Wild food plants and wild edible fungi in two valleys of the Qinling Mountains (Shaanxi, central China)

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Yongxiang Kang¹, Łukasz Łuczaj²*, Jin Kang¹ and Shijiao Zhang¹

Abstract

Background: The aim of the study was to investigate knowledge and use of wild food plants in two mountain valleys separated by Mount Taibai – the highest peak of northern China and one of its biodiversity hotspots, each adjacent to species-rich temperate forest vegetation.

Methods: Seventy two free lists were collected among the inhabitants of two mountain valleys (36 in each). All the studied households are within walking distance of primary forest vegetation, however the valleys differed in access to urban centers: Houzhenzi is very isolated, and the Dali valley has easier access to the cities of central Shaanxi.

Results: Altogether, 185 wild food plant species and 17 fungi folk taxa were mentioned. The mean number of freelisted wild foods was very high in Houzhenzi (mean 25) and slightly lower in Dali (mean 18). An average respondent listed many species of wild vegetables, a few wild fruits and very few fungi. Age and male gender had a positive but very low effect on the number of taxa listed.

Twelve taxa of wild vegetables (Allium spp., Amaranthus spp., Caryopteris divaricata, Helwingia japonica, Matteucia struthiopteris, Pteridium aquilinum, Toona sinensis, Cardamine macrophylla, Celastrus orbiculatus, Chenopodium album, Pimpinella sp., Staphylea buma & S. holocarpa), two species of edible fruits (Akebia trifoliata, Schisandra sphenanthera) and none of the mushrooms were freelisted by at least half of the respondents in one or two of the valleys.

Conclusion: The high number of wild vegetables listed is due to the high cultural position of this type of food in China compared to other parts of the world, as well as the high biodiversity of the village surroundings. A very high proportion of woodland species (42%, double the number of the ruderal species used) among the listed taxa is contrary to the general stereotype that wild vegetables in Asia are mainly ruderal species.

The very low interest in wild mushroom collecting is noteworthy and is difficult to explain. It may arise from the easy access to the cultivated Auricularia and Lentinula mushrooms and very steep terrain, making foraging for fungi difficult.

Keywords: Ethnobotany, Ethnomycology, Wild edible plants, Non-timber forest products

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Introduction
Chinese culinary culture is renowned for its use of an extremely large number of ingredients. In many parts of China a large number of wild vegetables is still used, both by peasants in remote rural areas and in restaurants, particularly those located in or near national parks and other high biodiversity areas [1-13], making China one of the best examples of a herbophilous country [13,14]. Since antiquity, Chinese scholars have extensively written about the food qualities of wild plants [15]. Research on the potential nutritional qualities of wild food resources and their distribution was carried out in most Chinese agricultural institutions during the 20th century. Although we know much about edible plants, which are used in various parts of China, this knowledge, due to its vast quantity, has still not been properly synthesized [16]. Comparative reviews of the use of wild food resources in different regions of China are also needed. Another interesting issue, little explored, is that of gender and age differences in the use of wild food resources (but see [11,12]).

In the previous paper from this part of the Qinling Mountains the use of wild edible plants and fungi in one relatively isolated mountain valley of the Qinling Mountains was documented [13], giving a detailed list of wild plants used there. As many as 159 species of edible plants and 13 taxa of fungi were recorded. A large proportion of them is still used. The local population has a deep knowledge of these plants and their preparation techniques. Additionally local farmers eat (after special preparation) considerable amounts of Aconitum carmichaeli tubers, a plant regarded as one of the most toxic plants on earth [17]. The aim of this study was to compare data from that valley with the use of wild food plants in the neighbouring valley characterized by easy access to the urban centers of the Shaanxi province. We also wanted to look at age and gender differences in the use of wild plants and fungi in these two places.

Study area
The study area was located in the vicinity of the Taibai Nature Reserve, with the highest peak of northern China in the center of the reserve (Mt Taibai 3767 m a.s.l.). The nature reserve protects a highly diverse flora – from warm temperate (with subtropical elements) to alpine at the top – of over 1700 species, which constitutes approximately 60% of the Qinling range flora [18,19] (Figure 1).

Two valleys were chosen for the study. The first valley is located in the Heihe National Forest Park, on the southern edge of the Mount Taibai. The National Forest Park (a less strict protection regime) is the southern extension of the Taibai Nature Reserve, and mainly protects species-rich forests. The area is completely covered by ancient forest vegetation and rocky outcrops. The river Heihe valley belongs to the Houzhenzi administrative unit (town, zhen(镇)), with an area of 822 km². It is a very isolated place, which has vehicular access to the county town of Zhouzhi (where the post-office and schools are located) only via a 2.5 h drive through a winding precipitous gorge, often blocked for days by falling rocks. Until 1962 the valley belonged to Foping county. The whole valley is inhabited by 3,500 people – ca. a thousand in the main settlement of Houzhenzi, and the rest in hamlets scattered in the forest. The studied villages lie between 1000 and 1400 a.s.l. At these altitudes the climate is humid temperate, with daily temperatures in summer oscillating around 20-30°C and winter temperatures around 10°C to –10°C. The mean annual temperature in Houzhenzi is 8.2°C, with a high rainfall of nearly 1000 mm, out of which 44% is concentrated in the summer months [20,21]. The dominant vegetation is the species-rich Quercus variabilis and Q.aliena var. acuteserrata forest, with an admixture of Pinus tabulaeformis, and many deciduous tree species (e.g. Acer spp., Tilia spp.).

Figure 1 The location of the studied valleys.
The majority of the local population are subsistence farmers who grow maize, potatoes, wheat and beans. The basic staples of the local population are potato, maize and rice. Each farm usually also has chickens and pigs, so eggs, poultry and cured pig meat (larou) are frequent components of diet as well. Sources of cash income are the orchards of zaopi (Cornus officinalis), walnuts (juglans regia) and northern Sechuan pepper (Zanthoxylum bungeanum). Digging out medicinal roots and collecting medicinal herbs for wholesale buyers is also a very popular activity. Many peasant families host tourists (many of them hikers), as part of the agritourist farm system called nongjiale (农家乐). A certain influx of tourists in the valley is caused by the fact that it lies on a picturesque and wild foot trail to Mount Taibai.

The second valley, later called Dali valley (after the largest village in it) is located on the northern edge of the Taibai Mt. It is less isolated than the former valley, being easily accessible by car from the county town Meixian, Xi’an and other cities in central Shaanxi. It belongs to the Meixian county, Yingtou administrative unit (town, zhen (镇)), with 11 villages, ca. 20 thousand inhabitants and 202 km². The actual valley we studied has about 1500 inhabitants and an area of 21 km². The studied villages lie between 700 and 1200 a.s.l. There is no meteorological data on the climate of the area. The mean temperature from Meixian County weather station (alt. ca. 550 m), 15 km from Dali, is about 12.9°C, so we estimate the mean temperature in Dali valley as 8 – 11°C, depending on elevation and location [22,23]. The dominant vegetation is the species-rich Quercus variabilis and Q.aliena var. acuteserrata forest, with an admixture of Pinus tabulaeformis, and many deciduous tree species (e.g. Acer spp., Tilia spp., Platyclusus orentalis, Sorbus spp., Litsea spp., etc.).

