

Research paper

Ethnobotany and diversity of medicinal plants used by the Buyi in eastern Yunnan, China

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ABSTRACT

The Buyi are a socio-linguistic group in Yunnan Province of southwest China that have a long history of using medicinal plants as part of their indigenous medical system. Given the limited written documentation of the Buyi indigenous medical system, the objective of this paper is to document the medicinal plants of the Buyi and associated traditional knowledge and transmission. Field research was conducted in four villages in Lubuge Township of Luoping County in Yunnan Province using ethnobotanical methodologies including participatory observation, semi-structured interviews, key informant interviews, and focus group discussions to elicit information on medicinal plants. In total, 120 informants (including 15 key informants who are healers) were interviewed. This study found that a total of 121 medicinal plant species belonging to 64 families are used by the Buyi including by local healers to treat different diseases. Among the medicinal plants recorded in this study, 56 species (46%) have not previously been documented in the scientific literature as having medicinal value, highlighting the pressing need for ethnobotanical documentation in indigenous communities. The most frequently used medicinal part was the leaf (24.9% of documented plants), and the most common preparation method was decoction (62.8% of medicinal). Medicinal plants were mainly used to treat rheumatism (12.4% of plants), trauma and injuries (9.6%). The documented plants are also used for other non-medicinal purposes including food, fodder, fencing, and ornamental. In addition, 35 of the medicinal plants are considered poisonous and are used by local Buyi healers for medicine. The traditional Buyi beliefs and practices associated with the documented medicinal plants likely contributes to their conservation in the environments and around Buyi communities. This study further highlights that ethnomedicinal knowledge of the Buyi is at risk of disappearing due to increased introduction and use of modern medicine in Buyi communities, livelihood changes, rapid modernization, and urbanization. Research, policy, and community programs are urgently needed to conserve the biocultural diversity associated with the Buyi medical system including ethnobotanical knowledge towards supporting both environmental and human wellbeing.

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communities throughout Asia. For example, indigenous and traditional medical systems account for a notable proportion of all healthcare provided in China (Zhu, 2016). Different socio-linguistic groups in China have their own indigenous and traditional medical systems and medicinal plant uses which vary on the basis of geography and associated ecology (Liu et al., 2016).

The Buyi are indigenous inhabitants of southwestern China that have long relied on medicinal plants for disease prevention and treatment as well as overall wellbeing. The Buyi are one of the 55 recognized minority socio-linguistic groups in China and are the 11th most populous with a population of approximately 2.87 million (Population Census Office of Ministry of Population of China, 2010). The ancestors of the Buyi traditionally lived around the regions of the Nanpan, Beipan, and Hongshui Rivers. The association of the Buyi with rivers and mountain regions has shaped their current living habits. For instance, the typical Buyi village is usually located in a mountainous area with a river nearby (Yu and Guo, 2018). The typical architectural style of the Buyi, called “gan lan” (stilt style), is designed with double floors with only the top floor for living for the purpose of avoiding moisture from nearby rivers, dangerous animals, and poisonous insects. The Buyi have had to overcome many natural challenges in order to survive in their surroundings of high-altitude mountains and humid river valleys. Over time, the Buyi have accumulated a large amount of indigenous knowledge of medicinal plants in their surroundings, which has helped to ensure their survival and the thriving of their communities. The Buyi ethnomedicinal system is comprised of unique theories and diagnostic methods, which are distinct from traditional Chinese medicine, Western medicine, and other ethnomedicinal systems (Liu and Xue, 2012).

The Buyi speak their own indigenous language, which belongs to the branch of Zhuang language family (Zhou, 2009). Their current written language was created in the 1950s as a combination of Latin and Pinyin systems (Zhou, 2009). The Buyi originated from one of the branches of the “bai yue” group, referred to as “luo yue” in China. The earliest literature regarding the Buyi dates back to the Han Dynasty (206BC–220AD). Since then, their name has been changed several times across different dynasties, including “pu yue”, “liao”, and “fan man”. The word “bu yi” was recorded in Chinese phonetically with “Bu” meaning ‘people’ or ‘linguistic group’. The Buyi people address themselves as “Yi” in a manner of respect (Editorial Committee of the Brief History of the Buyi People, 2008). The Buyi are mainly distributed in southwest China, including in Guizhou, Yunnan, and Sichuan provinces. More than 98% of the total population of Buyi people reside in Qiannan and Qianxinan prefectures of Guizhou Province. The remaining Buyi population is scattered in Luoping and Maguan counties of Yunnan, and in Ningnan County of Sichuan (Wang and Shang, 2009).

Several records about the medicinal plants used by the Buyi people have been compiled including the *Checklist of Medicinal Herbs of Guizhou* (Guizhou Institute of Traditional Chinese Medicine, 1988), *Flora of China* (Editorial Committee of Flora Reipublicae Popularis Sinicae, 2004), *Buyi Medicine*, and *the Utilization of Buyi Medicinal Herbs of the Buyi People Inhabited Letters* (Jia and Li, 2005). Furthermore, research has been carried out in several Buyi communities in Guizhou Province on the use of medicinal resources and documented 252 plants, 26 animals, and 11 minerals used for medicinal purposes (Pan et al., 2003). However, there remains limited documentation of the ethnobotany of Buyi medicinal plants in Yunnan and Sichuan Provinces. As Buyi healers have traditionally collected medicinal plants from their surrounding fields, it is hypothesized that the medicinal plants and composition of medicinal plant prescriptions used by the Buyi in Yunnan and Sichuan Provinces differ significantly from those used in Guizhou

Province due to variation in geography and certain cultural attributes.

The Buyi population in Luoping County of Yunnan Province is mainly concentrated in the Lubuge Buyi and Miao Autonomous Townships in a remote mountainous area with limited transportation, a distinct language, and extreme topographic variation. Consequently, the vegetation in and around Buyi communities in Yunnan is well preserved with high species diversity and a well forest coverage. The indigenous cultural practices of the Buyi are also well preserved in the remote communities in Luoping County.

Multicultural activities with other groups living around Buyi communities including the Miao, Yi, Bai, Hui, and Zhuang (Ju et al., 2013) are hypothesized to result in unique medical theories and medicinal plant uses by the Buyi communities living in Yunnan Province compared to those living in different geographic areas. Our previous ethnobotany studies indicate that the medicinal systems of the various indigenous people of Yunnan are vanishing due to habitat loss, influence from mainstream Chinese culture, development, and unsustainable resource utilization (Muthu et al., 2006; Li et al., 2006). Ethnobotanical research is urgently needed to investigate and document the medicinal system of Buyi communities in Yunnan Province in order to inform conservation efforts of biocultural diversity towards supporting both environmental and human wellbeing.

2. Material and methods

2.1. Buyi traditional culture

In general, one should be highly respected by the local people before becoming a healer in a Buyi community. For many local Buyi healers, healers do not ask for much money or goods from patients when they diagnose their patients' diseases. The local Buyi healers do not buy medicinal materials from markets or pharmacy stores. Instead, they will go to the natural habitats to collect any medicinal materials they require for their practice. They prescribe medicinal recipes to patients as a gift, and they continue taking care of patients until they recover. If the patients' health conditions continue getting worse, the healers will change their medicinal recipes (Cui and Tang, 2007).

The Buyi local healers believe in the “Jing, Qi and Xue”, three elements in Buyi ethnomedicine, which are a basic conceptual framework of the human body. When malfunction happens in these three elements, a patient's body will get an illness. Additionally, they also believe that a human's life is determined by the surrounding environmental conditions. If the environment has been damaged, one's life will also be negatively impacted. The above-mentioned theories have been used as basic framework for treatment disease and medicinal prescribing.

During the long process of human–nature interactions, the Buyi people not only accumulated abundant traditional knowledge for the utilization and protection of the natural environment and its resources, but also they have established an environmentally friendly network, which is closely connected with animals and plants, geographic conditions, and local climates. These traditional cultural beliefs are rooted in their religious beliefs, routine practices, ritual rules, and social regulations.

Simultaneously, the local ecological environment has also been influenced directly or indirectly by the Buyi people's traditional lifestyle, religious belief, and taboo. Here are two aspects:

- (1) The richness and diversity of plants and animals might be broadly utilized in the traditional manufacturing process, such as textile, batik, brocade, embroidery, bamboo weaving, and carving.

