



## Review

## Overview on development of ASEAN traditional and herbal medicines

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## ABSTRACT

Traditional medicine is an important and often underestimated part of health services. In some countries, it has a long history of use in health maintenance and in disease prevention and treatment, particularly for disease. WHO has always emphasized the important role of traditional, complementary and alternative medicine in human healthcare. In this review article, the author provided some information from the following five aspects: (1) Development basis of China ASEAN traditional medicine and herbal medicine; (2) The development and efficacy of traditional medicine theory system; (3) Industry development and regulation management of traditional medicine and herbal medicine products; (4) China-ASEAN traditional medicine exchanges and cooperation to promote traditional medicine cooperation and medicine trade, and (5) Strengthening academic and industrial cooperation and promoting the healthy development of traditional medicine and herbal medicine. It is believed that the information will have certain reference value for readers in studies on traditional and herbal medicines.

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**1. Introduction**

Traditional medicine (TM) is an important and often underestimated part of health services. In some countries, TM has a long history of use in health maintenance and in disease prevention and treatment, particularly for disease. The World Health Organization (WHO) emphasized the importance of the study on the prevalence and determinant of Traditional, Complementary and Alternative Medicine (TCAM) use (WHO, 2004).

Studies on the utilization of TCAM have been focused in go high income countries (Harris, Cooper, Relton, & Thomas, 2012). Although many populations in lower Mekong and ASEAN are reported to use TCAM to help meet their healthcare needs, precise-data are lacking (WHO, 2004).

The 10 Association of Southeast Asian Nations (ASEAN) countries refer to Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. The geographical position of ASEAN countries is extremely important, and it is an important gateway for “The belt and road initiative” to open to the south and carry out regional cooperation (Deng, 2019).

China and ASEAN countries have similar geographical and natural environment, rich medicinal biological resources, commonality of medicinal culture and complementarity of medicinal resources and consumption market, and have great potential for research and development cooperation in the field of traditional medicine.

From PMC database of USA National Library of Medicine, the author used “Herbal medicine” and “Traditional medicine” as keywords, to search the related information. The data search results are obtained as shown in Table 1. Except for China-ASEAN, it is found that the number of literatures related to Herbal medicine and Traditional medicine in other countries is 31.5% and 60.7%, respectively. From these data, we can see that traditional medicine and folk medicine researches still account for a significant proportion, which attracts the attention and painstaking research of international scientists. It also reflects the importance of the development of traditional medicine in the world medical system. Traditional and herbal medicines play an important role in protecting people’s health in China and ASEAN countries. Finally, a three-dimensional and continuous medical architecture was formed. ASEAN countries have also formed their own medical systems with regional characteristics, which are still an important means of treating diseases and daily healthcare.

China and all ASEAN countries are members of the World Health Community. We need to give full play to our respective advantages and make application contributions to the world health cause by using TM and HM. In this article, I will provide some

information from the following five aspects: (1) Development basis of China ASEAN traditional medicine and herbal medicine, (2) The development and efficacy of traditional medicine theory system, (3) Industry development and Regulation Management of traditional medicine and herbal medicine products, (4) China-ASEAN traditional medicine exchanges and cooperation to promote traditional medicine cooperation and medicine trade, and (5) Strengthening academic and industrial cooperation and promoting the healthy development of traditional medicine and herbal medicine. I believe that the information will have certain reference value for readers.

**2. Development basis of China-ASEAN traditional medicine and herbal medicine**

After the birth of “Experimental Medicine” as a typical modern medical system in 1900, the development of traditional medicine in various regions of the world can be said to be a hundred flowers bloom with their own characteristics; Traditional medicine (TM) and herbal medicine (HM) are usually defined as originating before the Renaissance and still plays a role in ensuring people’s health. Although traditional Chinese medicine (TCM) originated from the people, it has formed a complete framework after thousands of years, affecting the surrounding areas.

ASEAN countries are adjacent to China and have had exchanges in all aspects since ancient times. The mutual influence of national medical culture is of great significance to the development of national traditional medicine. Traditional medicine originates from the social practice of local people and adapts to local politics, econ-

**Table 1**  
 Data search results from PMC database of USA National Library of Medicine (1981–2021).

Nations	Number of literatures related to herbal medicine	Number of literatures related to traditional medicine
World	74,527	484,703
China	36,349	120,266
Brunei	192	460
Cambodia	549	3631
Indonesia	1981	8283
Laos	47	1659
Malaysia	3435	11,151
Myanmar	616	2704
Philippines	1014	5363
Singapor	2031	12,592
Thailand	3405	14,674
Vietnam	1383	9700
Other nations	23,525 (31.5%)	294,220 (60.7%)

omy, culture and social life. It is an important part of regional culture (Deng, 2019). Both China and ASEAN countries are in the coexistence of modern medicine and traditional medicine. All countries are facing the collision between traditional medicine and modern medicine. How to develop their strengths and avoid their weaknesses, not only retain the characteristics of their national traditional medicine, carry forward their national excellent culture, but also draw on their strengths, and integrate tradition and modernity, classics and science and technology are the same problems faced by all countries.

