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Woody vegetable species commonly used by communities in and around the tropical forest of Yunnan province, China

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Abstract

The woody vegetables are important green vegetables in the nutritional value of diet and economic value. In order to utilize and sustainable of the woody vegetable resources, the woody vegetable in Southwestern Yunnan was studied, according to field surveys, interviews, and market surveys. The totals of 35 species of commonly used woody vegetables were investigated in the site study, which belong to 25 families. The Araliaceae and Moraceae family had the highest proportion of woody vegetables with four species, following Leguminosea with three species, and Moringaceae and Juglandaceae had the next large species (2), and other only one species in each family. Most part used is young leaves and tender leaves 12 species, accounting for about 32.%. The fruits had the next commonly use part 8 species, accounting for about 22%, follow by flowers had five species, accounting for about 14%, of the total number.

Keywords: *Woody vegetables; Southwestern Yunnan; Traditional food.*

1. Introduction

In Most cases rural communities depend on wild resources including woody vegetables, herbs, and grasses to meet their food needs during a food crisis. The diversity in wild species offers variety in family meals and contributes to household food security. Numerous publications provide detailed knowledge of wild edible plants in specific locations in Yunnan, China (Zhang, L., *et al.* 2016). All show that the wild plants are essential for many Chinese meals, with different season's different species. In Swaziland, wild plants are still of great importance and contribute a greater share to the annual diet than domesticated crops (Pieroni, A., *et al*. 2005). Various reports also noted that many wild edibles are nutritionally rich (Muthoni, J., & Nyamongo, D. O. 2010) and can supplement nutritional requirements, especially vitamins and

micronutrients. Nutritional analysis of some wild food plants demonstrates that in many cases the nutritional quality of wild plants is comparable and, in some cases, even superior to domesticated varieties (Kabuye, C. H. S. 1997).

The selection of plants for wild edible use is anchored in a theory. The theories include among others the optimal foraging theory, and the theory of non-random plant selection (Ciofalo, A. J., *et al* 2018). The former predicts that foraging organisms will balance the effort it took to search for and consume that food. In so doing, individuals will place a high value on plants that yield more benefit per unit of foraging/processing time; as an abundance of plants with higher value increases, plants with lower value will no longer be used and individuals should have a quantitative threshold to decide when a specific plant should be included or excluded (Gillespie, S., *et al.* 2019). The latter theory asserts that plant selection is not random because species in the same family share some characteristics inherited from common ancestors (evolutionary relatedness) who in turn influence their physiology and ultimately their wild edible vegetable use.

China is a largely agricultural country with a large population, and the Chinese ability to safeguard food security during climate change is a vital issue. Since 2009, millions of people have been forced to live under food shortage by the continuous drought in Southwestern China. The market was the primary source of aid grains, and fears that the market would be unable to provide sufficient food make safeguarding food security in the face of climate change crucial. Traditional adaptive strategies of pre-market indigenous people are a potential source of innovation. In Northwest Yunnan, 173 wild edible plant species belonging to 76 families and 139 genera were recorded used by Naxi People (Zhang, L., *et al*, 2016).

2. Materials and Methods

2.1 Study area

Yunnan province is rich in wild edible resources, where there are about 882 species, and the species of resources account for 40.7% of the world's resources, and 90% of China's resources. So, Yunnan is known as "the kingdom of wild edible" (Rong, H. U. A., & Zhang, W. (2018). A variety of wild plant resources are used daily for food, medicine, fuel, fiber, oil, and resins, and also as materials for handicrafts (Sardeshpande, M., & Shackleton, C. 2019). Yunnan province, which has an area of 394,100 km^2 and a population of 47.368 million, the major ethnic groups are Yi, Bai, Hani, Zhuang, Dai, and Miao. The capital of the province is Kunming, and the located in southwest China. The terrain is largely mountainous, especially in the north and west. A series of high mountain chains spread across the province. There is a distinct canyon region to the west and a plateau region to the east. Yunnan's major rivers flow through the deep valleys between the mountains. The average elevation is 1,980 m; the mountains are highest in the north where they reach more than 5,000 m, and in the south no higher than 3,000 m. The climate is pleasant and fair weather because, of the province's location on south-facing mountain slopes, receiving the influence of both the pacific and Indian oceans, and although the growing period is long the rugged terrain provides little arable land. January average temperatures range from 8 to 17 °C, July averages vary from 21 to 27 °C, and average annual rainfall ranges from 600 to 2,300 millimeters, with over half the rain occurring between June and August. This topographic range combined with tropical moisture sustains extremely high biodiversity and high degrees of endemism, probably the richest botanically in the world's temperate regions. Perhaps 17,000 species of

higher plants, of which an estimated 2,500 are endemic, can be found in the province.

