

**TRADITIONAL USAGE OF WILD EDIBLE PLANTS REFLECTING THE  
DIETARY HABITS AND THE AWARENESS OF HEALTH CARE OF LI  
MINORITY IN BAOTING AND LINGSHUI, HAINAN ISLAND, CHINA:  
AN ETHNOBOTANICAL APPROACH**

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**Abstract**

Traditional usage of wild edible plants reflect the dietary habits as they have potential medicinal functions and the awareness of health care of Li Minority in Hainan Island. To facilitate the use and development of wild edible plants in Hainan Island, information was collected four times by semi-structured interviews in 17 traditional markets of Baoting and Lingshui. Twenty six species belonging to 24 genera under 16 families of vascular plants were recognized as wild edible plants. 84.62% of the total species were annual and perennial herbs. Above ground parts were the most frequently used parts. The most common preparation mode was plain-frying. Heat-clearing was the most common medicinal function. Weather, the size of population and plant diversity in local areas have close relationship with the species richness of wild edible plants traded in traditional markets. Geographical difference and time are not critical for the fluctuation of price.

**Introduction**

As the second largest island in China with an area of 34,000 km<sup>2</sup>, Hainan Island is remarkable for its rich biodiversity, which is an important source of edible and medicinal plants specially for native people. Li is the most predominant minority of Hainan and the first settlers of Hainan Island, from Guangdong and Guangxi long before the Qin Dynasty (221 - 206 B.C.) (Wang 2004). Li mostly lived in rainforest which provided rich sources for food, herbs and firewood, etc. However, Li had to struggle with natural disasters and tropical diseases (Davies and Wismer 2007). Consequently, they mainly relied on plants to get calories, cure diseases and keep healthy. Some plants could be used as food and medicine in daily life. Due to a long time of practice, Li developed rich knowledge of using plants as food and medicine (Gan *et al.* 2006, Zheng 2010). Ethnobotanical researches on Li in Hainan Island started in the mid-1990s and mainly focused on species diversity and medicinal usage of plants by Li (Huang 1995, Gan *et al.* 2008, Zheng *et al.* 2008, Ye *et al.* 2009, Xing *et al.* 2012, Zheng *et al.* 2013a). Recently, studies on a certain kind of medicinal plants were performed. For example, beverage plants by Li were studied (Bai and Li 2010, Qiu *et al.* 2014) and their health care functions were reported. Medicinal orchids by Li in Bawangling Mountain were investigated (Cun *et al.* 2014), and medicinal plant resources in the treatment of liver disease used by Li were summarized (Zheng *et al.* 2013b). Besides, detailed studies of medicinal plants in settlements of Li were performed (Zheng and Xing 2009, Zheng *et al.* 2013c). Traditional usage of medicinal plants around Limu Mountains and Mt. Yinggeling was documented, and medicinal plant traditions between Li and Hmong around Limu Mountains, and between Run and Qi around Mt. Yinggeling were discussed.

However, wild edible plants used by Li have not received enough attention as yet, though they can be used as vegetables and herbal medicines, have potential medicinal functions and keep Li healthy in day to day life (Zheng 2010, Zheng *et al.* 2013d, Liang *et al.* 2016). Besides, it is little

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known about wild edible plants sold by Li in traditional markets. Traditional usage of wild edible plants reflects the dietary habits and the awareness of health care in day to day life by Li. Consequently, a survey on wild edible plants traded in the traditional markets in two Li autonomous counties (Baoting County and Lingshui County) was carried out, in order to facilitate the use and development of wild edible plants in Hainan Island. Their species diversity, prices, preparation methods, medicinal usage and so on, were documented.

### Materials and Methods

The survey was carried out in Baoting Li-Miao Autonomous County and Lingshui Li Autonomous County. Baoting is adjacent to Lingshui, lying in the southeast part of Hainan Island. Baoting is located between latitude 18°23'-18°53' and longitude 109°21'-109°48', and Lingshui is located between latitude 18°21'-18°47' and longitude 109°45'-110°08' (Compile group of overviews of Baoting Li-Miao Autonomous County 2009, Compile group of overviews of Lingshui Li Autonomous County 2009).

