

Wild food plants and wild edible fungi of Heihe valley (Qinling Mountains, Shaanxi, central China): herbophilia and indifference to fruits and mushrooms

Yongxiang Kang¹, Łukasz Łuczaj^{2*}, Sebastian Ye³, Shijiao Zhang¹, Jin Kang¹

¹ College of Forestry, Northwest A&F University, Yangling 712100, China

² Department of Botany and Biotechnology of Economic Plants, University of Rzeszów, Werynia 502, 36-100 Kolbuszowa, Poland

³ Skargi 11/70, 39-300 Mielec, Poland

Abstract

The aim of the study was to investigate knowledge and use of wild food plants and fungi in Han (i.e. Chinese) nationality villages in central China, including famine plants used in the respondents' childhood. A valley adjacent to the extremely species-rich temperate forest vegetation of the Taibai Nature Reserve was chosen. Eighty-two people from 5 villages took part in the study. Altogether, 159 wild food plant species and 13 fungi folk taxa were mentioned by informants. The mean number of freelisted wild foods was very high (24.8; median – 21.5). An average respondent listed many species of wild vegetables (mean – 17, median – 14.5), a few wild fruits (mean – 5.9 and median – 6) and very few fungi (mean – 1.9, median – 1), which they had eaten.

Over 50% of respondents mentioned gathering the young shoots or leaves of *Celastrus orbiculatus*, *Staphylea bumalda* and *S. holocarpa*, *Caryopteris divaricata*, *Helwingia japonica*, *Pteridium aquilinum*, *Pimpinella* sp., *Amaranthus* spp., *Matteucia struthiopteris*, *Allium* spp., *Cardamine macrophylla* and *Chenopodium album*. Only one species of fruits (*Schisandra sphenanthera*) and none of the mushrooms were mentioned by over half of the respondents. Although very diverse, it can be noted that the use of wild vegetables has decreased compared to the second half of the 20th century, as informants listed several plants which they had stopped using (e.g. *Abelia engleriana*) due to the availability of cultivated vegetables and other foodstuffs. On the other hand, the collection of the most well-known wild vegetables is maintained by selling them to tourists visiting agritourist farms, and restaurants.

Keywords: ethnobotany, ethnomycology, wild edible plants, non-timber forest products, mycophobia, food security

Introduction

Wild food plant and fungi use in the world is very diverse. In many areas, mainly in urban centers or in the richest countries, few wild species are used, usually just a few wild fruits, mushrooms or green vegetables. However, in less developed countries wild food is still a significant component of nutrition. The use of wild greens and fungi shows a particularly interesting pattern as in some areas of the world these components of the diet are either avoided or little used (herbophobia and mycophobia, respectively), whereas in other areas they constitute an everyday part of nutrition [1]. For example in Amazonia and Eastern Europe wild greens are little used, in contrast to East Asia, India and parts of Africa [2]. Wild mushrooms are widely gathered in Italy, France, Catalonia, Slavic countries,

Turkey, Mexico and parts of Africa, but traditionally little used in England [3].

The country the most renowned for its wide contemporary use of wild components in the human diet is China. This stems from a few factors [4,5]:

(i) China frequently suffered severe food crises up until the 1960s, so the use of any natural resources was important to the inhabitants,

(ii) wild plants and animals are believed to contain more “qi” (“life energy”), so they are regarded as more nutritious and healthy,

(iii) Chinese culinary art likes indulging in a large number of, often strange, ingredients.

Although the research on potentially edible wild plants has been well developed in China (e.g. [5–10]), studies focused on documenting local traditions of wild plant and fungi use using the methodology of modern ethnobotany are relatively few, and the publications in international papers solely concern ethnic minorities, i.e. Mongolians [11,12], Shaxi in Sichuan [13,14], Miao in Hunan [15] and a variety of ethnic groups in Yunnan [9,10,16–18]. Two papers (in Chinese) concerning wild food resources in the Qinling Mountains were published, but from a different part of these mountains [19,20]. The relatively short list of species given in them [19,20] suggests that only the most

* Corresponding author. Email: lukasz.luczaj@interia.pl

This is an Open Access digital version of the article distributed under the terms of the Creative Commons Attribution 3.0 License (creativecommons.org/licenses/by/3.0/), which permits redistribution, commercial and non-commercial, provided that the article is properly cited.

commonly used species were included. The ethnomycology of edible mushrooms in China is also under-developed (in spite of the extensive literature on the economic use of mushrooms in China), and particularly lacking are studies simultaneously oriented towards wild vegetables, mushrooms and fruits.

Paradoxically, little is known about wild food plant use patterns in north-central, central and eastern China where the dominant Han (i.e. “Chinese”) population lives. The aim of our study was to fill this gap and to record wild food species in one little-developed, mountainous, rural area in the province of Shaanxi. For our study we chose probably the best-preserved forest complex in central China – the vicinity of the Taibai Nature Reserve, where the local population has a particularly rich choice of wild food plants and mushrooms.

The working hypothesis was that in an area of high biodiversity, in a country famous for the use of many species of wild foods, the farmers use a large number of wild vegetables, fruits and mushrooms in their nutrition, and this knowledge is widespread in the community. An additional aim was to elicit answers on the differences between present day use and use during the last widespread famine (1958–1960).

Study area

The study was located in the Heihe National Forest Park, on the southern edge 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. The National Forest Park (a less strict protection regime) is the southern extension of it, 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 (鎮)], 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. The whole valley is inhabited by 3500 people – ca. a thousand in the main settlement of Houzhenzi, and the rest in the hamlets scattered in the forest (Fig. 1).



Fig. 1 A typical landscape in Houzhenzi valley – small fields in a valley surrounded by dense primary forest vegetation. Photograph by Łukasz Łuczaj.

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 high rainfall of nearly 1000 mm, out of which 44% is concentrated in the summer months [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.).

The majority of the local population are subsistence farmers who grow maize, potatoes, wheat and beans [21,22]. 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 [21,22].

