

RESEARCH

Open Access



# Ethnobotany study on wild edible plants used by the Tujia ethnic group in Laifeng, southwest Hubei, China

Shuwang Hou<sup>1</sup>, Peiqing Huang<sup>1</sup> and Zhen Yao<sup>1\*</sup>

## Abstract

**Background** Wild edible plants hold a significant position in the lives of local residents, serving as a primary food source or supplement. Laifeng County, located in the hinterland of the central mountainous area of China, boasts abundant wild edible plant resources. The Tujia people, residing here for generations, have accumulated a wealth of traditional knowledge in the long-term practice of utilizing wild edible plants. The aim of this study is to document and organize the traditional utilization of wild edible plants by the Tujia ethnic group in Laifeng.

**Methods** An ethnobotanical investigation, comprising semi-structured interviews, key informant interviews, and participatory observations, was conducted in 26 traditional villages in Laifeng County from May 2023 to June 2024. A total of 252 informants were interviewed, from whom information about wild edible plants, including edible parts, food categories, consumption modes, and multiple uses was collected. The relative frequency of citation (RFC) and the cultural food significance index (CFSI) were calculated to identify the cultural importance of wild edible plants.

**Results** A total of 163 species of wild edible plants consumed by the Tujia people in Laifeng, belonging to 64 families and 118 genera and related traditional knowledge were collected, including vegetables (78), fruits (52), wine-soaking plants (12), spices (11), food substitutes (9), tea substitutes (6), nuts (5), coagulants (2), and oil (1). The most frequently used families were *Rosaceae*, *Asteraceae*, and *Poaceae*, with 23, 10, and 10 species, respectively. The most commonly utilized plant parts were fruits, leaves, and stems. RFC and CFSI analyses identified 14 species of wild edible plants with high cultural importance in the local diet, such as *Allium macrostemon*, *Houttuynia cordata*, and *Hovenia acerba*.

**Conclusions** The Tujia ethnic group in Laifeng demonstrates extensive knowledge in their traditional usage of wild edible plants, offering unique and robust insights into the harvesting, processing, and consumption of these resources. Over time, this practice has become an integral part of the local food culture. These findings contribute to the preservation of the Tujia culture of wild edible plants in Laifeng and the conservation and development of wild edible plant resources.

**Keywords** Wild edible plants, Tujia ethnic group, Laifeng, Ethnobotany, Traditional knowledge

## Introduction

Wild edible plants (WEPs), which are non-artificially cultivated and domesticated, and can be harvested from their indigenous habitats, serve as food sources [1, 2]. WEPs can serve as either the primary food source or a dietary supplement for local residents, thereby ensuring their sustenance security and balanced diet, as well

\*Correspondence:

Zhen Yao  
cjdxyaozhen@aliyun.com

<sup>1</sup> College of Horticulture and Gardening, Yangtze University, Jingzhou 434025, China



as functioning as a primary economic resource or supplement through their processing and commercialization [3–5]. Furthermore, WEPs could provide invaluable genetic reservoirs for the cultivation of novel crops and the identification of new germplasm [6, 7]. The practice of harvesting and consuming WEPs not only meets local dietary demands as a crucial element of a global sustenance strategy, but also aids in the preservation of local cultural traditions [8, 9].

In regard to WEPs, international research primarily focuses on countries and regions in Asia, Africa, and Europe [10–12]. Ethnobotanical surveys of WEPs in China have been undertaken among the Han [13], Tibetan [14, 15], Dulong [16], Yi [17], Naxi [18], Mongolian [19], and Gelao [20] ethnic groups. These studies both document the traditional knowledge of local consumption of wild plants and evaluate the importance and value of these WEPs in local culture using quantitative methods. Moreover, advanced modern food science and technology have been utilized in studying the nutritional composition of WEPs, establishing a new research direction in the ethnobotany of WEPs [21, 22].

The Tujia ethnic group, descendants of the ancient Ba people, boasts a rich history and profound cultural heritage, primarily distributed in the border areas of central southern and southwestern China [23, 24]. Through enduring production, lifestyle, and social practices, the Tujia people have accumulated extensive traditional knowledge and experience in consuming WEPs. At present, research on the Tujia ethnic group mainly focuses on anthropology, sociology, language, art, architecture, and other aspects, and has conducted detailed studies on the Tujia ethnic group from various perspectives [25]. However, scant research has been conducted that integrates the relationship between Tujia culture and local environment and plant resources. The Tujia people, having resided in the Wuling Mountains for generations, have long adapted to the mountainous environment, thereby forming a comprehensive set of traditional knowledge and agricultural practices associated with the utilization of wild edible plant resources. Therefore, it is necessary to study the Tujia ethnic group from the perspective of the mutual relationship between humans and plants [26].

Since its inception, ethnobotany has concentrated on the traditional knowledge and culture aspects of human botany, including their applications, to investigate the interrelationships between humans and plants [5, 27]. Nonetheless, contemporary research on the ethnobotany of the Tujia ethnic group largely centers on medicinal plants in western Hunan [28, 29] and southeastern Chongqing [30], with the majority of these studies honing in on the traditional knowledge of a specific type of

plant, such as *Akebia* sp. [31] and *Gesneriaceae* [32]. Few reports exist on the knowledge of WEPs traditionally utilized by the Tujia ethnic group. Only Wu provided an overview of the edible plants and cultural connotations of the Tujia ethnic group in the central China mountainous area [33]. There remains a pressing need to collate and examine extensive knowledge on the traditional utilization of Tujia plants.

Situated in the Enshi Tujia and Miao Autonomous Prefecture in southwestern Hubei Province, Laifeng County boasts a rich history. The original Sanmao Xuanfusi was founded here, making it as one of the earliest tusi (local hereditary tribal chieftains) settlements in the Tujia ethnic region. Laifeng County represents a typical settlement area for the Tujia ethnic group in the southwestern region of Hubei Province. As of the end of 2022, the Tujia ethnic group constitutes the most populous ethnic minority in Laifeng County. The extensive history of county development, distinctive geographical location, varied climate, rich natural resources, and self-sustained ethnic economy of Laifeng have fostered a unique Tujia ethnic culture, cultivating an array of exceptional traditional knowledge on WEPs utilization.

Given this context, the present study adopts ethnobotanical methods to conduct a systematic investigation of the WEPs traditionally utilized by the Tujia ethnic group in Laifeng, employing quantitative methods to identify and assess plants of high cultural significance. The significance of this study is multifold: (1) It aims to safeguard and perpetuate the traditional ecological knowledge of WEPs utilized by the Tujia ethnic group in Laifeng while striving to record and conserve as much traditional ecological knowledge and related technology as possible. (2) It seeks to examine the relationship between the traditional culture of the Tujia ethnic group in Laifeng and wild edible plant resources, explore WEPs with local Tujia characteristics, conserve and protect wild edible genetic resources, and offer firsthand data for the development of nascent edible plant resources. (3) It promotes the inheritance and further development of the high-quality traditional culture related to biodiversity of the Tujia ethnic group in Laifeng, thereby serving as a foundation for rural revitalization, biodiversity conservation, ecological civilization construction, and sustainable development.

## Methods

### Study sites

Laifeng County (29°06′–29°41′ N, 109°01′–109°27′ E) is under the jurisdiction of Enshi Tujia and Miao Autonomous Prefecture in Hubei Province. Situated in the southwest corner of Hubei, it borders Longshan in Hunan to the southeast, Youyang in Chongqing to the southwest,

and Xianfeng and Xuan'en to the north. Positioned at the junction of Hubei, Hunan, and Chongqing, and is known as "crossing three provinces with one foot" [34]. Laifeng County governs 8 townships, including Xiangfeng Town, Lushui Town, Dahe Town, Baifusi Town, Jiusi Town, Gelche Town, Manshui Township, and Sanhu Township, with 184 villages and 12 communities.

The climate of Laifeng County is characterized as a subtropical continental monsoon humid mountainous climate, with distinct four seasons, mild and humid conditions, ample rainfall, and simultaneous rain and heat. Furthermore, influenced by non-zonal factors such as topography and terrain, it exhibits a three-dimensional climate characteristic of diverse environments and significant vertical differences. The annual sunshine hours in Laifeng County are 4425.8 h, with an average annual temperature of 15.9 °C and an average annual precipitation of 1400 mm [35]. The superior climate and fertile soil conditions have created abundant and diverse biological resources in Laifeng County. Laifeng County has 706 species of high and low plants in 109 families, and 130 species of wild animal resources [36]. There are over a hundred unique resources in the county, and it is a favorable place for producing agricultural and specialty products as well as authentic Chinese medicinal herbs such as *Zingiber officinale*, *Vernicia fordii*, *Morella rubra*, and *Atractylodes macrocephala*.

Taking Laifeng County as the research area, an ethnobotanical survey was carried out in villages with rich plant diversity and well-preserved traditional Tujia

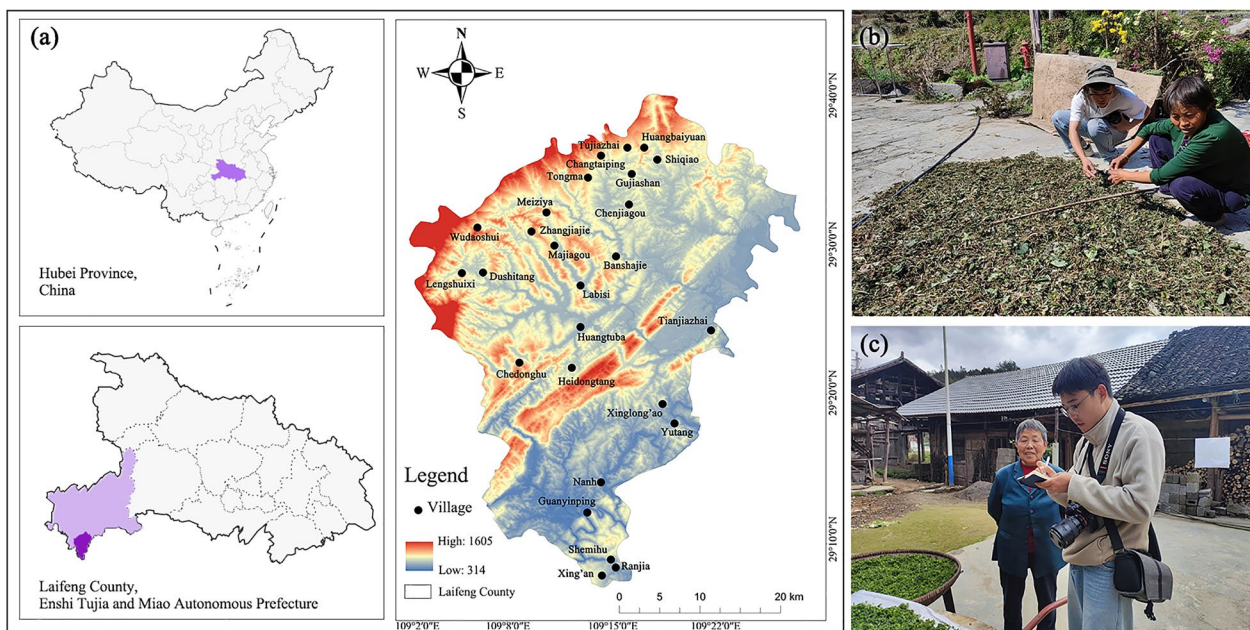
culture. Referring to the first to sixth batches of Chinese traditional villages, the first to third batches of Chinese ethnic minority characteristic villages, and the first to second batches of Chinese national forest villages, a total of 26 villages were identified as study sites (Fig. 1).

**Literature research**

Before conducting ethnobotany surveys, consult literature materials (*Flora of China*, *Flora of Hubei*, *Flora of Enshi*, *A Brief History of the Tujia Ethnic Group*), and use websites such as China National Knowledge Infrastructure and Web of Science to search for domestic and foreign research papers using keywords such as Tujia, Tujia research progress, Tujia ethnobotany, Tujia, Tujia ethnic group, and Tujia Ethnobotany. Understand the wild plant resources and related research progress of the Tujia ethnic group in Laifeng through literature research.

**Field survey and data collection**

Ethnobotanical surveys were conducted in 26 selected villages from May 2023 to June 2024. Key informant interviews, semi-structured interviews, and participatory observation methods were used for the survey, while simple random sampling, snowball random sampling, and other methods were utilized to select information reporters in villages [37]. A total of 252 interviewees reported information, including 125 males and 127 females. The age range of the interviewees spans from 8 to 98 years old, with the majority aged between 40 and 79 years old. Mostly, the interviewees were uneducated, elderly,



**Fig. 1** Study site. **a** Location of study sites; **b** participatory observation; **c** semi-structured interviews

and economically disadvantaged individuals. The identity of the information reporter includes farmers, salary workers, and retailers, with the majority being farmers (Table 1). During the interviews, primary inquiries and records included local names, availability, edible parts, frequency of use, consumption modes, taste, medicine use, collection months, and multiple uses of WEPs [38, 39].

We collected voucher specimens and took digital photos of the plants involved in the investigation, and labeled the specimens. In order to identify plants, the voucher specimens were studied and compared with reference books (*Flora of China*, *Flora of Hubei*, *Flora of Enshi*) and electronic online resources (<http://www.iplant.cn/>, <https://www.worldfloraonline.org/>, and <http://www.sp2000.org.cn/>). All vascular plants are named according to World Flora Online (<https://www.worldfloraonline.org/>), and Shuwang Hou has identified all plant species. The voucher specimens are stored at the herbarium of the College of Horticulture and Gardening, Yangtze University, in Jingzhou, Hubei Province.

#### Quantitative ethnobotanical research

Evaluate the importance of WEPs in the Tujia culture of Laifeng using the relative frequency of citation (RFC) and cultural food significance index (CFSI).

#### Relative frequency of citation (RFC)

Relative frequency of citation refers to the proportion of people mentioning a species (also known as frequency of citation, FC) to the total number of reported pieces of information, regardless of its usage type [16, 40].

$$\text{RFC} = \frac{\text{FC}_s}{N}$$

$N$  is the total number of information reporters.

The value of RFC ranges from 0 to 1. The larger the index value, the higher the frequency and importance of mention of this species in the Tujia ethnic group in Laifeng.

