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Ethnobotanical approaches of traditional medicine studies in Southwest China: a literature review

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Abstract

Ethnopharmacological relevance

The ethnopharmacology of Southwest China is extremely interesting because of the region's high level of cultural and medicinal plant diversity. Little work has been done to document the traditional medicinal practices in this area. This review aims to provide an overview of the current knowledge of how medicinal plants in this area are utilized, and conserved, in order to better understand the medicinal flora, identify research gaps, and suggest directions for further research.

Material and Methods:

A literature review was conducted that included peer reviewed journals, website, books, theses and scientific reports from 1979-2014. The distribution and characteristics of medicinal plant knowledge in each province, methods applied in research, and the fluctuations of literature in 5 year intervals were analyzed. The distribution research on different plant groups including fungi, ferns, mosses, and vascular plants were also analyzed.

Results and Discussion

A total of 436 publications from 1979-2014 were selected for analysis. References were classified into three stages: discovery stage, utilization stage and conservation stage. Detailed results about the focus of the references, the methods applied, the development and relationship among all folk medicine in Southwest China, Daodi ethnomedicinal resources, Pharmacological studies and Toxicology studies were discussed. While, compared to the rich medicinal flora, the complex demographics and cultural diversity, a large gap still exist to fully understand and document the medicinal flora.

Conclusions

Based on the review results, most research efforts in Southwest China focused on the first step: discovery of traditional usage, geographical distribution, and taxonomy of medicinal species. Only a small percentage of traditional uses or treatments have been tested by modern ethnobotanical approaches. Further research needs to put more emphasis on identifying adulterations, evaluating of Daodi medicine, and elucidating effective compounds from traditional drugs, using molecular and phytochemical approaches. Knowledge on ethnic and cultural aspects of medicinal plant species, to develop effective conservation and sustainable use protocols is lacking.

Keywords: medicinal plants, traditional knowledge, literature review, Ethnobotany, Southwest China, biodiversity conservation

1. Introduction

Southwest China is generally defined as the area that includes the provinces of Sichuan,

Yunnan and Guizhou, and Tibet Autonomous Region, and the municipality of Chongqing, (Ministry of Civil Affairs of the People's Republic of China, 2005). This area occupies 2,351,000 square kilometers, with a population of 195 million (Census 2012). The region is bordered by Pakistan, India, Nepal, Bhutan, Myanmar, Laos, and Vietnam.

The area represents a global biodiversity hotspot (Mittermeier et al., 1998; Myers et al., 2000). Its complex and diverse topography, and varying climates, provide a partial explanation for the high biodiversity. The lower elevations in South Yunnan (e.g. Yuanjiang River Valley) are characterized by a dry valley climate, while the Tibetan Plateau with an average elevation of above 4000m is characterized by an alpine cold climate. While the Sichuan Basin and Yunnan-Guizhou Plateau have a humid subtropical monsoon climate, the southern end of the region shows a tropical monsoon forest climate, and distinct wet and dry seasons.

Figure 1. Map of Southwest China (Green patch). Source: (DIVA-GIS).

This area is known as the “kingdom of plants”. So far, 25998 species and intraspecific taxa have been recorded (Fu et al., 2001). Of these 9190 are endemic. The medicinal flora of Southwest China is composed of approximately 5751 species, representing 80% of China’s medicinal flora (Chen, 1994).

The area is also famous for its large diversity of ethnic groups with very distinct traditional cultures. People from 33 ethnicities have been using plants as traditional medicine for thousands of years, including Achang, Bai, Bulang, Buyi, Tibeten,Dai, De'ang, Dong, Dulong, Hani, Han, Hui, Jinuo, Jingpo, Lahu, Lisu, Luoba, Maonan, Menba, Miao, Molao, Naxi, Nu, Pumi, Qiang, She, Shui, Tujia,Wa, Yao, Yi, Gelao, Zhuang people (Yang et al., 2011). Twelve of these groups are unique to the region and the other 21 have more than 80% of their population here (Yang et al., 2011).

Documentation, understanding, and conservation of medicinal plants are vital to human existence, and it is important to record the traditional knowledge. From 1979 to 2014 a number of studies were conducted in many villages in southwest China to discover new drugs, and several papers discussed how to utilize and conserve medicinal plants. However, compared to the enormous medicinal flora, only a small part of traditional ethnomedicinal knowledge has been recorded.