The majority of the local population are subsistence farmers who grow maize, potatoes, wheat, and beans. Sources of cash income are walnut orchards (juglans regia), kiwi fruits (Actinidia chinensis) and northern Sechuan pepper (Zanthoxylum bungeanum). Digging out medicinal roots and collecting medicinal herbs for wholesale buyers is much less important than in the Heihe valley, although a large company buying herbs from all over the central Qinling is located there. A number of stone processing businesses operate in the largest villages. Tourism is little developed and, in contrast to the Houzhenzi valley, there are very few nongjiale in the valley (in contrast to it a neighbouring valley has one of the main entrances to the Taibai Reserve (Red Valley Entrance) and experiences much tourism, but we did not study it due to the large proportion of outsiders who settled there).

Both valleys are inhabited by people of Chinese Han nationality. Most inhabitants are local, although some individuals are outsiders who (or whose families) settled, escaping mid-20th century famines from densely populated parts of Shaanxi and Sichuan, or migrated later due to the socio-cultural situation in China. They speak the Shaanxi dialect of Mandarin (Guanzhong dialect, a form of Zhongyuan dialect). The inhabitants of the Dali valley speak a standard form of the Guanzhong dialect, whereas in the Houzhenzi valley, which is more southern, the influence of the Sichuan dialect is visible [24-26]. A detailed description of the economic status of villages in a neighbouring valley of Qinling Mountains, also applicable to the study area, was given by Neurauter et al. [27].

**Methods**

The field research was conducted in June and July 2011, as well as in August 2012, using structured freelisting interviews (36 freelists were created in each valley). The listed taxa were identified using transect walks and cross-checking of the gathered herbarium specimens. Participant observation and long semi-structured interviews with key informants were also used to establish the role of wild food in the local communities.

The research was carried out following the code of ethics of the American Anthropological Association [28] and the International Society of Ethnobiology Code of Ethics [29] and general standards of collecting ethnobotanical data presented by major ethnobotany textbooks [30-33]. Oral prior informed consent was acquired.

In the Houzhenzi valley the interviewees came from the following villages: Houzhenzi, Diaoyutai, Huaerping, Jiangjiaping and Sanhe. The mean age of participants was 50 (median 49.5, aged from 16 to 83; 20 women and 16 men). In the Dali valley we interviewed people living in: Dalicun, Dawancun, Shapocun, Fufeng, Honghecun, Lijiahecun, Liguancun and Tangyu (21 women and 15 men). The mean age of participants was 58 (median 59, age from 27 to 84). During freelisting we separately asked, which species of wild vegetables (including underground organs), wild fruits and wild mushrooms were used. Making three separate freelists enabled the comparison of the use of these categories and helped elicit answers from the respondents [34,35]. Freelists were made orally and written down on the spot by our team, including the Chinese-script version of the plant/fungi names, which was available to the interviewees.

The study started from a few informants found using the snowball technique, but most interviewees were found by systematic walks through the village, visiting houses and asking the inhabitants if they wanted to take part in the study. We usually interviewed only one person from each household, only occasionally were two people from the same house interviewed, if there were signs that their knowledge differed (e.g. one of the spouses comes from another village, etc.). In a few cases free listing was done in the presence of other family
members or neighbours, but one person, delegated as the most knowledgeable, was the main interviewee. Voucher specimens are stored in the Department of Forestry, Northwest A&F University in Yangling.

A Spearman rank correlation matrix was calculated for all the variables studied. Additionally the Mann-Whitney U test was used to test differences between groups (male versus female population, Houzhenzi valley versus Dali valley). Unfortunately the distribution of variables was not normal, even after log-transformation, so we could not perform a multi-factor ANOVA analysis. An open access statistical program, PAST [36,37], was used for statistical analyses.

Results

General figures

Altogether 167 folk plant taxa with 185 species from 72 families and 17 fungi folk taxa (out of which we identified 12 taxa to genus or species level) were listed by the informants. This includes 126 species of green vegetables, 25 species with edible roots/rhizomes/tubers/bulbs, five species of flowers, 42 with edible fleshy fruits and four of dry fruits/seeds (Figure 2). In Houzhenzi 158 plant species and 14 fungi taxa were mentioned by the informants as eaten at least once in their lifetime, but only 130 plant species and 13 fungi species were confirmed as eaten by more than one person (Tables 1,2 and 3). In Dali 113 plant species and 12 fungi taxa were mentioned by the informants as eaten at least once in their lifetime, but only 77 plant species and 11 fungi taxa were confirmed as eaten by more than one person. There was a considerable overlap in the species listed in both valleys (Figure 2).

The mean number of freelisted wild foods (Figure 3) was higher in the Houzhenzi valley (24.8 and 17.6 respectively; Mann-Whitney U test, p < 0.05). A similar trend was observed in all the three categories: wild vegetables (mean 17.5 and 11.5 respectively), fruits (5.9 and 5.1) and fungi (1.9 and 1.0), though the difference was significant only for the vegetables. In both valleys people listed many species of wild vegetables, and few species of fruits, while they struggled to list edible fungi (Figures 3, 4).

The overall number of species was significantly positively correlated with the male gender (Spearman rho = 0.29, p < 0.05) and Houzhenzi valley (rho = 0.28, p < 0.05). There was a small correlation with age, but it was not significant. Species number versus age relationship was better explained by a polynomial curve (-0.00665 ×² + 0.8327 × -2.807, R² = 0.048, p = 0.18; Figure 5) with maximum values for people in their early sixties, though the fit was still not significant (p = 0.18).

As many as 42% of the folk taxa are typical woodland species and only 21% are ruderal species from fields and field edges. The remaining taxa come from forest edges, forest clearings, thickets, grasslands and water margins, thus in practice over half of the species come from woodland ecosystems. This high proportion of forest species and low proportion of ruderals is even more pronounced in Houzhenzi (44% and 14% respectively, compared to 41% and 25% in Dali, a not significant difference: Chi Squared test, p = 0.07). Although a large proportion of plants are woodland taxa, it is the herbs that dominate in the species list (69%), with shrubs, trees and vines playing a minor role (15%, 13% and 3% respectively).

Wild vegetables

Wild vegetables are the most important wild food category collected (Figures 3, 4 and 6, 7, 8, Table 3). This was expressed both by the fact that they constituted around two thirds of the species lists and that people most eagerly talked about them. They are also the only category of wild food stored for winter. Drying wild vegetables is a very common preserving technique (Figure 7). Households dry between 1-5 species each year, usually a few kg of dry shoots and leaves, but some households who host tourists can dry even a few times more. Formerly, wild vegetables were lacto-fermented, but now this is done very rarely.

