Traditional knowledge and its transmission of wild edibles used by the Naxi in Baidi Village, northwest Yunnan province

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Abstract

Background: The collection and consumption of wild edibles is an important part in livelihood strategies throughout the world. There is an urgent need to document and safeguard the wild food knowledge, especially in remote areas. The aims of this study are to accomplish detailed investigation of wild edibles used by the Naxi in Baidi village and evaluate them to identify innovative organic food products. Also, we aim to explore the characteristics of distribution and transmission of the traditional knowledge (TK) on wild edibles among the Naxi.

Methods: Data was collected through a semi-structured interview of key informants above the age of 20 years, chosen carefully by a snowball sampling. The interviews were supplemented by free lists and participatory observation methods. Informants below 20 years were interviewed to test their knowledge of traditional practices. A quantitative index like Cultural Importance Index (CI) was used to evaluate the relative importance of the different wild edibles. Linear regression and t-test were performed to test variation in the TK among the informants of different age groups and genders.

Results: Altogether 173 wild edible plant species belonging to 76 families and 139 genera were recorded in the study. Cardamine macrophylla, C. tangutorum and Eutrema yunnanense have traditionally been consumed as an important supplement to the diet, particularly during food shortages as wild vegetables. The age was found to have a significant effect on TK, but there was no significant difference between male and female informant in knowledge abundance. The traditional food knowledge was dynamic and affected by social factors. Also, it was descending partly among younger generations in Baidi.

Conclusion: Baidi village is a prime example of a rapidly changing community where local traditions compete with modern ways of life. Overall, this study provides a deeper understanding of the Naxi peoples’ knowledge on wild edibles. Some wild edibles might have an interesting dietary constituent, which need in-depth studies. Such detailed studies can help to promote the market on one hand and protect TK in the other. Protecting TK from disappearing in succeeding generations is necessary, and understanding the dynamics of TK is one important solution to this dilemma.

Keywords: Knowledge dynamics, Quantitative index, Organic food products, Naxi people, Gender

Background

Wild plants have gained renewed interest in recent years, and the tradition of gathering wild plants continues to the present day [1, 2]. The collection and consumption of wild edibles is an important part of livelihood strategies throughout the world [3]. Wild food also is an essential supplement to the local people’s daily nutrition in developing countries [2, 4, 5]. Schunko and Vogl [6] mentioned that collection and use of wild edibles are not only part of the cultural history of a region but also are part of people’s local identity, pride, and traditions. Moreover, wild foods can contribute to overcoming periods of food scarcity, and dishes made of wild foods can be functional foods [6]. Wild plant sources and their use are under severe threat as a result of economic globalization, environmental degradation and cultural homogenization [7]. There is an urgent need to document the traditional knowledge of plant uses and
conserve its habitat [7–9], especially where it is not yet completely lost [10]. Wild edibles are not an exception to this fact. It is important to document local knowledge before it vanishes along with the knowledgeable people, in the sense that it is slowly disappearing with the demise of those who have traditionally upheld it [11].

China is a fascinating and significant arena for studies on wild food use traditions, particularly Yunnan province [12]. Northwest Yunnan is one of biodiversity hotspots and is home to many minority groups. Some ethnobotanical researchers have documented wild edibles used by different minorities of this region [13–18].

The Naxi people, one of the main ethnic groups in northwest Yunnan, have accumulated rich knowledge on using wild edibles. Baidi Village (Sanba Naxi Nationality Township, Shangri-La City, Deqing Prefecture) is located in 27° 30′ N to 27° 28′ N and 100° 01′ E to 100° 05′ E, the Northwest of Yunnan Province, roughly between the two cities Lijiang and Diqing (Fig. 1). It is 103 kilometers from Shangri-La City and 170 kilometers from Lijiang city. The mountain in its territory belongs to Haba Snow Mountain, Yunling Mountain range. Baidi has an area of 8.26 km² and reaches an elevation of approximately 4500 m while networks of streams and rivers including Geji and Yangtze dissect numerous valleys, which make it encompass a rich diversity of plants. The village has 15 sections or groups of the settlement, eight of which belong to the Naxi (Fig. 1). In the northwest of the village, there is a big limestone terrace, Baishuitai (literal meaning white water terrace). Local people believe this place as a shrine and perform various religious activities [19]. It also is a famous scenic spot that attracts the considerable number of tourists all over the world.

Baidi comprises approximately 3000 inhabitants, and the majority of them are the Naxi ethnic minority along with about 25 % of the Han people and the Yi people. The Naxi in Baidi is culturally related to the Lijiang Naxi, but they are usually considered the purest of their race [20, 21]. Joseph Rock, who is a well-known researcher, studied the Naxi people closely and mentioned that the Naxi in Baidi is the most aboriginal among Naxi, and they follow their old religious customs, which are a mixture of shamanism and the pre-Buddhist Bon religion of Tibet. There are neither Lama temples nor Chinese temples as in the Lijiang city. The Naxi believes that mountains, rivers, trees, herbs, animals and humans, all have their unique spirits. Among these spirits of nature, the Shu spirits are the most important. According to a Naxi myth, farmland and livestock are in the realm of men while Shu rules the mountains and the rivers. Men frequently invaded the territory of Shu creating hostility and fights between men and Shu. Dongba priests, the mediators with spiritual powers, were then called to regain the harmony between them. They agreed that human beings must worship the Shu god of nature every year, in return Shu would provide men's need from nature and stop assaulting them. In this way, men and Shu lived in harmony afterward [21]. The religion and ceremonies of the Naxi represent the long history of keeping equilibrium between man and nature to guarantee the sustainability of natural resources.

Wild edibles in this article refer to those plants that grow without cultivation, including fungi and lichen, and consumed by Naxi people or local animals. It mostly includes native species growing in their natural habitat, but sometimes managed, as well as introduced species.
that have been naturalized [22]. In this paper, we documented angiosperm, gymnosperm, fern, fungi, lichen and algae, which are sources of vegetables, vitamin and functional food, forage, starch and sugar, edible pigments, oil and fats, beverage and honey source.

This study aims to accomplish detailed investigation into wild edibles used by the Naxi in Baidi village and evaluate them to identify innovative organic food products. Also, we aim to explore the distribution of traditional knowledge (TK) and its transmission pathways to the young generation of Naxi.

**Methods**

**Data collection**

The fieldwork was conducted in 2013 and 2014. Field studies included free lists, semi-structured interviews, and participatory observation. The total of 86 key informants was selected using snowball sampling [23, 24]. The ages of informants ranged from 21 to 91 (mean age 57 years old), and the sex ratio of informants was almost 1:1 (male to female was 42 to 44). To that 20 other participants below an age of 20 years (mean age 14 years old) were randomly invited. These youngsters were asked to fill the questionnaire with the purpose of documenting the traditional knowledge transmission.

In the first phase of the field research, participants were invited to list all wild edibles still used on a regular basis, and those were used only in the past. The interviews include the questions that were relevant to document detail information on all wild edibles including the source of knowledge about plant use. Every use report on edible plants included (1) number of useful plants mentioned and their botanical families, (2) most frequently used plant parts, (3) most cited species, (4) ways of consumption and preparation, (5) season of collection, (6) habitats where collected. In the second phase, we collected the wild edibles mentioned above with local gatherers. The participatory observation was utilized to secure the cultural implication of plant gathering, preparation, and distribution of wild edibles. Nomenclature of all vascular plants follows *Flora of China* [25], and the voucher specimens deposited at the herbarium of the Kunming Institute of Botany, CAS (KUN).

**Data analysis**

Ethnobotanical information collected from 86 key informants was properly documented and analyzed. We classified the wild edibles into the following categories based on usage or main chemical composition: carbohydrates, protein, oil and fats, vegetable, vitamin and functional food, beverage, condiments, forage, honey source and chewing and stimulate plants.

To quantify the use frequency of certain species, we calculated the utilization frequency [26], using following formula:

\[ f = \frac{N_m}{N_i} \]

In this formula, \( f \) represents the utilization frequency, \( N_m \) is the number of informants mentioned certain species, \( N_i \) represents the total number of informants. Higher the value of \( f \), the more frequent is the plant used.