#### Cultural food significance index (CFSI)

The cultural food significance index (CFSI) is used to evaluate the importance of WEPs in Laifeng Tujia culture [41, 42].

$$\text{CFSI} = \text{QI} \times \text{AI} \times \text{FUI} \times \text{PUI} \\ \times \text{MFFI} \times \text{TSAI} \times \text{FMRI} \times 10^{-2}$$

QI is the quotation frequency index, AI is the availability index, FUI is the frequency of utilization index, PUI is the parts used index, MFFI is the multifunctional food

use index, TSAI is the taste score appreciation index, and FMRI is the food-medicinal role index.

The larger the CFSI value, the more important the role this plant plays in the diet culture of the Tujia ethnic group in Laifeng.

#### Jaccard index (JI)

The Jaccard index (JI) is used to evaluate the similarity between the WEPs of the Tujia ethnic group in Laifeng and other different ethnic groups and areas [43, 44].

$$\text{JI} = \frac{c}{a + b - c}$$

$a$  is the species number of WEPs of Tujia ethnic group in Laifeng,  $b$  is species number of WEPs of other area, and  $c$  is the number of species common to both areas  $a$  and  $b$ .

## Results

### Diversity of wild edible plants

The variety of WEPs traditionally used by the Tujia ethnic group in Laifeng is abundant and diverse. Through extensive investigation and categorization, 163 different wild edible plants belonging to 64 families and 118 genera have been identified. Botanical and ethnobotanical information including family names, scientific names, Chinese names, habits, food categories, edible parts, consumption mode, collection months, multiple uses, FC, RFC, and CFSI is listed in Table 2. These WEPs comprise three groups: ferns (4 families and 4 species), gymnosperms (1 family and 1 species), and angiosperms (59 families and 158 species), with the angiosperms being the most plentiful. The families containing the most WEPs are *Rosaceae* (23), *Poaceae* (10), *Asteraceae* (10), *Amaranthaceae* (7), and *Lamiaceae* (7), accounting for 35.0% of the total number of species (Fig. 2a).

Categorized by their habits, the WEPs traditionally utilized by the Tujia ethnic group in Laifeng predominantly consist of herbs (69), comprising for 42.3% of the total. This is followed by shrubs (40, 24.5%), trees (24, 14.7%), and lianas (21, 12.9%). Bamboo plants are less common, with a total of 9 species (Fig. 2b). Due to their ease of harvesting, diverse variety, and broad distribution, herb plants are more frequently consumed than other habits.

The WEPs have also been categorized by their edible parts, yielding 16 categories including fruits, leaves, stems, aboveground parts, flowers, roots, seeds, rhizomes, the whole plant, etc. Fruits (68, 41.7%) are the most commonly consumed edible parts, followed by leaves (40, 24.5%) and stems (34, 20.9%) (Fig. 2c).

While the collection months may vary for different categories of WEPs, they are generally concentrated

**Table 1** Study site locations and demographic characteristics of respondents

Township	Village	Population	Gender		Age					Education level				Occupation			Location		Altitude (m)
			Male	Female	≤19	20-39	40-59	60-79	≥80	Illiterate	Primary school	Middle school	High school and above	Farmer	Retailer	Salary worker	Latitude (North)	Longitude (East)	
Baifusi	Ganyinping	-	1	7	0	0	4	4	0	3	3	1	1	5	2	1	29°12'1.50"	109°13'32.81"	373
	Nanhe	1041	6	4	0	0	4	5	1	4	4	1	1	7	2	1	29°13'53.75"	109°14'49.21"	387
	Ranjia	692	5	3	0	1	1	6	0	5	2	0	1	7	0	1	29°9'17.54"	109°15'28.86"	671
	Shemihu	636	5	5	0	0	3	5	2	5	3	0	2	8	0	2	29°9'37.35"	109°15'10.66"	630
	Xing'an	1125	5	5	0	0	2	6	2	5	3	1	1	9	0	1	29°7'44.68"	109°14'33.99"	584
	Chedonghu	1004	6	4	0	2	3	4	1	5	1	2	2	8	1	1	29°21'54.84"	109°9'2.81"	818
	Dushitang	1486	3	8	0	0	3	6	2	6	2	3	0	9	1	1	29°27'27.36"	109°7'1.29"	561
	Lengshuixi	919	5	7	0	2	3	4	3	7	3	0	2	10	1	1	29°27'23.39"	109°5'49.45"	606
	Wudoshui	715	6	4	0	0	4	6	0	5	2	2	1	8	1	1	29°31'18.77"	109°6'40.65"	726
	Zhangjiejie	947	2	7	0	1	1	4	3	6	1	0	2	6	2	1	29°30'47.46"	109°9'47.90"	782
Geleche	Chenjiagou	650	5	6	0	0	2	9	0	3	5	1	2	8	2	1	29°32'29.19"	109°16'25.45"	568
	Gujiaoshan	1623	6	3	0	0	3	5	1	4	4	0	1	8	0	1	29°34'37.90"	109°16'32.50"	645
	Tongma	1905	4	6	0	1	3	5	1	4	3	1	2	7	2	1	29°34'9.38"	109°13'31.05"	815
	Tujiazhai	1590	4	5	0	1	2	5	1	3	3	2	1	8	0	1	29°36'22.35"	109°16'24.55"	753
	Changtaiping	1241	8	1	0	0	2	6	1	4	3	1	1	7	1	1	29°35'35.92"	109°14'23.77"	818
	Banshajie	-	6	4	0	0	2	5	3	6	2	0	2	9	0	1	29°29'6.27"	109°15'22.96"	620
	Heidongtang	2225	6	4	0	0	4	5	1	5	3	1	1	6	2	2	29°21'51.21"	109°13'32.01"	652
	Huangtuba	1940	4	7	0	0	1	10	0	5	4	1	1	10	0	1	29°24'12.49"	109°13'10.31"	513
	Labisi	1854	4	4	0	1	1	6	0	5	2	1	0	7	0	1	29°27'7.74"	109°13'24.79"	531
	Majiagou	1128	4	4	0	0	0	8	0	4	1	2	1	6	1	1	29°29'37.66"	109°11'46.72"	563
Lvshui	Meiziya	714	7	2	0	0	4	5	0	5	1	1	2	8	0	1	29°32'8.74"	109°10'53.08"	776
	Tianjiazhai	1671	5	6	0	0	1	8	1	6	1	3	1	6	4	1	29°23'52.27"	109°21'43.04"	521
	Xinglong'ao	2594	5	4	0	0	4	2	1	3	2	3	1	6	1	2	29°19'41.67"	109°18'32.80"	587
	Yutang	2447	5	7	1	0	4	6	1	6	5	0	1	10	1	1	29°17'55.43"	109°19'32.95"	510
	Huangbaiyuan	1671	5	3	0	0	2	6	0	2	2	2	2	6	1	1	29°36'16.16"	109°17'25.96"	708
	Shiqiao	1318	3	7	0	0	3	6	1	6	3	0	1	8	1	1	29°35'29.00"	109°18'18.37"	569

**Table 2** Inventory of wild edible plants used by the Tujia ethnic group in Laifeng

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Diplazium esculentum</i> (Retz.) Sw	菜蕨	Athyriaceae	Sui jue	Herb	V	Tender leaf; stir-fried or boiled	3–6			Wild	16	0.063	2.25	LFE40122
<i>Peridium revolutum</i> (Blume) Nakai	毛轴蕨	Dennstaedtiaceae	Tian jue	Herb	V, Fs	Tender leaf; stir-fried or boiled Rhizome; make flour	2–6			Wild	200	0.794	519.75	LFE40008
<i>Scepteridium ternatum</i> (Thunb.) Lyon	阴地蕨	Ophioglossaceae	Du jio ji	Herb	V	Whole plant; stew with meat	1–12	Medicine, tonic	Yes	Wild	21	0.083	37.8	LFE40156
<i>Osmunda japonica</i> Thunb	紫萁	Osmundaceae	Mao mao jue	Herb	V	Tender leaf; stir-fried or boiled	3–4	Medicine		Wild	67	0.266	56.53	LFE40124
<i>Taxus wallichiana</i> var. <i>mairei</i> (Lemée and H. Lévl.) L.K.Fu and Nan Li	南方红豆杉	Taxaceae	Hong fei	Tree	F, Ws	Fruit; eaten raw or soaking in wine	10–11	Ornamental, medicine, firewood		Wild, cultivated	39	0.155	157.95	LFE30067
<i>Acorus gramineus</i> Alton	茴香菖蒲	Acoraceae	San nai	Herb	S	Leaf; spices	1–12			Wild, cultivated	16	0.063	17.28	LFE40167
<i>Actinidia callosa</i> var. <i>henryi</i> Maxim	京梨猕猴桃	Actinidiaceae	Ma nai nai	Liana	F, Ws	Fruit; eaten raw or soaking in wine	8–10			Wild	39	0.155	14.26	LFE30021
<i>Actinidia chinensis</i> Planch	中华猕猴桃	Actinidiaceae	Yang tao	Liana	F, Ws	Fruit; eaten raw or soaking in wine	8–10			Wild, cultivated	139	0.552	78.19	LFE40089
<i>Achyranthes aspera</i> L.	土牛膝	Amaranthaceae	Niu ke xi	Herb	V	Root; stew with meat	1–12	Roots and stems used as medicine to strengthen the muscles and bones	Yes	Wild	3	0.012	7.43	LFE40313
<i>Achyranthes bidentata</i> Blume	牛膝	Amaranthaceae	Niu ke xi	Herb	V	Root; stew with meat	1–12	Roots and stems used as medicine to strengthen the muscles and bones	Yes	Wild	5	0.020	12.38	LFE40159

**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Achyranthes longifolia</i> Makino	柳叶牛膝	Amaranthaceae	Hong niu ke xi	Herb	V	Root; stew with meat	1–12	Roots and stems used as medicine to strengthen the muscles and bones	Yes	Wild, cultivated	10	0.040	16.5	LFE40359
<i>Alternanthera philoxeroides</i> (Mart.) Griseb	喜旱莲 子草	Amaranthaceae	Kong tong cao	Herb	V	Tender stem and leaf; stir-fried or boiled	3–4	Fodder		Wild	1	0.004	0.48	LFE30102
<i>Amaranthus retroflexus</i> L.	反枝苋	Amaranthaceae	Tu han cai	Herb	V	Aboveground; stir-fried	5–7	Fodder		Wild	37	0.147	24.42	LFE40330
<i>Celosia argentea</i> L.	青葙	Amaranthaceae	Ji gong han	Herb	V	Tender stem and leaf; stir-fried or boiled	3–5	Fodder		Wild	9	0.036	1.8	LFE30103
<i>Chenopodium album</i> L.	藜	Amaranthaceae	Hui hui cai	Herb	V	Tender stem and leaf; stir-fried	4–5	Fodder		Wild	1	0.004	0.22	LFE40041
<i>Allium macrostemon</i> Bunge	薤白	Amaryllidaceae	Ye cong	Herb	V, S	Whole plant; spicisor pickle	1–4, 9–12	Medicine		Wild	204	0.810	6120	LFE30014
<i>Choerospondias axillaris</i> (Roxb.) B.L.Burtt and A.W.Hill	南酸枣	Anacardiaceae	Suan zao	Tree	F	Fruit; eaten raw	8–10			Wild	20	0.079	2.44	LFE30028
<i>Cryptotaenia japonica</i> Hassk	鸭儿芹	Apiaceae	Ya jio ban	Herb	V	Tender stem and leaf; stir-fried or boiled	3–5	Fodder		Wild, cultivated	104	0.413	589.68	LFE30088
<i>Oenanthe javanica</i> DC	水芹	Apiaceae	Ye qin cai	Herb	V	Tender stem and leaf; stir-fried	3–4	Fodder		Wild, cultivated	110	0.437	308	LFE40032
<i>Amorphophallus konjac</i> K. Koch	魔芋	Araceae	Mo yu	Herb	Fs	Tuber; make flour	10–11			Wild, cultivated	41	0.163	55.35	LFE30002
<i>Aralia echinocalydis</i> Hand.-Mazz	棘茎楸木	Araliaceae	Hong ci luo bu	Tree	V	Tender stem and leaf; stir-fried or cold and dressed with sauce	3–4	Roots used as medicine for rheumatism and traumatic injury		Wild	59	0.234	115.05	LFE40042

**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Aralia elata</i> (Miq.) Seem	糙木	Araliaceae	Ci luo bu	Tree	V	Tender stem and leaf; stir-fried or cold and dressed with sauce	3–4			Wild	99	0.393	111.38	LFE40212
<i>Eleutherococcus nodiflorus</i> (Dunn) S.X.Hu	细柱五加	Araliaceae	Wu jia pi	Shrub	V	Tender stem and leaf; stir-fried or make soup	3–4	Root barks used as medicine for traumatic injury	Yes	Wild, cultivated	13	0.052	29.25	LFE40091
<i>Heptapleurum delavayi</i> Franch	穗序鹤掌柴	Araliaceae	Dou chi ye	Tree	S	Leaf; placed under the black bean sauce to enhance the fragrance	1–12			Wild	7	0.028	6.3	LFE30056
<i>Hydrocotyle nepalensis</i> Hook	红马蹄草	Araliaceae	Yu dian cao	Herb	V	Aboveground; stir-fried	3–5	Whole plants used as medicine to improve eyesight	Yes	Wild	1	0.004	1.76	LFE40076
<i>Hydrocotyle sibthorpioides</i> Lam	天胡荽	Araliaceae	Yu dian cao	Herb	V	Aboveground; stir-fried	3–5	Whole plants used as medicine to improve eyesight	Yes	Wild	13	0.052	22.88	LFE40084
<i>Trachycarpus fortunei</i> (Hook.) H.Wendl	棕榈	Arecaceae	Zong su	Tree	V	Flower; stir-fried or boiled	3–4	Barks and leaves used as rope		Wild	1	0.004	0.09	LFE30033
<i>Diurandera major</i> Hemsl	鸚鹵草	Asparagaceae	Xu sen	Herb	V	Root; stew with meat	1–12	Ornamental; medicine	Yes	Wild, cultivated	10	0.040	19.5	LFE40017
<i>Ophiopogon japonicus</i> (Thunb.) Ker Gawl	麦冬	Asparagaceae	Luo zi zi	Herb	V	Root tuber; stew with meat	4–10	Root tubers used as medicine to moistening lung cough	Yes	Wild	3	0.012	2.97	LFE40013
<i>Polygonatum sibiricum</i> Red-oute	黄精	Asparagaceae	Huang jing	Herb	V	Rhizome; grilled or soaking in wine or stew with meat	1–12	Medicine	Yes	Wild, cultivated	27	0.107	105.3	LFE30066