- (2) Buyi traditional customs and taboos call for more people to understand local biological resources and protect natural resources, so as to ultimately protect the composition, structure, and function of the ecosystem, stabilize the energy flow and material circulation, and improve the overall ecological function in terms of religious belief and worship.

The living condition of Buyi village is characterized by the surrounded mountains and rivers. Also, the Buyi village is also surrounded by towering ancient trees. Where there is a sacred tree, there is a mountain god. The Buyi people believe that the sacred tree cannot be cut down or destroyed at any time, otherwise disaster will occur. Therefore, the tree will survive and thrive for a long time.

2.2. Study area

Luoping County is located in Qujing Prefecture of Eastern Yunnan province in China at 103°57'-104°43' E and 24°31'-25°25' N, at the junction of Guizhou, Guangxi, and Yunnan provinces (Fig. 1). Altitudes in Luoping County range from 772 to 2468 m above sea level. Luoping is characterized by year-round precipitation, being located within one of the highest rainfall areas in Yunnan Province. Its climate is mainly dominated by plateau monsoon, with a mean annual temperature of 15.1 °C, mean annual rainfall 1743.9 mm, and annual average relative humidity 85%. There are several rivers in this region, including the Duoyi, Kuaize, Huangni and Nanpan Rivers. Two townships (Lubuge and Changdi) in this county are dominated by the Buyi people (Editorial Committee of Luoping County Annals, Luoping County Annals Assembly, 2014).

Based on our prior studies and field investigations, Lubuge Township is an cultural hotspot of Buyi people in Yunnan Province due to its well-preserved traditional practices and beliefs. For example, the Buyi people of this region still wear clothing linked to their cultural identity. Previous studies of the Buyi in Yunnan have mainly focused on the morals, ethics, culture, religion, literature, arts and economic development of this region (Zhu and Wang, 2008; Gao, 2001). However, there is a lack of detailed information concerning the use of medicinal plants by the Buyi of Yunnan. The objective of this study is to document medicinal plants used to prevent and treat diseases by Buyi communities in Luoping County as well as traditional methods of preparation based on the Buyi medicinal system.

2.3. Methods

Ethnobotanical research was conducted in four Buyi rural communities (Duoyi, Muna, Bantai and Badahe) in Lubuge Township of Yunnan Province between 2015 and 2017. We carried our semi-structured interviews with Buyi households and Buyi healers who served as key informants. In addition, we carried out community walks and plant collections. The interviews asked informants about their use of medicinal plants and consisted of the following questions adapted from previous ethnobotanical studies in the regions (Liu et al., 2014; Wang, 2014): (1) What plants in your community have been traditionally used for medicines? (2) Who in your household and community uses medicinal plants? (3) What season/time of the year do you collect medicinal plants? (4) How are each of these medicinal plants collected? (5) Where do medicinal plants grow in your community and surroundings? (6) How are medicinal plants processed and prepared for treating human and animal ailments? and (7) How do the Buyi people preserve medical technologies and associated cultural practices and traditional knowledge?

Fifteen healers from four villages were chosen as key informants. Another 105 informants were interviewed to gather information about local herbal medicinal knowledge, including experienced villagers, local healers, and herbal vendors. Information was recorded regarding the local names, medicinal parts, preparations, functional attributed, perceived toxicity levels, and other uses by Buyi informants. Voucher specimens of all documented plants through interviews were collected through community walks with Buyi healers and were examined to determine the species and botanical family using the *Flora of China* and the Subject Database of China Plant and Medicinal Plants of Yunnan Province (Jin, 2012; <http://www.plant.csdb.cn/>; Wan, 2016). The voucher specimens were then deposited in the Herbarium at Kunming Institute of Botany of the Chinese Academy of Sciences.

Findings were analyzed to tabulate the total number of medicinal plants belonging to different botanical families as well as the number of plants used to treat and prevent specific health conditions.

2.4. Data analysis

The data collected of medicinal plants in study area were collated into an inventory listing all the medicinal plants and related information. The use-value (UV) of each medicinal plant was calculated to evaluate the relative importance of each plant based on the number of times cited and the number of informants. The formula for UV is

$$UV = (\sum U_i) / N$$

U_i is the number of times cited by each informant for a certain medicinal plant, while N is the total number of informants (Sujarwo and Caneva, 2016).

3. Results

3.1. Buyi medicinal plants

A total of 121 botanical species were reported for medicinal purposes by the Buyi informants belonging to 64 families (Table 1). The first written documentation of the medicinal uses of these plants; specifically, 56 species were recorded for the first time in this study as medicinal plants (labeled with an asterisk in Table 1). The majority of documented medicinal plants have distinct local names in the Buyi language (labeled with a triangle mark in Table 1) while some are identified by their Mandarin names.

Among the 64 botanical families documented in this study, the Compositae was the most prevalent family with 10 species followed by the Polygonaceae, Araliaceae, Rubiaceae, Verbenaceae, Labiatae and Liliaceae (with 4 species each). Families with 3 species include Rosaceae, Apocynaceae, Smilacaceae, and Orchidaceae. Families with 2 species include Berberidaceae, Menispermaceae, Urticaceae, Umbelliferae, Asclepiadaceae, Solanaceae, Acanthaceae, and Araceae.

The most commonly reported medicinal plants include the following: *Sargentodoxa cuneata* (Lardizabalaceae), *Uncaria scandens* (Rubiaceae), *Paederia scandens* (Rubiaceae), *Sinomenium acutum* (Menispermaceae), *Stephania delavayi* (Menispermaceae), *Hedera nepalensis* (Araliaceae), *Schefflera venulosa* (Araliaceae), *Munronia pinnata* (Meliaceae), *Munronia henryi* (Meliaceae), *Schisandra propinqua* (Schisandraceae), *Uncaria macrophylla* (Rubiaceae), *Zanthoxylum nitidum* (Rubiaceae), *Ardisia mamillata* (Primulaceae), *Alsophila spinulosa* (Cyatheaceae), *Smilax* sp (Smilacaceae), *Liquidambar formosana* (Altingiaceae), *Clerodendrum yunnanense* (Lamiaceae), *Tetragium sichouense* (Vitaceae),

