

Ethnobotany of Wild Edible Plants in Multi-ethnic Areas of Gansu-Ningxia- Inner Mongolia Junction Zone

Xiaohuan Jia

Zunyi Medical University

Yongxia Zhao

Zunyi Medical University

Yunyue Zhu

Zunyi Medical University

Xin Zen

Zunyi Medical University

Xuehui Liang

Zunyi Medical University

Jian Xie

Zunyi Medical University

Faming Wu (✉ wufaming@zmu.edu.cn)

Zunyi Medical University

Research Article

Keywords: Ethnobotany, Wild plants, Healthy plants

Posted Date: May 31st, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1694601/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Abstract

Introduction: In recent years, research on wild edible plant resources has become a hotspot. Hassan Nature Reserve is a multi-ethnic mixed area mainly composed of Han, Hui and Mongolian. The edible development of wild plant resources in this area is extremely high. However, with the advancement of urbanization and the development of modern agricultural technology, such resources have been seriously damaged, and the related traditional knowledge such as national medicine has been lost.

Methods: With the methods of literature study, interview with village and community organizations, participatory observation and quantitative evaluation of ethnobotany, the wild edible plants in Hassan region of Gansu-Ningxia-Inner Mongolia interchange belt were investigated and studied.

Results: The survey results showed that there were 53 species (varieties) of wild edible plants belonging to 24 families in this area, with 8 species and 7 species in Compositae and Liliaceae, respectively, being the most abundant. The young stems and leaves were the most edible parts, with 17 species, followed by the fruits (including young fruits) with 16 species. In addition, the edible parts also included root or rhizome (bulb), seed, whole plant, skin, etc. There were two types of raw food and cooked food, raw food was mainly used as snacks, mainly fruit; The cooked food is mainly vegetables with tender stems and leaves as the main, in addition can also be used as seasoning, medicinal diet, emergency food in the famine years. Important (CFSI>500) wild edible health-care plants in the region include: *Mulgedium tataricum* (L.) DC., *Nostoc commune*, *Sonchus arvensis* L., *Taraxacum mongolicum* Hand.-Mazz., *Allium schoenoprasum*, *Robinia pseudoacacia*, *Hemerocallis citrina* Baroni, *Elaeagnus angustifolia* Linn., *Medicago sativa* L., *Ulmus pumila* L., *Stachys sieboldii* Miq. var. *sieboldii*, *Tooinensis* (A. Juss.) Roem. var. *sinensis*, had high utilization value and utilization rate in the locality.

Conclusion: In summary, the species, edible parts, edible categories, edible methods and health care functions of wild edible plants in this area are diverse, and the traditional utilization knowledge is rich, and some wild plants have high development value.

Background

Wild edible plants have always played a very important role in the human development history [1], especially in the famine era. Wild edible plants are not only the life-saving food but also the life-saving medicine [2]. With abundant materials, the wild edible plants are also an indispensable part of people's life [3]. Because the wild edible plants are derived from natural resources and have good health care functions, they are respected by today's society and have great market potential [4, 5]. The research on wild edible plant resources has been carried out both in China and abroad. In particular, it has become a hot topic in the research on plant resources in recent years. Many wild resource products have become hot commodities in the market and popular health foods [6–10]. Scholars in China mainly focused on the investigation and study of edible wild plant resources with minority characteristics [11–14], which provided certain information resources for the development and utilization of national wild edible plant resources.

Hassan Nature Reserve is located in the arid area of the Loess Plateau, which is the meeting area of Gansu, Ningxia and Inner Mongolia. The regional characteristics form a multi-ethnic mixed area mainly composed of Han, Hui and Mongolian. Due to less precipitation and large evaporation in this area [15], plant resources in this area are relatively scarce in both species and reserves. Since ancient times, the region has been a poverty-stricken area with shortage of materials. However, at the same time, the exchange and integration of Hui, Han, and Mongolian ethnic groups with a long history have accumulated rich traditional application experience of wild edible plants, which has also contributed to the extremely high degree of exploitation of the edible nature of wild plant resources in the region. However, with the advancement of urbanization and the development of modern agricultural technology, such resources have been seriously damaged, and the related traditional knowledge such as national medicine has been lost. Therefore, this paper explored, recorded, summarized and summarized the traditional knowledge of edible wild plant resources in this area, which played a very positive role in the protection of traditional culture and the sustainable development and utilization of wild edible plant resources.

Methods

Study area

In this study, the Jingyuan County, Pingchuan District, and Jingtai County in Baiyin City, Gansu Province (Fig.1) with Hassan Mountain Nature Reserve as the center radiation was investigated. The area spanned the latitude of 36° to 37° 38' north, and the longitude of 103° 33' to 105° 51' east. It was located in the transition zone of three major regions: the loess plateau in west Gansu Province, the Yanyu pulse in Shandong Province of Qilian Mountains, and the Tengger Desert. It belonged to the transition zone from the semi-arid zone of the middle temperate zone to the arid zone. The annual average temperature was 6–9 °C, and the annual rainfall was 180–450 mm [16]. The area is a multi-ethnic habitat, the main ethnic groups in the territory are the Han, Hui and Mongolian, in addition to the Tibetan, Manchu and other ethnic groups [17], the economy is based on agriculture and industry, the main crops are wheat, corn, rice, quinoa, potato, broad bean, flax, onion, rape, jujube, medlar, etc [18–20]. In addition, the region is also an important post station of the Silk Road, and relying on the advantages of this resource, it actively develops characteristic industries, and integrates multiple cultures such as the Yellow River culture, the Silk Road culture, the farming culture, the folk culture and the red culture, forming a unique local culture [21].

Ethnobotanical information collection

In the process of field investigation, key person interviews, semi-structured interviews and participatory rural evaluation methods were used. The basic contents of the interviews were "5W+1H" [22], the traditional knowledge of edible wild plants was mastered, and the basic information of the information reporter as well as the local common name, edible parts, edible categories, edible methods, and health care functions of edible plants were recorded, organized and analyzed. And the participatory observation method [23] was also used to understand the types, uses, functions, edible parts and methods of wild plants

collected and eaten by the local people in their daily life. In addition to this, the interviewees were investigated through telephone communication. The contents of the interview were the same as those of the field investigation.