The disease spectrum of China and ASEAN countries is similar, thus forming similar medication habits. TCM has a good foundation in ASEAN countries. Vietnam, Thailand, Singapore and other countries have successively recognized the legal status of TCM or TCM practitioners, and services are expected to be incorporated into the mainstream of national medicine in Malaysia. In recent years, traditional medicine industry and medical care have flourished in ASEAN countries. The potential for cooperation between China and ASEAN countries in the fields of TM education, health and scientific research has also been continuously stimulated.

### 3. Development and efficacy of traditional medicine theory system

#### 3.1. In China

The theoretical system of traditional Chinese medicine was initially formed from the Warring States period to the Han Dynasty. The completion of medical monographs such as *The Yellow Emperor's Internal Classic*, *Treatise on Typhoid and Miscellaneous diseases* and *Shennong's Herbal Classic* marked the initial formation of the theoretical system of TCM. The development of medical theory and practice after the Han Dynasty gradually enriched and improved this theoretical system. TCM is a medical theoretical system with the theory of *Yin Yang* and five elements as the guiding ideology, the physiology and pathology of *Zang Fu* organs and meridians as the basis, and the overall concept and syndrome differentiation and treatment as the basic characteristics (Hu, Ju, Jun, & Wang, 2015; Yan, 2005; Zeng, 2010). The philosophical thinking of traditional Chinese medicine adheres to the ancient simple materialism, absorbs the essence of dialectics, and uses *Yin Yang* and five elements as support. The theory of *Zang Xiang*, the theory of *Qi*, blood and body fluid and the theory of meridians can be summarized and explained in detail and comprehensively on pathology; The holistic view and syndrome differentiation and treatment are fully reflected in the explanation of etiology, disease diagnosis and treatment and daily health care. The practice of Chinese medicine culture proves its advanced nature.

The guiding opinions on strengthening the construction of TCM culture points out that the culture is the foundation and soul of TCM, the internal driving force for the sustainable development and the inexhaustible source of academic innovation and progress of TCM (State, 2016). The culture not only includes the traditional concept of summarizing the characteristics of TCM, but also has the material basis that can present the TCM characteristics. It inherits Chinese traditional philosophy, and runs through it with literary and historical ideas. It has gradually formed a basic framework including spirit, behavior and material, and includes philosophical basis and cultural roots, extension of TCM medical ethics and code of conduct, the historical relics and environmental image of TCM classics, and cultural inheritance and dissemination. The Chinese government attaches great importance to the development and dissemination of the culture. To TCM regulations, several opinions support and promote the development of TCM products, the TCM law also supports the TCM development through multiple means

such as politics, economy and culture (State Council, 2003; State Council, 2008; SCNPC, 2016).

#### 3.2. In ASEAN countries

Thai culture has historically been heavily influenced by Indian and Chinese culture. Its traditional medicine is mainly derived from longevity Vedic medicine in India, known as “ancient medicine” in Thailand, and TCM is introduced from China. Indian medicine was first introduced to Thailand by the Buddhist monk Chiwa ghumen, who is still revered as the founder of Thai medicine.

The harsh natural environment has enabled people in various regions to inherit profound experience in overcoming diseases and pain and protecting health, and finally formed a three-dimensional and continuous medical framework. ASEAN countries have also formed their own medical systems with regional characteristics, which is still an important means of disease treatment and daily healthcare.

Thai medicine originated from the Indian medical system and later integrated into TCM to form the Thai traditional medical culture system. Thai traditional medicine integrates the four elements of Indian Buddhism, the Vedic thought of life, the basic system of traditional Chinese medicine, astrology, supernatural and other ideas (Xu, 2003; Yan, 2005), and attaches importance to the correlation and balance of the four elements of “wind”, “fire”, “water” and “Earth” to achieve human health. Thai medicine materials come from animals, plants and minerals. According to different importance, they are subdivided into main drugs, auxiliary drugs, control drugs and toner and flavor agents. The introduction of modern medicine had a certain impact on traditional medicine until 70 years after the 19th century. In the tenth development plan (2008–2011), the Thai government vigorously supports traditional and folk medical technology through Legislative Council (Wang, 2010). In terms of TM education, some measures have also been taken to promote the inheritance and revival of TM.

Vietnamese TM began in the hung era (Huang, 1998), which is similar to TCM, such as medical origin, theoretical system, development process, etc. However, it has a large output of medicinal plants and has unique diagnosis and treatment characteristics for diseases caused by humid climate. Finally, it forms a clinical diagnosis and treatment technology that inherits the TCM concept to innovate and develop its own characteristics in practice.

In other ASEAN countries, the aborigines of Indonesia and Malaysia learned to use herbs to treat diseases and wounds in complex natural environment, forming the “local medicine” that has been handed down to this day. Singapore's traditional medicine is deeply influenced by the traditional medical concepts of China, Malaysia, India and other places. In terms of medical treatment in the Philippines, the provincial responsibility system and limited hierarchical referral system are mainly implemented. The government implements the Philippine health plan, which can provide small medical insurance benefits for most people. Traditional medicine in the Philippines mainly focuses on bone setting, massage and herbal medicine. The local government and people have a good acceptance of acupuncture and moxibustion. However, there are still many restrictions on the TCM theory and development in the local area (Qin et al., 2021).

