

Ethnobotanical of the Wild Edible Healthy Functional Plant Resources of the Gelao People in Northern Guizhou, China

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Abstract

Introduction: Gelao is a unique minority in southwest China, which has a unique culture on the utilization of edible plant resources, including a large number of medicinal plant resources. They believe that at least 61 species are edible and have medicinal value, and they are used for health care in their lives. Ethnobotany research can understand the local knowledge of Gelao people regarding the traditional use of plants and the relationship between Gelao people and their living environment in order to keep and pass on this traditional knowledge forever. At the same time, we can also explore wild plant resources with high utilization value such as medicine plants, discuss their development value, and provide appropriate suggestions for protecting biodiversity and sustainable development and utilization of wild resources in minority areas.

Methods: The edible wild plant resources and their applied ethnic knowledge were investigated by taking Daozhen County, Wuchuan County and Zheng'an County in Northern Guizhou as the study areas, and Gelao residents as the main interviewees and by using the methods of literature research, village interviews, participatory observation and quantitative evaluation of ethnobotany.

Results: The survey results showed that 151 species of wild plants belonging to 67 families are collected and eaten by Gelao residents in this area, among which 61 species are considered by Gelao residents to have medicinal value, accounting for 40.4% of the total, and 43 were collected in Chinese Pharmacopoeia (2020 edition). There are 57 plants species with fruits as their edible parts, so they eat more snack items. This was followed by 54 species of plants whose young seedlings and leaves are the edible parts, most of which are consumed cold or stir-fried. In addition, other edible parts include roots or rhizomes (bulbs), flowers, whole plants, seeds, fruiting bodies, and stems. There were two consumption modes: raw and cooked. Raw foods are mainly consumed as snacks, which mainly comprise fruits. Cooked foods are mainly vegetables that mainly consumed cold or stir-fried. In addition, some plant resources were be used seasoning, infused wines, condiments, and miscellaneous grains. The main medicinal functions are nourishing and reducing heatiness, the nourishing were mainly from "Shen" and Liliaceae, while the reducing heatiness were mainly from plants of Asteraceae, and others include anti-hangover, anticancer and insecticidal functions. There were 38 species of important edible wild plants (CFSI>500) in Northern Guizhou, and these wild plants have a high utilization rate in this area. *Houttuynia cordata* Thunb. and *Mentha suaveolens* Ehrh. are the most representative edible wild plants in this area. The species, edible parts, edible categories, consumption modes and medicinal functions of edible wild plants in this area are diverse, and the traditional knowledge on their uses is rich. However, the number of wild plant species eaten by the reporters and their related processing information were positively correlated with age, which indicates that the rich traditional knowledge in this area is gradually disappearing with the urbanization process.

Conclusions: Gelao is a special ethnic group in mountainous area of northern Guizhou with a rich history of edible wild plant. With the development of social economy, the traditional knowledge accumulated from generations to generations is gradually forgotten by the younger generation, and the inheritance is faced with great risks. This study collect, sort out and spread these traditional knowledge, which is of great value

to the protection and inheritance of these precious traditional knowledge and also fully demonstrate the value and importance of our work.

Background

Wild plant resources play an indispensable role in the history of human development [1]. They are not only used to fill gaps in food supply caused by drought or resource shortages but also play an important role in maintaining the livelihood security of people in resource-deficient areas and in balancing the nutritional value of diets [2, 3]. With globalization, the food crisis has become prominent, and edible wild plant resources, especially those with a long tradition of use as food, will become an important supplementary food source for humans [4, 5].

The Gelao people are a unique minority in Southwest China, of whom more than 90% live in the northern part of Guizhou Province [6]. The mountainous geographical environment and abundant precipitation [7] make this an area rich in wildlife diversity, with many rare, endemic and ancient groups preserved. Northern Guizhou is one of the key land biodiversity areas in China given its high concentration of important biodiversity groups, which also has international significance [8, 9]. At the same time, the mountainous geography leads to a lack of sufficient cultivated land in this area. As a result, abundant wild plant resources have become an important supplementary food source for the Gelao people [10]. Over their long history, the Gelao people, combining their environmental conditions, religious beliefs and cultural customs, formed a unique traditional food culture and accumulated rich traditional knowledge in the utilization of wild plant resources [11]. This traditional knowledge related to the available wild plant resources has a great influence on the protection and sustainable development and utilization of regional biodiversity [12, 13]. However, the Gelao people have no written language, and their traditional culture is thus mainly spread by word-of-mouth [6]. This mode of communication is easily thwarted by urbanization. With the rapid development of China's economy and information technology, the relocation of ethnic minorities is also accelerating, and the rich ethnic knowledge accumulated for thousands of years by ethnic minorities without their own written language is rapidly disappearing [14, 15]. This is no exception for the Gelao nationality. Therefore, a new way for communicating the traditional knowledge of the Gelao people is required.

Through ethnobotany research, we can understand the local knowledge of Gelao people regarding the traditional use of plants and the relationship between Gelao people and their living environment in order to keep and pass on this traditional knowledge forever. At the same time, we can also explore wild plant resources with high utilization value, discuss their development value, and provide appropriate suggestions for protecting biodiversity and sustainable development and utilization of wild resources in minority areas.

Materials And Methods

Study area

In this study, Daozhen County, Wuchuan County and Zheng 'an County in northern Guizhou are taken as the investigation areas (Figure 1). This region spans 28°9' to 29°13' N, 107°4' to 108°13' E. It is located in the southeast, middle and east of Dalou Mountain and the upper reaches of the Furong River. It has a subtropical humid monsoon climate and a mid-subtropical humid monsoon climate; its average annual temperature is 8~16.14°C, and the annual precipitation is 800~1400 mm. This area is a multiethnic settlement, and the main Chinese ethnic groups are the Gelao, Miao and Han. Typical traditional agriculture in mountainous areas and industrial parks are the mainstay, and the main crops are corn, rice, potato, tea, pepper, *Chimonanthus praecox* and other Chinese herbal medicines, such as *Codonopsis radix*, *Bletilla striata* Rchb.f. and *Pseudocydonia* (C. K. Schneid.) C. K. Schneid. This area is located in the intersection zone between Guizhou and Chongqing, which is an important economic and cultural intersection area between southern Chongqing and northern Guizhou and has developed a unique diversified local culture.

Ethnobotanical information collection

In the field investigation process, key-person interviews, semistructured interviews and participatory rural evaluation methods were adopted, and the basic content of interviews followed the "5W+1H" question pattern [16]. This helped to uncover the traditional knowledge of edible wild plants and record, sort out and analyze the basic information provided by information reporters and the local common names, edible parts, edible categories, consumption modes and medicinal functions of edible plants.

The participatory observation method was used [17] to understand the species, uses, functions, edible parts and edible methods of wild plants collected and eaten in the daily life of the local people.

Video telephone interviews were also conducted, and the interview content was the same as that of the field survey.

Ethnobotanical quantitative evaluation method

The cultural food significance index (CFSI) was used to evaluate the edible wild plants in this area.

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

Where FQI is the frequency of quotation index, AI is the commonness 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 [18].

