Wild edible plants collected and consumed by the locals in Daqinggou, Inner Mongolia, China

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Abstract

Background: Knowledge of wild edible plants is an important part of traditional knowledge. It is closely related to traditional human agriculture, as well as biodiversity. This study aimed to conduct a detailed investigation and evaluation of wild edible plants that are collected and consumed by the Mongolian and Han locals in Daqinggou and to provide valuable data for the development and utilization of plant resources.

Methods: In the 9 site visits to the area of Daqinggou during the period of 2017–2019, the authors used key informant interviews, semistructured interviews, and questionnaires to collect utilization information regarding precollected species of local wild edible plants. By combining the data obtained from 101 key informants, the authors used the Cultural Food Significance Index (CFSI), a quantitative index to evaluate the relative importance of the wild edible plants that were discussed in the aforementioned interviews.

Results: The investigation results show that the Mongolian people provided 67 folk names, corresponding to 57 wild plants, and the Han Chinese provided 58 folk names, corresponding to 49 wild plants. A total of 61 edible wild plant species belonging to 29 families and 52 genera were recorded as edible resources for the locals in Daqinggou. The uses include grains, oil and fat resources, vegetables, fruits, beverages, condiments, and snacks. The most commonly reported purpose of wild edible plants is using them as vegetables, followed by using them as beverages and fruits. The most widely used edible parts are fruits, leaves, and other aerial parts. Eating raw and cooked plants are the usual methods of consuming wild edible plants according to the locals. In addition, the CFSI of 61 wild edible plant species shows that 27 species have characteristics of medical food.

Conclusions: The knowledge and experience of naming and consuming wild plants by the Mongolian people and Han Chinese in Daqinggou are an important manifestation of the direct interaction between locals and plants. The CSFI evaluation of the wild edible plants consumed by the locals in Daqinggou establishes the utilization of some wild plants as part of the traditional knowledge of medical food.

Keywords: Wild edible plants, Mongolian people, Han Chinese, Daqinggou, CFSI, Ethnobotany

Background

Since 1992, as party to the Convention on Biological Diversity (CBD), China has made positive efforts in the protection and inheritance of traditional knowledge related to biological diversity and biological resources. The diversity of traditional edible plant resources and related knowledge are important aspects of traditional knowledge and biodiversity. They have a significant impact on the conservation and sustainable development of regional biodiversity [1–6]. As most kinds of edible plants are wild plants, research on wild edible plants is also an important subject of ethnobotanical study [7].

Wild edible plant species are uncultivated and undomesticated. They can be food sources, however,
through collection and consumption from the natural environment. Many linguistic groups refer to numerous edible plants as “famine relief food,” which plays an important role in the survival of individuals or the whole community during a period of food shortage [8]. In recent years, wild edible plants have become popular for their nutritional value and health care functions [9]. Therefore, the utilization of wild edible plants is continuously increasing. The ethnobotany research in China concerning wild edible plants has so far been concentrated mainly in South China. For example, the Naxi people, Hani people, and Tibetan people in Yunnan Province have the habit of gathering and eating wild plants [10–12]. The Shui people and Dong people of Guizhou Province have recorded the use of wild plants as starters for preparing fermented beverages [13, 14]. Although some papers on the use of wild food plants have been published from the area of northern China (e.g., Inner Mongolia [15, 16], Tibet [17], Shaanxi [18, 19], and Gansu [20, 21]), this area is not widely studied.