#### 3.3. Comparison of ASEAN-China traditional medicine culture

The world's recognition of TCM culture is gradually deepening. Traditional Chinese medicine has a far-reaching impact on the traditional medical culture of ASEAN countries. The two complement each other and promote each other (Wang, Wei, Liu, & Cao, 2021).



Fig. 1. China-ASEAN Traditional Medicine in Chinese (A) and English (B) editions.

### 3.3.1. TM has a long history

The development history of China and ASEAN countries can be traced back to ancient times, which is the practical achievement of the local people's struggle against nature and disease. Although the culture of some countries (such as the Philippines) has been greatly impacted in modern times, its historical origin cannot be changed.

### 3.3.2. Theoretical system interaction

Among the cultures of ASEAN countries, only Thailand and Vietnam have formed a relatively complete theoretical system. North Vietnam was under the jurisdiction of China as early as the Qin Dynasty, and Vietnam was granted the state of Vietnam in the Qing Dynasty. In fact, there is no difference between Vietnamese medicine and traditional Chinese medicine (Duan et al., 2005). Thai medicine and TCM have a deep foundation of Oriental philosophy, but Thai medicine has a strong religious color, while TCM is greatly weakened and emphasizes the equality between man and nature. The traditional medical culture of other ASEAN countries has not formed a relatively complete theoretical system, and most of them still remain in the stage of experience accumulation. The medical cultural exchanges between ASEAN countries and China are deepening, the trade of medicinal materials is frequent, and the TCM theoretical system is gradually integrated into the elements of other countries.

### 3.3.3. Development process is arduous and tortuous

China and Southeast Asian countries have suffered from war and famine, and the destruction and destruction of local traditional medical culture is irreversible. However, traditional medicine still spreads today because of its practicability, scientificity and mass. Although the degree and speed of development of traditional Chinese medicine and traditional medicine in ASEAN countries are different, they generally tend to pay attention to, improve and progress.

### 3.3.4. Inheritance and development are of far-reaching significance

TM has a long history and rugged road, but from the perspective of development trend, governments of various countries gradually recognize traditional medicine and strive to spread traditional medicine culture through various efforts. In this process, most governments occupy the dominant position of cultural inheritance and communication, and institutionalize the inheritance of traditional medical culture in the form of legislation; Some countries also promote this process in the form of local non-governmental organization activities. Education plays a vital role in the dissemination and

continuation of medicine. At the same time, theoretical systematization is of far-reaching significance to enhance the influence of medicine. TCM and Thai medicine with relatively mature structure have gradually moved to the world.

### 3.3.5. Traditional medicine has its own characteristics

After thousands of years of precipitation and experience accumulation, the TCM culture of various countries has formed distinct regional characteristics. The long-term and relatively stable feudal rule in the process of Chinese historical development provides a solid political guarantee for the inheritance of TCM culture, and the culture can be well preserved; After 1949, the development of economy and science and technology made the TCM theoretical system more and more perfect in China. TM in ASEAN countries focuses more on the diagnosis and treatment of one or several kinds of diseases. There is a lack of understanding of people as a whole, and the diagnosis and treatment system is lacking.

### 3.4. A new starting point for China-ASEAN cooperation

TM and HM has become a key area of cooperation between China and ASEAN. In August 2016, at the invitation of the Ministry of health of Laos, the Ministry of health of Cambodia, the government of Sarawak State of Malaysia and the Federation of Traditional Chinese Medicine and Acupuncture of Malaysia, Guangxi University of traditional Chinese Medicine and other relevant units successively went to Laos, Cambodia and Malaysia for exchanges and reached a series of cooperation.

After seven years of cooperative research on traditional drug resources, a publication *China-ASEAN Traditional Medicine* was published in Chinese and English editions (Fig. 1).

The resources and application information are more than 350 species of traditional medicines based on systematically investigated, studied and analyzed. The book provides a scientific basis for further development and cooperation. *Chinese-ASEAN Traditional Medicine* records the distribution, chemical composition, pharmacological action and application of 350 species of TMs and HMs commonly used in China and 10 ASEAN countries (Deng, 2019). The publication of this book provides a model for China and ASEAN countries to carry out research on traditional medicinal plant resources and literatures, and plays an extremely important role in promoting cooperation and exchanges between China and ASEAN countries in TM research and enhancing the academic status. (Li et al., 2021). In 2017, the establishment of the China-ASEAN Joint Laboratory for International Cooperation in Tra-



ditional Medicines Research provided an organizational guarantee for more in-depth cooperation among various parties.

#### 4. Industry development and regulation management of traditional medicine and herbal medicine products

In this paper, we have read some review literatures that provides useful information for our understanding development of traditional and herbal medicine in ASEAN countries (Hu et al., 2015; Qin, Liang, Louis, Shi, Zhao, Song, Xu, & Cao, 2021; Wang, 2010; Xu, 2003; Yan, 2005; Zeng, 2010). However, TM is of enormous importance in developing countries including ASEAN countries, where it is usually firmly embedded in the healthcare systems. The 2014–2023 Strategy for Traditional Medicine from the WHO posits that TM and HM treatments are the main source of healthcare, and often the only one, for millions of people (WHO, 2002; WHO, 2013).

