

# Introductory Chapter

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## 1. Introduction

The long-term clinical practice of traditional Chinese medicine (TCM) confirms its importance and essential role in the health care system in China, especially in the prevention and treatment of chronic diseases [1]. TCM is not only looked upon as a bright pearl, but also a treasure house in Chinese ancient culture. TCM has made great contribution to the health of Chinese people for thousands of years, and it became an independent medical system in world medical field with its special clinical effect, rational theory system and rich practice experience [2]. TCM is the holistic medicine under the guidance of system theory, emphasizing harmony between human and nature, focusing on equilibrium and balance, and focusing on state of functional system and normal function of the human organism viewing it as the integral entity. TCM is based on the Chinese philosophy of Yin-Yang and Five Elements. The oldest classic of TCM is *Huangdi Neijing* (Inner Canon of Huangdi or the Yellow Emperor's Medicine Classic), which was written around 2300 years ago. The basic theory of TCM includes five-zang organs and six-fu organs, qi (vital energy), blood, and meridians. TCM is based on the holistic principles and emphasizes harmony with the universe. It categorizes the causes of diseases into two groups: external causes and internal causes. It differentiates syndromes according to the eight principles (yin, yang, exterior, interior, cold, heat, deficiency (*xu*) and excess (*shi*)). Besides, the theory of TCM property is also one of the basic theories of the science of TCM. It is the connection between the TCM theory and the clinic. The interpreting of the scientific meaning of TCM property is one of the critical problems for the modernization process of TCM. It mainly includes four properties, five flavors, toxicity, and raising, lowering, floating, and sinking.

Although, TCM at present is based on the phytochemistry and the pharmacology research, this study provides an example for the modernization of TCM with certain research ideas. In fact, it has followed the study of Western medicine research method [3]. Nowadays, though a large number of young researchers are engaged in the study of TCM, some are deviating from unique characteristics of Chinese medicine. With the developing of their research work, people come to realize the importance of TCM characteristics, and begin to lay more emphasis on its special clinical effect, rational theory system and rich practice experience. Otherwise, the essential character of the role of TCM cannot be fully and correctly explained. It is essential to clarify the role of TCM theory, principles of TCM and material basis. In a manner of speaking, this is an effective way to develop TCM industry in the direction of TCM theory with the idea of modern scientific technology. This leads us to

conclude that Chinese medicine is the subject area with the most potentiality and the possibility for original innovation. So, it is necessary for discussing practical application, promotion and worldwide spreading of TCM knowledge. Moreover, there is a new chance and challenge for the TCM industry.

## 2. Discussion

Chinese medicines have been attracting interest and acceptance in many countries. An estimated 1.5 billion people now use these preparations worldwide. This may be primarily because of the general belief that herbal drugs are without any side effect besides being cheap and locally available [4]. The abundant philosophical connotation of TCM, its profound cultural foundation, and its integration with great wisdom of the world are still amazing the world. TCM theories are originated from the profound experiences and understanding of ancient Chinese medicine practitioners. As far as I am concerned, digging TCM theories is able to effectively break through the bottleneck of the development of Chinese medicine. In order to make sufficient use of the advantages of TCM, it is essential to clarify the role of TCM theory, principles of TCM and material basis. In that case, we wrote this book *Recent Advances in Theories and Practice of Chinese Medicine* with 26 chapters. It is divided into four sections, namely, basic theories of TCM, clinical practice, pharmacological experimental research and pharmacodynamic material base research, respectively. Next, we make a briefly introduction of these four sections by several representative chapters, respectively.