**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Hemerocallis fulva</i> (L.) L.	萱草	Asphodelaceae	Ye huang hua cai	Herb	V	Tender stem and leaf; flower; stir-fried	3–7	Ornamental		Wild	21	0.083	13.65	LFE40336
<i>Artemisia lancea</i> Vaniot	矮蒿	Asteraceae	Ku hao	Herb	V	Tender stem and leaf; mix with glutinous rice to steam	2–4	Stems and leaves used as medicine for knife wound		Wild	192	0.762	414.72	LFE40006
<i>Artemisia indica</i> Willd	五月艾	Asteraceae	Bai hao	Herb	V	Tender stem and leaf; pound and mix glutinous rice flour to make glutinous rice cakes	3–5	Hanging on the doors on the Dragon Boat Festival to ward off evil spirits		Wild	180	0.714	777.6	LFE30042
<i>Aster indicus</i> L.	马兰	Asteraceae	Ni qiu quan	Herb	V	Tender stem and leaf; stir-fried or cold and dressed with sauce or make soup	3–4	Whole plants used as medicine for cold and upset stomach		Wild	4	0.016	3.12	LFE30043
<i>Chrysanthemum indicum</i> L.	野菊	Asteraceae	Mao hao	Herb	Ts	Flower; soak in water	7–11	Ornamental, flowers used as medicine to improve eyesight		Wild	4	0.016	5.4	LFE40043
<i>Cirsium arvense</i> var. <i>integrifolium</i> Wimm. and Grab	刺儿菜	Asteraceae	Ci ga cai	Herb	V	Leaf; stir-fried or boiled	3–5	Fodder		Wild	5	0.020	0.8	LFE30053
<i>Cirsium japonicum</i> DC	蓟	Asteraceae	Da ci ga cai	Herb	V	Leaf; stir-fried or boiled	3–4	Medicine		Wild, cultivated	4	0.016	0.64	LFE40343
<i>Crassocephalum crepidioides</i> S.Moore	野苘蒿	Asteraceae	Liang gen cai	Herb	V	Tender stem and leaf; stir-fried or boiled	3–5	Fodder		Wild	10	0.040	2.4	LFE30012
<i>Lactuca indica</i> L.	翅果菊	Asteraceae	Tu er cao	Herb	V	Tender stem and leaf; stir-fried	3–4	Fodder		Wild	2	0.008	0.44	LFE40206

**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Pseudognaphalium affine</i> (D. Don) Anderb	鼠曲草	Asteraceae	Sui qu	Herb	V	Tender stem and leaf; pound and mix glutinous rice flour to make glutinous rice cakes	3–5	Fodder		Wild	129	0.512	928.8	LFE30013
<i>Taraxacum mongolicum</i> Hand.-Mazz	蒲公英	Asteraceae	Pu gong ying	Herb	V	Aboveground; stir-fried or cold and dressed with sauce	2–4	Whole plants used as medicine for cold		Wild, cultivated	5	0.020	5.2	LFE40197
<i>Capsella bursa-pastoris</i> Medik	芥	Brassicaceae	Di mi cai	Herb	V	Aboveground; stir-fried or boiled	2–4	Whole plants used as medicine for cold and dyspepsia		Wild	59	0.234	169.92	LFE30041
<i>Codonopsis javanica</i> subsp. <i>japonica</i> (Maxim. ex Makino) Lammer	小花金钱豹	Campanulaceae	Ye dang sen	Liana	V	Root; stew with meat	10–11	Whole plants used as medicine to strengthen the muscles and bones	Yes	Wild	16	0.063	39	LFE30044
<i>Cyclocodon lancifolius</i> (Roxb.) Kurz	轮钟草	Campanulaceae	Suan pan zi	Herb	F, V	Fruit, eaten raw Tender stem and leaf; stir-fried	9–10	Roots used as medicine for gynecopathy		Wild	8	0.032	0.78	LFE40276
<i>Lonicera japonica</i> Thunb	忍冬	Caprifoliaceae	Jin yin hua	Liana	Ts	Flower; soak in water	4–7	Ornamental, whole plants used as medicine for cold and bronchitis		Wild, cultivated	17	0.067	34.43	LFE40140
<i>Stellaria aquatica</i> Scop	鹅肠菜	Caryophyllaceae	Da e cang	Herb	V	Aboveground; stir-fried	3–4	Fodder		Wild	1	0.004	0.77	LFE40009
<i>Stellaria media</i> (L.) Vill	繁缕	Caryophyllaceae	E e cang	Herb	V	Aboveground; stir-fried	2–3	Fodder		Wild	3	0.012	2.31	LFE40021
<i>Disporum longistylum</i> (H. Lévl. and Vaniot) H. Hara	长蕊万寿竹	Colchicaceae	Bai long xu	Herb	V	Rhizome; stew with meat	1–12	Roots used as medicine to strengthen the muscles and bones	Yes	Wild	7	0.028	20.48	LFE40001

**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Commelina com-munis</i> L.	鸭跖草	Com-melinaceae	Zu ya cai	Herb	V	Tender stem and leaf; stir-fried	4–6			Wild	6	0.024	1.65	LFE40379
<i>Streptolirion volubile</i> Edgew	竹叶子	Com-melinaceae	Zu pi kong	Herb	V	Aboveground; stir-fried or boiled	4–6			Wild	6	0.024	0.39	LFE40284
<i>Calystegia hederacea</i> Wall	打碗花	Convolvulaceae	Po wan hua teng	Herb	V	Aboveground; stir-fried	1–12	Fodder		Wild	6	0.024	2.48	LFE40337
<i>Cornus capitata</i> Wall	头状四照花	Cornaceae	Li ba zi	Tree	F	Fruit; eaten raw	9–10	Ornamental		Wild	64	0.254	4.68	LFE40253
<i>Sedum emarginatum</i> Miqo	凹叶景天	Crassulaceae	Ma ci han	Herb	V	Aboveground; stir-fried or cold and dressed with sauce	3–10			Wild	1	0.004	1.04	LFE30049
<i>Sedum sarmentosum</i> Bunge	垂盆草	Crassulaceae	Gou ya ban	Herb	V	Aboveground; stir-fried or cold and dressed with sauce	3–10	Whole plants used as medicine for dog bite and traumatic injury		Wild	7	0.028	33.6	LFE40231
<i>Eleocharis dulcis</i> (Burmf.) Trin. ex Hensch	荸荠	Cyperaceae	Ci gu zi	Herb	V	Corm; eaten raw	12,1–2			Wild, cultivated	2	0.008	0.11	LFE40262
<i>Dioscorea alata</i> L.	参薯	Dioscoreaceae	Jio ban sao	Liana	Fs	Tuber; steamed or grilled	10–12			Wild, cultivated	6	0.024	0.59	LFE40289
<i>Dioscorea bulbifera</i> L.	黄独	Dioscoreaceae	Mao quan tou	Liana	Fs	Tuber; steamed or grilled	8–10	Medicine		Wild	7	0.028	1.54	LFE40412
<i>Dioscorea polystachya</i> Turcz	薯蕷	Dioscoreaceae	Ye san yo	Liana	Fs	Tuber; steamed or grilled	10–11			Wild	2	0.008	0.17	LFE30022
<i>Diospyros kaki</i> Lf	柿	Ebenaceae	Yao dai si	Tree	F	Fruit; eaten raw	10–12	Firewood		Wild, cultivated	20	0.079	2.93	LFE40409
<i>Diospyros kaki</i> var. <i>silvestris</i> Makino	野柿	Ebenaceae	You si	Tree	F	Fruit; eaten raw	10–12	Firewood		Wild	49	0.194	7.17	LFE30024
<i>Eleagnus henryi</i> Warb. ex Diels	宜昌胡颓子	Elaeagnaceae	Yang nai nai	Shrub	F	Fruit; eaten raw	3–4			Wild, cultivated	49	0.194	7.17	LFE30020
<i>Eleagnus lanceolata</i> Warb	披针叶胡颓子	Elaeagnaceae	Niu nai nai	Shrub	F	Fruit; eaten raw	4–5	Ornamental		Wild	18	0.071	2.03	LFE40387
<i>Eleagnus magna</i> (Servett.) Rehder	银粟牛奶子	Elaeagnaceae	Ban cuan zi	Shrub	F	Fruit; eaten raw	6–7			Wild	19	0.075	2.14	LFE40395

**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Elaeagnus pumgens</i> Thunb	胡颓子	Elaeagnaceae	Niu nai nai	Shrub	F	Fruit; eaten raw	3–4	Ornamental		Wild, cultivated	59	0.234	9.96	LFE30019
<i>Rhododendron simsii</i> Planch	杜鹃	Ericaceae	Yan san hong	Shrub	V	Flower; eaten raw	3–4	Ornamental		Wild, cultivated	11	0.044	1.07	LFE40303
<i>Astragalus sinicus</i> L.	紫云英	Fabaceae	Yang que hua	Herb	V	Flower, tender stem and leaf; stir-fried	3–4	Fodder		Wild	1	0.004	0.26	LFE40179
<i>Callerya dielsiana</i> (Harms ex Diels) L.K.Phan ex Z.Wei and Pedley	香花鸡血藤	Fabaceae	Ai ba dou	Shrub	V	Seed; grilled or boiled	6–10	Ornamental, used as medicine for traumatic injury		Wild	11	0.044	5.45	LFE40324
<i>Caragana sinica</i> (Buc'hoz) Rehder	锦鸡儿	Fabaceae	Yang que hua	Herb	V	Flower; stir-fried or make soup	3–4	Ornamental, medicine		Wild, cultivated	41	0.163	16.14	LFE40160
<i>Pueraria montana</i> var. <i>lobata</i> (Willd.) Maesen and S.M.Almeida ex Sanjappa and Predeep	葛	Fabaceae	Guo ma teng	Liana	Fs	Root; make flour	11–12, 1–2	Roots and stems used as medicine for cold		Wild, cultivated	42	0.167	6.14	LFE40260
<i>Pueraria montana</i> var. <i>thomsonii</i> (Benth.) Wiersma ex D.B.Ward	粉葛	Fabaceae	Nan guo	Liana	Fs	Root; make flour	11–12, 1–2			Wild	11	0.044	3.71	LFE40036
<i>Robinia pseudacacia</i> L.	刺槐	Fabaceae	Ci huai hua	Tree	V	Flower; make soup	4–5	Ornamental		Wild, cultivated	2	0.008	0.15	LFE30027
<i>Castanea henryi</i> Rehder and E.H.Wilson	锥栗	Fagaceae	Jian li	Tree	N	Seed; eaten raw or boiled	9–11	Firewood		Wild	73	0.290	49.28	LFE30047
<i>Castanea mollissima</i> Blume	栗	Fagaceae	Ban li	Tree	N	Seed; eaten raw or boiled	8–10	Firewood		Wild, cultivated	139	0.552	131.36	LFE30100
<i>Castanopsis eyrei</i> Tutch	甜槠	Fagaceae	Si li	Tree	N	Seed; eaten raw or boiled	9–11	Firewood		Wild, cultivated	122	0.484	115.29	LFE30025
<i>Castanopsis tibetana</i> Hance	钩锥	Fagaceae	Hou li	Tree	N	Seed; eaten raw or boiled	9–11	Firewood		Wild	73	0.290	30.11	LFE30052

**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Corallodiscus cordatulus</i> (Craib) B.L.Burtt	珊瑚盖岩	Gesneriaceae	Fu xin cao	Herb	V	Whole plant; stew with meat	1–12	Whole plants used as medicine for headache and traumatic injury	Yes	Wild	21	0.083	31.5	LFE40155
<i>Iris japonica</i> Thunb	蝴蝶花	Iridaceae	Dou jiang cao	Herb	C	Leaf; make tofu	4–10	Ornamental		Wild	3	0.012	2.34	LFE40031
<i>Juglans regia</i> L.	胡桃	Juglandaceae	Huo tao	Tree	N	Seed; eaten raw	9–10	Firewood		Wild, cultivated	6	0.024	0.25	LFE30058
<i>Agastache rugosa</i> Kuntze	藿香	Lamiaceae	Huo xiang cao	Herb	S	Leaf; spices	4–10			Wild, cultivated	1	0.004	1.8	LFE40366
<i>Clerodendrum bungei</i> Steud	臭牡丹	Lamiaceae	Cou mu dan	Shrub	V	Root; stew with meat	1–12	Ornamental, medicine	Yes	Wild, cultivated	2	0.008	4.68	LFE40079
<i>Lycopus lucidus</i> Turcz. ex Benth	地笋	Lamiaceae	San luo si	Herb	V	Rhizome; stir-fried or cold and dressed with sauce	11–12	Medicine		Wild, cultivated	3	0.012	3.04	LFE40012
<i>Perilla frutescens</i> (L.) Britton	紫苏	Lamiaceae	Zi su	Herb	S	Leaf; spices	3–10			Wild, cultivated	15	0.060	32.4	LFE40350
<i>Perilla frutescens</i> var. <i>crispata</i> (Thunb.) H.Deane	茵茴苏	Lamiaceae	Zi su	Herb	S	Leaf; spices	3–10			Cultivated	6	0.024	12.96	LFE40312
<i>Premna microphylla</i> Turcz	豆腐柴	Lamiaceae	Ban ji pao	Shrub	C	Leaf; make tofu	5–10	Whole plants used as medicine for traumatic injury and hemostasis		Wild	28	0.111	18.9	LFE40376
<i>Prunella vulgaris</i> L.	夏枯草	Lamiaceae	Feng kuo cao	Herb	Ts	Aboveground; soak in water	4–6	Roots used as medicine for rheumatism and cold		Wild	1	0.004	3.12	LFE40109
<i>Akebia trifoliata</i> (Thunb.) Koidz	三叶木通	Lardizabaceae	Ba yue gua	Liana	F	Fruit; eaten raw	7–9	Fruits used as medicine to promote diuresis		Wild	99	0.393	16.71	LFE40394

