Ethnobotanical study on traditional medicinal recorded in the Naxi Dongba Sutras

Haitao Li (15894318030@126.com)

Yunnan Key Laboratory of Southern Medicinal Utilization, Yunnan Branch, Institute of Medicinal Plant Development, chinese Academy of Medical Sciences & Peking Union Medical College https://orcid.org/0000-0003-2876-7249

Zhiyong Li

School of Pharmacy, Minzu University of China; Yunnan Province Resources of Development and Collaborative Innovation Center for New Traditional Chinese Medicine.

Xiaobo Zhang

State key laboratory breeding base of Dao-di Herbs, National Resource Center for Chinese Materia Medical, China Academy of Chinese Medical Sciences.

Shaohua Yang

Institute of Alpine Economics and Botany, Yunnan Academy of Agricultural Scicences.

Cui Chen

Institute of Alpine Economics and Botany, Yunnan Academy of Agricultural Scicences.

Qingning Yang

Lijiang Medical Association of Minorities.

Chengfeng He

Lijiang Medical Association of Minorities.

Jingyuan Song

Key Lab of Chinese Medicine Resources Conservation, State Administration of Traditional Chinese Medicine of the People's Repubulic of China, Institute of Medicinal Plant Development, Chinese Academy of Mdedical Sciences & Peking Union Medical College.

Jianqin Liu

Lijiang Medical Association of Minorities.

Research

Keywords: Ethnobotany, Lijiang City, The Dongba Sutras, Naxi people, Traditional medicine

Posted Date: February 4th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-187962/v1

Abstract

Background: The Naxi people, living in Southwest China, have a long history and a rich characteristic culture. Their ancestors recorded their life practices by ancient hieroglyphs and gradually formed the Dongba Sutras, which, among other knowledge, included the traditional knowledge of Naxi medicine. In the past, most studies on the Dongba Sutras focused on the humanistic culture of Naxi people, whereas studies have rarely focused on Naxi herbal medicinal plants described in the Dongba Sutras. Studying this aspect is helpful for exploring the traditional culture of Naxi people from the perspective of traditional medicine.

Methods: From February to September 2019, we screened the medicinal plants from the Dongba Sutras with the help of Dongba. Then, we carried out field investigatios and collected voucher specimens of traditional medicinal plants with the help of 104 Naxi folk healers. The specimens were identified and stored in the Herbarium of Yunnan Branch, Institute of Medicinal Plants, Chinese Academy of Medical Sciences (IMDY). Through semi-structured interviews, we obtained ethnobotanical information of medicinal plants. The obtained quantitative data were analysed using the informant consensus factor (ICF) method and the number of citations.

Results: A total 85 species of medicinal plants belonging to 51 families and 71 genera were recorded in the Dongba Sutras. Among them, 25 species were endemic to China, and eight species were only distributed in Naxi distribution areas. These medicinal plants were mainly obtained from the wild, and 22 species could be used as food. The most frequent method of taking medicinal materials was oral-taking after decoction, followed by topical and sometimes buccal. The methods of processing these medicinal materials included water decoction, warm water flushing, and drinking after soaking. The medicinal plants in the Dongba Sutras are used to treat 96 conditions classified into 13 disease groups according to the International Classification of Primary Care second edition. Further analysis indicated that most of these plant species were utilised for treating diseases from the digestive (D) group, followed by the those from the respiratory (R) group, musculoskeletal (L) group, general, and unspecified (A) group. Moreover, the Naxi people have high consensus on the treatments of diseases from these four pathological groups.

Conclusions: Naxi traditional medicine is simple and unique. The ancient Naxi people recorded their highly developed medical culture in the Dongba Sutras. Natural plant resources found around them were their primary choices for both medicine and diet therapy. The ecological ethics of Naxi people have positive significance for the conservation of wild resources in their area.

Background

The Naxi people inhabit areas of Southwest China, and they have a long history and a rich characteristic culture. Dongba symbols are the only hieroglyphs in the world that are still in use [1]. Because of the outstanding work of Joseph F. Rock [2], Naxi people and their Dongba culture are famous throughout the world. Dongba Sutras have become the main written materials for studying the Dongba culture. The content of Dongba Sutras covers the history, philosophy, society, religion, language and script, music, art, dance, as well as many other traditional subjects related to the Dongba culture. It is praised by academic circles as "the encyclopedia of ancient Naxi people"[3]. Naxi medical culture is an important part of Dongba culture. The Dongba Sutras contain information about the unique medical culture of Naxi people, and they are the most important documents for studying Naxi medicine. The name ‘Dongba’ is the appellation of the Naxi religious clergy and can be translated as ‘the wise’. They are senior intellectuals and the main inheritors of the Dongba culture of the Naxi people, and most of them are skilled in singing, dancing, calligraphy, history, painting, and medicine.

Naxi ancestors have rich medical experience in the practice of fighting against diseases, and they created ‘Naxi medicine’ or ‘Dongba medicine’ [4]. These traditional medical experiences have been recorded by the Naxi people in the form of hieroglyphs, and they formed the Dongba Sutras.

Currently, there are about 30 000 volumes of the Dongba Sutras, which are mainly stored in museums and libraries in China, the United States, Germany, France, Great Britain, and other countries [3]. These sutras are based on extensive experience in treating diseases and provide great knowledge of medicine. *Chien Song Lü* and *Chongren Pandi to Find Medicine* are the most representative sutras [5]. *Chien Song Lü* is the only medical book written in hieroglyphs of the Naxi people, and it includes data on dozens of medicinal plants. *Chongren Pandi to Find Medicine* includes records of the traditional treatment methods, the morphology and function of some medicinal plants, and it has important reference value for the current medical practice [5]. The publication entitled *The Complete Works of Dongba Sutras in Naxi* [6] lays the foundation for deciphering the mysterious Naxi Dongba medicine.

In addition to the Dongba Sutras, in Naxi culture, a lot of valuable traditional knowledge has been transmitted orally, including a lot of precious medical information. Therefore, Naxi culture still needs to be further studied and systematically organised [4]. In recent decades, ethnomedicinal knowledge in Naxi communities has lost rapidly along with high-speeded development of Chinese economy. In particular, Lijiang is a famous tourism destination, and few young generation study traditional medicinal knowledge from old generation. Less and

less Naxi people use (or even recognize) traditional medicinal plants. Thus, it becomes very urgent and necessary to study medicinal plants recorded in the Dongba Sutras.

Materials And Methods

Study area

Lijiang is a prefecture-level city in Yunnan Province, Southwest China. It is located in Hengduan Mountains, between 25°23'–27°56'N and 99°23'–101°11'E. The total area of Lijiang City covers 20 600 km^2 [7]. The terrain of the area is high in the northwestern part and low in the southeastern part, with the highest altitude of 5 596 m and the lowest altitude of 1 015 m. The maximum altitude difference of Lijiang is 4 581 m [8].

The climate of Lijiang belongs to subtropical humid climate [9]. There is abundant rainfall and a distinct dry and wet season. The average annual rainfall is about 1 000 mm, and the rainy season lasts from May to October being particularly pronounced in July and August. The annual average temperature is between 13 ℃ and 20 ℃, the average temperature of the hottest month is 18–26 ℃, and the average temperature of the coldest month is 4–12 ℃. Lijiang has 2 500 h of annual sunshine and 147 kcal/cm^2 of annual solar radiation [9].

Lijiang has a forest coverage rate of 70%. The area is rich in medicinal materials and other exploitable biological resources, and is known as the ‘kingdom of alpine plants’ and ‘hometown of medicinal materials’ [8].

The key areas of the present study were Gucheng District and Yulong County in Lijiang City, Yunnan Province, China. This area is the most concentrated area of Naxi population in the world, with about 210 000 people, accounting for 68.5% of the total Naxi population. Naxi people live in mountainous areas with inconvenient transportation and abundant biological resources, which is why their traditional is the most convenient mean of resisting diseases. At the same time, inheritance model of Dongba culture is masters teaching apprentices, that makes a better inheritance of the Naxi traditional medicinal culture.

Data collection

From February to September 2019, we screened the medicinal plants from the Dongba Sutras with the help of Dongba. Then, we carried out field research with assistances from 104 Naxi folk healers and collected traditional medicinal plant specimens. The basic survey information such as age, and gender was collected and recorded. Using semi-structured interviews [10], ethnobotanical knowledge was obtained, including information about the local name, medicinal parts, harvesting methods, preparation methods, and indications of the medicinal plants from the Dongba Sutras. The informed consent of the participants was obtained before conducting the interviews, and the ethical guidelines prescribed by the International Society of Ethnobiology[11] were followed. The local names were transliterated from Naxi or local Chinese pronunciation into the Roman alphabet following the Scheme for the Chinese Phonetic Alphabet [12] and the Basic Rules for Hanyu Pinyin Orthography [13]. The diseases treated by the medicinal plants from the Dongba Sutras were classified according to the International Classification of Primary Care (ICPC-2) [14] of the WHO (World Health Organization) [15][16].

Plant materials

With the help of Naxi folk healers, 3–5 specimens of each medicinal plant species were collected, and the information about their habitats (e.g., altitude, latitude, longitude, and vegetation type), plant morphology (e.g., plant height, colour of flowers, and corolla type) and date of collection were recorded. The scientific and Chinese names were recorded on the label. Plant specimens were stored at the Herbarium, Yunnan Branch, Institute of Medicinal Plants, Chinese Academy of Medical Science (IMDY).