The number of wild vegetables listed was positively and significantly correlated with place (Houzhenzi versus Dali), male gender and age (Spearman rho equals 0.35, 0.27 and 0.26 respectively), however these are relatively low correlation values.

The ruderal species are collected near homesteads. Their growth is often promoted by sparing them from being sprayed with glyphosate (e.g. Chenopodium album, Hemerocallis spp.). Some forest species are harvested up
to 5 km from the villages, up to the altitude of 1800 m a.s.l. At even higher altitudes, wild plants are only harvested while collecting medicinal herbs, which grow even higher.

Wild vegetables are frequently eaten in all meals, mainly as a side dish (cai). The commonest preparation technique is boiling, then straining and sprinkling them with some oil in which Szechuan pepper, garlic, and sometimes ginger, have been fried. This is a side dish, called liang ban, accompanied by home-made wheat bread (bing), rice or other stir-fried foods. Frequently wild vegetables are also put into broad, home-made noodles served in a spicy and sour soup. They are also, rarely, lacto-fermented. Wild vegetables are also sold in all the local restaurants and every agritourist farm has them on their menu.

Fruits
Wild fruits are little appreciated. They are occasionally gathered for fun by children or grown-ups going to the forest. They have never been stored or dried, and are not incorporated in any dishes by anyone, apart from dried Schisandra and Akebia fruits (the latter more rarely), used medicinally. There was no significant correlation between the number of fruits listed and age, location or gender.

Fungi
Few fungi species are used in both valleys. Most people never go to the forest with the purpose of collecting mushrooms, apart from going to collect cultivated Auricularia sp. and Lentinula edodes grown on piles of logs located in the woods. There was no significant correlation between the number of fungi listed and age, location or gender, though the difference between the male and female groups was bordering on significance level (Mann-Whitney U test, p = 0.08, Spearman rho = 0.20).

The most frequently mentioned mushrooms in both valleys are Cantherellus cibarius, an unidentified Agaricales (called banlijun, i.e. “chestnut mushroom”), Ramaria spp. treated by locals as one folk taxon and Grifola umbellata, (its sclerotia are additionally collected for medicinal purposes). More than half of the respondents had never collected wild fungi in the forest.

Famine plants
All the older informants were asked about plants eaten during the severe food shortages that plagued China until the last case of famine in 1958-60. However this revealed only a few “famine” plants, as the respondents stated that they rather ate the same wild plants but in larger quantities. Underground organs of plants were particularly eagerly sought after: the rhizomes of Pueraria lobata, Pteridium aquilinum, Polygonatum spp., Sinacalia tangutica, the bulbs of Lilium giganteum and other Lilium species. Nowadays the consumption of underground organs of wild plants has practically ceased. Many respondents also mentioned using the leaves of Abelia engleriana to make a special dish called shenxiandoufu (i.e. fairy tofu). According to legend, during times of famine a fairy/wizard/holy man passed through the area and taught people how to make a special famine tofu

| Table 1 Rank correlation matrix (Spearman rho coefficient) |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Male gender = 1 | -0.34**         |                  |                  |                  |                  |
| Houzhenzi valley = 1 | -0.25*          | 0.028           |                  |                  |                  |
| No of all species | 0.16            | 0.23            | 0.31**          |                  |                  |
| No of vegetable species | 0.26*          | 0.27*          | 0.35**          | 0.89***         |                  |
| No of fruit species | -0.025          | 0.029          | 0.089           | 0.68***         | 0.35**          |
| No of fungi | -0.0009         | 0.20           | 0.14            | 0.46***         | 0.28*          |

*** p < 0.001; ** p < 0.01; * p <0.05; values without asterisks are not statistically significant.

| Table 2 Basic features of plant and fungi use in the Qinling mountains |
|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                   | No. of species used | Frequency of use | Consumption after boiling or stir-frying or in soup | Raw consumption | Drying for further use | Lacto-fermenting | Gender differentiation | Age differentiation |
|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Wild vegetables  | high             | high             | yes              | no               | frequently       | rarely, more often in the past | men know slightly more | low              |
| Wild fruits      | intermediate     | low              | no               | yes              | never            | no              | no              | insignificant   |
| Wild fungi       | low              | low              | yes              | no               | very rarely      | no              | men know slightly more (?)) | insignificant |
Table 3 Wild food species used in the northern slope of the Qinling mountains (plant families given according to APGIII [69])

| Family               | Name                                 | Part used for food | Habitat in Houzhenzi | Frequency in Houzhenzi | Name in Houzhenzi | Name in Dali | Ma Voucher no. |
|----------------------|--------------------------------------|--------------------|----------------------|------------------------|-------------------|--------------|---------------|
| **VASCULAR PLANTS**  | Actinidiaceae Actinidia chinensis Planch. | fr f               | ***                  | ***                    | yemihoutao        | yemihoutao   | 193           |
|                      | Actinidia polygama Franch. & Sav.     | fr f               |                      | 1                      | gezaomihoutao     |              |               |
|                      | Amaranthaceae Achyranthes bidentata Blume | ap e               |                      | *                      | niuxi             |              | 185           |
|                      | Amaranthus caudatus L.                 | ap r               | **                   | 1                      | tianximi          |              |               |
|                      | Amaranthus retroflexus L., A. paniculatus L., A. viridis L. etc. | ap r               | ****                 | ****                  | hancai, renhancai |              |               |
|                      | Chenopodium album L., Chenopodium giganteum D. Don | ap r               | ****                 | ***                   | huihuicai         |              |               |
|                      | Chenopodium glaucum L.                 | ap e               |                      | *                      | yes               |              |               |
|                      | Kochia scoparia (L.) Schrad.           | ap e               |                      | yes                    | yes               |              |               |
| Amaryllidaceae       | Allium funckiacfolium Hand.-Mazz.     | ap                 |                      |                        |                   |              |               |
|                      | Allium senescens L.                   | ap e               |                      |                        |                   |              |               |
|                      | Allium ovalifolium Hand.-Mazz., Allium cf victorialis L. | ap, u             | e                    | *                      | gejiu, yejiu      |              |               |
|                      | Allium paepalanthoides Ary Shaw       | ap, u             | e                    | ***                   | tiansuan          |              |               |
|                      | Allium spp. (Allium cf. senescens L.; Allium macrostemon Bunge) | ap e             | ****                 | ****                   | aijucai, aisan, yesuan, yongbaotou, luoejiru, zongbaotou, yejiucal |              |               |
|                      | Allium tuberosum Rottler ex Spreng.   | ap e               |                      | 1                      |                   | jejiu         |               |
| Anacardiaceae        | Rhus potatinii Maxim.                 | ap f               | 1                    | *                      | wubeizhushu       |              |               |
|                      | Rhus verniciflua Stokes               | ap f               | *                    | 1                      | qishu             |              |               |
| Apiaceae             | Cryptotaenia japonica Hassk.          | ap f               | *                    |                        | yajiuban          |              |               |
|                      | Daucus carota L.                      | ap r               |                      | 1                      | tiansuon          |              |               |
|                      | Ligusticum sinense Oliv. 'Chuanhsing ' | ap r               |                      | 1                      | chuanxiong        |              |               |
|                      | Ligusticum levisticum L.              | ap r               |                      | 1                      |                   |               | x             |
|                      | Oenanthe javanica DC.                 | ap x               | 1                    | **                     | beizhe            |              |               |
|                      | Pimpinella sp.                        | ap f w             | ****                 |                        | shuiqincai, shaqincai |              |               |

