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An ethnobotanical study on wild edible plants in Taishan County, Guangdong, China

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Globally, wild edible plants (WEPs) play a critical role in sustaining livelihoods and preserving cultural heritage. This study investigates traditional knowledge of WEPs in Taishan County, Guangdong Province of China, through market surveys, semi-structured interviews ($n = 162$), and participant observation, with the primary objective of sustainable utilization of WEPs and safeguarding their cultural significance. Finally, 131 WEPs belonging to 59 families were identified, which are mainly used as tea substitutes, wild vegetables, and spices. We analyzed the diversity of consumed WEPs, documented the utilized plant parts and preparation methods, selected 8 culturally significant species [*Portulaca oleracea* L., *Houttuynia cordata* Thunb., *Plantago asiatica* L., *Centella asiatica* (L.) Urb., *Amaranthus spinosus* L., *Perilla frutescens* (L.) Britton, *Hypericum japonicum* Thunb. ex Murray, and *Eleutherococcus trifolius* (L.) S. Y. Hu] via the Cultural Food Significance Index (CFSI) analysis, and provided the sustainable utilization strategies. These plants are deeply embedded in local traditions, including medicinal herbal teas, nutritious Cantonese-style soups, and bitter-tasting tonic dishes, embodying the “Food as Medicine” philosophy. However, this knowledge is now predominantly held by older generations, and threatened by rapid urbanization and youth disengagement. Future research should prioritize strategies to conserve cultural and ecological diversity while incorporating WEPs into contemporary food systems.

KEYWORDS

wild edible plants, Taishan County, ethnobotany, the cultural food significance index, traditional knowledge

1 Introduction

Wild edible plants (WEPs) are defined as uncultivated species collected from natural ecosystems for food purposes (Dong, 1994; Ju et al., 2013; Fongnossie et al., 2020). These plants occur in wild or semi-wild conditions, growing naturally without human cultivation (García-Herrera et al., 2014). Globally, WEPs serve as a crucial resource, particularly during seasonal food shortages and famine conditions (Heywood, 1999).

Historically, WEPs have provided fundamental nutritional security for human populations. Even following the development of agriculture, they continued to serve as essential emergency foods during crop failures (Asfaw et al., 2023). During the Great Irish Famine from 1845 to 1852, rural communities heavily relied on WEPs like nettles and wild garlic to compensate for potato shortages (Salaman and Burton, 1985). Similarly, in the 1980s Ethiopia, wild grasses and shrubs constituted up to 40% of dietary intake in famine-stricken regions, with species like *Ensete ventricosum* (Welw.) Cheesman preventing widespread starvation (Rahmato, 1991).

These cases demonstrate the critical role of WEPs as food security safety nets.

In the mountainous regions of Yunnan Province, China, the rich diversity of WEPs constitutes a vital source of nutrients for local communities (Ghorbani et al., 2012; Luo et al., 2019). Beyond nutrition, WEP consumption enhances dietary diversity, promotes health, and safeguards traditional food cultures (Johns and Eyzaguirre, 2006; Bharucha and Pretty, 2010). However, modern urbanization shows excessive reliance on few cultivated species - just 15 crops provide 90% of global calorie intake, with over 4 billion people relying mainly on rice, maize and wheat (Khouri et al., 2014; Bélanger and Pilling, 2019; Antonelli et al., 2020). This dietary homogenization has created significant research gaps regarding WEPs' untapped nutritional potential. Systematic development of diverse WEP species could substantially improve food security while addressing the limitations of conventional agriculture (Heywood, 2013; Hunter et al., 2019).

China ranks among the world's most biodiverse nations, harboring an extensive variety of WEPs. Recent WEP research has primarily focused on ethnobotanical studies of ethnic minorities in regions like Tibet, Yunnan and Inner Mongolia, including groups such as the Lhoba, Hani, Yi, Dulong, Mongolian, Sherpa, etc. (Luo et al., 2019; Sachula et al., 2020; Chen et al., 2021; Cheng et al., 2022). These investigations have recorded WEP species utilized at study sites along with their traditional processing and consumption methods. The Cultural Food Significance Index (CFSI) has been widely applied to assess the cultural importance of WEPs significant to local communities. Some researchers have further researched the nutritional composition of locally consumed WEPs. For example, Wang et al. evaluated the nutritional and health benefits (including amino acids, fats, energy, vitamins, and minerals) of four wild vegetables popular among the Yi ethnic group in Liangshan, Sichuan Province of China. Their results indicated that these four wild vegetables possess substantial nutritional value and health benefits (Ding et al., 2019; Wang et al., 2020). Qiu et al. published two studies in 2004 and 2005 analyzing the nutrient composition of various wild vegetable species. The first study measured the concentrations of nitrate, nitrite, and vitamin C in six species from the Amaranthaceae family, including *Celosia argentea* L., *Amaranthus spinosus* L., *A. cruentus* L., *Alternanthera philoxeroides* (Mart.) Griseb., *A. viridis* L., and *A. tricolor* L. (Qiu and Zeng, 2004). The second study analyzed the same nutrients in eight wild vegetable species from the Asteraceae family: *Crassocephalum crepidioides* (Benth.) S. Moore, *Emilia sonchifolia* (L.) DC., *Sonchus wightianus* DC., *Lactuca sibirica* (L.) Benth. ex Maxim., *Elephantopus scaber* L., *Erigeron canadensis* L., *Artemisia argyi* H. Lévl. & Vaniot, and *A. lactiflora* Wall. ex DC (Qiu and Zeng, 2005). These studies provide comprehensive nutritional and safety assessments of these wild vegetables, offering valuable guidance for safer consumption.

Taishan, a coastal and well-known tourist destination located in the southwestern part of the Pearl River Delta in Guangdong Province, is a cradle of Cantonese culture with the Han ethnic group as the

majority (Committee, 2011). Characterized by mountainous terrain and coastal scenery, the region features a warm and humid climate (Committee, 2011). Local communities have developed extensive traditional knowledge of WEP harvesting and consumption adapted to the area's unique geography, climate, and biodiversity. These practices provide both food and medicinal resources and contribute to global food security. However, urbanization and tourism development have eroded traditional WEP practices. Despite this, coastal Han communities' WEP knowledge has received limited scholarly attention (Wang, 2019), making documentation in Taishan County imperative.

Ethnobotany examines human-plant relationships, focusing on traditional botanical knowledge in economic, medicinal, daily life, and cultural contexts. This discipline investigates human roles in conserving plants and the environment, applies traditional knowledge to sustainable development and ecological civilization, and analyzes plants' impacts on human economies, languages, and cultures (Li and Long, 2019). Ethnobotanical quantitative research systematically collects and analyzes data to elucidate traditional knowledge about plant resources, providing a scientific foundation for biodiversity conservation, cultural preservation, and sustainable resource use. Such research is vital for assessing the status of traditional botanical knowledge (Huai and Khasbagan, 2010). The Cultural Food Significance Index (CFSI), proposed by Pieroni et al. in 2001, evaluates plant species' cultural significance and remains the primary quantitative method for WEP studies (Pieroni, 2001).