Plant identification

The following literature was used to identify the family and species names of the collected plants: *Flora of China* [17], *Flora Reipublicae Popularis Sinicae* [18], and *Flora Yunnanica* [19]. The scientific names were checked in The Plant List website [20]. All the plants listed are sorted at family level circumscription follows APG Ⅳ[21].

Data analysis

The data obtained in this study were analysed using Microsoft Office Excel (2010) spreadsheet software. Quantitative data analysis was conducted using the informant consensus factor (ICF) method and the number of citations. ICF was calculated as ICF = (Nur - Nt)/(Nur - 1), where Nur is the sum of plant species used by all the respondents to treat a particular disease, and Nt is the number of identical plant species used by all the respondents to treat a particular disease [22].

Results And Discussion

Demographic features of the respondents

A total of 104 respondents were interviewed (Table 1). Among them, male respondents highly outnumbered the female respondents, and 79.81% of them were over 50 years old. Naxi people live in the mountainous areas and commonly collect medicinal plants. In this harsh environment, men have an advantage over women due to their physical abilities. Because the experience of treating diseases is based on long-term practice, the medical experience mastered by older healers is more comprehensive and reliable than those learned by younger healers. Moreover, it ensures reliability of the knowledge obtained in this survey.

The educational level of the respondents was generally low, and most of them had no higher education. However, this did not affect the reliability of the results, because the acquired traditional knowledge has truly maintained the characteristics of the Naxi people.

The respondents were mainly Naxi (71.158%), followed by the Lisu (15.38%). Other ethnic groups included Han, Tibetan, Bai, and Yi. All of these people lived in Naxi communities, and their medical skills were learned from Naxi healers. All the respondents were folk healers. Although there are many ways to learn medical skills, most respondents (70.19%) developed their medical experiences with the help of their ancestors. None of the respondents had regular jobs, and many of them were local Dongba who were priests and folk healers.

Table 1 Demographic features of the respondents

Demographic features	Number	Proportion (%)
Age		
31–40	7	6.73
41–50	14	13.46
51–60	28	26.92
61–70	24	23.08
71–80	24	23.08
81 and above	7	6.73
Sex		
Female	4	3.85
Male	100	96.15
Education level		
Illiterate	10	9.62
Primary school	61	58.65
Junior middle school	12	11.54
Senior middle school	8	7.69
Teacher training school	1	0.96
School of health	2	1.92
Polytechnic school	5	4.81
Junior college	4	3.85
University	1	0.96
Nationality		
Naxi	74	71.15
Lisu	16	15.38
Han	5	4.81
Zang	5	4.81
Bai	3	2.88
Yi	1	0.96
Ways of learning medicine		
Ancestral	73	70.19
Ancestral,*master	8	7.69
Master	7	6.73
Ancestral,self-taught	6	5.77
Master,self-taught	4	3.85
Ancestral, learning at school	2	1.92
Ancestral,self-taught, learning at school	1	0.96
Master, learning at school	1	0.96
Master,self-taught, learning at school	1	0.96
Self-taught	1	0.96

*Master: an authority qualified to teach apprentices

Diversity of medicinal plants in the Dongba Sutras

According to our investigation, a total of 85 species of medicinal plants belonging to 51 families and 71 genera were recorded in the Dongba Sutras (Table 2). In the middle and high altitude areas, the main tree species belonged to the families Pinaceae, Cupressaceae, Ericaceae, and Fagaceae. Almost all parts of these plants can be used as medicine, especially their branches, which are often used by Naxi priests for various sacrificial activities. The highest numbers of plant species recorded belonged to the families Asteraceae (six species) and

Polygonaceae (six species), followed by the Rosaceae (four species). It is worth mentioning that from the genus *Rheum* alone, we recorded three species. In addition to *Rheum officinale* recorded in the Pharmacopoeia of People's Republic of China [23], we also recorded *R. delavayi* and *R. likiangense*, but their usage was different from that of *R. officinale* recorded in the Pharmacopoeia of People's Republic of China.

Table 2 Number of medicinal plants contained in the Dongba Sutras

Category	Number of families	Number of genera	Number of species
Fungi	3	3	3
Pteridophyta	3	3	3
Gymnospermae	2	3	5
Angiospermae	43	62	74
Total	51	71	85

Of all recorded species, herbaceous plants (49 species) accounted for the greatest number (Table 3), followed by trees (21 species) and shrubs (5 species). As herbaceous plants can more easily survive in a new environment than trees and shrubs [24], especially in the alpine mountains inhabited by the Naxi people, there are lacks of diversity of tree species, whereas the low herbaceous plants were abundant. At the same time, herbaceous plants are more convenient to collect than other plant life forms. Thus, the utilisation rate of herbaceous plants is higher than that of trees and shrubs.

Table 3 Habits of medicinal plants contained in the Dongba Sutras

Living habits	Number of species	Proportion (%)
Herbs	49	57.65%
Trees	21	24.71%
Shrubs	5	5.88%
Woody vines	4	4.71%
Climbing shrubs	3	3.53%
Herbaceous climbers	3	3.53%
Total	**85**	**100.00%**

The medicinal parts of 85 medicinal plant species used by the respondents are indicated in Tables 4 and 10. The Naxi people knew that different medicinal parts have different effects. According to our analysis, in addition to plant's medicinal efficacy, the difficulty of its collection also affects which parts would be used. The Naxi people preferred to collect easily collectable plant parts as raw materials for medicinal preparations. Among plant life forms, herbs and small shrubs are most commonly used as medicines, and the respondents reported that for this purpose, they used Whole plants, roots, or rhizomes, whereas when trees, big shrubs, or woody vines are used for medicinal preparations, the respondents used stems, branches, leaves, or bark. The flowering and fruiting periods of these plants are short; therefore, their fruits, seeds, flowers, and buds are seldom used as medicinal parts. Plant secretions are rarely used as medicinal materials because of the difficulty of their collection.

Table 4 Medicinal parts of plants recorded in the Dongba Sutras

Medicinal parts	Number of species	Proportion (%)
Roots or rhizomes	29	24.37%
Whole plants	22	18.49%
Leaves	19	15.97%
Stems or branches	17	14.29%
Fruits or seeds	9	7.56%
Flowers or flower buds	8	6.72%
Bark	8	6.72%
Aerial parts	3	2.52%
Fungi (Fruit body)	3	2.52%
Secretions	1	0.84%
Total	119	100.00%

Note: One or more parts of the same plant can be used as medicine, which is why the total number of medicinal parts exceeds the total number of species.

Most of the medicinal plants in the Dongba Sutras are common plants in the studied area. The abundance of medicinal plants, determined according to the classification of abundance by Germany Ecologist Oscar Drude [25], is shown in Table 5. According to this classification, the highest number of species used by the respondents is forest species, such as *Quercus aquifolioides*, *Q. aliena* var. *acuteserrata*, *Populus rotundifolia* var. *bonatii*, and *Pinus yunnanensis*. The group with few or dispersed plants included only three species: *Poria cocos*, *Dobinea*

delavayi, and *Panax japonicus* var. m*ajor*. Although the medicinal materials from these plants are rarely found in the wild, they have been cultivated in the area and thus have been successfully used as medicines.

Table 5 Abundance of medicinal plants contained in the Dongba Sutras

Abundance*	Number of species	Proportion (%)
Soe	4	4.71%
Cop3	13	15.29%
Cop2	17	20.00%
Cop1	38	44.71%
Sp	10	11.76%
Sol	3	3.53%
Un	0	0.00%
Total	85	100.00%

*Soe (Sociales): High number of individuals, the above ground plant part is closed;

Cop3 (Copiosae): High number of individuals, but the above ground plant part is not closed;

Cop2: Large and common plants;

Cop1: Large plants, but small populations;

Sp (Sparsal): Low number of plants, scattered;

Sol (Solitariae): Low number of plants, sparse;

Un (Unicum): Only one individual.

Since ancient times, Naxi people have lived in mountainous areas, where transportation is inconvenient. The medicines they used were collected in the mountains, and rare medicinal plants were cultivated in their courtyards in order to be convenient for collection. Therefore, the medicinal plants described in the Dongba Sutras were mainly wild plants, accounting for 76.47% of all medicinal plants described in the Dongba Sutras (Table 6). Because of the small population of Naxi people, their use of wild medicinal plants does not present a threat to the stability of wild plant populations.

Table 6 Sources of drugs contained in the Dongba Sutras

Sources	Number of species	Proportion (%)
Wild	65	76.47%
Cultivated	7	8.24%
Mixture of wild and cultivated	13	15.29%
Total	85	100.00%

Food therapy is an important characteristic of Chinese culture and traditional Chinese medicine (TCM). "One Root"26The life of the Naxi people is closely related with medical dietary plants, and their medicinal diets are indispensable to the health of their communities[27]. Among the medicinal plants in the Dongba Sutras, 22 species can be consumed as vegetables, fruits, dried fruits, or condiments (Table 7). For example, *Lagenaria siceraria, Brassica rapa, Foeniculum vulgare,* and *Allium ascalonicum* are common vegetable species. *Setaria italica* var. *germanica* is also used as food. For a long time, the Naxi people considered that these foods and vegetables can be used to treat and prevent diseases. Thus, they recorded them in the Dongba Sutras. Some of these medicines are used to prepare tea, and do not have any negative side effects. For example, the Aerial parts of *Elsholtzia rugulosa* which has the effect of relieving summer heat. The plant as substitute for tea is easy to collect and prepare, and has widely been used by the Naxi people. This indicated that in the Naxi people, maintaining a healthy daily diet is a very important factor in disease prevention.