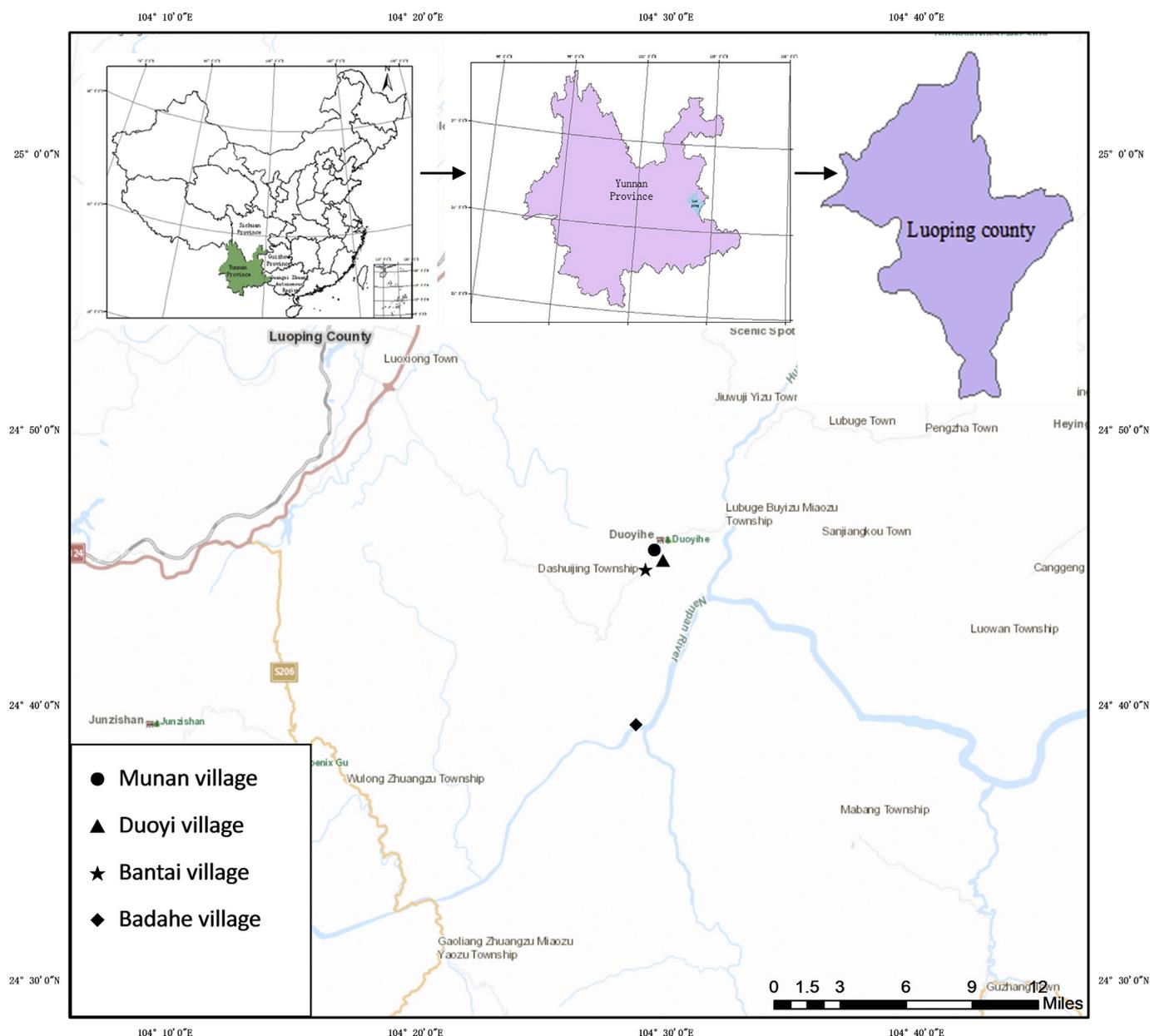


Fig. 1. Sketch map of study site.

Boehmeria nivea (Urticaceae), *Solanum indicum* (Solanaceae), *Pinus yunnanensis* (Pinaceae).

3.2. Plant parts and types of preparation

The plant parts used for medicinal purposes of the documented medicinal plants of the Buyi medical system are listed in Table 2. Leaves (23.72%) and whole plants (23.72%) were the most frequently used parts, followed by stems (17.95%) and roots (11.54%). Other parts that are less prevalent include the vine (6.41%), rhizome (4.49%) and fruit (5.11%).

The most common method of preparing the medicinal plants is using the decoction method (62.8%), followed by crushing the plant material for making a poultice (23.1%), broth (4.1%), soaking in alcohol (2.5%). Some species were used with other natural materials, such as the preparation of tonics made of medicinal plants

combined with brown sugar, grains, chicken, pork and other materials.

3.3. Medicinal plant uses

The documented plants in this study are used for a wide range of health conditions (Table 3) by Buyi communities. A total of 40 health conditions were reported for the documented medicinal plants used by the Buyi. The most prevalent uses of the medicinal plants were for rheumatism (12.4%), trauma and injuries (9.6%), detoxification (5.7%), inflammation (5.1%), gynecological diseases (4.0%), tonics for overall health (2.8%), and pediatric diseases (1.7%).

The most prevalent plants reported for treatment of rheumatism were *A. spinulosa* (Cyatheaceae), *A. mamillata* (Primulaceae), *Angiopteris* sp (Marattiaceae), *Asplenium antiquum* (Aspleniaceae), *B. nivea* (Urticaceae), *Chloranthus holostegius* (Chloranthaceae), *C. yunnanense* (Lamiaceae), *Euonymus yunnanensis* (Celastraceae),

Table 1
List of ethnomedicinal plants commonly used by the Buyi people in eastern Yunnan.

Voucher number	Scientific name	Family name	Local name	Part used	Preparation	UV	Medicinal uses	Poisonous tissue	Additional local uses
LBG097 ^a	<i>Achyranthes longifolia</i> M.	Amaranthaceae	Hong niu xi	Whole plant	Decoction	0.43	Anaemia		
LBG018 ^a	<i>Acmella calva</i> (DC.) R.K.Jansen	Compositae	Jin niu kou	Flower	Soak in alcohol	0.37	Toothache, dental caries		
LBGB001	<i>Acorus calamus</i> L.	Acoraceae	Guo gang pu [▲]	Whole plant	Crush and poultice	0.44	Inflammation of lymph	Root	Ornamental plant at dragon boat festival
LBG092 ^a	<i>Justicia adhatoda</i> L.	Acanthaceae	Guo zuan	Stem, leaf, flower	Crush and poultice	0.12	Inflammation		
LBG047	<i>Agrimonia pilosa</i> Ledeb.	Rosaceae	Na gang	Leaf	Decoction	0.41	Hepatitis, nasosinusitis		
LBG075	<i>Ajuga decumbens</i> Thunb.	Labiatae	Nia zi mu guai	Whole plant	Crush and poultice	0.23	Injuries from falls		
LBG011 ^a	<i>Alocasia cucullata</i> (Lour.) G.Don	Araceae	Bi shi lin	Rhizome, stem, leaf	Decoction	0.30	Gastroenteropathy, stomachache	Whole	Ornamental plant
LBG010 ^a	<i>Alsophila spinulosa</i> (Wall. ex Hook.) R.	Cyatheaceae	Long gu feng	Stem, leaf	Decoction	0.45	Injuries from falls, rheumatism, epilepsy	Whole	Landscape plan
LBG032 ^a	<i>Alstonia scholaris</i> (L.) R. Br.	Apocynaceae	Ba zhua jin long	Stem, leaf	Decoction	0.14	Hemostasis, acesodyne	Leaf and bark	Latex for the raw materials of chewing gum
LBG015	<i>Alstonia yunnanensis</i> Diels.	Apocynaceae	San bai bang	Leaf	Crush and poultice	0.41	Fracture, ostealgia, injuries from falls	Leaf	
LBG014 ^a	<i>Angiopteris</i> sp.	Angiopteridaceae	Gu li wai	Rhizome	Decoction	0.24	Rheumatism, epilepsy		
LBG056 ^a	<i>Ardisia mamillata</i> Hance.	Myrsinaceae	Mao qing gang	Whole plant	Decoction	0.45	Rheumatism, ostealgia, injuries from falls		
LBGB002	<i>Artemisia carvifolia</i> Buch.-Ham. ex Roxb.	Compositae	Ya ai	Leaf	Decoction, fume	0.45	Inflammation		
LBG112	<i>Artemisia argyi</i> H.Lév. & Vaniot	Compositae	Bai hao	Stem, leaf	Crush and poultice	0.44	Nose bleeding, traumatic injury, wound		Ornamental plant at dragon boat festival
LBG012 ^a	<i>Asplenium antiquum</i> Makino	Aspleniaceae	Ming rong ruo	Leaf	Crush and poultice	0.23	Rheumatism		
LBG079 ^a	<i>Basella rubra</i> L.	Basellaceae	Teng qi	Vine, leaf	Decoction, broth	0.35	Anaemia		Fruit juice as a harmless food colorants Fiber crops
LBG108	<i>Boehmeria nivea</i> (L.) Gaudich.	Urticaceae	Da huo ma	Stem, leaf	Crush and poultice, soak in alcohol	0.49	Rheumatism		
LBGB003	<i>Boehmeria siamensis</i> Craib.	Urticaceae	Ge ju lw	Bark, leaf	Crush and poultice	0.27	Fracture, ostealgia, injuries from falls		
LBGB004	<i>Bougainvillea glabra</i> Choisy	Nyctaginaceae	Luo lin	Root	Crush and poultice	0.25	Detumescence, hemostasis		Ornamental plant
LBG004 ^a	<i>Bryophyllum pinnatum</i> (Lam.) Oken	Crassulaceae	Luo di sheng gen	Stem, leaf	Decoction	0.17	Detumescence, burn		Ornamental plant
LBG029 ^a	<i>Buddleja officinalis</i> Maxim.	Loganiaceae	Lu ya	Stem, leaf, flower	Decoction	0.26	Icteric hepatitis	Root, leaf	Yellow dyestuffs
LBG090	<i>Bulbophyllum odoratissimum</i> (Sm.) Lindl. ex Wall.	Orchidaceae	Guo sang ye	Whole plant	Decoction, crush and poultice	0.16	Pneumonia, pulmonary tuberculosis, fracture		Ornamental plant
LBG078 ^a	<i>Callicarpa arborea</i> Roxb.	Verbenaceae	Mang zi	Stem, leaf	Crush and poultice	0.28	Inflammation, hemostasis		Landscape plant
LBG087 ^a	<i>Callicarpa bodinieri</i> H.Lév.	Verbenaceae	Jie gu dan	Whole plant	Crush and poultice	0.25	Fracture		Landscape plant
LBG101 ^a	<i>Campylandra wattii</i> C.B.Clarke.	Liliaceae	Wan nian zhu	Stem	Crush and poultice, soak in alcohol	0.32	Hemorrhoids		Ornamental plant
LBGB005	<i>Canna indica</i> L.	Cannaceae	Ya yai	Root	Crush and decoction	0.21	Gynecologic diseases		Ornamental plant
LBG074	<i>Carthamus tinctorius</i> L.	Compositae	Hong hua [▲]	Flower	Crush and decoction	0.40	Overwork, hemostasis		Edible oil
LBG065	<i>Centella asiatica</i> (L.) Urb.	Umbelliferae	Gai liang	Whole plant	Decoction	0.38	Jaundice, hepatitis		