**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Akebia trifoliata</i> subsp. <i>australis</i> (Diels) T.Shimizu	白木通	Lardizababaceae	San ye lan	Liana	F	Fruit; eaten raw	6–9	Fruits used as medicine to promote diuresis		Wild, cultivated	37	0.147	6.24	LFE40393
<i>Holboellia angustifolia</i> Wall	五月瓜藤	Lardizababaceae	Qi ye lan	Liana	F	Fruit; eaten raw	7–9			Wild	31	0.123	5.23	LFE40383
<i>Stauntonia chinensis</i> DC	野木瓜	Lardizababaceae	Huang na gua	Liana	F	Fruit; eaten raw	9–10			Wild	14	0.056	2.36	LFE40420
<i>Cinnamomum tazia</i> (Buch-Ham) Kosterm ex M Gangop	少花桂	Lauraceae	Xiang gui zi	Tree	S	Bark; spices	9–10			Wild, cultivated	12	0.048	6.48	LFE30038
<i>Litsea mollis</i> (Blume) Boerl	毛叶木姜子	Lauraceae	Mu jiang zi	Tree	S	Fruit; spices or cold and dressed with sauce	5–7			Wild, cultivated	106	0.421	556.5	LFE40020
<i>Clintonia udensis</i> Trautv. and C.A.Mey	七筋姑	Liliaceae	Jian dao cao	Herb	F	Fruit; eaten raw	7–8			Wild	2	0.008	0.05	LFE40057
<i>Lilium brownii</i> FE.Br. ex Miellez	野百合	Liliaceae	Ye be huo	Herb	Fs	Bulb; grilled or steamed	6–7			Wild	23	0.091	13.46	LFE40431
<i>Taxillus sutchuenensis</i> Danser	川桑寄生	Loranthaceae	Ji sen ca	Shrub	Ts	Whole plant; soak in water	1–12	Roots used as medicine for rheumatism		Wild	2	0.008	2.6	LFE30064
<i>Toona sinensis</i> (A.Juss.) M.Roem	香椿	Meliaceae	Cun dian	Tree	V	Tender stem and leaf; stir-fried or cold and dressed with sauce	3–5	Firewood		Wild	140	0.556	183.75	LFE40170
<i>Ficus tikoua</i> Bureau	地果	Moraceae	Di pi pa	Liana	F	Fruit; eaten raw	7–9	Whole plants used as medicine for cold and upset stomach		Wild	24	0.095	18.9	LFE40038
<i>Morus alba</i> L.	桑	Moraceae	Sang pao	Tree	F	Fruit; eaten raw or soaking in wine	4–5	Firewood		Wild, cultivated	16	0.063	1.8	LFE40098

**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Musa basjoo</i> Siebold and Zucc. ex Linna	芭蕉	Musaceae	Ba jiao	Herb	V	Flower; stew with meat Tender stem and leaf; boiled	3–7	Ornamental, fodder, packaging		Wild, cultivated	17	0.067	4.76	LFE30104
<i>Morella rubra</i> Lour	杨梅	Myricaceae	Yang mei	Tree	F, Ws	Fruit; eaten raw or soaking in wine	6–7	Ornamental		Wild, cultivated	51	0.202	154.91	LFE40252
<i>Phytolacca acinosa</i> Roxb	商陆	Phytolaccaceae	Liu luo bo	Herb	V	Root; stew with meat	8–10	Medicine	Yes	Wild	16	0.063	23.4	LFE40207
<i>Plantago asiatica</i> L.	车前	Plantaginaceae	Ke ma cao	Herb	V	Aboveground; stir-fried or boiled	3–8	Whole plants used as medicine for cold and cough		Wild	6	0.024	31.2	LFE40107
<i>Bambusa emeiensis</i> L.C.Chia and H.L.Fung	慈竹	Poaceae	Peng zu	Bamboo	V	Tender stem; stir-fried or boiled	6–9	Firewood, material for weaving tools		Wild, cultivated	26	0.103	13.52	LFE40399
<i>Chimonobambusa purpurea</i> Hsueh f. & T.P.Yi	刺黑竹	Poaceae	Ci zu	Bamboo	V	Tender stem; stir-fried or boiled	9–10	Firewood, material for weaving tools		Wild	22	0.087	1.65	LFE30035
<i>Imperata cylindrica</i> (L.) Raeusch	白茅	Poaceae	Mao qian	Herb	V	Tender stem; eaten raw	3–4	Roots used as medicine for cold and hemostasis		Wild	7	0.028	1.82	LFE30074
<i>Indocalamus tessellatus</i> (Munro) Keng f	箬竹	Poaceae	Zong ba ye	Bamboo	Ws	Leaf; soaking in wine	5–8	Packaging		Wild, cultivated	26	0.103	20.28	LFE30040
<i>Phyllostachys nidularia</i> Munro	篔竹	Poaceae	Be zu	Bamboo	V	Tender stem; stir-fried or boiled or pickle	4–5	Firewood, material for weaving tools		Wild, cultivated	99	0.393	59.4	LFE30034
<i>Phyllostachys edulis</i> (Carrière) J.Houz	毛竹	Poaceae	Lan zu	Bamboo	V	Tender stem; stir-fried or boiled or pickle	2–4	Firewood, material for weaving tools		Wild, cultivated	186	0.738	133.92	LFE30029

Table 2 (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Phyllostachys heteroclada</i> Oliv	水竹	Poaceae	Sui zu	Bamboo	V	Tender stem; stir-fried or boiled or pickle	4–5	Firewood, material for weaving tools		Wild, cultivated	175	0.694	126	LFE30031
<i>Phyllostachys nigra</i> var. <i>henonis</i> (Mitford) Rendle	毛金竹	Poaceae	Jin zu	Bamboo	V	Tender stem; stir-fried or boiled	4–5	Firewood, material for weaving tools		Wild, cultivated	76	0.302	34.2	LFE40097
<i>Phyllostachys reticulata</i> (Rupt.) K.Koch	桂竹	Poaceae	Ban zu	Bamboo	V	Tender stem; stir-fried or boiled	5–6	Firewood, material for weaving tools		Wild, cultivated	34	0.135	7.65	LFE40400
<i>Pleioblastus maculatus</i> (McClure) C.D.Chu and C.S.Chao	斑苦竹	Poaceae	Ku zu	Bamboo	V	Tender stem; stir-fried or boiled	5–6	Firewood, material for weaving tools		Wild, cultivated	31	0.123	11.63	LFE40391
<i>Pleuropteris multiflorus</i> Turcz. ex Nakai	何首乌	Polygonaceae	Ye jiao teng	Herb	V	Root tuber; stew with meat	10–12	Roots used as medicine for nephrothy and stabilizing nerves	Yes	Wild	1	0.004	1.56	LFE40177
<i>Reynoutria japonica</i> Houtt	虎杖	Polygonaceae	Suan tan gan	Herb	V	Stem; eaten raw or cold and dressed with sauce	3–4	Rhizomes used as medicine for jaundice hepatitis	Yes	Wild, cultivated	5	0.020	3.25	LFE40184
<i>Lysimachia paridiformis</i> Franch	落地梅	Primulaceae	Si kuai wa	Herb	V	Whole plant; stew with meat	1–12	Whole plants used as medicine for children who are frightened	Yes	Wild	5	0.020	8.8	LFE40158
<i>Berchemia sinica</i> C.K.Schneid	勾儿茶	Rhamnaceae	Long gu zan	Shrub	F	Fruit; eaten raw	9–10			Wild	3	0.012	0.29	LFE30095
<i>Hovenia acerba</i> Lindl	枳椇	Rhamnaceae	Ji zao	Tree	F, Ws	Fruit stalk; eaten raw or soaking in wine	9–11	Fruit stalks used as medicine for cold and leg cramp		Wild, cultivated	153	0.607	1652.4	LFE40034
<i>Chaenomeles cathayensis</i> (Hemsl) C.K.Schneid	木瓜海棠	Rosaceae	Mu gua	Shrub	Ws	Fruit; soaking in wine	9–10	Roots and fruits used as medicine for rheumatism		Wild, cultivated	9	0.036	15.80	LFE40065



**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Crataegus cuneata</i> Siebold and Zucc	野山楂	Rosaceae	San za	Shrub	F, Ts	Fruit; eaten raw Tender leaf; soak in water	3–4, 9–10			Wild	2	0.008	0.20	LFE30055
<i>Eriobotrya japonica</i> (Thunb.) Lindl	枇杷	Rosaceae	Pi pa	Tree	F	Fruit; eaten raw	5–6	Ornamental, leaves and flowers used as medicine for cold		Wild, cultivated	92	0.365	99.36	LFE40249
<i>Fragaria nilgerrensis</i> Schlttd. ex J.Gay	黄毛草莓	Rosaceae	Ye cao mei	Herb	F	Fruit; eaten raw	6–8			Wild	10	0.040	0.68	LFE40025
<i>Prunus conradinae</i> Koehne	华中樱桃	Rosaceae	Ye en tao	Tree	F	Fruit; eaten raw	4–5	Ornamental		Wild	95	0.377	13.36	LFE40068
<i>Pyracantha fortuneana</i> (Maxim.) H.L.Li	火棘	Rosaceae	Jiu bei liang	Shrub	F, Ws	Fruit; eaten raw or soaking in wine	8–11	Ornamental, fruits and leaves used as medicine for gynecopathy and blister ulcer		Wild	77	0.306	33.78	LFE30009
<i>Pyracantha loureiri</i> (Kostel.) Merr	全缘火棘	Rosaceae	Jiu bei liang	Shrub	F, Ws	Fruit; eaten raw or soaking in wine	9–11	Ornamental, fruits and leaves used as medicine for gynecopathy and blister ulcer		Wild	15	0.060	6.58	LFE40307
<i>Rosa laevigata</i> Michx	金樱子	Rosaceae	Tang guan guan	Shrub	F, Ws	Fruit; eaten raw or soaking in wine	7–11	Ornamental		Wild	161	0.639	684.65	LFE40165
<i>Rosa multiflora</i> var. <i>cathayensis</i> Rehder and E.H.Wilson	粉团蔷薇	Rosaceae	Be ci tai	Shrub	V	Tender stem; eaten raw	3–4	Ornamental		Wild	28	0.111	3.98	LFE40191
<i>Rosa roxburghii</i> f. <i>normalis</i> Rehder and E.H.Wilson	单瓣缙丝花	Rosaceae	Ci guo guo	Shrub	F, Ws	Fruit; eaten raw or soaking in wine	8–10	Fruits used as medicine for gynecopathy		Wild	154	0.611	654.89	LFE40347

**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Rosa rubus</i> H.Lév. and Vaniot	悬钩子 蔷薇	Rosaceae	Hong ci tai	Shrub	V	Tender stem; eaten raw	3–4	Ornamental		Wild	47	0.187	7.71	LFE40023
<i>Rubus amphidasys</i> Focke	周毛悬钩子	Rosaceae	Lao fu pao	Shrub	F	Fruit; eaten raw	7–8	Tender stems and leaves used as medicine for gynecopathy and diarrhea		Wild	11	0.044	4.95	LFE40067
<i>Rubus biflorus</i> Buch.-Ham. ex Sm	粉枝莓	Rosaceae	Huang long pao	Shrub	F	Fruit; eaten raw	5–7	Tender stems and leaves used as medicine for diarrhea		Wild	2	0.008	0.20	LFE40069
<i>Rubus chroosepalus</i> Focke	毛莓	Rosaceae	Gai wan pao	Shrub	F	Fruit; eaten raw	7–8	Tender stems and leaves used as medicine for diarrhea		Wild	11	0.044	1.07	LFE40355
<i>Rubus corchorifolius</i> L.f	山莓	Rosaceae	San yue pao	Shrub	F	Fruit; eaten raw	4–5	Tender stems and leaves used as medicine for diarrhea		Wild	217	0.861	260.4	LFE40058
<i>Rubus coreanus</i> Miq	插田蕨	Rosaceae	Be ci pao	Shrub	F	Fruit; eaten raw	6–7	Tender stems and leaves used as medicine for diarrhea		Wild	69	0.274	62.1	LFE40425
<i>Rubus innominatus</i> S.Moore	白叶莓	Rosaceae	Da gu pao	Shrub	F	Fruit; eaten raw	7–8	Tender stems and leaves used as medicine for diarrhea		Wild	48	0.190	43.2	LFE40326
<i>Rubus lambertianus</i> Ser	高粱蕨	Rosaceae	Suan pao	Shrub	F	Fruit; eaten raw	9–11	Tender stems and leaves used as medicine for diarrhea		Wild	42	0.167	37.8	LFE30048

**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Rubus parkeri</i> Hance	乌藤子	Rosaceae	Wu pao	Shrub	F	Fruit; eaten raw	7–8	Tender stems and leaves used as medicine for diarrhea		Wild	13	0.052	1.46	LFE30005
<i>Rubus parvifolius</i> L.	茅莓	Rosaceae	Hao yang pao	Shrub	F	Fruit; eaten raw	6–7	Tender stems and leaves used as medicine for diarrhea		Wild	67	0.266	45.73	LFE40356
<i>Rubus rosifolius</i> Sm	空心藤	Rosaceae	Kong tong pao	Shrub	F	Fruit; eaten raw	4–5	Tender stems and leaves used as medicine for diarrhea		Wild	124	0.492	130.2	LFE30018
<i>Rubus setchuenensis</i> Bureau and Franch	川莓	Rosaceae	Wu pao	Shrub	F	Fruit; eaten raw	10–12	Tender stems and leaves used as medicine for knife wound, dye the fabric black		Wild	83	0.329	89.64	LFE30006
<i>Rubus wallichianus</i> Wight and Aitn	红毛悬钩子	Rosaceae	Hou zi pao	Shrub	F	Fruit; eaten raw	5–6	Tender stems and leaves used as medicine for diarrhea		Wild, cultivated	31	0.123	4.36	LFE40392
<i>Zanthoxylum armatum</i> DC	竹叶花椒	Rutaceae	Ye hua jiao	Shrub	S	Fruit; spices	9–12			Wild, cultivated	52	0.206	175.5	LFE40427
<i>Zanthoxylum bungeanum</i> Maxim	花椒	Rutaceae	Hua jiao	Tree	S	Fruit; spices Tender leaf; stir-fried or boiled	6–9			Wild, cultivated	77	0.306	623.7	LFE40428
<i>Zanthoxylum dimorphophyllum</i> Hemsl	异叶花椒	Rutaceae	Hu jiao ci	Shrub	S	Fruit; spices	9–11			Wild	5	0.020	1.13	LFE30004
<i>Houttuynia cordata</i> Thunb	蕺菜	Saururaceae	Ze er gen	Herb	V	Rhizome; cold and dressed with sauce	2–4	Whole plants used as medicine for cold	Yes	Wild, cultivated	205	0.813	4612.5	LFE40039
<i>Illicium henryi</i> Diels	红茴香	Schisan-draceae	Ba guo xiang	Shrub	S	Fruit; spices	8–10			Wild, cultivated	22	0.087	11.14	LFE40095