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| Table 3 Wild food species used in the northern slope of the Qinling mountains (plant families given according to APGIII [69]) (Continued) |
|---------------------------------------------------------------------------------------------------------------|
| **Tongoloa silaifolia (de Bois.) Wolff**                                                                        |
| Araliaceae                                                                                                      |
| Acanthopanax gracilistylus W. W.Sm.                                                                        |
| Aralias chinensis L.                                                                                           |
| Aristolochiaceae                                                                                               |
| Asarum himalaicum Hook.f. & Thomson ex Klotzsch                                                             |
| Asarum sieboldii Miq.                                                                                         |
| Asclepiadaceae                                                                                                |
| Cynanchum giraldii Schltr.                                                                                    |
| Asparagaceae                                                                                                |
| Polygonatum cyronema Hua                                                                                      |
| Polygonatum megaphyllum P.Y.Li and Polygonatum odoratum L.                                                    |
| Smilacina japonica A.Gray, Smilacina henryi (Baker) Hara                                                    |
| Asteraceae                                                                                                     |
| Carduus crispus L.                                                                                             |
| Anaphalis aureopunctata f. flavesens Lingelh et Borza                                                         |
| Anaphalis margaritacea Benth. & Hook.f.                                                                     |
| Arctium lappa L.                                                                                              |
| Artemisia sacrorum Ledeb.                                                                                      |
| Artemisia argyi H.Lév. & Vaniot                                                                                  |
| Artemisia capillaris Thunb.                                                                                     |
| Artemisia subdigitata Mattf.                                                                                    |
| Cacalia roborowskii (Maxim.) Y. Ling                                                                          |
| Cirsiunm arvense var. setosum (Wild.) C.A.Mey                                                                      |
| Cirsiunm spp. eg Cirsiunm botryoides Petrak ex Hand.-Mzt.                                                        |
| Cirsiunm segetum Bunge                                                                                         |
| Conyza canadensis (L.) Cronquist                                                                               |
| Erigeron acer L.                                                                                               |

| Plant Family | Genus | Species | Family | Common Names | Other Common Names |
|--------------|-------|---------|--------|--------------|-------------------|
| Tongoloa silaifolia | (de Bois.) Wolff | | | | |
| Araliaceae | Acanthopanax gracilistylus | W. W.Sm. | | | |
| Aralias chinensis | | L. | | | |
| Aristolochiaceae | Asarum himalaicum | Hook.f. & Thomson ex Klotzsch | | | |
| Asarum sieboldii | Miq. | | | | |
| Asclepiadaceae | Cynanchum giraldii | Schltr. | | | |
| Asparagaceae | Polygonatum cyronema | Hua | | | |
| Polygonatum megaphyllum | P.Y.Li and Polygonatum odoratum | L. | | | |
| Smilacina japonica | A.Gray, Smilacina henryi (Baker) | Hara | | | |
| Asteraceae | Carduus crispus | L. | | | |
| Anaphalis aureopunctata | flavesens Lingelh et Borza | | | | |
| Anaphalis margaritacea | Benth. & Hook.f. | | | | |
| Arctium lappa | | L. | | | |
| Artemisia sacrorum | Ledeb. | | | | |
| Artemisia argyi | H.Lév. & Vaniot | | | | |
| Artemisia capillaris | Thunb. | | | | |
| Artemisia subdigitata | Mattf. | | | | |
| Cacalia roborowskii | (Maxim.) Y. Ling | | | | |
| Cirsiunm arvense var. setosum | (Wild.) C.A.Mey | | | | |
| Cirsiunm spp. eg | Cirsiunm botryoides | Petrak ex Hand.-Mzt. | | | |
| Cirsiunm segetum | Bunge | | | | |
| Conyza canadensis | (L.) Cronquist | | | | |
| Erigeron acer | L. | | | | |

| Common Names | | |
|--------------|---|---|
| **taibaisanqi** | | |
| **cilongpao** | | |
| **huabeimaoqi** | | |
| **huazhushen** | | |
| **plantoucai** | | |
| **shiqucao** | | |
| **qingmingcai** | | |
| **niubangzi** | | |
| **ai** | | |
| **honghuamiao, ciji** | | |
| **xiaoji** | | |
| **guangguangcao** | | |
| | | |
| **太白三七** | | |
| **剥龙袍** | | |
| **刺龙袍** | | |
| **毛细辛** | | |
| | | |
| **x** | | |
| **74** | | |
| **24, 163** | | |
| **133** | | |
| **31, 34** | | |
| **6, 129** | | |
| **137** | | |
| **116, 161** | | |
| **23, 156** | | |
| **44** | | |
| **178, 210** | | |
| **x** | | |
| **62, 101, 117** | | |
| **141** | | |
| **141** | | |
| **21** | | |
| **141** | | |
| **59** | | |

**Note:** The above table lists wild food species used in the northern slope of the Qinling mountains, along with their scientific names and common names according to APGIII classification.
Table 3 Wild food species used in the northern slope of the Qinling mountains (plant families given according to APGIII [69]) (Continued)

| Species                                      | Family          | Common Name     | aliases                                                                 | Numbers  |
|----------------------------------------------|-----------------|-----------------|------------------------------------------------------------------------|----------|
| Hieracium sp.                                |                 |                 | kumaicai, kuqu                                                       | 197      |
| Ixeris denticulata (Houtt.) Stebbins         |                 |                 |                                                                         |          |
| Ixeris chinensis Nakai.                      |                 |                 |                                                                         |          |
| Ixeris sonchifolia Hance                     |                 |                 |                                                                         |          |
| Kalimeris pinnatifida (Maxim.) Kitarn.       |                 |                 |                                                                         |          |
| Lactuca serriola L.                          |                 |                 |                                                                         |          |
| Leontopodium japonicum Miq.                 |                 |                 |                                                                         |          |
| Picris hieracioides L.                       |                 |                 |                                                                         |          |
| Saussurea dolichopoda Diels                  |                 |                 |                                                                         |          |
| Senecio scandens Ham.                         |                 |                 |                                                                         |          |
| Sinacalia tangutica (Maxim.) B.Nord.         |                 |                 |                                                                         |          |
| Sonchus asper L                              |                 |                 |                                                                         |          |
| Sonchus oleraceus L.                         |                 |                 |                                                                         |          |
| Sylilbum marianum L.                         |                 |                 |                                                                         |          |
| Taraxacum mongolicum Han.-Mzt               |                 |                 |                                                                         |          |
| Balsaminaceae Impatiens notolopha Maxim.    |                 |                 |                                                                         |          |
| Begoniaceae Begonia sinensis A.DC.           |                 |                 |                                                                         |          |
| Brassicaceae Capsella bursa-pastoris Medik.  |                 |                 |                                                                         |          |
| Cardamine engleri ana O.E. Schultz.          |                 |                 |                                                                         |          |
| Cardamine macrophylla Willd.                 |                 |                 |                                                                         |          |
| Cardamine spp. (other smaller species e.g. Cardamine flexuosa With., C. hirsuta L.) |                 |                 |                                                                         |          |
| Descurainia sophia (L) Webb ex Prantl        |                 |                 |                                                                         |          |
| Rorippa montana Small                        |                 |                 |                                                                         |          |
| Rorippa indica L.                            |                 |                 |                                                                         |          |
| Thlaspi arvense L.                           |                 |                 |                                                                         |          |