### 2.1 Studies on basic theories of TCM

#### 2.1.1 Metabonomics research of the four properties in TCM based on UPLC-QTOF-MS

The theory of TCM property is an important part of theories of TCM. It is one of the basic theories of the science of TCM, which is composed of multiple contents. It mainly includes four properties (Si Xing), five flavors (Wu Wei), channel tropism (Guijing), toxicity, and raising, lowering, floating and sinking (Sheng Jiang Fu Chen). It is the connection between the TCM theory and the clinic. The interpreting of the scientific meaning of TCM property is one of the critical problems for the modernization process of TCM. In TCM, diagnosis and medication are based on "Syndrome" ("ZHENG" in Chinese Mandarin), which can be regarded as a profile of symptom combination, or clinical phenotypes, such as Cold or Hot Syndrome, and "Hot medication curing Cold Syndrome and Cold medication curing Hot Syndrome" is a standard therapeutic guide line. This classical systems medicine at the macro level has been validated and developed by its repeated clinical practice for thousands of years. Hot and Cold medication are the four properties of Chinese medicinal herbs, precisely including cold, hot, warm and cool, which are also called the four natures or "four xing" in TCM. Cold-cool and warm-hot are two completely opposite categories of natures, whereas cold and cool or hot and warm differ in the degree. Chinese medicinal herbs with cold and cool nature can clear away heat, purge fire and eliminate toxic materials, which are mainly used for heat-syndrome; while with hot and warm nature have the actions of expelling cold, which are mainly used for cold syndrome. The four natures are summarized mainly from the body's response. On the base of syndrome differentiation theory, only distinguish heat or cold nature of disease, and have a good understanding of the cold or hot property of TCM, so selectively apply corresponding medicinal herbs that you could achieve the desired effect.

The theories of TCM are so broad and profound, and considered the civilization treasure of China. The four properties, the essence and important component of TCM theories, the high

generalization on the basic property and typical characteristics of TCM, are a significant theoretical foundation for the clinical use of Chinese medicine. In recent 30 years more and more reports on the four natures of TCM have appeared in the literature. To date several aspects of research such as the characteristics of thermodynamics, the changes of nervous system and the endocrine glands, energy metabolism, the systems biology analysis include genome, transcriptome, proteome, and metabolome are all supposed to explore the macro and micro framework on the four properties, among which metabonomics is the most novel tool. It is a rapidly growing area of scientific research, which has been widely used in disease diagnosis, biomarker discovery, and research into the disease mechanisms.

Metabonomics is an emerging subject of the post-genome era, which, together with genomics, transcriptomics and proteomics, jointly constitutes the 'Systems Biology'. Metabonomics is the branch of science concerned with the quantitative understandings of the metabolite component of integrated living systems and its dynamic responses to the changes of both endogenous factors (such as physiology and development) and exogenous factors (such as environmental factors and xenobiotics). Recently, as a novel systemic approach to study metabolic profile and accelerate the course of drug development, metabonomics has achieved great growth, which is attracting more and more concerns from the academic community [5]. Metabolite or metabolic profiling, the compositional analysis of low molecular-weight (MW) species in biological samples (urine, plasma and serum), has been in existence for at least 35 years and has traditionally used mass spectrometry (MS) coupled to some modern separation technique such as ultra-performance liquid chromatography (UPLC) and gas chromatography (GC) for resolution and detection [6]. Integrity of metabonomic processes includes sample collection and pretreatment, data collection and analysis, and metabolic variation interpretation.

In this study, UPLC-QTOF-MS techniques coupled to metabonomics methods were used to prove the existence of the four properties in TCM, to illustrate its multi-component, multi-target, multi-channel and the complex mechanism. Metabonomics aims to assess metabolic changes in a comprehensive and global manner in order to infer biological functions and provide the detailed biochemical responses of cellular systems. We successfully established predict models based on cold and hot medicines as references. To estimate the predictive ability of our model, we used herb-Flos Datura to cross-validation, and excellent separation among the TCM varieties obtained by OPLS-DA, which a hot medication belonging to the hot medication group, are presented in terms of recognition and prediction abilities. It represented the percentage of the samples correctly classified during model training and cross-validation, respectively, while the prediction ability was only qualitative rather than quantitative.

This chapter is aimed at guiding researchers to understand a new way of drug discovery based on the theory of TCM property. More commonly, some researchers focused on traditional chemical constituents and ignore many other effective ones in TCM so that the characteristics of TCM were seriously lost. Also, it could be applied to explore Western medicine properties to effectively guide the clinical application. Considering the encouraging results obtained in this study, it seems to be very promising approach to apply metabonomics for further study on theory of TCM property.