The Inner Mongolia Autonomous Region is multi-ethnic, with Mongolian culture as the main body and Han Chinese as the majority. Since the 1990s, ethnobotanists have carried out a series of studies on regional ethnobotany in several regions of Inner Mongolia and have cataloged the wild edible plants of the local Mongolian people [15, 16, 22–24]. In the past, ethnobotanical studies in Inner Mongolia have not been performed with comparative studies between Mongolian people and Han Chinese. This study investigates the Mongolian people and Han Chinese in Daqinggou and records the wild edible plants and related traditional knowledge that locals have previously used and are currently using.
| Index of categories | Availability | Index value |
|---------------------|--------------|-------------|
| Availability index (AI) | Very common | 4.0 |
|                     | Common       | 3.0 |
|                     | Intermediate | 2.0 |
|                     | Rare         | 1.0 |
| Localization of the use index value | Ubiquitous | = |
|                     | Localized    | −0.5 |
|                     | Very localized| −0.1 |
| Frequency of use index (FUI) | Utilization frequency | Index value |
|                     | Ordinary year | 5.0 |
|                     | In season     | 3.0 |
|                     | Not used during the past 30 years | 1.0 |
| Part used index (PUI) | Part used | Index value |
|                     | Aerial parts | 3 |
|                     | Stems and leaves | 2 |
|                     | Roots, bulbs, leaves, fruits | 1.5 |
|                     | Bark, stems, seeds, kernel | 1.0 |
|                     | Flowers, inflorescence, female cone, shoots | 0.75 |
| Multifunctional food use index (MFFI) | Usage | Index value |
|                     | Raw, as snacks, cold dishes, dipped in sauce, salted | 1.5 |
|                     | Boiled, steamed, fried | 1 |
|                     | Ingredient for restricted purposes | 0.75 |
|                     | Condiment, grain, oil and fats | 0.5 |
|                     | (Usage in mixtures) | (−0.5) |
| Taste score appreciation (TSAI) | Taste appreciation | Index value |
|                     | Best          | 10 |
|                     | Good          | 7.5 |
|                     | Fair          | 6.5 |
|                     | Poor          | 5.5 |
|                     | Terrible      | 4.0 |
| Food-medicinal role index (FMRI) | Role as food-medicine | Index value |
|                     | Important (“that food is a medicine”, with clear specification of the treated affections) | 5.0 |
| Index of categories | Availability                      | Index value |
|---------------------|-----------------------------------|-------------|
|                     | Intermediate ("that food is very healthy") | 3.0         |
|                     | Not recognized                     | 1.0         |
| Species                               | Folk Chinese name | Folk Mongolian name | Usage                                      | Edible part(s) and mode of consumption                                      | Linguistic groups | Voucher numbers |
|---------------------------------------|-------------------|---------------------|--------------------------------------------|---------------------------------------------------------------------------|--------------------|-----------------|
| Abutilon theophrasti Medic.           | Qing má 青麻      | Him-a               | Grain                                      | Seed, dried and used as grain                                              | M/H                | D1909-001       |
| Adenophora remotiflora (Sieb. et Zucc.) Miq. | Wài bò cài 落葉菜, tǔ dànɡ shèn 土党参 | Uhlahu nogug-a     | Vegetable/beverage                         | Tender leaf, fried, consumed as soup. Root, soaked with wine               | M/H                | D1806-032       |
| Adenophora polyantha Nakai            | Shā shèn 沙參      | Uhlahu nogug-a     | Vegetable/beverage                         | Tender leaf, to make soup or fried. Root, soaked with wine                | M/H                | D1806-036       |
| Allium macrostemon Bunge              | Xiāo gèn suàn 小根蒜 | Jiecong (BN), togdausu | Vegetable/condiment                       | Tender aerial parts and bulb, fried, dipped in sauce. Tender aerial parts, used for seasoning | M/H                | D1806-011       |
| Allium ramosum L.                     | Shān jiù cǎi 山韭菜 | Heger-e in gogud    | Vegetable/condiment                       | Tender aerial parts, fried, boiled as stuffing for pasta. Tender aerial parts and inflorescence, salted (consumed as leek flower sauce) | M/H                | D1709-002       |
| Allium senescens L.                   | Máng gé ěr (BN) 芒格尔 | Manggir            | Vegetable/condiment                       | Tender aerial parts, fried, boiled as stuffing for pasta, dipped in sauce or used for seasoning | M/H                | D1806-013       |
| Amaranthus retroflexus L.             | Xiàn cài 彼菜      | arbai               | Vegetable/grain                            | Tender stem and leaf, consumed as soup, boiled as stuffing for pasta. Seed, dried and used as grain | M/H                | D1806-003       |
| Armeniaca sibirica (L.) Lam.          | Shān xínɡ 山杏      | Heger-e in guilesu  | Vegetable/fruit/oil and fats               | Seed, salted. Fruit, eaten raw. Kernel, oil extracted                     | M/H                | D1805-002       |
| Artemisia frigida Willd.              | Xiāo bái hǎo 小白蒿 | Cagan sirazī       | Vegetable                                  | Tender aerial parts, steamed with flour, consumed as soup                | M/H                | D1806-015       |
| Athyrium brevifrons Nakai ex Kitag.   | Shān jué cǎi 山蕨菜, lǎo yínɡ bànɡ 老鹰膀子 | Juecai (BN), togus in segul | Vegetable                                  | Leaf, cold and dressed with sauce, salted, fried, consumed as soup or boiled as stuffing for pasta | M/H                | D1805-009       |
| Cotula palustris L. var. sibirica Regel | Lú ti cài 驴蹄菜   | Vegetable           | Leaf, cold and dressed with sauce or fried |                                                                         | H                  | D1806-029       |
| Cannabis sativa L.f. ruderalis (Janisch) Chu |                     | Olusus              | Oil and fats                               | Seed, oil extracted                                                      | M                  | D1810-003       |