This study employs ethnobotanical methods to investigate Han communities' traditional WEP use in Taishan County, Guangdong Province, conducting quantitative analysis to identify culturally significant plants. The research aims to address the following questions: (1) Which wild plants are consumed by local residents? (2) Which plant parts are utilized and how are they processed/prepared? (3) Which plants hold the greatest community importance? (4) How can these plants be sustainably utilized and protected? Through addressing these questions, this work systematically documents and analyzes traditional knowledge related to plant resources, with particular emphasis on their cultural significance and utilization patterns.

2 Materials and methods

2.1 Study area

Taishan County is located in the southwestern part of the Pearl River Delta within Guangdong Province, with geographic coordinates ranging from 21°34'N to 22°27'N and from 112°18'E to 113°03'E (Figure 1). Its urban center, Taicheng, is situated 146 kilometers southwest of Guangzhou, the provincial capital, and serves as a prominent hub for overseas Chinese communities. The County has 31 ethnic groups, with the Han majority constituting 99.07% of the population. The region has a subtropical monsoon climate featuring mild temperatures and distinct seasons.

Although the summit areas are sparsely vegetated, the mid- and low-elevation zones support a diverse flora, contributing to the region's overall botanical richness. Nevertheless, the region maintains rich botanical diversity. Overseas Chinese communities originating from 13 countries and regions-including Indonesia, Vietnam,

Abbreviations: CFSI, Cultural food significance index; QI, Frequency of quotation index; AI, Availability index; FUI, Frequency of utilization index; PUI, Parts used index; MFFI, Multifunctional food use index; TSAI, Taste score appreciation index; FMRI, Food-medicinal role index; WEPs, Wild edible plants; Wv, Wild vegetables; Wf, Wild fruits; Sp, Spices; Ts, Tea substitutes; Lb, Liquor brewing; Sn, Snack; Fd, Food dyeing.

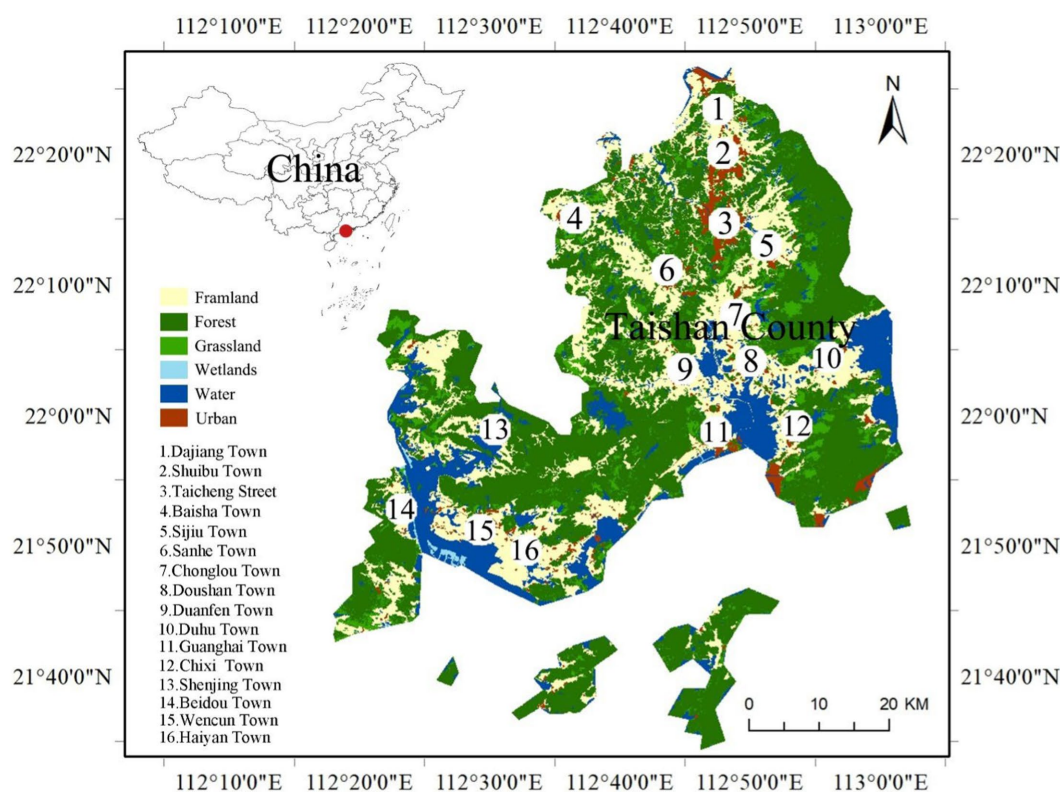


FIGURE 1
The map of study sites.

Thailand, Malaysia, and Myanmar have established a Southeast Asian-themed park in Haiyan Town, earning it the nickname “mini United Nations” (Committee, 2011).

2.2 Ethnobotanical information collection

2.2.1 Field surveys and data collection

From May to December 2023, we conducted comprehensive field surveys in Taishan County employing multiple ethnobotanical methods, including semi-structured interviews, participant observation, and market survey (Wang and Wang, 2017). Before market survey, we conducted preliminary research through literature review and online consultations with Taishan residents to identify the most representative markets in each township. Consequently, the markets with the largest scale, the greatest diversity of wild edible plants (WEPs), and the highest number of vendors in each town were selected for further field investigation. Finally, a total of 15 markets distributed in 15 towns and three markets distributed in one urban subdistrict in Taishan County's mainland area were surveyed (Figure 1; Supplementary Table S1).

Over this seven-month period, we interviewed a total of 162 respondents using a combined sampling approach that involved an initial random selection of vendors offering diverse plant varieties, which was then supplemented by snowball sampling through vendor recommendations of knowledgeable informants. The sample comprised 54 males (33.3%) and 108 females (66.7%), with female

vendors accounted for two-thirds of participants. This gender distribution reflects women's traditional dominance in domestic food preparation, a factor correlated with greater knowledge of WEPs. Field observations further confirmed women's active involvement in both wild harvesting and marketing of WEPs.

We systematically documented traditional knowledge regarding WEPs utilization, collecting detailed data on informants (gender, ethnicity, and age) and WEPs, including scientific names, local names, uses, edible parts, food categories, consumption modes, and medicinal applications.