Each species mentioned by an informant within one food category was a use report (UR). To determine diversity of uses and the consensus of informants, we used the Cultural Importance Index (CI), which can be mathematically expressed as [27]:

\[ CI_s = \sum_{u=1}^{N_u} \sum_{i=1}^{N_i} UR_{ui}/N \]

\( N \) is the total number of informants, and \( NC \) is the total number of use categories. Therefore, the CI is the sum of the proportion of informants that mention each of the use categories for a given species. This index indicates the spread of the use (number of informants) of each species, as well as the diversity of its uses. Every additional use category is a measure of the relative importance of each plant use [27]. Therefore, multiple uses of a species is an indicator of higher CI value.

Also, the Cultural Food Significance Index (CFSI) was calculated to evaluate the cultural significance of wild edibles using following formula given by Andrea Pieroni [28]:

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

This index takes into consideration a wide variety of factors in the evaluation of a specific wild edible. The CFSI include quotation frequency (QI, frequency of quotation index), availability(AI, availability index), typology of the used parts(PUI, parts used index), frequency of use (FUI, frequency of utilization index), kind and number of the food uses (MFFI, multifunctional food use index), taste appreciation (TSAI, taste score appreciation index) and perceived role as food medicine (FMRI, food-medicinal role index). The use of this index allows for exploring the potential wild greens.

To analyze how TK varied according to the characteristics of the different informants, we performed linear regression and t-test using R software (version 3.2.2), taking “Number of edible plants cited by each informant” as the variable to the model. We also consider two entities representing personal data, “ages” (a quantitative variable) and “gender” (a qualitative variable taking a value of male or female). Furthermore, documentation of our
field investigation was compared with the nutrition information reported in the various relevant literatures.

**Results and discussion**

The traditional diet culture of the Baidi village has developed from nomadic lifestyle into an agricultural and pastoral context. Cultivated species play a crucial role in the local diet, but they have a long history of wild edibles gathering. The 86 informants (Fig. 2) of Baidi village reported 173 wild edible species belonging to 76 families and 139 genera (Table 1) that they still collecting or had gathered in the past. Table 1 lists the wild edibles mentioned at least by two informants. Botanical and ethnomedical information about these plants include scientific name, family, voucher or digital photograph number, vernacular name, food categories, part(s) used and mode of consumption (prevalence of use) and collecting habitat (season) [29]. Food categories include carbohydrates, oil and fats, vegetable, vitamin and functional food, beverage, condiments, forage, and honey source. On average, 20.6 edible taxa were listed per informant. The highest number of wild edibles included vegetables (mean – 13.2 species), whereas vitamins and functional foods were frequently used (mean – 7.4). Other categories were less frequent in use such as carbohydrates (mean –0.4), Edible pigments (mean –0.36), Oil and fats (mean – 1.8), Beverage (mean –0.34), Honey source plant (mean –0.23). CI and CFSI values of the wild edibles, except the forage category, cited at least three times were calculated (Table 1).

**Diversity of wild edibles**

Almost all major groups of wild plants in Baidi village have edible members that are reported to have been used by the indigenous Naxi people. Exceptions to the bryophytes, documented wild edibles include algae, lichen, fungi, fern, gymnosperm and angiosperm (Table 2). Most of the documented species were angiosperm with 126 species belonging to 53 families. Rosaceae was the biggest family with 18 wild edibles (Fig. 3), whereas 32 families contained only one edible plant species. Fungi was the second largest group containing 37 species representing 17 families. Gymnosperm included one species (one family), fern four species (two families), lichen three species (two families), and algae two species (one family). About one-sixth of 173 wild edibles were included in more than one food category, as listed in Table 3. As to the collecting habitats [29], most of these plants were collected from the wild populations nearby the village. It was also common that there was a small-scale cultivation of wild plants in the home gardens and all the space surrounding human habitations. Different plant parts were used as a source of food in Baidi village, but the most used parts were different depending on the purpose of the foods (such as forage and food medicines). Leaves, fruits, and the complete aerial parts were the mostly consumed by humans while the animals consumed leaves.