Methods

The field research was conducted in June and July 2011, as well as in August 2012, using transect walks and semi-structured interviews with key informants, individual and group freelisting interviews (36 freelists were created), and cross-checking of the gathered herbarium specimens with key informants. Altogether, 82 people from five settlements (Houzhenzi, Diaoyutai, Huaerping, Jiangjiaping, Sanhe) took part in the study. The mean age of participants was 50 (from 16 to 83). The data were supplemented by participant observations by one of the authors (S. Y.) who had frequently visited the area, in 2007–2010, during all seasons of the year. During freelisting we separately asked, which species of wild vegetables (including underground organs), wild fruits and wild mushrooms were used. Making the three separate freelists enabled the comparison of the use of these categories and helped elicit answers from the respondents [23,24]. Freelists were made orally and written down on the spot by our team, including the Chinese-script version of the plant/fungi names.

The nine restaurants selling wild vegetables in Houzhenzi were also visited and menus were photographed in order to record the taxa sold and their price.

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 aimed at interviewing 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.). We also displayed some of our collections (mushrooms and some wild vegetables) in the main street of Houzhenzi, to observe the reactions and comments of people to the edible taxa shown.

Voucher specimens were collected from the specimens gathered during transect walks or supplied by informants, and are stored in the Department of Forestry, Northwest A&F University in Yangling.

Results

General figures

Altogether, 159 plant species from 59 families (classified as 139 folk taxa) and 13 fungi taxa were mentioned by the informants as eaten at least once, but only 128 plant species

and 12 fungi species were confirmed as eaten by more than one person (Tab. 1, Tab. 2, Tab. 3). The leaves and green parts of 104 species have been used, roots/rhizomes/tubers/bulbs of 18 species, flowers of 4 species and fruits of 36 species. Respondents mentioned wild vegetables most eagerly, and generally had problems listing wild fruits and fungi, stating that they are unimportant and are collected rarely. The gathering of young shoots of *Celastrus orbiculatus* and *Staphylea* spp. (mainly *Staphylea bumalda*, also *S. holocarpa*) was mentioned by nearly every respondent. Over 50% of respondents also mentioned gathering the young shoots or leaves of *Caryopteris divaricata*, *Helwingia japonica*, *Pteridium aquilinum*, *Pimpinella* sp., *Amaranthus* spp., *Matteucia struthiopteris*, *Allium* spp., *Cardamine macrophylla* and *Chenopodium album* (Fig. 2, Fig. 3). Six wild vegetables are served in most local restaurants (Tab. 3). Only one species of fruits (*Schisandra sphenanthera*) and none of the mushrooms were mentioned by over half of the respondents.

The mean number of freelisted wild foods was 24.8 (median – 21.5). An average respondent listed many species of wild vegetables (mean – 17, median – 14.5), a few wild fruits (mean – 5.9 and median – 6) and very few fungi (mean – 1.9, median – 1) as eaten.

The domination of wild vegetables in foraging activities is also confirmed by the fact that they are the only category of wild food stored for winter. Drying is a very common preserving technique (Fig. 4). Households dry between 1–5 species each year, usually a few kg of dry shoots and leaves, but some households who host tourists [so called “nong jia le” (农家乐)] can even dry a few dozen kg of dry “ye cai” (wild vegetables). Particularly large amounts of *Chenopodium album* are dried, as they are often used as winter fodder for pigs as well. Other commonly dried foods include *Staphylea* spp., *Helwingia japonica*, *Celastrus orbiculatus*, *Toona sinensis* and *Cardamine macrophylla*. Also, plants which are usually not treated as “ye cai”, but as pig food (e.g. *Artemisia subdigitata*), are dried for the animals. In 2011 and 2012 dried *Staphylea* shoots were sold at the local food shop in Houzhenzi at 40 ¥/kg. Dried *Chenopodium* was, in 2011, sold to tourists a few km before entering the village, along with dried *Auricularia* and *Lentinula* mushrooms. Most families dry 1–5 species of wild vegetables outside on the concrete, on mats or inside the house on newspapers. Formerly wild vegetables were lacto-fermented, but now this is done very rarely.

Forest species, species of grasslands and forest edges as well as ruderal species are well represented in the list of collected taxa (however typical forest species dominate with 44% taxa, only 15% taxa are ruderal species, the rest are ubiquitous species or species of intermediate successional stages). The ruderal species are collected near homesteads. Their growth is often promoted. For instance when a farmer sprays their *Cornus officinalis* plantation with glyphosphate, they leave a clump of wild vegetables unsprayed. One of the most protected species is *Chenopodium album*, which is harvested and dried at the turn of May and June. 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.

All the older informants were asked about plants eaten during the severe food shortages that plagued China until the last case of famine in 1958–1960. The usual response was that they ate the same species but in larger quantities. They said that they were lucky having so many wild vegetables around, as some people from other, more populated areas had to take refuge in

Tab. 1 Most commonly freelisted species in the study.

Species	Category	N = 36
<i>Celastrus orbiculatus</i>	v	35
<i>Staphylea</i> spp.	v	33
<i>Caryopteris divaricata</i>	v	27
<i>Helwingia japonica</i>	v	27
<i>Pteridium aquilinum</i>	v	26
<i>Pimpinella</i> sp.	v	24
<i>Amaranthus</i> spp.	v	24
<i>Matteucia struthiopteris</i>	v	23
<i>Cardamine macrophylla</i>	v	22
<i>Schisandra sphenanthera</i>	f	22
<i>Chenopodium album</i>	v	22
<i>Allium</i> spp.	v	20
<i>Toona sinensis</i>	v	18
<i>Akebia trifoliata</i>	f	18
<i>Rubus</i> spp.	f	17
<i>Prunus salicina</i>	f	15
<i>Chrysosplenium biondianum</i>	v	15
<i>Saussurea dolichopoda</i>	v	14
<i>Decaisnea fargesii</i>	f	14
<i>Adenophora</i> spp.	v	13
<i>Cantharellus cibarius</i>	m	13
<i>Allium paepalanthoides</i>	v	12
<i>Sedum amplibracteatum</i>	v	11
<i>Eleagnus umbellata</i>	f	11
<i>Tricyrtis macropoda</i>	v	11

f – fruit; m – mushroom; N – number of freelists; v – green vegetable.