Voucher specimens of each WEP species were collected and deposited in the Herbarium of South China Agricultural University (CANT). The plant specimens were identified by the authors (Chunmei He, Shuangyu Zhang and Yuling Li) using the following references: *Flora of Guangdong* (Chen, 1987), *Taishan County Journal* (Committee, 2011), *Wild Vegetable Resources of China* (Guan et al., 2013), *Wild Fruit and Vegetable Resources in the Tropical Coastal Zone of China* (Wang, 2019), *Chinese Dietary Therapy Materia Medica* (Yan and Ding, 2018), and *Identification and Utilization of Medicinal and Food Plants* (Sun et al., 2009). All species were further verified through the following online databases: iPlant,¹ Tropicos,² and for non-native species, POWO.³

¹ <https://www.iplant.cn/>

² <http://www.tropicos.org/>

³ <https://powo.science.kew.org/>

2.2.2 Data analysis

The collected data were analyzed statistically using Microsoft Excel, ArcGIS was used to map the distribution of survey locations, and Adobe Photoshop was utilized for editing and arranging plant specimen photographs. A quantitative ethnobotanical approach based on the Cultural Food Significance Index (CFSI), was employed to assess the most culturally significant wild plant species according to local informants. The CFSI assesses the cultural significance of food resources within specific communities, facilitating the identification of wild edible species with both high cultural value and practical utilization. The CFSI was calculated as follows:

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

We employed seven quantitative indices to systematically analyze wild edible plant utilization patterns. The Frequency of Quotation Index (FQI) represents the total number of positive responses when informants listed known and used plants, while the Availability Index (AI) reflects local perceptions of plant availability, weighted by distribution range (widespread vs. endemic). The Frequency of Utilization Index (FUI) quantifies usage frequency per species, complemented by the Parts Used Index (PUI) which assesses multipurpose applications of different plant parts. For culinary evaluation, the Multi-Functional Food Use Index (MFFI) systematically documents potential food applications, and the Taste Score Appreciation Index (TSAI) quantifies local taste preferences through standardized scoring. Finally, the Food-Medicinal Role Index (FMRI) evaluates perceived dual-purpose properties. All index values were calculated according to [Supplementary Table S2](#). The composite CFSI value, integrating these multidimensional factors, serves as a preliminarily screening tool for identifying edible plants with high cultural acceptance and utilization potential ([Pieroni, 2001](#)). Species with higher CFSI values are considered more culturally important ([Sujarwo and Caneva, 2016](#)).

3 Results

3.1 Information on respondents

A total of 162 respondents participated in the survey, with the population primarily comprised middle-aged and elderly respondents aged 41–70 years ($N = 116$), with the following age distribution: 31–40 years ($n = 7$), 41–50 years ($n = 41$), 61–70 years ($n = 52$), and 70–80 years ($n = 16$). Respondents noted that due to limited local job opportunities and low wages, younger individuals often migrate to cities for better employment. Furthermore, many young people have little interest in wild plants, resulting in a generational gap in WEP knowledge.

Occupationally, most respondents (156, 95.1%) were rural farmers with limited formal education, reflecting Taishan County's demographic transition characterized by selective outmigration of younger generations to urban areas ([Committee, 2011](#)). This demographic shift has resulted in an aging agricultural population that maintains comprehensive traditional knowledge of WEPs, particularly evident in rural markets where both vendors and consumers are predominantly elderly residents.

It should be noted that the near absence of other occupational groups (e.g., white-collar workers, shop owners, or civil servants) in

our sample reflects their minimal knowledge of WEPs, which consequently led to their exclusion during our participant selection process. Regarding economic data, while direct income reporting proved challenging due to privacy concerns, we referenced the official 2024 statistics from Jiangmen Municipal Bureau of Statistics indicating an average monthly income of 5,000 CNY (Chinese Yuan) for county residents as a proxy for respondents' economic status.

Consumption patterns indicated that economic factors were secondary to personal preference, taste, and accessibility in determining WEP use. The affordable price range (10–20 CNY per half-kilograms for raw materials, 15–40 CNY for restaurant dishes, and 5–10 CNY for traditional herbal teas) made WEPs accessible across income levels, though preparation methods differed - lower-income consumers predominantly prepared WEPs at home, while higher-income respondents more frequently consumed prepared dishes in commercial settings.

Most acquired WEP knowledge from elders or informal exchanges with peers and vendors, although their understanding was generally limited to a few common species. Five respondents (3.1%) operated herbal stores, selling certain wild plants for consumption—which is unsurprising, as over half of Taishan County's WEPs have medicinal or dual medicinal-edible uses, primarily because these plants serve as ingredients for traditional herbal teas (particularly Cantonese-style herbal teas) and belong to China's traditional medicinal plant repertoire ([Li, 2002](#); [Chang et al., 2015](#); [Yan and Ding, 2018](#)). Additionally, one teacher (0.6%), with a botany background and prior research experience acted as a key informant.

3.2 Diversity of WEPs in Taishan County

In Taishan County, our survey documented 131 WEP species spanning from 59 families and 117 genera, including several non-native species. We systematically recorded ethnobotanical data on these WEPs—such as scientific names, local names, uses, edible parts, food categories, modes of consumption, and medicinal applications—based on local practices. These data were compiled into an alphabetized checklist organized by Latin names within families ([Supplementary Table S3](#)).

Six families emerged as the most commonly consumed ([Figure 2](#)): Asteraceae (13 species, e.g., *Artemisia argyi*, *A. lactiflora*, *A. indica* Willd., *Blumea balsamifera* (L.) DC.), Fabaceae (13 species, e.g., *Abrus pulchellus* subsp. *Cantonensis* (Hance) Verdc., *Abrus pulchellus* subsp. *Mollis* (Hance) Verdc., *Cheniella corymbosa* (Roxb.) R. Clark & Mackinder, *Flemingia prostrata* Roxb. f. ex Roxb.), Lamiaceae (9 species, e.g., *Callicarpa peichieniana* Chun & S. L. Chen, *Leonurus japonicus* Houtt., *Mentha canadensis* L., *Orthosiphon aristatus* (Blume) Miq.), Acanthaceae (5 species, e.g., *Avicennia marina* (Forssk.) Vierh., *Dicliptera chinensis* (L.) Juss.), Rubiaceae (5 species, e.g., *Oldenlandia corymbosa* L., *Paederia foetida* L.), and Poaceae (5 species, e.g., *Dendrocalamus latiflorus* Munro, *Eragrostis tenella* (L.) P. Beauv. ex Roemer & Schult.).

3.3 Types of WEPs edible parts

This study documented 10 edible plant parts utilized in Taishan County's WEPs: whole aerial parts, shoots, whole plant (intact, uncut), roots, stems, stems and leaves (intact, uncut), fruits, flowers, leaves,

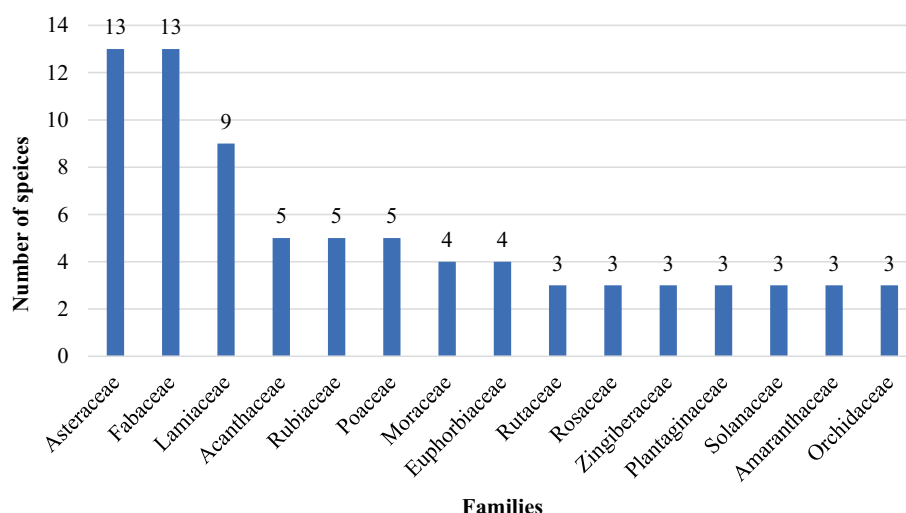


FIGURE 2
Fifteen prevalent families with most species number used by Taishan County residents in daily life.