**Wild vegetables**

This group was the biggest food category with 75 edible species belonging to 40 families. Russulaceae belonged
| Taxon | Family | Vernacular name | Food categories | Part(s) used and mode of consumption (prevalence of use) | Collecting habitatb (season) | Voucher number | FC | f | CI | CFSI |
|-------|--------|-----------------|-----------------|----------------------------------------------------------|-----------------------------|----------------|----|---|----|------|
| Acorus gramineus Sol. ex Aiton | Acoraceae | vitamine & functional food | Rhizomes, boiled in water without garnish (TC). | AE(all seasons) | P1408 |
| Amaranthus sp. | Amaranthaceae | vegetable | Leaves, fried (TC). | SC-CA-UA (spring) | 0354 |
| Chenopodium album L. | Amaranthaceae | mulv | Leaves, fried (TC). | CA-UA (spring and summer) | 0151 |
| Kochia scoparia (L.) Schrad. | Amaranthaceae | vegetable | Leaves, fried (TC). | CA-UA (spring and summer) | P1413 |
| Allium sp. | Amaryllidaceae | gu | edible condiments, vegetable | Leaves, fried (TC). | FO (spring and summer) | 0355 | 40 | 0.47 | 0.47 | 24.00 |
| Pistacia weinmannifolia J. Poiss. ex Franch. | Anacardiaceae | yizhu | vitamine & functional food | Fruits, eaten raw (AB). | FO-CA-UA(summer and autumn) | 0055 | 16 | 0.19 | 0.19 | 5.40 |
| Ligusticum sinense cv. Chuanxiong S. H. Qiu & et al. | Apiaceae | root | vegetable | Roots, boiled in water (TC). | FO(all seasons) |
| Oenanthe javanica (Bl.) DC. | Apiaceae | zen axi | vegetable | Leaves, fried (TC). | AE(all seasons) | 0045 | 31 | 0.36 | 0.36 | 27.90 |
| Cynanchum auriculatum Royle ex Wight | Apocynaceae | niezi | vegetable | Leaves and stems, boiled in water (AB). | SC-UA (all seasons) | 0088 |
| Marsdenia sp. | Apocynaceae | Lubei | vegetable | Leaves and stems, boiled in water (AB). | SC (spring and summer) | 0234 |
| Amorphophallus konjac K. Koch | Araceae | Bulei | carbohydrates | Tubers, dried, smashed and boiled in water for making curd (TC). | FO-CA-SC (autumn) | 0052 |
| Arisaema elephas Buchet | Araceae | Babaxiluo | forage, vitamine & functional food | Roots, boiled in water (TC). Leaves, eaten raw as forage (TC). | SC-CA-UA (all seasons) | 0048 |
| Arisaema erubescens (Wall.) Schott | Araceae | Rihaxiluo | forage, vitamine & functional food | Roots, boiled in water (TC). Leaves, eaten raw as forage (TC). | SC-CA-UA (all seasons) | 0095 |
| Asparagus cochinchinensis (Lour.) Merr. | Asparagaceae | Laosha | vitamine & functional food | Roots, boiled in water (TC). | FO-SC-UA (all seasons) | 0047 |
| Maianthemum japonicum (A. Gray) La Frankie | Asparagaceae | Abu | vegetable | Leaves, fried (TC). | FO (spring and summer) | 0011 | 53 | 0.62 | 0.62 | 55.65 |
| Arctium lappa L. | Asteraceae | Elaba | vegetable, vitamine & functional food | Roots, stewed (TC). | SC-CA-UA (all seasons) | 0258 | 4 | 0.05 | 0.05 | 7.02 |
| Artemisia sieversiana Ehrhart ex Willd. | Asteraceae | forage, vitamine & functional food | Whole plant, boiled in water (AB). Aerial part, eaten raw as forage (TC). | FO-SC-UA (spring, summer and autumn) | 0137 |
| Carpesium cernuum L. | Asteraceae | La men ga | forage, vitamine & functional food | Whole plant, boiled in water (TC). Aerial part, eaten raw as forage (TC). | SC-UA (all seasons) | 0299 |
| Plant Name                  | Family           | Common Name/Usage | Notes                                                                 | Location                  | Code |
|-----------------------------|------------------|-------------------|----------------------------------------------------------------------|---------------------------|------|
| Carpesium sp.               | Asteraceae       | La men ga         | forage, vitamin & functional food                                     | Whole plant, boiled in water (TC). Aerial part, eaten raw as forage (TC). | SC-UA (all seasons) | 0150 |
| Cichorium intybus L.        | Asteraceae       | vegetable, forage | Leaves, fried (TC).                                                   |                           | SC-CA-UA (all seasons) | P1407|
| Cirsium lijiangense Petr. & Hand.-Mazz. | Asteraceae | Raqiku            | vegetable, vitamin & functional food                                 | Roots, stewed (TC).       | SC-CA-UA (all seasons) | 0260 3 0.03 0.03 5.27 |
| Galinsoga parviflora Cav.   | Asteraceae       | Murukepei; Youcong| forage                                                                | Aerial part, eaten raw (TC). | CA (spring, summer, autumn) | 0020 |
| Hippolytia delavayi (Franch. ex W. W. Smith) C. Shih | Asteraceae | Bunasi            | vitamin & functional food                                            | Roots, boiled in water (TC). | FO (all seasons) | 0114 |
| Leibnizia anandra (L.) Turcz. | Asteraceae       | Mumeicidei        | forage                                                                | Aerial part, eaten raw or boiled in water (AB). | CA (spring, summer, autumn) | 0061 |
| Sigesbeckia orientalis L.   | Asteraceae       | Umeiheiba         | forage                                                                | Aerial part, eaten raw or boiled in water (TC). | CA (spring, summer, autumn) | 0101 |
| Sonchus oleraceus L.        | Asteraceae       | Umeisennier       | vegetable                                                             | Leaves, fried (TC).       | CA-UA (spring) | P1420 |
| Taraxacum mongolicum Hand.-Mazz. | Asteraceae | Pugongying        | vegetable, vitamin & functional food                                 | Whole plant, boiled in water (TC). | SC-CA-UA (all seasons) | 0189 70 0.81 0.85 157.50 |
| Begonia grandis Dryand.     | Begoniaceae      | Akangzi           | vegetable                                                             | Tender leaves and stems, eaten raw (AB). | FO-CA-UA(summer and autumn) | 0087 |
| Berberis sp.                | Berberidaceae    | Csílv             | vitamin & functional food                                            | Fruits, eaten raw (TC).   | FO-CA-UA(summer and autumn) | 0007 4 0.05 0.05 1.35 |
| Cynoglossum amabile Stapf & J. R. Drumm. | Boraginaceae | forage            | Aerial part, eaten raw or boiled in water (AB).                      |                            | CA (spring, autumn) | 0064 |
| Ehretia dicksonii Hance     | Boraginaceae     | Buna              | forage, vitamin & functional food                                     | Fruits, eaten raw (AB). Leaves, as forage (AB). | SC-CA-UA (all seasons) | 0207 4 0.05 0.05 1.35 |
| Capsella bursa-pastoris (L.) Medik. | Brassicaceae | vegetable         | Leaves, fried (TC).                                                   |                            | SC-CA-UA (spring) | 0198 |
| Cardamine macrophylla Willd. | Brassicaceae    | You               | vegetable                                                             | Leaves, fried (TC).       | FO (spring and summer) | 0266 76 0.88 0.94 205.20 |
| Cardamine tangutorum O. E. Schulz | Brassicaceae | You              | vegetable                                                             | Leaves, fried (TC).       | FO (spring and summer) | 0353 76 0.88 0.94 205.20 |
| Eutrema yunnanense Franch.  | Brassicaceae     | Bei               | vegetable, forage                                                     | Leaves, fried (TC). Eaten raw by animals. | FO (spring and summer) | 0352 73 0.85 0.85 65.70 |
| Nasturtium officinale R. Br. | Brassicaceae    | Shuicai, Xiyangcai| vegetable                                                             | Leaves, fried (CC).       | AE(all seasons) | 0166 45 0.52 0.52 206.72 |
| Thlaspi arvense L.          | Brassicaceae     | Jucu              | oil & fats, vitamin & functional food                                 | Seeds, dried and boiled in water (AB). Whole plant, boiled in water as functional food (AB). | SC-CA-UA (summer) | 0129 |
| Adenophora stricta Miq.     | Campanulaceae    | Apudada           | vitamin & functional food                                            | Roots, stewed in meat (TC). Leaves, eaten raw (TC). | CA (all seasons) | 0038 38 0.44 0.45 106.88 |
| Plant Name                               | Family       | Common Name     | Part(s) Used                                                                 | Preparation Method                          | Season                        | Code | P Value 1 | P Value 2 | P Value 3 |
|-----------------------------------------|--------------|-----------------|-----------------------------------------------------------------------------|---------------------------------------------|-------------------------------|------|------------|------------|-----------|
| Cannabis sativa L.                      | Cannabaceae  | Samei           | Oil & fats                                                                  | Seeds, dried and boiled in water (AB).      | SC-CA-UA (summer and autumn) | P1422| 67         | 0.78       | 0.78      |
| Dipsacus asper Wall. ex DC.             | Caprifoliaceae| Caprifoliaceae  | Vitamine & functional food                                                 | Roots, boiled in water (TC).               | FO-SC-CA-UA (all seasons)    | P1421|            |            |           |
| Sambucus adnata Wall. ex DC.            | Caprifoliaceae| Shousi          | Vitamine & functional food                                                 | Whole plant, boiled in water (TC).         | FO-SC (all seasons)           | 3    | 0.03       | 0.03       | 1.01      |
| Sambucus javanica Blume                 | Caprifoliaceae| Munongzi        | Vitamine & functional food                                                 | Whole plant, boiled in water (TC).         | SC-CA-UA (all seasons)       | 0227 |            |            |           |
| Valeriana jatamansi Jones               | Caprifoliaceae| Matixiang       | Vegetable, vitamin & functional food                                       | Whole plant, stewed (TC).                 | SC-CA-UA (all seasons)       | 0041 | 67         | 0.78       | 0.90      |
| Viburnum betulifolium Batalin           | Adoxaceae    | Efuni           | Vitamine & functional food                                                 | Fruits, eaten raw (TC).                    | FO-CA-UA (summer and autumn) | 0122 | 30         | 0.35       | 0.35      |
| Viburnum cylindricum Buch.-Ham. ex D. Don| Adoxaceae    | Ciifuni         | Vitamine & functional food                                                 | Fruits, eaten raw (TC).                    | FO-CA-UA (summer and autumn) | 0213 | 30         | 0.35       | 0.35      |
| Viburnum foetidum var. ceanothoides (C. H. Wright) Handel-Mazzetti | Adoxaceae |          |                                  |                                                |                                |      |            |            |           |
| Cuscuta chinensis Lam.                  | Convolvulaceae| Mulupabie       | Vegetable, vitamin & functional food                                       | Whole plant, boiled in water (TC).         | SC-CA-UA (all seasons)       | 0156 |            |            |           |
| Cornus capitata Wall.                   | Cornaceae    | Laka            | Vitamine & functional food                                                 | Fruits, eaten raw (TC).                    | FO-CA-UA (summer and autumn) | 0086 | 52         | 0.60       | 0.60      |
| Cyperus sp.                             | Cyperaceae   | Wongdanzi       | Forage                                                                      | Aerial part, eaten raw or boiled in water (TC). | CA (spring, summer and autumn) |      | 7          | 0.08       | 0.08      |
| Dioscorea deltoidea Wall. ex Griseb.    | Dioscoreaceae| Rua ba; Luamba   | Carbohydrates                                                               | Tubers, dried and boiled in water (TC).    | FO-CA-SC (autumn)             | 0094 |            |            | 4.73      |
| Dioscorea yunnanensis Prain & Burkii   | Dioscoreaceae|                | Vitamine & functional food                                                 | Roots, boiled in water (TC).               | FO-SC-CA-UA (all seasons)    | P1409|            |            |           |