Tab. 2 Wild food plants sold in the restaurants in Houzhenzi.

Species	N
<i>Staphylea</i> spp. (mainly <i>S. bumalda</i>)	9
<i>Toona sinensis</i>	8
<i>Chenopodium album</i>	7
<i>Matteucia struthiopteris</i>	6
<i>Pteridium aquilinum</i>	6
<i>Celastrus orbiculatus</i>	6
<i>Helwingia japonica</i>	2
<i>Medicago sativa</i>	1
<i>Cardamine macrophylla</i>	1
<i>Caryopteris divaricata</i>	1
<i>Pimpinella</i> sp.	1
<i>Lychnis senno</i>	1

N – No. of restaurants selling wild food plants (total = 9).

their mountains to avoid starvation. However, asking questions about the last time the particular species was used revealed that there is a group of taxa which could clearly be called famine plants – species, which were used in this area until the mid-20th century and are not used any more. These include: the leaves of *Abelia engleriana*, the rhizomes of *Pueraria lobata*,

Tab. 3 The list of wild edible plants and fungi confirmed by at least two respondents.

Scientific name	Family (according to APGIII [31])	Part used	Frequency	Local name in pinyin	Local name in Chinese
Vascular plants					
<i>Abelia engleriana</i> Rehder	Linneaceae (formerly in Caprifoliaceae)	aerial parts	***	shen xian dou fu	神仙豆腐
<i>Achyranthes bidentata</i> Blume	Amaranthaceae	aerial parts	*	niu xi	牛膝
<i>Actinidia chinensis</i> Planch.	Actinidiaceae	fruit	***	ye mi hou tao	野猕猴桃
<i>Adenophora</i> spp. (<i>A. capillaris</i> Hemsl., <i>A. polyantha</i> Nakai)	Campanulaceae	whole plant	***	nai jiang cai	奶浆菜
<i>Akebia trifoliata</i> (Thunb.) Koidz.	Lardizabalaceae	fruit	****	ba yue gua, ba yue zha	奶浆菜, 八月炸
<i>Allium ovalifolium</i> Hand.-Mazz., <i>A. cf. victorialis</i> L.	Amaryllidaceae (formerly in Liliaceae)	whole plant	*	ge jiu, ye jiu	茗韭, 野韭
<i>Allium paepalanthoides</i> Airy Shaw	Amaryllidaceae (formerly in Liliaceae)	whole plant	***	tian suan	天蒜
<i>Allium</i> spp. (<i>A. cf. senescens</i> L., <i>A. macrostemon</i> Bunge)	Amaryllidaceae (formerly in Liliaceae)	aerial parts	****	ai jiu cai, ai suan, ye suan, yong bao tou, luo er jiu, zong bao tou, ye jiu cai	崖韭菜, 崖蒜, 野蒜, 罗儿韭, 棕包头, 野韭菜
<i>Amaranthus caudatus</i> L.	Amaranthaceae	aerial parts	**	tian xi mi	甜苜蓿
<i>Amaranthus retroflexus</i> L., <i>A. paniculatus</i> L., <i>A. viridis</i> L.	Amaranthaceae	aerial parts	****	han cai, ren han cai	汉菜, 人汉菜
<i>Anaphalis aureopunctata</i> Lingelsh et Borza	Asteraceae	aerial parts	*	shi qu cao	鼠曲草
<i>Anaphalis margaritacea</i> Benth. & Hook. f.	Asteraceae	aerial parts	*	qing ming cai	清明菜
<i>Aralia chinensis</i> L.	Araliaceae	tender buds	**	ci long pao	刺龙袍
<i>Arctium lappa</i> L.	Asteraceae	leaf stalks, underground parts	*	niu bang zi	牛蒡子
<i>Artemisia subdigitata</i> Mattf.	Asteraceae	aerial parts	*	ai	艾
<i>Asarum himalaicum</i> Hook. f. & Thomson ex Klotzsch	Aristolochiaceae	whole plant (as spice)	*	mao xi xin	毛细辛
<i>Asarum sieboldii</i> Miq.	Aristolochiaceae	whole plant (as spice)	*	xi xin	细辛
<i>Begonia sinensis</i> A. DC.	Begoniaceae	aerial parts	*	yi kou xie	一口血
<i>Berchemia sinica</i> Schneid.	Rhamnaceae	fruit	*	ya gu teng, gou er cha	亚古藤、勾儿茶
<i>Boehmeria gracilis</i> C. H. Wright	Urticaceae	aerial parts	*	hong he ma	红河麻
<i>Boehmeria tricuspis</i> Makino	Urticaceae	aerial parts	*	he ma	河麻
<i>Broussonetia papyrifera</i> (L.) Vent.	Moraceae	leaves	*	gou shu guo, gou ye	构树果, 构叶
<i>Cacalia roborowskii</i> (Maxim.) Y. Ling	Asteraceae	aerial parts	*	xiong er duo	熊耳朵
<i>Capsella bursa-pastoris</i> Medik.	Brassicaceae	aerial parts	***	di di cai	地地菜
<i>Cardamine macrophylla</i> Willd.	Brassicaceae	aerial parts	***	shi jia cai	石夹菜
<i>Cardamine</i> spp. (other smaller species e.g. <i>C. flexuosa</i> With., <i>C. hirsuta</i> L.)	Brassicaceae	aerial parts	*	xiao shi jia cai	小石夹菜
<i>Caryopteris divaricata</i> Maxim.	Lamiaceae (formerly in Verbenaceae)	aerial parts	****	chou lao han, lao han xiang	臭老汉/老汉香
<i>Castanea mollissima</i> Blume	Fagaceae	fruit	**	ye mao li, ye ban li	野毛栗, 野板栗
<i>Celastrus orbiculatus</i> Thunb.	Celastraceae	aerial parts	****	bai wan ye	白蔓叶
<i>Cephalotaxus sinensis</i> (Rehder & E. H. Wilson) H. L. Li	Cephalotaxaceae	pseudo-fruit	*	bai gai guo, bi zi shu, shui bai, sun guo	白盖果、篦子树、水柏、松果
<i>Chenopodium album</i> L., also <i>C. giganteum</i> D. Don	Amaranthaceae (formerly Chenopodiaceae)	aerial parts	****	hui hui cai	灰灰菜
<i>Chrysosplenium biondianum</i> Engl.	Saxifragaceae	aerial parts	***	hong jin cai	红筋菜
<i>Cirsium arvense</i> var. <i>setosum</i> (Willd.) C. A. Mey	Asteraceae	aerial parts	**	hong hua miao, ci ji	红花苗, 刺薊
<i>Cirsium</i> spp. eg <i>Cirsium botryoides</i> Petrak ex Hand.-Mzt.	Asteraceae	aerial parts	*	xiao ji	小薊
<i>Clerodendrum trichotomum</i> Thunb.	Lamiaceae	aerial parts	*	chou mu dan, chou lao han	臭牡丹、臭老汉
<i>Commelina benghalensis</i> L.	Commelinaceae	aerial parts	*	dan zhu ye, zhu ye cao, mian da zi	淡竹叶、竹叶草、面达子
<i>Cornus kousa</i> Bürger ex Miq.	Cornaceae	fruit	***	shi zao	石枣