The total size of Baoting is 1166.6 km<sup>2</sup> and that of Lingshui is 1128 km<sup>2</sup>. Both Baoting and Lingshui belong to the tropical monsoon climate, are influenced by monsoons, and have rich sunshine and plenty of rainfall. The mean annual temperature of Baoting is 20.7 - 24.5°C and the mean annual rainfall is 1800 - 2300 mm, while those of Lingshui are 19.8 - 24.7°C and 1654 mm. Baoting has 15,990 people, 56.2% of which are Li and 3.8% Miao. Lingshui consists of 30,3272 people, 22% of them are Li.

Baoting and Lingshui are around Diaoluo Mountain. Baoting is in the heartland of Diaoluo Mountain but not Lingshui. Diaoluo Mountain is famous for its rich floristic diversity and typical tropical rainforest. Based on recent researches, 2126 vascular plant species were recorded in Diaoluo Mountain, including quite a few endemic species to Hainan (Qin 2013).

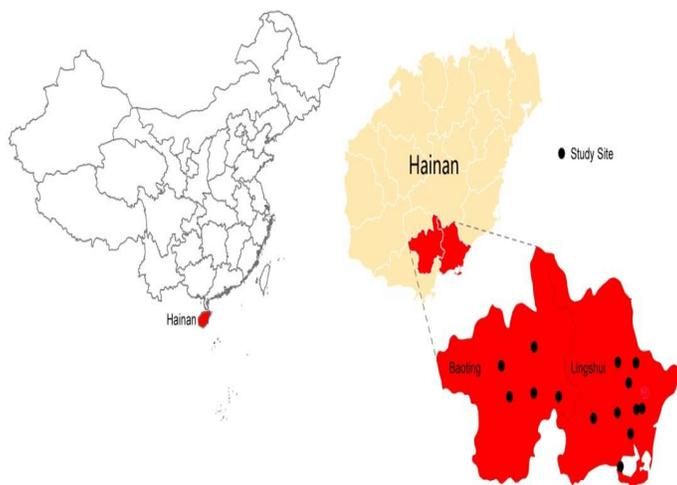


Fig. 1. Location of the study areas.

The survey was conducted four times from the start of rainy season to the start of dry season, May, 2016 to December, 2016, in 17 traditional markets: five in Baoting (markets in Baocheng, Nanmao, Xinzheng, Jinjiang and Liugong), 12 in Lingshui (four in Lingcheng, the others in Yelin, Sancai, Xincun, Longguang, Wenluo, Timeng, Benhao and Lingmen) (Fig. 1). The size of population of each town is shown in Table 1.

**Table 1. The size of population of each town.**

T	BC	NM	XZ	JJ	LG	LC	YL	SC	XC	LG	WL	TM	BH	LM
P	25651	11585	10108	8687	6371	30384	53366	12478	16824	18573	13976	16337	17965	11825

T, town; BC, Baocheng; NM, Nanmao; XZ, Xinzheng; JJ, Jinjiang; LG, Liugong; LC, Lingcheng; YL, Yelin; SC, Sancai; XC, Xincun; LG, Longguang; WL, Wenluo; TM, Timeng; BH, Benhao; LM, Lingmen and P, population.