| Geum humile (Bunge) Sok.               | Ōu Ⅱ 欧李          | Ulagan-a            | Fruit/beverage                             | Fruit, eaten raw. Root, soaked with wine                                 | M/H                | D1906-001       |
| Chrysanthemum coccineumum Wild.       | Hùi cǎi 灰菜       | Gurbalzin noil      | Vegetable                                  | Tender stem and leaf, boiled as stuffing for pasta, boiled and mixed with cream | M/H                | D1805-005       |
| Chrysanthemum album L.                | hùi cǎi 灰菜       | Noil                | Vegetable                                  | Tender stem and leaf, boiled as stuffing for pasta, boiled and mixed with cream | M/H                | D1806-001       |
| Oryzium setosum (Willd.) MB.           | Cinu-a in haltar   | Vegetable           | Tender leaf, fried                         |                                                                         | M                  | D1806-014       |
| Species | Folk Chinese name | Folk Mongolian name | Usage | Edible part(s) and mode of consumption | Linguistic groups | Voucher numbers |
|---------|------------------|---------------------|-------|----------------------------------------|------------------|----------------|
| Codonopsis lanceolata (Sieb. et Zucc.) Trautv. | Sun orhudai | Vegetable | Root, salted | M | D1806-025 |
| Corylus heterophylla Fisch. ex Trautv. | Zhěn zì 植子 | Sid | Fruit, eaten raw, fried | M/H | D1810-002 |
| Crataegus pinnatifida Bunge. var. major N.E. Br. | Shān lǐ hóng 山里红 | Dologun-a | Vegetable/fruit | M/H | D1805-003 |
| Cynanchum chinense R. Br. | Temegen hēhu | Vegetable | Young fruit, eaten raw | M | D1806-006 |
| Cynanchum thesioides (Freyn) K. Schum. | Lāo piáo老瓢, lāo guá瓢老瓜瓢 | Temegen hēhu | Vegetable/snack | M/H | D1806-018 |
| Dendranthema indicum (L.) Des Moul. | Yě jú huá 野菊花 | Beverage | Flower, dried and made into tea | H | D1810-004 |
| Ephedra sinica Stapf | Má huáng 麻黄 | Zegergen-e | Mature female cone, eaten raw | M/H | D1810-005 |
| Erodium stephanianum Willd. | Hóng gēn 红根 | manziuhai | Fruit, eaten raw | M/H | D1808-002 |
| Fagopyrum esculentum Moench | Qiáo mài huā 荞麦花 | Sagad | Flower, boiled and mixed with flour | M/H | D1808-001 |
| Ferula bungeana Kitag. | Shān huì xiāng 山茴香 | Vegetable | Tender aerial parts, boiled as stuffing for pasta, made into gruel or used for seasoning | H | D1806-019 |
| Hemerocallis minor Mill. | Hǔ huá zǐ 黄花子 | Huanghuacai (BN), honghu huxuar, sir-a huxuar | Vegetable | Flower, consumed as soup, fried, boiled and mixed with cream | M/H | D1806-016 |
| Hémiptelea davidi (Hance) Planch. | Har-a sanduu | Vegetable | Tender leaf and young fruit, consumed as soup | M | D1806-024 |
| Juglans mandshurica Maxim. | Shān hē tāo 山核桃 | Husig-a, noyan modu | Snack | Fruit, eaten raw | M/H | D1808-003 |
| Kochia scoparia (L.) Schrad. | Sào zhōu cài 扫帚菜 | Sugur nogo | Vegetable | Tender aerial parts, fried, steamed with flour | M/H | D1806-028 |
| Lespedeza davurica (Laxm.) Schindl. | Hurbhei | Vegetable/beverage | Tender stem and leaf, fried, steamed with flour. Shoot, dried in the shade or baked and made into tea | M | D1806-030 |
| Lilium pumilum DC. | Hóng huá zǐ 红花子, bāi hé 百合 | Saralang huxuar | Vegetable | Flower, fried. Bulb, consumed as soup | M/H | D1709-001 |
| Lycium chinense Mill. | Gōu qǐ 柿杞 | Gouqi (BN) | Beverage | Fruit, soaked with wine | M/H | D1806-034 |
| Malus baccata (L.) Borkh. | Shān dìng zǐ 山定子 | uril | Fruit | Fruit, eaten raw | M/H | D1805-004 |
| Malva verticillata L. | Har-a nogug-a, tugur nogug-a | Vegetable | Leaf, consumed as soup, steamed with flour | M | D1806-005 |
| Species | Folk Chinese name | Folk Mongolian name | Usage | Edible part(s) and mode of consumption | Linguistic groups | Voucher numbers |
|---------|-------------------|---------------------|-------|----------------------------------------|------------------|-----------------|
| *Oenanthe javanica* (Bl.) DC. | Shān qín cài 山芹菜 | Cogur nogug-a | Vegetable | Stem and leaf, cold and dressed with sauce, fried, boiled as stuffing for pasta | M/H | D1806-031 |
| *Orostachys malacophylla* (Pall.) Fisch. | Suàn tǎ 面塔 | Muur in himusu | Snack | Tender aerial parts, eaten raw | M/H | D1806-023 |
| *Radix avium* Mill. | Chòu lǐ 炙李子 | Moil | Fruit | Fruit, eaten raw | M/H | D1805-007 |
| *Ranunculus lactiflorus* Pall. | Bái shòu 白芍 | Can-a | Beverage | Flower, dried and made into tea | M/H | D1906-002 |
| *Periploca sepium* Bunge | Yáng nǎi zi 羊奶子 | Imag-an eber, Šugusu modu | Vegetable/snack | Tender leaf steamed with flour. Tender fruit, eaten raw | M/H | D1806-007 |
| *Rumex depressus* Willd. | Chē gōu lu cài 车轱辘菜 | Chegulucai(BN), elzigen cihi | Vegetable | Tender leaf, cold and dressed with sauce | M/H | D1806-008 |
| *Polygonatum odoratum* (Mill.) Druce | Suāng bù lǚ 酸不溜 | Simeldeg | Snack | Tender stem, eaten raw | M/H | D1806-022 |
| *Polygonum aviculare* L. | Mǎ lián cài 马莲菜, mà zha cài 蚂蚱菜 | Majincai (BN) | Vegetable | Tender stem and leaf, dipped in sauce | M/H | D1806-004 |
| *Potentilla longifolia* Willd. ex Schlcht. | Taulai in tangnai | Vegetable | Tender stem and leaf, consumed as soup or steamed with flour | M | D1806-017 |
| *Pyrus ussuriensis* Maxim. | Shān lí 山梨 | Hegerein ilam-a | Fruit | Fruit, eaten raw | M/H | D1810-006 |
| *Quercus mongolica* Fisch. ex Ledeb. | Xiăng zi 橡子, zuó shù 柞树 | Carasu | Grain/beverage/oil and fats/snack | Seed, dried and ground into flour, made wine, oil extracted or fried | M/H | D1806-001 |
| *Salsola collina* Pall. | Zhū máo cài 豌毛菜, zhá bù lèng 扎不楞 | Hamhuul | Vegetable | Tender aerial parts, consumed as soup | M/H | D1806-002 |
| *Salvia miltiorrhiza* Batalin. | Nohai in Yṣim | Fruit/beverage | Fruit, eaten raw, soaked with wine | M | D1806-020 |
| *Sorrel uliginosus* DC. | Qǔ má cài 取麻菜 | gasigun nogug-a | Vegetable/beverage | Tender stem and leaf, dipped in sauce, cold and dressed with sauce, made into tea | M/H | D1806-009 |
| *Taraxacum mongolicum* Hand. -Mazz. | Pò pò ding 柏蓬丁 | Bobodeng (BN) | Vegetable/beverage | Tender stem and leaf, dipped in sauce, cold and dressed with sauce or fried. Flower and root, dried and made into tea | M/H | D1806-010 |
Table 2 Ethnobotanical inventory of wild edible plants used by Daqinggou locals in Inner Mongolia (Continued)

