Establishment of Platforms to Facilitate the Inheritance and Innovation of Chinese Medicinal Authentication

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Chinese medicinal authentication is the first and most fundamental step for standardizing Chinese medicinals for global markets and research. Many issues related to authentication have remained unresolved since ancient times. Determining the authenticity and quality of Chinese medicinals remains as much a frontier as it is an essential science in guaranteeing the safety and efficacy of Chinese medicinals in clinical use. In this review, a path of inheritance and innovation of macro-/microscopic identification techniques is explored, featuring the establishment of the dynamic Chinese medicinal database and the research Centre for Standardization of Chinese Medicines (CSCM).

Key words: Centre for Standardization of Chinese Medicines (CSCM), Chinese medicinal authentication, dynamic Chinese medicinal database, macro-/microscopic identification.

Traditional Chinese medicine (TCM), a quintessence of Chinese culture, has earned worldwide recognition for its efficacy. As TCM undergoes rapid globalization, the safety of Chinese medicinals is drawing international concern. The market for medicinal materials expands, requiring greater quantities of accurately identified, quality-assured materials delivered to the international herbal markets. Chinese medicinal authentication is the first and most fundamental step for standardizing Chinese medicinals for global markets and research. Many issues related to authentication have remained unresolved since ancient times. Thus determining the authenticity and quality of Chinese medicinals remains as much a frontier as it is an essential science in guaranteeing the safety and efficacy of Chinese medicinals in clinical use.

Quality evaluation is one aspect of Chinese medicinal authentication process. Problems related to species and quality have caused huge economic losses. Even more important, quality control of Chinese medicinals is directly connected to the clinical effectiveness of TCM. Authentication of medicinals can be a matter of life and death in clinical practice and will almost certainly influence the fate of Chinese medicinals. For these reasons, research on Chinese medicinal authentication is of high priority and should be supported and conducted immediately. As an international trade center, Hong Kong is the source of many Chinese medicinal materials reaching international markets. The quality of Chinese medicinals in Hong Kong directly reflects the status of
oversea herbal markets. In this capacity, Chinese medicinal authentication is of international importance. In this review, our efforts of establishing the dynamic Chinese medicinal database to provide comprehensive information and the research Centre for Standardization of Chinese Medicines (CsCM) to conduct research on the inheritance and innovation of macro-/microscopic identification measurements are discussed.

1. Establishment of the dynamic Chinese medicinal database based on open access resources and academic publications

1.1 Establishment of a Chinese medicine specimen center (http://cmmuseum.hkbu.edu.hk/bucmm/eng_index.html)

In 2003, the Bank of China (Hong Kong) Chinese Medicines Center was established at Hong Kong Baptist University. As a site for educational exhibitions open to the public as well as a repository for voucher specimens used in research, this center is characterized by its simultaneous collection of medicinal materials and corresponding voucher specimens, which are preserved in a herbarium that meets international standards. The herbarium is internationally acclaimed and has hosted more than 70,000 visitors since its inception.


Featuring a combination of photos and text, the Medicinal Plant Images Database and the Chinese Medicinal Material Images Database systematically categorize and present comprehensive knowledge on over 1,000 medicinal plants and 420 medicinal materials. The former was honored by the American Library Association (ALA) Presidential Citations for Innovative International Library Projects in 2012.

1.3 Compilation of monographs

(1) Encyclopedia of Medicinal Plants: Sponsored by the Hong Kong Innovation and Technology Commission – Hong Kong Jockey Club Institute of Chinese Medicine, this is a 4-volume comprehensive encyclopedia of medicinal plants in both English and Chinese. Based on years of field research in China and abroad, this text is rich with information derived from firsthand experience at production regions and the latest scientific literature, and features a comprehensive overview of the chemistry, pharmacology, and clinical applications of 800 medicinal plants from around the world. In 2010, this text was awarded China’s top prize for outstanding scientific publications. Prof. Hildebert Wagner, a renowned expert in pharmacognosy from Germany, praised the text with the statement: “With the research efforts of the authors and their research teams, the Encyclopedia has consolidated in a systematic way numerous useful and updated references, photos, chemical structures, pharmacological uses, clinical applications and expert comments on each medicinal plant around the world, making it an excellent desktop reference (Zhao and Xiao 2010)

(2) Easily Confused Chinese Medicines in Hong Kong: Organized by the Chinese Medicine Merchants Association and funded by the Trade and Industry Department of HKSAR, this project was a systematic study on easily confused medicinals that was completed through the collaboration of more than 30 organizations. Over 10,000 samples of medicinal materials were collected and authenticated from 2004 to 2005. As a result of this study, a bilingual text was published and over 20,000 copies of this book were distributed to the public for free. Following promotion and education by the government, industry and educational institutions, adulterated Chinese medicinal materials in the Hong Kong herbal market decreased sharply, setting a precedent in the international herbal market. The impact of this
text was highly praised by experts in the field of pharmacognosy (Zhao and Li 2007, Heinrich 2009).