The present study focused on wild edible plants. Stalls with no wild edible plants were not considered. Cultivated plants which had escaped to wild and indigenous plants which had been cultivated by local people were included. During the investigation, basic information, such as the stall properties (fixed or unfixed), gender and age, was collected. Besides, semi-structured informant interviews were carried out individually with the stall holders (Zhang *et al.* 2007), accompanied by one experienced local guide. The following three questions were answered by each stall holder: (1) Can you tell me the source of these plants (gathered yourself or purchased from other collectors)? (2) Where did you collect these plants? (3) What are the plants' local names, prices, applications, and preparation methods? Photographs of each target plant were taken, and voucher specimens were purchased directly from the stall holders. Plants were identified according to Flora Republicae Popularis Sinicae and Flora Hainanica (Delectis Florae Reipublicae Popularis Sinicae Agendae Academiae Sinicae, 1959 - 2004; Instituti Botanici Austro-Sinensis Academiae Sinicae, 1964 - 1977). Voucher specimens were deposited in Hainan University.

## Results and Discussion

There were 78.3 stall holders on average interviewed. According to Table 2, 89.3% ( $\pm 2.5$ ) of the stalls were unfixed, randomly distributing in or outside the markets, indicating that they were not predominant in traditional markets. Holders of the unfixed stalls were rural famers. They collected wild edible plants from gardens or mountains around their houses and carried them to the markets when they had time. The remaining stalls were fixed; and the holders were retailers who purchased edible plants from professional collectors or growers.

Females played a significant role in the activities of collecting and selling wild edible plants, since 80.7% ( $\pm 3.6\%$ ) of the stall holders were female, which is in agreement with the former study by Zheng (2010). The 78.3 holders fell into four age groups: (1)  $\leq 30$ , (2) 31-40, (3) 41-50, (4)  $\geq 51$ . Similar to the previous ethnobotanical study of Li Minority (Zheng 2010), the majority of the stall holders engaged in the trade of wild edible plants were 31 to 40 years old, who were active in plant collecting and selling. Besides, stall holders over 50 years old took up 21.1% ( $\pm 2.2$ ), who were rich in knowledge about the usage of wild edible plants.

Totally, 26 species belonging to 24 genera in 16 families of vascular plants were reported as wild edible plants, including two ferns and 24 angiosperms (Fig. 2). Among them, the most prevalent family was Compositae with five species. Compositae is the important family to local flora (Qin 2013), suggesting that the composition of wild edible plants in the traditional markets are closely linked with the composition of local flora (Zheng and Xing 2009).

Annual and perennial herbs were the largest number of species, which represented 84.62% of the total species, followed by lianas (7.69%), shrubs (3.85%), and trees (3.85%). Such a proportion is consistent with previous ethnobotanical studies (Zheng 2010, Zheng *et al.* 2013d), indicating that herbs are the main sources of wild edible plants in Baoting and Lingshui. Sixteen species were collected from the wild places (61.54%), six species (23.08%) were only harvested in home gardens, and 15.38% were collected in both wild places and home gardens. The plants cultivated were *Solanum americanum* Miller, *Gynura divaricata* (L.) DC., *Asystasia chelonoides* Nees, and

so on, which were also reported in the previous ethnobotanical study on Li Minority (Zheng 2010). The number of cultivated species indicates that the demand for wild edible plants is considerable and the experience of cultivating is developed in local areas.



Fig. 2. Six species of wild vegetables traded in Baoting and Lingshui, Hainan Island, China. A. *Centella asiatica* (L.) Urban; B. *Pteridium aquilinum* (L.) Kuhn var. *latiusculum* (Desv.) Underw. ex Heller; C. *Amaranthus lividus* L.; D. *Costus speciosus* (Koen.) Smith; E. *Crassocephalum crepidioides* (Benth.) S. Moore and F. *Dillenia pentagyna* Roxb..

Twenty species were only used as wild edible plants, while six as both wild edible plants and herbal medicines. The number of plants used as herbal medicines was much less than that as wild edible plants, which was different from the result reported in the previous ethnobotanical study on Li Minority (Zheng 2010). It is because this study focused on wild edible plants, and stalls without wild edible plants were not considered in the present study. Totally, over ground parts (53.85%) were the most frequently used parts of plants, accounting for 14 species, followed by whole plants (15.38%) (Fig. 3). Roots, fruits, shoots, stems, and flowers were used in minor percentages. Such a proportion is like the previous study (Zheng 2010). Which part of the plant used is relative to life form. Over ground parts were all from annual and perennial herbs, but not from shrubs or trees. Particularly, the whole plants were only from short herbs with strong reproductive capacity, indicating a sustainable way collecting wild plants by local people. Roots required in some

medicinal preparations were from shrubs. It would be harmful to local vegetation, but roots were used in a minor percentage.