##### 4.1. Thailand TM and HM products

The overall development plan for the Thai herbal industry is being drafted in the hope of determining the development direction of the Thai herbal industry so as to promote the rapid development of the industry.

Thai doctors treat patients mainly by consultation and then prescription. Treatment methods commonly used include diarrhea and laxative method, sometimes also with sweat, vomiting two methods. There are nearly 5000 kinds of traditional medicine used in Thailand, mainly from plant medicine, and a small amount of animal and mineral medicine. There are 600 kinds of commercial medicinal materials. In the plant medicine including the leaves and roots, there are many species of lianas, many medicinal materials for the sweet or sour taste of the product. In addition, it is estimated that there are as many as 1,800 herbs known locally in Thailand, of which 300 are very common in the Thai consumer market.

The Thai government has provided policy guidance on the direction of action for the herbal industry over the next five years. Thailand is very suitable for the cultivation of herbal ingredients, rich in geographical environment and climate diversity, so Thailand has become an important source for the search for natural medicinal materials. Thai authorities are drawing up a master plan for the country's herbal industry, which they hope will shape the country's future as an ASEAN base and hub for the herbal industry and as a leading global exporter of herbal ingredients (Wang, 2010).

Although Thailand is rich in medicinal materials, it has not made remarkable achievements in the biopharmaceutical industry due to its backward scientific research and technology. If the modern biopharmaceutical industry is anything to go by, the use of Thai herbs in this area is already on the rise. In the past, Thailand's contribution in these areas has been mostly in the form of material source, with relatively little in the way of refining and follow-up studies. Some industries have introduced some Thai herbs as important medicines into the modern pharmaceutical manufacturing industry.

It is known that the current laws and regulations governing traditional medicine in Thailand are derived from the pharmaceutical act No.1 BE.2510 (1967), as amended, and include: pharmaceutical act No. 2, BE.2518 (1975); pharmaceutical act No. 3, BE.2522 (1979); pharmaceutical act No. 4, BE.2527 (1984); and pharmaceutical act No. 5, BE.2530 (1987). The registration, production, sales and supervision of Thai drugs are managed by the Food and Drug Administration (FDA) under the Health Ministry of Thailand, which is mainly divided into two categories, namely modern drugs and TMs.

In Thailand, drug registration, production, sale and supervision are managed by FDA under the Health Ministry of Thailand. Thai medicines can be simply divided into traditional medicines (traditional drugs) and modern medicines (modern drugs), among which modern medicines can be divided into over-the-counter medicines (household remedy), ready-packed medicines (ready-packed drugs), dangerous medicines (dangerous drugs) and specially controlled medicines (specially controlled drugs). Dangerous drugs can be purchased without prescription, but they must be prepared and distributed by pharmacists. For drugs that may have potential health risks, if misused, they can only be sold after obtaining prescription permission.

TM refers to the local recorded in the official Pharmacopoeia of Thailand, or the traditional medicine recognized or approved by the Ministry of Public Health of Thailand. Its supervision and registration are less strict than modern medicine. TM registration application is relatively simple, applicants only need to apply for drug registration certificate, and do not need to submit analysis method. Since 1997, many documents have introduced the registration requirements of Thai herbal products (Ming, 1997; Wang, 2010; Wenku.baidu, 2019; Wongyai, 2007; Yaozh, 2018)

Kiattibhoom Vongrachit (Director, Department of Thai Medicine and Alternative Medicine Development) said that both traditional medicine system and alternative medicine are certified by the Health Ministry of Thailand, which covers Thai TM, TCM and chiropractic therapy, which play an important role in the field of public health services in Thailand. The Ministry of Traditional and Alternative Medicine Development of Thailand, which was established in 2002. To revive TM, it is a national authority in promoting TM development, and its management shows three characteristics.

##### 4.2. Market of HM/TM products in Thailand is developing rapidly.

From the intuitive figures, in 2016, five countries in the world accounted for 61% of the retail value of HM /TM products, and Thailand was one of them. From 2011 to 2016, Thailand and China had a significant growth momentum in the retail value of HM/TM products, with the fastest growth rates of 68% and 57%, respectively.

##### 4.2.1. Thailand attaches great importance to the development of TM and is committed to revising and improving relevant policies and mechanisms.

The Thai government attaches great importance to the long-term development of TM, and is committed to revising and improving the development policies and mechanisms related to TM. The constitution of the kingdom of Thailand contains relevant regulations on national development and reform, the 20-year national strategy (2017–2036) draft proposed in recent years and expected to be approved in 2018, and the national public health reform plan focusing on industry, service and education and so on.