| Diospyros lotus L.                      | Ebenaceae    | Tazhu           | Vitamine & functional food                                                 | Fruits, eaten raw (TC).                    | FO-CA-UA (summer and autumn) | P1417| 3          | 0.03       | 0.03      |
| Elaeagnus umbellata Thunb.              | Elaeagnaceae |                | Vegetable                                                                   | Fruits, eaten raw (TC).                    | SC-UA (autumn)               | 0211 |            |            |           |
| Hippophae rhamnoides L.                 | Elaeagnaceae | Zhu             | Beverage                                                                    | Fruits, fermented for sour taste (AB).      | FO-SC (autumn)               |      |            |            |           |
| Pyrola atropurpurea Franch.             | Ericaceae    |                | Forage                                                                      | Aerial part, eaten raw or boiled in water (TC). | FO (spring, summer and autumn) |      |            |            |           |
| Vaccinium fragile Franch.               | Ericaceae    | Anmiximi        | Vitamine & functional food                                                 | Fruits, eaten raw (AB).                    | FO-CA-UA (summer and autumn) | 0021 |            |            |           |
| Bauhinia sp.                            | Fabaceae     | Huangrekei      | Forage                                                                      | Leaves, eaten raw or boiled in water (TC). | FO (spring, summer and autumn) | 0142 |            |            |           |
| Cassia sp.                              | Fabaceae     | Wujiaba         | Forage                                                                      | Leaves, eaten raw or boiled in water for livestocks (TC). | FO (spring, summer and autumn) | 0319 |            |            |           |
| Lespedeza sp.         | Fabaceae | Fushibeibei     | forage   | Leaves, eaten raw or boiled in water (AB). | FO (spring, summer and autumn) | 0100 |
|----------------------|----------|----------------|----------|-------------------------------------------|---------------------------------|------|
| Lespedeza thunbergii subsp. elliptica (Benth. ex Maxim.) H. Ohashi | Fabaceae |                |          |                                           |                                 |      |
| Medicago lupulina L.  | Fabaceae | Mosu           | forage   | Aerial part, eaten raw or boiled in water (TC). | CA (spring, summer and autumn)  | 0239 |
| Piptanthus nepalensis (Hook.) Sweet | Fabaceae | Murekei        | forage   | Leaves, eaten raw or boiled in water (TC). | FO (spring, summer and autumn)  | 0105 |
| Trifolium repens L.   | Fabaceae | Laba           | forage   | Tender Leaves, eaten raw or boiled in water (TC). | FO (all seasons)                | 0098 |
| Quercus sp.           | Fagaceae |                |          |                                           |                                 |      |
| Gentiana rigescens Franch. | Gentianaceae | Yinini, Zii  | forage   | Whole plant, boiled in water (TC).          |                                 |      |
| Helwingia chinensis Batalin | Helwingiaceae | Ninahagubii | vegetable | Tender leaves, fried (AB).                  | FO (spring and summer)          | 0215 |
| Hypericum forestii (Chitt.) N. Robson | Hypericaceae | Muwaniba     | honey source plant | Flowers, sucked (AB). | SC-CA-UA (summer) | 0243 |
| Itea yunnanensis Franch. | Iteaceae | Piejulu        | forage   | Tender leaves, eaten raw (TC).             | FO-CA-UA (spring and autumn)   | 0077 |
| Juglans cathayensis Dode | Juglandaceae | Gudu         | oil & fats | Seeds, dried and boiled in water (AB).      | FO-SC-UA (autumn and winter)   | P1412 |
| Dracocephalum sp.     | Lamiaceae | Bingba        | forage   | Aerial part, eaten raw or boiled in water (AB). | FO (spring, summer and autumn) | 0039 |
| Elsholtzia strobilifera (Benth.) Benth. | Lamiaceae |                | edible condiments | Seeds, dried, for seasoning (AB). | SC-CA-UA (autumn and winter) | 0192 |
| Mentha canadensis L.  | Lamiaceae | Angzhi         | vegetable, edible condiments | Tender leaves and stems, fried, or cold and dressed with sauce (TC). | CA-UA (all seasons)          | 0012 |
| Origanum vulgare L.   | Lamiaceae | Kedu           | edible condiments | Seeds and leaves, dried, for seasoning (AB). | SC-CA-UA (autumn and winter) | 0058 |
| Salvia trijuga Diels  | Lamiaceae |                | vitamine & functional food | Roots, boiled in water (TC). | FO-SC-UA (all seasons) | 0119 |
| Streptolirion volubile Edgew. | Commelinaceae | Mailexu     | forage   | Aerial part, eaten raw (TC).               | CA (spring, summer and autumn) | 0030 |
| Malva verticillata L. | Malvaceae |                | carbohydrates | Tubers, dried and boiled in water (TC).    | FO-CA-SC (autumn)            | 0152 |
| Ficus sarmentosa Buch.-Ham. ex Sm. | Moraceae | Kesulu        | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (spring and autumn) | 0040 |
| Morus mongolica (Bureau) C. K. Schneid. | Moraceae | Ciiliu         | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (spring and autumn) | 0132 |
| Species                          | Family          | Usage          | Description                                                                 | Season                  | Code     |
|---------------------------------|-----------------|----------------|-----------------------------------------------------------------------------|-------------------------|----------|
| Epipactis mairei Schlr.         | Orchidaceae     | forage         | Aerial part, eaten raw or boiled in water (AB).                             | FO (spring, summer and autumn) | 0026     |
| Habenaria sp.                   | Orchidaceae     | vitamin & functional food | Tubers, boiled in water (AB).                                              | FO (autumn)             | 0037     |
| Oxalis acetosella L.            | Oxalidaceae     | forage         | Aerial part, eaten raw or boiled in water (TC).                             | CA (spring, summer and autumn) | 0313     |
| Plantago asiatica L.            | Plantaginaceae  | vegetable, vitamin & functional food | Whole plant, boiled in water (TC).                                          | SC-CA-UA (all seasons)  | 0049 64 0.74 0.78 144.00 |
| Avena fatua L.                  | Poaceae         | carbohydrate forage | Seeds, dried, smashed and fried (TC). Whole plant for animal (TC).         | CA (summer and autumn)  | P1419    |
| Catabrosa aquatica (L.) P. Beauv.| Poaceae         | forage         | Aerial part, eaten raw or boiled in water (TC).                             | CA (spring, summer and autumn) | 0256     |
| Echinochloa crusgalli (L.) P. Beauv.| Poaceae         | forage         | Aerial part, eaten raw or boiled in water (TC).                             | CA (spring, summer and autumn) | 0146     |
| Phyllostachys glauca McClure    | Poaceae         | vegetable      | Young shoots, fried (TC).                                                   | SC-CA-UA (spring and early summer) | 0154 5 0.06 0.06 1.13 |
| Setaria viridis (L.) P. Beauv.  | Poaceae         | forage         | Aerial part, eaten raw or boiled in water (TC).                             | CA (spring, summer and autumn) | 0144     |
| Fagopyrum dibotrys (D. Don) H.Hara | Polygonaceae   | forage         | Aerial part, eaten raw or boiled in water (TC).                             | CA (all seasons)        | 0015     |
| Fagopyrum gracilipes (Hemsl) Dammmer ex Diels | Polygonaceae | forage         | Aerial part, eaten raw or boiled in water (TC).                             | CA (spring, summer and autumn) | 0141     |
| Oxyria sinensis Hemsl.          | Polygonaceae    | vegetable, forage | Young shoots, eaten raw by people (AB). Leaves, eaten by animals (TC).     | SC-CA-UA (spring, summer and autumn) | 0176 10 0.12 0.23 15.19 |
| Polygonum capitatum Buch.-Ham. ex D. Don | Polygonaceae   | forage         | Aerial part, eaten raw (TC).                                                | CA (spring, summer and autumn) | 0144     |
| Polygonum paleaceum Wall.       | Polygonaceae    | vitamin & functional food | Roots, boiled in water (TC).                                               | FO (all seasons)        | 0015     |
| Polygonum runcinatum Buch.-Ham. ex D. Don | Polygonaceae | forage         | Aerial part, eaten raw or boiled in water (TC).                             | SC-CA-UA (spring, summer and autumn) | 0237 6 0.07 0.07 4.68 |
| Rumex acetosa L.                | Polygonaceae    | vegetable      | Young shoots, eaten raw (AB).                                               | SC-CA-UA (spring, summer and autumn) | 0236     |
| Myrsine africana L.             | Primulaceae     | vitamin & functional food | Fruits, eaten raw (AB).                                                    | FO-CA-UA (summer and autumn) | 0076     |
| Clematis armandii Franch.       | Ranunculaceae   | vegetable      | Young shoots, fried (TC).                                                   | SC-CA-UA (spring)       | 0163     |
| Clematis ranunculoides Franch.  | Ranunculaceae   | forage         | Aerial part, eaten raw or boiled in water (TC).                             | CA (spring, summer and autumn) | 0046     |
| Common Name | Family | Other Names | Habitat | Uses | Collection Period |
|-------------|--------|-------------|---------|------|-------------------|
| Thalictrum aquilegifolium var. sibiricum | Ranunculaceae | Renuba | forage | Aerial part, eaten raw or boiled in water (TC). | CA (spring, summer and autumn) |
| Zaphophyllum montana W. W. Smith | Rhamnaceae | Cipa | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (summer and autumn) |
| Amygdalus davidiana (Carrière) de Vos ex Henry | Rosaceae | Buji,buka | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (summer and autumn) |
| Cerasus cerasoides (Buch.-Ham. ex D. Don) S. Y. Sokolov | Rosaceae | Sibu | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (summer and autumn) |
| Docynia delavayi (Franch.) C. K. Schneid. | Rosaceae | Anmenbuzi; Aliibuji; Ameibuji | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (summer and autumn) |
| Fragaria nilgerrensis Schltdl. ex J. Gay | Rosaceae | Ameibuji | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (summer and autumn) |
| Malus rockii Rehder | Rosaceae | Ameibuji | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (summer and autumn) |
| Malus yunnanensis (Franch.) C.K. Schneid. | Rosaceae | Lvba | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (summer and autumn) |
| Osteomeles schwerinae C. K. Schneid. | Rosaceae | Dazhu | vitamin & functional food | Fruits, eaten raw (AB). | FO-CA-UA (summer and autumn) |
| Potentilla kleiniana Wight & Arn. | Rosaceae | forage | Aerial part, eaten raw or boiled in water (TC). | CA (spring, summer and autumn) |
| Prunus serotina | Rosaceae | Chuda | vitamin & functional food, beverage, oil & fats | Fruits, eaten raw (AB). Seeds, smashed and boiled in water for oil (CC). Leaves, for making functional tea (TC). | SC-CA-UA (spring, summer and autumn) |
| Pyracantha angustifolia (Franch.) C. K. Schneid. | Rosaceae | Anmilaximi; Saigulu; Youlubuzhu | vitamin & functional food | Fruits, eaten raw (AB). | FO-CA-UA (summer and autumn) |
| Pyracantha fortuneana (Maxim.) H. L. Li | Rosaceae | Abalugu | vitamin & functional food | Fruits, eaten raw (AB). | FO-CA-UA (summer and autumn) |
| Pyrus pashia Buch.-Ham. ex D. Don | Rosaceae | vitamine & functional food | Fruits, eaten raw (TC). | FO-CA-UA (summer and autumn) |
| Rosa sp. | Rosaceae | Haducii | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (summer and autumn) |
| Rubus biflorus Buch.-Ham. ex Sm. | Rosaceae | Cipaaha | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (summer and autumn) |
| Rubus sp. | Rosaceae | Ciinaaha | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (summer and autumn) |
| Rubus sp. | Rosaceae | Emaiji | vitamin & functional food | Fruits, eaten raw (TC). | FO-CA-UA (summer and autumn) |
Table 1 Inventory of wild edibles gathered and consumed in the Baidi village (Continued)