Table 7 List of medicinal and edible plant species recorded in the Dongba Sutras

ID	Family	Scientific name	Resource type	Food type
1	Amaranthaceae	*Amaranthus hypochondriacus*	Wild	Vegetable
2	Amaryllidaceae	*Allium ascalonicum*	Cultivated	Vegetable
3	Amaryllidaceae	*Allium hookeri*	Cultivated, wild	Vegetable
4	Amaryllidaceae	*Allium sativum*	Cultivated	Vegetable
5	Apiaceae	*Foeniculum vulgare*	Cultivated	Vegetable
6	Brassicaceae	*Brassica rapa*	Cultivated	Vegetable
7	Cactaceae	*Opuntia ficus-indica*	Cultivated, wild	Fruit
8	Cannabaceae	*Cannabis sativa*	Cultivated, wild	Condiment
9	Cucurbitaceae	*Lagenaria siceraria*	Cultivated	Vegetable
10	Ebenaceae	*Diospyros lotus*	Cultivated, wild	Fruit
11	Fabaceae	*Pueraria lobata* var. *thomsonii*	Wild	Beverage
12	Juglandaceae	*Juglans regia*	Cultivated, wild	Dry fruit
13	Lamiaceae	*Elsholtzia rugulosa*	Wild	Beverage
14	Lauraceae	*Neocinnamomum delavayi*	Wild	Condiment
15	Pinaceae	*Pinus armandii*	Wild	Dry fruit
16	Poaceae	*Setaria italica* var. *germanica*	Cultivated	Food
17	Polyporaceae	*Poria cocos*	Wild	Vegetable
18	Rosaceae	*Prunus mume*	Cultivated, wild	Fruit
19	Rosaceae	*Rubus biflorus*	Wild	Fruit
20	Rosaceae	*Rubus coreanus* var. *tomentosus*	Wild	Fruit
21	Rosaceae	*Rubus niveus*	Wild	Fruit
22	Schizophyllaceae	*Schizophyllum commune*	Wild	Vegetable

Medicine preparation methods and applications

The folk preparation methods of traditional Naxi medicine were relatively simple (Fig. 1A); most of them included washing and direct drying of the plant material (49.18%), followed by crushing (20.49%), soaking (13.93%), using fresh products (9.84%), blending with other agents (3.28%), and carbonisation (3.28%). The medium used in the soaking process was mainly wine or water, whereas the medium used in blending included edible oils, vinegar, honey, etc. The use of fresh plant parts as medicine is characteristic for Naxi medicine because this method is simpler to use than other methods. In this method, the medicinal parts are removed from the plants and washed, and they are used after mashing or chewing. In addition, juice extracted directly from plant is also a common method of fresh plant intake, and is mostly used for topical application. The main method of medicine consummation was oral, followed by topical and rarely buccal (Fig. 1B). Oral administration included three methods: boiling in water, washing in warm water, and drinking after soaking.

ICF, conditions and diseases treated by the studied plant species

The informant consensus factor (ICF) is a measure of information diversity. The higher the ICF value, the greater the difference among plant species used in the treatment of a given disease, and the lower the ICF value, the smaller the difference among plant species used in the treatment of a disease [22]. We found that the medicinal plants in the Dongba Sutras are used to treat 96 conditions, which can be classified into 13 disease groups according to ICPC-2 (Table 8 and 10). The highest ICF values were recorded for the eye group (F), cardiovascular group (K), and psychological group (P) (ICF = 1.50), followed by the neurological group (N), female genital group (X), and male genital group (Y) (ICF: 1.00). Among the medicinal plants provided by different respondents, there are very few (only one or none) identical plants that can be used to treat the same group of diseases. This showed that there are many differences among Naxi people in the methods of treating a specific disease, i.e., that they have low consensus about disease treatment methods. There are two possible reasons for this: (1) as the Naxi people live in biodiversity-rich areas, the abundant medicinal plant resources provided them with a wide choice of medicinal plants to use [28], and (2) different Naxi folk healers may have different degrees of understanding of the same disease (e.g., some may be focused more on the symptoms of a disease, but ignore or miss the real cause of the disease).

Further analysis indicated that most of the plant species were utilised for the group of digestive diseases (D; Nur=36, Nt=15), followed by the respiratory (R; Nur=29, Nt=13,), musculoskeletal (L; Nur=21, Nt=12) , and the general and unspecified disease group (A; Nur=21, Nt=5). The ICF values of these four disease groups were low: Group D: 0.60; Group R: 0.57; group L: 0.45; and group A: 0.75. These low values indicated that these four groups of diseases are common diseases in Naxi people living areas, and Naxi folk healers have high consensus on the treatment of these diseases.

For the treatment of diabetes (T89: Diabetes Insulin Dependent or T90: Diabetes Non-Insulin Dependent), which is an endocrine disease belongs to the group of endocrine/metabolic and nutritional, only one plant species was cited in the Dongba Sutras. *Diaphragma juglandis fructus*, the dry wood diaphragm tissue (xylem septa) that grows inside the walnut (*Juglans regia*), was reported as a medicinal plant that can be used to treat diabetes, and the consensus on this treatment was high. A pervious study reported that the flavonoids from

Diaphragma juglandis fructus have significant anti-diabetic activity [29]. This shows that as the knowledge on folk medicine is collected from long-term practical experience, its scientific nature has yet to be proven by modern science. With more research, more information from traditional medicinal practices will be scientifically proven.

Table 8 Informant consensus factor (ICF) values of the medicinal plants contained in the Dongba Sutras

Disease types	The sum of plant species (Nur)	The number of identical plant species used (Nt)	ICF
A: General and unspecified	21	6	0.75
D: Digestive	36	15	0.60
F: Eye	3	0	1.50
K: Cardiovascular	3	0	1.50
L: Musculoskeletal	21	12	0.45
N: Neurological	4	1	1.00
P: Psychological	3	0	1.50
R: Respiratory	29	13	0.57
S: Skin	11	2	0.90
T: Endocrine/metabolic and nutritional	1	1	-
U: Urological	12	4	0.73
X: Female genital	16	1	1.00
Y: Male genital	14	1	1.00

The plant species with the highest number of use reports were *Rheum likiangense* (13 use reports), *Reineckea carnea* (11 use reports), *Rheum delavayi* (10 use reports), and *Hypericum augustinii* (10 use reports). *Rheum likiangense* and *R. delavayi* are endemic to a small district, and *Reineckea carnea and Hypericum augustinii* are endemic to China. This emphasises the uniqueness of Naxi medicinal plants.

Analysis of endemic species

Among the medicinal plants in the Dongba Sutras, 25 species are endemic to China, accounting for 29.41% of the total number of medicinal plant species in the Dongba Sutras (85 species) (Table 9). Moreover, there are eight species only distributed in the areas inhabited by Naxi people (Fig. 2), including northwest Yunnan, southwest Sichuan, and Southeast Tibet. Examples include *Populus rotundifolia* var. *bonatii, Rheum likiangense, Chesneya polystichoides, Geranium strictipes, Dobinea delavayi, Wikstroemia delavayi, Rhododendron wardii,* and *Scutellaria likiangensis.*

The Naxi people consider human beings and nature as brothers. This ecological ethics concept lays the foundation for the Naxi people to live in harmony with nature; it shows the most primitive and simple concept of environmental conservation by human beings[30]. The distribution area of these plant species is very small. Although the Naxi people have been using these plants as medicinal materials for a long time, their populations are still stable, indicating that Naxi people attach great importance to plant conservation when collecting these medicinal plants.The Naxi people collect medicinal materials from their surroundings to treat many diseases. They never harm the environment during plant collecting, and they are grateful for being able to take advantage of wild medicinal plants. This fully embodies their idea of maintaining ecological balance.Meanwhile, artificial cultivation was adopted to expand the population of medicinal plants with rare natural resources in order to minimise their impact on wild plant resources.