| Species                        | Folk Chinese name | Folk Mongolian name | Usage                | Edible part(s) and mode of consumption | Linguistic groups | Voucher numbers |
|--------------------------------|-------------------|---------------------|----------------------|----------------------------------------|-------------------|-----------------|
| Thymus quinquecostatus Cêlak.  | Shānhuājiāo 山花椒 | Huajiao (BN), huaju ebesu (BN) | Condiment            | Aerial parts, used for seasoning        | M/H               | D1806-012       |
| var. asiaticus (Kitagawa) C.Y. Wu & Y.C. Huang |                     |                     |                      |                                        |                   |                 |
| Tilia mongolica Maxim.         | Duànshù 椴树       | Domu modu           | Vegetable            | Tender leaf, steamed with flour, consumed as soup | M/H               | D1805-006       |
| Ulmus macrocarpa Hance         | Yúshù 楸树         | Deltu               | Vegetable            | Tender leaf and fruit, consumed as soup  | M/H               | D1805-001       |
| Ulmus pumila L.                | Yúshù 楸树         | Hallasu             | Vegetable/grain      | Tender leaf and fruit consumed as soup. Bark, dried and ground into flour | M/H               | D1805-008       |
| Urtica angustifolia Fisch. ex  | Usun halagai      | Vegetable           | Tender stem and leaf, consumed as soup | M                   | D1806-026       |
| Horrem.                        |                    |                     |                      |                                        |                   |                 |
| Urtica cannabina L.            | Hālá hǎi cài (BN) 哈拉嗨菜 | Halagai            | Vegetable            | Tender stem and leaf, consumed as soup  | M/H               | D1806-033       |
| Vitis amurensis Rupr.          | Shānpú tào 山葡萄  | Heger-e in Y3m      | Vegetable/fruit/beverage | Tender leaf steamed with flour. Fruit, eaten raw, made wine | M/H               | D1806-021       |
| Xanthoceras sorbifolium Bunge  | Sengdeng modu      | Snack               | Seed, eaten raw, fried |                                        | M                 | D1808-004       |