Quantitative evaluation of ethnobotany

The national plant cultural importance index (CFSI) was used to evaluate the wild edible plants in the investigated area.

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

Where FQI was the reference frequency index, AI was the commonness index, FUI was the utilization frequency index, PUI was the utilization site index, MFFI was the multifunctional food utilization index, TSI was the taste evaluation index, and FMRI was the medicinal diet function index [24].

Each index was graded and assigned with reference to Research Methods of Ethnobotany [22]: Frequency of quotation index (FQI): the number of people mentioning a plant in all information reports. Availability index (AI): It was divided into very common (4.0), common (3.0), general (2.0) and uncommon (1.0). Frequency of utilization index (FUI): It was divided into more than once a week (5.0), once a week (4.0), once a month (3.0), more than once a year but less than once a month (2.0), once a year (1.0) and not used for nearly 30 years (0.5). Parts used index (PUI): it was divided into whole plant (4.00), aboveground and underground parts (3.00), tender leaves and tender stems and leaves (2.00), flowers, fruits (1.50), tender roots, stems and stipules (1.00), and tender buds (0.75). Multifunctional food use index (MFFI): it is divided into raw food and cold mix (1.5), boiling, stewing and flavoring (1.0), special-purpose flavoring (0.75) and raw food as snack (0.50); Taste score evaluation index (TSI): it was classified as excellent (10.0), very good (9.0), good (7.5), average (6.5), poor (5.5) and very poor (4.5). Food-medicinal role index (FMRI): It was divided into very high (5.0 as medicine and food), high (4.0 for treating certain disease as medicine), medium high (3.0 for very healthy food), medium low (2.0 for healthy food, efficacy unknown) and unknown (1.0).

Specimen identification

Species identification was conducted on the plants collected through investigation with reference to the full-text electronic edition of Flora of China (<http://www.iplant.cn/frps>) [25], Atlas of Desert Plants in China [26] and Field Identification Manual of Common Plants in China (Qilian Mountain Volume) [27], and various information materials were collected and analyzed according to the research purpose, and the icon was drawn.

Results

Basic Information of Information Reporters

The age distribution of 175 informants was segmented and the results showed that all informants were between 18 and 85 years of age, 25 between 18 and 25 years of age, 25 between 25 and 30 years of age, 42 between 30 and 35 years of age, 22 between 36 and 45 years of age, 21 between 46 and 55 years of age, 19 between 56 and 65 years of age and 21 over 65 years of age; 142 persons of rural origin (born in rural areas and grew up in rural areas during childhood and adolescence), accounting for 81.14 per cent of the total, and 33 persons of urban origin (born and living in urban areas), accounting for 18.86 per cent of the total; There were 87 males and 33 females, with the ratio of male to female close to 1:1. There were 148 Han nationality reporters, 22 Hui nationality reporters and 5 Mongolian nationality reporters (Fig.2).

The results of the survey showed that the species of wild plants eaten by the reporter had a positive correlation with age. Eleven wild plant species were consumed by each of the 25 reporters under 25 years of age, while up to 47 wild plant species were consumed by each of the 21 reporters over 65 years of age, 4.27 times the number of reported species under 25 years of age. Most of the 11 wild plants eaten by people under the age of 25 are common wild vegetables (tender stems and leaves), such as: *S. arvensis* L., *M. tataricum* (L.) DC., *N. commune*, *T. mongolicum* Hand.-Mazz., *A. schoenoprasum*, *R. pseudoacacia*, *U. pumila* L., *T. sinensis* (A. Juss.) Roem. var. *sinensis*, etc.; The significantly more species reported by people over 65 years old than those reported by people of other age groups are mainly dermatophytes and spermatophytes, such as *U. pumila* L., *C. album* Linn. These plants were only eaten in the famine years. With the abundant material information and the fact that our people are no longer short of food, these plants are rarely eaten by people.

The edible wild plant species is also directly related to the growth environment of the reporter. The edible wild plant species of the reporter from rural areas are significantly higher than those of the reporter from urban areas. Taking the reporter at the age of 30–35 as an example, among them, 37 wild plants have been eaten by all the reporters from rural areas, while only 14 wild plants have been eaten by all the reporters from urban areas. These 14 plants are also mainly wild vegetables. Such as *S. arvensis* L., *N. commune*, *T. mongolicum* Hand.-Mazz., *A. schoenoprasum*, *T. sinensis* (A. Juss.) Roem. var. *sinensis*, and so on. These are also the current urban food and beverage units often appear in the species, *A. schoenoprasum*, *T. sinensis* (A. Juss.) Roem. var. *sinensis* has been based on artificial cultivation.

Sources of wild edible plants in Hassan Area

A statistical analysis was made on wild edible plants in hassan region. there were 53 species (incomplete statistics) of wild edible plants belonging to 24 families in hassan region. Compositae and Liliaceae performed best among them, with 8 wild edible plants belonging to compositae and 7 wild edible plants belonging to liliaceae, which were mainly eaten as wild vegetables. The 8 wild edible plants belonging to compositae had a relatively wide distribution range and were basically distributed in the investigation area, among which *Mulgedium tataricum* (L.) DC., *Sonchus arvensis* L. and *Taraxacum mongolicum* Hand.-Mazz were the most common wild vegetables in the region. The distribution of edible wild plants of Liliaceae is relatively regional and their plant communities are relatively concentrated. There were four, four and three species of wild edible plants belonging to *Solanaceae*, *Chenopodiaceae* and *Rosaceae*, respectively. Most of the wild edible plants belonging to these three families were snacks.