(continued on next page)

Table 1 (continued)

Voucher number	Scientific name	Family name	Local name	Part used	Preparation	UV	Medicinal uses	Poisonous tissue	Additional local uses
LBG058	<i>Chloranthus holostegius</i> (Hand.-Mazz.) C.Pei & San	Chloranthaceae	Si kuai wa [▲]	Whole plant	Decoction	0.42	Injuries from falls, overwork, rheumatism, pediatric fever	Whole	
LBG021 ^a	<i>Chonemorpha megacalyx</i> Pierre ex Spire	Apocynaceae	Yin si du zhong	Bark	Decoction, broth	0.15	Nephropathy	Hairs	
LBGB006	<i>Cinnamomum glanduliferum</i> (Wall.) Meisn.	Lauraceae	Mai shang	Fruit	Crush and decoction	0.41	Fever	Camphor	Repellent
LBGB007	<i>Cirsium japonicum</i> (Thunb.) Fisch. ex DC.	Compositae	Guo ai	Root	Crush and decoction	0.19	Injuries from falls		
LBG052 ^a	<i>Clerodendrum yunnanense</i> Hu.	Verbenaceae	Chou mu dan	Root, leaf	Decoction	0.47	Rheumatism, sore on waist and leg		
LBGB008	<i>Crotalaria sessiliflora</i> L.	Liliaceae	Na jio	Whole plant	Decoction	0.22	Pediatric diseases	Seed	
LBG114 ^a	<i>Cudrania tricuspidata</i> (Carrière) Bureau ex Lavallée	Moraceae	Lao shui ci	Stem, leaf	Decoction	0.26	Icteric hepatitis		Yellow dyestuff
LBG002	<i>Cycas revoluta</i> Thunb.	Cycadaceae	Bi sang	Whole plant	Decoction	0.15	Gastritis, gastrorrhagia, large intestine bleeding	Seed	Edible starch of stems and landscape plant
LBG062	<i>Cynanchum auriculatum</i> Royle ex Wight	Asclepiadaceae	Ge shan xiao	Earthnut	Decoction	0.43	Gastrosis	Root	
LBG104 ^a	<i>Dendrobium loddigesii</i> Rolfe.	Orchidaceae	Huang cao [▲]	Whole plant	Decoction	0.14	Legs paralysis, bedridden		Ornamental plant
LBGB009	<i>Dichondra micrantha</i> Urb.	Convolvulaceae	Ting ma	Whole plant	Decoction	0.45	Fracture, ostealgia, injuries from falls		Ornamental plant
LBG008 ^a	<i>Dichrocephala integrifolia</i> (L.f.) Kuntze.	Compositae	N/A	Whole plant	Decoction	0.21	Pulmonary tuberculosis	Whole	
LBG098 ^a	<i>Dicliptera chinensis</i> (L.) Juss.	Acanthaceae	Guo jiang	Whole plant	Decoction	0.19	Cholecystitis		
LBG095 ^a	<i>Diurathera major</i> Hemsl.	Liliaceae	Xiao huang qi	Root, flower	Decoction	0.15	Gynaecopathia, icteric hepatitis		Ornamental plant
LBG006	<i>Duchesnea indica</i> (Jacks.) Focke.	Rosaceae	Gao ma	Stem, leaf	Crush and poultice	0.22	Snakebite	Whole	Ornamental plant
LBG066 ^a	<i>Eclipta prostrata</i> (L.) L.	Compositae	Han lian cao	Stem, leaf, flower	Decoction	0.15	Hepatitis		
LBGB010	<i>Eriobotrya japonica</i> (Thunb.) Lindl.	Rosaceae	Pipa [▲]	Fruit	Eat	0.43	Lung disease	Seed and leaf	Fruit
LBG044	<i>Eucommia ulmoides</i> Oliv.	Eucommiaceae	Gao wang ma	Stem	Decoction	0.35	Nephritis		
LBG026 ^a	<i>Euonymus yunnanensis</i> Franch.	Celastraceae	Jin si du zhong	Stem	Decoction	0.21	Injuries from falls, rheumatism, wound	Whole	
LUGB011	<i>Euphorbia helioscopia</i> L.	Euphorbiaceae	Guo ya	Whole plant	Decoction	0.14	Stomach, intestine disease	Whole	
LBG024 ^a	<i>Flemingia macrophylla</i> (Willd.) Merr.	Papilionaceae	Guo bu a	Root	Crush and poultice	0.31	Traumatic injury		
LBGB012	<i>Foeniculum vulgare</i> Mill.	Umbelliferae	Ya wan	Whole plant	Decoction	0.44	Stomach, intestine disease		Vegetables and seasoning
LBG069	<i>Gardenia jasminoides</i> J.Ellis.	Rubiaceae	Zhi zi	Fruit	Decoction	0.25	Icteric hepatitis		Ornamental plant and dyestuffs
LBG072	<i>Gentiana rigescens</i> Franch. ex Hemsl.	Gentianaceae	Long dan [▲]	Whole plant	Decoction	0.37	Inflammation, liver trouble, stomatitis		
LBG096	<i>Glechoma longituba</i> (Nakai) Kuprian.	Labiatae	Ba ge nu nang	Stem, leaf	Decoction	0.41	Pediatric fever, overwork, strain, fracture		
LBG055 ^a	<i>Hedera helix</i> L.	Araliaceae	San gu feng	Vine, leaf	Medicine bath	0.14	Skin disinfection	Berry	Landscape plant

Table 1 (continued)