Tab. 3 (continued)

Scientific name	Family (according to APGIII [31])	Part used	Frequency	Local name in pinyin	Local name in Chinese
<i>Corylus heterophylla</i> Fisch. ex Besser	Corylaceae	fruit	*	zhen zi, mao li, mao li zi shu, xiao xiang zi shu	
<i>Crataegus hupehensis</i> Sarg.	Rosaceae	fruit	*	ye shan zha	野山楂
<i>Cryptotaenia japonica</i> Hassk.	Apiaceae	aerial parts	*	ya jiao ban	鸭脚板
<i>Cynanchum giraldii</i> Schltr.	Asclepiadiaceae	underground parts	*	ge shan xiao	隔山消
<i>Decaisnea fargesii</i> Franch.	Lardizabalaceae	fruit	***	mao shi gua, ye xiang jiao	猫屎瓜, 野香蕉
<i>Descurainia sophia</i> (L.) Webb ex Prantl (?)	Brassicaceae	aerial parts	**	yin chen, mi hao	茵陈, 米蒿
<i>Dioscorea batatas</i> Decne.	Dioscoreaceae	underground parts	*	shan yao	山药
<i>Elaeagnus umbellata</i> Thunb.	Eleagnaceae	fruit	***	yang nai zi, niu nai zi	羊奶子, 牛奶子
<i>Fragaria</i> spp. (<i>F. corymbosa</i> Losinsk., <i>F. pentaphylla</i> Losinsk.)	Rosaceae	fruit	***	cao mei, di pao, di di pao xiang pao	草莓, 地泡, 地地泡, 香泡
<i>Helwingia japonica</i> (Thunb.) F. Dietr.	Helwingiaceae	leaves	****	ye shang hua	叶上花
<i>Hemerocallis</i> spp. (<i>H. dumortierii</i> C. Morren, <i>H. fulva</i> L.)	Xanthorrhoeaceae (formerly Liliaceae)	flowers	**	ye huang hua	野黄花
<i>Hieracium</i> sp.	Asteraceae	aerial parts	*?	ku mai cai	苦苣菜
<i>Impatiens notolopha</i> Maxim.	Balsaminaceae	aerial parts	*	dao laon nen	到老嫩
<i>Ixeris sonchifolia</i> Hance	Asteraceae	aerial parts	***	ku mai cai	苦苣菜
<i>Juglans cathayensis</i> Dode	Juglandaceae	fruit	**	ye he tao	野核桃
<i>Kalimeris pinnatifida</i> (Maxim.) Kitam.	Asteraceae	aerial parts	*	ma lan tou	马兰头
<i>Kochia scoparia</i> (L.) Schrad.	Amaranthaceae (formerly Chenopodiaceae)	aerial parts	*	tie sao ba	铁扫把
<i>Lactuca serriola</i> L.	Asteraceae	aerial parts	**	xiao bai jiang, xiao ku ma cai, ku ma cai	小苦苣菜, 苦 苣菜
<i>Leontopodium japonicum</i> Miq.	Asteraceae	aerial parts	*	shi qu cao	石曲草
<i>Ligusticum sinense</i> Oliv., Chuanhsiung	Apiaceae	aerial parts	*	chuan xiong	川芎
<i>Lilium giganteum</i> Wall.	Liliaceae	underground parts	**	shui bai he	水百合
<i>Lilium</i> spp. (<i>L. leichtlinii</i> Hook. f., <i>L. tigrinum</i> Ker Gawl.)	Liliaceae	underground parts	**	ye bai he	野百合
<i>Lonicera standishii</i> Carr.	Caprifoliaceae	fruit	*	ku tang pao	苦糖泡
<i>Lychnis senno</i> Siebold & Zucc.	Caryophyllaceae	whole plant	*	huang hua cai	黄花菜
<i>Lycopus lucidus</i> Turcz. ex Benth.	Lamiaceae	aerial parts	*	ye bai cai, ze lan	野白菜, 泽兰
<i>Matteucia struthiopteris</i> (L.) Tod.	Onocleaceae	tender shoots	****	ji tou cai	鸡头菜
<i>Medicago sativa</i> L.	Fabaceae	aerial parts	*	mu xi cai	苜蓿菜
<i>Morus australis</i> Poir.	Moraceae	fruit	*	sang pao, sang shu	桑泡, 桑树
<i>Oxalis</i> spp. (<i>O. griffithii</i> Edgew. & Hook. f., <i>O. corniculata</i> L.)	Oxalidaceae	aerial parts	*	suan cao, suan cai, suan suan cao	酸草, 酸菜, 酸酸草
<i>Picris hieracioides</i> L.	Asteraceae	aerial parts	*?	ku mai cai	苦苣菜
<i>Pilea mongolica</i> Wedd.	Urticaceae	aerial parts	*	dao lao nen	到老嫩
<i>Pimpinella</i> sp. (probably a new taxon related to <i>Pimpinella arguta</i> Diels and <i>P. rhomboidea</i> Diels)	Apiaceae	aerial parts	****	shui qin cai, sha qin cai	水芹菜, 沙芹菜
<i>Plantago asiatica</i> L.	Plantaginaceae	aerial parts	*	kai men ye, che qian cao, che qian zi	开门叶、车前 草、车前子
<i>Polygonatum megaphyllum</i> P. Y. Li and <i>Polygonatum odoratum</i> L.	Asparagaceae (formerly in Liliaceae)	underground parts	*	yu zhu, yu zhu shen	玉竹, 玉竹参
<i>Polygonum ciliinerve</i> (Nakai) Ohwi	Polygonaceae	underground parts	*	qiao mai tou	荞麦头
<i>Potentilla arbuscula</i> D. Don var. <i>veitchii</i> (E. H. Wilson) Liou	Rosaceae	aerial parts	*	guan yin cha	观音茶
<i>Prunus armeniaca</i> L.	Rosaceae	fruit	**	ye xing	野杏
<i>Prunus canescens</i> Bois, <i>P. pilosiuscula</i> Koehne	Rosaceae	fruit	**	ye ying tao	野樱桃
<i>Prunus</i> cf. <i>polytricha</i> Koehne	Rosaceae	fruit	*	chuan tao	川桃
<i>Prunus persica</i> (L.) Batsch	Rosaceae	fruit	**	ye tao zi	野桃子
<i>Prunus salicina</i> Lindl.	Rosaceae	fruit	***	ye li zi, ze maili, huo li zi, huo li, ye mai li	野李子, 火李子, 火李, 野麦李
<i>Pteridium aquilinum</i> (L.) Kuhn	Dennstaedtiaceae	tender shoots and underground parts	****	jue cai, jue gen, long zhua	蕨菜, 蕨根, 龙爪菜