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Table 3 Wild food species used in the northern slope of the Qinling mountains (plant families given according to APGIII [69]) (Continued)

| Family                  | Species                        | Gender | Type | Plant Family | Common Name         | Synonym |
|-------------------------|--------------------------------|--------|------|--------------|---------------------|---------|
| Campanulaceae           | Adenophora spp. (Adenophora    | ap, u  | e    | ***          | naijiangcai         | 奶浆菜  |
|                         | capillaris Hemsl., Adenophora |        |      |              | naiercai, nainaicai | 奶儿菜， |
|                         | polyantha Nakai)               |        |      |              |                     | 奶妈菜  |
| Caprifoliaceae          | Lonicera standishii Carr.      | fr     | f    | *            | kutangpao           | 羊奶泡  |
|                         |                                |        |      |              | yangnaizi, kutangpao| 羊奶泡   |
| Sambucus williamssii Hance | fr | f | 1 | jiegum | shuhuacai         | 树花菜  |
| Viburnum sarmentii Koehne | ap | f | 1 | (no name) |                     |         |
| Caryophyllaceae         | Arenaria serpyllifolia L.      | ap     | e    | *            | yangnaizi           | 羊奶草  |
|                         |                                |        |      |              | yangnaizi, kutangpao| 羊奶泡   |
|                         | Caprifoliaceae                 | ap     | e    | *            | honghuacai          | 鸭儿肠  |
|                         |                                |        |      |              |                     |         |
| Celastraceae            | Celastrus orbiculatus Thunb.   | ap     | f    | ****        | baiwanye            | 白蔓叶  |
|                         | Euonymus alatus (Thunb.) Siebold | fr | f | 1 | bashu, bamu | 另木, 巴木 |
|                         | Parnassia wightiana Wall.      | ap     | f    | 1 | xinyecao     | 心叶草  |
| Cephalotaxaceae         | Cephalotaxus sinensis (Rehder & E.H.Wilson) HLLi | fr | f | * | baigeiguo, bizhiu, shuibai, sunguo | 白皮果, 缘子树, 水柏, 松果 |
| Commelinaceae           | Commelina communis L.          | ap     | r    | 1 | dazhuhye, zhuyecao, mianzai | 淡竹叶, 叶竹草, 面杖子 |
| Convolvulaceae          | Tricyrtis macropoda Miq.       | ap     | f    | ***        | huangguacai         | 黄瓜菜  |
|                         | Calystegia hederacea Wall.     | ap     | r    | *         |                     |         |
|                         | Cuscuta cf chinensis L.         | ap     | e    | 1         | jingtiansanqi       | 景天三七  |
|                         | Cornus kousa Bürger ex Miq.    | fr     | f    | ***        | shizao              | 石枣  |
|                         | Corylus heterophylla Fisch. ex Besser | fr | f | * | zhenzi, maoli, maolizihu, | 椪子, 毛栗子树 |
|                         | Sedum aizoon L., S. sarmentosum Bunge, pampaninii Raym.-Hamet, S. lineare Thunb. | ap | e | ** | gouchiyuan, gouzicai, machihiji, dabusi, chuijicai | 狗牙菜, 打不死 |
|                         | Sedum ampliplectatum K.T.Fu     | ap     | f    | ***        | huagiaomian, lazimiao, lajiaomiao, yelacai | 花荠蔓, 野辣子 荷苗, 辣椒苗, 叶辣椒 |
|                         | Sedum verticillatum L.          | ap     | e    | 1         | jingtiansanqi       | 景天三七  |
|                         | Gynostemma pentaphyllum (Thunb.) Makino | ap | e | 1 | jiaogulan | 绞股蓝  |