For all edible plants, plain-frying was the most common preparation mode, accounting for 20 species, followed by quick-boiling (5), salad (5), soup (4), and frying with meat (3). Only a minor proportion of edible plants were made into sauce or salted. Such an edible preparation mode indicates local people prefer food prepared with little salt and oil, and like to make up water by food, which is in close relation to the hot weather. For medicinal plants, most plants (four species) were prepared using fresh material in the form of decoction, taken as tea after meals. Roots of *Morinda officinalis* How and *Millettia speciosa* Champ. were prepared in the form of alcohol maceration (introduced in alcohol for a few days) and broth (made soup with meat or chicken), because alcohol and fat could help medicinal components release.

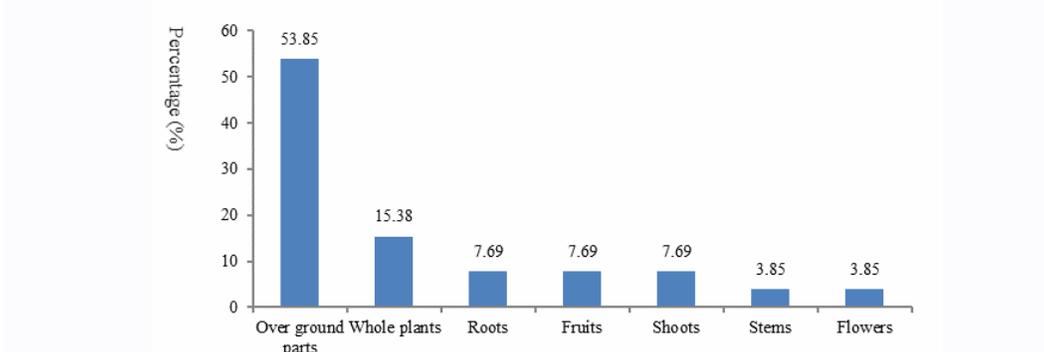


Fig. 3. Plant parts used as wild vegetables traded in Baoting and Lingshui, Hainan Island, China.

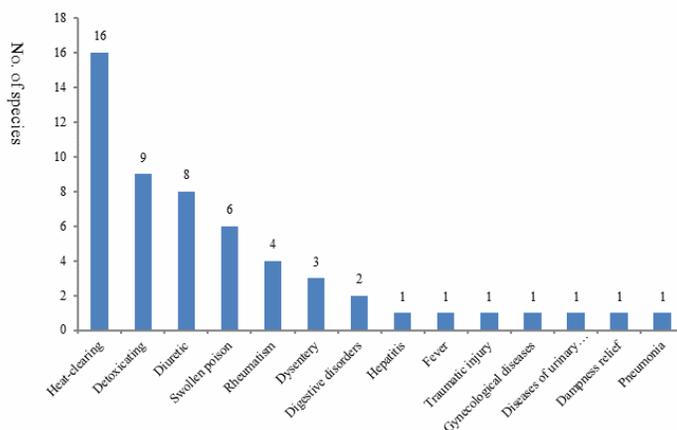


Fig. 4. Medicinal functions of wild edible plants traded in Baoting and Lingshui, Hainan Island, China.