*Species in the inventory are arranged alphabetically by the plant scientific name.
*BN borrowed name
Folk Han names of wild edible plants are written using Chinese pinyin and Chinese character names [41].
Folk Mongolian names are spelled with the Mongolian phonetic symbol [42].
Daqinggou is a national nature reserve of precious broad-leaved mixed forests, with a population of nearly 800. Locals are engaged in semifarming, semianimal husbandry, or tourism. It is a mixed area of Mongolian people and Han Chinese, with a large Mongolian population, all of whom speak Chinese. Daqinggou is located 24 km southwest of Horqin Left Wing Rear Banner, Tongliao City, Inner Mongolia Autonomous Region, longitude 120° 13′–122° 15′, north latitude 42° 45′–42° 48′ (Fig. 1), with a total area of 81.83 km² and a forest area of 45.95 km². The landform consists of sand dunes, sandy land and plains belonging to the subsidence zone of the Liaohe River Basin [25]. According to the “climatic regionalization of China,” it is in the transition zone from the Northeast temperate semihumid climate zone to the Inner Mongolia temperate semiarid climate zone, with an average annual temperature of 5.6 °C and mean annual rainfall of approximately 450 mm. The length of the frost-free period in the area is approximately 145 days [26].

The flora mainly consists of the flora of Changbai Mountain and Mongolian, combining the species of North China flora [27]. A total of 104 families, 320 genera, and 528 species of vascular plants grow in Daqinggou. Among them, 13 species belong to 10 different families of ferns, 3 species belong to 3 different families of gymnosperms, and 511 species belong to 91 different families of angiosperms [28].