##### 4.2.2. TM and HM products are an important part of “Thailand 4.0” strategy.

At present, Thailand is entering an important stage of the 4.0 era. It needs to develop high value-added industries through innovation and technology application, promote Thailand's economic transformation and upgrading, enhance its competitiveness, and promote economic and social stability, prosperity and sustainable development. At the beginning of 2017, an official from the International Affairs Bureau of the Investment Promotion Council of Thailand revealed that the Thai government has put forward the economic development strategy of “Thailand 4.0” in an all-round way. In the future, it will focus on the development of five existing advantageous industries such as automobile manufacturing, intelligent electronics, tourism and biotechnology, and accelerate the development of five emerging industries such as robot manufac-

**Table 2**  
Most commonly used plant parts.

Used plant parts	Number of species	Ratio/%
Stem	82	35.9
Root	59	25.8
Leaf	31	13.5
Brak	20	8.8
Fruit	14	6.1
Rhizoma	8	3.6
Flower	4	1.8
Shoot	4	1.8
Sap	2	0.9
Seed	2	0.9
While plant	2	0.9
Total	228	100

(Data source form [Junsongduang et al., 2020](#)).

**Table 3**  
Preparation methods for medicinal plants used by four healers in Roi Et, Thailand.

Preparation methods	Number of species	Ratio/%
Decoction	124	76
Crush or grind and apply to skin	23	14
Grind with water and drink	10	6
Soaked and bath	6	3
Eat as food	4	2
Soaked and drink	4	2
Eat as fresh	3	1
Boil and bath	2	1
Steamed	2	1
Chewed	1	0.5
Grind with water and wash hair	1	0.5
Grind with lemon juice and drink	1	0.5
Total	201	100

(Data resource form [Junsongduang et al., 2020](#)).

turing, aviation, biofuels and biochemistry, digital economy and all-round medical industry. Thailand's economic development strategy with innovation as the main line is highly consistent with the development concept and goal of "the belt and road" initiative ([Wang, 2017](#)). TM and HM products are regarded as an important part of the "Thailand 4.0" high value-added economic model. The national herbal medicine policy committee and the overall plan for the development of HM production have a strong driving force for the formulation and improvement of the national herbal medicine policy. In the future, relying on the three development engines of brand remodeling, dual protection and research and innovation, Thai traditional medicine is expected to achieve considerable development.

#### 4.3. Thailand companies have regulated herbal medicines in national drug Administration

The products are allow hospitals to replace modern medicines with herbs for the first time. The government encouraged doctors to use herbs instead of modern medicines. This will reduce the huge cost of importing western medicines. Many Thai doctors are reluctant to use herbal remedies, in part because they can buy prescriptions from big pharmaceutical companies.

Phumthum et al reviewed available the Thailand medicinal plants according to information about ethnomedicinal uses of Thailand medicinal plants in 64 published scientific reports between 1990 and 2014. The authors found 2187 plant species in 206 families from 16,789 user reports. These data came from 19 ethnic groups living in 121 villages throughout Thailand. Five families present very high use values (Fabaceae, Asteraceae, Acanthaceae, Lamiaceae, and Zingiberaceae) and three species present very high use values (*Chromolaena odorata* (L.) R.M.King & H.Rob.,

*Blumea balsamifera* (L.) DC., and *Cheilocostus speciosus* (J.Koenig) C.D. Specht.). Stems and leaves were the most used plant parts, and other parts of the plants were used in medicinal recipes. They found 2187 plant species that were used in traditional medicine in Thailand. It is suggesting that they may produce bioactive compounds with strong physiological effects ([Phumthum et al., 2018](#)).

The Thai traditional medicine composed medicinal plants and herbal remedies that can treat both pain and cervical cancer. Medicinal plants and herbal remedies were selected to investigate for biological activity related to woman's health. There have five specials (*Boesenbergia rotunda* Linn, *Piper nigrum* Linn, *Zingiber cassumunar* Roxb, *Zingiber officinale* Roscoe, *Zingiber zerumbet* (L.) Smith, and *Dioscorea birmanica* Prain & Burkill). Jaiaree et al investigated cytotoxic and anti-inflammatory activities of Thai medicinal plants by spectrophotometry technique and bioassay in Hela cells, cervical cancer cells, by sulforhodamine B assay, inhibition of nitric oxide and prostaglandin E2 production in lipopolysaccharide-stimulated mouse macrophage RAW 264.7 cells. This study examined and showed that *P. nigrum*, *Z. officinale*, *B. rotunda* and *Z. cassumunar* showed potent inhibitory activity on nitric oxide and PGE2 production. This study suggested that Thai medicinal plants which have often been used in the treatment of pain and cancer by Thai traditional practitioners. It showed high anti-inflammatory properties on both pathways which represent chronic and acute inflammation. In addition, *Z. zerumbet* and *D. birmanica*, which has often been used in the treatment of cancer, also showed high cytotoxic activity against cervical cancer cells ([Jaiaree, Itharat, & Ruangnoo, 2016](#)).

Junsongduang et al searched for the medicinal plants with the healers to review and document the availability of medicinal plants at each locality and in different habitats around the villages. They use values (UV) to estimate the importance of each medicinal plant and informant agreement ratios (IAR) to understand how widely known the uses herbal medicine. The four Phu Tai traditional healers knew 162 medicinal plant species in 141 genera and 63 families. The family with the most medicinal plants was Leguminosae with 15 species. The plant part that they used most commonly was the stem, which was used for 82 species ([Table 2](#)). The most common preparation method was decoction, which was done for 124 species ([Table 3](#)). The most important and widely used medicinal plants were *Rothmannia wittii*, which had the highest UV of 1.7. Most medicinal plants were used for treating tonic for 34 species ([Junsongduang et al., 2020](#)).