Table 9 Chinese endemic plant species recorded in the Dongba Sutras

ID	Family	Scientific name	Distribution*	Abundance**	Resource type
1	Anacardiaceae	*Dobinea delavayi*	**SW**	Sol	Wild
2	Boraginaceae	*Ehretia corylifolia*	SW	Cop1	Wild
3	Caryophyllaceae	*Psammosilene tunicoides*	SW	Sp	Wild
4	Compositae	*Artemisia yunnanensis*	SW,W	Cop2	Wild
5	Compositae	*Crepis napifera*	SW	Cop2	Wild
6	Cupressaceae	*Cupressus duclouxiana*	SW	Cop1	Wild
7	Ericaceae	*Rhododendron racemosum*	SW	Cop3	Wild
8	Ericaceae	*Rhododendron wardii*	**SW**	Cop1	Wild
9	Geraniaceae	*Geranium strictipes*	**SW**	Cop1	Wild
10	Gramineae	*Fargesia orbiculata*	SW	Cop1	Wild
11	Guttiferae	*Hypericum augustinii*	SW	Cop3	Wild
12	Labiatae	*Scutellaria likiangensis*	**SW**	Cop1	Wild
13	Leguminosae	*Chesneya polystichoides*	**SW**	Sp	Wild
14	Liliaceae	*Asparagus meioclados*	SW	Cop1	Wild
15	Magnoliaceae	*Magnolia delavayi*	SW	Sp	Cultivated
16	Pinaceae	*Pinus yunnanensis*	SW,S	Soe	Wild
17	Polygonaceae	*Rheum likiangense*	**SW**	Sp	Wild
18	Polygonaceae	*Rheum officinale*	SW,S,C	Cop2	Cultivated,wild
19	Rosaceae	*Rubus coreanus* var. *tomentosus*	SW,C,W	Cop2	Wild
20	Sabiaceae	*Meliosma cuneifolia*	SW,C,W	Cop1	Wild
21	Salicaceae	*Populus rotundifolia* var. *bonatii*	**SW**	Soe	Wild
22	Salicaceae	*Salix variegata*	SW,C,W	Cop3	Wild
23	Sapindaceae	*Sapindus delavayi*	SW,C	Sp	Cultivated,wild
24	Tamaricaceae	*Myricaria paniculata*	SW,C,W	Cop1	Wild
25	Thymelaeaceae	*Wikstroemia delavayi*	**SW**	Cop1	Wild

*Note：SW–Southwest China; C–Central China; W–West China; S–South China

**Soe (Sociales): High number of individuals, the above ground plant part is closed;

Cop3 (Copiosae): High number of individuals, but the above ground plant part is not closed;

Cop2: Large and common plants;

Cop1: Large plants, but small populations;

Sp (Sparsal): Low number of plants, scattered;

Sol (Solitariae): Low number of plants, sparse;

Un (Unicum): Only one individual.

Conclusions

A variety of herbal medicine were recorded in the Dongba Sutras

The medicinal plants used by the Naxi people are diverse. A variety of herbal medicine closely related to the life of the Naxi people were recorded in the Dongba Sutras. A total of 85 species of medicinal plants belonging to 51 families and 71 genera were recorded in the Dongba Sutras, Among which 25 species are endemic to China, and 8 species are distributed in a small region. There were 22 species medicinal dietary plants were recorded in the Dongba Sutras.

The basic features of traditional Naxi medicine

The knowledge of traditional Naxi medicine are always in the hands of the elderly and clergy. The traditional apprenticeship between the elderly and the young make an assurance of the knowledge inheritance from age to age. Dongba, as the clergyman in Naxi people, record the most important medical knowledge in the Dongba Sutras for better inheritance.

In the processing of medicinal materials, Naxi people make good use of fresh products, medicinal liquids and plant powders. No complex processing is required from the raw plants to the medicine used, which is very convenient. Medicinal liquids can fully dissolve alcohol soluble active substances and are easy to store. Different types of mixed powder are used internally or externally suiting the remedy to the different cases, which not only brings convenient to clinical uses but also protect the intellectual property rights of the folk healers because it is hard to know which medicinal plants are used in the powders.

The Naxi ancestors inhabit mountainous areas and are seldom influenced by alien cultures. As a result, the methods of medication are easy to follow, mainly inlcuding decocting, oral consumption with warm water, topical, etc. And the processing technology of Naxi medicine only include some simple procedures like washing, drying, and crushing.

Four groups of diseases are common diseases in Naxi people living areas, they are the group of digestive diseases (D), followed by the respiratory (R), musculoskeletal (L) and the general and unspecified disease group (A). The Naxi folk healers have high consensus on the

treatment of these diseases.

The ecological ethics of Naxi people have positive significance for the conservation of wild plant resources

Hengduan mounainous where Naxi people live own one of the greatest aboundent biodiversity in the world. Naxi people always keep the scientific ecological ethics concept in mind. The Naxi people never harm the environment during plant collecting, and they are grateful for being able to take advantage of wild medicinal plants. Meanwhile, artificial cultivation is adopted to expand the population of medicinal plants with rare natural resources in order to minimise their impact on wild plant resources.

Dongba Sutras are recorded in hieroglyphics, thus only the Dongbas, as the clergymen, can could fully understand them. Contents of the Dongba Sutras are all-encompassing. Medical knowledge only takes a small part of whole contents, and the records are not comprehensive enough. In addition, the folk medicinal knowledge orally passed down. Thus, it is necessary to further deepen the investigation and research efforts to systematically organise and catalogue the Naxi people's unique traditional medicine, exhibiting its due brilliance.

Table 10 Ethnomedicinal data of the medicinal plant species recorded in the Dongba Sutras

Chinese name	Naxi name	Scientific name	Family/voucher specimen/habitat[a]/habit[b]	Part used	Preparation method	Route of administration	Diseases treated/number of respondents (ICPC-2)
zhu sheng rou qiu jun	men mu	*Engleromyces goetzi* P.Henn.	Hypocreaceae/NX0759/W/H	Fruit body	Drying	Oral	Elevated Blood Pressure K85 (57) Headache N01 (64) Throat Symptom R21 (52)
lie zhe jun	si du mou pei	*Schizophyllum commune* Fr.	Schizophyllaceae/NX0360/W/H	Fruit body	Drying	Oral	Cough R05 (104) Pleurisy / Pleural Effusion R82 (104)
fu ling	tuo ken liu	*Poria cocos* (Schw.) Wolf	Polyporaceae/NX0581/W/H	Fruit body	Drying/Soaking	Oral/Topical	Gonorrhoea Female X71 (12) Limited Function/Disability (L) L28 (68)
dian zhuang juan bai	ci liu liu ru da bie	*Selaginella pulvinata* (Hook. et Grev.) Maxim.	Selaginellaceae/NX0281/W/H	Roots	Charring	Oral	Bleeding/Haemorrhage NOS A10 (76)
jie jie cao	mie liu ku sa	*Equisetum ramosissimum* Desf.	Equisetaceae/NX0364,NX0657/W/H	Whole plants	Charring/Drying	Oral	Eye Discharge F03 (80) Genital Disease Male other Y99 (46) Menstruation Excessive X06 (72)
chuan dian hu jue	lu ba di li	*Drynaria delavayi* Christ.	Drynariaceae/NX0151/W/H	Rhizomes	Crushing	Topical	Fracture: Femur L75 (78) Fracture: Hand / Foot Bone L74 (64) Fracture: Other L76 (43) Fracture: Radius / Ulna L72 (37) Fracture: Tibia / Fibula L73 (90) Limited Function/Disability (L) L28 (89) Musculoskeletal Disease other L99 (44) Osteoarthrosis other L91 (37) Pelvis Symptom / Complaint Female X17 (18)
li jiang yun shan	li ben le	*Picea likiangensis* (Franch) Pritz	Pinaceae/NX0318/W/T	Fruits	Drying	Oral	Osteoarthrosis other L91 (102) Rheumatoid / Seropositive Arthritis L88 (99)
hua shan song	se tong	*Pinus armandii* Franch.	Pinaceae/NX0223,NX0322/W/T	Secretion	Drying	Oral	Constipation D12 (25) Cough R05 (52) Epilepsy N88 (37)
yun nan song	ge bo ha	*Pinus yunnanensis* Franch.	Pinaceae/NX0159/W/T	Flowers,Branches	Crushing/Stirring	Oral	Acute Bronchitis / Bronchiolitis R78 (75 Chronic Bronchitis R79 (84) Limited Function/Disability (L) L28 (28) Pneumonia R81 (76) Tuberculosis A70 (23)
gan xiang bai	xiong ban	*Cupressus duclouxiana* Hickel	Cupressaceae/NX0558/W/T	Branches,Leaves	Drying	Topical	Leg/Thigh Symptom L14 (87) Low Back Symptom L03 (68) Muscle Pain L18 (104)
gao shan bai	xiu xu	*Sabina squamata* (Buch.-Hamilt.) Ant.	Cupressaceae/NX0257,NX0614/W/S or T	Branches,Leaves	Drying	Oral/Topical	Intermenstrual Bleeding X08 (100) Menstruation Irregular / Frequent X07 (86)
hong hua wu wei zi	gua ji liu	*Schisandra rubriflora* (Franch.) Rehd. et Wils.	Schisandraceae/NX0248/W/WV	Bark	Soaking	Oral	Abdominal Pain Localized other D06 (44) Cystitis / Urinary Infection other U71 (32) Pain General/Multiple Sites A01 (104) Sleep Disturbance P06 (46) Trauma/Injury A80 (104)
shan yu lan	han yi ba da	*Magnolia delavayi* Franch.	Magnoliaceae/NX0701/C/T	Flowers	Soaking	Oral	Abdominal Pain Epigastric D02 (53)
xin zhang	sei bi	*Neocinnamomum delavayi* (Lec.) Liou	Lauraceae/NX0760/W/T	Leaves,Bark	Stirring	Topical	Diarrhoea D11 (45)
chang pu	ji chu buer	*Acorus calamus* L.	Acoraceae/NX0116/C,W/H	Whole plants	Crushing	Oral	Abdominal Pain Epigastric D02 (99) Influenza R80 (104) Mumps D71 (104) Upper Respiratory Infection Acute R74 (58)
dong fang ze xie	he ke gu	*Alisma orientale* (Samuel.) Juz.	Alismataceae/NX0520/C,W/H	Roots	Drying	Oral	Dysuria / Painful Urination U01 (72)