Tab. 3 (continued)

Scientific name	Family (according to APGIII [31])	Part used	Frequency	Local name in pinyin	Local name in Chinese
<i>Pueraria lobata</i> (Willd.) Ohwi	Fabaceae	underground parts	**	ge gen	葛根
<i>Pyrola decorata</i> Andres	Ericaceae	aerial parts (spice and infusion)	*	hong ru, shou cha	红茹、寿茶
<i>Pyrola rotundifolia</i> L.	Ericaceae	aerial parts (spice and infusion)	*	bairu, shou cha	白茹、寿茶
<i>Pyrus xerophila</i> T. T. Yu	Rosaceae	fruit	***	ye li, ma li, shan li	野梨, 麻梨, 山梨
<i>Rhus verniciflua</i> Stokes	Anacardiaceae	aerial parts	*	qi shu	漆树
<i>Robinia pseudoacacia</i> L.	Fabaceae	flowers	*	huai hua	槐花
<i>Rorippa montana</i> Small	Brassicaceae	aerial parts	*	man jing cai, la la cai	蔓茎菜, 辣辣菜
<i>Rosa</i> sp.	Rosaceae	young shoots	*	ci mei hua	刺玫花
<i>Rubus coreanus</i> Miq.	Rosaceae	fruit	**	ci pao, di pao, fu pen zi	刺泡, 地泡、覆盆子
<i>Rubus flosculosus</i> Focke	Rosaceae	fruit	**	cai zi pao	菜子泡
<i>Rubus pungens</i> Cambess.	Rosaceae	fruit	**	huang ci pao	黄刺泡
<i>Rubus</i> spp.	Rosaceae	fruit	***	duan yang pao, xuan gou zi	端阳泡, 悬钩子
<i>Rumex crispus</i> L.	Polygonaceae	aerial parts	**	niu she tou, ye da huang	牛舌头
<i>Sabia shensiensis</i> H. Y. Chen	Sabiaceae	aerial parts	*	qing teng cai, teng er cai	青藤菜, 藤儿菜
<i>Saussurea dolichopoda</i> Diels	Asteraceae	aerial parts	***	kong tong cai, kong xin cai	空筒菜, 空心菜
<i>Schisandra sphenanthera</i> Rehder & E. H. Wilson	Schisandraceae	fruit	****	wu wei zi	五味子
<i>Sedum aizoon</i> L., <i>S. sarmentosum</i> Bunge, <i>S. pampaninii</i> Raym.-Hamet, <i>S. lineare</i> Thunb.	Crassulaceae	aerial parts	**	gou ya ban, gou za cai, machijie, da bu si, chui pen cao	狗牙瓣, 打不死
<i>Sedum amplibracteatum</i> K. T. Fu	Crassulaceae	aerial parts	***	hua qiao man, la zi miao, la jiao miao, ye la cai	花芥蔓, 野辣子苗苗, 辣椒苗, 叶辣菜
<i>Silene conoidea</i> L.	Caryophyllaceae	aerial parts	*	mai pian cai	麦片菜
<i>Sinacalia tangutica</i> (Maxim.) B. Nord.	Asteraceae	underground parts	*	shui luo bo	水萝卜
<i>Smilacina japonica</i> A. Gray, <i>Smilacina henryi</i> (Baker) Hara	Asparagaceae (formerly in Liliaceae)	aerial parts	*	pian tou cai	偏头菜
<i>Stachys affinis</i> Bunge	Lamiaceae	underground parts	*	di gu niu	地牯牛
<i>Staphylea bumalda</i> DC., <i>S. holocarpa</i> Hemsl.	Staphyleaceae	aerial parts, flowers	****	shu hua cai	树花菜
<i>Stellaria media</i> (L.) Vill.	Caryophyllaceae	aerial parts	*	e er chang	鹅儿肠
<i>Taraxacum mongolicum</i> Han.-Mzt	Asteraceae	aerial parts	**	pu gong ying, ku mai cai, da ku cai	蒲公英、苦菜、大苦菜
<i>Thlaspi arvense</i> L.	Brassicaceae	aerial parts	***	ji dan huang	鸡蛋黄
<i>Toona sinensis</i> (Juss.) M. Roem.	Meliaceae	tender leaf shoots	****	xiang chun	香椿
<i>Tricyrtis macropoda</i> Miq.	Liliaceae	aerial parts	***	huang gua cai	黄瓜菜
<i>Ulmus bergmanniana</i> C. K. Schneid., <i>U. propinqua</i> Koidz., <i>U. pumila</i> L.	Ulmaceae	leaves, bark, immature fruit	**	yu shu	榆树
<i>Urtica fissa</i> E. Pritz. ex Diels	Urticaceae	aerial parts	*	bai he ma	白河麻
<i>Vicia cracca</i> L.	Fabaceae	aerial parts	*	ye wan dou jian	野豌豆尖
<i>Vitis ficifolia</i> Bunge	Vitaceae	fruit	***	ye pu tao	野葡萄
<i>Zanthoxylum bungeanum</i> Maxim.	Rutaceae	fruits, aerial parts	*	ye hua jiao	野花椒
Fungi					
<i>Boletus</i> spp.	Boletaceae		**	niu gan jun, da jiao gu	牛肝菌, 大脚菇
<i>Cantharellus cibarius</i> Fr.	Cantharellaceae		***	huang si jun	牛肝菌
<i>Grifola umbellata</i> (Pers.) Pilát	Meripilaceae		***	zhu ling jun	猪苓菌
<i>Hericium</i> sp.	Hericiaceae		**	hou tou jun	猴头菌
<i>Laetiporus sulphureus</i> (Bull.) Murrill (??)	Polyporaceae		*	ji guan jun	鸡冠菌
<i>Lentinula edodes</i> (Berk.) Pegler (more often cultivated)	Marasmiaceae		*	ye xiang gu	野香菇
<i>Morchella</i> sp.	Morchellaceae		**	yang que jun	羊雀菌