Voucher number	Scientific name	Family name	Local name	Part used	Preparation	UV	Medicinal uses	Poisonous tissue	Additional local uses
LBG111	<i>Hedera nepalensis</i> K.Koch.	Araliaceae	San gu feng lin	Vine, leaf	Decoction	0.57	Furuncle on foot, eliminating naevi		Landscape plant
LBGB013	<i>Hibiscus syriacus</i> L.	Malvaceae	Guo mu jin	Flower	Decoction	0.39	Stomach, intestine disease		Landscape plant
LBG053	<i>Houttuynia cordata</i> Thunb.	Saururaceae	Bie lan	Root	Decoction	0.44	Duresis	Whole	Vegetables and seasoning
LBG071 ^a	<i>Hypericum japonicum</i> Thunb.	Hypericaceae	Tian ji huang [▲]	Stem	Decoction	0.23	Hepatitis		
LBGB014	<i>Iris tectorum</i> Maxim.	Iridaceae	Ya yan hua	Rhizome	Crush and poultice	0.41	Injuries from falls, rheumatism, wound	Stem and root	Ornamental plant
LBGB015	<i>Juncus effusus</i> L.	Juncaceae	Guo tang	Stem	Decoction	0.31	Urethral problems		
LBG078	<i>Leonurus japonicus</i> Houtt.	Labiatae	Guo gang leng	Whole plant	Decoction	0.51	Gynaecopathia	Seed	
LBG115	<i>Lepisorus</i> sp.	Polypodiaceae	Piao dai cao	Whole plant	Decoction	0.32	Sore throat		
LBG081 ^a	<i>Ligularia hodgsonii</i> Hook.	Compositae	Gong ai ao	Whole plant	Boil and poultice	0.12	Pruritus		
LBG067	<i>Liquidambar formosana</i> Hance.	Hamamelidaceae	Geng xiang (lu lu tong)	Leaf, fruit	Crush and poultice, decoction	0.62	Rheumatism		Black dyestuff and construction
LBG070	<i>Lonicera japonica</i> Thunb.	Caprifoliaceae	Jin yin hua [▲]	Stem, leaf	Decoction	0.43	Influenza, tonsillite		
LBG073 ^a	<i>Loranthus</i> sp.	Loranthaceae	Ma sang ji sheng	Stem, leaf	Decoction	0.36	Ischialgia, paralysis, injuries from falls		
LBG025	<i>Lygodium japonicum</i> (Thunb.) Sw.	Lygodiaceae	Gu gou	Whole plant	Decoction, broth	0.42	Lithangiuria, diabetes		
LBG118	<i>Mahonia bealei</i> (Fortune) Pynaert.	Berberidaceae	N/A	Whole plant	Decoction, broth	0.43	Ulcer furunculosis, hot eyes		Landscape plant
LBG120 ^a	<i>Mahonia fortunei</i> (Lindl.) Fedde	Berberidaceae	N/A	Whole plant	Decoction	0.43	Inflammation, jaundice, hot eyes		Landscape plant
LBG023 ^a	<i>Marsdenia tenacissima</i> (Roxb.) Moon	Asclepiadaceae	Gao dou sha	Root	Decoction	0.27	Lung heat, phthisic, pulmonary tuberculosis, antineoplastic		
LBG051 ^a	<i>Momordica charantia</i> L.	Curcubitaceae	Gao ma la gang mu	Vine, leaf	Decoction	0.39	Hepatitis, nasosinusitis		Vegetable
LBGB016	<i>Morus alba</i> L.	Moraceae	Mai sang	Fruit, leaf	Eat, decoction	0.35	Common cold		Fruit
LBG057	<i>Munronia pinnata</i> (Wall.) W.Theob.	Meliaceae	Ai tuo tuo	Whole plant	Decoction	0.51	Overwork, rheumatism	Whole	
LBG028 ^a	<i>Myrica esculenta</i> Buch.-Ham. ex D. Don.	Myricaceae	Hai pei lei	Bark	Decoction	0.22	Chronic enteritis		Fruit
LBGB017	<i>Nandina domestica</i> Thunb.	Berberidaceae	Guo bei ling	Root	Crush and decoction 54	0.32	Inflammation, inflammation of lymph	Fruit	Landscaped plant
LBG091 ^a	<i>Oberonia cavaleriei</i> Finet.	Orchidaceae	Mou lang	Whole plant	Decoction 55, crush and poultice	0.41	Traumatic injury, bleeding, fracture, gonorrhea		
LBG059 ^a	<i>Oenanthe javanica</i> (Blume) DC.	Umbelliferae	Bai hua cao	Whole plant	Decoction	0.36	Rheumatism, gynaecopathia		Vegetable
LBG045	<i>Oroxylum indicum</i> (L.) Kurz	Bignoniaceae	Wan mei long gua	Fruit	Decoction	0.40	Hepatitis, nasosinusitis		
LBG088	<i>Oxalis corniculata</i> L.	Oxalidaceae	Suan jiang cao	Whole plant	Crush and poultice	0.26	Fracture, overwork, snakebite	Whole	Ornamental plant
LBG060 ^a	<i>Paederia scandens</i> (Lour.) Merr.	Rubiaceae	Niu jin teng	Vine, leaf	Decoction	0.52	Rheumatism	Whole	
LBG068 ^a	<i>Panax notoginseng</i> (Burkill) F.H.Chen	Araliaceae	San qi [▲]	Rhizome	Decoction	0.43	Blood circulation, injuries from falls		
LBGB022	<i>Peristrophe japonica</i> (Thunb.) Bremek.	Acanthaceae	Guo yue	Stem, leaf	Decoction	0.13	Inflammation, hemostasis, Gynecologic diseases		Red dyestuff

(continued on next page)

Table 1 (continued)

Voucher number	Scientific name	Family name	Local name	Part used	Preparation	UV	Medicinal uses	Poisonous tissue	Additional local uses
LBG038	<i>Pinus yunnanensis</i> Franch.	Pinaceae	Da jie	Stem	Decoction	0.44	Rheumatism, injuries from falls		Construction
LBG013	<i>Plantago major</i> L.	Plantaginaceae	Guo po sheng	Whole plant	Decoction	0.43	Nasosinusitis, pulmonary tuberculosis, nephritis		
LBGB018	<i>Platycodon grandiflorus</i> (Jacq.) A.D.C.	Campanulaceae	Jie geng [▲]	Root	Decoction	0.42	Lung disease		
LBG049 ^a	<i>Pollia miranda</i> (H.Lév.) H.Hara.	Commelinaceae	N/A	Stem, leaf	Decoction	0.18	Inflammation		
LBG019 ^a	<i>Polygonatum kingianum</i> Collett & Hemsl.	Liliaceae	Guo dao ji	Rhizome	Decoction, broth	0.41	Swirl, dizzy		
LBG061 ^a	<i>Polygonum capitatum</i> Buch.-Ham. ex D.Don	Polygonaceae	Ba gu yan	Whole plant	Decoction	0.24	Analgesic		
LBG121	<i>Fallopia multiflora</i> (Thunb.) Harald.	Polygonaceae	He shou wu [▲]	Earthnut	Decoction	0.42	Hepatitis, anaemia		
LBG080	<i>Portulaca oleracea</i> L.	Portulacaceae	Gao mao du	Stem, leaf	Decoction	0.38	Malnutrition, indigestion syndrome		Vegetable
LBG005 ^a	<i>Potentilla lineata</i> Trevir.	Rosaceae	Fan bai ye	Whole plant	Decoction	0.28	Gastroenteritis, gastrorrhagia, bloody flux, dysentery		
LBG063 ^a	<i>Lobelia angulata</i> G.Forst.	Campanulaceae	Bi ye ya mu	Whole plant	Decoction	0.25	Rheumatism, traumatic injury		
LBG022	<i>Prunella vulgaris</i> L.	Labiatae	Xia ku cao [▲]	Whole plant, leaf	Burn into ash	0.39	Nasosinusitis		
LBG003	<i>Pteris cretica</i> L.	Pteridaceae	Feng wei cao	Stem, leaf	Decoction	0.22	Cholecystitis		
LBG020	<i>Reineckea carnea</i> (Andrews) Kunth	Liliaceae	Fen mei wai fing	Leaf	Crush and poultice, soak in alcohol	0.42	Fracture, rheumatism, injuries from falls		Ornamental plant
LBGB021	<i>Reynoutria japonica</i> Houtt.	Polygonaceae	Guo xie ling	Stem, leaf	Crush and poultice	0.26	Fracture, rheumatism, injuries from falls		
LBG048 ^a	<i>Rhaphidophora decursiva</i> (Roxb.) Schott	Araceae	Guo shan long	Vine, leaf	Decoction	0.32	Gastritis, gastrorrhagia, large intestine bleeding		
LBG001	<i>Rumex nepalensis</i> Spreng.	Polygonaceae	Da huang	Whole plant	Decoction	0.17	Inflammation, detumescence, diminish sore		
LBG104	<i>Sabia parviflora</i> Wall.	Sabiaceae	Ya xi qiang	Whole plant	Decoction	0.43	Hepatitis, icteric hepatitis		Tea
LBG035	<i>Sargentodoxa cuneata</i> (Oliv.) Rehder & E.H.Wilson	Sargentodoxaceae	Gao lu (gao zai)	Root, stem, leaf	Decoction	0.58	Rheumatism, injuries from falls		Cane substitute
LBG064	<i>Schefflera venulosa</i> (Wight & Arn.) Harms	Araliaceae	Mai dang du	Stem, leaf	Decoction	0.53	Hemostasis, acesodyne, fracture, rheumatism		
LBG039	<i>Schisandra propinqua</i> (Wall.) Baill.	Schisandraceae	Gao yi nou	Vine	Decoction, soak in alcohol, broth	0.61	Tonic		
LBG082	<i>Senecio scandens</i> Buch.-Ham. ex D.Don	Compositae	Xiao gan yao	Whole plant	Decoction	0.41	Gastric diseases	Whole	
LBG054 ^a	<i>Sinomenium acutum</i> (Thunb.) Rehder & E.H.Wilson	Menispermaceae	Ge bou	Vine	Decoction	0.55	Rheumatism	Stem and root	
LBG083 ^a	<i>Smilax china</i> L.	Smilacaceae	Jin gang ci	Rhizome	Decoction	0.21	Nephropathy, overwork		Edible starch from root, fence and vines.
LBG085 ^a	<i>Smilax glabra</i> Roxb.	Smilacaceae	Tu fu ling	Rhizome	Decoction; soak in alcohol	0.19	Injuries, nephropathy, overwork, smallpox		