| Plant Family | Genus                  | Species                        | Habitat                          | Characteristics                                                      | Collection Period               | Output 1 | Output 2 | Output 3 |
|-------------|------------------------|--------------------------------|----------------------------------|----------------------------------------------------------------------|------------------------------|----------|----------|----------|
| Sorbus      | hemsleyi (C. K. Schneid.) Rehder | Sorbus hemsleyi (C. K. Schneid.) Rehder | Rosaceae                         | Forage                                                               | FO-CA-UA (summer and autumn) | 0275     | 48       | 0.56     | 135.00   |
| Sorbus      | hupehensis C. K. Schneid. | Sorbus hupehensis C. K. Schneid. | Rosaceae                         | Forage                                                               | FO-CA-UA (summer and autumn) | 0121     | 5        | 0.06     | 0.08     | 13.78    |
| Rubia       | membranacea Diels      | Rubia membranacea Diels        | Rubiaceae                        | Forage                                                               | CA (spring, summer and autumn)| 0250     | 10       | 0.12     | 0.12     | 2.25     |
| Zanthoxylum | armatum DC.             | Zanthoxylum armatum DC.         | Rutaceae                         | Edible condiments                                                   | FO-SC-CA (autumn)            | 0139     | 4        | 0.05     | 0.05     | 1.35     |
| Zanthoxylum | bungeanum Maxim.       | Zanthoxylum bungeanum Maxim.    | Rutaceae                         | Edible condiments                                                   | FO-SC-CA (autumn)            | 0078     | 5        | 0.06     | 0.08     | 13.78    |
| Houttuynia  | cordata Thunb.          | Houttuynia cordata Thunb.       | Saururaceae                      | Forage                                                               | CA-UA (all seasons)          | 0044     | 74       | 0.86     | 1.21     | 2164.50  |
| Schisandra  | sp.                    | Schisandra sp.                 | Schisandraceae                   | Forage                                                               | FO (spring)                  | 0143     | 12       | 0.14     | 0.14     | 8.10     |
| Debregeasia | orientalis C. J. Chen   | Debregeasia orientalis C. J. Chen | Urticaceae                      | Forage                                                               | SC-CA-UA (spring)            | 0014     | 11       | 0.13     | 0.13     | 96.80    |
| Verbena     | officinalis L.          | Verbena officinalis L.          | Verbenaceae                      | Forage                                                               | SC-CA-UA (all seasons)       | 0180     | 4        | 0.05     | 0.05     | 1.35     |
| Viola sp.   |                        |                                | Violaceae                        | Forage                                                               | SC-CA-UA (all seasons)       | 0084     | 4        | 0.05     | 0.05     | 1.35     |
| Ampelopsis  | delavayana Planch.      | Ampelopsis delavayana Planch.   | Vitaceae                         | Forage                                                               | FO-CU-UA (spring and autumn) | 0250     | 10       | 0.12     | 0.12     | 2.25     |
| Gymnosperm  |                        |                                | Pinaceae                         | Forage                                                               | FO-SC (autumn)               | 0222     | 38       | 0.44     | 0.44     | 51.3     |
| Pinus armandi | Franch.               | Pinus armandi Franch.           | Pinaceae                         | Forage                                                               | FO (spring, summer and autumn)| 0267     | 38       | 0.44     | 0.44     | 51.3     |
| Equisetum   | hyemale L.              | Equisetum hyemale L.            | Equisetaceae                     | Forage                                                               | FO (spring and summer)       | 0143     | 12       | 0.14     | 0.14     | 8.10     |
| Adiantum sp.|                      |                                | Pteridaceae                      | Forage                                                               | FO (spring and summer)       | 0250     | 10       | 0.12     | 0.12     | 2.25     |
| Pteridium   | aquilinum var. latisculum (Desv.) Underw. ex Heller. | Pteridium aquilinum var. latisculum (Desv.) Underw. ex Heller. | Pteridaceae | Forage | Aerial part, eaten raw or boiled in water (TC). | CA (spring, summer and autumn) | 0078 | 5 | 0.06 | 0.08 | 13.78 |
| Pteridium   | revolutum (Blume) Nakai | Pteridium revolutum (Blume) Nakai | Pteridaceae | Forage | Aerial part, eaten raw or boiled in water (TC). | FO (spring and summer) | 0222 | 38 | 0.44 | 0.44 | 51.3 |
| Mushroom    |                        |                                | Pteridaceae                      | Forage                                                               | FO (spring and summer)       | 0267     | 38       | 0.44     | 0.44     | 51.3     |
| Auicularia  | sp.                    | Auicularia sp.                 | Auriculariaceae                  | Forage                                                               | FO (spring and summer)       | 0143     | 12       | 0.14     | 0.14     | 8.10     |
| Boletus     | edulis Bull.            | Boletus edulis Bull.            | Boletaceae                       | Forage                                                               | FO (spring and summer)       | 0222     | 38       | 0.44     | 0.44     | 51.3     |
| Table 1 | Inventory of wild edibles gathered and consumed in the Baidi village (Continued) |
|----------|--------------------------------------------------------------------------------|
| Tylopilus balloui (Peck) Sing | Boletaceae | Niuganjun | vegetable | Fruit body, stewed, fried (TC). | FO (summer and autumn) |
| Tylopilus sp. | Boletaceae | Bamu | vegetable | Fruit body, stewed, fried (TC). | FO (summer and autumn) | 10 | 0.12 | 0.12 | 5.20 |
| Cantharellus cibarius Fr. | Cantharellaceae | Jiyoujun | vegetable | Fruit body, stewed, fried (TC). | FO (summer and autumn) | P1405 | 10 | 0.12 | 0.12 | 6.00 |
| Cordyceps sobolifera (Hill.) Berk. et Br. | Clavicipitaceae | Chongcao | vitamine & functional food | Fruit body, stewed (TC). | FO (summer) |
| Entoloma clypeatum (L.) P. Kumm. | Entolomataceae | Yiwojun | vegetable | Fruit body, fried (TC). | FO (summer and autumn) | P1406 |
| Gomphus sp. | Gomphaceae | Labajun | vegetable | Fruit body, stewed, fried (TC). | FO (summer and autumn) |
| Hericium sp. | Hericiaceae | Houtoujun | vegetable | Fruit body, stewed (TC). | FO (spring, summer and autumn) | 5 | 0.06 | 0.06 | 2.60 |
| Laccaria laccata (Scop.) Cooke | Hydnangiaceae | Tashimu | vegetable | Fruit body, stewed, fried (TC). | FO (summer and autumn) | 0282 |
| Hygrophorus sp. | Hygrophoraceae | Huanglasan | vegetable | Fruit body, fried (TC). | FO (autumn) | 3 | 0.03 | 0.03 | 1.80 |
| Engleromyces sp. | Hypocreaceae | Zhujun | vegetable | Fruit body, dried and stewed (TC). | FO (summer and autumn) |
| Lentinula sp. | Marasmiaceae | Zhemu | vegetable | Fruit body, fried (TC). | FO (summer and autumn) | 6 | 0.07 | 0.07 | 3.60 |
| Lactarius hatsudake Tanaka | Russulaceae | Tongbulu | vegetable | Fruit body, stewed (TC). | FO (summer) |
| Lactarius sp. 1 | Russulaceae | Saobajun | vegetable | Fruit body, stewed, fried (TC). | FO (spring and summer) | 0278 | 3 | 0.03 | 0.03 | 1.80 |
| Lactarius sp. 2 | Russulaceae | Baipajun | vegetable | Fruit body, stewed, fried (TC). | FO (spring and summer) | 0338 | 14 | 0.16 | 0.16 | 8.40 |
| Lactarius sp. 3 | Russulaceae | Minuka | vegetable | Fruit body, stewed, fried (TC). | FO (spring and summer) | 0341 | 17 | 0.20 | 0.20 | 10.20 |
| Lactarius sp. 4 | Russulaceae | Angzhishi | vegetable | Fruit body, stewed, fried (TC). | FO (spring and summer) | 0284 |
| Lactarius sp. 5 | Russulaceae | Jucu | vegetable | Fruit body, stewed, fried (TC). | FO (spring and summer) | 0285 |
| Lactarius sp. 6 | Russulaceae | Jucu | vegetable | Fruit body, stewed, fried (TC). | FO (spring and summer) | 0288 |
| Lactarius sp. 7 | Russulaceae | Jucu | vegetable | Fruit body, stewed, fried (TC). | FO (spring and summer) | 0281 |
Table 1 Inventory of wild edibles gathered and consumed in the Baidi village (Continued)