Methods
Field work
From 2017 to 2019, the authors completed 7 field studies in Daqinggou; there are two villages within the reserve and five villages in the surrounding area. Field studies included key informant interviews (Fig. 2), semistructured interviews, and questionnaires. Local farmers, retailers, and reserve staff were selected as the informants, and 227 people were interviewed. A total of 101 key informants participated in the interviews via selection using snowball sampling and intentional sampling [7, 29–32]. The ages of informants ranged from 24 to 88 (mean age 58 years), and the gender and ethnic ratios of informants were both almost 1:1 (male to female was 53 to 48, Mongolian to Han was 51 to 50). Among them, 65 people were interviewed through semistructured interviews, including questions that were relevant to document detailed information on all edible wild plants. The questions investigated included the following: What wild plants do you usually eat? Do you know any other folk name for the plant? What are the edible parts and mode of consumption of each plant? What ailment does this plant treat? Where is the habitat of the plants? Is the plant easy or difficult to collect? In 7 villages, 200 questionnaires (Additional file) about the CFSI of edible plants were distributed, and 116 valid questionnaires were collected.

Voucher specimen
Ethnobotanical interviews and the collection of voucher specimens were carried out in two ways: locals were invited to find and collect voucher specimens of related plants at the field sites; voucher specimens were precollected and used in key informant interviews [23, 33]. A total of 84 plant specimens were aggregated as wild edible plants used by the locals. Among the collected specimens, 57 species, 3 varieties, and 1 form were identified [34, 35].

Quantitative analysis
The CFSI was calculated to evaluate the cultural significance of wild edible plants by the following formula given by Andrea Pieroni [36]:

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

The formula takes into account seven indices [10, 37–40], which express the frequency of quotation (QI), availability (AI), frequency of use (FUI), plant parts used (PUI), multifunctional food use (MFF), taste score appreciation (TSAI), and the food-medicinal role (FMRI). Based on the local cultural characteristics, the index was graded and evaluated (Table 1).

Table 3 Food category diversity

| Usage      | Number | Percentage |
|------------|--------|------------|
| Vegetable  | 40     | 47.62      |
| Beverage   | 12     | 14.29      |
| Snack      | 10     | 11.90      |
| Fruit      | 9      | 10.71      |
| Condiment  | 5      | 5.95       |
| Grain      | 5      | 5.95       |
| Oil and fats | 3   | 3.57       |

Table 4 Diversity of edible parts

| Edible part                | Number | Percentage |
|----------------------------|--------|------------|
| Fruit                      | 17     | 20.73      |
| Leaf                       | 16     | 19.51      |
| Aerial parts               | 12     | 14.63      |
| Stem and leaf              | 11     | 13.41      |
| Flower (inflorescence)     | 7      | 8.54       |
| Seed (kernel)              | 7      | 8.54       |
| Root                       | 6      | 7.32       |
| Bulb                       | 2      | 2.44       |
| Bark                       | 1      | 1.22       |
| Stem                       | 1      | 1.22       |
| Shoot                      | 1      | 1.22       |
| Female cone                | 1      | 1.22       |
Results and discussion

Ethnobotanical inventory

There are 61 species of wild plants consumed by local people. Among them, 1 species belongs to pteridophyta, 1 species belongs to gymnosperms, and 59 species belong to 27 different families of angiosperms. This paper is summarized in the form of an ethnobotanical inventory to facilitate the analysis and evaluation. The contents of the inventory include the scientific names of species, folk Chinese and Mongolian names, usage, edible part(s) and mode of consumption, linguistic groups, and voucher numbers (Table 2).

Life form characteristics of wild edible plants

The life forms of wild edible plants used by the locals are small trees, trees, shrubs, subshrubs, lianas, annual herbs, and perennial herbs. Among them, 26 species are perennial herbs and account for 43% of the total species; 12 species are annual herbs, and 11 species are trees, accounting for 20% and 18%, respectively, of the total species.

Daqinggou is a part of the steppe of Eurasia. Because of the plant distribution in the reserve, it is closely related to the broad-leaved forest of East Asia [27]. Therefore, woody plants also account for a certain proportion in this area.

Folk names

The Mongolian people and Han Chinese living in Daqinggou are able to name most of the wild plants in their own language. Among 57 species of wild plants collected and consumed by Mongolian people, 47 species have Mongolian names, and the other 10 species directly borrow Chinese names. Among 49 species of wild plants collected and consumed by Han Chinese, Allium senescens is called măng gê ěr, and Urtica cannabina is called hā là hái cài, from the plant’s folk Mongolian names manggir and halagai. Therefore, the Mongolian people and Han Chinese also present exchange and reference phenomena in the nomenclature of wild edible plants.

Food categories

The usage of wild edible plants by locals presents high diversity. According to their eating habits, food categories include grains, oils and fats, vegetables, fruits, beverages, condiments and snacks. There are 84 kinds of related plants corresponding to different usages, which is more than the total number of edible plant species, because some of the same plants have different usages (Table 3).

Among them, the wild plants used as vegetables are the most abundant. Grains were gathered and consumed during times of food shortage and famine. At present, only the bark of Ulmus pumila is dried and ground into flour, which is appropriately added to corn flour to increase its strength. In fact, this is a traditional way of using vegetable gum.