Tab. 3 (continued)

Scientific name	Family (according to APGIII [31])	Part used	Frequency	Local name in pinyin	Local name in Chinese
<i>Pleurotus</i> sp.	Pleurotaceae		*	dong jun	冻菌
<i>Ramaria</i> spp.	Gomphaceae		**	shua ba jun	刷把菌
Unidentified terrestrial gilled mushroom	?		**	ban li jun	板栗菌
Unidentified mushroom	?		*	bao gu jun	包谷菌
Unidentified mushroom	?		*	qiao mian jun	荞面菌

Frequency: **** > 50% of respondents; *** > ¼ of respondents; ** > ⅓ of respondents; * ⅓ of respondents or less, but at least 2 respondents.

Pteridium aquilinum, *Polygonatum* spp., *Sinacalia tangutica*, the bulbs of *Lilium giganteum* and other *Lilium* species, and the bark of *Ulmus* spp. Nowadays the consumption of underground organs of plants has practically ceased and is restricted to the occasional use of *Lilium* spp. and *Stachys affinis*.

Wild vegetables are eaten in any of the daily three meals. The commonest preparation technique is boiling, then straining and sprinkling them with some oil in which Sichuan pepper, garlic, and sometimes ginger, was fried. Then they are served, warm or cold. This is a side dish, called “liang ban”, accompanied by home-made wheat bread (“bing”), rice or other stir-fried foods. Sometimes wild vegetables are also put into broad, home-made noodles served in spicy and sour soup. They are also, rarely, lacto-fermented. Dried vegetables are first soaked in water for a few minutes or hours and then used like fresh vegetables. Some respondents say that in the case of *Staphylea* shoots, drying even improves their taste and digestibility. Wild vegetables are also sold in all the local restaurants (Tab. 2), and every agritourist farm has them on their menu.

Fruits are and have always been less appreciated than wild greens. They are sometimes collected for fun by children or grown-ups going to the forest to collect wild greens, medicinal herbs or wood. They have never been stored for winter and are not used in any dishes by anyone, apart from dried *Schisandra* and *Akebia* fruits, used medicinally. In spite of this, most people easily mentioned a few species of wild fruits they had eaten.



Fig. 2 *Staphylea bumalda* flowering shoots, boiled, strained and sprinkled with oil, Houzhenzi, 2011. Photograph by Łukasz Łuczaj.

Few fungi species are used, as most of them are generally feared. We found only one inhabitant of the valley, who had a hobby of collecting wild edible mushrooms, which he developed after gathering *Boletus* species for sale a few years ago. Others never go to the forest with the purpose of collecting mushrooms, apart from going to collect cultivated *Auricularia* and *Lentinula edodes* grown on piles of logs located in the woods. The only mushrooms relatively more widely known and accepted are *Cantharellus cibarius*, an unidentified *Agaricales* (called “banlijun”, i.e. “chestnut mushroom”), *Ramaria* spp. (and possibly *Clavaria* spp.) treated by locals as one folk taxon “shuabajun” (i.e. “brush mushroom”) and *Grifola umbellata*, whose sclerotia are collected for medicinal purposes, although fruiting bodies are occasionally eaten as well. However, only a third of the respondents have ever eaten the most commonly listed mushroom, *Cantharellus cibarius*. More than half of the respondents had never collected wild fungi in the forest. A few people who eat *Boletus* spp. species started doing so after taking part in commercial mushroom collecting a few years ago.

Discussion

The large number of used wild greens in this study is one of the highest recorded on such a small scale in the history of ethnobotanical studies. The only comparable study, by Zou [15], recorded the use of 335 taxa of wild vegetables, belonging to 87



Fig. 3 *Pteridium aquilinum* shoots, boiled, strained and sprinkled with oil, Houzhenzi, 2011. Photograph by Łukasz Łuczaj.