and seeds. The classification was based on the PUI values from the CFSI calculation formula (Pieroni, 2001), with two additional categories (whole plant and stems-and-leaves) incorporated based on our field survey findings, as these were not originally specified in the standard CFSI scoring system. Local communities demonstrate sophisticated utilization of different plant components for distinct purposes. For example, the flowers of *Lonicera confusa* (Sweet) DC. are brewed as tea, while its roots are prepared as traditional herbal tea. The utilization of edible parts of WEPs exhibits the following distribution pattern: whole aerial parts are the most commonly utilized, found in 37 species (27%), followed by shoots in 18 species (13%). The whole plant and roots are equally utilized, each accounting for 17 species (12%). Stems are utilized in 15 species (11%), while the stems and leaves are used in 13 species (10%). Among other edible parts, fruits are utilized in 9 species (7%), flowers in 6 species (4%), leaves alone in 4 species (3%), and seeds in only 1 species (1%) (Figure 3).

3.4 Food categories of WEPs

In Taishan County, WEPs are classified into seven food categories: tea substitutes (106 species), wild vegetables (34 species), spices (13 species), food dyeing (6 species), wild fruits (5 species), snacks (4 species), and liquor brewing (3 species). A single plant species often has multiple uses, reflecting the versatility of WEPs in local cuisine and traditional practices. For example, the roots of *Houttuynia cordata* Thunb. can be eaten raw in salads, used as a spice in soups, or brewed into traditional herbal tea (Figure 4).

3.4.1 Tea substitutes

In Taishan County, 106 species of WEPs from 52 families serve as tea substitutes, representing the most extensively utilized food category. The most prominent families include: Fabaceae (13 species): *Abrus pulchellus* subsp. *cantonensis* and *Grona styracifolia* (Osbeck) H. Ohashi & K. Ohashi; Asteraceae (10 species): *Artemisia indica* and *Elephantopus scaber*; Lamiaceae (7 species): *Mentha crispata* Schrad.

ex Willd. and *Orthosiphon aristatus*; Acanthaceae (5 species): *Dicliptera chinensis* and *Peristrophe bivalvis* (L.) Merr. The primary edible parts used for tea substitutes are: whole aerial parts (36 species), followed by the whole plant (17 species), roots (16 species), stems and leaves (13 species), stem (10 species), shoots (8 species), fruits (3 species), leaves (3 species), and flowers (2 species) (Figure 5). Selection criteria for these parts include flavor profile, medicinal properties, and cultural significance. Locals traditionally brew these teas to alleviate damp-heat-related health issues prevalent in the regional climate.

In Taishan County, both fresh and dried traditional herbal tea plants are available in local markets, with prices ranging from a few to hundred CNY per half-kilograms, depending primarily on availability (Figure 6). For instance, *Oldenlandia corymbosa* and *Scleromitrium diffusum* (Willd.) R. J. Wang, which share similar morphological characteristics and uses, are collectively referred to as “蛇舌草” by locals and priced at around 10 CNY per half-kilograms. *Centella asiatica* (L.) Urb., a widely utilized species in Taishan County, grows remarkably fast and is extremely abundant, often forming large contiguous patches. This characteristic enables large-scale harvesting of the plant. It is generally sold at 8 CNY per half-kilograms.

The consumption methods of tea substitutes primarily involve two distinct approaches: simmering and brewing. Herbal teas are typically prepared by simmering, which utilizes various edible parts including the whole plant, roots, stems, or leaves, resulting in a dark brown and bitter beverage (Liu et al., 2013). In local practices, specific species are selectively used for their therapeutic properties. For example, *Taraxacum mongolicum* Hand.-Mazz. and *Scleromitrium diffusum* are traditionally used for heat-clearing teas, while *Perilla frutescens* (L.) Britton and *Lonicera japonica* Thunb. are used for cough-relieving and lung-moistening teas. These traditional herbal teas can be brewed at home or purchased commercially through pharmacies and specialty stores.

Alternatively, brewed tea substitutes, containing aromatic components such as *Lonicera japonica* flowers or *Abrus pulchellus* subsp. *cantonensis* (Hance) Verdc. leaves, have a more delicate flavor profile, characterized by subtle fragrance, mild bitterness, and natural sweetness. These infusions are generally prepared fresh in household

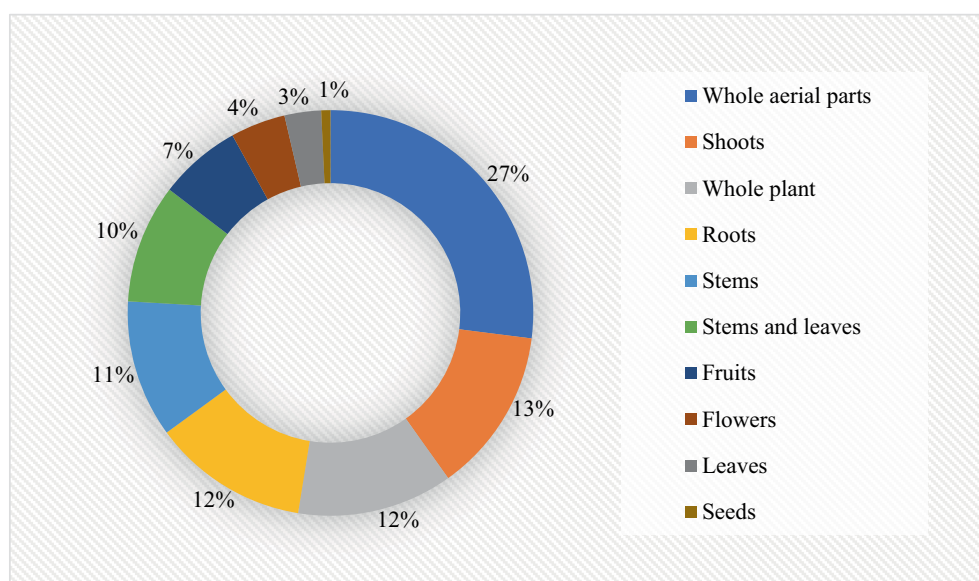


FIGURE 3
Edible parts of WEPs in Taishan County.