Edible parts of wild edible plants in Hassan Area

Among the 53 wild edible plants, the tender stems and leaves (including tender buds) were the most widely used parts, with 17 species, followed by the fruits (including tender fruits) with 16 species. In addition, the edible parts included root or rhizome (bulb), seed and whole plant (Tab.1). There were two types of raw food and cooked food, raw food was mainly used as snacks, mainly fruit; The cooked food is mainly vegetables, and some wild edible plants have multiple edible parts or multiple eating methods (Fig.3). In addition, there are people who are mainly used as flavoring and medicated diet, such as *Thymus quinquecostatus* Celak, *C. deserticola* Ma, *C. songaricum* Rupr. The edible parts of herbs were mostly young stems and leaves, which were mainly eaten as wild vegetables, while tall woody plants mainly provided fresh and tender fruits or mature fruit seeds, which were mainly eaten as snacks. The wild edible plants whose edible parts were tender stems and leaves and tender buds were generally eaten as vegetables after being mixed with cold or pickled, and the fruits, roots and rhizomes were mainly eaten as snacks and fresh. The seeds and skins are mainly eaten for emergency in the famine years as supplementary food. In the present age with abundant materials, the seeds are rarely eaten by people, such as the seeds of *Corispermum* L. and *C. album* Linn.

Quantitative evaluation of edible wild plants in Hassan Area

The results of CFSI comparison of wild edible plants in Mount Hassan are shown in Tab.2 and Fig.4. The edible wild plants in the region were clustered based on the plant cultural importance index (CFSI) to screen out the wild edible plants which were widely used in the region, with high value and played an important role in the traditional diet of local people. The plants with the first important sequence (CFSI>500) are *M. tataricum* (L.) DC., *N. commune*, *S. arvensis* L., *T. mongolicum* Hand.-Mazz., *A. schoenoprasum*, *R. pseudoacacia*, *H. citrina* Baroni, *E. angustifolia* Linn., *M. sativa* L., *U. pumila* L., *S. sieboldii* Miq. var. *sieboldii*, *T. sinensis* (A. Juss.) Roem. var. *sinensis*, mainly wild vegetables. The first series of wild edible plants play an important role in the life of the local people. *Sonchus oleraceus* (L.) Gaertn, *Sonchus oleraceus* (L.) Gaertn., *Allium mongolicum* Regel., *Medicago sativa* L. and *Deda* (L.) Gaertn. have been the good dishes for the local people since ancient times. In the era when the greenhouse was not widely used, *Sonchus oleraceus* L., *Allium mongolicum* Regel and *Medicago sativa* L. are the main vegetables for the local people in spring. At present, these vegetables are also the most representative wild vegetable varieties for the catering organizations in the region. The plants with the second important sequence (500>CFSI≥100) included, mainly wild vegetables and snack plants, and this part of wild plants also had good edible development value, such as *Z. jujuba* Mill. var. *spinosa* (Bunge) Hu ex H. F. Chow, *H. rhamnoides* L., and the reason for the low CFSI value was mainly related to its narrow distribution range and edible parts. The most plants in the third important sequence (100>CFSI≥10) were mainly snacks, and some of them had high medicinal value, such as *C. songaricum* Rupr., *I. indigotica* Fortune, *C. deserticola* Ma. The plants of the Fourth Important Sequence (10>CFSI) were mainly distributed in some special areas or with poor taste, which were mostly collected and eaten in the famine years. The providers of information were mainly the elderly. At present, they were rarely eaten by people, such as *C.L.*, *P. davidiana*.

Discussion

The results showed that people's recognition of edible wild plants in this area gradually decreased with the passage of time (calculated based on the age of the reporter). This result was basically consistent with the historical process of the gradual transformation of materials from "scarcity-sufficiency-abundance" in the social and economic development of China. The wild edible healthy plant is not only used as a supplement of daily food in a material shortage year, but also used as a life-saving food and a life-saving medicine in many times. Nowadays, the wild edible plants have become a kind of wild interest and living swap [24, 28, 29]. At present, the sustainable development and utilization of wild edible plant resources in this area are still in the primary stage. Except for a few varieties, the potential of other wild edible plant resources has not yet been found, and the protection and artificial domestication and cultivation of this wild edible plant resource are still blank. At the same time, there is a lack of research on the nutritional value and safety performance of these traditional edible wild plants, and these gaps are the shackles for the development and application of rich and huge potential wild edible plant resources [30–32], which need to be explored and studied by scientific researchers.

At the same time, with the rapid economic development, by the return to nature, green food and other ideological trend, the wild edible plant resources gradually become the object of people. Many consumers have a "curiosity-seeking" mentality towards wild edible plants [33], and consider eating pure natural wild plants as a fashionable behavior. Under the influence of these mentality and behaviors, the demand for wild edible plant resources has greatly increased. However, this area belongs to the arid area of the Loess Plateau, and the ecological environment is extremely fragile. The collection of a large number of wild edible plants will inevitably lead to the destruction of the ecological environment. Thus impairing the unique value of wild edible plant resources in ecology, resource science, genetic breeding science, nutrition and other disciplines [34], which is very unfavorable for the scientific development and utilization of wild edible plants. Therefore, high attention should be paid to the basic research of wild edible plant resources to lay a foundation for their sustainable development and utilization.

The wild edible plant resources are not only the characteristic delicacies on the dining table of people and the good health care medicine, but also a regional strategic resource. Especially, the wild edible plant resources in the poverty alleviation strategy have great characteristics. The good use of this strategic resource will play a great role in promoting the poverty alleviation. These resources can not only be processed into a variety of delicious food, most of the resources also have health care, ecological protection, ornamental value, its market prospect and mining potential is very huge. Moreover, there are many successful precedents for reference both at home and abroad. In summary, the wild edible plant resources have a broad market prospect and great development value. However, the basic research on wild edible plant resources is mostly blank, and the research and development space is very huge.

Declarations

Acknowledgements

We are very grateful to the local people in Hassan area, who provided valuable information about wild edible plants and hospitality.