No in-depth review of the current state of knowledge ethnomedicine of Southwest China exists. In consideration of the significance of this area, a comprehensive systematic review on this subject is urgently needed. Therefore, following three steps of humans' recognition: discovery, utilization and conservation, this review aims to: (1) give an overview on the progress of current studies; (2) highlight and summarize development prospects of traditional medicine; (3) identify research gaps and suggest directions for further research.

2. Research methods

2.1 Data collection

Scientific studies published in journals, books, thesis and reports were reviewed. A literature search covered different electronic databases (ISI Web of Science, Wanfang Data, VIP Information, Science Direct, and Google Scholar) using specific search terms such as "medicinal plants", "traditional", "ethnomedicine", "herbal", "Chinese medicine" and combined with geographical names: "Southwest China", "Yunnan", "Tibet/Xizang", "Sichuan", "Chongqing", "Guizhou" or ethnic groups names such as "Tibetan", "Dai", "Yi" etc.

Publications presenting first-hand ethnobotanical information and previously published reviews were consulted. A publication was considered to be ethnomedicinal when it dealt with the relationship between humans and plants for therapeutic use, plant cultivation, investigation of plant use, and plant conservation; studies focusing only on pharmacology or bioactivity were excluded. In addition, papers which mainly focused on a much larger area, or which only referred to a small part of medicinal plant use in Southwest China, were not included in the statistical analysis.

Chinese and English references were consulted equally, as well as some data written in ethnic languages such as Naxi, Tibetan, Dai, if a Chinese translation version existed.

2.2 Inclusion criteria

Several ethnic groups have an interprovincial or cross-border distribution, and publications on their medicinal plant use, and thus publications from their wider settlement area were included in this review.

2.3 Data analysis

The review process included eliminating unreliable 'grey literature' such as drafts, website articles and pre-prints of submitted articles, scientific reports and conference papers (Falagas et al., 2008; Jacsó, 2005). The review process covered a total of 436 publications about the use of medicinal plant species.

3. Results and discussion

3.1 An overview of literature published and their focus

A total of 436 publications from 1979-2014 were selected for analysis. Compared to the rich medicinal flora, the complex demographics and cultural diversity, a large gap still exist to fully understand and document the medicinal flora.

Approximately 73% of all studies (320 out of 436) focused on the discovery stage, especially the inventory of medicinal plant resources (Fig. 2). Chen (2000) e.g. provided an inventory of medicinal species of *Elaeagnus* L. in Sichuan and Chongqing; Gong et al. (2009a) researched traditional Tibetan medicinal orchids in the Eastern Qinghai-Tibet Plateau; Ghorbani et al. (2011) carried out ethnobotanical studies of medicinal plants utilized by the Hani ethnicity in Nabanhe River Watershed, Yunnan. Very little research on the utilization stage (the understanding of traditional remedies for modern use, molecular identification), and conservation stage exists to date.

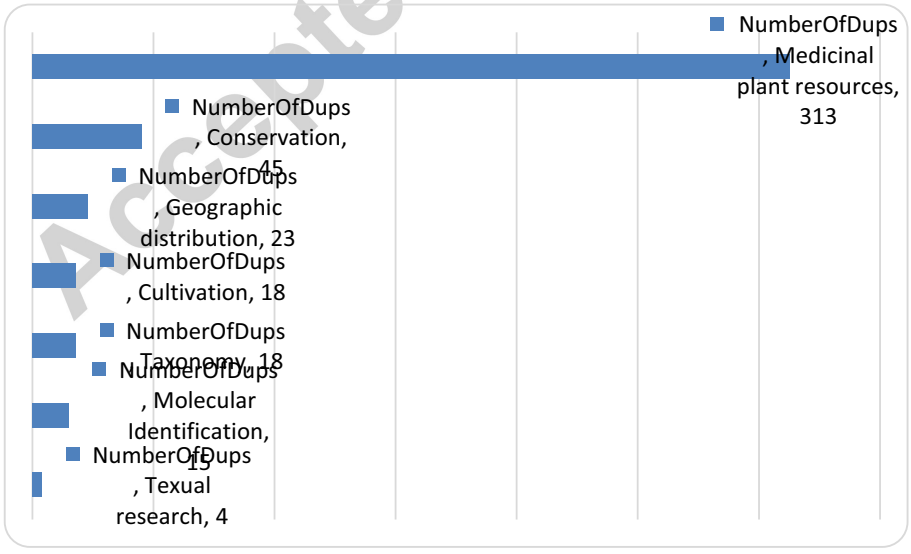

Figure 2. Methods applied in research on medicinal plants in southwest China.