According to the Common Research Methods of Ethnobotany [17], these indices are graded and assigned as follows: Frequency of quotation index (FQI): the number of people who mentioned a plant among all information reporters; Availability index (AI): divided into very common (4.0), common (3.0), average (2.0) and uncommon (1.0); Frequency of utilization index (FUI): divided into more than once a week (5.0), once a week (4.0), once a month (3.0), more than once a year but less than once a month (2.0), once a year (1.0)

and unused for nearly 30 years (0.5); Parts used index (PUI): divided into whole plant (4.00), overground and underground parts (3.00), tender leaves and stems and leaves (2.00), flowers and fruits (1.50), tender roots, stems and stipules (1.00) and buds (0.75); Multifunctional food use index (MFFI): divided into raw food and cold salad (1.5), boiling, stewing and seasoning (1.0), special purpose and condiments (0.75) and raw food as snacks (0.50); Taste score evaluation index (TSAI): divided into excellent (10.0), very good (9.0), good (7.5), fair (6.5), poor (5.5) and very poor (4.5); Food-medicinal role index (FMRI): divided into very high (as medicinal food: 5.0), high (as medicine to treat a certain disease: 4.0), moderately high (very healthy food: 3.0), moderately low (healthy food, unknown efficacy: 2.0) and unknown or possibly toxic (1.0).

Specimen identification

In the process of investigation, we collect the first recorded specimens, and record the collection time, detailed place names (including latitude, longitude and altitude), local and Latin names of the plants. Specimens were identified based on the electronic version of the full text of the Flora of China (<http://www.iplant.cn/frps>) [19], the Illustration of Flowering Plants in Hengduan Mountain [20], and the Field Identification Manual of Common Plants in China, Hengshan Book [21]. Plants collected during the study were identified to the species level and specimens were prepared and sorted, and collected information were analyzed and visualized using charts. Voucher Specimen numbers were provided in Table 1 and the specimens were deposited in the Life Science Museum and Pharmacognosy Teaching and Research Section of Zunyi Medical University.

Results

Basic information from reports

The age distribution of the 174 information reporters was divided into age groups. The results showed that all information reporters were aged between 17 and 89, including 15 between 17 and 25, 24 between 26 and 30, 18 between 31 and 35, 33 between 36 and 45, 47 between 46 and 55, and 18 between 56 and 6, and 19 between 65 and 89. There were 89 males and 85 females, with a male to female ratio of nearly 1:1. There were 147 information reporters of Gelao nationality (accounting for 84.48% of the total), 21 of the Miao nationality and 6 of the Han nationality. The results show a positive correlation between the species of wild plants eaten by the reporter and age, and with the increase in the reporter's age, the number of edible plant species and corresponding information that can be provided are more abundant. This pattern is consistent with our earlier research on edible wild plant resources in Hasi Mountain [22]. A total of 16.40 species of wild plants have been eaten by 15 reporters under the age of 25, most of which are common wild vegetables or fruits, and most of them only know the local names of plants, and they can provide less information about specific plants and eating methods. However, 19 reporters over 65 years old have eaten as many as 66.05 kinds of wild plants per capita, which is 4.03 times that of reporters under 25 years old, and some special knowledge is only known by elderly individuals, but no one has made use of this

knowledge to make special foods, such as using wild fruit to make wine and using *Vitex negundo* L. and other plants as condiments to make sauce (Figure. 2).

Sources of Gelao edible wild plants in Northern Guizhou

The edible plants in Gelao people's residential areas in Northern Guizhou were statistically analyzed. Incomplete statistics showed that there were 151 species (varieties) of traditional edible wild plants in this area, belonging to 67 families, with Asteraceae, Rosaceae and Poaceae being the most abundant families, with 16, 13 and 8 species, respectively (Table 1). Among the 16 species of edible wild plants in Asteraceae, the edible part of *Dendranthema indicum* (L.) Des Moul. is the inflorescence, whereas in all the other plants the tender seedlings and leaves are the edible parts. Among these plants, several are mainly used to make a kind of food called "Ba", such as *Gnaphalium affine* D.Don, *Artemisia lavandulifolia* DC., and *Artemisia indica* Willd (Figure 3). Regarding the 13 edible wild plants in Rosaceae, the fruits of most are the edible part, and they are mainly consumed as snacks. Lamiaceae, Lamiaceae, Campanulaceae and Apiaceae also had a good number of edible species. Asparagaceae Moraceae and Araceae each had four edible wild species. However, Araceae may contain more edible species, but it was difficult to distinguish them during the investigation.

Edible parts of Gelao edible wild plants in Northern Guizhou

Among the 151 species of edible wild plants, fruits (including young fruits) were the most common edible parts, with 57 species. Trees and shrubs were the main types of plants, and they were most frequently consumed as snacks. Most of the preserved fruits have poor taste or are abundant but not easy to preserve, such as *Rosa roxburghii* Tratt., *Chaenomeles speciosa* (Sweet) Nakai, and *Ficus carica* L. The fruits used for making infused wine cannot be eaten directly, but they have specific medicinal functions, such as *Rosa laevigata* Michx. and *Taxus wallichiana* var. *chinensis* (Pilg.) Florin. There were 54 species of young stems and leaves (tender leaves, tender seedlings, tender buds) consumed, most of which were consumed cold or stir-fried. Most of the plant types are annual herbs or perennial herbaceous plants that die in autumn and winter and grow new buds in spring, represented by Asteraceae and Apiaceae. In addition, the edible parts included roots or rhizomes (bulbs), flowers, twigs, whole plants, fruiting bodies, etc. There were two consumption modes: raw and cooked. Raw foods were mainly consumed as snacks, which mainly included fruits. Cooked foods were mainly vegetables, which were mainly consumed cold or stir-fried with young stems and leaves. In addition, the edible wild plants were also used as seasoning, infused wine, condiments, miscellaneous grains, etc. Some plants had many edible parts, such as *Allium macranthum* Baker and *Pyracantha fortuneana* (Maxim.) H.L.Li. (Table 1). Some local names of plants are named by the foods what they can be made. For example, Doufuchai (*Premna microphylla* Turcz.) means a plant that can make tofu (Figure 5), and Bing Fenzi (*Nicandra physalodes* (L.) Gaertn.) means that the seeds of this plant are mainly used to make a summer-relieving drink.

Medicinal function of Gelao edible wild plants in Northern Guizhou

Among the 151 species of edible wild plants counted, there were 61 species that local residents believe have medicinal value in addition to edible value, accounting for 40.4% of the total (Table 1). Medicinal functions included mainly nourishing and reducing 'heatiness', and for most of the nourishing plants, the roots were the edible parts. Local residents refer to the plant roots with nourishing effects as "sen", such as tangshen (*Codonopsis radix*), paoshen (*Adenophora stricta* Miq.), tutangshen (*Campanumoea javanica* Blume), turenshen (*Talinum paniculatum* (Jacq.) Gaertn.) and hongshen (*Phytolacca americana* L.). Edible plants used for reducing heatiness and relieving summer heat were mainly herbaceous plants, including some vines and trees whose edible parts were the flowers and leaves. Plants whose leaves and flowers are soaked in water for drinking are collectively called "tea", such as KuDing tea, Tian tea and JinYinHua tea. Apart from general nourishing effects, a few edible wild plants also have some special nourishing effects. Generally, nourishing foods are used to make stews or infused wine with chicken, pork ribs and pig trotters, such as stewed chicken with DangShen and stewed pork ribs with paoshen. Special nourishing plants include Yang-tonifying plants (to improve male sexual function) and brain-nourishing plants. Generally, Yang-tonifying plants are used to make infused wine and drunk, such as Jinyingzi and Yinyanghuo, and brain-nourishing plants are mostly seeds and kernels, such as Hetao. Heatiness-reducing edible wild plants are mostly eaten cold or drunk in tea, such as Ma Lan, Pugongying, and Jinyingzi.