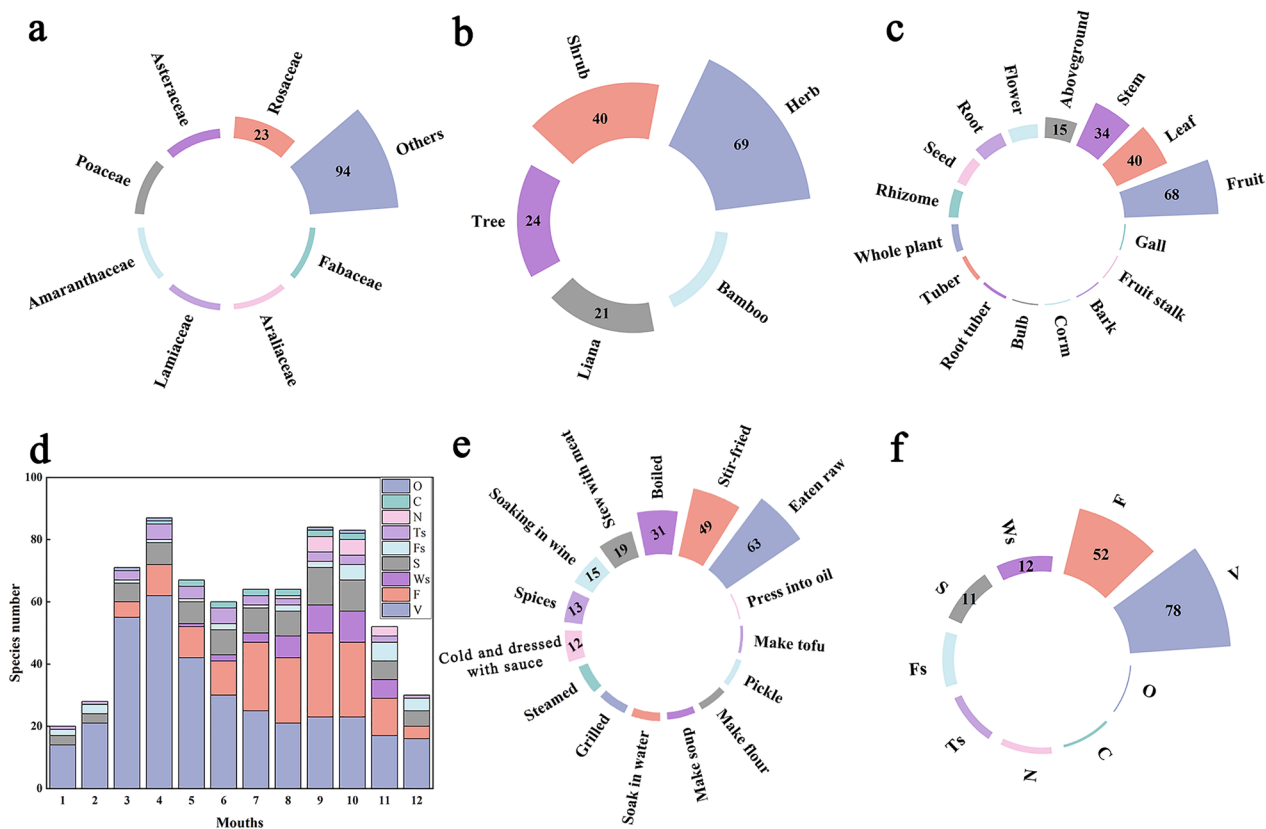
**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Kadsura longipedunculata</i> Finet and Gagnep	南五味子	Schisan-draceae	Fan tuo zi	Liana	F	Fruit; eaten raw	9–12			Wild	4	0.016	0.45	LFE40389
<i>Schisandra henryi</i> C.B.Clarke	翼梗五味子	Schisan-draceae	Cen tuo	Liana	F	Fruit; eaten raw	7–9	Whole plants used as medicine for rheumatism and gastrostia		Wild	55	0.218	14.85	LFE40369
<i>Schisandra sphenanthera</i> Rehder and E.H.Wilson	华中五味子	Schisan-draceae	Xue cen tuo	Liana	F	Fruit; eaten raw	7–9	Whole plants used as medicine for rheumatism and gastrostia		Wild	26	0.103	7.61	LFE40373
<i>Smilax china</i> L.	菝葜	Smilacaceae	Jin gang teng	Shrub	F, V	Fruit; eaten raw Tender stem and leaf; stir-fried	3–5, 9–11	Roots used as medicine for traumatic injury		Wild	11	0.044	23.82	LFE40224
<i>Smilax glabra</i> Roxb	土茯苓	Smilacaceae	Jin gang teng	Shrub	Fs	Rhizome; make flour or stew with meat or soaking in wine	8–12	Roots used as medicine for gastrostia	Yes	Wild	6	0.024	4.39	LFE40419
<i>Lycium chinense</i> Mill	枸杞	Solanaceae	Gou ji	Shrub	Ws	Fruit; soaking in wine	8–11	Ornamental		Wild, cultivated	4	0.016	4.68	LFE40348
<i>Talinum paniculatum</i> (Jacq.) Gaertn	土人参	Talinaceae	Yang sen	Herb	V	Root; stew with meat Leaf; stir-fried or boiled	1–12	Ornamental, medicine	Yes	Wild, cultivated	9	0.036	7.02	LFE40403
<i>Camellia oleifera</i> C.Abel	油茶	Theaceae	You ca	Shrub	O, F	Seed; press into oil Gall; eaten raw	3–4, 9–10	Ornamental, Stem barks used as medicine for knife wound, firewood		Wild, cultivated	111	0.440	124.88	LFE40110
<i>Debregeasia orientalis</i> C.J.Chen	水麻	Urticaceae	Sui ma	Shrub	F	Fruit; eaten raw	5–7	Leaves used as medicine for burns and scalds		Wild	24	0.095	13.86	LFE30045

**Table 2** (continued)

Scientific name	Chinese name	Family name	Local name	Habit	Food categories	Edible part and consumption mode	Collection months	Multiple uses	Medicinal food	Habitat	FC	RFC	CFSI	Voucher number
<i>Laportea bulbifera</i> (Siebold and Zucc.) Wedd	珠芽艾麻	Urticaceae	Hong huo ma	Herb	V	Tender leaf; boiled or stew with meat	6–7	Roots used as medicine for rheumatism, traumatic injury and blister ulcer	Yes	Wild, cultivated	6	0.024	7.8	LFE40406
<i>Urtica fissa</i> E.Pritz	荨麻	Urticaceae	Be huo ma	Herb	V	Tender leaf; boiled or stew with meat	6–7	Roots used as medicine for rheumatism, traumatic injury and blister ulcer	Yes	Wild, cultivated	7	0.028	18.2	LFE30046
<i>Viburnum</i> sp.	荚蒾属	Viburnaceae	Ruan huan zi	Shrub	F	Fruit; eaten raw	8–9	Ornamental		Wild	10	0.040	0.98	LFE40210
<i>Viola philippica</i> Cav	紫花地丁	Violaceae	Hua kou jian	Herb	V	Aboveground; stir-fried or boiled	3–5	Whole plants used as medicine for knife wound		Wild	1	0.004	3.12	LFE40132
<i>Nekemias grossedentata</i> (Hand-Mazz.) J.Wen and Z.L.Nie	大边牛果藤	Vitaceae	Teng ca	Liana	Ts	Tender stem and leaf; soak in water	3–6			Wild, cultivated	45	0.179	324	LFE40047
<i>Vitis davidii</i> (Rom. Caill.) Foëx	刺葡萄	Vitaceae	Ye pu tao	Liana	F	Fruit; eaten raw	7–10			Wild	15	0.060	1.69	LFE40378
<i>Vitis flexuosa</i> Thunb	葛藤葡萄	Vitaceae	Sui pu tao	Liana	F	Fruit; eaten raw	7–11			Wild	45	0.179	6.33	LFE40423
<i>Vitis heyneana</i> Schult	毛葡萄	Vitaceae	Ye pu tao	Liana	F	Fruit; eaten raw	7–10			Wild	32	0.127	3.6	LFE40396
<i>Hedychium coronarium</i> J.Koenig	姜花	Zingiberaceae	Cao guo	Herb	S	Fruit; spices Flower; make soup Rhizome; stir-fried	4–12	Ornamental, roots used as medicine for headache	Yes	Wild, cultivated	6	0.024	38.27	LFE40285
<i>Zingiber striolatum</i> Diels	阳荷	Zingiberaceae	Yang huo	Herb	V	Flower; stir-fried or cold and dressed with sauce	7–9	Ornamental, medicine		Wild, cultivated	17	0.067	30.98	LFE30023

Food categories: V vegetables; F fruits; Ws wine-soaking plants; S spices; Fs food substitutes; Ts tea substitutes; N nuts; C coagulants; O oil



**Fig. 2** Diversity of wild edible plants used by the Tujia ethnic group in Laifeng. **a** Family distribution; **b** habit distribution; **c** edible parts distribution; **d** collection months; **e** consumption mode distribution; **f** food category distribution

from March to October (Fig. 2d). The Tujia ethnic group in Laifeng prefer to collect tender stems and leaves of wild plants as vegetables for consumption, predominantly gathering wild vegetables from March to May in spring. Wild fruits and nuts have more variety, with the greatest collection occurring in summer and autumn from July to October, during which mature fruits and seeds are more abundant.

Owing to the diversity WEPs and dietary habits, various consumption modes are employed. There are 15 consumption modes for WEPs, including being eaten raw, stir-fried, boiled, stewing with meat, soaking in wine, used as spices, and cold and dressed with sauce, etc. Eaten raw is the most common method, with a total of 63 species, accounting for 38.7%, followed by stir-fried (49) and boiled (31) (Fig. 2e).

**Classification of wild edible plants**

Based on the diverse purpose of consumption, the WEPs can be categorized into 9 distinct groups: vegetables, fruits, wine-soaking plants, spices, food substitutes, tea substitutes, nuts, coagulants, and oil. Among these, wild vegetables (78) and wild fruits (52) constitute the majority, accounting for 79.8% of the total species (Fig. 2f). This

is followed by wine-soaking plants (12) and spices (11), as along with food substitutes (9), tea substitutes (6), nuts (5), and coagulants (2). Oil use is the least category, with only 1 species.

**Wild vegetables**

A total of 78 types of wild vegetables are traditionally utilized by the Tujia ethnic group in Laifeng, primarily consisting of leaves, stems, and aboveground parts. These are principally processed using methods such as stir-frying, boiling, and stewing with meat. The most frequently mentioned ones are *Allium macrostemon*, *Houttuynia cordata*, *Pseudognaphalium affine*, and *Artemisia indica*. *A macrostemon* is a wild vegetable universally consumed by households of the Tujia ethnic group in Laifeng. It is typically served as a cold or pickled vegetable and can also be employed as a spice (Fig. 3a, b). *A macrostemon* is widely distributed in Laifeng County and is also cultivated in some Tujia courtyards as a supplement to *Allium fistulosum*, which is the principal spice. According to the Tujia ethnic group in Laifeng, *A macrostemon* possesses a more potent aroma and certain medicinal properties, rendering it beneficial as a vegetable and spice.

*Houttuynia cordata* is a medicinal and edible plant deeply cherished by the Tujia ethnic group in Laifeng. Every spring, as the temperature rises and new leaves sprout from the roots of *H cordata*, it is an optimal time to consume its tender roots and stems. Contrarily to the practice in Yunnan and Guizhou where the entire *H cordata* is consumed, the Tujia ethnic group in Laifeng restrict their consumption to the tender roots and stems, served cold and dressed with sauce. The above ground parts are more commonly utilized as herbal medicine to treat colds. In the local market town of Laifeng in spring, it is common to see vendors selling washed or pickled *H cordata* roots (Fig. 3c).

*Pseudognaphalium affine* and *Artemisia indica* are frequently used by the Tujia ethnic group in Laifeng to prepare glutinous rice cakes (Fig. 3d–f). In March and April, the Tujia ethnic group in Laifeng gathers the tender stems and leaves of *P affine* and *A indica*, processes them to remove their bitterness through hammering, kneading,

and washing, and then mixes them with glutinous rice flour to produce cakes. These cakes are filled with ingredients such as bacon, *Allium macrostemon*, *Allium sativum*, dried tofu, and peppers, and are covered with leaves of *Citrus sinensis*. Cakes sold in the market town are typically made by combining *P affine* and *A indica*. Using only *P affine* results in softer cakes that are less easy to shape, while using *A indica* alone gives the cakes a darker color. The perfect blend of *P affine* and *A indica* results in cakes with a harmonious balance of color, aroma, and taste. Apart from *P affine* and *A indica*, *Artemisia lancea*, also known as “bitter Artemisia” by locals, is often used to prepare Shefan, a meal made by steaming a mixture of *A lancea* and glutinous rice (Fig. 3g–i).

### Wild fruits

A total of 52 wild fruits are utilized for consumption by the Tujia ethnic group in Laifeng, typically eaten raw or employed for fruit wine production. The most popular



**Fig. 3** WEPs used as vegetables. **a** *Allium macrostemon* being dried; **b** *Allium macrostemon* and *Pteridium revolutum* being sold; **c** *Houttuynia cordata*; **d** *Artemisia indica*; **e** *Pseudognaphalium affine*; **f** Make *Artemisia indica* and *Pseudognaphalium affine* cakes; **g** *Artemisia lancea*; **h** she Fan; **i** process *Artemisia lancea*

ones include *Hovenia acerba*, *Rosa laevigata*, and *Rosa roxburghii* f. *normalis*. *H acerba* is consumed in the form of mature fruit stalks. In addition to eat it raw, the Tujia ethnic group in Laifeng also soaks it in wine, positing that the *H acerba* wine can alleviate weakness and cramps in the hands and feet (Fig. 4a). Studies have indicated that the extract from the stem of *H acerba* possesses robust antioxidant activity [45].