Authors' contributions

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

Funding

The study was funded by the National Natural Science Foundation of China (81760679) , Young Talents Growth Project of the Education Department of Guizhou Province (Qianjiaohe KY Zi [2017] 196), Science and Technology planning project of Guizhou Province (Guizhou Science and Technology Foundation [2019] No.1332) , Doctor foundation of Zunyi Medical University (F-941), Science and Technology Fund of Guizhou Provincial Health Commission (gzwkj2021-539), Innovation and Entrepreneurship Training program for Students of Zunyi Medical University (ZYDC2022040).

Availability of data and materials

All data, materials, and information are collected from the study sites.

Ethics approval and consent to participate

The authors asked for permission from the local authorities and the people interviewed to carry out the study.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

¹ School of Pharmacy, Zunyi Medical University, Zunyi 563000, China. ² School of Preclinical Medicine, Zunyi Medical University, Zunyi 563000, China. ³ Jingyuan County Water Affairs Bureau, Baiyin 730900, China.

References

1. Breeding MJAUoBBL. Wild edible plants : promoting dietary diversity in poor communities of Lebanon; final technical report. 2006. <http://dx.doi.org/http://hdl.handle.net/10625/38050>
2. Pinela J, Carvalho AM, Food IFJ, Toxicology C. Wild edible plants: Nutritional and toxicological characteristics, retrieval strategies and importance for today's society. 2017;110:165-88. <http://dx.doi.org/10.1016/j.fct.2017.10.020>
3. Peduruhewa PS, Jayathunge K, Liyanage RJJofS. Potential of Underutilized Wild Edible Plants as the Food for the Future – A Review. 2021;9(4):136-47. <http://dx.doi.org/10.12691/jfs-9-4-1>
4. Hlberg MKJFF. A profound explanation of why eating green (wild) edible plants promote health and longevity. 2021. <http://dx.doi.org/10.1002/fft2.106>
5. Dop MC, Kefi F, Karous O, Verger EO, Nutrition CTJPH. Identification and frequency of consumption of wild edible plants over a year in central Tunisia: a mixed-methods approach. 2019;23(5):1-13. <http://dx.doi.org/Identification>
6. Cheng Z, Lu X, Lin F, Naeem A, Long CJJoE, Ethnomedicine. Ethnobotanical study on wild edible plants used by Dulong people in northwestern Yunnan, China. 2022. <http://dx.doi.org/10.1186/s13002-022-00501-3>
7. Cao Y, Li R, Zhou S, Song L, Quan R, Hu HJBC. Ethnobotanical study on wild edible plants used by three trans-boundary ethnic groups in Jiangcheng County, Pu'er, Southwest China. 2020(1). <http://dx.doi.org/10.21203/rs.3.rs-40805/v1>
8. Nanagulyan S, Zakaryan N, Kartashyan N, Piwowarczyk R, Ethnobiology UUJJo, Ethnomedicine. Wild plants and fungi sold in the markets of Yerevan (Armenia). 2020;16. <http://dx.doi.org/10.1186/s13002-020-00375-3>
9. Pereira AG, Fraga-Corral M, García-Oliveira P, Jimenez-Lopez C, Loureno-Lopes C, Carpena M, et al. Culinary and nutritional value of edible wild plants from northern Spain rich in phenolic compounds with potential health benefits. 2020;11. <http://dx.doi.org/10.1039/D0FO002147D>
10. Uczaj U, Lamxay V, Tongchan K, Xayphakatsa K, Karbarz MJJoE, Ethnomedicine. Wild food plants and fungi sold in the markets of Luang Prabang, Lao PDR. 2021;17(1). <http://dx.doi.org/Wild food plants and fungi sold in the markets of Luang Prabang, Lao PDR>
11. Khasbagan, Yeruhan, Zhao HJPD, Resources. Study on Traditional Knowledge of Wild Edible Plants Used by the Mongolians in Xilingol Typical Steppe Area. 2011. <http://dx.doi.org/10.3724/SP.J.1011.2011.00093>
12. Ding X, Zhang Y, Wang L, Zhuang H, Wang Y. Being Blessed by Qomolangma: The Diversity and Local Knowledge of Wild Edible Plants Used by Chenthang Sherpa People to Treat Seasonal Food Shortage. 2021. <http://dx.doi.org/10.21203/rs.3.rs-211888/v1>
13. Luo BS, Liu B, Zhang H, Zhang H, Long CJJoE, Ethnomedicine. Wild edible plants collected by Hani from terraced rice paddy agroecosystem in Honghe Prefecture, Yunnan, China. 2019;15(1). <http://dx.doi.org/10.1186/s13002-019-0336-x>
14. Yang J, Chen WY, Fu Y, Yang T, Luo XD, Wang YH, et al. Medicinal and edible plants used by the Lhoba people in Medog County, Tibet, China. (1872-7573 (Electronic)). <http://dx.doi.org/10.1016/j.jep.2019.112430>