Quantitative evaluation of Gelao edible wild plants in Northern Guizhou

The comparison results of the cultural food significance index (CFSI) of Gelao edible wild plants in Northern Guizhou are shown in Table 2 and Figure 6. The edible wild plants in this area were clustered based on the CFSI, and those with broad application and high value, which played an important role in the local people's traditional diet, are highlighted. There were 38 species of plants ranked in the first most important category (CFSI>500), represented by *Houttuynia cordata* Thunb., *Mentha suaveolens* Ehrh. (Yuxiangcai) (Figure 4), *Taraxacum mongolicum* Hand.-Mazz., *Callipteris esculenta* (Retz.) J.Sm., *Perilla frutescens* (L.) Britton and *Capsella bursa-pastoris* (L.) Medik. These edible wild plants play an important role in the lives of local people and are the best products on local people's daily table. These plants are widely distributed in this area and are seen almost everywhere. *H. cordata* Thunb., *M. suaveolens* Ehrh., *T. mongolicum* Hand.-Mazz., *P. frutescens* (L.) Britton, *T. paniculatum* (Jacq.) Gaertn., *Agastache rugosa* Kuntze and other plants are the favorite garden plants of local residents and are common in flower beds, vegetable gardens and even flower pots. There were 55 species of plants ranked in the second most important category (500>CFSI≥100). Fruits (snacks) and vegetables are the main plants in this category, and the CFSI value of wild vegetables was higher than that of fruits, ranking at the top of the second category. These plants are also widely distributed in this area and provide a variety of fruits and vegetables for local residents. The reason for their relatively low CFSI value is mainly related to their edible parts, taste and degree of domestication and cultivation by local residents. There were 44 species of plants

ranked in the third most important category ($100 > \text{CFSI} \geq 10$). Roots (rhizomes) and fruits were the main edible parts of the plants in this category. Moreover, there were many plants with medicinal functions in this category, such as asparagus and *Asparagus cochinchinensis* (Lour.) Merr., *Ophiopogon japonicus* (Thunb.) Ker Gawl., *Mentha haplocalyx* Briq., *Ganoderma lucidum* (Leyss. Ex Fr.) Karst., *C. speciosa* (Sweet) Nakai, *Lonicera macrantha* Spreng. and *Polygonatum odoratum* (Mill.) Druce. The fourth most important category ($10 > \text{CFSI}$) had the lowest number of plants, with 14 species. The plants included in this category were mainly plants with special distribution areas, poor taste or special uses, such as *V. negundo* L.

Discussion

Guizhou Province located in southwest China, has abundant rainfall and changeable terrain. The special geographical environment has created a suitable environment for plants, and a wide variety of plant resources have also provided abundant food resources to local residents [10]. The results show that, compared with our previous research results on edible wild plant resources in arid areas of northwest China's Loess Plateau (Hassan area), the edible wild plant resources collected in the concentrated areas of the Gelao people in Northern Guizhou are much richer in species, edible categories and consumption modes. The Gelao people have a rich traditional knowledge of plant identification, medicinal uses and resource protection.

Gelao people's botanical understanding of edible wild plant resources

Based on long-term experience, the local Gelao people have accumulated a wealth of traditional knowledge on the rich and varied local edible wild plant resources, not only in terms of their use as food but also as medicine. However, regarding the strict classification of plants, the local residents' level of understanding is limited. For some plants with more related species, the local residents often collectively call them a name according to their edible parts. For example, many plants in the Caprifoliaceae are consumed as honeysuckle, and individuals can only distinguished them based on leaf size, flower length and color. Only red fruits and yellow fruits can be distinguished among various *P. fortuneana* (Maxim.) H.L. Li varieties, and the differences among other species are attributed to their differences in light, water and soil nutrient requirements in the growing environment. The tender seedlings of various ferns are collectively called juecai/juetai moss. Some individuals can tell the differences among these ferns, but they are mostly distinguished based on the picking season, taste and so on.

However, not all related plants are treated as the same kind. Although the local residents collectively refer to the fruits of *Rubus* L. (Rosaceae) as paoer/peier, they have named them different types of "bubble" according to their color, taste and picking season; for example, yellow bubbles and black bubbles are named after their color, and sour bubbles are named after their taste. *M. haplocalyx* Briq. is a traditional Chinese medicine [23], and *M. suaveolens* Ehrh. is a close relative that is often used as a fake substitute in traditional Chinese medicine. However, local residents believe that *M. suaveolens* Ehrh. is the genuine *M.*

haplocalyx Briq., that is, fish coriander, and that *M. haplocalyx* Briq. is used as the substitute. *Pseudocydonia* is also divided into two kinds by local residents according to the shape of the fruit: one is sharp and medicinal whereas the other is round and edible.

Gelao people's understanding of the medicinal uses of edible wild plant resources

The Gelao people's understanding of the medicinal function of plants in this area is mainly based on their knowledge of traditional Chinese medicine. Nourishing, heatiness-reducing, appetizing and dampness-eliminating are all descriptions of the efficacy of traditional Chinese medicine [24]. The Gelao people's description of a plant's specific medicinal function is also consistent with those of traditional Chinese medicine, but it is relatively much simpler. The heatiness-reducing plants eaten by the Gelao people are generally aimed at inflammatory fever (excessive internal heat) diseases, such as mouth ulcer, gingival inflammation, halitosis, etc., and can also be used to regulate the similar internal heat effects caused by eating spicy hot pot, while plants that can relieve summer heat are mainly used to deal with hot summer weather and prevent heatstroke. In addition, some knowledge comes directly from traditional Chinese medicine or modern medicine. For example, plants whose edible parts are seeds (kernels) are generally considered to have nourishing effects, and the information that *Carya cathayensis* Sarg. kernels can nourish the brain comes from traditional Chinese medicine [25]. This may be directly related to the fact that *T. chinensis* (Pilg.) Florin (HongDouShan) contains taxol, a prominent anticancer drug [26]. However, we do not know whether the fruit of *T. chinensis* can cure cancer.

Gelao people's knowledge of plant medicinal uses may also be related to the local climate. The region is rich in plant resources that are used as raw materials for fermented foods. These fermented foods include fruit wines, vinegar, sauces, fermented bean curd, and fermented beverages. However, due to the influence of industrialization, it is difficult to find Gelao residents who can provide accurate information about fermented foods at present, but we have learned much such information from local supermarkets. In addition, local residents also like to soak fruits in low-alcohol liquor to make fruit wines with various flavors and colors, such as YangMei wine, CiLi wine and FuPenZi wine. In addition to fruit wine, residents in this area are also enjoy other types of infused wines. Various plants are soaked in various kinds of wines according to their efficacy in treating diseases, medicinal functions or other special properties. Typical infused wines can be used for dispelling wind and dampness (*Gastrodia elata* Blume), improving male sexual function (*Epimedium borealiguizhouense* S. Z. He & Y. K. Yang, *R. laevigata* Michx.) and to fight cancer (HongDouShan fruit). Of course, in most cases, many plant species are mixed and soaked together, and some medicinal wines are soaked with animal medicinal materials.