This research was conducted in local communities in southwestern Yunnan, China, reseachers investigated and documented traditional knowledge and edible woody vegetables used by the different ethnic groups people, different prefectures; Qing-menkou and Yong-qing villages in Si Mao prefecture, Pu Wen in Xishuangbanna prefecture, Tu-Jiuba and Tian-Jingpu in Bao Shan prefecture, Yang Bi in Dali prefecture, and Hu Wa village in De hong prefecture, northwestern Yunnan. The study areas are enclosed by high mountains on seven sides, these are located in the middle of the plateau. Less than 15 percent of the land is used for agriculture.

This study findings are based on woody vegetables, fieldwork was carried out during five visits from July to November 2019 in the summer (July, August), and autumn (September, October, and November). The aim objective is to investigate, document, and interpret the species of woody vegetables people consumed. And how they prepare and consume these vegetables. The field investigation was designed to focus on the three questions, above. The study site was randomly selected, belonging to five prefectures were randomly selected to carries out the woody vegetable investigation. The informants were selected from among those still working in farming as their main activity, both males and females were interviewed. Woody vegetables data were collected through semi-structured interviews, key informant interviews, group discussions, questionnaires, and direct observation (Cassino, M. F., *et al* 2019).

2.2 Questionnaire

Questionnaires was used in order to obtain information regarding: a) what edible woody vegetable did the people collect for consumption? b) Which parts that they used as food? And c) how did they prepare this plant for consumption?

During the field survey, the local people's pronunciations, parts used, modes of preparation, and collection time period were recorded. Because local people's pronunciations are different in each region, also the name of some species was pronounced the same as in Mandarin Chinese, we recorded the names in Chinese pinyin and Chinese characters by the translator from the forest office in that location.

2.3 Collection of wild edible samples and plant identification

The data were supplemented by participant observation by one of the authors (Wang Lei) who had frequently visited the area, in 2015-2019, during all seasons of the years. Specimens of all the used plants in traditional consumption were collected from the area and listed by local name were collected during guided field walks and identified with the help of published floras, search through the internet, and other references with common Mandarin Chinese plant names and corresponding scientific names. The nomenclature of all voucher plants follows the *floras of China* (Qin, H., Jin, X., & Guo, K. 2020; Flora of China.2018) . The samples with the help of a Taxonomist were matched with specimens deposited at the Yunnan Forest Research Institute, Kunming, China.

3. Results

3.1 Woody Vegetable Resources in

The natural resources in Yunnan over have their influence on the socio-economic as well as culture and religious network of the community's society. The wild edible of the study area is rich and provides useful species. The study documented 35 woody vegetable species, belonging to 25 families (Tab 1). Araliaceae and Moraceae family had the highest proportion of woody vegetables with four species, following Leguminosea with three species, and Moringaceae and Juglandaceae had the next large species (2), and other only one species in each family.

3.2 Classification of Woody Vegetables

The edible parts of woody vegetables are young leaves-tender leaves, flowers, fruits, shoots, and whole plants. In addition, some species used flowers and fruits; young leaves and fruits; young leaves and flowers. According to different edible parts, woody vegetables are divided into six categories: young leaves, flowers, fruits, seeds, shoots, and whole plants.

Edible young leaves-tender leaves, there are 12 species, nine families: *Acanthopanax senticosus* (Rupr. Maxim.); *Macropanax* Miq; *Crateva unilocalaris* Buch.-Ham.; *Sauropus androgynus* (L.)Merr.; *Ginkgo biloba* L.; *Litsea chinpingensis* Yang et P. H. Huang; *Acascia pennata* (Linn.) Willd.; *Toona sinensis* (A. Juss.) Roem.; *Meliantha longistaminea*; *Syzygium laosense* (Gagnep.) Merr. et Perry; *Lepionurs sylvestris* BI.*; Styrax hemsleyanus* Diels (Figure 2).