Chinese name	Naxi name	Scientific name	Family/voucher specimen/habitat[a]/habit[b]	Part used	Preparation method	Route of administration	Diseases treated/number of respondents (ICPC-2)
shou shen	a you la ba	*Gymnadenia conopsea* (L.) R. Br.	Orchidaceae/NX0352/W/H	Roots	Crushing/Drying	Oral	Cough R05 (74) Low Back Symptom L03 (45) Pain General/Multiple Sites A01 (55) Sexual Function Symptom / Complaint Male Y08 (31)
xi nan shou shen	a you la ba	*Gymnadenia orchidis* Lindl.	Orchidaceae/NX0349/W/H	Roots	Crushing/Drying	Oral	Cough R05 (74) Low Back Symptom L03 (45) Pain General/Multiple Sites A01 (55) Sexual Function Symptom / Complaint Male Y08 (31)
shou cao	lu bu ge	*Spiranthes sinensis* (Pers.) Ames	Orchidaceae/NX0122,NX0544/W/H	Whole plants	Crushing/Soaking/Stirring	Oral/Topical	Herpes Zoster S70 (53) Low Back Symptom L03 (86) Pain General/Multiple Sites A01 (97) Sexual Function Symptom / Complaint Male Y08 (24)
huo cong	cong ke pei er	*Allium ascalonicum* L.	Amaryllidaceae/NX0746/C/H	Whole plants	Drying	Oral	Influenza R80 (69) Upper Respiratory Infection Acute R74 (104)
kuan ye jiu	ju ge shu	*Allium hookeri* Thwaites	Amaryllidaceae/NX0705/C,W/H	Leaves,Roots	Fresh	Topical	Allergy/Allergic Reation A92 (93)
suan	gu	*Allium sativum* L.	Amaryllidaceae/NX0764/C/H	Whole plants	Drying/Fresh	Oral/Topical	Animal / Human Bite S13 (98) Insect Bite / Sting S12 (104)
mi chi tian men dong	ai xu	Asparagus meioclados Lévl.	Asparagaceae/NX0640/W/H	Roots	Drying	Oral	Cough R05 (104) Respiratory Disease other R99 (69)
ji xiang cao	gu ke gu zhe le	*Reineckea carnea* (Andrews) Kunth	Asparagaceae/NX0651/W/H	Whole plants	Crushing/Fresh/Drying	Oral/Topical	Acute Bronchitis / Bronchiolitis R78 (101) Chronic Bronchitis R79 (103) Cystitis / Urinary Infection other U71 (45) Fracture: Femur L75 (79) Fracture: Hand / Foot Bone L74 (65) Fracture: Other L76 (47) Fracture: Radius / Ulna L72 (53) Fracture: Tibia / Fibula L73 (100) Genital symptom / Complaint Female other X29 (36) Low Back Symptom L03 (100) Pain General/Multiple Sites A01 (66)
dian jiang hua	gu shu	*Hedychium yunnanense* Gagnep.	Zingiberaceae/NX0610/W/H	Roots	Drying/Fresh	Oral/Topical	Influenza R80 (88) Orchitis / Epididymitis Y74 (18) Osteoarthrosis other L91 (64) Rheumatoid / Seropositive Arthritis L88 (59) Upper Respiratory Infection Acute R74 (74)
chang yuan qiao jian zhu	ju me	*Fargesia orbiculata* Yi	Poaceae/NX0665/W/S	Leaves	Charring	Oral	Influenza R80 (58) Trauma/Injury A80 (28) Upper Respiratory Infection Acute R74 (79)
su	chong jing	*Setaria italica* (L.) Beauv. var. *germanica* (Mill.) Schred.	Poaceae/NX0765/C/H	Whole plants	Drying	Oral	Dyspepsia / Indigestion D07 (35)
jin mao tie xian lian	hai ke si zi beng	*Clematis chrysocoma* Franch.	Ranunculaceae/NX0370/W/WV	Whole plants	Drying	Oral	Bladder Symptom U13 (67)
he bing tie xian lian	ze die ba	*Clematis connata* DC.	Ranunculaceae/NX0721/W/WV	Stem	Drying	Oral	Pelvis Symptom / Complaint Female other X17 (39)
pao hua shu	gai si ze	*Meliosma cuneifolia* Franch.	Sabiaceae/NX0669/W/T	Leaves,Stem	Drying	Oral	Cystitis / Urinary Infection other U71 (15)
chuan dian que er dou	wen lu ban qi shi	*Chesneya polystichoides* (Hand.-Mazz.) Ali	Fabaceae/NX0265,NX0691/W/H	Roots	Soaking	Oral	Weakness / Tiredness General A04 (85

Chinese name	Naxi name	Scientific name	Family/voucher specimen/habitat[a]/habit[b]	Part used	Preparation method	Route of administration	Diseases treated/number of respondents (ICPC-2)
fen ge	gai gan er	*Pueraria lobata* var. *thomsonii* (Benth.)van der Maesen	Fabaceae/NX0632/W/SC	Roots,Flowers	Drying	Oral	Elevated Blood Pressure K85 (86) Headache N01 (103) Neck Symptom L01 (74) Pneumonia R81 (41) Vertigo / Dizziness N17 (104)
mei	se ka hao	*Prunus mume* Siebold et Zucc.	Rosaceae/NX0435/C,W/T	Fruits	Charring/Drying	Topical/Oral	Abdominal Pain D01 (104) Asthma R96 (77) Diarrhoea D11 (86) Nose Bleed / Epistaxis R06 (104)
fen zhi mei	qi pa ke	*Rubus biflorus* Buch.-Ham. ex Smith	Rosaceae/NX0145,NX0552/W/CS	Roots,Branches,Leaves	Drying	Oral	Menstruation Irregular / Frequent X07 (67)
mao ye cha tian pao	qi dong bei	*Rubus coreanus* var. *tomentosus* Card.	Rosaceae/NX0661/W/CS	Roots	Drying	Oral	Cystitis / Urinary Infection other U71 (100) Menstruation Irregular / Frequent X07 (67) Prostate Symptom Y06 (53) Urinary Calculus U95 (99)
hong pao ci teng	a le de ken	*Rubus niveus* Thunb.	Rosaceae/NX0461,NX0659/W/CS	Roots,Leaves,Fruits	Drying	Oral	Cystitis / Urinary Infection other U71 (94) Menstruation Irregular / Frequent X07 (67) Prostate Symptom Y06 (53) Urinary Calculus U95 (99)
zhou zhi shu li	qi na ze	*Rhamnus virgata* Roxb.	Rhamnaceae/NX0655/W/T	Leaves,Branches	Drying	Oral	Malignancy A79 (86)
da ma	sa	*Cannabis sativa* L.	Cannabaceae/NX0561,NX0630/C,W/H	Fruits,Leaves,StemBark	Crushing/Drying	Oral	Constipation D12 (46)
rui chi hu li	la ze	*Quercus aliena* Bl. var. *acuteserrata* Maxim. ex Wenz.	Fagaceae/NX0646/W/T	Branches,Leaves	Drying	Oral	Osteoarthrosis other L91 (101) Rheumatoid / Seropositive Arthritis L88 (104)
chuan dian gao shan li	bei shi	*Quercus aquifolioides* Rehd. et Wils.	Fagaceae/NX0241/W/T	Fruits,Bark,Flowers	Drying	Oral	Nose Bleed / Epistaxis R06 (55) Viral Hepatitis D72 (66)
hu tao	gu bai du duo	*Juglans regia* L.	Juglandaceae/NX0570/C,W/T	Bark	Soaking/Drying	Oral	Cholecystitis/Cholelithiasis D98 (63) Diabetes Insulin Dependent T89 (75) Diabetes Non-Insulin Dependent T90 (69) Dyspepsia/Indigestion D07 (90) Influenza R80 (79) Upper Respiratory Infection Acute R74 (81)
hu lu	bei pu de	*Lagenaria siceraria* (Molina) Standl.	Cucurbitaceae/NX0675/C/HV	Leaves	Drying	Oral	Genital Disease Male other Y99 (68)
mao gua	gu bu luo lan	*Solena amplexicaulis* (Lam.) Gandhi	Cucurbitaceae/NX0763/W/HV	Roots	Fresh	Topical	Burn / Scald S14 (22) Cough R05 (45)
wu bing jin tao	ni mei hei tu ba	*Hypericum augustinii* N. Robson	Hypericaceae/NX0142/W/WV	Whole plants	Crushing/Drying	Oral/Topical	Acute Hepatitis A D73 (75) Dyspepsia/Indigestion D07 (48) Genital Disease Male other Y99 (90) Gonorrhoea Male Y71 (101) Pain General/Multiple Sites A01 (12) Prostate Symptom Y06 (96) Psoriasis S91 (42) Pyelonephritis / Pyelitis U70 (21) Viral Hepatitis D72 (59) Worms/Other Parasites D96 (97)
Dian nan shan yang	la ka	*Populus rotundifolia* Griff. var. *bonatii* (H. Lév.) C. Wang & S. L. Tung	Salicaceae/NX0672/W/T	Bark	Soaking/Drying	Oral/Topical	Infectious Disease A78 (88) Viral Disease A77 (79) Worms/Other Parasites D96 (22)
chui liu	re pei	*Salix babylonica* L.	Salicaceae/NX0555/W/T	Branches,Leaves,Roots	Fresh	Oral	Teeth/Gum Symptom D19 (17)
qiu hua liu	ji re	*Salix variegata* Franch.	Salicaceae/NX0563/W/T	Branches,Leaves	Drying	Oral	Haematuria U06 (97) Urinary Calculus U95 (79) Viral Hepatitis D72 (45)