Some plants that are considered poisonous by modern knowledge are also fully utilized as food by residents of Northern Guizhou, the most important of which is the Araceae [27]. Many species of Araceae are called YeMoYu by locals. *Solanum tuberosum* L. and other Araceae are usually steamed and cooked with potatoes, sweet *Solanum tuberosum* L., Dioscorea, etc., and there is no information about poisonings from consumption of these plants. This is somewhat similar to eating *Aconitum* L. plants in some areas of

Yunnan [28]. The toxic components in the roots of these plants may be destroyed during high-temperature cooking [29], making the food safe. However, local people also have the habit of eating fresh DuJuanHua. However, we did not obtain any useful information during the study on how they distinguish toxic from nontoxic DuJuanHua. However, information about poisonous mushrooms was mentioned repeatedly, which may be related to the local government's vigorous awareness campaign on the subject. For example, some young children can sing the following song about poisonous mushrooms: "Red umbrella, white stalk, after eating you'll be dead...".

Gelao people's understanding of resource protection

Among the edible wild plants with CFSI>500, except *Osmunda lancea* Thunb., *A. elata* (Miq.) Seem. and *C. bursa-pastoris* (L.) Medik., which are rich in resources and are not damaged by eating (young seedlings and leaves are the main edible parts), a large number of plants are cultivated in the courtyards of local residents, such as *H. cordata* Thunb., *M. suaveolens* Ehrh., *Zingiber striolatum* Diels., *Lilium brownii* F.E.Br. ex Mieliez. and *Polygonatum sibiricum* Delar. ex Redoute. The main purpose of cultivation is to facilitate eating, and at the same time, it is an effective protection strategy for these frequently eaten resources.

Local residents also consciously protect some rare plants. For example, the whole plant of *G. elata* Blume is not dug, and a certain number of provenances will be reserved so that this valuable medicinal and edible plant resource can sustainably provide food for residents. The collection of *E. borealiguizhouense* S. Z. He & Y. K. Yang has gradually changed from the previous whole-plant digging to the method of collecting leaves and keeping roots. For plants whose roots are eaten, residents basically follow the principle of picking large ones and keeping small ones. At the same time, they will consciously spread the seeds of rare plants to help their population expand, such as *Codonopsis radix*, *T. paniculatum* (Jacq.) Gaertn., and *L. brownii* F.E.Br. ex Mieliez. (pearl bud).

Current status of Gelao people's traditional cultural knowledge

Although the reporters were mainly Gelao people, we found that there was no considerable difference between the residents belonging to this ethnic group, their Miao and Tujia neighbors, and the local Han people. This differs from the ethnic groups in northern China, such as Tibetans and Mongolians, who have their own characteristics [30, 31]. The traditional cultural knowledge of the Gelao people is basically only displayed in festivals or performances for travelers. Their knowledge of the uses of wild plant resources is no different from that of the local Han people. The 151 species of edible plants cited by the Gelao reporters are found in various recipes or works by the Han people [10, 32]. The ethnic characteristics of the Gelao people have thus basically died out. At the same time, we also found that the amount of information provided by the reporters was positively correlated with age. Most young people under the age of 25 only know that there are certain plants that can be eaten, and they have eaten them before, but they know little about the plants and how to prepare them.

Conclusions

Gelao is a special ethnic group in mountainous areas of northern Guizhou who affected by mountainous geographical environment and shortage of land resources, their ancestors had the habit of collecting wild plants as food supplement. During the process of long-term collection and utilization of wild plant resources, Gelao people have summed up a great deal of traditional knowledge, which has been passed down and accumulated from generation to generation. However, with the development of social economy, the traditional knowledge accumulated from generations to generations is gradually forgotten by the younger generation, and the inheritance is faced with great risks. Through the ethnobotanical research, we collect, sort out and spread these traditional knowledge, which is of great value to the protection and inheritance of these precious traditional knowledge.

Declarations

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CRedit authorship contribution statement

FMW organized the study team and provided technical support. JX and FSL executed the research plan. FMW and JX identified the specimen and wrote the manuscript. YXZ and SL collected the data. FMW reviewed the manuscript. All authors took part in the field works. All authors were involved in the drafting and revision of the manuscript and approved the final revision. All authors read and approved the final manuscript.

Data availability

The authors confirm that the data supporting the findings and conclusions of this study are available in the article and its supplementary material.

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Declaration of Competing Interest

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

Abbreviations

5W+1H Why What Where When Who How

FQI Frequency of quotation 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

CFSI Cultural food significance index

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Table 1

Table 1 is available in the Supplementary Files section.

Table 2

Table.2 Quantitative evaluation index of edible wild plants in Hassan area

Plant name	FQI	AI	FUI	PUI	MFFI	TSAI	FMRI	CFSI
<i>A. macranthum</i>	47	3	3	4	1.5	10	3	761.40
<i>A. chrysanthum</i>	58	3	3	3	1.5	10	3	704.70
<i>A. cochinchinensis</i>	22	2	2	3	0.75	9	5	89.10
<i>O. japonicus</i>	31	2	2	2	0.75	9	5	83.70
<i>P. sibiricum</i>	52	3	2	3	0.75	7.5	5	263.25
<i>P. odoratum</i>	28	2	1	3	0.75	7.5	5	47.25
<i>L. brownii</i>	49	4	2	3	1.5	9	5	793.80
<i>H. citrina</i>	66	4	3	1.5	1.5	6.5	4	463.32
<i>S. china</i>	9	2	1	0.75	1.5	6.5	5	6.58
<i>S. altissima</i>	7	2	1	0.75	1.5	5.5	5	4.33
<i>P. orientalis</i>	121	5	1	2	0.75	7.5	5	340.31
<i>P. frutescens</i>	127	4	3	3	1.5	9	5	3086.10
<i>P. frutescens</i>	35	3	1	3	1.5	9	5	212.63
<i>R. pseudoacacia</i>	88	5	2	1.5	1.5	9	5	891.00
<i>A. rugosa</i>	92	5	3	3	1	10	5	2070.00
<i>M. suaveolens</i>	136	5	4	3	1	10	5	4080.00
<i>M. haplocalyx</i>	22	3	1	3	1	9	5	89.10
<i>S. affinis</i>	36	2	1	3	1.5	10	4	129.60
<i>I. kudingcha</i>	28	2	2	2	1	6.5	5	72.80
<i>P. lobata</i>	54	5	1	3	1	9	5	364.50
<i>V. gigantea</i>	19	5	2	2	1.5	7.5	2	85.50
<i>R. simsii</i>	24	2	1	1.5	0.5	7.5	2	5.40
<i>V. bracteatum</i>	36	1	1	1.5	0.5	9	2	4.86
<i>G. lucidum</i>	45	1	1	4	1	9	5	81.00
<i>L. gracile</i>	22	4	1	3	1	6.5	5	85.80
<i>P. edulis</i>	92	3	3	2	1.5	9	3	670.68
<i>P. bambusoides f. lacrima-deae</i>	78	3	2	2	1.5	9	3	379.08
<i>D. tsiangii</i>	36	3	1	2	1.5	9	3	87.48
<i>C. quadrangularis</i>	73	3	2	2	1.5	10	3	394.20