Edible fruits, these kinds of woody vegetables in Southwestern Yunnan have eighth species belonging to seven families: *Morus alba* L.; *Ficus carica* Linn.; *Phyllanthus emblica* L.; *Punica granatum* L.; *Ceriscoides howii* Lo; *Pyrus pashia*; and *Solanum torvum* Swartz; and *Zanthoxylum bungeanum* Maxim. (Figure 2).

Edible flowers, this edible part of woody vegetables has five species and five families: *Brassaiopsis palmata* (Roxb.) Kurz.; *Rhododendron decorum* Franch; *Bauhinia acuminata* L.; *Bauhinia variegata* L.; *Trachycarpus fortunei* (Hook.) H. Wendl. (Figure 2).

Edible shoots, this part of woody vegetable we called “shoot”. This shoot is not growing from the ground, but it grows between stem and branch. This paper found one species and family, *Aralia elata* (Miq.) Seem.

The edible whole plant is also found in only one species and family such as *Moringa oleifera.* And also, can be traditional medicine.

In addition, both edible parts: are young leaves and flowers, these edible parts have two species and two families: *Bombax malabaricum*; *Cassia siamea* (Lam.) H.S.; Young leaves and fruits, *Ficus altissima*; *Lycium chinense* Mill; and flowers and fruit have two species and one family, such as *Ficus auriculata* Lour and *Ficus altissima* (Moraceae).

3.3 The quality of woody vegetables resources

Most woody vegetables grow in the mountains, rural areas, in and around villages. Basically, vegetables are natural do not use pesticides and chemical fertilizers and growth regulators other chemicals. Woody vegetables are of high nutritional value and are rich contains protein, fat, carbohydrate, fiber, phosphorus, calcium, and vitamin. Usually, people cooked woody vegetables mixed with meat or other vegetables in different ways; such as stir-fried, boiled, steamed, and make as soup. The taste of fresh green vegetables from nature is a pleasant smell, delicious.

4. Discussion

The traditional knowledge of the woody vegetable use is still in practice among people who inhabited or live very close to forests. The people in research areas are extremely knowledgeable about native tree species, in particular about woody vegetables. Ethnobotanical research is crucial to documenting and assessment of the local use of resources. The 35 species identified in this paper indicate that the knowledge of the wild edible woody as documented by modern science is still insufficient. These results were related to those of Li Xiaojing *et al.* (2011) recorded respectively in the Tianjin, China 41 species. Muhammad Waheed., *et* al. (2020) recorded in Kasur and Punjab, Pakistan 7 species. Previous research on wild edible plants, for example, reported 284

species in Xishuangbanna (Xu You-Kai, *et al*. 2016), and 173 species in Naxi in Baidi Village, Northwest Yunnan Province (Yanfei Geng, *et al. 2016*). For future research, we expect that more woody species used as vegetables by indigenous people will be recorded.

The use of woody vegetables is of great benefit for the local communities, particularly for poor households in upland areas, with limited land resources for intensive cash crop cultivation and lower infrastructure. Existence and small-scale commercial collections do not show obvious destructive effects on most of the woody vegetable resources and on their natural environment. However, collecting woody vegetables from the forest should be considered an important component in the sustainable management of forests. Woody vegetables are rich in proteins, vitamins, and amino acids, they are found to be tastier than cultivated vegetables (You-Kai, X., *et al*. 2002, 2003, 2004).

The potential for habituating woody vegetables is great. For example, some species in this paper such *Toona sinensis* (A. Juss.) Roem., *acascia pennata* (Linn.) Willd., *Sauropus androgynus* (L.) Merr., and *Oroxylum indicum* (L.) Kurz., are suitable for cultivation in the gardens. These woody vegetables can support fresh vegetables in the summer season, this season when many cultivated vegetables do not grow well, so woody forest vegetables can supply the local people. In the future, China can be considered the most important genetic resource for vegetable breeding in other areas.

5. Conclusion

A total of 35 species are recorded from this area are consumed by locals by directly collecting from forests. Species like *Bauhinia acuminata* L., *Aralia elat*a (Miq.), *Ficus auriculata* Lour., *Oroxylum indicum* (L.) Kurz has become so popular that it is routinely collected from the wild and sold in the market. And there are several species very common use and of high value in the market such as *Acanthopanax senticosus* (Rupr. Maxim.), *Acascia pennata* (Linn.) Willd., *Sauropus androgynus* (L.) Merr., Seem., *Toona sinensis* (A. Juss.) Roem. These species some villagers have planted in the home garden. Edible woody vegetable comprises young leaves, 12 species (34.28%), fruits, 8 species (22.85%), flowers, 5 species (14.28%), and other parts. Traditional knowledge is important for harvesting and processing those plants. Edible woody vegetables have used as food and surviving.