There are three consumption modes of wild beverage plants: Locals collect different parts of the wild plants for processing and making tea; some elders also soak the roots or fruits of wild plants in wine to make medicinal wine for drinking; Quercus mongolica and Vitis amurensis are used to make wine. Most of the wild fruits mentioned above are eaten by shepherds as snacks to satisfy hunger and thirst.

Edible part(s) and mode of consumption

The edible parts of wild plants consumed by locals also present high diversity. According to statistics, apart from the aerial parts, the edible parts of most species are plant organs and organ combinations such as the root, stem, leaf, flower, fruit and seed, or specific parts such as the bulb, female cone, shoot, and bark. Twelve types are used. The most widely used edible parts are the fruit (17), leaf (16), and aerial parts (12) (Table 4).
| Species                        | QI  | AI  | FUI | PUI | MFFI | TSAI | FMRI | CFSI       | Ranking |
|-------------------------------|-----|-----|-----|-----|------|------|------|------------|---------|
| Taraxacum mongolicum         | 68.00 | 4.00 | 5.00 | 4.25 | 4.75 | 7.50 | 5.00 | 10295.63   | 1       |
| Crataegus pinnatifida var. major | 59.00 | 4.00 | 5.00 | 3.00 | 3.50 | 10.00 | 5.00 | 6195.00    | 2       |
| Sonchus wightianus            | 75.00 | 4.00 | 5.00 | 2.00 | 3.75 | 7.50 | 5.00 | 421875.00  | 3       |
| Ulmus pumilla                | 58.00 | 4.00 | 5.00 | 4.00 | 1.50 | 7.50 | 5.00 | 261000.00  | 4       |
| Allium macrostemon           | 44.00 | 2.50 | 3.00 | 4.50 | 3.00 | 10.00 | 5.00 | 222750.00  | 5       |
| Cerasus humilis               | 51.00 | 2.50 | 5.00 | 3.00 | 2.25 | 10.00 | 5.00 | 215156.00  | 6       |
| Allium ramosum               | 65.00 | 2.50 | 5.00 | 3.75 | 2.00 | 10.00 | 5.00 | 182813.00  | 7       |
| Armeniaca sibirica           | 55.00 | 3.00 | 3.00 | 2.00 | 3.50 | 10.00 | 5.00 | 173250.00  | 8       |
| Oenanthe javanica            | 72.00 | 3.00 | 3.00 | 2.00 | 2.00 | 10.00 | 5.00 | 108000.00  | 9       |
| Solanum nigrum               | 36.00 | 3.00 | 5.00 | 1.50 | 2.25 | 7.50 | 5.00 | 68344.00   | 10      |
| Plantago depressa            | 46.00 | 4.00 | 3.00 | 1.50 | 2.00 | 7.50 | 5.00 | 62100.00   | 11      |
| Allium senescens             | 53.00 | 2.50 | 3.00 | 3.00 | 1.50 | 10.00 | 5.00 | 53663.00   | 12      |
| Amaranthus retroflexus       | 53.00 | 4.00 | 3.00 | 3.00 | 1.00 | 7.50 | 5.00 | 42930.00   | 13      |
| Urtica cannabina             | 47.00 | 4.00 | 3.00 | 2.00 | 1.00 | 7.50 | 5.00 | 42300.00   | 14      |
| Vitis amurensis              | 49.00 | 1.50 | 3.00 | 3.00 | 3.25 | 6.50 | 5.00 | 41923.00   | 15      |
| Malva verticillata           | 31.00 | 4.00 | 5.00 | 1.50 | 2.00 | 7.50 | 5.00 | 41850.00   | 16      |
| Plantago asiatica            | 30.00 | 4.00 | 3.00 | 1.50 | 2.00 | 7.50 | 5.00 | 40500.00   | 17      |
| Portulaca oleracea           | 49.00 | 4.00 | 3.00 | 2.00 | 1.00 | 6.50 | 5.00 | 38220.00   | 18      |
| Ulmus macrocarpa             | 46.00 | 4.00 | 3.00 | 3.00 | 1.00 | 7.50 | 5.00 | 37260.00   | 19      |
| Quercus mongolica            | 40.00 | 4.00 | 3.00 | 1.00 | 2.75 | 5.50 | 5.00 | 36300.00   | 20      |
| Adenophora polyantha         | 18.00 | 2.50 | 3.00 | 3.00 | 2.75 | 6.50 | 5.00 | 36197.00   | 21      |
| Artemisia frigida            | 51.00 | 2.00 | 3.00 | 3.00 | 2.00 | 6.50 | 5.00 | 35802.00   | 22      |
| Cynanchum thesioides         | 45.00 | 2.50 | 3.00 | 1.50 | 3.00 | 7.50 | 5.00 | 34172.00   | 23      |
| Hereroacallis minor           | 45.00 | 1.50 | 5.00 | 1.50 | 3.00 | 7.50 | 5.00 | 34172.00   | 24      |
| Periploca sepium             | 65.00 | 3.00 | 3.00 | 3.00 | 2.50 | 7.50 | 1.00 | 32906.00   | 25      |
| Adenophora remotiflora       | 14.00 | 2.50 | 3.00 | 3.00 | 2.75 | 6.50 | 5.00 | 28153.00   | 26      |
| Potentilla longifolia        | 34.00 | 2.50 | 3.00 | 2.00 | 2.00 | 5.50 | 5.00 | 28070.00   | 27      |
| Juglans mandshurica          | 47.00 | 2.00 | 3.00 | 1.50 | 1.50 | 4.00 | 5.00 | 24300.00   | 28      |
| Salsola collina              | 45.00 | 3.00 | 3.00 | 3.00 | 1.00 | 40.00 | 5.00 | 23580.00   | 29      |
| Polygonum divaricatum        | 48.00 | 3.00 | 3.00 | 1.00 | 1.50 | 7.50 | 3.00 | 14580.00   | 30      |
| Chenopodium album            | 49.00 | 4.00 | 3.00 | 2.00 | 0.50 | 7.50 | 3.00 | 13230.00   | 31      |
| Athyrium brevifrons          | 38.00 | 2.50 | 3.00 | 1.50 | 3.50 | 7.50 | 1.00 | 11222.00   | 32      |
| Urtica angustifolia          | 14.00 | 3.50 | 3.00 | 2.00 | 1.00 | 7.50 | 5.00 | 11025.00   | 33      |
| Species                      | QI  | AI  | FUI | PUI  | MFFI | TSAI | FMRI | CFSI    | Ranking |
|------------------------------|-----|-----|-----|------|------|------|------|---------|---------|
| Lespedeza bicolor            | 6.00| 2.50| 3.00| 3.75 | 2.75 | 650  | 3.00 | 90.49   | 34      |
| Malus baccata                | 51.00| 3.00| 3.00| 1.50 | 1.50 | 650  | 1.00 | 67.13   | 35      |
| Chenopodium acuminatum       | 22.00| 4.00| 3.00| 2.00 | 0.50 | 750  | 3.00 | 59.40   | 36      |
| Polygonatum odoratum         | 9.00 | 2.50| 3.00| 1.50 | 1.50 | 750  | 5.00 | 56.95   | 37      |
| Dendranthera indicum         | 12.00| 4.00| 5.00| 0.75 | 0.75 | 750  | 5.00 | 50.68   | 38      |
| Padus avium                 | 34.00| 3.00| 3.00| 1.50 | 1.50 | 650  | 1.00 | 44.75   | 39      |
| Lycium chinense             | 13.00| 1.50| 5.00| 1.50 | 0.75 | 650  | 5.00 | 35.65   | 40      |
| Ephedra sinica              | 36.00| 1.50| 3.00| 2.00 | 1.50 | 650  | 3.00 | 35.54   | 41      |
| Kochia scoparia             | 13.00| 2.00| 3.00| 3.00 | 2.00 | 650  | 1.00 | 30.42   | 42      |
| Polygonum aviculare         | 20.00| 2.50| 3.00| 3.00 | 2.00 | 650  | 5.00 | 29.25   | 43      |
| Pyrus ussuriensis           | 52.00| 1.50| 3.00| 1.50 | 1.50 | 550  | 1.00 | 28.96   | 44      |
| Lilium pumilum              | 34.00| 0.50| 3.00| 0.75 | 2.00 | 750  | 5.00 | 28.69   | 45      |
| Ferula bungeana             | 14.00| 3.00| 3.00| 3.00 | 1.00 | 750  | 1.00 | 28.35   | 46      |
| Tilia mongolica             | 13.00| 3.00| 3.00| 1.50 | 2.00 | 650  | 1.00 | 22.82   | 47      |
| Corylus heterophylla        | 12.00| 1.90| 3.00| 1.50 | 2.50 | 750  | 1.00 | 19.24   | 48      |
| Xanthoceras sorbilium       | 25.00| 1.50| 1.00| 1.00 | 2.50 | 650  | 3.00 | 18.28   | 49      |
| Orostachys malacophylla     | 12.00| 0.50| 3.00| 1.50 | 1.50 | 0.50 | 5.00 | 11.81   | 51      |
| Erodium stephanianum        | 35.00| 2.00| 3.00| 1.50 | 2.50 | 550  | 5.00 | 11.41   | 52      |
| Cynanchum chinense          | 13.00| 2.00| 3.00| 1.50 | 1.50 | 650  | 1.00 | 11.41   | 53      |
| Hemiptelea davidii          | 9.00 | 1.50| 3.00| 3.00 | 1.00 | 650  | 1.00 | 7.90    | 54      |
| Thymus quinquecostatus var. asiaticus | 16.00 | 1.50 | 3.00 | 3.00 | 0.50 | 650  | 1.00 | 7.02    | 55      |
| Caltha palustris var. sibirica | 5.00 | 1.90| 3.00| 1.50 | 2.50 | 650  | 1.00 | 6.95    | 56      |
| Rheum lactiflorum           | 7.00 | 0.50| 3.00| 1.50 | 0.75 | 750  | 5.00 | 4.43    | 57      |
| Abutilon theophrasti        | 14.00| 3.00| 1.00| 0.50 | 0.50 | 400  | 5.00 | 4.20    | 58      |
| Cannabis sativa f. ruderalis | 12.00| 2.50| 1.00| 1.00 | 0.50 | 550  | 5.00 | 4.13    | 59      |
| Codonopsis lanceolata       | 2.00 | 1.50| 3.00| 1.50 | 1.50 | 650  | 1.00 | 1.32    | 60      |
| Cirsium setosum             | 2.00 | 2.50| 3.00| 1.50 | 1.00 | 550  | 1.00 | 1.24    | 61      |
| Fagopyrum esculentum        | 5.00 | 0.50| 1.00| 0.75 | 0.50 | 400  | 1.00 | 0.04    | 62      |
Wild edible plants are consumed in two ways, as raw food and as cooked food. The mature fruits and young fruits eaten by locals as fresh fruits and the tender stems and leaves consumed as snacks are raw food. The wild vegetables used by locals for steaming, frying, filling, soup, and seasoning plants are consumed as cooked food.