Table 1 (continued)

Voucher number	Scientific name	Family name	Local name	Part used	Preparation	UV	Medicinal uses	Poisonous tissue	Additional local uses
LBG116 ^a	<i>Smilax</i> sp.	Smilacaceae	Jin gang teng	Rhizome	Decoction	0.48	Eczema, Rheumatism, detoxifying, detumescence		
LBG089 ^a	<i>Solanum indicum</i> L.	Solanaceae	Huang la guo	Root, fruit, seed	Decoction, fume	0.53	Rheumatism, dental caries	Whole	
LBG007	<i>Solanum nigrum</i> L.	Solanaceae	Ma ding	Fruit	Crush and poultice	0.42	Furuncle on foot, eliminating naevi	Immature fruit	Young leaves for vegetable, mature fruit edible.
LBG017	<i>Stephania delavayi</i> Diels.	Menispermaceae	Ri mu dui	Earthnut	Crushed and poultice, decoction	0.54	Rheumatism, stomachache, gastroduodenal ulcer		
LBG016 ^a	<i>Tacca chantrieri</i> André	Taccaceae	Wang le xiang	Stem	Crush and poultice	0.14	Skin infection, detumescence	Whole	
LBG019	<i>Taraxacum mongolicum</i> Hand.-Mazz.	Compositae	Luo ai	Whole plant	Decoction	0.41	Inflammation, inflammation of lymph		Vegetable
LBG036 ^a	<i>Tetragymma sichouense</i> C.L. Li.	Vitaceae	Na gao le	Root	Decoction	0.45	Rheumatism, gastropathy		
LGB020	<i>Toricellia tiliifolia</i> DC.	Cornaceae	Guo qiang ling	Leaf	Crush and poultice	0.43	Fracture		
LBG041	<i>Uncaria macrophylla</i> Wall.	Rubiaceae	Gou wou nou	Vine	Decoction	0.51	Hepatitis, acute icteric hepatitis	Stem	
LBG040	<i>Uncaria scandens</i> (Sm.) Hutch.	Rubiaceae	Wou nou	Vine	Decoction	0.13	Rheumatism, injuries from falls		
LBG109 ^a	<i>Urtica fissa</i> E. Pritz.	Urticaceae	Huo ma	Shoot	Decoction	0.62	Rheumatism, digestive disease	Whole	
LBG009	<i>Verbena officinalis</i> L.	Verbenaceae	Nia muen	Whole plant	Decoction	0.42	Cholecystitis, icteric hepatitis, hepatitis, pruritus	Whole	
LBG027	<i>Woodwardia japonica</i> (L. f.) Sm.	Blechnaceae	Guan zhong	Root	Decoction	0.25	SARS, cephalomeningitis		
LBG046 ^a	<i>Xanthium strumarium</i> L.	Compositae	Wa gou ma	Fruit	Decoction	0.43	Hepatitis, nasosinusitis	seed and seeding	
LBG037 ^a	<i>Zanthoxylum nitidum</i> (Roxb.) DC.	Rutaceae	Liang mian zhen [▲]	Root	Decoction	0.48	Chronic enteritis	Whole	

Notes: ▲ Names were pronounced the same as Mandarin Chinese.

^a 56 species had medicinal values for the first time recorded from this study.

Table 2
Plant parts used.

Plant part	Species number of uses	Percent (%)
Leaf	37	23.72%
Whole plant	37	23.72%
Stem	28	17.95%
Root	18	11.54%
Vine	10	6.41%
Rhizome	7	4.49%
Flower	4	2.56%
Fruit	8	5.13%
Earthnut	3	1.92%
Bark	2	1.28%
Seed	1	0.64%
Shoot	1	0.64%
Total	156	100%

Iris tectorum (Iridaceae), *L. formosana* (Altingiaceae), *M. henryi* (Meliaceae), *Oenanthe javanica* (Apiaceae), *P. scandens* (Rubiaceae), *P. yunnanensis* (Pinaceae), *Reineckea carnea* (Asparagaceae), *Reynoutria japonica* (Polygonaceae), *S. cuneata* (Lardizabalaceae), *S. venulosa* (Araliaceae), *Sinomenium acutum* (Menispermaceae), *Smilax glabra* (Smilacaceae), *S. indicum* (Solanaceae), *S. delavayi*

(Menispermaceae), *T. sichouense* (Angiospermae), and *U. scandens* (Rubiaceae).

Another important medicinal plant category for the Buyi is trauma and injuries. The surveyed Buyi communities have notable knowledge about the use of medicinal plants for physical trauma and injuries given the nature of farming activities that may cause body injuries and sores. The prevalent medicinal plants reported for used for physical trauma and injuries were *C. holostegius* (Chloranthaceae), *S. glabra* (Smilacaceae), *R. carnea* (Asparagaceae), *Glechoma longituba* (Lamiaceae), *Oxalis corniculata* (*O. corniculata*), *S. cuneata* (Lardizabalaceae), *Alstonia yunnanensis* (Apocynaceae), *Oberonia myosurus* (Orchidaceae), *Bulbophyllum odoratissimum* (Orchidaceae), *Callicarpa bodinieri* (Lamiaceae), *U. scandens* (Rubiaceae), *P. yunnanensis* (Pinaceae), *A. spinulosa* (Cyatheaceae), *Evonymus yunnanensis* (Polyoporaceae), *S. venulosa* (Araliaceae), *Panax notoginseng* (Araliaceae), *S. propinqua* (Schisandraceae), *Z. nitidum* (Rutaceae) and *A. mamillata* (Primulaceae).

The interviews revealed that medicinal plants used for detoxification and inflammation have extensive definitions and usages. Plants used for detoxification and treating inflammation are primarily for reducing inflammation in the liver, gallbladder, lung, kidney, head and nose. Medicinal plants that were reported for treating inflammation linked to liver ailments were *Momordica charantia* (Cucurbitaceae), *Hypericum japonicum* (Cucurbitaceae),

Table 3
Diseases treated with herbal medicinal plants in Luoping County.

Diseases	Number of citation	Percentage (%)
Rheumatism	22	12.4
Trauma and injuries	17	9.6
Liver diseases	15	8.4
Intoxication	10	5.7
Inflammation	9	5.1
Analgesic	8	4.5
Fracture	7	4
Gastric diseases	7	4
Overwork	6	3.3
Nose ailments	6	3.3
Renal ailments	5	2.8
Skin diseases	5	2.8
Intestinal diseases	5	2.8
Respiratory system	5	2.8
Tonic	5	2.8
Hemostatic	5	2.8
Gynecologic diseases	4	2.3
Pediatric diseases	4	2.3
Cholecystic diseases	3	1.7
Parasitic diseases	2	1.1
Mental diseases	2	1.1
Invigoration	2	1.1
Anemia	2	1.1
Snakebite	2	1.1
Tooth ailments	2	1.1
Foot diseases	2	1.1
Freckle ailments	2	1.1
Calculus diseases	1	0.6
Diabetes	1	0.6
Cephalomeningitis	1	0.6
Urethral ailments	1	0.6
Physical weakness	1	0.6
Common cold	1	0.6
Burn	1	0.6
Neoplasm	1	0.6
Dizzy problems	1	0.6
Haemorrhoids	1	0.6
Infertile ailments	1	0.6
Smallpox	1	0.6
Gonorrhoea	1	0.6
Total	177	100

Xanthium sibiricum (Asteraceae), *Eclipta prostrate* (Asteraceae), *B. odoratissimum* (Orchidaceae), *Polygonum multiflorum* (Polygonaceae), *Polygonum cuspidatum* (Polygonaceae), *Verbena officinalis* (Verbenaceae), *U. macrophylla* (Rubiaceae), *Gardenia jasminoides* (Rubiaceae), *Agrimonia pilosa* (Rosaceae), *Sabia parviflora* (Sabiaceae), *Cudrania tricuspidata* (Moraceae), and *Oroxylum indicum* (Bignoniaceae).