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| Family Name          | Species Name                      | Common Names                  | Notes                  | Location | Uses                     |
|---------------------|----------------------------------|-------------------------------|------------------------|----------|--------------------------|
| Dennstaedtiaceae    | Pteridium aquilinum (L.) Kuhn    | **juecai, juegen, longzhua**  | **juecai, juegen**     | x 9, 214 | **juecai, juegen**       |
| Dioscoreaceae       | Dioscorea batatas Decne.         | **shanyao**                   | **shanyao**            | 53, 191, 209 | **shanyao**              |
| Dryopteridaceae     | Cyrtomium fortunei J.Sm.         | **xiaojitoucai**              | **small head**         | 111      |                          |
| Ebenaceae           | Diospyros lotus L.               | **shanyao**                   | **shanyao**            | 53, 191, 209 | **shanyao**              |
| Eleagnaceae         | Elaeagnus umbellata Thunb.       | **yangnaizi, niuanaizi**      | **yangnaizi**          | 29, 232  | **yangnaizi**            |
| Fabaceae            | Cercis chinensis Bunge           | **xiaoguoshaji**              | **xiaoguoshaji**       | 68       |                          |
| Ebenaceae           | Diospyros lotus L.               | **yangnaizi**                 | **yangnaizi**          | 29, 232  | **yangnaizi**            |
| Fabaceae            | Kummerovia stipueacea (Makim.) Makino | **qiabuqi**               | **qiabuqi**            | 29, 232  |                          |
| Ericaceae           | Pyrola decorata Andr.            | **hongru, shoucha**           | **hongru**             | 69       |                          |
| Ericaceae           | Pyrola rotundifolia L.           | **bairu, shoucha**            | **bairu**              | 69       |                          |
| Fabaceae            | Cercis chinensis Bunge           | **xiaoguoshaji**              | **xiaoguoshaji**       | 68       |                          |
| Fabaceae            | Kummerovia stipueacea (Makim.) Makino | **qiabuqi**               | **qiabuqi**            | 68       |                          |
| Fabaceae            | Medicago sativa L.               | **laozihou**                  | **laozihou**           | 54       |                          |
| Fabaceae            | Pueraria lobata (Willd.) Ohwi    | **gegen**                     | **gegen**              |          |                          |
| Fabaceae            | Robinia pseudoacacia L.          | **huaihua**                   | **huaihua**            | 40       |                          |
| Fabaceae            | Vicia cracca L.                  | **yewandoujian**              | **yewandoujian**       | 3, 71    |                          |
| Fabaceae            | Vicia sp.                        | **maoshaozi**                 | **maoshaozi**          |          |                          |
| Fabaceae            | Castanea mollissima Blume        | **yemaoli, yebanli**          | **yemaoli, yebanli**   | 130      |                          |
| Fabaceae            | Quercus variabilis Blume         | **xiangzhu**                  | **xiangzhu**           |          |                          |
| Helwingiaceae       | Ribes glacialis Wall.            | **no name**                   | **no name**            | 37       |                          |
| Juglandaceae        | Helwingia japonica (Thunb.) F. Dietr. | **yeshanghua**              | **yeshanghua**         | 22, 175  |                          |
| Lamiaceae           | Juglans cathayensis Dode         | **yehetao**                   | **yehetao**            | 109      |                          |
| Lamiaceae           | Caryopteris divaricata Maxim.    | **choulaohan, laohanzhang**   | **choulaohan, laohanzhang** |          |                          |
| Lamiaceae           | Clerodendrum trichotomum Thunb.  | **choumudan, choulaohan**     | **choumudan, choulaohan** | 11       |                          |
| Lamiaceae           | Lycopus lucidus Turcz. ex Benth. | **yebai, zelan**              | **yebai, zelan**       | 98       |                          |
| Lamiaceae           | Mentha halphcalyx Briq.          | **bohe, yuxiangcao**          | **bohe, yuxiangcao**   | 114      |                          |
| Lamiaceae           | Stachys affinis Bunge            | **diguniu**                   | **diguniu**            | 67, 157  |                          |
| Family               | Species                          | Common Names                      | Usage                                      |
|---------------------|----------------------------------|-----------------------------------|--------------------------------------------|
| Lardizabalaceae     | Akebia trifoliata (Thunb.) Koidz. | fr f                              | bayuegua, bayuezha                         |
|                     | Decaisnea fargesii Franch.       | fr f                              | bayuegua, bayuezha                         |
| Liliaceae           | Hemerocallis spp. (Hemerocallis | fl e                              | yehuanghua                                 |
|                     | dumortierii C.Morren, Hemerocallis fulva L.) |                          |                                            |
|                     | Lilium brownii F.E.Brown ex Spae | u f                              |                                            |
|                     | Lilium giganteum Wall.          | u w,f                            | shuibaihe                                  |
|                     | Lilium longiflorum Thunb.       | u                                 |                                            |
|                     | Lilium lancifolium Thunb. (as L. tigrinum) | u x,w                            | yebaihe                                    |
| Linaceae            | Abelia engleriiana Rehder        | ap f                              | shenxiandoufu                              |
| Malvaceae           | Grewia biloba G.Don. Var.       | fr e                              | gebengbeng                                 |
| Malva silnensis Cav. |                                  | if r                              | dawanhua                                   |
| Melliaceae          | Toona sinensis (Juss.) M.Roem.   | ap e                              | xiangchun                                  |
| Menispermaceae      | Cocculus trilobus (Thunb.) DC.   | ap x                              | heimanye                                   |
| Moraceae            | Broussonetia papyrifera (L.)     | ap, fl                            | goushuguo, gouye                           |
|                     | Morus australis Poir.            | fr f                              | sangpao, sangshu                           |
| Onocleaceae         | Matteucia struthiopterus (L.) Tod. | ap x                              | jitoucai                                   |
| Orchidaceae         | Bletilla striata Rchb.f.         | u f                              | tianma                                     |
|                     | Gastrodia elata Blume           | u f                              |                                            |
| Oxalidaceae         | Oxalis spp. (O. griffithii Edgew. & Hookf., O. corniculata L.) | ap f r                            | suancao, suancai, suansuancao             |
| Penthoraceae        | Penthorum chinense Pursh.        | ap f                              |                                            |
| Phytolaccaceae      | Phytolacca esculenta Van Houtte  | ap, u f r                         | jiangliusheng                              |
| Plantaginaceae      | Plantago asiatica L.             | ap r e                            | kaimenyen, cheqiancao, cheqianzi           |
|                     | Veronica didyma Tenore           | ap r                              |                                            |
| Poaceae             | unidentified Bambusae            | ap f                              | zhusun                                     |

Table 3 Wild food species used in the northern slope of the Qinling mountains (plant families given according to APGIII [69]) (Continued)
| Family               | Species                               | Common Names                      | Chinese Names       | Note  |
|----------------------|---------------------------------------|-----------------------------------|---------------------|-------|
| Polygonaceae         | *Polygonum aviculare* L.              | Bianwu                           | bianxu             | 63    |
|                      | *Polygonum ciliinerve* (Nakai) Ohwi   | *         | qiaomaitou         |       |
|                      | *Polygonum* gracilipes (Hemsl.)      | *         | *         |       |
| Portulacaceae        | *Portulaca oleracea* L.              | Machixian                         | machixian          | 144   |
| Primulaceae          | *Lysimachia hemsleyana* Maxim. ex Oliv. | Guoluhuang                       | guoluhuang         |       |
| Ranunculaceae        | *Aconitum carmichaelii* Debeaux      | Wuyao                             | wuyao              | 50    |
|                      | (more often cultivated)              | *         | wuyao              | 155   |
| Rhamnaceae           | *Berchemia sinica* Schneid.          | *         | *         |       |
|                      | *Hovenia dulcis* Thunb.              | *         | guaizao           |       |
|                      | *Zzyphus jujuba* var. spinosa (Bunge) Hu | *         | shanzao           |       |
| Rosaceae             | *Craategus hupehensis* Sarg.         | *         | *         |       |
|                      | *Fragaria corymbosa* Losinsk., *Fragaria pentaphylla* Losinsk.) | *         | *         |       |
|                      | *Malus prunifolia* (Willd.) Borkh.   | *         | *         |       |
|                      | *Potentilla indica* (Andrews) Th. Wolf | *         | *         |       |
|                      | *Potentilla sp.*                     | *         | *         |       |
|                      | *Prunus armeniaca* L.               | *         | *         |       |
|                      | *Prunus canescens* Bois, P. pilosulca Koehne | *         | *         | 39    |
|                      | *Prunus davidiana* Franch.           | *         | *         | 28    |
|                      | *Prunus cfr polytricha* Koehne       | *         | *         | 224   |
|                      | *Prunus persica* (L.) Batsch         | *         | *         | 38    |
|                      | *Prunus salicina* Lindl.             | *         | *         | 187   |
|                      | *Prunus tomentosa* Thunb.            | *         | *         | 170   |
|                      | *Pyrus xerophila* T.T.Yu             | *         | *         | 115   |
|                      | *Pyracantha fortuneana* (Maxim.) H.L.L.Li | *         | *         |       |