### **2.1.2 An approach to the nature of Qi in TCM-Qi and bioenergy**

TCM has been practiced for more than five thousand years, is a complete ancient medical system that takes a deep understanding of the laws and patterns of nature and applies them

to the human body. TCM believes that the human body is a microcosm of the Universal macrocosm. Therefore, humans must follow the laws of the Universe to achieve harmony and total health. Even today TCM practitioners use these essential theories to understand, diagnose and treat health problems. In TCM, "harmony" is the ultimate goal. So, when nature's Qi undergoes change as it does seasonally, a person's internal Qi will respond automatically. If, for any reason, it can't make a smooth transition to the energy of the next season, TCM understands that illness will result. Often Western Complementary and Alternative Medicine (CAM) practitioners and their patients or clients derive their understanding of TCM from acupuncture. However, acupuncture is only one of the major treatment modalities of this comprehensive medical system based on the understanding of Qi or vital energy. These major treatment modalities are Qigong, herbal therapy, acupuncture, foods for healing and Chinese psychology.

Meridians, or channels, are invisible pathways through which Qi flows that form an energy network that connects all parts of the body, and the body to the universe. The ancient medical text 'The Yellow Emperor's Inner Canon (Nei Jing)' states: "The function of the channel (meridian) is to transport the Qi and blood, and circulate yin and yang to nourish the body". The energy practice of Qigong, with its postures and movements, also affects the flow of Qi. The energy pathways and the Organ Systems they link provide TCM with a framework for identifying the root cause of health problems and the diagnoses to heal them. Meridians work by regulating the energy functions of the body and keeping it in harmony. If Qi stagnates for too long in any meridian, it can become blocked and eventually turn into matter, setting the stage for conditions that can create a physical mass. TCM Meridian Theory states: "As long as Qi flows freely through the meridians and the Organs work in harmony, the body can avoid disease".

The study of Qi phenomena in this Chapter may help bridge some of the apparent difference between Western and Eastern culture. This chapter covered the nature of Qi as well as its philosophical aspects and the significance in the modern civilization because the true foundation of TCM is Qi.

### **2.1.3 A geomedical approach to Chinese medicine: The origin of the yin-yang symbol**

This chapter shows how to compute Yin and Yang for different latitudes so traditional Chinese herbalists can quantify the efficacy of herbal drugs. Based on daylight hours, the chapter provides a simple formula that allows computation of Yin and Yang for each day of the year. Moreover, using daily Yin and Yang values, the chapter shows how to render the Yin-Yang symbol properly in accordance with its original meaning. Considering the importance of Yin and Yang in TCM, the rendering method presented in this chapter provides evidence that TCM, in its origin, is a geomedical science.

Herbal medicines collected from different geographic locations can significantly differ in their therapeutic efficacy. The concentration of bioactive substances varies depending on many local factors, such as sunshine hours or chemical and physical properties of the soil. To guarantee the optimal composition of herbal drugs, Chinese herbalists use "geo-authentic" herbs from recognized locations. However, it is often difficult to confirm geographical authenticity. The lack of formal models for Yin and Yang, and herbal efficacy in general, complicates objective comparisons and evaluations. Herbalists and practitioners of TCM need a better formal understanding of the Yin-Yang composition of each herb. This chapter contributes to the solution to this problem by providing a formal description of Yin and Yang. It shows in a

mathematical way how Yin and Yang vary depending on latitude. The latitude of a herb's location determines the number of daylight hours and sunshine the herb is exposed to during the year. The number of daylight hours is one of the components affecting the concentration and composition of bioactive substances and therefore the efficacy of the herb. To standardize herbal preparation and administration, rigorous mathematical methods are essential to measure the Yin-Yang composition of herbs quantitatively. The work presented in this chapter is a first step towards such standardization.

## **2.2 Clinical practice of TCM**

### **2.2.1 A comparison study on arterial blood pressure and pulse data of condenser microphone**

As a pilot study to investigate the relationship between Chinese and modern medicines with microphone pressure sensor, we conduct a cross analysis of pulse data measured by microphone sensor and intra-arterial catheter, and Electrical CardioGram (ECG.). Unlike the ABP and ECG data, which are widely applied in most modern hospitals, the microphone data acquisition system is noninvasive and is easy to construct. It uses the commercial microphone, the software and hardware built in a personal or notebook computer and the data analysis of time series data. The measuring point of the microphone data should have prominent feeling of pulse when one touches his forefinger's tip to the wrist skin. Then, one just firmly presses the front head of the small microphone to the point. Since a commercial electret condenser microphone is generally very sensitive, the time series data can be successfully picked up. This measuring technique is closely related to the ancient Chinese diagnostic technique via three fingers.