15. Lwab C, Swa B, Mza B, Lda B, Yxa BJAR. An hourly-scale assessment of sub-cloud evaporation effect on precipitation isotopes in a rainshadow oasis of northwest China. 2022. <http://dx.doi.org/https://doi.org/10.1016/j.atmosres.2022.106202>
16. Nan ZRJJoALR, Environment. The Main Eco-environmental Problems and Analysis on the Cause of Their Formation in Baiyin Region, Gansu province, Northwest of China. 2004. CNKI:SUN:GHZH.0.2004-S2-000
17. He ZX, Zou K, Zhang Y. [Evaluation and Countermeasures of Ecotourism Scenic Resources in Hasi Mountain Forest Park in Gansu Province]. China Forestry Economy. 2020(6):4. <http://dx.doi.org/10.13691/j.cnki.cn23-1539/f.2020.06.022>
18. Zhao JH. [Problems and countermeasures of crop seed market in Pingchuan District of Baiyin City]. Seed Science and Technology. 2021;39(15):28-29. <http://dx.doi.org/10.19904/j.cnki.cn14-1160/s.2021.15.013>
19. Li ZM, Niu YB. [Practice and Suggestion of Crop Germplasm Resources Survey and Collection in Jingyuan County]. Gansu Agriculture Science and Technology. 2022;53(3):4.
20. Ma XT. [Analysis on statistical method of farmland irrigation water consumption in Jingtai County]. Science and technology of Sichuan agriculture. 2021(10):2.
21. Luo GL. [Present situation, existing problems and countermeasures of high-quality development of agricultural industry in Jingyuan County]. Information of Agricultural Science and Technology. 2020(8):2. <http://dx.doi.org/CNKI:SUN:NYKJ.0.2020-08-027>
22. Li XF. [Current situation and development countermeasures of agricultural Industrialization in Jingyuan County]. Information of Agricultural Science and Technology. 2016(25):2. <http://dx.doi.org/CNKI:SUN:NYKJ.0.2016-25-001>
23. Wang ZG. [Jingtai county annals compilation Committee]. Lanzhou: Lanzhou university press. 1996.
24. Unknown. [Pingchuan district, Baiyin city vigorously develops circular economy to promote energy conservation and emission reduction]. Gansu Energy. 2012(4):1.
25. Jun Z. [The ancient ferry of the Yellow River and the Silk Road under the Hasi Mountain]. Silk Road. 2016(13):6. <http://dx.doi.org/10.3969/j.issn.1005-3115.2016.13.006>
26. Pei SJ, Long CL. [Applied ethnobotany]. Kunming: Yunnan Nationalities Publishing House. 2007.
27. Ding XY, Zhang Y, Wang L, Zhuang HF, Chen WY, Wang YA-OX. Collection calendar: the diversity and local knowledge of wild edible plants used by Chenthang Sherpa people to treat seasonal food shortages in Tibet, China. (1746-4269). <http://dx.doi.org/10.1186/s13002-021-00464-x>
28. Marrelli M, Statti G, Conforti FJM. A Review of Biologically Active Natural Products from Mediterranean Wild Edible Plants: Benefits in the Treatment of Obesity and Its Related Disorders. 2020;25(3):649. <http://dx.doi.org/10.3390/molecules25030649>
29. b VR-Ga, C MB, C AM, D AN, E CMB, b PD, et al. From famine foods to delicatessen: Interpreting trends in the use of wild edible plants through cultural ecosystem services - ScienceDirect. 2015;120:303-11. <http://dx.doi.org/10.1016/j.ecolecon.2015.11.003>
30. Su YL. [Investigation and Evaluation of Wild Edible Plant Resources in the Gogostai Hanwula National Nature Reserve in Inner Mongolia]. Inner Mongolia Normal University. 2014.
31. Cornara L, Smeriglio A, Frigerio J, Labra M, Di GE, Denaro M, et al. The problem of misidentification between edible and poisonous wild plants: Reports from the Mediterranean area. 2018:S0278691518302874-. <http://dx.doi.org/10.1016/j.fct.2018.04.066>
32. Ju Y. [Ethnobotanical survey of wild edible plants used by Tibetans in northwest Yunnan, China]. Minzu University of China. 2013.
33. Ceccanti C, Landi M, Benvenuti S, Pardossi A, Guidi LJM. Mediterranean Wild Edible Plants: Weeds or "New Functional Crops"? 2018;23(9). <http://dx.doi.org/10.3390/molecules23092299>
34. Xu LZ, Liao FL, Lai WN. [Scientific value of research and development of wild vegetables]. Chinese agricultural science bulletin. 2005;21(7):98. <http://dx.doi.org/10.3969/j.issn.1000-6850.2005.07.030>

Tables

Table 1 Catalogue of wild edible plants in mixed area of Hui and Han in Northwest China

Families and genera	Plant name	Local common name	Plant type	Edible part	Food category	Edible method	Health benefit
Compositae	<i>Mulgedium tataricum</i> (L.) DC.	Makucai	Perennial herb	Tender leaf / rhizome	Vegetables, medicinal materials	Cold and dressed with sauce /Pickle	Clearing and strengthening
	<i>Sonchus arvensis</i> L.	Tiankucai	Perennial herb	Tender leaf / rhizome	Vegetables	Cold and dressed with sauce /Pickle	Clearing and strengthening
	<i>Taraxacum mongolicum</i> Hand.-Mazz.	Huanghuangcai/ Huangercai	Perennial herb	Tender stem and leaf/Roots	Vegetables/snacks/medicinal materials	Fresh/Cold and dressed with sauce /Pickle	Clearing and strengthening
	<i>Cirsium souliei</i>		Perennial herb	Root	Snack	Fresh food	Hemostatic, antiphlogistic and swelling
	<i>Cichorium intybus</i> L.	Xiaokucai	Perennial herb	Tender leaf / rhizome	Vegetables	Fresh/cold/pickled	Clear heat, sterilization, promote urination, relieving swelling
	<i>Tragopogon pratensis</i> L.	Yangnaizi	Perennial herb	Bud	Snack	Fresh food	Nourish
	<i>Artemisia annua</i>	Artemisia annua	Annual herb	Bud	Vegetables		Clear heat, relieving summer intercalary malaria, cooling
	<i>Artemisia lavandulaefolia</i> DC.	Chinese mugwort	Perennial herb	Bud	Auxiliary food	Steam cooked food with mixed flour (moxa bun)	Regulate meridian, tranquilizing, removing dampness, relieving swelling, stop bleeding
Rosaceae	<i>Rosa omeiensis</i>	Youpingping	Large shrub	Ripe fruit	Snack	Fresh food after fresh frost	Quench and stop bleeding
	<i>Fragaria vesca</i> L.	Berries	Perennial herb	Ripe fruit	Snack	Fresh food	Clearing and detoxification
	<i>Armeniaca vulgaris</i> Lam. var. <i>ansu</i> (Maxim.) Yü et Lu	Wild apricots	Arbor	Ripe fruit	Snack	Fresh food	Relieving and moistening intestine
Liliaceae	<i>Allium schoenoprasum</i>	Shallot	Perennial herb	Tender leaf	Vegetables	Cold and dressed with sauce /Steamed buns	Dissipation and relief of exterior syndrome
	<i>Allium strictum</i>	Little garlic	Perennial herb	Bulb	Snacks/vegetables	Fresh food	Sterilization, digestive
	<i>Allium przewalskianum</i>	Spider lily	Perennial herb	Bulb	Snacks/vegetables	Fresh food	Sterilization, digestive
	<i>Allium mongolicum</i>	Flat leek	Perennial herb	Tender leaf	Vegetables	Cold and dressed with sauce /Pickle	Sterilization, stimulate appetite
	<i>Allium bidentatum</i>	Wild leek	Perennial herb	Tender leaf	Vegetables	Cold and dressed with sauce /Pickle	Destroy
	<i>Lilium pumilum</i>	Shan dan dan	Perennial herb	Bulb/Flower	Vegetables	Bulb salad/flower soup	Promote circulation, moisten, tranquil mind
	<i>Hemerocallis citrina</i> Baroni	Day lily	Perennial herb	Bud	Vegetables	Cold and dressed with sauce /Soup	Invigorate stomach, promote lactation, tonifying
Leguminosae	<i>Medicago sativa</i> L.	Alfalfa sprouts	Perennial herb	Bud	Vegetables	Cold and dressed with sauce	Hemostatic, diuresis, detoxification