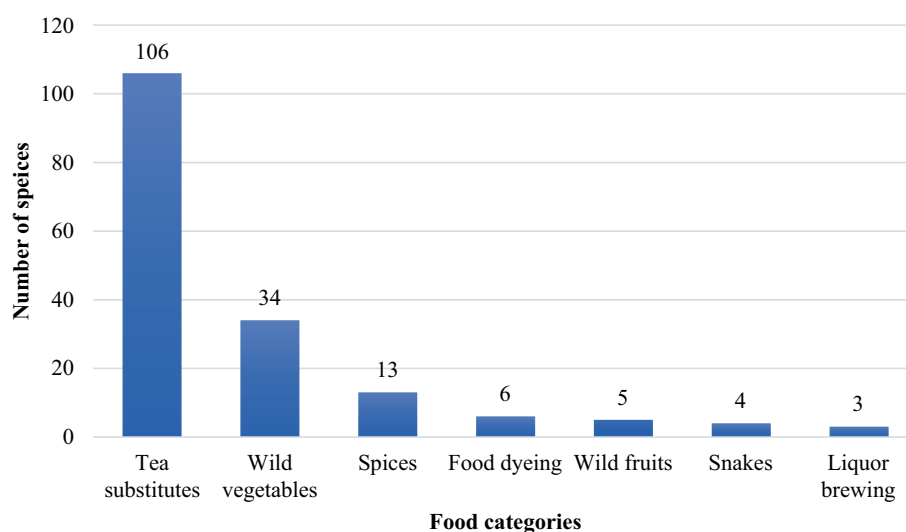


FIGURE 4
Food categories of WEPs in Taishan County.

settings, offering gentler therapeutic benefits compared to simmered versions.

3.4.2 Wild vegetables

In Taishan County, 33 species of WEPs belonging to 23 families are utilized as vegetables. The edible parts of these wild plants include shoots (15 species, e.g., *Eleutherococcus trifolius* (L.) S. Y. Hu and *Sauropus androgynus* auct. Non (L.) Merr.), stems (4 species, e.g., *Dendrocalamus latiflorus* and *Amorphophallus paeoniifolius* (Dennst.) Nicolson), whole aerial parts (5 species, e.g., *Rorippa indica* (L.) Hiern and *Portulaca oleracea* L.), whole plant (2 species, e.g., *Centella asiatica*), fruits (2 species, e.g., *Avicennia marina*), flowers (3 species, e.g., *Telosma cordata* (Burm.

f.) Merr.), and root (2 species, e.g., *Dioscorea polystachya*) (Figure 7).

The culinary preparation of these wild vegetables involves two techniques: stir-frying and soup stewing. Stir-frying predominantly utilizes the shoots and whole aerial parts, with *Alternanthera bettzickiana* and *Portulaca oleracea* Turcz. being representative examples. Soup stewing, which utilizes shoots and stems like those from *Eleutherococcus trifolius* and *Dendrocalamus latiflorus*, can be further categorized into two types based on ingredient characteristics. One involves ingredients that are difficult to soften, requiring prolonged simmering (2–4 h) at low heat with maintaining a gentle boil, exemplified by the roots of *Amaranthus spinosus* and *Ficus hirta* Vahl (Xu, 2004). The other involves ingredients that are

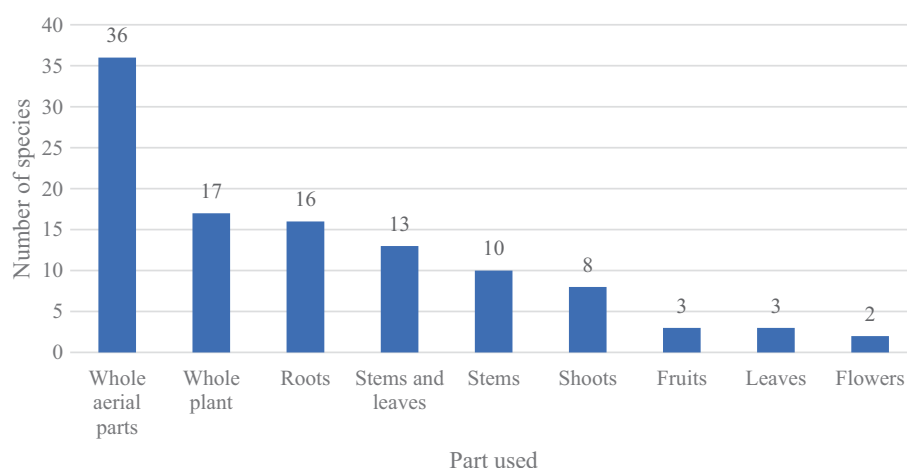


FIGURE 5
The utilization parts for tea substitutes of WEPS in Taishan County.



FIGURE 6
Some tea substitutes plants in Taishan County. (A) *Plantago asiatica*; (B) *Centella asiatica*; (C) *Amaranthus spinosus*; (D) *Eleutherococcus trifoliatus*; (E) *Murdannia bracteata*; (F) *Emilia sonchifolia*.

rapidly cooked in boiling water over high heat, usually completing within 30 min, such as the shoots of *Eleutherococcus trifoliatus*.

In Taishan County, locals utilize three wild plants—*Perilla frutescens*, *Portulaca oleracea*, and *Eleutherococcus trifoliatus*—for their culinary purposes, capitalizing on their seasonal abundance and unique flavors. *Perilla frutescens* and its cultivated variant *P. frutescens* var. *crispa* (Thunb.) Hand.-Mazz. (which was not included in the inventory) are locally called “紫苏”(zisu) due to their similar morphology, taste, and effects. During spring and summer, their shoots are frequently sold in local markets for 4–5 CNY per half-kilograms and are often stewed with river snails or duck to create dishes with a distinctive aroma. While many people forage for wild *Perilla* in the fields, others cultivate it to ensure a consistent supply. Next, *Portulaca oleracea*, locally nicknamed “瓜子菜”(guazicai) for its small, seed-like oval leaves, is harvested from the wild and sold in bundles for 3–5 CNY per half-kilograms.

It is typically stir-fried alone or with eggs, offering a mildly sour and smooth flavor profile. Lastly, *Acanthopanax trifoliatus*, locally called “三叶五加”(sanyewujia) or “苦刺菜”(kucicai), has its shoots harvested in spring and summer, selling for 3–6 CNY per bundle. It is often boiled with pork and preserved eggs to create a refreshing, slightly bitter soup, especially popular in summer (Figure 8).

3.4.3 Spices

In Taishan County, 13 WEPS from 8 families are utilized as spices, valued for their potent aromas that elevate local dishes. Key species include *Perilla frutescens*, *Houttuynia cordata*, *Ficus hirta*, *Artemisia indica*, and *Pluchea indica* (L.) Less. Seven species are primarily consumed for their shoots, while the remaining 6 species are utilized for their fruits (1 species), flowers (1 species), whole plants (1 species), roots (1 species), stems (1 species), and stems and leaves (1 species).