<i>I. tessellatus</i>	135	4	2	1.5	0.75	6.5	5	394.88
<i>P. australis</i>	75	3	1	1.5	0.75	4.5	3	34.17
<i>C. lacryma-jobi</i>	63	3	2	1.5	1	4.5	5	127.58
<i>T. wallichiana</i> var. <i>chinensis</i>	11	2	1	1.5	1	4.5	5	7.43
<i>C. cathayensis</i>	114	4	4	1.5	1.5	10	5	2052.00
<i>E. pungens</i>	34	2	2	1.5	0.5	7.5	3	22.95
<i>G. pentaphyllum</i>	27	1	2	1.5	1	7.5	5	30.38
<i>Z. striolatum</i>	69	4	3	2	1.5	9	3	670.68
<i>V. betonicifolia</i>	18	5	2	3	1.5	7.5	5	303.75
<i>M. cathayensis</i>	73	3	3	1.5	1.5	9	2	266.09
<i>S. emarginatum</i>	21	5	1	1.5	1.5	7.5	3	53.16
<i>S. sarmentosum</i>	32	5	1	1.5	1.5	7.5	3	81.00
<i>S. fui</i>	17	2	2	1.5	1.5	9	4	55.08
<i>A. stricta</i>	42	1	2	3	1	7.5	5	94.50
<i>D. bulleyana</i>	7	1	2	3	1	7.5	5	15.75
<i>C. tubulosa</i>	8	1	2	3	1	7.5	5	18.00
<i>C. pilosula</i> subsp. <i>tangshen</i>	52	2	2	3	1	7.5	5	234.00
<i>C. pilosula</i>	31	2	2	3	1	7.5	5	139.50
<i>C. javanica</i>	26	1	2	3	1	7.5	5	58.50
<i>A. indicus</i>	45	5	3	3	1.5	7.5	5	1139.06
<i>S. brachyotus</i>	83	5	3	2	1.5	9	3	1008.45
<i>C. crepidioides</i>	45	5	2	2	1.5	9	2	243.00
<i>G. affine</i>	147	5	4	2	1	9	2	1058.40
<i>A. indica</i>	78	5	4	1.5	1	9	4	842.40
<i>A. lavandulifolia</i>	92	5	3	1.5	1	7.5	3	465.75
<i>A. argyi</i>	56	4	3	1.5	1.5	7.5	5	567.00
<i>T. sect. Erythrocarpa</i>	135	5	3	3	1.5	9	5	4100.63
<i>D. indicum</i>	77	5	2	1.5	1	6.5	5	375.38
<i>C. arvense</i> var. <i>integrifolium</i>	38	5	1	2	1.5	7.5	3	128.25

<i>A. trinervius subsp. ageratoides</i>	124	5	3	2	1.5	7.5	3	1255.50
<i>Y. japonica</i>	36	4	2	2	1.5	9	3	233.28
<i>S. wightianus</i>	111	4	3	2	1.5	9	3	1078.92
<i>I. polycephala</i>	102	3	3	2	1.5	9	3	743.58
<i>I. chinensis</i>	53	5	2	2	1.5	9	3	429.30
<i>S. subulatum</i>	92	5	3	2	1.5	7.5	3	931.50
<i>C. mollissima</i>	101	2	3	1.5	0.5	9	4	163.62
<i>L. litseifolius</i>	32	2	2	1.5	1	9	5	86.40
<i>G. elata</i>	54	1	1	3	1	7.5	5	60.75
<i>C. album</i>	41	5	2	2	1.5	6.5	3	239.85
<i>T. sinensis</i>	98	2	3	1.5	1.5	9	3	357.21
<i>R. japonica</i>	63	4	2	1.5	1.5	9	3	306.18
<i>P. multiflorus</i>	48	5	1	2	1.5	7.5	5	270.00
<i>F. dibotrys</i>	22	5	3	1.5	1.5	7.5	3	167.06
<i>A. cordifolia</i>	47	4	3	1	1.5	7.5	3	190.35
<i>B. alba</i>	39	4	3	1	1	7.5	3	105.30
<i>P. microphylla</i>	63	3	2	1.5	1	7.5	3	127.58
<i>V. negundo</i>	13	4	1	2	0.5	4.5	2	4.68
<i>P. oleracea</i>	125	5	2	4	1.5	9	3	2025.00
<i>T. paniculatum</i>	35	4	2	4	1.5	9	5	756.00
<i>A. chinensis</i>	142	3	2	1.5	0.5	9	3	172.53
<i>A. polytricha</i>	46	2	2	4	1.5	10	3	331.20
<i>S. chinensis</i>	77	2	2	1.5	0.5	9	3	62.37
<i>A. trifoliata</i>	132	3	3	1.5	0.5	10	3	267.30
<i>O. fragrans</i>	54	5	2	1.5	0.75	9	3	164.03
<i>L. quihoui</i>	57	5	2	1.5	1	5.5	5	235.13
<i>N. commune</i>	84	5	3	4	1.5	10	3	2268.00
<i>B. edulis</i>	127	2	3	4	1.5	10	3	1371.60
<i>M. esculenta</i>	58	2	2	4	1.5	10	3	417.60
<i>A. elata</i>	117	5	3	2	1.5	9	3	1421.55

<i>R. roxburghii</i>	138	4	4	1.5	0.5	9	3	447.12
<i>C. japonica</i>	65	3	2	1.5	0.5	9	3	78.98
<i>C. speciosa</i>	65	3	2	1.5	0.5	6.5	4	76.05
<i>R. laevigata</i>	43	4	2	1.5	0.75	5.5	5	106.43
<i>P. fortuneana</i>	117	5	4	1.5	1	7.5	4	1053.00
<i>D. filipendula</i>	92	5	3	1.5	0.5	9	3	279.45
<i>F. vesca</i>	47	3	3	1.5	0.5	9	3	85.66
<i>R. coreanus</i>	58	4	3	1.5	0.5	9	3	140.94
<i>R. inopertus</i>	49	4	3	1.5	0.5	9	3	119.07
<i>R. pluribracteatus</i>	66	4	3	1.5	0.5	9	3	160.38
<i>R. parvifolius</i>	73	4	3	1.5	0.5	9	3	177.39
<i>R. idaeus</i>	57	4	3	1.5	0.5	9	5	230.85
<i>C. xerophila</i>	32	2	1	1.5	0.5	7.5	3	10.80
<i>N. physalodes</i>	72	2	2	1.5	1	10	3	129.60
<i>S. nigrum</i>	23	5	1	2	1.5	7.5	2	51.75
<i>A. bella-donna</i>	15	3	1	1.5	0.5	6.5	1	2.19
<i>A. officinarum</i>	21	2	1	1.5	0.5	7.5	3	7.09
<i>L. macrantha</i>	32	3	2	1.5	0.75	6.5	5	70.20
<i>L. humilis</i>	19	3	2	1.5	0.75	6.5	5	41.68
<i>L. hypoglauca</i>	7	1	1	1.5	0.75	6.5	5	2.56
<i>H. cordata</i>	149	5	5	4	1.5	7.5	5	8381.25
<i>H. sibthorpioides</i>	37	5	2	4	1.5	9	3	599.40
<i>L. sinense</i> var. <i>hupehense</i>	32	3	1	2	1.5	7.5	3	64.80
<i>O. javanica</i>	104	4	3	2	1.5	7.5	3	842.40
<i>C. japonica</i>	95	5	4	2	1.5	7.5	3	1282.50
<i>C. inclusum</i>	31	5	1	2	1.5	7.5	3	104.63
<i>B. papyrifera</i>	51	5	2	1.5	0.5	9	3	103.28
<i>M. alba</i>	77	4	3	1.5	0.5	10	5	346.50
<i>F. carica</i>	68	3	2	1.5	0.5	7.5	3	68.85
<i>F. tikoua</i>	59	3	1	1.5	0.5	7.5	3	29.87