	<i>Robinia pseudoacacia</i>	Huaihua	Arbor	Bud/flower	Snack	Fresh/cooked food	Stop bleeding
Solanaceae	<i>Lycium chinense</i> Mill. var. chinense	Chinese wolfberry	Large shrub	Fruit	Snack	Fresh/ Dried tea/ Soup (herbal)	Antipyretic, nourish and moisten lung
	<i>Lycium ruthenicum</i> Murr.	Black wolfberry	Small shrub	Fruit	Snack	Fresh/ Dried tea/ Soup	Lower blood pressure, nourish and regulate menstruation
	<i>Solanum septemlobum</i> Bunge	Wild tomato	Annual herb	Fruit	Snack	Fresh food	Clear away heat and swelling
	<i>Solanum tuberosum</i> L.	Suanqiuzi	Annual herb	Fruit	Snack	Fresh food after frost	Detoxify, detumescence, laxative
Cruciferae	<i>Lepidium apetalum</i>	Chilli	Annual herb	Tender root	Snack	Fresh food	Diuresis, phlegm
	<i>Isatis indigotica</i> Fortune	Folium Isatidis	Annual herb	Tender leaf	Vegetables	Cold and dressed with sauce	Clear heat, detoxify, cool blood
	<i>Brassica campestris</i>	Winter rape	Annual herb	Tender stem and leaf/Seeds	Vegetable/oil	Cold and dressed with sauce/Fried food/Oil from its seeds	Detumescence and disperse blood
Chenopodiaceae	<i>Chenopodium album</i> Linn	Huitiao	Annual herb	Bud/Seed	Vegetables, supplementary foods	Steamed buns with tender bud/ Cold and dressed with sauce/Making steamed bread with seed powder	Antihypertensive, analgesic, diuretic
	<i>Kochia scoparia</i> (L.) Schrad.	Qiansaozhou	Annual herb	Bud	Vegetables	Cold and dressed with sauce	Facilitate clearing
	藜 <i>Corispermum</i> L.	Mianpeng	Annual herb	Ripe seed	Auxiliary food	Making steamed bread with seed powder	Facilitate sterilization
	<i>Halogeton glomeratus</i> (Bieb.) C. A. Mey.	Shuipeng	Annual herb	Whole grass	Condiment	Burn into ash to make edible alkali	Relieve itching and damage
Elaeagnaceae	<i>Hippophae rhamnoides</i> L.	Seabuckthorn seed	Large shrub	Fruit/Leaf	Snacks/tea	Fresh fruit/Leaf tea	Relieve itching, promote circulation, eliminate phlegm
	<i>Elaeagnus angustifolia</i> Linn.	Narrow-leaved oleaster	Arbor	Ripe fruit	Snack	Fresh after removing astringency after frost	Cool blood, relieve diarrhea, clear heat
Berberidaceae	<i>Berberis diaphana</i> Maxim.	Suansuan/ Suanliuliu	Small shrub	Ripe fruit/ Tender leaf	Snack	Fresh food	Clearing and detoxifying
Asclepiadaceae	<i>Cynanchum thesioides</i> (Freyn) K. Schum. var. thesioides	Haoguo/ Haogua	Perennial herb	Tender fruit	Snack	Fresh food	Promote lactation
	<i>Cynanchum chinense</i> R.Br.	Yangnaijiao	Perennial herb	Fruit	Snack	Fresh food	Detoxify, relieve itching
Geraniaceae	<i>Geranium wilfordii</i> Maxim.	Luo tangmiao	Annual herb	Tender root	Snack	Fresh food	Promote circulation, relieve itching, and steady
Iridaceae	<i>Iris tenuifolia</i>	Suogua	Perennial herb	Tender fruit	Snack	Fresh food	Clear heat, detoxify, stop bleeding
Labiatae	<i>Thymus quinquecostatus</i> Celak.	Pepper/thyme	Perennial herb	Aboveground part	Condiment	After drying and crushing, mix it into the fried flour	Dispel stasis, relieve pain, inflammation