As to the post processing, a fast and diffusive filter is first used to remove the trend of all the data. The remaining part is just the Fourier spectrum of the periodic part of the time series because the fast filter is carried out on the spectral domain. By imposing a Gaussian window, the band-pass- limited spectra are obtained and the corresponding results of applying the inverse Fast Fourier Transforms (FFT) is the real part of the wavelet coefficient. Then, using the Hilbert transform, the energy or amplitude of the spectral bands is evaluated. The cross correlation coefficients of the real part between the ECG, ABP, and microphone data are separately calculated with the spectral center of the Gaussian window scans over the range of 0.1 to 10 Hz which are corresponding to several organ-meridian modes. Six test cases in an intensive care unit were examined. Most numerical results show that the microphone data is related to ABP data in the real part correlation in the spectral region around the heart rate mode. The similarity between two spectrograms is considered to have the partial energy correlation. It seems that all the test cases are not in critical situations because ABP to ECG or microphone data to ECG are either correlated or partially correlated and all of them still alive. Although the sample size does not achieve a reasonable statistical level, these limited cases show that the Chinese and modern medicines are closely related to each other.

In this Chapter, the ECG signals were obtained from the three-lead ECG recording device. The ABP signals were conveyed from an invasive arterial-line system which involves an insertion of an arterial catheter connecting to a conducting tube filled with properly pressured fluid. The mechanical signals were then transformed to the electrical ones with a midway pressure transducer. Both ECG and ABP data were transferred back to the Philips MP60 module which was the physiological signal monitoring system used in our study. The analog signals were output to the data acquisition card where they would be converted to the digital signals with a sampling rate of 500Hz and then forwarded to the portable computer for further analysis.

If we can prove that the microphone arterial signal's heart rate mode can be used to provide the index, the preventive medicine would become a practical issue for the general population. Moreover, the connection between the ancient Chinese and modern medicines will become more solid in near future.

### **2.2.2 Hyperspectral imaging technology used in tongue diagnosis**

Among the four diagnostic processes of TCM: inspection, auscultation and olfaction, inquiry, and pulse feeling and palpation, the examination of tongue is one of the most important approaches for getting significant evidences in diagnosing the patient's health conditions. However, owing to its drawbacks in quantification and standardization, the development of tongue diagnosis is stagnated. Computerized methods for TCM allow researchers to identify required information more efficiently, discover new relationships which are obscured by merely focusing on Western medicine, and bridge the gaps between Western Medicine and TCM. Therefore, getting the overall information about tongue surface is very important for computerized tongue diagnosis system. In this chapter, an acousto-optic tunable filter (AOTF) based hyperspectral tongue imaging system (THIS) which can capture hyperspectral images of human tongue at a series of wavelengths is developed and used in tongue diagnosis. The basic principles and instrumental systems of the new system, the data pre-processing method as well as some applications are presented. Compared with the pushbroom hyperspectral tongue imager used in our previous works, this new type of hyperspectral tongue imaging system has the advantage of having no moving parts and can be scanned at very high rates. As the hyperspectral tongue images can provide more information than the traditional charge coupled device CCD based images, we can find some successful applications in computerized tongue diagnosis such as tongue body segmentation, tongue colour analysis and discrimination, tongue cracks extraction and classification, sublingual veins analysis, etc. Preliminary experiments show that the AOTF-based hyperspectral tongue imaging system is superior to the traditional CCD based methods because the hyperspectral images can provide more information about the tongue surface. In future studies, we will extract the quantitative features of the tongue surface and find some methods to model the relationship between these features and certain diseases.