<i>V. amurensis</i>	44	1	1	1.5	0.5	7.5	3	7.43
<i>P. americana</i>	57	5	1	3	1	5.5	1	47.03
<i>C. bursa-pastoris</i>	94	5	4	4	1.5	9	3	3045.60
<i>D. lotus</i>	22	1	1	1.5	0.5	7.5	3	3.71
<i>D. kaki</i>	41	1	1	1.5	0.5	9	3	8.30
<i>H. acerba</i>	79	1	2	1.5	0.5	9	3	32.00
<i>D. japonica</i>	17	1	3	3	1	9	5	68.85
<i>D. nummularia</i>	43	3	3	3	1	9	5	522.45
<i>D. nipponica</i>	53	3	3	3	1	9	5	643.95
<i>P. massoniana</i>	76	5	3	1.5	0.5	10	3	256.50
<i>P. tabuliformis</i>	32	1	1	1.5	0.5	9	3	6.48
<i>C. esculenta</i>	139	5	4	3	1.5	10	3	3753.00
<i>P. ternata</i>	46	5	1	3	1	6.5	1	44.85
<i>A. variabilis</i>	72	5	1	3	1	6.5	1	70.20
<i>A. konjac</i>	94	4	2	3	1	7.5	3	507.60
<i>C. antiquorum</i>	83	3	2	3	1	7.5	1	112.05
<i>O. dillenii</i>	68	2	2	4	1.5	7.5	3	367.20
<i>A. tricolor</i>	45	4	4	4	1.5	9	3	1166.40
<i>E. borealiguizhouense</i>	25	3	2	4	0.75	5.5	5	123.75
<i>L. bulbifera</i>	45	2	2	2	1.5	7.5	1	40.50
<i>U. fissa</i>	34	4	2	2	1.5	7.5	1	61.20
<i>G. hirta</i>	42	4	3	1.5	0.5	9	3	102.06
<i>M. rubra</i>	39	3	2	1.5	0.5	7.5	3	39.49
<i>M. dodecandrum</i>	16	3	1	1.5	0.5	7.5	3	8.10
<i>T. fuciformis</i>	11	1	3	4	1.5	10	3	59.40
<i>G. biloba</i>	34	3	2	1.5	1	9	5	137.70
<i>T. ruticarpum</i>	27	2	2	1.5	0.75	6.5	3	23.69
<i>Z. simulans</i>	22	3	2	1.5	0.75	6.5	3	28.96
<i>L. pungens</i>	53	3	3	1.5	0.75	7.5	3	120.74

<i>O. lancea</i>	37	5	4	3	1.5	9	3	899.10
<i>O. corniculata</i>	21	5	2	1.5	0.5	9	3	42.53
<i>R. vinosa</i>	47	2	3	4	1.5	9	3	456.84
<i>C. albuminosa</i>	73	2	3	4	1.5	9	3	709.56

Figures

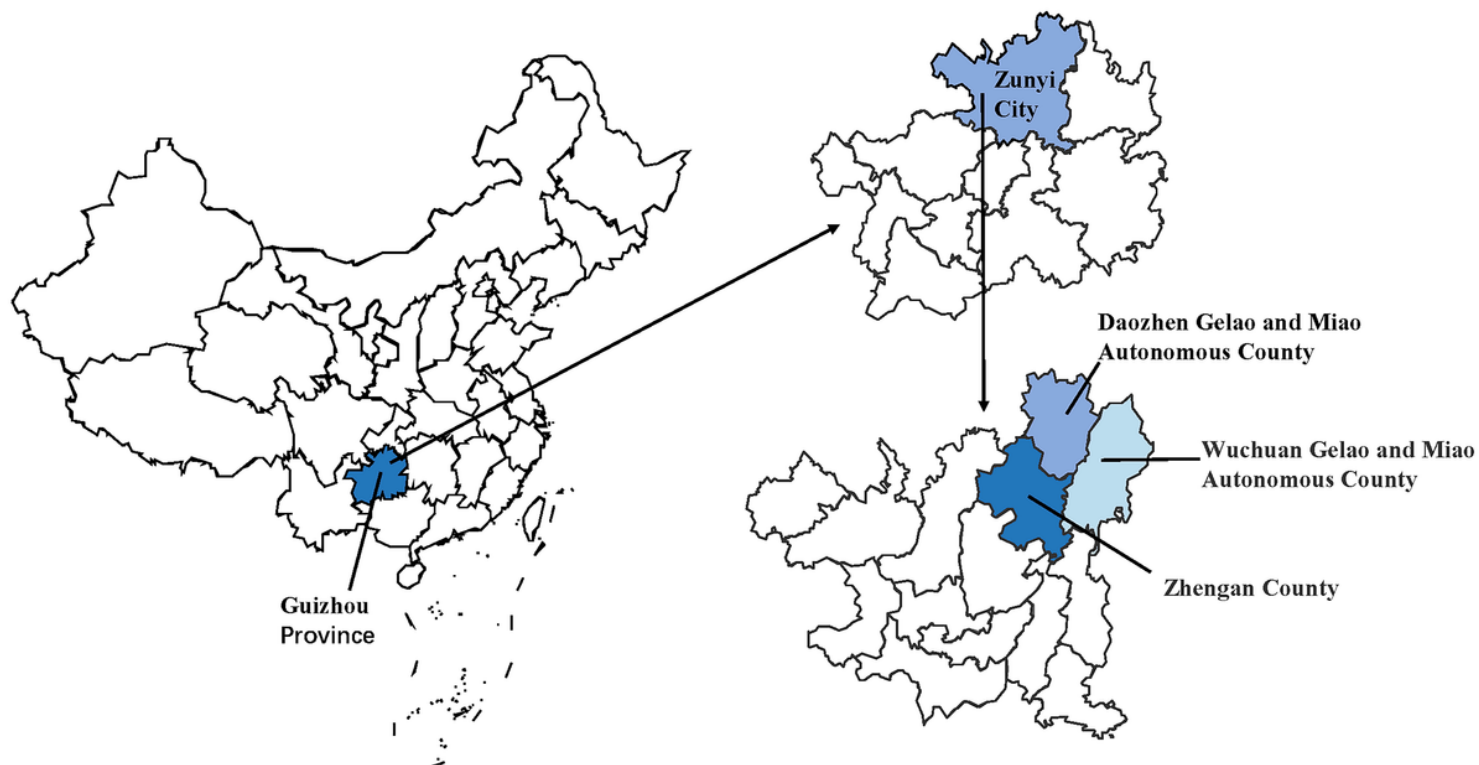


Figure 1

Survey area. Daozhen County, Wuchuan County and Zheng'an County belong to a minority autonomous county in the northeastern mountainous area of Guizhou Province.