Based on Roi Et experience, it is importance how to understand the Thai traditional medicine knowledge by Phu Thai healers for treating their patients. Their study is suggested that will be help to identify many highly valuable medicinal plant species with high potential for economic development through the sustainable collection. The medicinal plants with high UV should be subjected to pharmacological studies to validate their use and to isolate their bioactive compounds for further study. The pharmacological activities of these medicinal plants will be examined in preclinical and clinical tests to identify in next research.

#### 5. China-ASEAN traditional medicine exchanges and cooperation to promote traditional medicine cooperation and medicine trade

In 2013, Chinese leaders put forward the work initiative of building the "the belt and road" initiative cooperative economic belt. Since the implementation of the work, China has conducted trade cooperation with more than 100 countries. ASEAN is close to China in geographical position and cultural background, and has become China's third largest trading partner and the focus of the implementation of the "the belt and road" initiative, making

the import and export of medicines between China and ASEAN more convenient. However, due to the different economic level, medical conditions and policy environment of ASEAN countries, the development status of Chinese medicine trade market between China and ASEAN countries is also different. Qian et al analyzed what factors determine China's exports of primary and semi-finished products of TCM to ASEAN based on panel data from 2000 to 2011, and they suggested that it is able to improve the performance for leading role in technological innovation by state-owned enterprises, for taking advantage in suppliers, and increasing outward foreign investment (Qian, Yang, Zhao, & Bi, 2014). By combing the development status and related policies of Chinese medicine trade market between China and ASEAN countries, and combining with the background of "the belt and road initiative" initiative, we aim to put forward the development strategy of promoting Chinese medicine trade between China and ASEAN countries (Liu et al., 2021).

In 2019, the total trade volume of Chinese medicine products in China was US\$ 6.174 billion, and the export volume reached US\$ 4.019 billion, both showing an increasing trend. From 2018 to 2019, China's main export TCM products include extracts of TCMs, CHMs, Chinese patent medicines and health products; the extracts accounts have the highest proportion, followed by Chinese herbal medicines (Liu et al., 2021).

### 5.1. Singapore

Singapore has developed economy, ranking first in per capita GDP in ASEAN, and enjoys a superior geographical position. Traditional Chinese medicine products exported from China to Singapore are mainly Chinese herbal medicines. About 88% of Singaporeans use Chinese medicine. In 2000, the Chinese Medicine Registration Act was promulgated, which established the legal status of Chinese medicine practitioners. After the signing of China-Singapore Free Trade Agreement in 2008, there were fewer restrictions on varieties, and the quarantine standards and evaluation of both sides were more perfect. Singapore Health Science Bureau has issued GMP for the production of proprietary Chinese medicines, which focuses on the supervision of the safety and quality of proprietary Chinese medicines. However, there is no clear requirement for the effectiveness of medicines. Drug registration is mainly based on the Drug Law, and a registration system is adopted for the import of proprietary Chinese medicines. Import licenses are required for importing Chinese medicines. Western medicine is the main management standard of TCMs, which restricts the import of some TCMs.

### 5.2. Thailand

In 2000, Thailand established the legal status of TCM, and it was the first foreign country to legalize TCM. Chinese medicine is only a part of traditional medicine in Thailand. All foods and medicines shall be imported after professional testing and approved by the local Food and Drug Administration. Thailand's drug quality access standards are usually based on Thailand, the United States, the United Kingdom and the International Pharmacopoeia, and the registration of Chinese medicine products is very strict. TCM in Thailand has a different understanding of traditional Chinese medicine, and there are more restrictions on the import of Chinese patent medicines, which mainly treat hypertension, diabetes, heart disease, vascular embolism, kidney disease and acute infectious diseases are banned. In recent years, the Thai government has encouraged cooperation with Chinese medicine. In the training of TCM talents, we should establish a joint training system with Chinese TCM universities and establish Confucius Institute of TCM to promote the spread of TCM.

### 5.3. Vietnam

Vietnam has a long history of using TCMs, and adheres to the road of combining traditional Chinese medicine with Western medicine. In 2004, it promulgated the traditional medicine law, and has incorporated TCM into the national basic medical insurance. In terms of drug supervision, foreign pharmaceutical enterprises are allowed to set up offices in China, and drugs are allowed to be imported, but domestic distribution is prohibited. Due to the interference of Vietnamese government, Sino-Vietnamese trade is unstable. In recent years, convenience has been provided, but the confusion of the quality of TCMs has become a major factor restricting the trade of TCM products.