Table 3 Wild food species used in the northern slope of the Qinling mountains (plant families given according to APGIII [69]) (Continued)
Table 3 Wild food species used in the northern slope of the Qinling mountains (plant families given according to APGIII [69]) (Continued)

| Family            | Species                                   | Number | Common Name  | Scientific Name                  | Common Name  | Scientific Name                  | Common Name  | Scientific Name                  | Common Name  | Scientific Name                  | Common Name  | Scientific Name                  |
|-------------------|--------------------------------------------|--------|--------------|----------------------------------|--------------|----------------------------------|--------------|----------------------------------|--------------|----------------------------------|--------------|----------------------------------|
| Rubiaceae         | Galium aparine L.                          | ap     | r            | 1                                | ranwawa      | 然娃娃                           |              |                                  |              |                                  |              |                                  |
| Rutaceae          | Zanthoxylum bungeanum Maxim.               | ap, fr | f             | 1                                | yehuajiao    | 野花椒                           |              |                                  |              |                                  |              |                                  |
| Sabiaceae         | Sabia shensiensis H.Y.Chen                 | ap     | f             | 1                                | liuzhu       | 柳树                            |              |                                  |              |                                  |              |                                  |
| Salicaceae        | Salix cf babylonica L.                     | ap     | e             | 1                                | mairhuili,   | 面核桃,                           |              |                                  |              |                                  |              |                                  |
| Santalaceae       | Buckleya hentyi Diels                      | fr     | f             | 1                                | mimianwong   | 面面翁                           |              |                                  |              |                                  |              |                                  |
| Saxifragaceae     | Bergenia scopulosa T.P.Wang                | ap     | w             | 1                                | yuebaicai    | 野白菜                           |              |                                  |              |                                  |              |                                  |
| Chrysosplenium biondianum Engl. |                       | ap     | f             | ***                            | hongjincai   | 红筋菜                           |              |                                  |              |                                  |              |                                  |
| Chrysosplenium sinicum Maxim. |                       | ap     | ***            | ***                             | hongjincai   | 红筋菜                           |              |                                  |              |                                  |              |                                  |
| Schisandraceae    | Schisandra sphenanthera Rehder & E.H.Wilson | fr     | f             | ****                            | wuweizi      | 五味子                           |              |                                  |              |                                  |              |                                  |
| Solanaceae        | Physalis alkekengi L.                      | ap     | r             | *                                | guajindeng,  | 挂金, 灯笼                           |              |                                  |              |                                  |              |                                  |
| Solanum nigrum L. |                                           | ap     | r             | 1                                | suanjing     | 酸浆                            |              |                                  |              |                                  |              |                                  |
| Staphyleaceae     | Staphylea bumaalda DC., S. holocarpa Hems. | ap, fl | f             | ****                            | shuhuacai    | 树花菜                           |              |                                  |              |                                  |              |                                  |
| Ulmaceae          | Ulmus bergmanniana C.K. Schneid, Ulmus propinqua Koidz. | ap, b, if | f            | e                                | yushu        | 檗树                            |              |                                  |              |                                  |              |                                  |
| Urticaceae        | Boehmeria gracilis C.H.Wright              | ap     | x             | *                                | honghema     | 红河麻                           |              |                                  |              |                                  |              |                                  |
| Boehmeria tricuspis Makino |                       | ap     | x             | *                                | hema         | 河麻                            |              |                                  |              |                                  |              |                                  |
| Pilea mongolica Wedd. |                       | ap     | f             | *                                | daolaonen    | 到老嫩                           |              |                                  |              |                                  |              |                                  |
| Urtica fissa E.Pritz. ex Diels |                       | ap     | x             | *                                | baihema      | 白河麻                           |              |                                  |              |                                  |              |                                  |
| Violaceae         | Viola cf. grypoceras A.Gray               | ap     | r             | 1                                | didingcao    | 地丁草                           |              |                                  |              |                                  |              |                                  |
### Table 3 Wild food species used in the northern slope of the Qinling mountains (plant families given according to APGIII [69]) (Continued)

| Plant Family | Species | Frequency | Parts | Habitat Types | Habitat Types |
|--------------|---------|-----------|-------|---------------|---------------|
| Vitaceae     | Vitis ficifolia Bunge | fr | f | *** | *** | yeputao | yeputao | yeputao | Wild | 19 |
| **Fungi**    |         |           |       |               |               |
| Auriculariaceae | Auricularia sp. (more often cultivated) | fb | f | * | * | muer | muer | muer | Wild | 19 |
| Boletaceae   | Boletus spp. | fb | f | ** | * | niuganjun, dajiaogu | niuganjun | niuganjun | Forest | 204, 236 |
| Cantharellaceae | Cantharellus cibarius Fr. | fb | f | ** | ** | huangsijun | huangsijun, jiyoujun | huangsijun, jiyoujun | Forest | 203 |
| Gomphaceae   | Ramaria spp. | fb | f | *** | * | shuabajun | guoshuajun | guoshuajun | Forest | 205 |
| Hericiaceae  | Hericium sp. | fb | f | * | * | houtoujun | houtoujun | houtoujun | Forest | 205 |
| Marasmiaceae | Lentinula edodes (Berk.) Pegler (more often cultivated) | fb | f | ** | 1 | yexianggu | yexianggu | yexianggu | Grassland | 203 |
| Meripilaceae | Grifola umbellata (Pers.) Pilát | fb | f | ** | ** | zhulingjun | zhulingjun, zhulinghua | zhulingjun, zhulinghua | Grassland | 223 |
| Morchellaceae | Morchella sp. | fb | f | * | Yangquejun | Yangquejun | Yangquejun | Forest | 205 |
| Pleurotaceae | Pleurotus sp. | fb | f | *** | * | dongjun | dongjun | dongjun | Forest | 205 |
| Polyporaceae | Laetiporus sulphureus (?) | fb | f | * | Jiguanjun | Jiguanjun | Jiguanjun | Forest | 205 |
| Tricholomataceae | Tricholoma matsutake (S. Ito & S. Imai) Singer (?) | fb | f | * | | Songrongjun | Songrongjun | Songrongjun | Forest | 205 |
| **UNIDENTIFIED MUSHROOM** | | fb | f | * | | Qiaomianjun | Qiaomianjun | Qiaomianjun | Forest | 205 |
| **UNIDENTIFIED TERRESTRIAL GILLED MUSHROOM** | | fb | f | ** | ** | Banlijun | Banlijun, Maolijun | Banlijun, Maolijun | Forest | 205 |
| **UNIDENTIFIED MUSHROOM** | | fb | f | ** | | Qiaomajun | Qiaomajun | Qiaomajun | Forest | 205 |
| **UNIDENTIFIED MUSHROOM** | | fb | f | 1 | Baogujun | Baogujun | Baogujun | Grassland | 205 |
| **UNIDENTIFIED MUSHROOM** | | fb | f | * | | Yangdijun | Yangdijun | Yangdijun | Forest | 205 |
| **UNIDENTIFIED MUSHROOM** | | fb | f | * | | Mabojun | Mabojun | Mabojun | Forest | 205 |

Ma – Recorded by Ma et al. 2002 [38,39].

Habitat types: e – forest edges, shrubland, forest clearings, grassland; f – forest; r – ruderal; w – water edges; x – ubiquitous.