On the other hand, overall research activity has increased over time (Fig. 3). According to Cotton (1996), the earliest ethnobotanical studies in Asia date to 1981. However, ethnobotanical research in China is already included in numerous ancient medicinal books and dictionaries written in different languages.

Modern ethnobotanical studies in the region can be found as early as 1954-1960, and most publications during this period could be classified as phase 1 of Hunn's categories (2007) of the development of ethnobiology as a discipline. Liu (1954) e.g. provided an inventory of 62 medicinal plants, and Wang (1960) carried out preliminary investigation and ethnobotany interviews on the Tibet Plateau, recording 73 families, 160 genera and 286 medicinal plants in traditional Tibetan medicine. In the period from 1979-1984, only 2 publications about medicinal plants in Southwest China could be found. After that, the number of publications increased quickly, both in Chinese and English. Publication activity peaked 2005-2009, with 131 publications, mostly focusing on medicinal plant resources, conservation and geographic distribution. Although the number of publications fell to 87 in the period of 2010-2014, research quality increased, with more papers using molecular methods, and HPLC (High Performance Liquid Chromatography) fingerprinting, and more studies focused on propagation, regeneration, and pollination ecology of medicinal species. This indicates a modernization of approaches of ethnobotanical studies, and a switch to a more multidisciplinary approach.

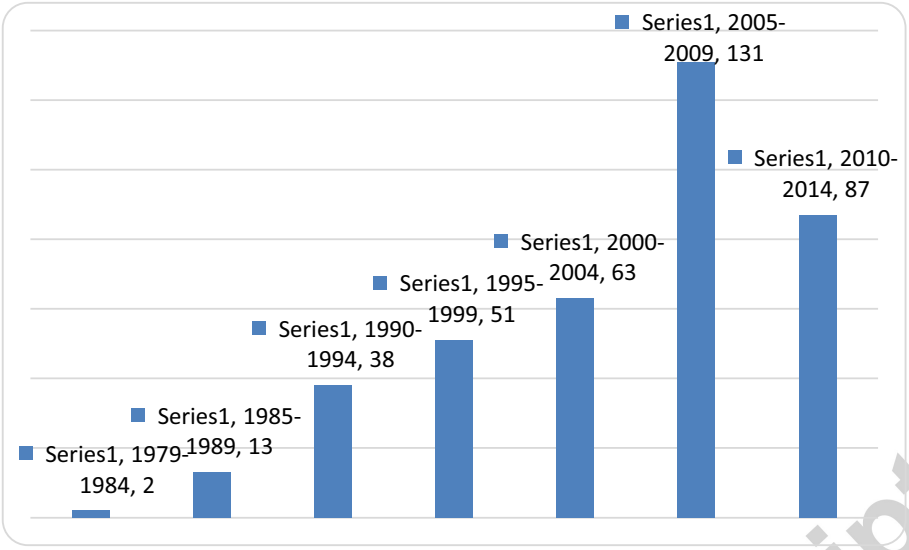

Figure 3. Number of publications in intervals of 5 years since 1979.

People in Yunnan, Sichuan (including Chongqing) and Guizhou use a similar number of medicinal plants, ranging from 3000-4012 species, while Tibet represented 27.2%, slightly fewer than other provinces. All the provinces in southwest China have a much larger number of medicinal species compared to other areas, such as Ningxia (Northwestern China), with only 917 recorded medicinal species (Wang and Wang, 2003).

If publications are divided by area, research in Yunnan has mostly focused on the northwest, south and southeast, while few studies have been carried out in the southwest, with scant coverage of Lincang, Baoshan, Dehong, and Nujiang prefectures. The mountainous setting isolates this area from mainstream society, and the knowledge of ethnic groups such as Nu, De'ang, Lahu and others is still waiting to be explored and documented. Research in Tibet focused on the southeast part, especially Linzhi, while the north and the west are still in need of research.