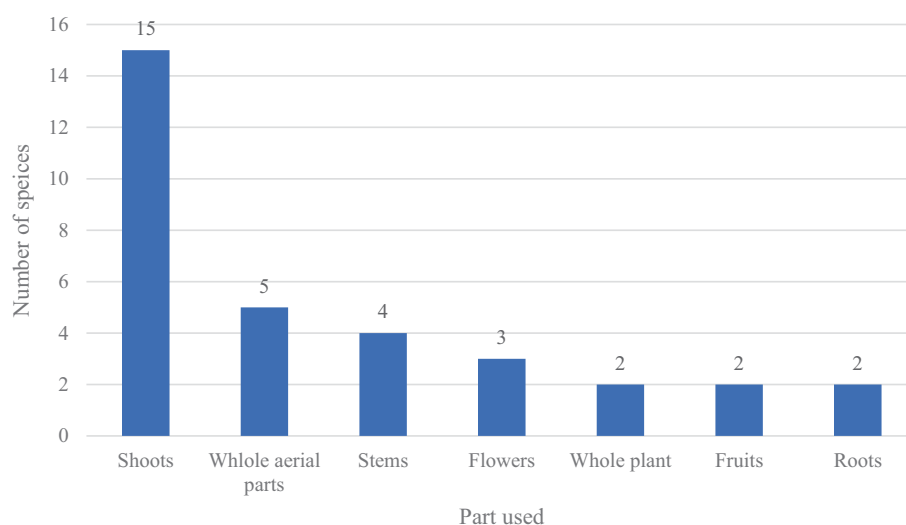


FIGURE 7
Edible parts of WEPs utilized as vegetables in Taishan County.

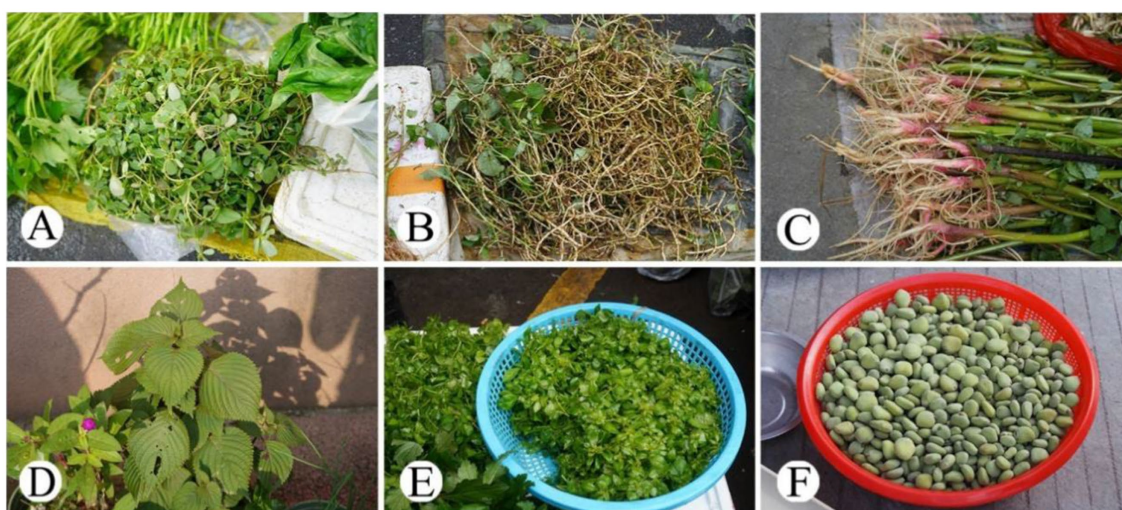


FIGURE 8
Common wild vegetable plants in Taishan County. (A) *Portulaca oleracea*; (B) *Houttuynia cordata*; (C) *Amaranthus spinosus*; (D) *Perilla frutescens*; (E) *Eleutherococcus trifolius*; (F) *Avicennia marina*.

In local markets, *Ficus hirta*, locally known as “五指毛桃”(wuzhimaotao), is prominently featured. Its dried roots are simmered in chicken soup, imparting a distinctive milky aroma that enhances the dish's flavor profile. This species is highly valued for its health benefits, particularly for strengthening the spleen and nourishing the lungs (Ma and Tang, 2018). Another notable spice, *Kaempferia galanga* L., adds a distinctive flavor to stir-fried meats, setting it apart from common ginger.

The seasonal utilization of plants such as *Artemisia argyi*, *A. indica*, and *Pluchea indica* traditionally spans from Tomb-Sweeping Day to the Dragon Boat Festival. Among these, *Artemisia argyi* (commonly known as Chinese mugwort) holds particular cultural significance as a widely used traditional herb throughout China (Liu et al., 2021). It is deeply rooted in Chinese folklore and traditional

practices, where it is believed to possess protective and purifying properties. During the Dragon Boat Festival, *Artemisia argyi* is often hung on doors and windows to ward off evil spirits, diseases, and misfortune, symbolizing blessings and good health for the household (Jin and Tian, 2018). In culinary practices, the shoots are boiled and mashed, then mixed with glutinous rice flour to prepare traditional festival foods such as “粿” (guo, a type of traditional rice cake).

In the Southeast Asian Cultural Village, residents introduced aromatic plants such as *Pandanus amaryllifolius* Roxb. (“斑斓叶,” banlanye; cultivated; excluded from Supplementary Table S2) and *Cymbopogon citratus* (DC.) Stapf (“柠檬草,” ningmengcao) that have gained popularity as spices. Their leaves are widely incorporated into both desserts and savory dishes, including Banlan Cake, Banlan Roll, and Lemongrass Chicken, which have become

local specialties. Notably, BanLan Cake, has achieved remarkable popularity and become a ubiquitous breakfast item across the entire county.

3.4.4 Food dyeing

Dyeing plants are species capable of producing distinct colors and demonstrating significant dyeing effects when combined with food materials. Five species are identified as possessing these properties: *Peristrophe bivalvis*, *Artemisia argyi*, *Artemisia indica*, *Paederia foetida*, and *Pluchea indica*.

The dyeing processes of *Peristrophe bivalvis* and *Peristrophe baphica* (locally called “红蓝草,” honglancao) are remarkably similar. Their stems and leaves are crushed to extract pigmented juice, which is then used to either soak glutinous rice or mix with rice flour, achieving the desired color transformation (Huang, 2005; Luo et al., 2019). While *Peristrophe bivalvis* intrinsically produces a blue pigment, *Peristrophe baphica* juice turns blue when alkalinized with wood ash. By applying acidic solutions of varying concentrations, the juice can be transformed into shades of pink, purple, or brownish-red hues. Additionally, the leaves of *Artemisia argyi*, *A. indica*, *Paederia foetida*, and *Pluchea indica* are either crushed or juiced and subsequently blended with glutinous rice flour to produce rice cakes with greenish-brown or blackish-brown coloration, imparting diverse flavors (Figure 9).

3.4.5 Wild fruits, snacks and liquor brewing

In Taishan County, five principal plant species have been identified: *Rhodomyrtus tomentosa* (Aiton) Hassk., *Pandanus tectorius* Parkinson, *Garcinia multiflora* Champ. ex Benth., *G. oblongifolia* Champ. ex Benth., and *Phyllanthus emblica* L. Among these, three species (*Rosa laevigata* Michx., *Phyllanthus emblica* and *Rhodomyrtus tomentosa*) are also utilized in traditional liquor production. Additionally, the fruits and seeds of four species (*Gnetum luofuense* C. Y. Cheng, *Phyllanthus emblica*, *Trapa natans* L. and *Rhodomyrtus*

tomentosa) are processed into snacks, demonstrating the multifunctional use of these plants.