Chinese name	Naxi name	Scientific name	Family/voucher specimen/habitat[a]/habit[b]	Part used	Preparation method	Route of administration	Diseases treated/number of respondents (ICPC-2)
zi di yu	qie sai che e	*Geranium strictipes* R. Knuth	Geraniaceae/NX0378/W/H	Roots	Crushing/Drying	Oral	Dyspepsia/Indigestion D07 (82) Mumps D71 (62) Pneumonia R81 (75) Viral Hepatitis D72 (48)
yang jiao tian ma	ju luo lan	*Dobinea delavayi* (Baill.) Baill.	Anacardiaceae/NX0762/W/H	Roots	Crushing	Oral	Limited Function / Disability (L) L28 (53)
chuan dian wu huan zi	ba de zi	*Sapindus delavayi* (Franch.) Radlk.	Sapindaceae/NX0125/C,W/T	Fruits	Drying	Oral	Dyspepsia/Indigestion D07 (25)
chuan lian	da liu	*Melia toosendan* Sieb. et Zucc.	Meliaceae/NX0169/W/T	Whole plants	Drying	Oral	Abdominal Pain D01 (100) Asthma R96 (94) Diarrhoea D11 (96)
lang du	lei bu ne du	*Stellera chamaejasme* Linn.	Thymelaeaceae/NX0077/W/H	Roots	Crushing	Oral	Constipation D12 (85)
lan cang rao hua	wai de	*Wikstroemia delavayi* Lecomte	Thymelaeaceae/NX0066,NX0660/W/S	Whole plants,Flowers or Bark	Crushing	Oral	Epilepsy N88 (23)
wu jing	a ke	*Brassica rapa* L.	Brassicaceae/NX0761/C/H	Roots	Drying	Oral	Bladder Symptom U13 (42)
tong qiao she gu	mu gu xu	*Balanophora involucrata* Hook. f.	Balanophoraceae/NX0502,NX0686/W/H	Whole plants	Soaking/Drying	Oral	Neoplasm of Eye/Adnexa F74 (23) Orchitis / Epididymitis Y74 (85) Trauma/Injury A80 (36) Viral Hepatitis D72 (27)
san chun shui bai zhi	ji xiu	*Myricaria paniculata* P. Y. Zhang et Y. J. Zhang	Tamaricaceae/NX0197,NX0717/W/S	BranchesLeaves	Drying	Oral/Topical	Osteoarthrosis other L91 (103) Rash Localized S06 (100) Rheumatoid / Seropositive Arthritis L88 (98)
jin qiao mai	ruo kao ken	*Fagopyrum dibotrys* (D. Don) Hara	Polygonaceae/NX0490,NX0528/W/H	Roots	Crushing/Drying	Oral	Abdominal Pain Epigastric D02 (69) Hair / Scalp Symptom S24 (65) Heartburn D03 (78) Mumps D71 (90) Peptic Ulcer other D86 (49)
huo tan mu	zei lan xu	*Polygonum chinense* L. var. chinense	Polygonaceae/NX0708/C,W/H	Whole plants	Drying	Oral	Cholecystitis/Cholelithiasis D98 (61)
dian bian da huang	lu zei ken	*Rheum delavayi* Franch.	Polygonaceae/NX0353/W/H	Roots	Drying/Fresh	Oral/Topical	Acute Bronchitis / Bronchiolitis R78 (89) Acute Hepatitis A D73 (103) Bleeding/Haemorrhage NOS A10 (26) Chronic Bronchitis R79 (104) Gastrointestinal Infection D70 (71) Haematuria U06 (59) Heartburn D03 (99) Influenza R80 (104) Pneumonia R81 (104) Upper Respiratory Infection Acute R74 (97)
li jiang da huang	ai san qi	*Rheum likiangense* Sam.	Polygonaceae/NX0262,NX0693/W/H	Roots	Soaking/Drying	Oral	Anal Fissure/Perianal Abscess D95 (85) Bleeding/Haemorrhage NOS A10 (95) Bursitis / Tendinitis / Synovitis NOS L87 (73) Gonorrhoea Female X71 (38) Lump / Swelling Localized S04 (85) Melaena D15 (74) Neck Symptom L01 (88) Pain / Tenderness of Skin S01 (78) Pain General/Multiple Sites A01 (83) Rectal Bleeding D16 (100) Throat Symptom R21 (58) Trauma/Injury A80 (79) Viral Hepatitis D72 (79)
yao yong da huang	hua zei de	*Rheum officinale* Baill.	Polygonaceae/NX0753/C,W/H	Roots	Drying	Oral	Constipation D12 (104) Diarrhoea D11 (104) Gonorrhoea Female X71 (104)

Chinese name	Naxi name	Scientific name	Family/voucher specimen/habitat[a]/habit[b]	Part used	Preparation method	Route of administration	Diseases treated/number of respondents (ICPC-2)
ni bo er suan mo	hua leng hua zei ke	*Rumex nepalensis* Spreng.	Polygonaceae/NX0074/W/H	Roots	Drying/Fresh	Oral/Topical	Constipation D12 (84) Pruritus S02 (36) Worms/Other Parasites D96 (90)
jin tie suo	du la pei	*Psammosilene tunicoides* W. C. Wu et C. Y. Wu	Caryophyllaceae/NX0488/W/H	Roots	Crushing/Soaking	Topical	Abdominal Pain Epigastric D02 (35) Bleeding/Haemorrhage NOS A10 (103) Musculoskeletal Disease other L99 (104) Osteoarthrosis other L91 (101) Pain General/Multiple Sites A01 (104) Rheumatoid / Seropositive Arthritis L88 (104) Trauma/Injury A80 (98)
qian sui gu	mei ru	*Amaranthus hypochondriacus* L.	Amaranthaceae/NX0525/W/H	Seeds	Drying	Oral	Dyspepsia/Indigestion D07 (39) Sleep Disturbance P06 (24)
li guo xian zhang	cong ren hei	*Opuntia ficus-indica* (L.) Mill.	Cactaceae/NX0109/C,W/H	Whole plants	Fresh	Topical	Burn / Scald S14 (99) Gonorrhoea Male Y71 (63)
jun qian zi	tao zhi	*Diospyros lotus* Linn.	Ebenaceae/NX0170/C,W/T	Fruits	Drying	Oral	Diarrhoea D11 (86)
pu tong lu ti cao	jiu gu lei	*Pyrola decorata* H. Andr.	Ericaceae/NX0152,NX0652/W/H	Whole plants	Drying	Oral	Abdominal Pain Localized other D06 (86) Acute Bronchitis / Bronchiolitis R78 (95) Chronic Bronchitis R79 (79) Influenza R80 (700) Mouth/Tongue/Lip Symptom D20 (79) Upper Respiratory Infection Acute R74 (69)
ye hua du juan	shua dai lan ba	*Rhododendron racemosum* Franch.	Ericaceae/NX0085/W/S	Branches,Flowers	Crushing	Topical	Psoriasis S91 (34)
huang bei du juan	mu gou ba shi	*Rhododendron wardii* W. W. Smith	Ericaceae/NX0310,NX0312/W/T	Flowers,Fruits	Crushing/Drying	Oral/Topical	Musculoskeletal Disease other L99 (87) Osteoarthrosis other L91 (76) Rheumatoid / Seropositive Arthritis L88 (82)
dian long dan cao	ji ka	*Gentiana rigescens* Franch. ex Hemsl.	Gentianaceae/NX0350/W/H	Whole plants	Crushing/Soak	Oral	Cholecystitis/Cholelithiasis D98 (104) Viral Hepatitis D72 (104)
xi nan cu kang shu	nu ao	*Ehretia corylifolia* C. H. Wright	Boraginaceae/NX0111/W/T	Whole plants	Soaking	Topical	Pruritus S02 (35)
ye ba zi	ke du	*Elsholtzia rugulosa* Hemsl.	Lamiaceae/NX0178/W/H	Leaves,Flowers	Crushing/Drying	Oral	Influenza R80 (77) Upper Respiratory Infection Acute R74 (104)
li jiang huang qin	bai qi ba pei ke	*Scutellaria likiangensis* Diels	Lamiaceae/NX0696/W/H	Roots	Soak/Drying	Oral/Buccal	Swallowing Problem D21 (95)
bian da xiu qiu	a you jian da ke	*Hemiphragma heterophyllum* Wall.	Plantaginaceae/NX0228/W/H	Whole plants	Drying	Oral	Low Back Symptom L03 (75) Menstruation Irregular / Frequent X07 (33) Musculoskeletal Disease other L99 (69) Osteoarthrosis other L91 (88) Pain General/Multiple Sites A01 (75)
kuan ye tu feng	du er mei gu fu pie	*Ainsliaea latifolia* (D. Don) Sch.-Bip.	Asteraceae/NX0098/W/H	Whole plants	Drying	Oral	Cough R05 (104) Haemoptysis R24 (82) Malaria A73 (36) Rheumatoid / Seropositive Arthritis L88 (87)
niu wei hao	qi ai	*Artemisia dubia* Wall. ex Bess.	Asteraceae/NX0707/W/H	Stem,Leaves	Soaking	Topical	Menstruation Absent / Scanty X05 (53)
nan ai hao	beng pei	*Artemisia verlotorum* Lamotte	Asteraceae/NX0358,NX0658/W/H	Aboveground part	Crushing/Soaking/Drying	Oral/Topical	Anal Fissure/Perianal Abscess D95 (45) Influenza R80 (104) Upper Respiratory Infection Acute R74 (75)
yun nan hao	beng na	*Artemisia yunnanensis* J. F. Jeffrey ex Diels	Asteraceae/NX0618/W/H	Branches,Leaves	Crushing	Topical	Nose Bleed / Epistaxis R06 (68)