Almost 91.3% of the documented medicinal flora were angiosperm, 6.84% (390 species) were ferns, very close to the 6.79% pteridophytes in the whole flora in China (Wu et al., 2013), while other groups were only represented by few species.

Table 1. Number of families, genera, and species in different groups of medicinal plants in Southwest China (Chen, 1994)

Group	Families	Genera	Species
Fungi	21	51	73
Lichens	7	7	12
Bryophytes	17	21	23
Pteridophytes	48	109	390
Angiospermae	182	1542	5202
Total	275	1730	5700

3.2 Development and relationship among all ethnic medicine in Southwest China

Majority sources of Traditional Chinese Medicine (TCM) are herbs, so "Chinese herbal medicine" are used in old books. It may include traditional ethnic medicine, modern medicine etc. TCM has a unique theoretical system and practice method, it has been used for the prevention, diagnosis and treatment of illness and rehabilitation of health by different ethnic groups in China. Application of these drugs adequately reflect several characteristics of Chinese history, culture, natural resources and other aspects(Gao, 2007).

33 ethnicities have a staggered distribution in Southwest China, most of them distributed

in the border areas. All ethnic minorities in this area practiced and developed their own local medicine, while, different ethnic groups have different traditional knowledge on herbs, partly due to their different life styles and culture, partly due to the distribution of plants. In general, they have a three-dimensional distribution based on the three-dimensional terrain, three-dimensional climate linked environment in Southwest China, such as Dai, Zhuang people live mainly in the valley areas; Hui, Bai, Naxi, Buyi and other ethnic groups mainly live at the plain areas; Hani, Lahu, Wa, Jingpo and other ethnic groups living in half mountains; Miao, Lisu, Nu, Dulong, Tibetan, Pumi and other ethnic groups living mainly in the high mountains.

Traditional medicine in Southwest China have deeply influenced each other. Most medicinal traditions share similar uses for certain herbs, but maintain a unique character of their own. The use of traditional medicine in the region is deeply rooted in the unique cultures, religions, beliefs, conventions, and each ethnic group's own characteristics, and ethnic medicine adapts treatments to local high incidence diseases, e.g. Dai medicine's therapeutic effect on rheumatism (Zhang and Peng, 2008). The applications of the same species can be different however. For instance, *He zi* (Chinese: 诃子; *Terminalia chebula* Retz., Combretaceae) is more prominent in Tibetan medicine compared to other parts of China (Zhang, 2007; Zhou and Zeng, 1984).

Among the 33 ethnic groups, four had a large number of historical medical documents, monographs about their own codified medicinal systems. Tibetan, Dai, and Yi medicine have been recorded in their own language for thousands of years. Examples are the *Four Medical Classics*（四部医典 *Si bu yi dian*） (12th century), *Crystal Materia*（晶珠本草 *jing zhu ben*

cao） (1673-1743), *Pattra-leaf Sanskrit Scripture*（贝叶经 *Bei ye jing*） (500 BC). In contrast, not many historical documents were found among other 29 ethnic groups, most of the traditional knowledge is transmitted orally from individual to individual, e.g. among the Nu, Dulong, Lahu, Pumi, some groups, e.g. the Yi, Miao, Zhuang, Bai, and Dong, have medical documents written in their own languages, or in Chinese.

With the renaissance of using herbs, more and more clinics or hospitals have opened to meet the needs of ethnic people. Most of the ethnic groups pound fresh or dry herbs for external use or to ingest a liquid extract, or they use Paozhi(Chinese: 炮制) processing to prepare for herbal drugs. Paozhi processing alters the properties of crude medicines using heat and combinations with various other ingredients. It may involve roasting, frying with honey, wine, earth, or vinegar, calcining, and other processes. Processing methods vary according to the herb variety and treatment required(Zhang, 2009).