| Species                           | Family               | Vernacular name | Type of collection | FC | CFSI | CI | P | Prevalence of use: | Collecting habitat: |
|-----------------------------------|----------------------|-----------------|--------------------|----|-----|----|---|--------------------|---------------------|
| Russula sp. 1                     | Russulaceae          | Kaca            | vegetable          |    |     |    | 0286 | 9                  | FO (summer and autumn) |
| Russula sp. 2                     | Russulaceae          | Zhebu           | vegetable          |    |     |    | 0340 | 9                  | FO (summer and autumn) |
| Russula sp. 3                     | Russulaceae          | Huotanjun       | vegetable          |    |     |    |      |                    | FO (summer)          |
| Russula sp. 4                     | Russulaceae          | Azimenihu       | vegetable          |    |     |    | 0283 |                    | FO (summer and autumn) |
| Russula virescens (schaeff. ex Zanted) Fr. | Russulaceae          | Qingtoujun     | vegetable          |    |     |    |      |                    | FO (summer)          |
| Thelephora sp.                    | Thelephoraceae       | Ganbajun        | vegetable          |    |     |    |      |                    | FO (summer)          |
| Tricholoma matsutake Sing         | Thelephoraceae       | Songmaojun      | vegetable          |    |     |    |      |                    | FO (summer)          |
| Tricholoma sp.                    | Thelephoraceae       | Songmaojun      | vegetable          |    |     |    |      |                    | FO (summer)          |
| Tricholoma sp.                    | Thelephoraceae       | Yumu            | vegetable          |    |     |    |      |                    | FO (summer)          |
| Tricholoma sp.                    | Thelephoraceae       | Yumu            | vegetable          |    |     |    |      |                    | FO (summer)          |
| Lyophyllum fumosum (Pers.: Fr.) P. D. Orton. | Tricholomataceae     | Yiwojun         | vegetable          |    |     |    |      |                    | FO (summer and autumn) |
| Lyophyllum sp.                    | Tricholomataceae     | Menzher          | , stewed (TC).     |    |     |    | 0280 | 31                 | FO (summer and autumn) |
| Marasmius sp.                     | Tricholomataceae     | Huangpifujun    | vegetable          |    |     |    |      |                    | FO (summer)          |
| Termitomyces sp. 1                | Tricholomataceae     | Mulu            | vegetable          |    |     |    | 0140 | 36                 | FO (summer and autumn) |
| Termitomyces sp. 2                | Tricholomataceae     | Umu             | vegetable          |    |     |    | 0140 |                    | FO (summer and autumn) |
| Lichen                            | Lobariteae           | vegetable       | Whole plant        |    |     |    | 0219 | 42                 | FO (all seasons)     |
| Lobaria retigera Trevis.          | Lobariteae           | vegetable       | Whole plant        |    |     |    | 0253 | 42                 | FO (all seasons)     |
| Lobaria yunnanensis Yoshim        | Lobariteae           | vegetable       | Whole plant        |    |     |    | 0279 |                    | AE (summer)          |
| Thamnolia vermicularia (Sw.) Ach. Ex Schae | Thamnoliaceae        | beverage        | Whole plant        |    |     |    | 0141 |                    | RP (spring)          |
| Algae                             | Nostoc commune Vaucher ex Bornet & Flahault | vegetable | Aerial part        |    |     |    | 0141 |                    | AE (summer)          |
| Nostoc sphaeroids Kutz            | Nostocaceae          | Bacai e         | vegetable          |    |     |    | 0141 |                    | FO (summer)          |