### 5.4. Indonesia

Indonesia is a populous country with abundant medicinal plant resources. In the Tang Dynasty, a large number of overseas Chinese moved to Indonesia, where traditional medicine was established and Chinese medicine was spread. Nowadays, the sales of tonics and Chinese medicines are large, and many varieties of TCM products such as Pien Tze Huang, Liushen Pills and bonesetting water are selling well. In 2009, Indonesia established the legal status of Chinese medicine. In 2011, it established the Department of Traditional Medicine to manage traditional medicine, and formulated and revised the Registration Procedure of TM and Standardized Herbs. It has a regulatory system for the listing of pharmaceutical products and has registered thousands of traditional medicines. After the government granted the sales license, the Food and Drug Administration conducted security check, authorization and registration. The annual growth rate of Indonesian pharmaceutical market is 8%, accounting for 27% of the whole ASEAN pharmaceutical market, of which 73% are Indonesian local pharmaceutical enterprises. The experience of multinational enterprises with better development in Indonesian market tells us that scientific research and technology is the secret of the sustainable development of foreign-funded enterprises in Indonesian market. If new drugs can be introduced into Indonesian market, it is of great significance to consolidate its position in Indonesian pharmaceutical industry.

### 5.5. Malaysia

Malaysia is located in the tropics, with abundant medicinal plant resources. Malaysia has less restrictions on its imports to China, and implements trade liberalization management. Malaysia has a large market for CHM products and proprietary Chinese medicines. In foreign trade, Malaysia requires all importers, wholesalers and manufacturers to obtain licenses and registers of all medicines. Some TCM products can also be registered as ordinary foods for sale according to the product formula. After 1983, Malaysia successively issued a number of regulations for classified management. In recent years, the Malaysian government has begun to attach importance to the development of Chinese medicine, and the trade service of TCM products has gradually become institutionalized and standardized.

### 5.6. Cambodia

The pharmaceutical market in Cambodia is promising in recent years. Cambodia has a long history of development of medicinal botany and abundant medicinal plant resources. The Cambodian government pays attention to the protection of TM resources, establishes relevant laws and regulations and strategic plans for the TM development, trains traditional doctors, and establishes a training team for TM hoping to jointly develop medical health tourism.

### 5.7. Laos

The medical system in Laos implements free medical treatment in public hospitals, but the medical conditions in Laos are relatively backward. With the rapid development of Laos' economy, besides the government's investment in hospitals and public health, the Lao people need other medical treatment channels and the supply of medicines with high quality and low price. At present, the pharmaceutical production and supply in Laos are far from meeting the domestic demand in Laos. Apart from the drugs with common diseases and frequently-occurring diseases, there is a bigger gap in tumor treatment and biopharmaceuticals, which is also a market opportunity for domestic pharmaceutical enterprises.

At the same time, in order to ensure the supply of drugs, the sale and supply of chain drugs is also an investment opportunity. In recent years, Laos and China have cooperated extensively in the field of traditional medicine. Experts from China and Laos have jointly conducted resource investigation, market investigation, visits by folk doctors, collection of traditional knowledge and species identification of medicinal plants in Laos. Following the principles of nationality, tradition, effectiveness and common use, 160 Laos-made medicinal materials and 40 prescription preparations were selected for inclusion in *Lao People's Democratic Republic Herb Pharmacopoeia* (*Lao Herb Pharmacopoeia*). Therefore, the Pharmacopoeia issued the quality standards of traditional medicines in line with the national conditions of Laos (Gu et al., 2021). In the future, Laos will build a national medicinal botanical garden to further expand cooperation with Chinese traditional medicine.

### 5.8. Philippines

The Philippines' medical system is mainly based on the provincial responsibility system. The Philippine government implement Philhealth program to provide medical insurance for most people. In Philippines, herbal medicine is a major form of traditional medicine. But there are many limitations on the development of TCM theory and application of Chinese herbal medicine (Qin, et al, 2021). In the further, it is possible to play of the advantages of TCM and HM for native high-risk diseases, and to make use of modern technologies.

### 5.9. General situation of Chinese herbal medicines imported from ASEAN countries

According to the official website of the General Administration of Customs, at present, Chinese herbal medicines from nine ASEAN countries including Laos, Cambodia, Malaysia, Myanmar, Thailand, Singapore, Indonesia, Vietnam and the Philippines are allowed to be exported to China, with total 134 species, including one specie from Cambodia, nine from Laos, 10 from Malaysia, 39 from Myanmar, 19 from Thailand, six from Singapore, 19 from Indonesia, 30 from Vietnam and one from Philippines. The medicinal materials include most botanical Chinese herbal medicines and a small amount Since 2011, the trade volume of Chinese herbal medicines between Guangxi and ASEAN countries has been increasing for eight consecutive years, with the annual trade volume exceeding 2 billion RMB, and the annual import and export of Chinese herbal medicines in the form of border trade has reached more than 700,000 tons. At the same time, the trade of medical devices, cosmetics and other products has become increasingly active. In May 2019, China's State Food and Drug Administration revised the Administrative Measures for Imported Medicinal Materials, which made it clear that the first imported medicinal materials should be examined and approved by the provincial drug supervision department, and the local provincial drug inspection agency should undertake the sample inspection work. After the implementation

of the above-mentioned measures, since September 2019, the inspection volume of imported medicinal materials in Guangxi has surged, and 90 inspection notices of imported medicinal materials have been received, involving 1,528 batches, about 5,000 tons, with a value of about 16.21 million US dollars, and the business volume has increased by over 300% year-on-year (Guangxi, 2020).