Fig. 4 Drying wild vegetables (*Chenopodium album* and *Staphylea bumalda*) on a farm in Diaoyutai in early June 2011. Photograph by Łukasz Łuczaj.

families and 119 genera in 10 villages of Hunan, however the latter study concerned a larger and more heterogenous area. Ghorbani [16] recorded the use of 173 wild food plants from 485 informants of four ethnic groups of Xishuanbanna valley, out of which only around a third were wild greens. However, his study concerned an area which was very heterogenous 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 a much higher rate of use per person (mean – over 24 species), with probably the highest average number of wild green vegetables listed per person (mean – 17 species) using freelisting techniques in any ethnobotanical study to date.

Knowledge of wild vegetables in China is additionally encoded in the language. Most wild vegetables have the word “cai”, i.e. vegetable, so it is enough to know the name and to be able to recognize the plant to be able to presume its use, i.e. if it is a “cai” (vegetable) or “cao”/“yao” (medicinal plant).

The relatively high geographical diversity of the use of “ye cai” in China should be emphasized. For example none of the articles on wild vegetables of Qinling Mts mention the use of *Staphylea* spp. nor *Pimpinella* sp. – locally important vegetables [19,20].

The widespread phenomenon of drying wild vegetables is worth attention. This ancient preservation technique is nowadays rarely used for wild vegetables across the globe. Storing a particular food for winter may mean that this is a culturally significant item.

Several taxa are semi-domesticated, and undergo varying degrees of active protection. Some are increasingly brought from the forest to be planted in gardens (*Toona sinensis*, *Staphylea bumalda*, *Asarum sieboldii*). The two species of mushrooms widely cultivated using tree logs left in the garden or in the forest, *Auricularia* sp. and *Lentinula edodes*, were mentioned by some respondents as wild vegetables as well. This shows that, similarly to other geographic areas, the distinction between the wild and the cultivated is not usually sharp [2,25,26].

The local population utilizes a large proportion of the local edible flora. However, strong cultural biases can be seen even in such a herbophilous community. Some edible wild vegetables, e.g. *Galinsoga* sp., *Reynoutria japonica*,

most *Polygonum* species and *Lamium barbatum* are not used, the common *Stellaria media*, is also eaten rarely and only by a few individuals.

Over half wild vegetables come from the forest. This is in contrast with some studies showing that human populations, even in wooded areas, tend to over-utilize the ruderal flora [27,28]. Here, at least two explanations are possible:

(i) the fields’ area is relatively small, so in the past the volume of wild vegetables from ruderal sites may not have been sufficient,

(ii) many edible ruderal taxa are regarded here as pig food, and we observed some degree of separating wild vegetables for human consumption and pig food (the exception here is *Chenopodium*, eaten both by humans and pigs).

What is interesting is the large domination of wild greens over fruits and fungi. A typical answer of a respondent to the question about what wild veg they had eaten was: “ye cai hen duo” (there are many wild vegetables). On the other hand, the same question about fruits or fungi resulted in the opposite answer, e.g. “ye mogu/junzi hen shao” (there are very few wild fungi).

Wild vegetables are intentionally collected here, they are well known to everyone and dried for winter in most houses. Fruits are something unimportant, play objects, something one finds on a forest walk to collect herbs, something only eaten raw. They are never cooked or dried or added to any dishes. The only exceptions are the fruits of *Schisandra*, which are dried and sold as medicine. The lack of interest in mushrooms is puzzling, as China is usually regarded as a mycophilous part of the world [3,29,30].

Conclusions

The studied community displays one of the highest levels of herbophilia known in human cultures. On the other hand the community shows relative indifference to wild fruits and fungi, which are rarely collected, and only as an additional activity.

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.

Acknowledgments

Many thanks to the inhabitants of the studied villages for their generous help in sharing information on the use of the species. The program was financially supported by the Forestry Research Foundation for the Public Service Industry of China (2009,04004) and by the University of Rzeszów (Institute of Biotechnology and Basic Sciences, as well as a special grant from the rector of the University). We are also grateful to Prof. Khasbagen (Hohhot, China) for his help in literature search.

References

1. Łuczaj Ł. Changes in the utilization of wild green vegetables in Poland since the 19th century: a comparison of four ethnobotanical surveys. *J Ethnopharmacol.* 2010;128(2):395–404. <http://dx.doi.org/10.1016/j.jep.2010.01.038>