(3) **Chinese Medicinal Identification, An Illustrated Approach:** This text systematically summarizes the distinguishing macroscopic features of 428 commonly used Chinese medicinal materials, using a highly visual presentation that combines abundant photographs with text. In addition to covering nomenclature, production regions, harvesting and post-harvest handling, actions and macroscopic descriptions, it summarizes the cultural heritage of experience-based differentiation and bridges traditional knowledge with a modern scientific approach. Rich full-color images illustrate not only the key macroscopic features of the crude medicinal materials and their decoction pieces, but also illustrate the differences among many items that are derived from multiple species of origin. As one of the top 100 publications in the science and technology category, its Chinese version was awarded a selected original works prize in the Chinese book campaign “three one-hundred” in 2012. Dr. Yukihiro Goda, the director of the Pharmacognosy Committee of the Japanese Pharmacopeia commented on its Japanese version: “This is a classic book that combines traditional experiences and modern scientific elucidation”. Its English version was recognized as “an incredibly valuable contribution to the herbal literature and is specifically useful for those involved in the use of Chinese medicinal plants in botanical dietary supplements and Chinese medicine (Zhao et al. 2014, Upton 2015)”.

(4) **An Illustrated Microscopic Identification of Chinese Materia Medica:** Sponsored by the Hong Kong Research Grants Council in 2001, a bilingual database of microscopic images was created, and Standard Operating Procedures for microscopic identification were published together with the International Society for Chinese Medicine (ISCM). Christine Leon from Kew’s Chinese Medicinal Plants Authentication and Conservation Center recommended this text with the statement “An Illustrated Microscopic Identification of Chinese Materia Medica represents a very significant contribution towards filling this acute knowledge gap (Zhao 2005)”.

(5) **Chinese Medicinal Microscopic Identification:** This monograph introduces the application of microscopic authentication. It records the microscopic features of 230 commonly used Chinese medicinal materials including plants, animals and minerals, as well as 10 Chinese patent medicines and 10 western herbs. The features of their transverse sections and powders are demonstrated by color pictures and concise descriptions. All the diagrams and descriptions in the book are originated from the first-hand data of the experimental research. Sketch, section illustration and enlarged special features are included in the transverse sections part, and typical and representative photos of the features of powder are provided. The key identification features are pointed out for each medicinal material. Some entries also include the major microscopic differences with their easily confused species (Zhao and Chen 2016).

2. Establishment of the research Centre for Standardization of Chinese Medicines (CSCM) (http://cscm.hkbu.edu.hk/) based on inheritance and innovation of macro-/microscopic identification techniques and related scientific disciplines

2.1 Assessing the material basis for “identifying quality based on appearance” through the combination of laser micro-dissection and LC-MS

Research demonstrates that there is a relationship between chemical constituents and the size, color, appearance, texture, aroma, and taste of medicinal materials; likewise, there is a close relationship between microscopic structures and the characteristics seen on the cross section of medicinal materials (Zhao et al. 2011). By using laser micro-dissection to isolate specific cellular structures, LC-MS can be used
to map the distribution of active constituents in the medicinal material. Through investigation of the relationship between cellular constituents and distinguishing macroscopic features, the concept of “identifying quality based on appearance” can be assessed objectively. The technique of laser micro-dissection combined with ultra high performance liquid chromatography-quadrupole/time of flight-mass spectrometry (UPLC-QTOF-MS) was first applied to analyze the tissue-specific chemical profile of Sinomenii Caulis. The results indicated that the active alkaloids were primarily distributed in the xylem, suggesting that large Sinomenii Caulis medicinal material is superior (Yi et al. 2012). This was in accordance with previous research applying matrix-assisted laser desorption/ionization time of flight mass spectrometry (MALDI-TOFMS) to analyze the characteristic metabolites in various tissue regions of Sinomenii Caulis from different geographic locations (Ng et al. 2007). This technique combining laser micro-dissection and LC-MS was established and applied to confirm the validity of traditional identification experience by correlating active components and morphological features. This method provides a feasible, fast, easy, and economic way to evaluate the quality of Chinese medicines based on morphology, and was also successfully used to assess (1) the relationship between microscopic structures and the alkaloid constituents of Aconiti Radix Lateralis Praeparata and Coptis Rhizoma (Jaiswal et al. 2014, Yi et al. 2015); (2) the different specifications of Chinese medicinal materials such as Rhei Radix et Rhizoma, Ginseng Radix, and Belamcandae Rhizoma on the market (Liang et al. 2013, Liang et al. 2014, Chen et al. 2014); and (3) the structural chemistry of Bupleuri Radix (Liang et al. 2014).