*Rosa laevigata* and *Rosa roxburghii* f. *normalis* are colloquially referred to as “sugar jars” and “prickly fruit,” respectively. They are both shrubs of the *Rosaceae* family and can also be soaked in wine for consumption apart from being eaten raw (Fig. 4b–e). These two WEPs typically flourish near rivers and ditches. However, their populations have largely diminished due to the construction of production and living infrastructure, as well as resent environmental damage.

Further, *Rubus* sp. are also cherished wild fruits of the Tujia ethnic group in Laifeng. *Rubus corchorifolius*, *R rosifolius*, *R coreanus*, and *R setchuenensis* are frequently

mentioned and highly favored for their taste (Fig. 4f–h). In the case of *Camellia oleifera*, galls derived from its fruits and leaves are consumed. During periods of food scarcity, these are also stir-fried to alleviate hunger (Fig. 4i).

**Spices**

Spice plants, encompassing a total of 11 wild species, feature prominently in the diet of the Tujia ethnic group in Laifeng. The Tujia ethnic group in Laifeng favors the consumption of the unripe, tender fruits of *Litsea mollis*, harvested from May to July. Following harvesting, it is immersed in oil and vinegar and consumed as a spice (Fig. 5a–b). Certain varieties of spices are cultivated in homegardens for convenient harvesting and use. The leaves of *Perilla frutescens* and *Perilla frutescens* var. *crispa* are frequently used to cook fish to eliminate the fishy smell (Fig. 5c). The leaves of *Acorus gramineus* are employed for stewing meat to enhance its aroma (Fig. 5d). The fruits of *Hedychium coronarium* are used



**Fig. 4** WEPs used as fruits. **a** *Hovenia acerba* wine; **b** *Rosa laevigata* wine; **c** *Rosa roxburghii* f. *normalis* wine; **d** *Rosa laevigata*; **e** *Rosa roxburghii* f. *normalis*; **f** *Rubus corchorifolius*; **g** *Rubus coreanus*; **h** *Rubus setchuenensis*; **i** galls on *Camellia oleifera*



for stewing chicken, the flowers are used for crafting oil tea soup, and the rhizomes are stir-fried. *Heptapleurum delavayi*, colloquially termed “fermented soybean leaf,” is favored by housewives, but is not directly utilized as a spice (Fig. 5e). Rather, it serves as a bedding to augment the aroma of fermented soybean during its production.

#### Food substitutes and tea substitutes

A total of 9 plant species serve as food substitutes, with *Amorphophallus konjac* and *Pteridium revolutum* being particularly favored by the Tujia ethnic group in Laifeng. A *konjac* tofu, made from tubers, and *P. revolutum* cake, derived from rhizomes, are commonly witnessed in the market town. Nevertheless, the powder production yield for both these plants is relatively low. Informants report that only approximately 3 kg of *P. revolutum* cake can be produced from 50 kg of its rhizomes (Fig. 5f–g).

Six types of tea substitutes exist, among which *Nekemia grossedentata*, colloquially referred to as “vine

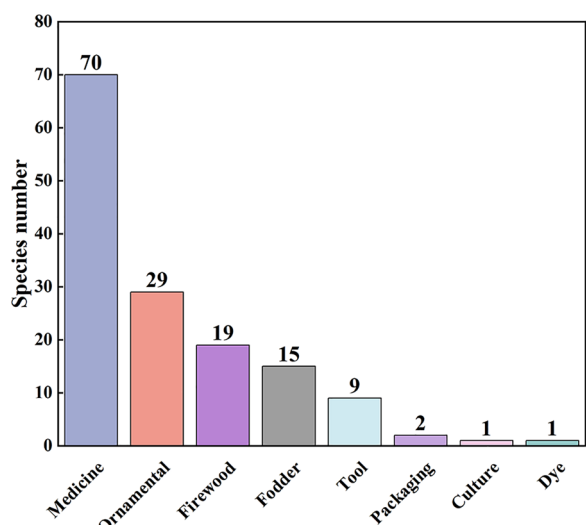
tea,” has emerged as a major industry in Laifeng County, exhibiting robust growth (Fig. 5h–i). The Tujia ethnic group of Laifeng harvests the tender stems and leaves of wild *N. grossedentata* in early spring, producing vine tea through the process of kneading, frying, and drying. Studies have indicated that tea brewed from *N. grossedentata* is rich in diverse flavonoids, exhibiting antibacterial and anti-inflammatory properties [46].

#### Multiple uses of wild edible plants

The 124 species (76.5%) of WEPs traditionally used by the Tujia ethnic group in Laifeng hold not only edible value, but also serve multiple uses such as medicinal, ornamental, material, and fodder (Fig. 6). Of these, 70 species are primarily used for their medicinal purposes. For example, *Polygonum sibiricum* (Fig. 7a), *Eleutherococcus nodiflorus*, *Aralia echinocaulis*, and others are frequently mentioned as medicinal and edible plants for treating conditions like rheumatism, traumatic injury, and bone grafting. Moreover, 23 species are regarded as tonics by



**Fig. 5** WEPs used as spices, food substitutes and tea substitute. **a** *Litsea mollis*; **b** *Litsea mollis* oil; **c** *Perilla frutescens*; **d** *Acorus gramineus*; **e** *Heptapleurum delavayi*; **f** *Amorphophallus konjac* cakes; **g** *Pteridium revolutum* cake; **h** *Nekemias grossedentata*; **i** *Nekemias grossedentata* tea



**Fig. 6** Multiple uses of wild edible plants used by the Tujia ethnic group in Laifeng

the Tujia people in Laifeng, including *Corallodiscus cordatulus*, *Sceptridium ternatum*, and *Disporum longistylum*, often used in meat stews for their medicinal properties (Fig. 7b–d).

In addition, certain WEPs have also been introduced and planted as ornamental plants in the homegardens of the Tujia ethnic group in Laifeng due to their ornamental value, such as *Caragana sinica*, *Taxus wallichiana* var. *mairei*, *Rhododendron simsii*, and *Elaeagnus* sp. (Fig. 7e–g). *Castanea henryi*, *Castanopsis eyrei*, and *Castanopsis tibetana*, which belong to the *Fagaceae* family, are commonly used as firewood and building materials. *Musa basjoo*, *Cryptotaenia japonica*, and *Oenante Javanica* are used as fodder for pigs and poultry. Bamboo is crafted into baskets, dustpans, pipes, among other production tools and everyday utensils (Fig. 7h). The leaves of *Musa basjoo* and *Indocalamus tessellatus* are used to wrap cake and Zongzi (Fig. 7i). In addition to making cake, *Artemisia indica* is also hung outside the door with *Artemisia argyi* during the Dragon Boat Festival to ward off evil



**Fig. 7** WEPs used for multiple uses. **a** *Polygonatum sibiricum*; **b** *Corallodiscus cordatulus*; **c** *Sceptridium ternatum*; **d** *Disporum longistylum*; **e** *Caragana sinica*; **f** *Taxus wallichiana* var. *mairei*; **g** *Rhododendron simsii*; **h** *Phyllostachys edulis* pipe; **i** Zongzi wrapped in *Indocalamus tessellatus*

spirits, possessing cultural value. The roots of *Rubus setchuenensis* are employed in fabric dyeing.

**Quantitative evaluation of wild edible plants**

The RFC and CFSI were employed to evaluate the value and importance of WEPs among the Tujia ethnic group in Laifeng. The results are shown in Table 2. The CFSI value ranges from 0.05 to 6120. Referring to Pieroni’s research, the CFSI values were divided into 6 groups, namely very high significance (CFSI ≥ 300), high significance (100 < CFSI ≤ 299), medium significance (20 < CFSI ≤ 100), low significance (5 < CFSI ≤ 20), variable low significance (1 < CFSI ≤ 5), and negligible significance (CFSI ≤ 1) [39].

In the 6 groups, the majority of species are clustered in the 4 groups with variable low significance, low significance, medium significance, and negative significance, comprised of 42, 40, 30, and 22 species, respectively. Next are two groups, high significance and very high significance, with 15 and 14 species, respectively.

A heat map analysis was performed on 59 species with high CFSI values in three groups: very high significance, high significance, and medium significance. The results are shown in Fig. 8. When comparing the top 59 species in the CFSI and RFC rankings, a total of 43 species are shared. RFC alone represents the frequency at which a certain species is mentioned by the Tujia ethnic group in Laifeng, while the CFSI is a comprehensive score that includes not only the frequency mentioned, but also indices such as consumption method, consumption frequency, and consumption taste. For instance, *Sceptrum ternatum*, considered a tonic by the Tujia ethnic group in Laifeng, boasts a good taste, but is relatively rare, with a CFSI of 37.8, placing it within the medium significance. During periods of scarcity, *Lactuca indica*, *Alternanthera philoxeroides*, and *Chenopodium album* were frequently consumed as wild vegetables, yet with the enhancement of

living standards, they are presently seldom consumed. Instead, they are utilized as fodder for pigs and poultry, and their CFSI is of negligible significance.

**Comparison of wild edible plants between Tujia ethnic group in Laifeng and other ethnic groups in different areas**

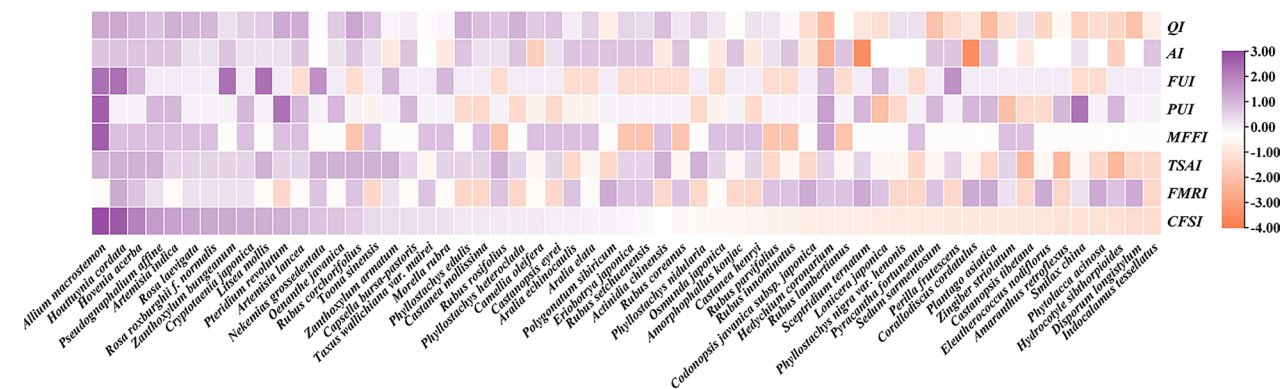
In order to explore the differences in WEPs utilized by the Tujia ethnic group in Laifeng and other ethnic groups in different areas, we conducted a Jaccard index between our study on the Tujia ethnic group in Laifeng and data from five distinct ethnic groups and areas in China [17, 20, 47–49]. The results indicate that among the five selected areas, the Gelao ethnic group in northern Guizhou exhibits the highest similarity to our study area, with a JI of 0.20, followed by the Gaowangjie area in Hunan and the Jianghua Yao Autonomous County in Hunan, with JI of 0.19 and 0.17, respectively. The Yi ethnic group in Liangshan Prefecture, Sichuan, and the Zhuang ethnic group in Fangchenggang, Guangxi, demonstrate the lowest degrees of similarity with our study area, with only 0.10 and 0.09, respectively (Table 3).

**Discussion**

**The traditional knowledge of WEPs of the Tujia ethnic group in Laifeng is an important component of their dietary culture**

The conventional utilization of WEPs is prevalent among local communities globally; however, the traditional knowledge of WEPs varies distinctly across different cultures [50]. The traditional knowledge concerning the use of WEPs by the Tujia ethnic group in Laifeng constitutes a significant component of their dietary culture, with the gathering and processing of WEPs serving as a tangible representation of their dietary practices.

The conventional utilization of WEPs by the Tujia ethnic group in Laifeng is extensive and varied. In total, 252 information reporters reported a total of 163 species of WEPs. In addition, different edible parts of 16 WEPs are



**Fig. 8** Heat map analysis of the top 59 CFSI of wild edible plants used by the Tujia ethnic group in Laifeng

**Table 3** Jaccard similarity index for wild edible plants between Tujia ethnic group in Laifeng and other ethnic groups in different areas

Nationality	Study area	Indices			Jaccard	References
		a	b	c		
Gelao	Northern Guizhou	163	141	50	0.20	[20]
–	Hunan Gaowangjie	163	48	33	0.19	[47]
Yao	Jianghua County	163	130	43	0.17	[48]
Yi	Liangshan Prefecture	163	105	25	0.10	[17]
Zhuang	Fangchenggang area	163	163	27	0.09	[49]

processed into 9 different categories of food through 15 consumption modes. Simultaneously, the pre-consumption procedure of WEPs thoroughly epitomizes the traditional wisdom of the Tujia cuisine culture in Laifeng [51]. The locals are well aware of the plants that require processing prior to consumption to eliminate their toxicity or unsuitable parts, in an effort to avoid a bitter or astringent taste and make the food more palatable. For instance, for all bamboo types, the local people blanch and soak freshly gathered tender stems before consumption, followed by either stir-frying or pickling.

Through long-term production and lifestyle practices, the Tujia ethnic group in Laifeng has developed a multitude of unique dietary cultures and habits. Many of these dietary practices preserve traditional knowledge associated with the utilization of WEPs, including oil tea soup preparation, Hezha creation, and Shefan production. The Tujia people enjoy consuming oil tea soup. In some Tujia communities in Laifeng, oil tea soup is a traditional delicacy that is essential for every meal. Oil tea soup, a snack characterized by the qualities of both tea and soup, is initially fried in oil to emanate a fragrant aroma. Subsequently, it is boiled with water, and spices such as *Allium sativum* and *Zingiber officinale* are added. After being removed from the pot, stir-fried rice and other ingredients are added, rendering it edible. When preparing oil tea soup, the Tujia ethnic group in Laifeng also adds flowers such as *Caragana sinica* and *Hedychium coronarium* as ingredients to enhance the aroma of the oil tea soup. Hezha, a soy product stewed with vegetables, constitutes a significant component of the Tujia ethnic group's cuisine. When preparing Hezha, soybeans are ground into soybean milk, followed by adding water, boiling, integrating shredded vegetables, and boiling again [52]. Besides integrating cultivated vegetables, the Tujia ethnic group in Laifeng occasionally utilizes wild vegetables, such as *Aralia elata*, as shredded vegetables for Hezha preparation. The Tujia ethnic group in Laifeng observes a traditional festival, known as She Day, on the second day of the second lunar month. The preparation of Shefan symbolizes the social aspect of the Tujia population in Laifeng [53]. There are ingredients such as *Artemisia*

*lancea*, glutinous rice, *Allium sativum*, *Allium macrostemon*, bacon, dried tofu, and others to steam Shefan. It is believed that consuming them and marking She Day stands for praying for a prosperous year.