3.3 Discovery stage—new medicinal species, geographic distribution data and recorded traditional knowledge

The biggest ethnobotanical surveys over the last for 40 years were conducted by the Yunnan Institute of Materia Medica for the Yunnan Chinese medicine resources protection and development agency. The project “Low latitude plateau natural medicine resources field investigation and research and development" scientifically recorded 451 new medicinal species for the first time, and 93 new geographic records for important medicinal species (http://www.pbh.yn.gov.cn/contents/34/4725.html). Gong et al. surveyed Orchidaceae and Polygonaceae (2009b) in the Eastern Qinghai-Tibet Plateau, representing the first

ethnomedicinal data recorded in this area. Li et al. (1997) investigated the use of medicinal Scrophulariaceae in Sichuan Province, and found 3 new species and 15 species first recorded as medicinal plants, publishing detailed distributions, drug effects, and information on the habitat of these 18 species. Wu and He (2010) made an ethnobotanical survey on medicinal species of Poaceae in Guizhou Province, with 28 species with medicinal value first recorded, while 3 previously recorded species were found to be wrongly identified and had to be excluded from the local medicinal flora.

A series of old publications contained systematic and comprehensive accounts for ethnomedicine before 1979, indicating that there is a considerable amount of information available on traditional medicines. After 1979, many books were translated from Tibetan, Yi and Dai ethnic languages emerged in large numbers, e.g. the Chinese edition of *New Revision Crystal Materia* (新修晶珠本草 *Xin xiu jing zhu ben cao*) (Luo, 2004). Some books include comprehensive introductions to the medicinal plants of the region, such as *A manual of traditional Chinese medicines of Yunnan* (Li, 1990), which recorded about 4000 medicinal species. *A manual of Famous-region traditional Chinese medicines of Sichuan* (Wan et al., 2005) recorded 49 medicines with detailed reviews of their ecological environment, the most suitable areas for cultivation, cultivation techniques, harvesting methods, production and marketing conditions, and medicinal properties.

Research on seed plants took up 90% of the total literature, while other groups especially fern, bryophytes and fungi (4%, 4% and 2%) were hardly studied. Bryophytes are traditionally used as medicine, and several species have been recorded in ancient herbals, such as *Qun Fang Pu* (群芳谱 *Qun Fang Pu*), and *Ge Wu Zong Lun* (格物总论 *Ge Wu Zong*

Lun). Mosses can easily be found in traditional markets in Guizhou, Yunnan and Sichuan. Some biologically active substances contained in bryophytes were found to have anticancer activities (Spjut et al., 1986). Screening programs already targeted a variety of mosses for antiviral activity, glioma, lymphocytic leukemia, lymphoblastic leukemia, and antitumor activity (Harrigan et al., 1993; Spjut et al., 1992). However, only six publications reported on the traditional use of mosses, with 47 species recorded as having medicinal value in Guizhou (Xiong and Luo, 1995). Wang et al. (2009a) recorded 18 medicinal species from Nabanhe Nature Reserve in Yunnan.

However, the great plant species and cultural diversity of the region are still not fully documented. Most new surveys after 1979 were done in Sichuan, Chongqing, Yunnan and Guizhou. Very few studies have been conducted on some ethnic groups in Yunnan and Tibet, hardly any on Lhoba and Menba medicine (Li et al., 2015).

3.4 Utilization stage— pharmacological studies of Daodi medicine

3.4.1 Ethnic regional medical practices

Local ethnic groups in Southwest China have over time developed a profound knowledge for utilizing plants, and produced their own medicine and medical knowledge in different regions, based on their unique culture. The total number of medicinal species encountered was 5751, representing 52% of the total number of medicinal plants recorded in China (Table 2) (Chen, 1994).

Many ethnic groups live in mountainous areas with low income level, and limited allopathic healthcare. As a result they developed a long history for practicing medicine, and

most influential one should be Han medicine practiced by Han people. Many of them borrowed and absorbed theory from Ayurveda, the traditional Indian medicine (TIM).

3.4.2 Daodi ethnomedicinal resources and their representation

In TCM, many species with long-standing traditional uses have been designated as Daodi medicinal material, which means that they are considered to have high medicinal efficacy. Geographic production of key materials for common TCM use in Southwest China fall under four subclassifications: "Chuan medicine," "Yun medicine," "Gui medicine," and "Tibet medicine" (Table 2) (Tian and Miao, 2014). Three hypothesis proposed for the formation of Daodi medicine: genetic variation, environmental modification and human selection (clinical selection, cultural preference, marketing selection) (Xiao and Xia, 1995). Based on the cultural diversity of Southwest China, local cultural selection and clinical selection played a significant role in the final formation of regional unique Daodi medicine.