According to Guangxi Drug Administration, in 2019, the number of Chinese herbal medicines imported from Guangxi port accounted for about 65% of the total amount of Chinese herbal medicines imported from China. Among them, the variety and quantity of ASEAN Chinese herbal medicines imported from Guangxi showed a spurt growth, and Guangxi gradually became the import channel of ASEAN Chinese herbal medicines. There are very few varieties and quantities of medicinal materials for inspection. Now, there are 11 Dendrobium, Saffron, Olibanum, Clove, Cardamom, Nutmeg, Piper longum, Cassia seed, Foeniculum vulgare, West Green Fruit and Saffron, mainly from ASEAN countries such as Indonesia, Cambodia and Malaysia, as well as countries along the "the belt and road initiative" such as Iran and India. Since August 2019, 141 medicines (medicinal materials) have been cleared through Nanning Port, with a total weight of 3,840 tons and a total value of 12.91 million US dollars. The import volume has increased by 300% compared with 2018 (Guangxi, 2020). In a short time, Nanning Port has leapt to the largest import port of Chinese herbal medicines (Customs, 2019).

## 6. Strengthening academic and industrial cooperation and promoting healthy development of traditional medicine and herbal medicine

### 6.1. High-noting research and development for treatment of COVID-19

In 2020, the world scientists are high-noted that the research and development on the efficacy and safety of TM, HM and natural products on the treatment of COVID-19 in basic and clinical application. (Albert et al., 2020; Deng et al., 2020; Forman, Atun, McKee, & Mossialos, 2020; Kong, Sakti, Sullivan, & Bhoo-Pathy, 2020; Lee, Walid, Kassa, Taha, & Zainal, 2021; Myint, Tiraphat, Jayasvasti, Hong, & Kasemsup, 2021; Sarin et al., 2020; Shanmugaraj, Bulaon, & Phoolcharoen, 2020; Verhoeven et al., 2021). Traditional, complementary and alternative medicine has many benefits in public healthcare. From 2020 to 2021, the China-ASEAN Joint Laboratory for International Cooperation in Traditional Medicine Research applied different platforms, video conference, work meeting, academic exchange, technologic and issue discuss on advantages of traditional medicines in prevention and control of outbreak of COVID-19 pandemic (Deng et al., 2020).

The National University of Singapore has established the state of the art BSL3-Core facility in the Yong Loo Lin School of Medicine as screening technology platform for new drug discovery research against SARS-CoV-2. They carried out to achieve high-throughput screening and screening scheme design to obtain valuable information (Deng et al., 2020).

### 6.2. Strengthen resources, medicinal values and application of traditional medicine resources

Specifically, it includes establishing a communication mechanism between China and ASEAN medical resources to meet the common needs of homology, complementarity and mutual assistance; Form a technical system for the protection of China-ASEAN medical resources, and establish a resource pool for the preservation and sharing of medicinal plant germplasm resources; Explore China-ASEAN medical resources cooperation projects, and



promote related cooperation such as plant resources survey, traditional knowledge mining and collation.

Many papers published by scientists discuss the role of traditional, complementary and alternative medicines in the prevention and treatment of non-communicable, infectious chronic and senile diseases and the management of these diseases, and attach great importance to the development, research and application of traditional medicine and traditional pharmacy (Deng et al., 2020; Myint, Tiraphat, Jayasvasti, Hong, & Kasemsup, 2021; Peltzer & Pengpid, 2018, 2019; Peltzer, Pengpid, Puckpinyo, Yi, & Anh, 2016; Pengpid & Peltzer, 2018; Pumthong et al., 2015)

### 6.3. Strengthen scientific research of traditional and herbal medicine

We should give full play to the role of institutions of higher learning, research institutes and medical institutions, and carry out scientific research cooperation in traditional medicine; Explore the cooperation and share mechanism in the field of traditional medicine, share technical experience and realize cross-border cooperation; Using the Internet carrier, we will establish a normalized sharing and exchange platform for scientific research between China and ASEAN.

### 6.4. Strengthen personnel training of traditional and herbal medicine

The training courses focus on new methods, new technologies and new tools for research on the medicinal value of traditional medicines, the topics include standardization and globalization of TM and HM, mechanism analysis of prevention and treatment for the diseases by TM and HM, precision-targeted metabolomics analysis in TCM, etc. These courses are important part of China and ASEAN cooperative education projects to further promote the interconnection and mutual recognition of traditional medicine related disciplines. TM theory and technology are meeting the diversified development needs, improving the quality of personnel training and strengthening the teaching reform and discipline construction of traditional medicine.

### 6.5. Strengthen exchange and cooperation of traditional and herbal medicine

We should make our efforts to form a regular exchange mechanism such as mutual visits and academic exchanges between personnel in the field of traditional medicine between China and ASEAN; Try to establish ASEAN sub-center of China-ASEAN traditional medicine exchange and cooperation center and play its due role; Actively carry out trade in traditional medical services between China and ASEAN, strengthen people-to-people exchanges, and carry out more in-depth cooperation and exchanges in medical services and medical products.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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