2.2 Expanding microscopic identification with new technologies, new methods, and digitized images that illustrate distinguishing microscopic characteristics

New technologies and methods have been applied in the study of microscopic identification. For example, polarizing microscope has been used in the studies of Chinese Patent Medicine Zhibao Sanbian Wan (Zhao et al. 1998); fluorescence microscope has been applied in distinguishing the medicinal herb Oldenlandia diffusa from confused species of the same genus (Liang et al. 2006) and the identification of medicinal bark (Huang et al. 2014); and the combination of microscopic technique and granulometric operation has been used to analyze and identify the starch grains in Chinese medicinals (Tong et al. 2007).

Conclusion

Authentication is a key component of Chinese medicinal quality assessment. Herbal medicine quality directly impacts the efficacy of Chinese medical treatment, and quality control is of vital importance for the future survival of herbal medicine. The implementation and completion of the establishment of the dynamic Chinese medicinal database and the research Centre for Standardization of Chinese Medicines (CSCM) preserve traditional knowledge of experience-based Chinese medicinal differentiation while elucidating its traditional technical terminology though a modern scientific understanding. At the same time, new perspectives and approaches will be used to explore the essence of “identifying quality based on evaluating appearance”, in order to promote the practical utilization of traditional quality differentiation.

Cultural and creative industries, medical services, education services, innovation and technology, environmental industries, and testing and certification services are the six industries where Hong Kong enjoys advantages for further advancement. According to the 2015 Policy Address of Hong Kong Special Administrative Region (HKSAR), the government of HKSAR will plan and develop a testing center for Chinese medicine to be managed by the Department of Health (DH). The testing center
will specialize in the testing of, and scientific research on, Chinese medicine with a view to setting reference standards for the safety, quality and testing methods of Chinese medicine. With the guidance of an advisory board formed by renowned international experts, the DH will continue to study and formulate more Hong Kong Chinese Materia Medica Standards (HKCMMS) through the testing center. The testing center will also embark on relevant hi-tech research with a view to strengthening the capability for the quality control and identification of Chinese medicine. A herbarium on Chinese medicine of international standard will be set up. Through various platforms and close collaboration with the relevant international and Mainland organizations, the testing center will help promote the HKCMMS and the reference standards for testing Chinese medicine as authoritative international benchmarks to pave the way for the internationalization of Hong Kong’s Chinese medicine industry (http://www.policyaddress.gov.hk). Chinese medicinal authentication is an indispensable component of the testing and certification service of Hong Kong. Hong Kong has the capability and responsibility to provide Chinese medicinal authentication and thus guarantee the quality of both imported and exported medicinal products via its ports.

The establishment of the dynamic Chinese medicinal database and the research Centre for Standardization of Chinese Medicines (CSCM) has been playing an important role in fulfilling the above-mentioned tasks set by HKSAR.

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趙 中振，陳 虎彪，郭 平，梁 之桃，E. Brand，黄 麗麗：中藥の選品技術の継承と発展のための基盤の確立
中薬の選品は国際的な取引と研究のために中薬を標準化する最初の最も基本的な一歩である。選品に関する多くの問題が昔から解決されずに残されている。中薬の選品と品質を明らかにすることは臨床での安全性と効果を保障するための不可欠な科学として最先端の研究である。この総説では、中薬に関する動的データベースの構築と、中薬標準化研究センター(CSCM)について、その概要を述べ、肉眼および顕微鏡での同定技術の継承と発展の歴史について明らかにする。
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