Other prevalent medicinal plant uses noted were the fruits of *Tetradium ruticarpum* to treat stomachache, leaf of *Solanum spirale* to treat skin diseases, and the root of *Begonia grandis* subsp. *sinensis* to treat burns. Although only a few species were reported for treatment of gynecological diseases, the informants highlighted that these species are considered very important for women. Four of these important plants used for are gynecological conditions are *Diuranthera major* (Asparagaceae), *Leonurus japonicas* (Lamiaceae), *O. javanica* (Apiaceae), and *Marsdenia tenacissima* (Apocynaceae).

Several medicinal plants used for overall health tonics were cooked with meats, including pork and chicken, which were viewed as improving the medicinal effect. These plants were *Polygonatum kingianum* (Asparagaceae), *Basella rubra* (Basellaceae), *Urtica fissa* (Urticaceae), and *Achyranthes longifolia* (Amaranthaceae).

Plants for treatment pediatric diseases had a low proportion among the total medicinal plants; however, while only several plants are used by the Buyi for medicinal purposes, they were reported as being very important. Pediatric malnutrition and

indigestion are treated in Buyi communities by *G. longituba* (Lamiaceae), *Senecio scandens* (Asteraceae), *Metaplexis japonica* (Apocynaceae), *Portulaca oleracea* (Portulacaceae). *Hedera helix* (Araliaceae) is used for skin-detoxification for newly born infants.

3.4. Poisonous species

As displayed in Table 1, almost one third (28%) of the reported medicinal plants (35/121) are perceived to be toxic. The most common poisonous plant part reported by informants was the whole plant (41.46%), followed by root (12.20%) and seed (12.20%). Other less poisonous plant parts that were reported are the leaf (9.76%), stem (7.32%) and bark (4.88%) (Table 4). Many of medicinal plants used by Buyi were reported to have side effects, highlighting the importance of ethnomedical knowledge of medicinal plant utilization in order to prevent serious harm to the human body.

3.5. Other uses of medicinal plants

In addition to medical uses, 41% of the reported medicinal plants (50) have other uses (Tables 1 and 5). The most prevalent uses of the documented plants other than medicine included ornamental (32%) and edible (30%) purposes, followed by landscape design (16%) and dyeing (10%). The remaining usages include for construction (4%), fencing (2%), and herbal teas (2%).

3.6. Diverse diagnostic methods

The Buyi medicinal system consists of unique diagnostic and treatment methods, particularly for the treatment of fractures, trauma and injuries, rheumatism, gynecological diseases and snakebites. There are some traditional Buyi medicinal prescriptions that have been shown to be effective in modern pharmacological experiments and clinical trials, and some pharmaceutical

Table 4
Poisonous tissue statistics.

Poisonous tissue	Number	Percentage (%)
Whole plant	17	41.46
Root	5	12.20
Seed	5	12.20
Leaf	4	9.76
Stem	3	7.32
Bark	2	4.88
Camphor	1	2.44
Berry	1	2.44
Fruit	1	2.44
Unripe fruit	1	2.44
Seeding	1	2.44
Total	41	100.00

Table 5
Types of multiple uses of medicinal plants used by local people.

Kind of usage	Number of species	Percentage
Ornamental	16	32.00
Edible	15	30.00
Landscape	8	16.00
Dyestuffs	5	10.00
Construction	2	4.00
Cane substitute	1	2.00
Tea	1	2.00
Repellent	1	2.00
Fence	1	2.00
Total	50	100.00

companies have developed these into new drugs or healthcare products, such as “Qing Feng Hu Gan Cha” and “Yi Si Chun Ru Ji”.

The Buyi healers often used fresh and raw plants for their medicines, and they typically do not use complex methods to process the remedies. For example, the fresh leaves of *Toricellia tiliifolia* are usually used to treat fractures. Methods of grinding, pounding, and powdering were most widely used to prepare these remedies in the study area.

This study found that 121 medicinal plant species belonging to 64 families are used by the Buyi to cure seven health conditions considered the most important for treatment (rheumatism, trauma and injuries, detoxifying and inflammation, gynecological disease, weakness, pediatric disease). The disease spectrum found in this study is similar to the Buyi medical culture in Guizhou Province, which can be explained by the following two reasons:

- 1) The Buyi people usually live in mountainous and high humidity areas. Such geographic and climate factors could cause these ailments to become common and to develop into regional diseases.
- 2) The Buyi often have to do onerous labor work including farming to support their livelihoods, which might make them more likely to suffer from injuries. Therefore, the medicinal knowledge for treating diseases such as trauma and injuries could have been gradually accumulated across the generations. For example, *C. holostegius* was commonly recognized by local people for its specific medicinal effect on injuries from falls and fractures.

3.7. Buyi medicinal resources and their multipurposes

The local healers have extensive knowledge on medicinal plants resources. Among the 121 identified species, most of them were collected from the wild habitats. Different plant parts are used to treat various diseases (Table 2).

Only a few medicinal plants were brought from neighboring regions. For example, *Eucommia ulmoides* was purchased from Qianxinan Prefecture in Guizhou Province. We ascribe this situation to the following factors:

- 1) Like the natural conditions of many other Buyi villages, the Buyi villages in Luoping County are located in an area with a well-preserved natural habitat, good ecological environment, and rich biodiversity, which may provide a favorable foundation for medicinal plant resources for the local folk doctors.
- 2) The Buyi are one of the indigenous groups in southwest China. They gradually formed their epistemologies, such as the value of harmonious relationship with nature during a long process of production and practice. In the belief-system of Buyi people, they usually have pantheistical adorations, such as habitats (e.g. sacred mountains), plants (e.g. divine arbors, bamboo) animals or mythological creatures (e.g. fish, dragon), and natural elements (e.g. fire). All of these ideas played a positive role in environmental protection and sustained the Buyi ethnic culture over time.

Most local names of medicinal plants are in local Buyi pronunciation. But the pronouncement of 13 species is the same as mandarin Chinese, including *Acorus calamus* (Changpu), *Carthamus tinctorius* (Honghua), *Chloranthus holostegius* (Sikuaiwa), *Dendrobium loddigesii* (Huangcao), *Eriobotrya japonica* (Pipa), *Gentiana rigescens* (Longdan), *H. japonicum* (Tianjihuang), *Lonicera japonica* (Jinyinhua), *O. corniculata* (Suanjiangcao), *P. notoginseng* (Sanqi), *Plantago major* (Cheqian), *Prunella vulgaris* (Xiakucao) and

Z. nitidum (Liang mian zhen). In fact, these 13 medicinal species are normally used as traditional Chinese medicine and widely used in many prescriptions. Since Buyi people are living alongside other linguistic groups, some local healers' traditional medicinal technologies might be influenced by traditional Chinese medicine and by other ethnic groups. Therefore, local Buyi pronunciation of some medicines are same as mandarin Chinese.

Multipurpose plants play an important role in the diversity of plant utilization and can be used as an indicator of regional bio-cultural diversity. Two-use plants were most common among multipurpose plants, with ornamental-medicinal plants being the most popular among two-use plants. Some plants have three uses, such as *Cycas revoluta*, *G. jasminoides* and *Foeniculum vulgare*. The multipurpose value of a plant is essentially determined by the plant itself. Trees tend to have more uses than herbaceous plants. Multipurpose plants studies contribute to the standard recording of regional or ethnic traditional ecological knowledge, the identification of plant uses with their potential applications, and the promotion of regional natural cultural diversity protection.