The new system can capture image scenes in contiguous but narrow spectral bands under the control of the AOTF controller. The hyperspectral tongue images provided by the instrument can be visualized as a 3D cube because of its intrinsic structure, where the cube face is a function of the spatial coordinates and the depth is a function of wavelength. In this case, each spatial point on the face is characterized by its own spectrum (often called spectral signature). This spectrum is directly corresponds to the amount of energy that the tongue represented, as hyperspectral sensors commonly utilize the simple fact that a tongue can emits light in certain frequency bands. Consequently, the hyperspectral tongue image data provides a wealth of information about an image scene which is potentially very helpful to tongue diagnosis.

### **2.2.3 Advances in Chinese medicine diagnosis: From traditional methods to computational models**

Although Chinese and Western physicians were not distinct in their conceptual framework, their respective medical practices evolved on different cultures and historical contexts. Therefore, it is expected that the advances on medical knowledge represent this cultural divergence.

Many efforts have been made to integrate the ancient, traditional knowledge of Chinese medicine into contemporary, Eastern medical practice. Diagnosis is the key element in this integration of medical systems since it links the patient's needs to the available therapeutic resources. The art of Chinese medicine diagnosis was enriched throughout history but its main traditional aspect remains unchanged: the exclusive use of information available to the naked senses. Clinical information provided by vision, hearing, smelling, and touching is interpreted in a framework of Chinese medicine theories of physiology. No equipment or instrument was developed with specific diagnostic purposes or based on Chinese medicine theories. However, advances in computation and biomedical instruments allowed more powerful analysis of clinical data and quantification of parameters otherwise assessed only in a qualitative fashion. As a consequence, computer models for diagnosis in Chinese medicine were developed and tested in the last few decades and are promising tools in the clinical environment.

This chapter introduces the traditional methods of diagnosis in Chinese medicine and introduces their evolution into computational models. Current methods for validation of computational model by the assessment of their diagnostic accuracy and possible sources of errors are also presented. Finally, perspectives on the issue of computational diagnosis are discussed.

## **2.3 Pharmacological experimental research**

### **2.3.1 Effects of vasoactive Chinese herbs on the endothelial NO system**

Nitric oxide (NO) produced by the endothelial NO synthase (eNOS) plays a protective role in the vasculature. It is a potent vasodilator and protects blood vessels from thrombosis by inhibiting platelet aggregation and adhesion. In addition, endothelial NO possesses multiple anti-atherosclerotic properties. Interestingly, the purported effects of "circulation-improving" herbs used in TCM show striking similarities with the vascular actions of eNOS-derived NO. Therefore, we hypothesized that part of the pharmacological effects of such TCM herbs may be mediated by NO.

This Chapter studied the effects of 17 Chinese herbs with potential effects on the vasculature, and have identified *Salviae miltiorrhizae radix*, *Zizyphi spinosae semen* and *Prunella vulgaris* L. as potent eNOS-upregulating agents. In cultured human endothelial cells, aqueous extracts of these herbs increased eNOS promoter activity, eNOS mRNA and protein expression, as well as NO production in a concentration- and time-dependent manner. In addition, we have studied the constituents from the abovementioned Chinese herbs and have found that ursolic acid and betulinic acid are capable of enhancing eNOS gene expression. More recently, we have found that betulinic acid also stimulated NO production through post-translational mechanisms. By enhancing eNOS phosphorylation at serine 1177 and dephosphorylation at threonine 495, betulinic acid also increases eNOS enzymatic activity. In summary, we have described the pharmacological effects of Chinese herbs on endothelial NO system and have identified some active compounds from these plants. By performing modern pharmacological studies, we have provided some molecular mechanisms that may partially explain the therapeutic effects described in TCM.

### **2.3.2 Traditional Chinese herbal medicine – East meets West in validation and therapeutic application**

The holistic views of TCM generally have no conflicts with the western medicine, perhaps they were just expressed in different terms. Western medicine is usually more concrete in diagnosis and judgment. Treatment is often quicker, particularly in acute cases, and surgery