Wild fruits are primarily consumed fresh. The blackish-purple berries of *Rhodomyrtus tomentosa* are sold at 15 CNY per half-kilogram, though consumption should be moderated due to potential constipation effects (Wei et al., 2024). *Phyllanthus emblica* fruits undergo a distinctive flavor transition from astringent to sweet during ripening and are valued at 8 CNY per half-kilograms. The fruits of *Garcinia multiflora* and *G. oblongifolia*, resembling *Garcinia mangostana* in taste but smaller in size, are particularly favored by children. *Pandanus tectorius* requires special preparation—soaking in saltwater for at least 30 min, to remove toxicity before consumption—due to its mildly sweet taste. Traditional liquor production employs two primary methods for processing *Rosa laevigata*, *Phyllanthus emblica*, and *Rhodomyrtus tomentosa*: the Crushing Method, where washed fruits are crushed and soaked in white spirit within sealed glass or ceramic containers; and the Steaming Method, where fruits are steamed, dried, and then soaked with rock sugar in white spirit. Both techniques require a minimum three-month fermentation period, reflecting the community’s understanding of biochemical transformation processes.

The processing of these plants into snack forms exhibits typical traditional knowledge. The seeds of *Gnetum luofuense*, harvested in autumn and winter, are roasted and consumed as a treat. *Phyllanthus emblica* fruits demonstrate remarkable versatility in snack preparation, with three distinct processing methods, i.e., raw consumption, quick-pickling (using sugar, salt, and chili powder), and long-term jar marination. *Rhodomyrtus tomentosa* fruits are transformed through steaming and sugar-pickling processes into chewy candied products, highlighting the community’s innovative preservation techniques.

The multiple utilization of these species highlights their significant cultural and economic value. For instance, both *Rhodomyrtus tomentosa* and *Phyllanthus emblica* serve multiple purposes: they are consumed as fresh wild fruits, processed into snacks, and used in



FIGURE 9

Food made from WEPS. (A) The soup made of the shoots of *Eleutherococcus trifolius* and minced pork; (B) “粿” (guo) made with the shoots of *Paederia foetida* and glutinous rice flour; (C) “粿” (guo) made with the shoots of *Pluchea indica* and glutinous rice flour; (D) Flower-shaped “粿” made with the shoots of *Artemisia indica* or *A. argyi* and glutinous rice flour; (E) Round “粿” made with the shoots of *Artemisia indica* or *A. argyi* and glutinous rice flour; (F) Banlan roll made with the leaves of *Pandanus amaryllifolius*, wheat flour, glutinous rice flour and corn starch.

liquor brewing. Among these, *Phyllanthus emblica* stands out for its exceptional versatility, as it is eaten raw, pickled, or fermented into alcoholic beverages. The multiple utilization methods and the diversity of edible species of WEPs in Taishan County indicate that local residents have deep-rooted knowledge of these plants which are seamlessly integrated into their daily life.

3.5 Analysis of the relative frequency of citation

Based on the calculation results of the Cultural Food Significance Index (CFSI) for WEPs in Taishan County, species with extensive utilization and high cultural value have been identified (Supplementary Table S2). The WEPs are classified into four groups according to their CFSI values: very high significance (CFSI > 500), high significance (500 > CFSI ≥ 100), moderate significance (100 > CFSI ≥ 10), and low significance (CFSI < 10).

1. Very high significance (CFSI > 500):

This category comprises eight species: *Portulaca oleracea*, *Houttuynia cordata*, *Plantago asiatica* L., *Centella asiatica*, *Amaranthus spinosus*, *Perilla frutescens*, *Hypericum japonicum* Thunb. ex Murray, and *Eleutherococcus trifoliatus*. These widely distributed and easily accessible species primarily function as wild vegetables while also serving as ingredients for traditional herbal teas and spices. Among them, *Portulaca oleracea* exhibits the highest CFSI value due to its dual medicinal-culinary applications, high nutritional value, and current utilization across multiple industries including pharmaceuticals, nutraceuticals, cosmetics, haircare products, and animal feed. These multifunctional characteristics suggest that *P. oleracea* holds considerable potential for further development in herbal medicine and related industries (Wang et al., 2018).

2. High significance (500 > CFSI ≥ 100):

This group comprises 12 species: *Murdannia bracteata* (C. B. Clarke) J. K. Morton ex D. Y. Hong, *Emilia sonchifolia*, *Ficus hirta*, *Abrus pulchellus* subsp. *cantonensis*, *Smilax glabra* Roxb., *Peristrophe bivalvis*, *Nanhaia speciosa* (Champ. ex Benth.) J. Compton & Schrire, *Dicliptera chinensis*, *Elephantopus scaber*, *Leonurus japonicus*, *Scleromitrium diffusum*, and *Artemisia argyi*. Widely distributed, these species serve multiple purposes—including tea substitutes, vegetables, food dyeing materials, snacks, and spices for the local population. Their comparatively lower CFSI values (relative to the > 500 CFSI tier) reflect limited edible portions, distinct taste/flavor characteristics, and specialized usage applications.

3. Moderate significance (100 > CFSI ≥ 10):

A total of 36 plant species fall into this category. These plants serve primarily as tea substitutes and wild vegetables. Although their growing areas, distribution ranges, and harvestable quantities are less extensive than those in the higher significance categories, they are relatively easy to collect and are incorporated into the daily diets of local residents, albeit with a lower consumption frequency. Examples include *Oldenlandia corymbosa* and *Amorphophallus paeoniifolius*.

4. Low significance (CFSI < 10):

This category includes 75 rarely encountered and infrequently consumed plant species. Primarily utilized as medicinal tea substitutes, these species typically exhibit strong therapeutic properties and pronounced bitter flavors. Representative examples include *Physalis angulata* L. and *Eragrostis tenella*. Their limited usage patterns appear attributable to two key factors: characteristically intense medicinal flavors and constrained ecological availability.

4 Discussion

4.1 Characteristics of WEPs in Taishan County

4.1.1 Health-promoting effects of WEPs

The consumption of WEPs among in Taishan County is predominantly influenced by two key factors. First, the region's hot, humid climate and distinctive geography have cultivated a traditional dependence on medicinal WEPs to address health concerns related to damp-heat conditions. Second, WEPs serve as crucial dietary supplements that compensate for nutritional deficiencies in local diets. Numerous studies demonstrate that wild vegetables generally possess greater nutritional value than their cultivated counterparts (Xiao and Wei, 1996; Guil-Guerrero et al., 1999; Srivastava, 2011; Riquelme et al., 2016; Fu et al., 2018).

Our CFSI analysis identified 118 Taishan WEP species in Taishan County that serve dual medicinal and nutritional purposes. Through comprehensive field surveys and literature reviews, we found these species are most commonly prepared either as traditional herbal teas or incorporation into soups. These traditional preparation methods have been pharmacologically validated for their health benefits. For instance, animal studies have shown that Guangdong herbal tea formulations can enhance anaerobic metabolism, regulate lipoprotein levels, and reduce blood glucose concentrations (He et al., 2009; You et al., 2012). A specific herbal tea preparation combining *Lonicera japonica* and *Chrysanthemum indicum* L. flowers, *Morus alba* L. and *Microcos paniculata* L. leaves, *Perotis indica* (L.) Kuntze roots, and *Persicaria chinensis* (L.) H. Gross whole aerial parts has demonstrated efficacy in clearing pathogenic heat and inhibiting HSP70 expression in rat shock models (Hu et al., 2008).