6. Conflict of Interest

We are certifying that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Table 1 Woody vegetables species used by local people in Southwestern Yunnan Province, China.

No	Chinese name	*Scientific name*	Family	Parts used
1	刺五加	*Acanthopanax senticosus* (Rupr. Maxim.)	Araliaceae	young & tender leaves
2	火炼菜	*Macropanax* Miq		young & tender leaves
3	苦凉苞	*Brassaiopsis palmata* (Roxb.) Kurz.		Flowers
4	刺龙苞/刺老苞	*Aralia elata* (Miq.) Seem.		shoots
5	海船	*Oroxylum indicum* (L.) Kurz	Bignoniaceae	Flowers, fruits
6	攀枝花	*bombax malabaricum*	Bombacaceae	young leaves and flowers
7	刺椿头/帕棍/树头菜	*Crateva unilocalaris* Buch.-Ham.	Capparaceae	young & tender leaves
8	大白杜鹃	*Rhododendron decorum* Franch	Ericaceae	flowers
9	甜菜/树豆尖	*Sauropus androgynus* (L.)Merr.	Euphorbiaceae	young & tender leaves
10	银杏	*Ginkgo biloba* L.	Ginkgoaceae	leaves
11	胡桃/核桃	*Juglans regia*	Juglandaceae	Flowers &Fruits
12	泡核桃/茶核桃	*Juglans sigillata*		Flowers &Fruits
13	木姜子/金平木姜子	*Litsea chinpingensis* Yang et P. H. Huang	Lauraceae	young & tender leaves
14	白花羊蹄甲	*Bauhinia acuminata* L.	Leguminoceae	flowers
15	白货 /弯叶树	*Bauhinia variegata* L.	Leguminosae	flowers
16	铁刀木	*Cassia siamea* (Lam.) H.S.		young leave and flowers
17	臭菜	*acascia pennata* (Linn.) Willd.		young & tender leaves
18	香椿	*Toona sinensis* (A. Juss.) Roem.	Meliaceae	young & tender leaves
19	辣木	*Moringa oleifera*	Moringaceae	whole plant
20	长蕊甜菜/长蕊木兰	*Melientha longistaminea*		young & tender leaves

21	象耳朵叶/大果榕	*Ficus auriculata* Lour.		young leaves, fruits
22	桑树/家桑	*Morus alba* L.	Moraceae	fruits
23	大叶榕/高山榕	*Ficus altissima*		young leaves, fruits
24	无花果	*Ficus carica* Linn.		fruits
25	老挝蒲桃	*Syzygium laosense* (Gagnep.) Merr. et Perry	Myrtaceae	young & tender leaves
26	鳞尾木	*Lepionurs sylvestris* BI.	Opiliaceae	young & tender leaves
27	余甘子	*Phyllanthus emblica* L.	Phyllanthaceae	fruits
28	石榴	*Punica granatum* L.	Punicaceae	fruits
29	棕苞	*Trachycarpus fortunei* (Hook.) H. Wendl.	Palmae	Flowers
30	花椒	*Zanthoxylum bungeanum* Maxim.	Rutaceae	Seeds
31	酸木瓜	*Ceriscoides howii* Lo	Rubiaceae	fruits
32	海棠梨 / 棠梨刺	*Pyrus pashia*	Rosaceae	fruits
33	枸杞	*Lycium chinense* Mill	Solanaceae	young leaves, fruits
34	水茄	*Solanum torvum* Swartz	Solanaceae	fruits
35	老喔头菜/老鸹铃	*Styrax hemsleyanus* Diels	Styracaceae	young & tender leaves