Table 2. Number and percentage of medicinal plants, by province, in China (Chen, 1994)

Area	Number of species	Percentage in China
Yunnan (Yun medicine)	4012	36.4%
Guizhou (Gui medicine)	3987	36.2%
Sichuan (including Chongqing) (Chuan medicine)	3963	36.0%
Tibet (Tibetan medicine)	3000	27.2%
SW China	5751	52.2%
China	11020	/

Examples include:

(1) *San qi* (Chinese:三七; *Panax notoginseng* (Burkill) F. H. Chen ex C. H. Chow, Araliaceae) in Yunnan;

(2) *Tian ma* (Chinese:天麻; *Gastrodia elata* Blume, family Ochidaceae); *Du zhong* (Chinese: 杜仲; *Eucommia ulmoides* Oliv., Eucommiaceae) in Guizhou;

(3) *Chuan xiong* (Chinese:川穹; *Ligusticum sinense* Oliv., Apiaceae); *Chuan huang lian* (Chinese:川黄连; *Coptis chinensis* Franch., Ranunculaceae); *Chuan fu zi* (Chinese:川附子; *Aconitum carmichaelii* Debeaux, Ranunculaceae); *Chuan du huo* (Chinese: 川独活; *Heracleum hemsleyanum* Diels, Apiaceae) in Sichuan;

(4) *Zang hui xiang* (Chinese:藏茴香; *Carum carvi* L., Apiaceae); *Shan lang dang* (Chinese: 山莨菪; *Anisodus tanguticus* (Maxim.) Pascher, Solanaceae); *Zang dang shen* (Chinese:藏党参; *Codonopsis pilosula* (Franch.) Nannf., Campanulaceae); *Xue lian hua* (Chinese:雪莲花; *Saussurea involucrata* (Kar. & Kir.) Sch. Bip., Asteraceae) in Tibet (Ding et al., 2001; Huang and Chen, 1996; Liang, 2013).

A variety of traditional medicine have been used for thousands of years. While, with the unsustainable exploration and consumption of Daodi medicine. Many Daodi meidicinal species were over-harvested. Sustainable development and conservation of Daodi medicine has become a serious issue.

3.4.3 Pharmacological studies

While medicinal plants have been used for thousands of years, their efficacy is still a matter of debate, and adulterants are a serious problem. Li et al.(2005) documented the root of

Dian huang qin (Chinese:滇黄芩; *Scutellaria amoena* C. H. Wright, Lamiaceae) from old book records through textual research. Liu (1985) used morphological classification to distinguish misused species. Shu et al. (1998), Xiao et al. (2000) and Zeng and Yan (2000) used RAPD(Random Amplification Polymorphic DNA) to find differences at a molecular level. Many studies used DNA barcoding for quality evaluation of Chinese medicinal materials (Chen et al., 2014; Chen et al., 2007; Li et al., 2011; Zhang, 2003; Zhu et al., 2010), e.g. in case of high value species such as saffron (Chinese:红花; *Crocus sativus* L., Iridaceae) (Huang et al., 2015; Ma et al., 2001), *Bei mu* (Chinese:贝母; *Fritillaria* spp., Liliaceae) (Li et al., 2003; Wang et al., 2005), Shi hu (Chinese:石槲; *Dendrobium* spp., Orchidaceae) (Yao et al., 2009) and *Xiao hua qing feng ten* (Chinese:小花清风藤; *Sabia parviflora* Wall. ex Roxb., Sabiaceae) (Sui et al., 2011).

To sum up, molecular identification and HPLC fingerprint chromatogram applied in Traditional medicine have developed rapidly in recent years, which accelerated the progress of standardization in identifying traditional medicine, and allow for improvement of user safety by fast identifying adulterants in the market and in traditional preparations by using various ways of technologies and research methods (Guo et al., 2010; Huang et al., 2015; Ma et al., 2001; Sui et al., 2011).