is its strength. Its weak points are that it sees disease as something to be measured and quantified and often ignores the psychological, social and behavioral factors involved in illness. Chinese medicine, on the other hand, can be too flexible and too general where diagnosis and judgment are concerned, and sometimes relies too heavily on the individual practitioner's experiences. Its strong points are its highly flexible approach, which enabling treatments to be changed as the patient improve, and its emphasis on preventive medicine. The Chinese way tends to treat the whole body rather than to try to isolate a particular infected area. And, finally, the herbs themselves, compared with chemically produced medicines, are relatively cheap and easy to use. They have minimal side-effects, and most have been tried and tested for over many thousand years. Western medicine focuses more on symptomatic management, whereas TCM focuses more on cause and effect. Western medicine is more useful for first-aid and surgical interventions, whereas TCM is more useful in treating internal and chronic illnesses. An ideal health care system should be established to concern people's physical and mental health, to deal with all personal problems, and to improve people's quality of life. A new model of health care should be composed by a different medical system to provide a holistic approach. TCM, today as an alternative and complementary medicine should be included into the conventional medicine to form the new modern medicine. This is in line with the aim of the WHO to promote recognition of traditional medicine and to support its integration into the mainstream health service. There is space of integration for TCM and modern medicine. A new paradigm for developing medicine is needed, and Chinese medicine could make a significant contribution in this field. To achieve such integration, modern science and technology had to be used to study the action, efficacy and toxicity of Chinese medicines. Although, there are many issues to concern, especially safe and effectiveness, some compromise and agreement are needed. Thus botanicals should be defined, authenticated and documented as to their source and conditions of cultivation using modern methodology. Manufacturing and preparation processes of Chinese medicine should be carefully monitored and standardized. Claims for Chinese medicine should be verified from rigorous controlled trials. Interaction between Western and Chinese medicines should be better studied and information obtained centralized into accessible databases. This would be an enormous undertaking requiring international collaboration and participation of governments worldwide. In fact, the feasibility of herbal validation by using Western methods is well-illustrated. In particular, concerns about identity authentication, quality control, evidences of efficacy and safety of herbal remedies, are being addressed with the modern science and technology, and ultimately allow the gathering of information necessarily to support clinical trials. Along with this route, efforts being played will return with the transition of TCM into a recognized science specialty to fill up the gaps between Eastern and Western medical approaches. In this perspective, it may not be necessary to isolate the active ingredients from herbal remedies or purity them to finally become chemical drugs. To promote the effectiveness, Chinese herbal medicine can remain in formulae but standardizations are needed. Meanwhile, both Chinese and western practitioners should come together and sort out the best treatment they can offer to patients, which very often may be the combination of the modern and Chinese medicine, instead of favoring one over the other. Conventional Western medicine and Chinese medicine should be seen as complementary to each other, rather than as alternatives. Both types of medicine have their advantages and drawbacks, which is why they need to work hand in hand for optimal results. Together, Chinese and Western medicine could form the most effective disease treatment the world has ever known.

### 2.3.3 Targeting effect of traditional Chinese medicine

Meridian guide drug had the effect of synergy and attenuation, and this effect based on concentrated drug at target-site. Meridian guide effect had an close relationship with drug transporters and metabolism enzyme. Different components had different affinity to transporters or enzymes, and meridian guide effect is the combination of all components in meridian guide drug. Therefore, it is necessary to investigate the exact effect of main components of meridian guide drug on transporters and metabolism enzyme, establish the relationship between its dose and its effect as well as effects in kinds of diseases. As we known more about the relationship among components in meridian guide drug, kinds of transporters and metabolism enzymes, activity in normal and disease state, we could design target delivery system freely as we like.

## 2.4 Pharmacodynamic material base research

### 2.4.1 Therapeutic effects of lignans isolated from schisandra chinensis on hepatic carcinoma

The development of novel therapeutic drugs for hepatic carcinoma is a very important objective in the field of pharmacological research. Among the variety of approaches thus far pursued to develop novel drugs, identification and screening of natural compounds from medical herbs has proven a very effective one – not least, because this method saves a great deal of time and cost. Recently, many institutes and companies in advanced countries have focused on an approach to novel drugs for hepatic carcinoma via the use of various lignins isolated from *S. chinensis*. This chapter introduces three lignans and one blend which may prove valuable in efforts to combat hepatic carcinoma. Gomisin A at high concentration was found to significantly induce anti-proliferative and pro-apoptotic effects in hepatic carcinoma. Schizandrin A markedly increased vincristine-induced hepatic carcinoma apoptosis and anti-tumor activity. Additionally, tigloygomisin H induced the death of hepatic carcinoma cells and inhibited quinone reductase activity. Furthermore, KY88 was a blend composed of 10 herbal extracts and effects a dose-dependent inhibition of hepatocellular carcinoma cellular proliferation. Collectively, the results of this chapter demonstrated that these lignins and the blend from *S. chinensis* were regarded as an anti-cancer drug candidate capable of inducing apoptosis and inhibiting the cell proliferation of hepatocellular carcinoma via a variety of mechanisms.