2. Turner NJ, Łuczaj Ł, Migliorini P, Pieroni A, Dreon AL, Sacchetti LE, et al. Edible and tended wild plants, traditional ecological knowledge and agroecology. *Crit Rev Plant Sci.* 2011;30(1–2):198–225. <http://dx.doi.org/10.1080/07352689.2011.554492>
3. Boa ER. Wild edible fungi: a global overview of their use and importance to people. Rome: FAO; 2004.
4. Anderson EN. The food of China. New Haven: Yale University Press; 1988.
5. Hu SY. Food plants of China. Hong Kong: Chinese University Press; 2005.
6. Long CL. Strategies for agrobiodiversity conservation and promotion: a case from Yunnan, China. *Biodivers Conserv.* 2003;12(6):1145–1156.
7. Wu X. “Turning waste into things of value”: marketing fern, Kudzu, and *Osmunda* in Enshi Prefecture, China. *J Dev Soc.* 2003;19(4):433–457. <http://dx.doi.org/10.1177/0169796X0301900401>
8. Wang X, Du X. Recent status of the development and strategies of exploitation of non wood forest products in China. *Lin Ye Ke Xue Yan Jiu.* 1997;10(2):199–205.
9. You-Kai X, Guo-Da T, Hong-Mao L, Kang-La Y, Xiang-Sheng D. Wild vegetable resources and market survey in Xishuangbanna, southwest China. *Econ Bot.* 2004;58(4):647–667. [http://dx.doi.org/10.1663/0013-0001\(2004\)058\[0647:WVRAMS\]2.0.CO;2](http://dx.doi.org/10.1663/0013-0001(2004)058[0647:WVRAMS]2.0.CO;2)
10. Zhang XP, Wu JL, Li Y, Liu F, Wang JQ. Investigation on species resources and utilization of wild vegetable in nabanhe watershed nature reserve, Xishuangbanna. *Journal of Southwest Forestry College.* 2004;24:21–24.
11. Huai KHY, Pei SJ. Wild plants in the diet of Arhorchin Mongol herdsmen in inner Mongolia. *Econ Bot.* 2000;54(4):528–536. <http://dx.doi.org/10.1007/BF02866550>
12. Wujisguleng W, Khasbagen K. An integrated assessment of wild vegetable resources in Inner Mongolian Autonomous Region, China. *J Ethnobiol Ethnomed.* 2010;6(1):34. <http://dx.doi.org/10.1186/1746-4269-6-34>
13. Weckerle CS, Huber FK, Yongping Y, Weibang S. Plant knowledge of the Shuhi in the Hengduan mountains, Southwest China. *Econ Bot.* 2006;60(1):3–23. [http://dx.doi.org/10.1663/0013-0001\(2006\)60\[3:PKOTSI\]2.0.CO;2](http://dx.doi.org/10.1663/0013-0001(2006)60[3:PKOTSI]2.0.CO;2)
14. Huber FK, Ineichen R, Yang Y, Weckerle CS. Livelihood and conservation aspects of non-wood forest product collection in the Shaxi Valley, southwest China. *Econ Bot.* 2010;64(3):189–204. <http://dx.doi.org/10.1007/s12231-010-9126-z>
15. Zou X, Huang F, Hao L, Zhao J, Mao H, Zhang J, et al. The socio-economic importance of wild vegetable resources and their conservation: a case study from China. *Kew Bull.* 2011;65(4):577–582. <http://dx.doi.org/10.1007/s12225-010-9239-7>
16. Ghorbani A, Langenberger G, Sauerborn J. A comparison of the wild food plant use knowledge of ethnic minorities in Naban River Watershed National Nature Reserve, Yunnan, SW China. *J Ethnobiol Ethnomed.* 2012;8(1):17. <http://dx.doi.org/10.1186/1746-4269-8-17>
17. Ghorbani A, Langenberger G, Liu JX, Wehner S, Sauerborn J. Diversity of medicinal and food plants as non-timber forest products in Naban River Watershed National Nature Reserve (China): implications for livelihood improvement and biodiversity conservation. *Econ Bot.* 2012;66(2):178–191. <http://dx.doi.org/10.1007/s12231-012-9188-1>
18. Jin C, Yin-Chun S, Gui-Qin C, Wen-Dun W. Ethnobotanical studies on wild edible fruits in southern Yunnan: folk names; nutritional value and uses. *Econ Bot.* 1999;53(1):2–14. <http://dx.doi.org/10.1007/BF02860785>
19. Ma X, Zhang J, Lu S, Cui Z, Zhao H, Zheng J. The survey of the distribution of wild vegetables in the northern slope of the Qinling Mountains. *Quarterly of Forest By-Product and Speciality in China.* 2002;61(2):49–50.
20. Ma X, Hu P, Wu J, Zhang J, Cui Z. The habitat, development and utilization of wild vegetables in the northern slope of the Qinling Mountains. *Special Economic Animal.* 2002;2:37–38.
21. Economic survey of the Zhouzhi County Houzhenzi town, protected areas from 2007 [Internet]. 2007 [cited 2012 Sep 20]; Available from: http://wwf.nwsuaf.edu.cn/article/2007/0912/news_219.html
22. Kang Y, Łuczaj Ł, Ye S. The highly toxic *Aconitum carmichaelii* Debeaux as a root vegetable in the Qinling Mountains (Shaanxi, China). *Genet Resour Crop Evol.* 2012;59(7):1569–1575. <http://dx.doi.org/10.1007/s10722-012-9853-3>
23. Quinlan M. Considerations for collecting freelists in the field: examples from ethnobotany. *Field Methods.* 2005;17(3):219–234. <http://dx.doi.org/10.1177/1525822X05277460>
24. Sutrop U. List task and a cognitive salience index. *Field Methods.* 2001;13(3):263–276. <http://dx.doi.org/10.1177/1525822X0101300303>
25. McClatchey WC. Wild food plants of Remote Oceania. *Acta Soc Bot Pol.* 2012;81(4):371–380. <http://dx.doi.org/10.5586/asbp.2012.034>
26. Łuczaj Ł, Pieroni A, Tardío J, Pardo-de-Santayana M, Sökand R, Svanberg I, et al. Wild food plant use in 21st century Europe: the disappearance of old traditions and the search for new cuisines involving wild edibles. *Acta Soc Bot Pol.* 2012;81(4):359–370. <http://dx.doi.org/10.5586/asbp.2012.031>
27. Voeks RA. Disturbance pharmacopoeias: medicine and myth from the humid tropics. *Ann Assoc Am Geogr.* 2004;94(4):868–888. <http://dx.doi.org/10.1111/j.1467-8306.2004.00439.x>
28. Sökand R, Kalle R. Change in medical plant use in Estonian ethnomedicine: a historical comparison between 1888 and 1994. *J Ethnopharmacol.* 2011;135(2):251–260. <http://dx.doi.org/10.1016/j.jep.2011.02.030>
29. Yamin-Pasternak S. Ethnomycology: fungi and mushrooms in cultural entanglements. In: Anderson EN, Pearsall D, Hunn E, Turner N, editors. *Ethnobiology.* Hoboken NJ: Wiley and Sons; 2011. p. 213–230. <http://dx.doi.org/10.1002/9781118015872.ch13>
30. Arora D. The houses that matsutake built. *Econ Bot.* 2008;62(3):278–290. <http://dx.doi.org/10.1007/s12231-008-9048-1>
31. The Angiosperm Phylogeny Group. An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. *Bot J Linn Soc.* 2009;161(2):105–121. <http://dx.doi.org/10.1111/j.1095-8339.2009.00996.x>