	<i>Stachys sieboldii</i> Miq. var. sieboldii	Sweet potato/ Screw vegetable	Annual herb	Root tuber	Vegetables	Cold and dressed with sauce /Pickle	Clearing and det
Ulmaceae	<i>Ulmus pumila</i> L.	Yuqian	Arbor	Fruit/Skin	Snacks/Supplements	Fresh /Steamed food	Detume diuresis constip
Salicaceae	<i>Populus davidiana</i>	White poplar	Arbor	Tender bud/Skin	Vegetables	Cold and dressed with sauce /cooking	Dispel v removir stasis a elimina phlegm
Orobanchaceae	<i>Cistanche deserticola</i> Ma	Desert-living cistanche	Annual herb	Complete stool	Health foods	Medicated diet	Tonifyir replenis essence moister intestin
Cynomoriaceae	<i>Cynomorium songaricum</i> Rupr.	Chinese cynomorium	Annual herb	Complete stool	Health foods	Medicated diet	Tonifyir moister dryness replenis essence
Meliaceae	<i>Toona sinensis</i> (A. Juss.) Roem. var. sinensis	Chinese toon	Arbor	Bud	Vegetables	Cold and dressed with sauce	Tonifyir deficier diminis inflamn and sto bleedin
Umbelliferae	<i>Daucus carota</i> L.	Wild carrot	Annual herb	Root	Snack	Cooked for consumption	Detume and elir phlegm
Rhamnaceae	<i>Ziziphus jujuba</i> Mill. var. spinosa (Bunge) Hu ex H. F. Chow	Wild jujube	Large shrub	Fruit	Snack	Fresh/Sun-dried food	Tonifyir promot product astringi sweatin
Polygonaceae	<i>Rheum nanum</i> Siev. ex Pall.	Huanggouluanzi	Perennial herb	Root	Snack	Roasted cooked food (similar to potatoes and sweet potatoes)	Clear h invigora stomac relieve
Gramineae	<i>Avena fatua</i> L.	Oat	Annual herb	Seed	Auxiliary food	To make fried flour /fermented glutinous rice	Tonifyir deficier astringi sweatin stoppin bleedin
	<i>Panicum miliaceum</i> L.	Huosui	Annual herb	Ears of tender diseased plants	Snack	Fresh food	Relievir and rep qi
Zygophyllaceae	<i>Zygophyllum fabago</i> L.	Miandandan	Small shrub	Fruit	Snack	Fresh food	Antihyp spasme hypogly
Nostocales	<i>Nostoc commune</i>	Diruanzi/ Dedacai	Fungus	Complete stool	Auxiliary food	Steamed stuffed bun	Clear h invigora
	<i>Nostoc flagelliforme</i>	Toufacai	Fungus	Complete stool	Auxiliary food	Omelette	Enrich t lowerin pressur promot urinat

Note: fried noodles is a kind of food (dry food) made in the north by parching and grinding grains such as wheat and oats into flour.

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

Plant name	FQI	AI	FUI	PUI	MFFI	TSAI	FMRI	CFSI
<i>Mulgedium tataricum</i> (L.) DC.	165	4.0	4.0	3.00	1.50	7.5	5.0	4455.00
<i>Sonchus arvensis</i> L.	158	4.0	4.0	3.00	1.50	7.5	5.0	4266.00
<i>Taraxacum mongolicum</i> Hand.-Mazz.	162	4.0	3.0	3.00	1.50	7.5	5.0	3280.50
<i>Cirsium souliei</i>	24	3.0	1.0	2.00	1.50	6.5	4.0	56.16
<i>Cichorium intybus</i> L.	18	2.0	1.0	2.00	1.50	7.5	4.0	32.40
<i>Tragopogon pratensis</i> L.	11	2.0	1.0	2.00	0.50	6.5	5.0	7.15
<i>Artemisia annua</i>	34	4.0	1.0	2.00	1.00	5.5	5.0	74.80
<i>Artemisia lavandulaefolia</i> DC.	28	4.0	1.0	2.00	1.00	5.5	5.0	61.60
<i>Rosa omeiensis</i>	36	1.0	1.0	1.50	0.50	9.0	2.0	4.86
<i>Fragaria vesca</i> L.	35	1.0	2.0	1.50	0.50	9.0	2.0	9.45
<i>Armeniaca vulgaris</i> Lam. var. <i>ansu</i> (Maxim.) Yü et Lu	52	1.0	1.0	1.50	0.50	7.5	4.0	11.70
<i>Allium schoenoprasum</i>	137	3.0	4.0	3.00	1.50	9.0	3.0	1997.46
<i>Allium strictum</i>	111	2.0	1.0	3.00	1.50	9.0	3.0	269.73
<i>Allium przewalskianum</i>	76	2.0	1.0	3.00	1.50	9.0	3.0	184.68
<i>Allium mongolicum</i>	58	2.0	1.0	3.00	1.50	9.0	3.0	140.94
<i>Allium bidentatum</i>	34	2.0	1.0	3.00	1.50	9.0	3.0	82.62
<i>Lilium pumilum</i>	63	2.0	1.0	3.00	1.50	9.0	5.0	255.15
<i>Hemerocallis citrina</i> Baroni	137	3.0	3.0	1.50	1.50	9.0	4.0	998.73
<i>Medicago sativa</i> L.	121	4.0	4.0	0.75	1.50	9.0	3.0	588.06
<i>Robinia pseudoacacia</i>	89	5.0	3.0	1.50	1.00	10.0	5.0	1001.25
<i>Lycium chinense</i> Mill. var. <i>chinense</i>	45	5.0	4.0	1.50	0.50	10.0	5.0	337.50
<i>Lycium ruthenicum</i> Murr.	63	2.0	2.0	1.50	0.50	10.0	5.0	94.50
<i>Solanum septemlobum</i> Bunge	38	1.0	1.0	1.50	0.50	9.0	2.0	5.13
<i>Solanum tuberosum</i> L.	22	4.0	1.0	1.50	0.50	6.5	1.0	4.29
<i>Lepidium apetalum</i>	86	5.0	2.0	1.00	0.50	6.5	2.0	55.90
<i>Isatis indigotica</i> Fortune	31	1.0	2.0	1.00	1.50	7.5	5.0	34.88
<i>Brassica campestris</i>	42	2.0	2.0	3.00	1.50	7.5	3.0	170.10
<i>Chenopodium album</i> Linn	27	5.0	1.0	2.50	1.50	5.5	2.0	55.69
<i>Kochia scoparia</i> (L.) Schrad.	29	4.0	1.0	2.50	1.50	5.5	5.0	119.63
<i>Corispermum</i> L.	11	4.0	0.5	1.50	1.00	5.5	1.0	1.82
<i>Halogeton glomeratus</i> (Bieb.) C. A. Mey.	45	5.0	1.0	3.00	0.75	6.5	1.0	32.91
<i>Hippophae rhamnoides</i> L.	62	4.0	2.0	1.50	0.50	7.5	5.0	139.50
<i>Elaeagnus angustifolia</i> Linn.	136	5.0	5.0	1.50	0.50	9.0	3.0	688.50
<i>Berberis diaphana</i> Maxim.	58	2.0	1.0	1.50	0.50	9.0	4.0	31.32
<i>Cynanchum thesioides</i> (Freyn) K. Schum. var. <i>thesioides</i>	72	3.0	2.0	1.50	0.50	10.0	3.0	97.20
<i>Cynanchum chinense</i> R.Br.	44	3.0	1.0	1.50	0.50	7.5	2.0	14.85
<i>Geranium wilfordii</i> Maxim.	56	4.0	2.0	1.00	0.50	7.5	5.0	84.00
<i>Iris tenuifolia</i>	54	3.0	1.0	1.50	0.50	9.0	2.0	21.87
<i>Thymus quinquecostatus</i> Celak.	66	2.0	1.0	3.00	0.75	9.0	5.0	133.65
<i>Stachys sieboldii</i> Miq. var. <i>sieboldii</i>	78	4.0	3.0	1.00	1.50	9.0	4.0	505.44
<i>Ulmus pumila</i> L.	129	5.0	2.0	1.50	1.00	9.0	3.0	522.45
<i>Populus davidiana</i>	32	5.0	0.5	0.75	1.50	5.5	2.0	9.90
<i>Cistanche deserticola</i> Ma	29	1.0	1.0	4.00	0.75	7.5	5.0	32.63