### 2.4.2 Separation and quantification of component monosaccharides of polysaccharide extracts from ephedra sinica by MECC with photodiode array detector

TCM polysaccharides with multiple pharmacological activities have recently stimulated the interest of academia and the pharmaceutical industries. In fact, the roles of water-soluble polysaccharides from traditional Chinese medicines in biological processes have been studied with increasing attention over the past recent years because of their broad spectrum of therapeutic properties and relatively low toxicity. Indeed, immunomodulation, anti-tumour, antiviral, anticoagulant, hypoglycaemic, anti-complementary, anti-inflammatory and antioxidation bioactivities have been presented by many polysaccharides extracted from medicinal fungi and plants.

The *Ephedra* plant, or “Mahuang” of traditional Chinese medicine, is one of the oldest medicinal plants known to mankind. More than 45 species of *Ephedra* plants exist and are indigenous to regions of Asia, North, Central and South America and Europe. Mahuang contains ephedrine alkaloids as their principal components, which are primarily localized in

the aerial parts of the plant. In recent years, many herbs used in popular medicine have been reported to contain polysaccharides with a great variety of biological activities and the water-soluble Mahuang polysaccharides are also demonstrated to be one of the main bioactive constituents of *Ephedra* plant except for a series of ephedrine alkaloids. For these reasons, great interest arose on the reliable analytical methods of the Mahuang polysaccharides, which can be used for exploring the new functional products with polysaccharides due to its pharmacological importance and application in the pharmaceutical industry. Immunosuppressive effects of acidic polysaccharides from the stems of *E. sinica* have been demonstrated by carbon clearance test, delayed type hypersensitivity reaction and humoral immune response *in vivo*.

In this chapter, a rapid and sensitive method was optimized and validated for the separation and quantification of derivatized monosaccharides in cold water-soluble polysaccharide extract from the stems of *E. sinica* using 1-phenyl-3-methyl-5-pyrazolone (PMP) as precolumn derivatization reagent by micellar electrokinetic capillary chromatography (MECC) with photodiode array detector. The separation was carried out on an unmodified fused silica capillary and UV detection at 250 nm, and the 8 PMP derivatives of mannose, rhamnose, glucuronic acid, galacturonic acid, glucose, xylose, galactose and arabinose were baseline separated within 12 min.

### 3. Conclusion

This book may help our readers gain a deeper understanding of unique characteristics of TCM and will bridge the gap between the methods of Chinese medicine and modern biomedicine through the discussion of TCM with advanced instrumental methods. Also, it will be providing cutting-edge information about TCM research including its basic theories, diagnostic approach, current clinical applications, latest advances, and so on. Hopefully, it could play a very important role in disseminating TCM knowledge, promoting TCM influence in the world and accelerating the modernization of TCM.

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## **Recent Advances in Theories and Practice of Chinese Medicine**

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During the recent years, traditional Chinese medicine (TCM) has attracted the attention of researchers all over the world. It is looked upon not only as a bright pearl, but also a treasure house of ancient Chinese culture. Nowadays, TCM has become a subject area with high potential and the possibility for original innovation. This book titled Recent Advances in Theories and Practice of Chinese Medicine provides an authoritative and cutting-edge insight into TCM research, including its basic theories, diagnostic approach, current clinical applications, latest advances, and more. It discusses many often neglected important issues, such as the theory of TCM property, and how to carry out TCM research in the direction of TCM property theory using modern scientific technology. The authors of this book comprise an international group of recognized researchers who possess abundant clinical knowledge and research background due to their years of practicing TCM. Hopefully, this book will help our readers gain a deeper understanding of the unique characteristics of Chinese medicine.

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