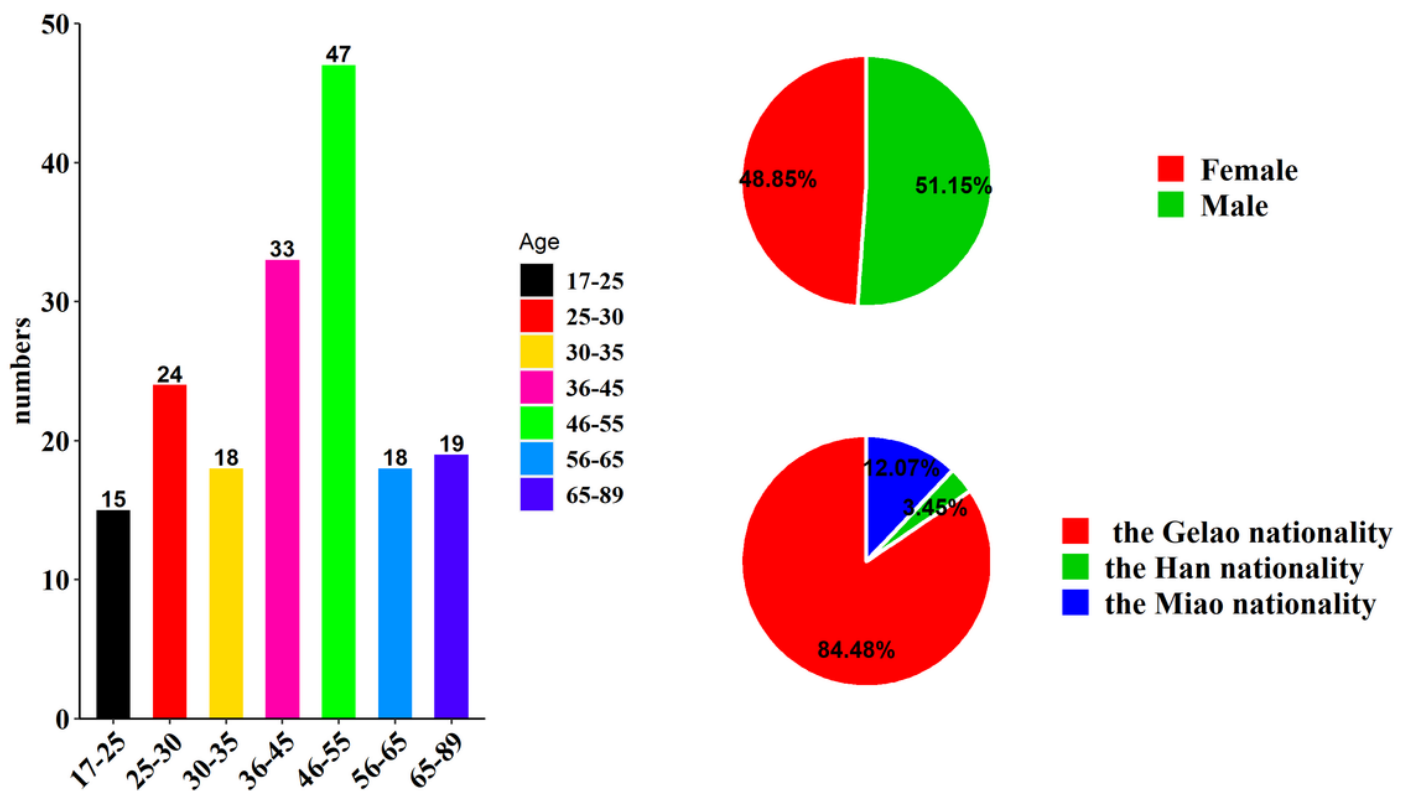


Figure 2

Basic information about the interviewees



Figure 3

Buns made with *Gnaphalium affine* D. Don (A) and *Artemisia lavandulifolia* DC. (B). A is “Qingming”Ba which is made by flour and *Gnaphalium affine* D. Don with the function of enhancing digestion. B is “Aimomo” which is made by flour and *Artemisia lavandulifolia* DC. with the function of sterilization and digestion.

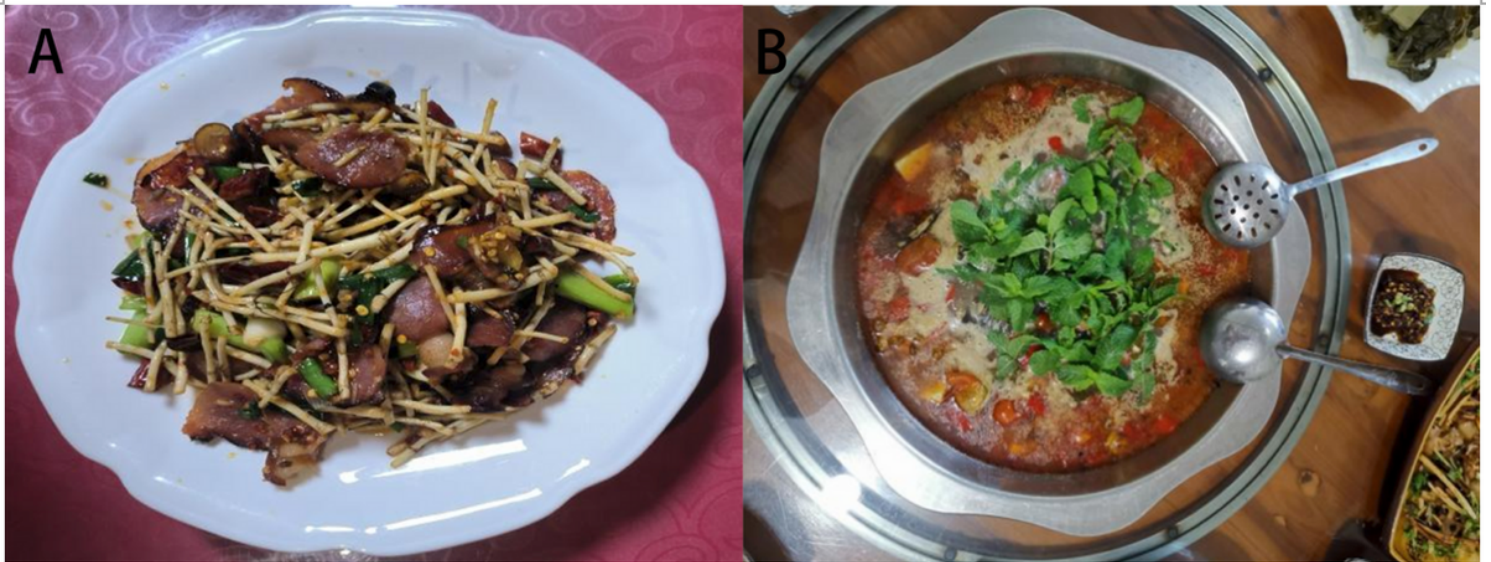


Figure 4

Stir-fried preserved pork with *Houttuynia cordata* Thunb. (A) and pork cooked with *Mentha suaveolens* Ehrh. (B). *Houttuynia cordata* Thunb. and *Mentha suaveolens* Ehrh. are usually used as seasonings of Gelao nationality, which have relieve inflammation and antiviral effects.