<i>Cynomorium songaricum</i> Rupr.	36	1.0	1.0	4.00	0.75	7.5	5.0	40.50
<i>Toona sinensis</i> (A. Juss.) Roem. var. <i>sinensis</i>	121	4.0	4.0	0.75	1.50	9.0	3.0	588.06
<i>Daucus carota</i> L.	25	2.0	0.5	1.00	1.00	6.5	2.0	3.25
<i>Ziziphus jujuba</i> Mill. var. <i>spinosa</i> (Bunge) Hu ex H. F. Chow	78	2.0	3.0	1.50	0.50	9.0	5.0	157.95
<i>Rheum nanum</i> Siev. ex Pall.	21	1.0	1.0	3.00	1.00	7.5	2.0	9.45
<i>Avena fatua</i> L.	17	4.0	0.5	1.50	1.00	6.5	2.0	6.63
<i>Panicum miliaceum</i> L.	46	3.0	0.5	1.50	0.50	7.5	2.0	7.76
<i>Zygophyllum fabago</i> L.	32	1.0	1.0	1.50	0.50	7.5	1.0	1.80
<i>Nostoc commune</i>	162	5.0	4.0	4.00	1.50	9.0	4.0	6998.40
<i>Bangia atropurpurea</i> (Roth) C. Agardh	37	2.0	1.0	4.00	1.50	9.0	5.0	199.80

Figures

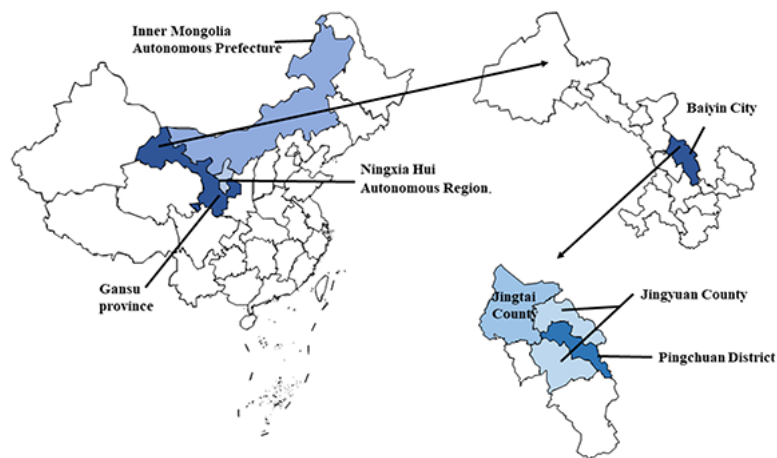


Figure 1

Survey area

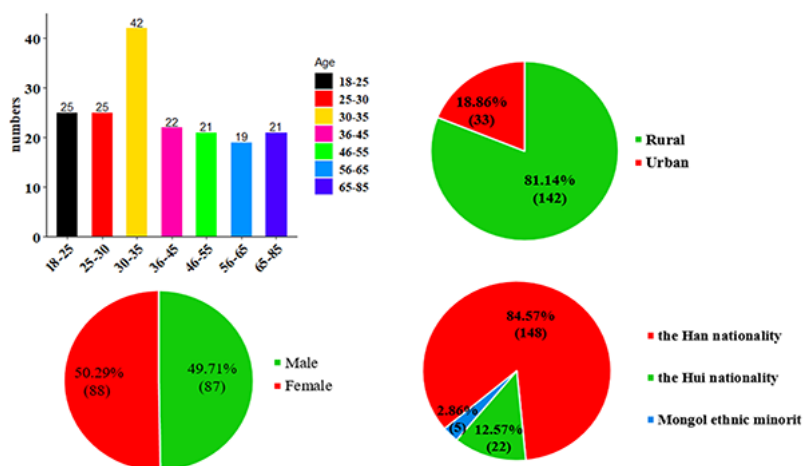


Figure 2

Basic Information of Information Reporters



Figure 3

Steamed stuffed bun with ground ear and salad shallot



Figure 4

Heatmap of edible wild plants in Hassan area