3.4.4 Toxicology studies

Toxic plants are important elements of ethnomedicine. In Southwest China, indigenous people use toxic plants to treat different health problems (Guo et al., 1990; Guo et al., 1991; Zhu et al., 2006), which is quite similar in other countries (Al-Qura'n, 2005; Arias, 2000;

Neuwinger, 2004). Eleven species were thought to be deadly toxic among five ethnic groups (Dai, Lahu, Miao, Tujia, and Wa (Huai, 2010; Li and Li, 2012). The toxicological risk of improper usage of *Aconitum* remains very high (Singhuber et al., 2009). Araceae, Asteraceae, Euphorbiaceae, and Fabaceae are four important families which contain rich toxic plants (Singhuber et al., 2009). Most toxic plants were used to treat injuries from falls, broken bones, and skin problems (Harvey et al., 1998).

Previous studies on toxic plants focused on different aspects of drug toxicity, including their chemical compositions and pharmacological effects (Bisset, 1981; Gao and Li, 1996; Liu, 2011; Singhuber et al., 2009) and also the relationships between the uses of toxic plants and their taxonomic and cultural contexts in some different ethnic groups (Huai, 2010). Some studies about over dose and misusage of toxic plants in ethnomedicine combined western medicine to detoxification for patients using experimental model in rats (Liu, 2010; Wang et al., 2015; Yuan, 2000).

3.5 Conservation stage—Commercial trade and Clinical practice of ethnomedicine in Southwest China

People local to Southwest China have a long history of trading fresh and dry medicinal plants, mainly in traditional marketplaces, often in large volumes (Lin et al., 2012; Wan, 2004). The Dragon Boat Festival Jingxi drug market can be traced back 700 years, with 476 medicinal species recorded. Each year, more than 10,000 buyers visit 5000 trade stalls and the total transactions can amount to 400 tons (Huang et al., 2012; Wang et al., 2009; Yang et al., 2009).

Over the past 10 years, the number of periodic traditional markets has however decreased sharply, with market stalls being gradually replaced by small rural shops(Wang et al., 2013b) . Traditional street markets are very important for local Bai, Han and Tibetan traders, but the number of stalls gradually decreased from 354 in the 1980s to 287 in the 1990s, then to 248 during the 2010s, and the number of medicinal plants available also decreased. In addition, more adultered or inferior herbs are sold at the remaining traditional markets.

Several researchers carried out inventories in other traditional markets, including Xishuangbanna Dai Autonomous Prefecture in Yunnan (Pei, 1981), Liping Miao and Dong Autonomous County in Guizhou (Zhao et al., 2010), Wenshan Zhuang and Miao Autonomous Prefecture in Yunnan (Long, 2009), Jinping Miao, Yao and Dai Autonomous County (Li et al., 2006; Li et al., 2008), Jinping County Red Head Yao communities in Yunnan (Li et al., 2006; Long and Li, 2004), Honghe Hani and Yi Autonomous Prefecture in Yunnan (Lee et al., 2008), Mianning Yi, and Han mixed zone in Sichuan(Wang et al., 2013a).

Despite of the shrinking number of traditional markets, awareness and interests on practicing natural and traditional medicine, and other alternative treatments are increasing (Bussmann and Sharon, 2009). Ethnomedicines do not only play a positive role in the treatment of many different categories of disease, but also help in prevention of disease (Wen and Qiao, 2006). The development of ethnic hospitals in southwest China is very fast, and currently there are about 165 ethnic hospitals, including 57 Tibetan hospitals. In addition to the system set up in their respective ethnic minority areas (Wen and Qiao, 2006).

Nine hundred and six ethnic medicinal plant preparations of nine provinces and 156 manufacturing enterprises have been approved by the food and drug administration in China (Wen and Qiao, 2006). Since the 1980s, Tibetan, Dong, Dai people have established their own College of Ethnomedicine to conserve the cultural heritage, while in Tibet, Sichuan, Yunnan and other places have established a National Institute of Medicine.

Publications on conservation highlight excessive harvesting and environmental destruction, which have resulted in severe pressure on many species (Cunningham, 2001; López-Pujol et al., 2006), e.g. snow lotus (*Saussurea laniceps* Hand.-Mazz., Asteraceae) in Northwest Yunnan (Wayne and Salick, 2005). According to the *List of Rare and Endangered Plants in China* (1987) and the *List of the Important Wild Plants for Conservation in China (I)* (The National Forestry Bureau and Chinese Ministry of Agriculture, 1999), 105 plant species are endangered in Sichuan Province, and 37 of them are widely used in traditional medicine. An indication that conservation is quickly gaining importance is that 54 of the 436 references found in this study included different aspects of the topic, e.g. sustainable use and management of medicinal plant resources, sustainable use of wild medicinal plants, sustainable application of medicinal plants, resource status and conservation policy of endangered medicinal materials (Dinaburg, 2008; Liu et al., 2008), as well as propagation experiments (Guo et al., 1998; He and Jia, 2009; Yang et al., 2012).