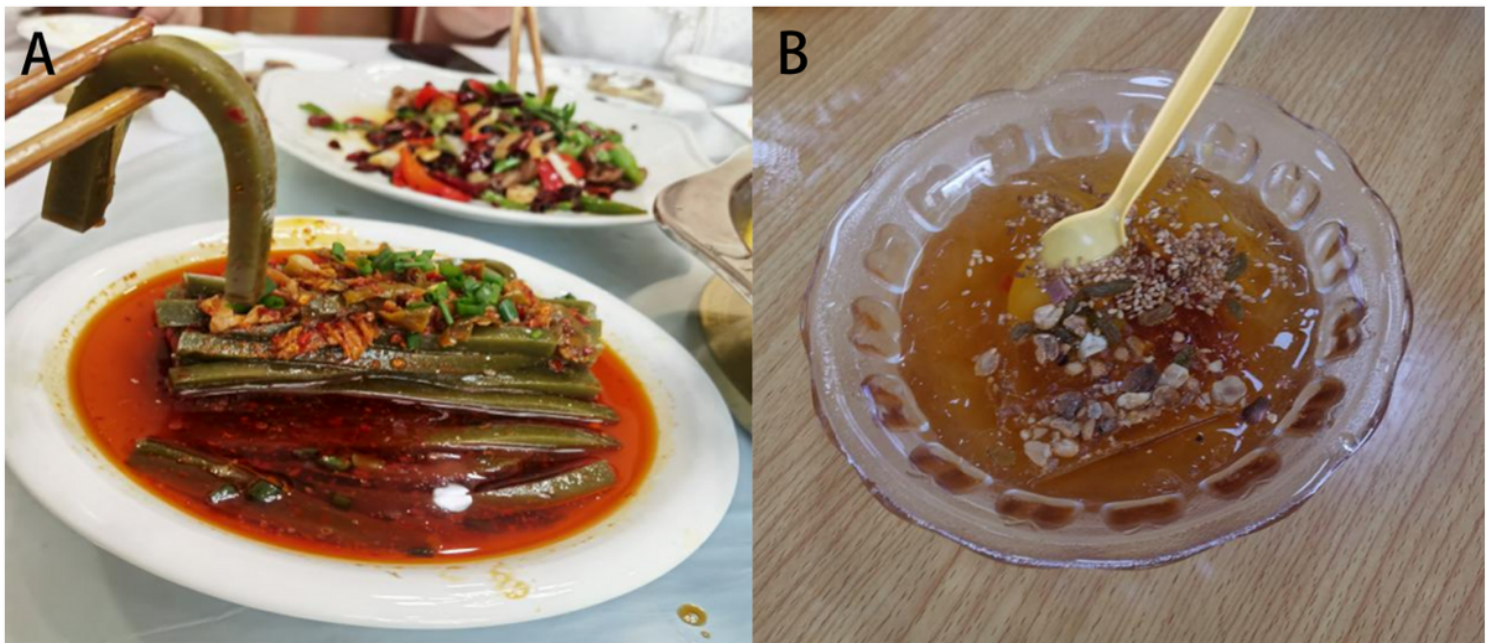
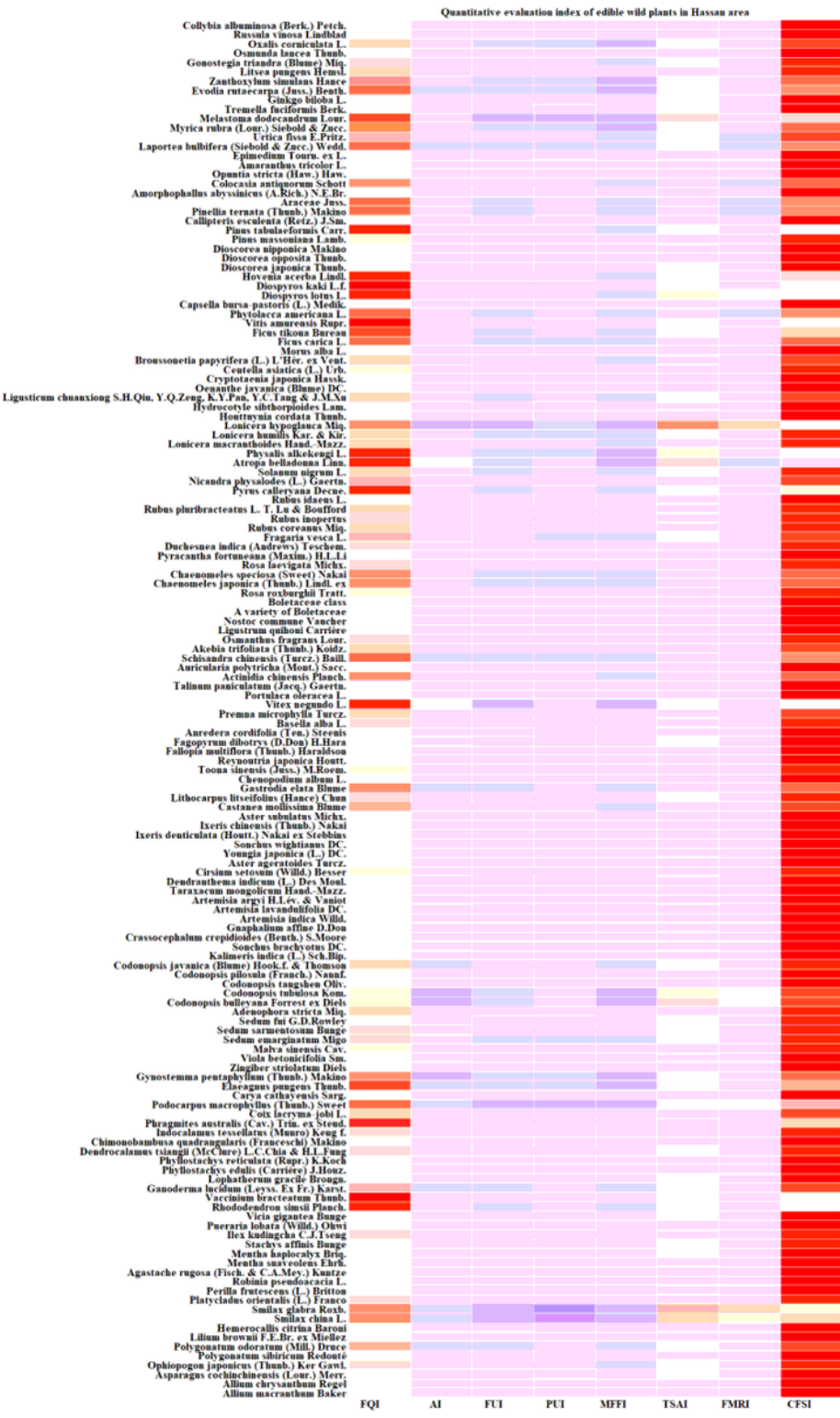


Figure 5

A kind of tofu made with *Premna microphylla* Turcz. (A) and a beverage made with *Nicandra physalodes* (L.) Gaertn. (B). A is made by adding plant ash into the juice kneaded from the leaves of *Premna microphylla* Turcz. B is made from *Nicandra physalodes* (L.) Gaertn. seeds by boiling and freezing.



Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Table1.docx](#)
- [Supplementarymaterials.xlsx](#)