Parts consumed: fr – fruit, ap – aerial parts, u – underground parts, fl – flowers, b – bark, fb – fruiting body, ls – leaf stalks, if – immature fruits.

Frequency: **** > 50% of respondents; *** > 1/4 of respondents; ** > 1/8 of respondents; * from 2 to 8 respondents; 1 – one respondent.
with this plant, which saved people from starvation. The bark of Ulmus spp. was used to make famine bread, however not in the 1958-60 famine, but in the previous 1940s famine (before the Liberation), which in this area is remembered as being more severe.

**Discussion**

It was already pointed out by Kang et al. [13] that the large number of wild greens used in this valley is one of the highest recorded on such a small scale in ethnobotanical studies. Only Zou et al. [9] recorded more, noting the use of 335 taxa of wild vegetables in 10 villages of Hunan, however the latter study was carried out in a larger and more heterogeneous area. Ghorbani et al. [11] recorded the use of 173 wild food plants from 485 informants of four ethnic groups of Naban valley of Xishuangbanna (tropical area of south China), out of which only around a third were wild greens, in contrast to our study where they dominate. However, Ghorbani’s study concerned an area, which was very heterogeneous in terms of elevation, inhabitants and vegetation. The average number of wild food plants listed by one informant was only around 10 species, whereas in this study we documented twice as many taxa per person.

The presented list is also much longer than the lists of wild food plants reported in previous studies from the Qinling Mountains, east from our study area, in the south of the Huxian county [38,39]. Although there was a partial overlap in the species lists (Table 3), the differences show a high geographical diversity of wild vegetable use. Some of these differences may come from differences in habitats, some from cultural choices, and some from the fact that

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**Figure 3** Species numbers freelisted by particular groups: maxima, minima, median (thick line inside a box), 25 and 75 percentile (borders of the box). Outliers are marked with a small circle.

**Figure 4** Use categories in the listed species.
It was already pointed out by us in the previous paper [13] that knowledge of wild vegetables in China is additionally encoded in the language (many wild vegetables have cai, i.e. vegetable), in their name. In our study it was 39 taxa (a third of the wild vegetables recorded, mainly the most commonly used ones). Another factor may nowadays help to preserve the knowledge of wild vegetables in China. It is the commodification of wild vegetables by involving them in tourism. Nowadays, nearly every national park in China has local restaurants of wild vegetables (often called "mountain wild vegetables" to emphasize their "naturalness") (e.g. [9,11,13]).

This is part of a broader process of trying to promote or create local attractions in rural China with the hope of drawing the attention of tourists [40]. A similar process occurs in Europe, where wild foods are incorporated in haute cuisine and in revitalized regional dishes [41].

It must be pointed out that the number of wild foods used in many parts of China, in its species-rich parts outside the areas of intense agriculture, is probably an example of an area utilizing the largest number of plant species available to human populations. This huge list of plants is mainly made up by wild greens. This attitude was named by Łuczaj [42] as herbophilia, and here in China it takes its most extreme form. The number of wild food plants used in the studied valley comparable to the lists of edible plants recorded on a country scale in Europe (e.g. [43-49]). The utilization of such a large number of greens may also be found in some communities in other countries of Eastern Asia, e.g. Japan, Korea, Vietnam and Thailand [50-57], as well as in some parts of India and Africa [54,57]. The number of wild food plants used by the studied communities in the Qinling Mountains is similar to that used by the few communities in the world.
previously reported as using the highest numbers of wild food plants species (between 171 and 252), i.e. Igbo ib southern Nigeria, Dalit in Andhra Pradesh or Karen in NW Thailand ([57] after [54]).

In many tropical and subtropical areas the choice of species is limited by the fact that primary tropical vegetation has thick leathery leaves and mainly ruderal plants are eaten. In the mountains of China the choice of edible species is increased by two factors:

1. large elevation differences enabling easy access to different vegetation zones;
2. deciduous vegetation with many forest understory perennials with delicate leaves and buds.

In our study around half of the wild vegetables come from the forest. This is in contrast with other ethnobotanical studies showing that human populations, even in wooded areas, tend to over-utilize the ruderal flora [14,58-60]. On the other hand the results of this study are very similar to the data on the use of wild food plants by the Karen ethnic group in the forests of NW Thailand, for whom wild forest vegetables also constitute a major part of the wild plants consumed [55]. Interestingly, the large diversity of wild vegetables (also those which are typical woodland species) used in Eastern Asia remains in stark contrast with the extremely low number of wild vegetables used in the Amazon in similar environments [61].

What is interesting is the large domination of wild greens over fruits and fungi. The list of mushrooms is for example shorter than the number of mushroom species used locally in Poland [62] or Mexico [63]. The lack of interest in wild edible mushrooms in the studied area is puzzling, as China is sometimes regarded as a mycophilous part of the world [64,65]. It may arise from the easy access to the cultivated *Auricularia* and *Lentinula* mushrooms and extremely steep terrain, making foraging for fungi difficult. In Yunnan, famous for edible fungi, the hills and mountains are often less steep (LL, personal observations). Collecting mushrooms requires more walking to find them than in the case of wild vegetables whose location is more permanent. Our results encourage further research into the knowledge and use of edible fungi in rural areas in China.

**Do men know more?**

In the Qinling mountains the collection of wild food plants is the domain of both sexes. On the other hand it must be noted that men slightly outperform women in listing slightly more species of wild vegetables, and many more species of fungi (Table 3). These results may be caused by the fact that a larger proportion of men get involved, regularly or occasionally, in collecting medicinal plants for sale. As they make long trips into higher elevations they acquire a vast knowledge of local woodland flora. This may explain the larger number of species listed, even though it may be the women who spend more hours collecting wild plants. This slight domination of men in this domain is quite unusual, as in many countries it is the women who are the main holders of knowledge on wild vegetables (e.g. [42,66,67]), and even fungi [68]. This unusual tendency was also noted in Poland, where it is the men who are more involved in collecting wild fungi [62].

**Conclusions**

The study yielded one of the longest lists of wild food plants used locally ever recorded in ethnobotanical studies. In both the studied valleys, wild vegetables are still widely used throughout the year and preserved for winter. In the more developed Dali valley people use slightly fewer wild vegetables than in the Houzhenzi area. Although usually only a few species are collected in larger quantities, knowledge about these plants is still very alive. On the other hand the community shows relative indifference to wild fruits and fungi, which are rarely collected, and only as an additional activity. There were small differences in the knowledge of wild foods among the members of different age groups and between men and women.

The results of this study show that further in-depth ethnobotanical research is needed to determine patterns in wild food plant and fungi use in different parts of China, as locally these patterns may be extremely variable. Also more research recording age and gender differences is needed.

**Competing interests**

The authors state that they have no competing interests.

**Authors’ contributions**

All the authors took part in the interviewing process in the field, voucher specimen preparation and data processing, and read the final version of the manuscript. LL designed the study, YK organized the expedition, led the interviews and identified most taxa. LL and YK wrote the article together. All authors read and approved the final manuscript.

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