In this study, the most common function of edible plants was heat-clearing (16 species), followed by detoxicating with nine species (Fig. 4). Eight species could be used as diuretic and six species could relieve swollen poison. The top four common functions are closely related with the weather. The weather is so hot that local people are more likely to get heat syndrome, such as dry mouths, sore throats, and oliguria. A few plant species were recorded to treat rheumatism (4), dysentery (3), and digestive disorders (2). Most of the Li dwell in mountainous areas with high humidity for a very long time and have to do farm work nearby all the year round. In such a case,

people are more likely to get rheumatic diseases (Li *et al.* 2006). Poor public health care conditions and local people's eating habits may lead to dysentery and digestive disorders. For example, livestock are not raised in captivity but freely go about in village. In order to save time, a whole day's staple food which is always rice is prepared in early morning and eaten whole day (Zheng and Xing 2009).

What affects the species richness of plants traded in traditional markets? According to the number of plant species recorded, respectively in May, July, October and December, Baoting and Lingshui had similar sales trend (Fig. 5). The number of plant species was largest in May and decreased gradually. Rainfall and temperature are critical factors for the growth of plants. Compared with July, October and December, humidity, wetness and heat in May would be the most suitable for the growth of plants. Bad weather, such as heavy rain and typhoon in July and August in Hainan Island, not only inhibit the growth of wild edible plants but also increase the difficulty to collect them. Besides weather, the size of population nearby and plant diversity in local areas have close relationships with the species richness of plants in traditional markets. On one hand, larger population demands larger quantity of vegetables. For example, the species richness of plants in the

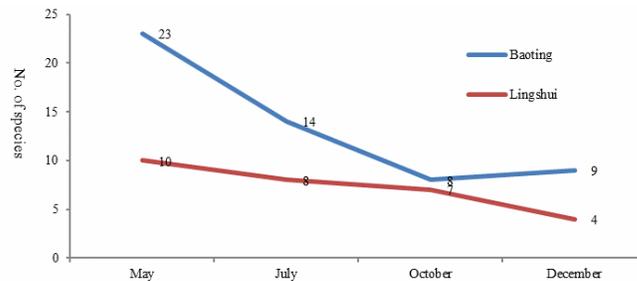


Fig. 5. Species number of wild edible plants from May to December traded in Baoting and Lingshui, Hainan Island, China.

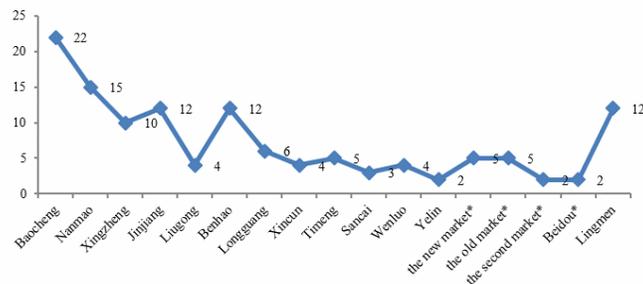


Fig. 6. Species number of wild edible plants traded in the traditional markets of Baoting and Lingshui, Hainan Island, China. Baocheng, Nanmao, Xingzheng, Jinjiang and Liugong in Baoting, the others in Lingshui. The four markets in Lingcheng marked with an asterisk (\*).

traditional markets of Baoting decreased obviously with the size of population nearby (Fig. 6 and Table 1). On the other hand, the higher plant diversity in local area contributes to the larger species number of vegetables. For example, plants in the traditional markets were much more abundant in Benhao and Lingmen than those in Xincun and Sancai (Fig. 6). It is because Benhao and Lingmen were much closer to Diaoluo Mountain, whereas Xincun and Sancai were far from Diaoluo Mountain but close to seaside.

How high are the prices of wild edible plants in traditional markets? Price is a good indicator of the supply and demand of a product (Randriamiharisoa *et al.* 2015). Plants with higher price indicate they were in higher demand and lower supply. In this study, the prices of *Millettia speciosa* and *Morinda officinalis* were highest, which cost 60 - 160/kg. Except them, the majority of plants were no more than 16/kg, and most of them were sold at a similar price, usually 6 - 10/kg. The main reason is that it is difficult to collect the roots of *Millettia speciosa* and *Morinda officinalis* in the wild.