Species in inventory are ordered from higher to lower plants, and they are arranged firstly by family taxa and then by genus taxa. Vernacular name of wild edibles are written using Chinese pinyin.

The types of collecting habitats are based on the characterization proposed by Calabuig (2008)

FC: frequency of citation, CFSI: cultural food significance index, CI: cultural importance index

a Prevalence of use: AB: Abandoned, CC: Currently consumed, TC: Traditionally consumed
b Collecting habitat: FO: Forests (oak woods, pine woods, etc.); SC: Scrublands (Pistacia, etc.); AE: Aquatic environments (streams, ditch, wet places, etc.); RP: Rock places (rocky slopes, rocks, etc.); CA: Cultivated areas (orchards, farmland, etc.); UA: Urban and periurban areas (villages, roads, etc.)

Voucher number with P means voucher photograph number, and the one without P means voucher specimen number.
to fungi had the highest number of species (11 species) eaten as vegetables (Fig. 4). Often wild vegetables were cooked in oil or fat or consumed in stews and soups. The most common procedure was to boil them first and then fried with garlic and chilies. The pork fat was common compared to vegetable oil for frying. The consumption of wild vegetable eaten raw was very rare.

The most frequently reported species were *Cardamine macrophylla* Willd., *C. tangutorum* O. E. Schulz., *Eutrema yunnanense* Franch. and *Houttuynia cordata* Thunb. All of these consumed after frying, except the last one, consumed as a salad with sauce. The first three species grow in the mountains, local people collected these species most often while grazing their cattle and horses during the spring and summer seasons. *Houttuynia cordata* grew wild in cropland and was collected by the local people when they finished their farm work. These four wild vegetables had been consumed for a long time, especially in the time of food shortages, later became the most popular vegetables in Baidi village. Wild gathered vegetables had different chemical composition and nutritional value from cultivated ones, according to Zeghichi [30]. Another two wild vegetables often used in the past, especially in time of food shortage, were the well-known *Lobaria retigera* Trevis. and *L. yunnanensis* Yoshim. (laolongpi is a vernacular name for both). These two plants are still consumed in other regions, like the Naxi in Lijiang city. These two species are proved to have high nutritional values such as antioxidant activity [31], but the Naxi in Baidi village abandoned this food tradition because of the unpleasant taste.

Most of the wild vegetables were defined as “bitter”, according to the Naxi, who related this to the concept of “healthy”. This kind of vegetable was considered “healthy” without any specification. According to Johns [32], such use had cultural significance related to the ingestion rather than taste.

| Table 2 Number of species and number of families in different plant categories |
|-------------------------------|------------------------------|------------------|
| Plant categories | Number of families | Number of species |
| Angiosperm | 53 | 126 |
| Gymnospermae | 1 | 1 |
| Fern | 2 | 4 |
| Fungi | 17 | 37 |
| Lichen | 2 | 3 |
| Algae | 1 | 2 |
| Total | 76 | 173 |

| Table 3 Number of species in different food categories |
|-------------------------------|-------------------------------|
| Food categories | Number of species |
| Vegetable | 75 |
| Vitamin and functional food | 60 |
| Forage | 40 |
| Carbohydrates | 6 |
| Edible pigments | 6 |
| Oil and fats | 5 |
| Beverage | 4 |
| Honey source plant | 1 |

![Fig. 3 Family distribution of wild edible plant species of angiosperm category](image-url)
Mushrooms also played a significant role in the local diet. Of 37 fungi species, most were eaten as vegetables and could be gathered during spring and fall. The mushrooms were consumed while fresh or after drying, and mostly grilled like meat. The harvesting of fungi for markets also had been one of main economic activities in the Baidi village. According to informants, *Boletus edulis* Bull., *Cantharellus cibarius* Fr. and *Entoloma clypeatum* (L.) P. Kumm., for example, were sold to Lijiang city, and to other provinces, such as Guangdong in Southern China. Women and children were the primary collectors of mushrooms. Mushrooms are the source of food in more than 80 countries worldwide, and their commercial harvesting is an important business in many countries, such as Turkey, the USA and Bhutan [33].

**Vitamin and functional food**

This food category included mainly wild fruits, which had a high content of vitamins and minerals, and food medicines consumed as both edible plants and medicinal plants. This group, with 60 species, was the second largest regarding the number of wild edibles cited.

Of the 30 wild edible fruits, Rosaceae was the largest family. Most of them did not have market value and sporadically gathered for household consumption, except *Malus pumila* Mill. and *Pyrus pashia* Buch.-Ham. ex D. Don. The most frequently eaten fruit was *Cornus capitata* Wall. for the Naxi. According to Johns [34], wild fruits are more fibrous and contain higher concentrations of vitamins and a greater diversity of secondary compounds compared to the cultivated species. Our study showed that many wild fruits were used as snacks, mainly by children in the past when cultivated fruits were not frequently available. They were probably a good source of vitamins and minerals but have become less important now, such as *Rubus biflorus* Buch.-Ham. ex Sm.

We documented 33 species belonging to food medicines. It is interesting that food medicines can also be wild vegetables and wild fruits. For example, *Houttuynia cordata* was delicious salad and antiphlogosis medicine. Similarly, *Sorbus hupehensis* C. K. Schneid. was tasty fruit and medicine to high blood pressure. Balick and Cox [35] explained aboriginal people do not make a clear distinction between edible and medicinal plants; we documented similar findings in the traditional practice of the Naxi in Baidi village. This kind of practices also exists in other Naxi villages in Shangri-La [15]. Moreover, some food preparations were taken exclusively for medicinal purpose, for example, *Habenaria* sp. fried with eggs was the most commonly used medicine for a cough [36, 37].

**Carbohydrates and edible condiments**

In the past, underground parts of some wild edibles such as *Dioscorea oppositifolia* that contain a high amount of starch used to be consumed, especially in the time of hardship. We documented six wild edibles used as the source of carbohydrates, out of that two were abandoned, and the remaining four were occasionally consumed. The main reason for the decrease in consumption was the diversity and abundance of cultivated crops in Baidi village. It was very common that wild edibles once frequently consumed in the past were now considered as weeds.

![Fig. 4 Percentage of wild vegetables in each family](image-url)
and rarely eaten. Such kind of change in perception has been reported from several places in Turkey, India and Brazil [38–40].

There were only six condiments from the wild source in the diet of Baidi village according to this study. The most often consumed species was *Zanthoxylum armatum* DC. The use of condiments not only enhances the flavor of certain dishes but also provides preservative and medicinal properties (anti-parasitic) [41].

**Oil and fats, beverage and honey source plant**

The Naxi in Baidi used total five wild edibles as a source of oil and fats, of which *Juglans mandshurica* Maxim. and *Cannabis sativa* L. were most commonly used. These two species were still widely used to make oil and fats. Similarly, *Prinsepia utilis* oil, rich in flavonoid and have been proved to have an anti-bacteria effect [42, 43], was also frequently used.

A total of four wild edibles recorded were used as the beverage. Fruits of *Schisandra* sp. were usually soaked in wine, which make the liquor medicinal [44, 45]. Leaves of the three species (*Hippophae rhamnoides, Prinsepia utilis* and *Thamnolia vermicularia*), were used to make vinegar and tea. Tea made of *Prinsepia utilis* has been proved to have significant immunosuppressive and anti-tumor activity [46, 47].

*Hypericum forestii* (Chittenden) N. Robson was the only honey source plant. The local name for this species is “muwaniba”, which means it blooms during Dragon Boat Festival. This species with bright flowers attracts lots of bees during the flowering season, and local children have the habits of sucking its nectar for a sweet taste.

**Forage**

Altogether 40 wild species belong to 20 families were used as animal fodder in Baidi village. According to informants, they divided fodder plants into two groups: cropland group and mountain group based on the habitats. In mountain group, *Eutrema yunnanense* was the favorite fodder for the cattle. In cropland group, *Fagopyrum gracilipes* (Hems.) Dammer was often intentionally cultivated as animal fodder. Naxi women collected and carried those fodders from the cropland for stall feeding. The fodder plants also included *Oxystena sinensis* Hems. and *Cichorium intybus* L., the local people once consumed both of these during the food scarcity.

**Evaluating and selecting of wild edibles based on traditional wisdom**

Twenty wild edibles were selected (Table 4) using four quantitative indices (FC, f, CI and CFSI). The ranks of