Chinese name	Naxi name	Scientific name	Family/voucher specimen/habitat[a]/habit[b]	Part used	Preparation method	Route of administration	Diseases treated/number of respondents (ICPC-2)
wu jing huan yang shen	ze ge	*Crepis napifera* (Franch.) Babcock	Asteraceae/NX0748/W/H	Roots	Fresh	Topical/Oral	Genital Disease Male other Y99 (46) Visual Disturbance other F05 (25) Whooping Cough R71 (101)
da ding cao	jiu ban er	*Gerbera anandria* (L.) Sch.-Bip.	Asteraceae/NX0464/W/H	Whole plants	Crushing/Drying	Oral	Gonorrhoea Female X71 (23) Worms/Other Parasites D96 (52)
jie gu mu	su kua na	*Sambucus williamsii* Hance	Adoxaceae/NX0049/C,W/S	Bark	Crushing	Topical	Fracture: Femur L75 (95) Fracture: Hand / Foot Bone L74 (86) Fracture: Other L76 (78) Fracture: Radius / Ulna L72 (77) Fracture: Tibia / Fibula L73 (89) Low Back Symptom L03 (63) Osteoarthrosis other L91 (58) Pain General/Multiple Sites A01 (58) Rheumatoid / Seropositive Arthritis L88 (101)
zhu zi shen	man hai lü	*Panax japonicus* var. *major* (Burkill) C. Y. Wu & K. M. Feng	Araliaceae/NX0536,NX0736/C,W/H	Roots	Crushing	Oral	Elevated Blood Pressure K85 (96) Genital Disease Male other Y99 (29) Low Back Symptom L03 (84) Pain General/Multiple Sites A01 (104) Trauma/Injury A80 (104)
chuan dian chai hu	mu ru	*Bupleurum candollei* Wall. ex DC.	Apiaceae/NX0453/W/H	Whole plants	Drying	Oral	Influenza R80 (100) Pneumonia R81 (86) Upper Respiratory Infection Acute R74 (104)
hui xiang	lai wu ci e	*Foeniculum vulgare* Mill.	Apiaceae/NX0108/C/H	Whole plants	Fresh	Oral	Abdominal Pain Localized other D06 (46) Bedwetting / Enuresis P12 (24) Cystitis / Urinary Infection other U71 (77) Gonorrhoea Female X71 (23) Orchitis / Epididymitis Y74 (31) Urinary Frequency / Urgency U02 (101)
bai liang du	guo ru ke huo	*Heracleum candicans* Wall. ex DC.	Apiaceae/NX0334/W/H	Roots	Crushing/Drying	Oral	Abdominal Pain D01 (86) Abdominal Pain Epigastric D02 (69) Cough R05 (58)

[a] Habitat: W, wild; C, cultivated.

[b] Habit: H: herbs; T: trees; S: shrubs; WV: woody vines; CS: climbing shrubs; HV: herbal vines

Abbreviations

APG Ⅳ: The Angiosperm Phylogeny Group classification for the orders and families of flowering plants ed.Ⅳ

AQSIQ: General Administration of Quality Supervision of China.

IMDY: The Herbarium, Yunnan Branch, Institute of Medicinal Plants, Chinese Academy of Medical Science.

ICF: The informant consensus factor.

ICPC-2: International Classification of Primary Care, revised second ed.

WONCA: World Organization of Family Doctors.

WHO: World health organization

Declarations

Acknowledgments

We are grateful to Yunnan Provincial Office of the Fourth National Census of Traditional Chinese Medicine Resources and Lijiang Municipal government, all members of Lijiang Medical Association of Minorities, and Academician Luqi Huang, President of Chinese Academy of Traditional Chinese Medicine for their help during the study.

Authors' contribution

Jianqin Liu: designed the study. **Jingyuan Song**: designed and revised the manuscript. **Haitao Li**: performed ethnobotanical plants surveys,prepared herbarium samples, botanical identification of plant species, Data curation data Formal analysis, analysis and Writing - original draft wrote the manuscript. **Zhiyong Li**: performed ethnobotanical plants surveys, Data curation data Formal analysis. **Xiaobo Zhang**: Data curation data Formal analysis. **Shaohua Yang**: performed ethnobotanical plants surveys and prepared herbarium samples, botanical identification of plant species. **Cui Chen**: performed ethnobotanical plants surveys and prepared herbarium samples, botanical identification of plant species. **Qingning Yang**: performed ethnobotanical plants surveys and prepared herbarium samples, Data curation. **Chengfeng He**: performed ethnobotanical plants surveys and prepared herbarium samples, Data curation. All authors have read and approved the final version of the manuscript.

Fundings

This research was supported by accreditation scheme from State Administration of Traditional Chinese Medicine of the People's Republic of China (Grant No. GZY-KJS-2018-004) and Public Health Service Subsidy of Traditional Chinese Medicine in 2018 "The Project of National Census of Traditional Chinese Medicine Resources" ((2018) No. 43).

Availability of data and materials

All data generated or analyzed during this study are included in this published article (and its supplementary information files).

Ethics approval and consent to participate

Not applicable.

Consent for publication

Prior and informed consent of local people's pictures had been obtained for publication.

Competing interests

All the authors declare that there is no conflict of interest.

Author details

[1]Key Lab of Chinese Medicine Resources Conservation, State Administration of Traditional Chinese Medicine of the People's Republic of China, Institute of Medicinal Plant Development, Chinese Academy of Medical Sciences & Peking Union Medical College, Beijing, 100193, P. R. China. [2]Yunnan Key Laboratory of Southern Medicinal Utilization,Yunnan Branch, Institute of Medicinal Plant Development, Chinese Academy of Medical Sciences & Peking Union Medical College, Jinghong, Yunnan 666100, P. R. China. [3]School of Pharmacy, Minzu University of China, Beijing, 100081, P. R. China. [4]Yunnan Province Resources of Development and Collaborative Innovation Center for New Traditional Chinese Medicine, Kunming, 650051, P. R. China. [5]State key laboratory breeding base of Dao-di Herbs, National Resource Center for Chinese Materia Medical, China Academy of Chinese Medical Sciences, Beijing, 100700, P. R. China. [6]Institute of Alpine Economics and Botany, Yunnan Academy of Agricultural Scicences, Lijiang, 674100, P. R. China. [7]Lijiang Medical Association of Minorities, Lijiang, 674100, P. R. China.

References

1. Wang Y, Zheng J. A flower of national medicine nurtured by Dongba culture. Journal of Yunnan University of Traditional Chinese Medicine. 2006; 4: 55. https://doi.org/10.19288/ j.cnki.issn. 1000-2723.2006.04.023.
2. Rock, J.F.. The Ancient Na-Khi Kingdom of Southwest China. Kunming: Yunnan Fine Arts Publishing House; 1999.

