence base for the rationale of traditional practice, and pharmaceutical development and integration into medical practice. In this chapter, we have introduced topics and issues involved in preclinical and clinical disciplines in phytotherapy and further critical reviews may be found in the following chapters of this book.

In the modern and developing economies, chronic diseases such as obesity, diabetes, metabolic syndrome, mental illness, and cancer are leading causes of preventable deaths and are not successfully managed by current clinical and public health measures. There is a clear mandate for the identification of novel approaches, including the development of phytotherapies with respect to both clinical treatment and prevention. There is also a demand for researchers in phytotherapy to be more competitive and have higher profile and impact. Translational research and latest technology such as systems biology, proteomics, and metabolomics are some of the promising approaches to providing a stronger evidence base for traditional medicines, and also to develop new products and formulations for the prevention and treatment of life-threatening chronic conditions for the benefit and well-being of humankind.

REFERENCES