4. Conclusion and prospects

Research on ethnomedicine in Southwestern China is piecemeal and incomplete. Future studies should focus on unstudied ethnic groups, larger geographical areas, and medicinal

fungi, bryophytes and pteridophytes.

New methods including molecular biology and phytochemistry are vital to the utilization stage. Future research should put more emphasis on the identification of adulterants, evaluation of Daodi medicine, and toxicology studies.

The conservation of medicinal plant resources is gradually considered important in Southwest China, and should be highlighted in future studies, especially because a large proportion of medicinal plant species from Southwest China are on the endangered species list. Studies on elucidating alternatives for endangered species are needed to protect endangered species, and to discover related species that may not have been previously recorded for their medicinal value.

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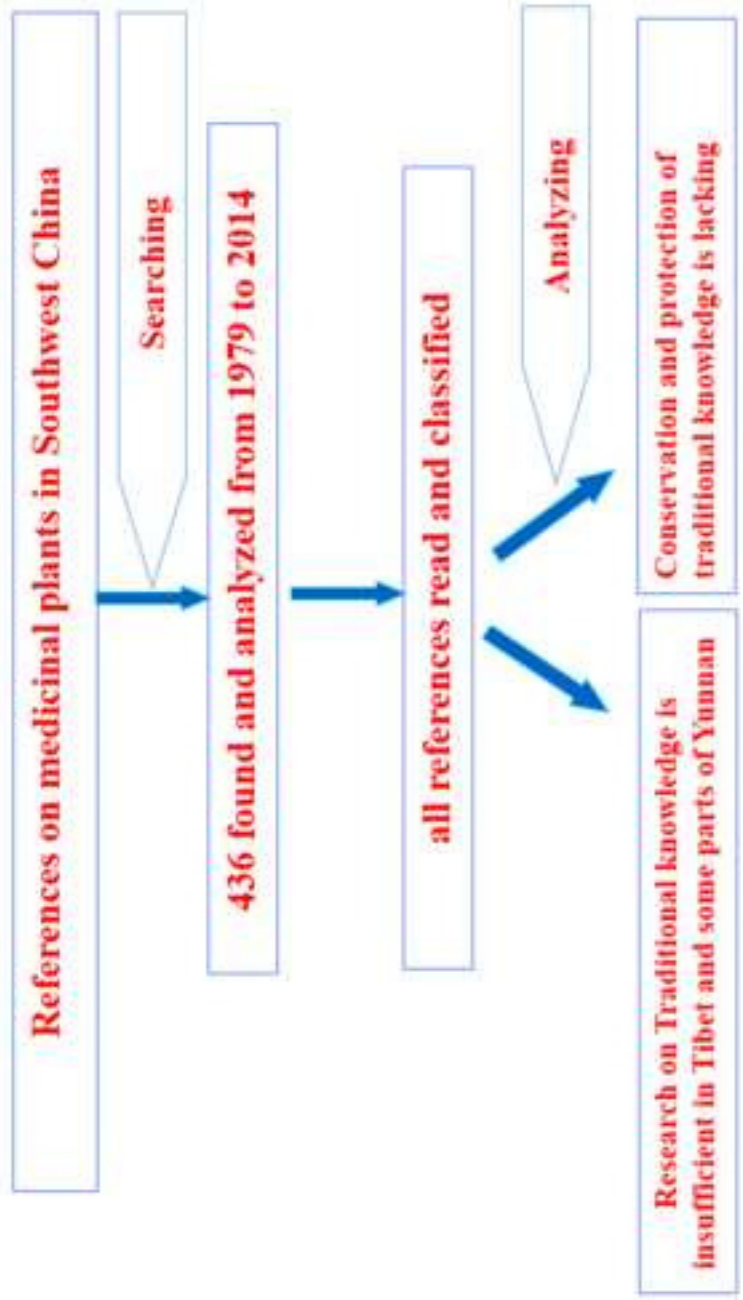

Graphical Abstract