It is worth mentioning that due to the mountainous area of Laifeng County, the Tujia ethnic group traditionally chooses high mountains to live in. Therefore, the Tujia ethnic group settlement area in Laifeng is fragmented into discrete units by the terrain, resulting in the regional characteristics of the traditional knowledge of WEPs of the Tujia ethnic group in Laifeng. For instance, exclusively the inhabitants of Lengshuixi Village in Dahe Town consider that the fruit of *Viburnum* sp. to be edible. Similarly, locales such as Green Water Town, Manshui Town, and Jiushi Town do not consume *Osmunda japonica*. Yet it is regarded as a valuable resource in areas such as Dahe Town, Geleche Town, and Baifusi Town. Overall, these variations in the usage of traditional knowledge of WEPs contribute to the diversity of culinary culture of the Tujia ethnic group in Laifeng.

Comparisons of Jaccard index with data from other areas and ethnic groups showed that areas with high *J*I values are geographically closer to our study area. Previous study has indicated that a high *J*I may reflect that the study area is located within the same geological belt, possessing similar socioeconomic and cultural characteristics [16]. Most of the areas compared are located in southwestern China, which may share similar dietary habits. Additionally, the distribution and composition of resources may also influence the lifestyle of local residents, potentially impacting the collection and consumption of WEPs [54]. Our results included 66 plant species that were not listed in other data sources, such as *Actinidia callosa* var. *henryi*, *Achyranthes longifolia*, *Codonopsis javanica* subsp. *japonica*, *Caragana sinica*, *Corallodiscus cordatulus*, and *Clerodendrum bungei*. This may be attributed to cultural differences.

#### WEPs of the Tujia ethnic group in Laifeng and their relationship with medicine and health

WEPs not only contribute to food diversity in local communities but also advocate health [55]. Even prior to the

scientific substantiation of the nutritional, protective, and therapeutic effects of WEPs, their health and medicinal benefits were already recognized within local communities [56]. The interconnection between food and medicine is widespread globally, and many WEPs overlap with traditional treatment systems and cannot be separated [51, 57]. Our research indicates that 70 species of WEPs used by the Tujia ethnic group in Laifeng serve medicinal purposes. These types are commonly employed to treat injuries and ailments such as traumatic injury, rheumatism, gynecological diseases, and knife wounds, bearing similarities to the remedies used in the Tujia and Miao communities in the region of Xiangxi, adjacent to Laifeng County [28]. The Tujia ethnic group in Laifeng often utilizes these medicinally valuable WEPs to prepare medicinal wine for either external or internal use to attain medicinal effects. In addition, we have also investigated the medicinal plants utilized by the Tujia ethnic group in Laifeng, such as *Dyssma versipellis* and *Achilles millefolium*. These are widely used for treating diseases but are excluded from Table 2.

The homology of medicine and food can be traced back to the Zhou Dynasty in China, which refers to certain foods that not only fulfill basic nutritional needs but also possess medicinal properties similar to herbs, plants, or traditional medicines [49]. In Laifeng, there exists a robust tradition of using food for treatment. Of the 70 kinds of WEPs that can be used for medicine, 23 types are considered as homologous plants of medicine and food by the Tujia people in Laifeng, or as part of a tonic diet. These plants are typically used for stewing with meat, bones, and other foods, playing a role in tonifying deficiency, strengthening muscles and bones, and enhancing eyesight. Stewing is the preferred method of consumption for its health benefits, a conclusion that aligns with research findings in other regions [49, 58].

It is worth mentioning that the potential toxicity of WEPs also needs to be taken seriously. Studies have shown that certain types of WEPs contain oxalates and other potentially toxic compounds, which often exert toxic effects on the human body [59, 60]. The fruit of *Illium henryi* is documented in the *Flora of China* as highly toxic. However, during the investigation, it was found that the Tujia ethnic group in Laifeng use their fruits as spices, and their consumption knowledge deserves further research. In addition, further toxicology research on WEPs should be conducted to identify specific toxic components and ensure consumer safety.

#### **Protection and utilization of WEPs of the Tujia ethnic group in Laifeng**

The mastery of knowledge about WEPs by informants is significantly positively correlated with their age, implying

that older informants possess more extensive knowledge [16]. With the development of the economy and society, the continuous trend of migrant workers has led to a high degree of hollowing out and aging within rural communities [61]. The majority of residents in the surveyed villages are elderly, with 68.7% of the respondents being over 60 years old. Similar to most local residents in the region, the traditional knowledge of using WEPs among the Tujia ethnic group in Laifeng is mainly transmitted orally [62]. However, the knowledge is fading away due to the aging of the informants, raising the possibility that no one will inherit it. Due to the improvement of living standards, an increasing number of local residents, especially the younger generation, opt to cultivate a single species or purchase food to fulfill their daily consumption needs, thereby presenting a challenge to the traditional utilization knowledge of WEPs. In addition, factors such as climate change, land use changes, and the impact of human activities on the environment pose a serious threat to the habitat of WEPs.

Concurrently, with the increasing emphasis placed on health preservation and dietary diversity by modern individuals, the opportunities for the development and utilization of WEPs have also increased. Through the application of modern food science methods to analyze the nutritional components, medicinal value, and functions of WEPs, the scientific validity of traditional knowledge of using WEPs is examined, thereby providing a foundation for their development and utilization. The nutritional, phytochemical, and pharmacological studies of some representative WEPs of the Tujia ethnic group in Laifeng have demonstrated the rationality of local people's use of WEPs and revealed their potential development and utilization value. The fruits of *Elaeagnus* sp. are rich in nutrients such as VC, VB1, phosphorus, and calcium, making them very suitable for processing and making fruit juice, fruit wine, and other products [63]. The main nutritional components of *Castanea henryi* are starch, sugars, and being rich in protein, fat, fiber, vitamin C, and mineral elements [64]. The fruit of *Pyracantha fortuneana* is rich in various vitamins, amino acids, anthocyanins, polysaccharides, and flavonoids, which have good in vitro antioxidant, antibacterial, whitening, lipid-lowering, blood coagulation promoting, anti-aging, anti-inflammatory, and other effects [65]. Indeed, some species of WEPs of the Tujia ethnic group in Laifeng have also been developed into healthy, ecological products, contributing to the local economy, such as *Nekemias grossedentata*, *Rosa roxburghii* f. *normalis*, and *Litsea mollis*. Combining the development of WEPs with local industries is a beneficial strategy to address the challenges of hollowing out local villages and aging populations [66].

Furthermore, the local homegarden management plays a protective role for WEPs, with the homegarden serving as an important gene pool for WEPs [54, 67]. In the survey, it was found that some WEPs were introduced and cultivated by the Tujia ethnic group in Laifeng from the wild in their own homegardens for ornamental, edible, and medicinal purposes, such as *Taxus wallichiana* var. *mairei*, *Caragana sinica*, and *Diurandthera major*. In addition, *Polygonatum sibiricum* is widely planted in the homegardens of the Tujia ethnic group in Laifeng due to its economic value. This practice, to some extent, protects the distribution and sustainable utilization of WEPs, while also making the homegardens of the Tujia ethnic group in Laifeng full of wildness and beautifying the living environment. Meanwhile, it is worth further studying how homegarden management affects WEPs in the future.

## Conclusion

The study conducted an ethnobotanical survey of WEPs across 26 villages in Laifeng, recording 163 species of WEPs from 64 families and 118 genera, along with corresponding traditional knowledge from the Tujia ethnic group in Laifeng. The traditional utilization of WEPs by the Tujia ethnic group in Laifeng is rich in knowledge, with local individuals displaying unique and rich insights into the collection, processing, and consumption of WEPs, which has become a part of the local food culture. WEPs play an important role in the vitality of the Tujia ethnic group in Laifeng, among which *Allium macrostemon*, *Houttuynia cordata*, *Hovenia dulcis*, *Forssythia suspensa*, and *Artemisia argyi* have high cultural importance. In the current social context characterized by changes in production and lifestyle, as well as rural revitalization, the traditional knowledge of WEPs among the Tujia ethnic group in Laifeng can promote local biodiversity conservation, healthy ecological diets, and the development and sustainable utilization of these plant resources. Decision-makers should consider the value of WEPs and protect and develop traditional knowledge related to local and WEPs.

## Abbreviations

WEP	Wild edible plant
RFC	Relative frequency of citation
FC	Frequency of citation
CFSI	Cultural food significance index
QI	Quotation frequency index
AI	Availability index
FUI	Frequency of utilization index
PUI	Parts used index
MFFI	Multifunctional food use index
TSAI	Taste score appreciation index
FMRI	Food-medicinal role index
V	Vegetables
F	Fruits
Ws	Wine-soaking plants

S	Spices
Fs	Food substitutes
Ts	Tea substitutes
N	Nuts
C	Coagulants
O	Oil

## Acknowledgements

We would like to thank all the respondents in the Laifeng Country for sharing their knowledge with us, especially those who helped us in the field survey.

## Author contributions

SWH planned and designed the study. SWH and PQH collected the data. SWH identified the plants. SWH interpreted and analyzed data and wrote the manuscript. SWH and ZY modified the manuscript. All authors read and approved the final version.

## Funding

This work has not received any funding support.

## Availability of data and materials

All data generated or analyzed during this study was included in this published article (along with the supplementary files).

## Declarations

### Ethics approval and consent to participate

Not applicable.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

Received: 25 July 2024 Accepted: 27 September 2024

Published online: 07 October 2024

## References

- Ju Y, Zhuo J, Liu B, Long C. Eating from the wild: diversity of wild edible plants used by Tibetans in Shangri-la region, Yunnan. *China J Ethnobiol Ethnomed*. 2013;9(1):1–22. <https://doi.org/10.1186/1746-4269-9-28>.
- Heywood VH. Ethnopharmacology, food production, nutrition and biodiversity conservation: towards a sustainable future for indigenous peoples. *J Ethnopharmacol*. 2011;137(1):1–15. <https://doi.org/10.1016/j.jep.2011.05.027>.
- Ceccanti C, Landi M, Benvenuti S, Pardossi A, Guidi L. Mediterranean wild edible plants: weeds or “new functional crops”? *Molecules*. 2018;23(9):2299. <https://doi.org/10.3390/molecules23092299>.
- Misra S, Maikhuri RK, Kala CP, Rao KS, Saxena KG. Wild leafy vegetables: a study of their subsistence dietetic support to the inhabitants of Nanda Devi biosphere reserve. *India J Ethnobiol Ethnomed*. 2008;4:1–9. <https://doi.org/10.1186/1746-4269-4-15>.
- Cheng Z, Zhang Q, Long C. Research status of ethnobotany (2017–2022). *Biodiv Sci*. 2022;30(07):98–110. <https://doi.org/10.17520/biods.2022372>.
- Pironon S, Soto GM. Plant agrodiversity to the rescue. *Nat Clim Change*. 2021;11(1):6–8. <https://doi.org/10.1038/s41558-020-00925-3>.
- Siddique KHM, Li X, Gruber K. Rediscovering Asia's forgotten crops to fight chronic and hidden hunger. *Nat Plants*. 2021;7(2):116–22. <https://doi.org/10.1038/s41477-021-00850-z>.
- Shrestha PM, Dhillion SS. Diversity and traditional knowledge concerning wild food species in a locally managed forest in Nepal. *Agroforest Syst*. 2006;66:55–63. <https://doi.org/10.1007/s10457-005-6642-4>.
- Cantwell-Jones A, Ball J, Collar D, Diazgranados M, Douglas R, Forest F, Hawkins J, Howes MJR, Ulian T, Vaitla B, Pironon S. Global plant diversity as a reservoir of micronutrients for humanity. *Nat Plants*. 2022;8(3):225–32. <https://doi.org/10.1038/s41477-022-01100-6>.