As the most widely consumed wild plants in the region, there are seven types of traditional wild vegetables (Fig. 3). Wild vegetables are frequently soaked in cold water or blanched in boiling water and then used for stir-frying or soups. For the local Mongolian people, cream is also a commonly used condiment with cooked wild vegetables. In particular, local people like to eat wild vegetables with flour and to add salt, a little oil and wild vegetables into the dough to steam a unique pasta called “bulasu”.

Cultural food significance index (CFSI)
The CFSI values were calculated following the abovementioned formula, with a minimum of 0.04 and a maximum of 10,295.63 (Table 5). It was possible to classify the cited botanical species into six groups [36, 37]: species with very high significance (CFSI = 1000 and higher), high significance (CFSI = 500–999), moderate significance (CFSI = 250–499), low significance (CFSI = 50–249), very low significance (CFSI = 5–49), and negligible significance (CFSI < 5) (Fig. 4).

*Taraxacum mongolicum* ranks first in the CFSI, attributed to its high quotation index, multifunctional food use index value and food-medicinal role index value. Its tender stem and leaf can be used as vegetables; flowers and roots can be used for herbal drinks and have the functions of heat clearing. *Fagopyrum esculentum* ranks last with the CFSI because of the very low frequency of consumption over the past 30 years. Its flowers and a small amount of flour are cooked to satisfy hunger only in the famine years. Its flowers and a small amount of flour are cooked to satisfy hunger only in the famine years. This reported use only exists in the memory of the elderly.

**Wild edible plants used for diet therapy**
In addition to their edible function, many wild edible plants also have health care functions, and a wide range of diseases can be prevented and cured by

| Folk diet therapy function | Number | Representative plant |
|---------------------------|--------|----------------------|
| Treating rheumatism       | 6      | *Abutilon theophrasti*, *Adenophora polyantha*, *Cerasus humilis*, *Erodium stephanianum*, *Urtica angustifolia*, *Urtica cannabina* |
| Heat clearing             | 4      | *Dendranthema indicum*, *Polygonum aviculare*, *Sonchus wightianus*, *Taraxacum mongolicum* |
| Diuresis                  | 3      | *Plantago depressa*, *Plantago asiatica*, *Ulmus pumila* |
| Relieving cough           | 3      | *Ameniaca sibirica*, *Ufhum pumilum*, *Solanum nigrum* |
| Tonifying Qi              | 3      | *Lycium chinense*, *Paeonia lactiflora*, *Polygonatum odoratum* |
| Heat clearing and detoxifying | 2    | *Portulaca oleracea*, *Potentilla longifolia* |
| Promoting digestion       | 2      | *Allium macrostemon*, *Crataegus pinnatifida var. major* |
| Relieving the bowels      | 2      | *Adenophora remotiflora*, *Cannabis sativa f. ruderalis* |
| Lowering blood pressure   | 2      | *Portulaca oleracea*, *Salvola collina* |
| Reducing blood glucose    | 1      | *Polygonatum odoratum* |
| Relieving diarrhea        | 1      | *Quercus mongolica* |
| Improving eyesight        | 1      | *Lycium chinense* |
The当地人使用这些植物作为药物，用于治疗：关节炎、利尿、清热、补气（表6）。例如，关节炎患者可以通过饮用由Adenophora polyantha和Cerasus humilis根制成的药酒来缓解疼痛。根据传统民间知识，Sonchus arvensis的草药茶可以用于“清热”。米糠制成的Quercus mongolica小吃可以治疗儿童腹泻（图5）。

**Conclusions**

总共61种野生植物被当地人食用。其中，Abutilon theophrasti、Fagopyrum esculentum和Lycium chinense已被减少至路边、荒地和田野的野生可食植物的记录。与其对照的路边和田野的野生植物的记录。对应蒙古人和汉人的75种野生植物和科学名称的记录。85.07%和84.48%，分别，这表明科学知识有高一致性。蒙古族和汉人的传统知识在共享植物名称[48–50]。然而，可食部分的选择和消费在这两个族群之间几乎是相同的。根据统计，最常吃的野生可食植物的可食部分是基于科学基础和值得进一步研究。

**Supplementary information**

Supplementary information accompanies this paper at https://doi.org/10.1186/s13002-020-00411-2.

**Additional file 1.** Questionnaires.
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Authors’ contributions

The fieldwork for data collection was conducted by S, K, G, and YYZ. The voucher specimens were identified by S, K, and HZ. Data analysis and manuscript preparation were performed by S and K. All authors read and approved the final manuscript.

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Availability of data and materials

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Ethics approval and consent to participate

Consent for publication

Consent for publication of the information gathered, and they were assured of their objectives and the eventual publication of the information gathered, and they were assured that the informants’ identities would remain undisclosed.

Competing interests

The authors declare that they have no competing interests.

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