**Table 2. Characteristics of traditional markets and informants.**

Indicator	Description	Frequency (%)
Age	≤30	6.3 (±2.0)
	31-40	46.6 (±9.3)
	41-50	26.0 (±6.8)
	≥51	21.1 (±2.2)
Gender	Female	80.7 (±3.6)
	Male	19.3 (±3.6)
Stall	Fixed	10.7 (±2.5)
	Unfixed	89.3 (±2.5)

**Table 3. Average price per kilogram of the top 10 wild edible plants from May to December in Baoting and Lingshui, Hainan Island, China. Species out of store marked with a forward slash (/).**

Species	Study site	May	July	October	December
<i>Amaranthus spinosus</i> L.	Baoting	¥3.5	/	/	/
	Lingshui	¥3.5	/	¥3.5	¥4
<i>Crassocephalum crepidioides</i> (Benth.) S. Moore	Baoting	¥3	/	¥5	¥5
	Lingshui	¥2.5	¥3.75	¥5	¥2
<i>Solanum americanum</i> Miller	Baoting	¥3	/	¥6.5	¥5
	Lingshui	¥3.66	/	/	¥2
<i>Costus speciosus</i> (Koen.) Smith	Baoting	¥6	¥6	¥6	/
	Lingshui	¥6	¥6	¥4.5	/
<i>Piper sarmentosum</i> Roxb.	Baoting	¥4	¥6	¥5	/
	Lingshui	¥5.66	¥4	¥4	/
<i>Amaranthus lividus</i> L.	Baoting	¥2.75	¥3	/	/
	Lingshui	¥2.62	¥3.5	/	/
<i>Enydra fluctuans</i> Lour.	Baoting	¥5	¥5	¥4	¥4.5
	Lingshui	/	¥2.5	¥2.5	/
<i>Oenanthe javanica</i> (Blume) DC.	Baoting	¥4.5	/	/	/
	Lingshui	¥6	/	/	/
<i>Pteridium aquilinum</i> (L.) Kuhn var. <i>latiusculum</i> (Desv.) Underw. ex Heller	Baoting	¥5	□5	¥5	¥5
	Lingshui	¥4	/	¥5	/
<i>Centella asiatica</i> (L.) Urban	Baoting	¥5	¥4.33	¥5	¥5
	Lingshui	¥2.5	¥3	/	/

What affects the price? In terms of frequency, the top 10 species of the total commercial plants were *Centella asiatica* (L.) Urban (32.35%), *Pteridium aquilinum* (L.) Kuhn var. *latiusculum*

(Desv.) Underw. ex Heller (26.47%), *Oenanthe javanica* (Blume) DC. (23.53%), and so on. Among the top 10 species, the prices of the same species in the same month were similar in Baoting and Lingshui, and the fluctuation range was 0 - 3/kg (Table 3). Thus, geographical difference is not the critical factor for the fluctuation of prices. Developing transportation and information technology may narrow the gap of prices. Besides, there is not a unique relationship between price and time, which needs further study.

Twenty six species belonging to 24 genera under 16 families of vascular plants are recognized as wild edible plants. Twenty species are used by Li as wild vegetables, while six as both edible plants and herbal medicines. Li have rich knowledge to use wild plants as vegetables and medicines in a sustainable way. For example, above ground parts and whole plants are the most frequently used parts of plants, which are collected from herbs, especially those with strong reproductive capacity. They get calories, keep healthy and fight against with diseases in daily life with the help of wild plants. Due to the hot weather, Li usually suffer from heat syndrome. Thus, heat-clearing, detoxicating, to be used as diuretic and to relieve swollen poison are the common medicinal functions of wild edible plants. Weather, the size of population and plant diversity in local areas have close relationship with the species richness of wild edible plants traded in traditional markets. Geographical difference is not the critical factor for the fluctuation of price. Besides, there is not a unique relationship between price and time. Further study is required to make the complicated situation clear to facilitate the use and development of wild edible plants.

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