| Latin name                           | Vernacular name | Indices   | Ranking |
|--------------------------------------|-----------------|-----------|---------|
|                                      |                 | FC       | f       | CI        | CFSI | FC       | f       | CI       | CFSI |
| Cardamine macrophylla Willd.         | You             | 76       | 0.88    | 0.94     | 205.20 | 1         | 1       | 2        | 3     |
| Cardamine tangutorum O. E. Schulz    | You             | 76       | 0.88    | 0.94     | 205.20 | 1         | 1       | 2        | 3     |
| Houttuynia cordata Thunb.            | Arunaha, Azina  | 74       | 0.86    | 1.21     | 2164.50 | 2         | 2       | 1        | 1     |
| Eutrema yunnanense Franch.           | Bei             | 73       | 0.85    | 0.85     | 65.70  | 3         | 3       | 4        | 13    |
| Taraxacum mongolicum Hand.-Mazz.     | Pugongying      | 70       | 0.81    | 0.85     | 157.50 | 4         | 4       | 6        |       |
| Cannabis sativa L.                   | Samei           | 67       | 0.78    | 0.78     | 24.12  | 5         | 5       | 6        | 18    |
| Juglans cathayensis Dode             | Gudu            | 67       | 0.78    | 0.80     | 20.35  | 5         | 5       | 5        | 21    |
| Valeriana jatamansi Jones           | Matixiang       | 67       | 0.78    | 0.90     | 120.60 | 5         | 5       | 5        | 9     |
| Plantago asiatica L.                 | Umeiheizhou     | 64       | 0.74    | 0.78     | 144.00 | 6         | 6       | 6        | 7     |
| Maianthemum japonicum (A. Gray) La Frankie | Abuz         | 53       | 0.62    | 0.62     | 55.65  | 7         | 7       | 7        | 14    |
| Cornus capitata Wall.                | Laka            | 52       | 0.60    | 0.60     | 14.04  | 8         | 8       | 8        | 24    |
| Docynia delavayi (Franch.) C. K. Schneid. | Sibu           | 51       | 0.59    | 0.59     | 11.48  | 9         | 9       | 9        | 26    |
| Sorbus hemsleyi (C. K. Schneid.) Rehder | Erniaji         | 48       | 0.56    | 0.56     | 135.00 | 10        | 10      | 11       | 8     |
| Sorbus hupehensis C. K. Schneid.     | Yumiaji         | 48       | 0.56    | 0.56     | 135.00 | 10        | 10      | 11       | 8     |
| Nasturtium officinale R. Br.         | Shucai          | 45       | 0.52    | 0.52     | 206.72 | 11        | 11      | 12       | 2     |
| Prinsepia utilis Royce               | Chuda           | 45       | 0.52    | 0.57     | 177.69 | 11        | 11      | 10       | 4     |
| Mentha canadensis L.                 | Angzhai         | 43       | 0.50    | 0.50     | 169.31 | 12        | 12      | 13       | 5     |
| Lobaria retigera Trevis.             | Laolongpi       | 42       | 0.49    | 0.49     | 3.47   | 13        | 13      | 14       | 38    |
| Lobaria yunnanensis Yoshim           | Laolongpi       | 42       | 0.49    | 0.49     | 3.47   | 13        | 13      | 14       | 38    |
| Allium sp.                           | Gu              | 40       | 0.47    | 0.47     | 24.00  | 14        | 14      | 15       | 19    |
some species based on different indices were different, indicating that different indices assigned particular importance of the various attributes, such as the multiplicity of uses and taste appreciation [27].

**Food botanicals with high CI values**

Wild edibles that had high CI values were Houttuynia cordata (1.21), Cardamine macrophylla (0.94), C. tangutorum (0.94), Valeriana jatamansi Jones (0.90) and Eutrema yunnanense (0.85). Whole plants of Houttuynia cordata and Valeriana jatamansi were consumed as functional food having a medicinal property, whereas the others were frequently eaten leafy vegetables.

Wild edibles with high CI values might have an interesting dietary constituent and needed further research. Also, a plant with a low CI value could be an important plant for a few people [27].

**Food botanicals with high CFSI values**

Wild edibles that had high CFSI values had different ranks from those with high CI values, and they were Houttuynia cordata (2164.50), Nasturtium officinale (206.72), Cardamine macrophylla (205.20), Cardamine tangutorum (205.20) and Prinsepia utilis (177.69). Three of them (Houttuynia cordata, Cardamine tangutorum and Cardamine macrophylla) were also in the front rank when assessed with CI values, but only Houttuynia cordata was positioned the same place when assessed with CFSI and CI values. Eutrema yunnanense growing on the high-elevation mountains ranked 13th with CFSI index, attributed to its low availability index value, multifunctional food use index value and food-medicinal role index value. The local people consumed Eutrema yunnanense only as vegetables, and the collection was often time-consuming due to its mountain-grown habitat. While Nasturtium officinale and Prinsepia utilis were in the front position for their high availability index value, and food-medicinal-role index value respectively.

**Traditional wisdom from the Naxi**

Our interview indicated a long history of consumption of Cardamine macrophylla, C. tangutorum and Eutrema yunnanense (Fig. 5). The results of quantitative indices showed that Cardamine macrophylla, C. tangutorum, and Eutrema yunnanense were in front positions. Hence,
we selected these three species as most promising organic products. Relevant literature studies show that high levels of vitamin C, minerals, fibers and protein have been reported in Cardamine macrophylla [48–52]. Also, low concentration of heavy metal has been found in this wild edible species. As its affinity, C. tangutorum, theoretically also had abundant nutrient components. Furthermore, other species of Cardamine are consumed as wild vegetables in Tanzania, India, Poland, United States and Slovakia [53–57]. Eutrema wasabi Maxim. is one of the raw materials of mustard. The species has proved to have anti-bacterial activity and flavor components [58, 59], and it has been developed as a condiment for many years by Lijiang Washabi Company Eutrema yunnanense widely consumed in Baidi village seems to be a potential vegetable. Additionally, as an affinity of E. wasabi, this species may have a similar chemical component with E. wasabi, and consequently use a substitute for E. wasabi.

Apart from the consumption in the rural area, the market of these wild edibles was expanded in the nearby city areas in the recent years. However, the scientific research regarding nutritional, phytochemical or phytopharmacological analysis was not conducted on the wild edibles recorded in Baidi village. In the context of increasing interest in the health potential foods, such as functional food and pharmafood, studies on wild edibles regarding the nutritional and medicinal qualities, and as potential alternative crops may be very useful [60]. The resurgence of the interest in the wild edibles was also consistent with a reappraisal of traditional cuisines, for example in European countries and with the general claim for ‘natural’ foods [61].

**Age, gender and knowledge dynamics**

**Age, gender, and traditional knowledge**

All the informants in Baidi agreed that they consumed less number of wild edibles compared to the previous decades. Our results indicate the younger people almost could not identify, gather and process these species. Similarly, many middle-aged informants regarded the consumption of wild edibles as a symbol of poverty as they consumed these wild edibles during the time of scarcity. However, the gathering of wild edibles, such as Cardamine macrophylla, C. tangutorum and Eutrema yunnanense in the spring still represents a significant role in the daily diet. Overall, the number of wild edibles cited by informants increased with age according to our regression analysis (Fig. 6), even the correlation was weak (P value < 0.01, the coefficient = 0.19). Concurrent to our results, differences in the knowledge of wild food plants and wild edible fungi among different age groups is reported in two valleys of Shaanxi, central China [62]. However, decreasing knowledge trends in youngsters are common as in the case of other parts of the Himalayas [7]. A study in a Caribbean village finds that the older the people, the less they are affected by external influences [63]. In Baidi, many young people have migrated to other cities in Yunnan to search for employment and education in recent decades. According to our informants, such migration severely disrupted the transfer of local wild edibles knowledge between generations and led to the loss of TK.

The t-test results showed that there were no significant differences between females and males (P value = 0.361), even the number of species cited by women and men in different age groups fluctuated all the time. According to Pfeiffer and Butz [64], gender is a critical variable that influences local knowledge distribution, as it is highly correlated with other sociocultural factors including occupation, education, resource access, and social status and networks. Women tend to know more traditional knowledge [65, 66] because of the sociocultural factors mentioned above. Women are usually unemployed in the rural areas, dedicating themselves to the household and subsistence activities, and they combine this information with their cultural background as well as external knowledge to improve their subsistence
there was no significant difference in knowledge between male and female informants. The traditional food knowledge of the Naxi in Baidi is dynamic, affected by social factors and communicated with the outsiders' food knowledge. Overall, this study provides a deeper understanding of the Naxi traditional knowledge on wild edibles. The study suggests some wild edibles might have an interesting dietary constituent, which necessitates further investigation on the nutrition value as well as market opportunities. With scientific evidence on nutrition value and market opportunity, more people will be attracted toward the wild edibles that will help in addressing food security issues along with the conservation of traditional knowledge of the aboriginal population.

Competing interests
The authors declare that they have no competing interests.

Authors’ contributions
WYH and GYF conceived and designed the research. WYH funded this study. GYF and ZY collected the data, and ZY provided the botanical identification. GYF analyzed the data and prepared the manuscript. HHY undertook a critical review of the manuscript. SR reviewed and rewrote the manuscript. All authors read and approved the final manuscript.

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