4. Discussion

4.1. The characteristics of Buyi medicinal plants in eastern Yunnan

Among the 64 botanical families documented in this study, the Compositae was the most prevalent family with 10 species. Medicinal plants in the Compositae have previously been shown to be commonly used by Buyi communities as well as easily obtained in their rural surroundings (Wu et al., 2017). As one of the largest families of seed plants over the world, the Compositae plants are easily available in local communities. The biomass and population sizes of Compositae plants are usually very large.

Specific edible uses of medicinal plants were as a vegetable, fruit, seasoning and starch (Sui et al., 2011). The local people used *Smilax china* as fence, and they hung *A. calamus* and *Artemisia argyi* on the door for cultural purposes and traditional way during Dragon Boat Festival (Shu et al., 2018). *Houttuynia cordata* and *P. oleracea* have been used both as vegetable and medicine by local people for a long time (Ye et al., 2015). Finally, medicinal dietary ferns were frequently used by Buyi people, such as they used ferns to treat influenza (Teng et al., 2016; Ye et al., 2016).

Previous research has highlighted how Buyi healers use multiple traditional methods to treat diseases including pocket (Doudu) therapy, moxibustion (Jiukao) therapy, curettage (Guazhi) therapy, light therapy (Dadenghuo) therapy, and egg rolling (Gundan) therapy (Pan et al., 2003; Xiong and Long, 2018) (Table 6). The abundant medicinal plants in Buyi region provide resources for healer's multiple traditional methods to treat diseases.

4.2. Conservation issues

Some medicinal plants used by the local people had not been found in our field surveys in Luoping County. Furthermore, the new medicinal plants and remedies we have documented imply the medicinal knowledge in Buyi marginal regions in Yunnan Province may serve to supplement the whole Buyi medicinal system, which should be protected and maintained.

Nevertheless, our investigation indicated that the traditional medicinal knowledge and methods in Luoping County are facing a danger of extinction. After extensive interviews with the local healers, we summarized the following main reasons for this situation.

Firstly, the young generation has little interest or is not willing to work hard to study traditional medicinal knowledge. Most of them have left their hometowns to earn money in big cities such as

Table 6
Traditional therapies used by the local healers.

Therapy type	Chinese name	Specific process	Diseases treated
Pocket therapy (Doudu)	兜肚 疗法	Put medicines into a special sewing bag (Chinese name Doudu). Put it on the abdomen, so achieve the purpose of treatment through the pores of the skin to absorb drug smell. Usually used <i>Zingiber officinale</i> and <i>Tetradium ruticarpum</i> .	Gynecologic diseases, stomachache
Moxibustion therapy (Jiukao)	灸烤 疗法	Dry leaves of <i>Artemisia argyi</i> and porphyzation, make moxa cone. Fire moxa cone, barbecue affected part.	Rheumatism
Curettage therapy (Guazhi)	刮治法	Use the edge of coppers, coins or bowls to dip in tung oil or canola oil, light scrapping skin, appear red mark.	Clearing heat, intestine disease, common cold
Light therapy (Dadenghuo)	打灯火 疗法	Use the stem of <i>Juncus effuses</i> to dip in tung oil or canola oil, heat affected part and leave quickly.	Pediatric diseases
Egg rolling therapy (Gundan)	滚蛋 疗法	Use cooked hot egg with eggshell to roll back and forth on the patients' stomach when the temperature of egg is moderate.	Common cold, intestine disease
Tangerine therapy (Gunju)	滚橘 疗法	Use orange or smaller grapefruit roasted on the stove or fire hot, and then roll around the patients' forehead when their temperature is moderate.	Common cold, clearing heat
Canister therapy (Tongxun)	筒薰 疗法	Decoct medicine into soup, and then pour the soup into bamboo tube when it is hot, use a wet towel to cover on the mouth of bamboo tube, post on the affected part, and let the heat washed up from the mouth of bamboo tube until the soup is cold.	Oral disease, intestine disease

Beijing, Guangzhou, and Kunming. For instance, an experienced herbal doctor who passed away in 2004 once asked his children to study their traditional medicinal knowledge. However, his children refused because she thought there is no value in studying this knowledge. Consequently, his precious medicinal experiences and knowledge have, unfortunately, faded way.

What makes a medicinal culture endangered is not just the number of users, but also how old the users are. If it is used by teens it is relatively safe. The critically endangered cultural systems are those that are only used by the elderly. Why do people reject the medicinal culture from their ancestors? When the next generation reaches their teens, they might not want to enter into the old tradition. The change is not always voluntary; the deadliest weapon's is often not government policy but economic globalization (Yang et al., 2015).

Secondly, the influences of mainstream medicinal culture are also causing reduced popularity of traditional medicinal knowledge. Compared with indigenous medicinal therapies, modern medical care often has advantages of fast recovery periods, precise curative effects, and other conveniences, so it has become a first choice of the local people. Only when some diseases cannot be cured by modern medicinal treatments, the local people will turn to the traditional medicine.

A growing interest in cultural identity may prevent the direst predications from coming true. The ethnic groups have not lost pride in their traditional remedies, but they have to adapt to higher social-economic pressures. They usually cannot refuse to use the modern medicine if they move to an urban area. When an unwritten and unrecorded traditional knowledge disappears, it is lost to science forever.

Thirdly, the inheritance and further development of the local Buyi medicinal culture is limited by some traditional conceptions such as limiting knowledge only to the men in the family. Women

are not allowed to study traditional medicinal knowledge, or to use medicinal plants.

The present study revealed the richness of medicinal plants and importance of traditional medicinal knowledge among the Buyi communities in Luoping County. We understand the urgency and difficulties to save the endangered traditional knowledge. Further surveys are necessary to identify priority of traditional knowledge for better conservation. Intensive studies including phytochemical and pharmacological investigations will help to confirm the functions and dynamics of important Buyi herbal medicines such as *S. parviflora* and its crude products (Sui et al., 2011). The results from these efforts together supporting from current positive policies will be able to attract interests from stakeholders including local healers and their potential successors, publics, investors, enthusiasts, and institutions. Thus the endangered traditional Buyi medicinal knowledge will possibly be conserved throughout documentation, inheritance and sustainable uses.

In all 121 plant species documented in this study, 2 species (*C. revoluta* and *Tacca chantrieri*) are listed in China Red Data Book while 3 orchids (*D. loddigesii*, *Oberonia cavaleriei* and *B. odoratissimum*) will be listed. These species were used in a small amount, but they should be informed through various approaches such as new media, in particular, the most popular social media in China named WeChat. The alternatives to these species may be recommended since a lot of medicinal plants occur in Luoping County.

We anticipate that the traditional medicinal knowledge of the Buyi people in the marginal regions such as Yunnan should be emphasized, since it is an indispensable part of the whole Buyi medicinal culture. The remaining Buyi communities should be intensively investigated in order to build a comprehensive perspective on the Buyi medicinal knowledge system. Furthermore, local government policy support would be essential to ensure that

the whole of Buyi medicinal culture is continuous development in a sustainable way (Yang et al., 2015).

5. Conclusion

Medicinal plants used by the Buyi people in Luoping are very diverse. One hundred and twenty-one species in 54 families were documented for treating various ailments based on our ethnobotanical surveys in only four villages, in which 56 species were recorded for the first time in this study. Leaves and whole plants were commonly used by the Buyi healers in the form of decoction. The Buyi communities have abundant medicinal resources and traditional knowledge. However along with the development of global economy, the specialized knowledge of Buyi medicine resources are threatened by human activities and natural causes, and associated traditional knowledge is eroding rapidly. So it is thus urgent and necessary to prevent the further loss of the specialized knowledge of ethnic group. This is the best accomplished by recording and documenting their unique practice and their relationship to medicinal plants.

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Authors' contributions

CL conceived of and designed the study. YX and XS conducted data collection, integrated the inventory and its analysis, and wrote the manuscript. CL, ZW, YX and XS identified the plants. SA supported with preparation of the manuscript.

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Declaration of competing interest

The authors declare that they have no competing interests.

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