3. Chen HG. Dongba Scripture: An Encyclopedia of ancient Naxi Society. Yunnan Archives. 1999; 5: 26.
4. Chen HY. Research on the excavation and utilization of ancient medical books of ethnic minorities in Southwest China. Beijing: Nationalities Publishing House; 2011.
5. Chen YX, Xu LY, Yang LF. Research on excavation and utilization of Naxi Dongba ancient medical literature from the perspective of national memory inheritance. Chinese Journal of Ethnomedicine and Ethnopharmacy. 2018; 27 (14): 10–13.
6. Institute of Dongba Culture. The Complete Works of Dongba Sutras in Naxi. Kunming: Yunnan People's Publishing House; 1999.
7. Lijiang Municipal People's Government Portal, 2020. http://www.lijiang.gov.cn/culture/ (accessed 23 October 2020).
8. Yunnan Network, 2020. http://lijiang.yunnan.cn/system/2018/07/03/030014212.shtml (accessed 23 October 2020).
9. China Weather Network. Lijang City, Analysis of Lijiang Climate Background for the period of 1971–2000. 2020. http://www.weather.com.cn/cityintro/101291401.shtml (accessed 23 October 2020).
10. Martin G.J.. Ethnobotany: A Methods Manual, WWF for Nature International. London: Chapman and Hall; 1995.
11. International Society of Ethnobiology. ISE code of ethics (with 2008 additions). 2006.
12. Ministry of Education of the People's Republic of China website. 1958. http://www.moe.gov.cn/jyb_sjzl/ziliao/A19/195802/t19580201_186000.html (accessed 23 October 2020)
13. AQSIQ, SAC. Gb/T16159. Basic Rules for Hanyu Pinyin Orthography. 2012.
14. International Classification Committee of Wonca. International Classification of Primary Care, revised second ed. Oxford: Oxford University Press; 2015.
15. Yebouk C., Redouan F.Z., Benítez G., Bouhbal M., Kadiri M., Boumediana A.I., Molero-Mesa J., Merzouki A.. Ethnobotanical study of medicinal plants in the Adrar Province, Mauritania. J. Ethnopharmacol. 2020; 246: 112217. https://doi.org/10.1016/j.jep.2019.112217.
16. Staub P.O., Geck M.S., Weckerle C.S., Casu L., Leonti M.. Classifying diseases and remedies in ethnomedicine and ethnopharmacology. J. Ethnopharmacol. 2015; 174: 514–519. https:// doi.org/10.1016/j.jep.2015.08.051.
17. Editorial Committee of Flora of China. Flora of China. Beijing: Science Press; 1989–2013.
18. Editorial Committee of Flora Reipublicae Popularis Sinicae. Flora Peipublicae Popularis Sinicae. Beijing: Science Press; 1959–2004.
19. Editorial Committee of Flora Yunnanica. Flora Yunnanica. Beijing: Science Press; 1977–2006.
20. The Plant List. 2020. http://www.theplantlist.org (accessed 23 October 2020).
21. The Angiosperm Phylogeny Group, M. W. Chase, M. J. M. Christenhusz, M. F. Fay, J. W. Byng, W. S. Judd, D. E. Soltis, D. J. Mabberley, A. N. Sennikov, P. S. Soltis, P. F. Stevens. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG IV, Botanical Journal of the Linnean Society. 2016; 181(5):1-20. https://doi.org/10.1111/boj.12385.
22. Wang YH, Wang C. Common Research Methods of Ethnobotany. Hangzhou: Zhejiang Education Publishing House; 2017.
23. Chinese Pharmacopoeia Commission. Pharmacopoeia of the People's Republic of China. Beijing: China Medicinal Science Press; 2020.
24. Wu GF, Feng ZJ., Ma WL, Zhou XJ., Lang KC, Hu RL, Wang CJ, Li RG. Botany. Beijing: Higher Education Press; 1992.
25. Ministry of Ecology and Environment of the People's Republic of China website. 2014. http://www.mee.gov.cn/ywgz/fgbz/bz/bzwb/stzl/201411/t20141106_291239.shtml (accessed 23 October 2020).
26. Xie GZ, Tang XY, Li XJ, Liu H, Zhang SH. Development and Application of "One Root of Medicine and Food", Modern Chinese Medicine. 2020; 22(09): 1428-1433. https://doi.org/10.13313/j.issn.1673-4890.20200229001
27. Zhang, L., Zhang, Y., Pei, S. et al. Ethnobotanical survey of medicinal dietary plants used by the Naxi People in Lijiang Area, Northwest Yunnan, China. J Ethnobiology Ethnomedicine. 2015; 11:40. https://doi.org/10.1186/s13002-015-0030-6.
28. Dalar A., Mukemre M., Unal M., Ozgokce F.. Traditional medicinal plants of Ağrı Province, Turkey. J. Ethnopharmacol. 2018; 226: 56–72. https:// doi.org/10.1016/j.jep.2018.08.004.
29. Li GY, Cheng YG, Zeng TC, Li MJ, Sun RR, Li HF, Kong XP, Pei MR. Action mechanism of total flavonoids of Diaphragma Juglandis Fructus in treating type 2 diabetes mellitus based on network pharmacology and cellular experimental validation of AKT/FoxO1 signaling pathway. Drug Evaluation Research. 2019;42(1): 30–40. https://doi.org/10.7501/j.issn.2019. 01.005.
30. Zheng J, Wang Y. Study on Dongba Medicine of Naxi Nationality. Kunming: Yunnan Science and Technology Press; 2006.

Figures

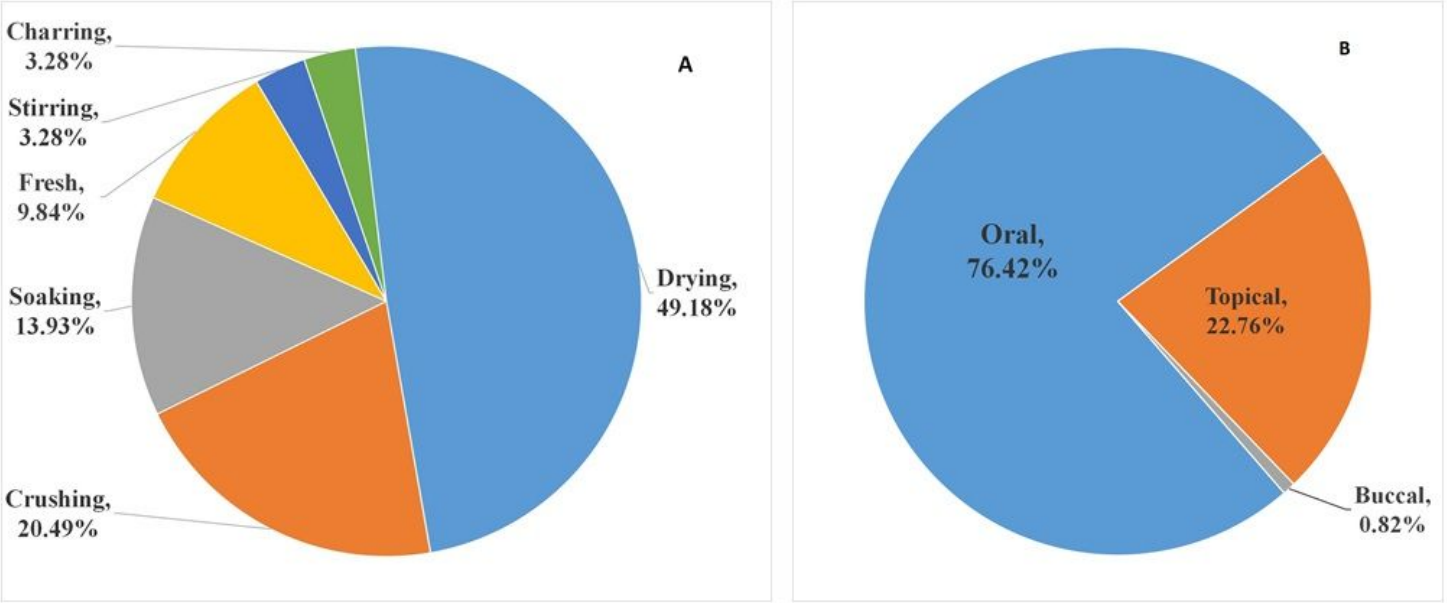

Figure 1

Preparation methods of medicinal materials. B: Medicine administration methods used by the Naxi people.

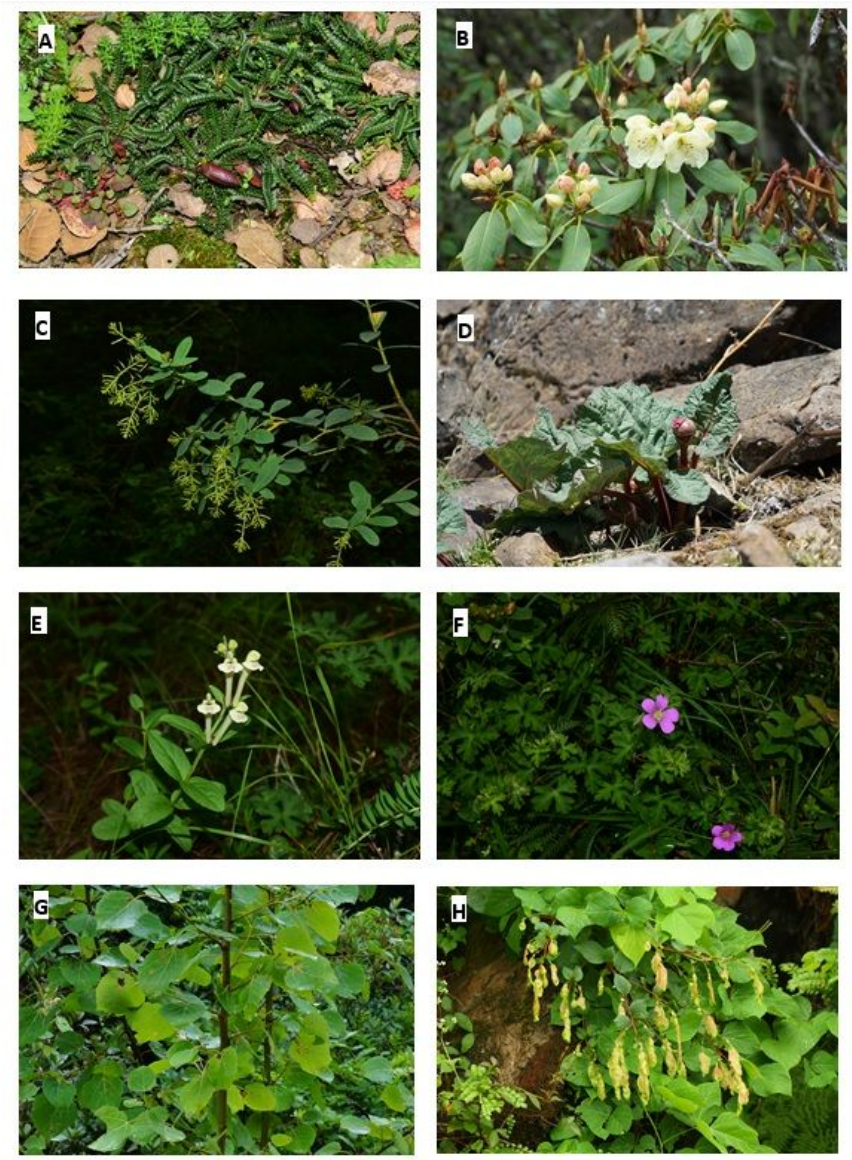

Figure 2

Eight plant species endemic to China present in the areas inhabited by Naxi people. A: Chesneya polystichoides; B: Rhododendron wardii; C: Wikstroemia delavayi; D: Rheum likiangense; E: Scutellaria likiangensis; F: Geranium strictipes; G: Populus rotundifolia var. bonatii; H: Dobinea delavayi