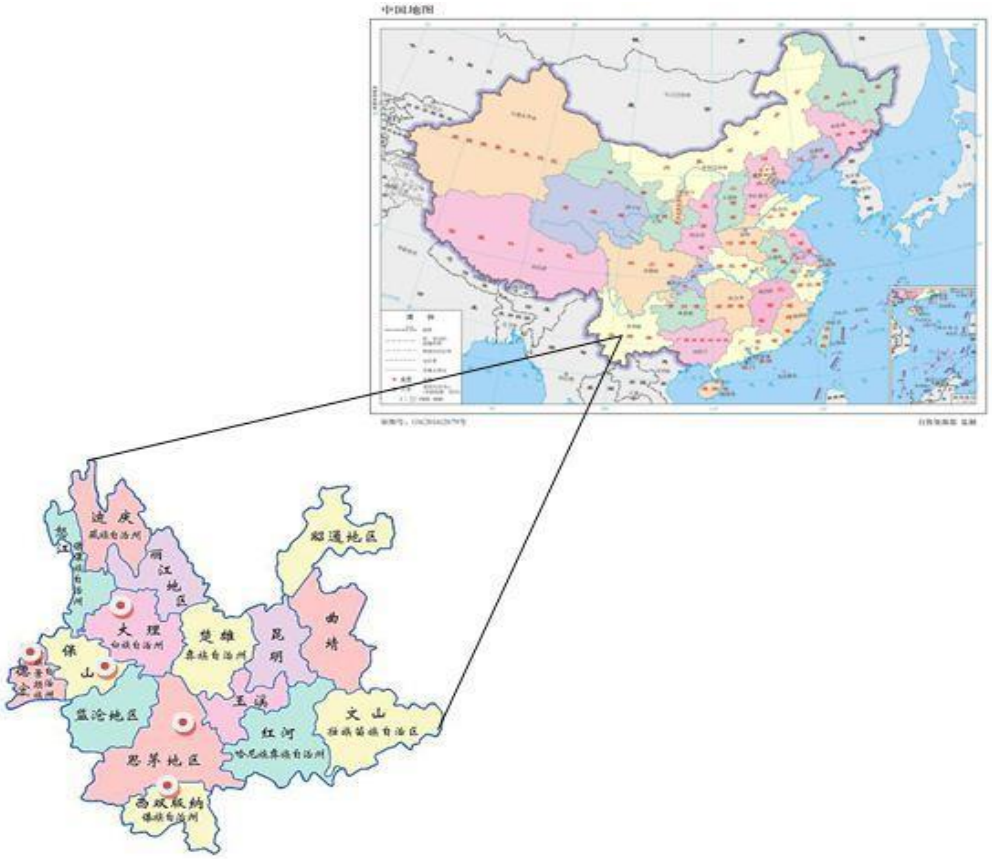

Figure 1. Study area map

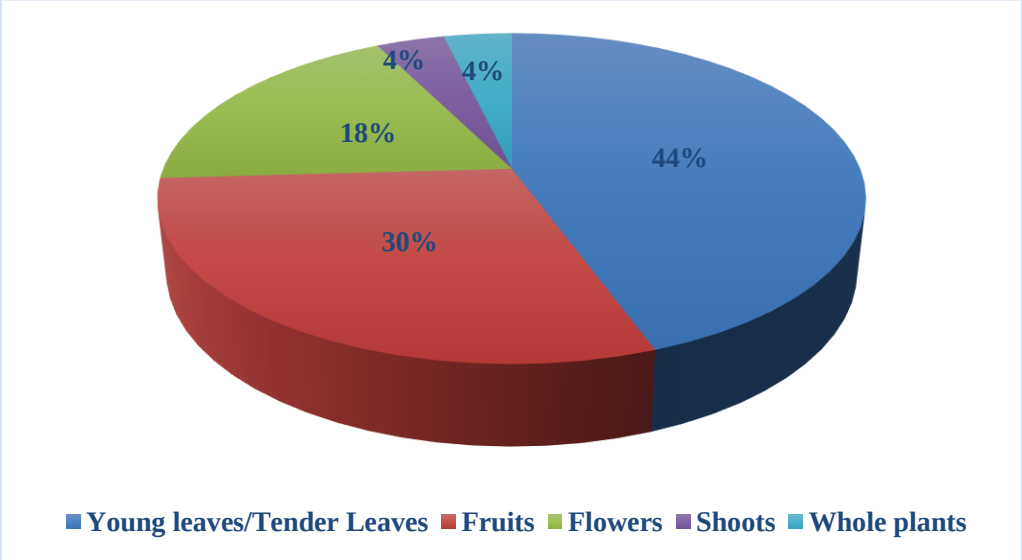

Figure 2. Edible parts of woody vegetable in Southwestern Yunnan,China.