10. Yaipharembi N, Huidrom E, Nongalleima K, Singh HB. An Ethnobotanical study on the dietary use of wild trees as traditional vegetables by three ethnic communities in Manipur. *North East India Econ Bot.* 2023;77(3):324–39. <https://doi.org/10.1007/s12231-023-09582-x>.
11. Motti R, Bonanomi G, Lanzotti V, Sacchi R. The contribution of wild edible plants to the Mediterranean diet: an ethnobotanical case study along the coast of Campania (Southern Italy). *Econ Bot.* 2020;74(3):249–72. <https://doi.org/10.1007/s12231-020-09504-1>.
12. Hankiso M, Warkineh B, Asfaw Z, Debella A. Ethnobotany of wild edible plants in Soro District of Hadiya Zone, Southern Ethiopia. *J Ethnobiol Ethnomed.* 2023;19(1):1–23. <https://doi.org/10.1186/s13002-023-00588-2>.
13. Kang Y, Luczaj Ł, Kang J, Zhang S. Wild food plants and wild edible fungi in two valleys of the Qinling Mountains (Shaanxi, Central China). *J Ethnobiol Ethnomed.* 2013;9:1–20. <https://doi.org/10.1186/1746-4269-9-26>.
14. Kang Y, Luczaj L, Kang J, Wang F, Hou J, Guo Q. Wild food plants used by the Tibetans of Gongba Valley (Zhouqu County, Gansu, China). *J Ethnobiol Ethnomed.* 2014;10:20. <https://doi.org/10.1186/1746-4269-10-20>.
15. Guo CA, Ding XY, Addi YW, Zhang Y, Zhang XQ, Zhuang HF, Wang YH. An ethnobotany survey of wild plants used by the Tibetan people of the Yadong River Valley, Tibet, China. *J Ethnobiol Ethnomed.* 2022;18(1):28. <https://doi.org/10.1186/s13002-022-00518-8>.
16. Cheng Z, Lu X, Lin F, Naeem A, Long C. Ethnobotanical study on wild edible plants used by Dulong people in Northwestern Yunnan. *China J Ethnobiol Ethnomed.* 2022;18(1):1–21. <https://doi.org/10.1186/s13002-022-00501-3>.
17. Wang J, Seyler BC, Ticktin T, Zeng Y, Ayu K. An ethnobotanical survey of wild edible plants used by the Yi people of Liangshan Prefecture, Sichuan Province, China. *J Ethnobiol Ethnomed.* 2020;16(1):1–27. <https://doi.org/10.1186/s13002-019-0349-5>.
18. Zhang L, Chai Z, Zhang Y, Geng Y, Wang Y. Ethnobotanical study of traditional edible plants used by the Naxi people during droughts. *J Ethnobiol Ethnomed.* 2016;12(1):1–16. <https://doi.org/10.1186/s13002-016-0113-z>.
19. Geilebagan S, Zhang YY, Khasbagan HZ. Wild edible plants collected and consumed by the locals in Daqinggou, Inner Mongolia, China. *J Ethnobiol Ethnomed.* 2020;16(1):1–16. <https://doi.org/10.1186/s13002-020-00411-2>.
20. Xie J, Liu F, Jia X, Zhao Y, Liu X, Luo M, He Y, Liu S, Wu F. Ethnobotanical study of the wild edible and healthy functional plant resources of the Gelao people in Northern Guizhou. *China J Ethnobiol Ethnomed.* 2022;18(1):1–26. <https://doi.org/10.1186/s13002-022-00572-2>.
21. Cheng Z, Lu X, Hu X, Zhang Q, Ali M, Long C. Dulong people's traditional knowledge of *Caryota obtusa* (Arecaceae): a potential starch plant with emphasis on its starch properties and distribution prediction. *Econ Bot.* 2023;77(1):63–81. <https://doi.org/10.1007/s12231-022-09565-4>.
22. Thakur A, Singh S, Dulta K, Singh N, Ali B, Hafeez A, Vodnar DC, Marc RA. Nutritional evaluation, phytochemical makeup, antibacterial and antioxidant properties of wild plants utilized as food by the Gaddis—a tribal tribe in the Western Himalayas. *Front Agron.* 2022;4:1010309. <https://doi.org/10.3389/fagro.2022.1010309>.
23. Wu Z. A discussion on the formation and development trajectory of the Tujia ethnic group. *Guizhou Ethn Stud.* 1986;1:41–50. <https://doi.org/10.13965/j.cnki.gzmzyj.10026959.1986.01.009>.
24. Chen G, Xu L, Luo W. Study on traditional medicinal plant resource usage of Tujia nationality through ethnobotanical approaches in the Yongding district of the Zhangjiajie City. *J Minzu Univ China (Nat Sci Ed).* 2011;20(02):54–8. <https://doi.org/10.3969/j.issn.1005-8036.2011.02.012>.
25. Xiong X. Progress and prospect of Tujia people studies since the 21st century——based on CSSCI bibliometrics and subject word prediction. *J Yangtze Norm Univ.* 2022;38(05):60–9. <https://doi.org/10.19933/j.cnki.ISSN1674-3652.2022.05.008>.
26. Huang H. Tujia ethnic group. Urumqi: Xinjiang Fine Arts Photography Press; 2010.
27. Pei S, Huai H. Ethnobotany. Shanghai: Shanghai Science and Technology Press; 2007.
28. He JW, Gao HT, Liu X, Li Q, Luo J, Yan J, Luo BS. Botanical drugs for bruises used in the Xiangxi Region of China, a place rich in martial culture. *Tradit Med Res.* 2023;8(11):65. <https://doi.org/10.53388/TMR20230507002>.
29. He J, Yao P, Li Z, Bu L, Zeng Z, Long C. Investigation and suggestions on sustainable utilization of medicinal plants to dispel wind and eliminate dampness in Xiangxi Region. *Guihaia.* 2021;41(11):1839–49. <https://doi.org/10.11931/guihaia.gxzw202004027>.
30. Zhou X, Peng F, Xiong Z. Ethnobotanical study of “Shizhu Huanglian” (*Coptis chinensis*). *Hubei Agric Sci.* 2012;51(02):221–7. <https://doi.org/10.14088/j.cnki.issn0439-8114.2012.02.037>.
31. Yu Z, Liu X, Liu X, Huang Z, Han M, Gong X, Xie X, Yang Q, Jiang X, Wang MS, Tang WY. Ethnobotanical study of *Akebia* utilized by Tujia in Zhangjiajie. *Chin Wild Plant Resour.* 2018;37(04):51–3. <https://doi.org/10.3969/j.issn.1006-9690.2018.04.011>.
32. Zhang S, Li H. Investigation on traditional pharmacology of *Gesneriaceae* plants in Enshi Tujia ethnic group. *J Hubei Minzu Univ (Med Ed).* 2012;29(04):61.
33. Wu X. Tucang: ethnobotanical study on edible plants in the mountainous areas of Central China. Shanghai: Fudan University Press; 2010.
34. Yang W. Investigation of forest germplasm resources in Laifeng County of Enshi Tujia and Miao autonomous prefecture. *Hubei Forest Sci Technol.* 2020;49(06):49–54.
35. Tian C, Hou S, Xia P, Yao Z. Weeds occurrence and their green control in cigar tobacco fields of Laifeng County. *Tob Sci Technol.* 2022;55(12):25–32. <https://doi.org/10.16135/j.issn1002-0861.2022.0067>.
36. Compilation Committee of Laifeng County Annals. *Laifeng County Annals*. Beijing: Local records Press; 2014.
37. Wang Y. Common research methods in ethnobotany. Hangzhou: Zhejiang Education Publishing House; 2017.
38. Geng Y, Zhang Y, Ranjitkar S, Huai H, Wang Y. Traditional knowledge and its transmission of wild edibles used by the Naxi in Baidi Village, Northwest Yunnan province. *J Ethnobiol Ethnomed.* 2016;12:1–21. <https://doi.org/10.1186/s13002-016-0082-2>.
39. Chai ZZ, Wang C, Wang YH. Field survey on the dye plants used by Dai people in Xishuangbanna. *Guihaia.* 2017;37(01):56–63. <https://doi.org/10.11931/guihaia.gxzw201603027>.
40. Luo BS, Li F, Ahmed S, Long C. Diversity and use of medicinal plants for soup making in traditional diets of the Hakka in West Fujian. *China J Ethnobiol Ethnomed.* 2019;15(1):1–15. <https://doi.org/10.1186/s13002-019-0335-y>.
41. Pieroni A. Evaluation of the cultural significance of wild food botanicals traditionally consumed in Northwestern Tuscany. *Italy J Ethnobiol.* 2001;21(1):89–104.
42. Sujarwo W, Caneva G. Using quantitative indices to evaluate the cultural importance of food and nutraceutical plants: comparative data from the Island of Bali (Indonesia). *J Cult Herit.* 2016;18:342–8. <https://doi.org/10.1016/j.culher.2015.06.006>.
43. Ma Y, Luo B, Zhu Q, Ma D, Wen Q, Feng J, Xue D. Changes in traditional ecological knowledge of forage plants in immigrant villages of Ningxia. *China J Ethnobiol Ethnomed.* 2019;15(1):1–25. <https://doi.org/10.1186/s13002-019-0333-0>.
44. Yaseen G, Ahmad M, Sultana S, Alharrasi AS, Hussain J, Zafar M. Ethnobotany of medicinal plants in the Thar Desert (Sindh) of Pakistan. *J Ethnopharmacol.* 2015;2015(163):43–59. <https://doi.org/10.1016/j.jep.2014.12.053>.
45. Zhang Y, Zhang Z, Liu L, Li C, Zhu S, Liu X. Extraction and antioxidant activity of flavone from *Hovenia dulcis* peduncle. *Food Sci Technol.* 2024;49(04):251–60. <https://doi.org/10.13684/j.cnki.spkj.2024.04.036>.
46. Zhou X, Chen J, Fang J, Wang W. Research progress on antibacterial effects of *Ampelopsis grossedentata*. *Chin Tradit Herb Drugs.* 2017;48(22):4819–25. <https://doi.org/10.7501/j.issn.0253-2670.2017.22.034>.
47. Jiang N, Guo Q, Zhu C, Pan M, Zhou Y, Liu S, Peng X. Investigation and analysis of wild edible plant resources in Gaowangjie national natural reserve of Hu'nan Province. *Forest By-Prod Spec Ch.* 2020;03:66. <https://doi.org/10.13268/j.cnki.fbsic.2020.03.030>.
48. Fang Q, Cheng Z, Zhang R, Luo B, Long C. Wild edible plants of the Yao people in Jianghua, China: plant-associated traditional knowledge and practice vital for food security and ecosystem service. *J Ethnobiol Ethnomed.* 2024;20(1):80. <https://doi.org/10.1186/s13002-024-00724-6>.
49. Liu S, Huang X, Bin Z, Yu B, Lu Z, Hu R, Long C. Wild edible plants and their cultural significance among the Zhuang ethnic group in Fangchenggang, Guangxi, China. *J Ethnobiol Ethnomed.* 2023;19(1):52. <https://doi.org/10.1186/s13002-023-00623-2>.
50. Cámara-Leret R, Bascompte J. Language extinction triggers the loss of unique medicinal knowledge. *P Natl Acad Sci USA.* 2021;118(24):e2103683118. <https://doi.org/10.1073/pnas.2103683118>.

51. Zhang Q, Cheng Z, Fan Y, Zhang D, Wang M, Zhang J, Sommano S, Wu X, Long C. Ethnobotanical study on edible flowers in Xishuangbanna, China. *J Ethnobiol Ethnomed*. 2023;19(1):43. <https://doi.org/10.1186/s13002-023-00608-1>.
52. Wu X. "Ethnic foods" and regional identity: the Hezha Restaurants in Enshi. *Food Foodways*. 2004;12(4):225–46. <https://doi.org/10.1080/07409710490518546>.
53. Yao W, Liu P. On the features of the diet culture of Tujia minority in the western part of Hubei Province. *J Hubei Minzu Univ (Philos Social Sci)*. 2007;3:11–5. <https://doi.org/10.13501/j.cnki.42-1328/c.2007.03.038>.
54. Luo J, Li Q, He JW, Yan J, Zhang S, Chang X, Wu T. Local knowledge of homegarden plants in Miao ethnic communities in Laershan region, Xiangxi area, China. *J Ethnobiol Ethnomed*. 2024;20(1):37. <https://doi.org/10.1186/s13002-024-00676-x>.
55. Jeambey Z, Johns T, Talhouk S, Batal M. Perceived health and medicinal properties of six species of wild edible plants in North-East Lebanon. *Public Health Nutr*. 2009;12(10):1902–11. <https://doi.org/10.1017/S136898009004832>.
56. Etkin NL. Medicinal cuisines: diet and ethopharmacology. *Int J Pharmacogn*. 1996;34(5):313–26. <https://doi.org/10.1076/phbi.34.5.313.13246>.
57. Zhang L, Zhang Y, Pei S, Geng Y, Wang C, Wang Y. Ethnobotanical survey of medicinal dietary plants used by the Naxi people in Lijiang Area, Northwest Yunnan, China. *J Ethnobiol Ethnomed*. 2015;11:1–11. <https://doi.org/10.1186/s13002-015-0030-6>.
58. Luo B, Tong Y, Liu Y, Zhang Y, Qin Y, Hu R. Ethnobotanical insights into the traditional food plants of the Baiku Yao community: a study of cultural significance, utilization, and conservation. *J Ethnobiol Ethnomed*. 2024;20(1):52. <https://doi.org/10.1186/s13002-024-00691-y>.
59. Pinela J, Carvalho AM, Ferreira ICFR. Wild edible plants: nutritional and toxicological characteristics, retrieval strategies and importance for today's society. *Food Chem Toxicol*. 2017;110:165–88. <https://doi.org/10.1016/j.fct.2017.10.020>.
60. Kristanc L, Kreft S. European medicinal and edible plants associated with subacute and chronic toxicity part I: plants with carcinogenic, teratogenic and endocrine-disrupting effects. *Food Chem Toxicol*. 2016;92:150–64. <https://doi.org/10.1016/j.fct.2016.04.007>.
61. Zhu Q, Qiao J, Han D, Xiao J, Xu J, Wang W. Labor force outflow and influencing factors in specialized villages of Henan Province. *Prog Geog*. 2024;43(3):573–86. <https://doi.org/10.18306/dlkxjz.2024.03.012>.
62. Tardío J, Pardo-de-Santayana M, Morales R. Ethnobotanical review of wild edible plants in Spain. *Bot J Linn Soc*. 2006;152(1):27–71. <https://doi.org/10.1111/j.1095-8339.2006.00549.x>.
63. Dong Z, Lei X, Zhou R, Fu X, Liu Y, He Y, Hua X, Cao B, Wang Z, Li J. Component analysis and quality evaluation on nutrients in 40 *Elaeagnus* fruits. *Non Wood Forest Res*. 2019;37(01):107–16. <https://doi.org/10.14067/j.cnki.1003-8981.2019.01.016>.
64. He Y, Zhu G, Fan X. Comparative analysis on nut qualities of four *Castanea henryi* cultivars. *Hubei Forest Sci Technol*. 2022;51(05):18–22.
65. Qiu J, Liu F, Liang G, Zhu L, Ran H, Liu Y, Wu M. Correlation analysis of nutritional components and climatic factors of wild *Pyracantha fortuneana* fruit in Guizhou Province. *Biotic Resour*. 2023;45(06):592–9. <https://doi.org/10.14188/j.ajsh.2023.06.009>.
66. Li M, Jia N, Lenzen M, Malik A, Wei L, Jin Y, Raubenheimer D. Global food-miles account for nearly 20% of total food-systems emissions. *Nat Food*. 2022;3(6):445–53. <https://doi.org/10.1038/s43016-022-00531-w>.
67. Xiao Y, Li C, Xu Y. Study on ethnobotany of homegarden plants of Dai Nationality in Xishuangbanna. *J Plant Resour Environ*. 2021;30(02):59–67. <https://doi.org/10.3969/j.issn.1674-7895.2021.02.08>.

## Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.