Similarly, Cantonese-style soups have shown significant health benefits (Yao, 2019). A notable formulation containing *Polygonatum odoratum* (Mill.) Druce and *Ophiopogon japonicus* (L. f.) Ker Gawl. roots, *Bombax ceiba* L. and *Selenicereus undatus* (Haw.) D. R. Hunt flowers, and *Abrus pulchellus* subsp. *cantonensis* whole aerial parts has been associated with reduced nasopharyngeal cancer incidence in high-risk areas of Guangdong Province (Li et al., 2017). These findings collectively underscore the significant role of traditional WEP preparations in both health maintenance and disease prevention within the region.

4.1.2 Preference for bitter-tasting plants

Taishan County residents have developed a distinct culinary preference for bitter-tasting plants, a dietary tradition shaped by cultural practices and adaptation to the region's hot, humid climate (Wang, 1995; Liu et al., 2013). Through generations of experiential

knowledge, locals have identified and incorporated bitter plants such as *Eleutherococcus trifolius*, *Dicliptera chinensis*, *Rorippa indica*, and *Gynura divaricata* (L.) DC. into their diets as dietary vegetables. To moderate their intense flavor, traditional cooking methods like blanching are routinely employed to reduce bitterness prior to consumption (Guan et al., 2013).

This flavor preference is physiologically adaptive, as the local climate increases susceptibility to heat-and humidity-related health conditions. In Southern China, bitter plants such as *Lonicera confusa* and *Lonicera japonica* (locally called “金银花,” jinyinhua) are widely utilized both in traditional herbal teas and dali health products (Mo and Geng, 2009). Similarly, *Scleromitrium diffusum* and *Oldenlandia corymbosa* (both known as “蛇舌草,” sheshecao) maintain popularity despite frequent market misidentified due to morphological similarity (Cheng et al., 2017).

While valued for their medicinal properties, these plants are primarily cherished for their cultural significance and efficacy in addressing climate-associated health issues through traditional dietary practices. Prime example are the summer consumption of the shoots of *Eleutherococcus trifolius* soups with lean meats or *Scleromitrium diffusum* and *Oldenlandia corymbosa* herbal teas - practices developed to counteract heat-related ailments. Such bitter plant usage in Taishan County reflects a deeply rooted culinary tradition that extends beyond healthcare, representing an integrated system of flavor appreciation, ecological wisdom, and environmental adaptation.

4.1.3 The consumption of non-native plants

Taishan County exhibits a distinctive pattern of consuming invasive and naturalized WEPs, with 17 species from 13 families incorporated into local practices. Among these, *Portulaca oleracea* and *Amaranthus spinosus* demonstrate exceptional cultural and dietary importance, both achieving CFSI values above 500. These species are not only ecologically abundant but also deeply integrated into daily life. *Portulaca oleracea* serves as a prime example of a dual-purpose medically food, being officially recognized among 78 wild plants approved for both dietary and therapeutic use by the Ministry of Health of China. Its inclusion in the 2008 Beijing Olympics menu and designation by the World Health Organization (WHO) as a globally important medicinal species underscore its value (Alam et al., 2014; Wang and Song, 2015). Contemporary pharmacological research has validated its diverse therapeutic properties, including antibacterial, lipid-lowering, anti-aging, muscle-relaxing, anti-inflammatory, analgesic, and wound-healing effects (Zhou et al., 2015). Similarly, *Amaranthus spinosus* is primarily harvested as a wild vegetable, with local communities consuming its shoots and incorporating its roots into health-promoting soups (Alam et al., 2014).

These non-native species share several adaptive advantages that enhance their utility in Taishan County. Many species, such as *Portulaca oleracea*, *Amaranthus spinosus*, *Mirabilis jalapa* L., and *Solanum americanum* Mill., originate from tropical or subtropical regions, making them particularly suited to the local climate. Their capacity to thrive in disturbed habitats and marginal lands increases accessibility, while their rapid growth cycles facilitate frequent harvesting. Species such as *Cymbopogon citratus* and *Eclipta prostrata* (L.) L. are commonly found in open fields and along roadsides, making them easily accessible for use (Haubrock et al., 2021).

Culinary applications predominantly feature these plants in traditional herbal teas and soups. *Imperata cylindrica* var. *major*

(Nees) C. E. Hubb. and *Scoparia dulcis* are routinely prepared as herbal infusions (Li et al., 2017), while *Anredera cordifolia* and *Amaranthus spinosus* are valued soup ingredients for their combined nutritional and medicinal benefits (He et al., 2009). Beyond dietary uses, many species are employed for their therapeutic properties: *Euphorbia hirta* L. and *Senna occidentalis* (L.) Link for their anti-inflammatory and detoxifying effects (Kumar et al., 2010; Nde et al., 2022), and *Selenicereus undatus* for its antioxidant capacity (Nde et al., 2022).

This incorporation of non-native species into local food and healthcare systems demonstrates the community's adaptive resourcefulness in meeting nutritional and health requirements. The practice reflects both the cultural significance of these plants and their ecological contribution to community well-being. Through sustainable utilization of naturalized species, Taishan residents have developed innovative solutions to food security and health management within their unique environmental context.

4.2 Suggestions on the development, utilization and protection of WEP resources in Taishan County

4.2.1 Preserve and promote the traditional knowledge related to WEPs

It is imperative to preserve local dietary traditions, as traditional knowledge of WEPs is increasingly threatened by urban modernization. Ethnobotanical studies and systematic research are urgently needed to document and safeguard this invaluable heritage (Bharucha and Pretty, 2010; Turner et al., 2011).

During interviews, respondents reported that WEP knowledge is primarily passed down orally and through hands-on demonstrations, with elders teaching younger generations. However, this knowledge is now mostly retained by older individuals. Younger generations show little interest in learning about WEPs, mainly because plant-based food preparation is perceived as complex, and there are few engaging or accessible ways to learn (Reyes-García et al., 2013). Furthermore, the lack of standardized techniques and low public awareness have hindered the wider adoption of WEP-based foods, which remain limited to household consumption rather than entering mainstream cuisine.

To tackle these challenges, innovative and engaging educational methods must be developed to revive youth interest in WEPs (Turner et al., 2011). Digital outreach tools could prove particularly effective in this regard, including mobile applications delivering WEP information in youth-friendly formats, interactive nature trails enhanced with QR code technology, and engaging video series. Such approaches, combined with establishing technical guidelines and awareness campaigns, could facilitate the commercialization of WEP-derived foods while preserving traditional knowledge (Tilman and Clark, 2014; Ran et al., 2022). This integrated strategy would promote the sustainable use of local plant resources, ensuring their cultural and dietary relevance for future generations.

4.2.2 Formulate production standards for WEP-based food and promote local specialties

According to our survey, Taishan County residents, traditionally prepare “粿” (guo) using the shoots of *Artemisia indica*, *Paederia*

foetida, and *Pluchea indica*. This dish is highly valued for its distinctive aroma and flavor. With government support, these plants are now cultivated on a large-scale. Standardized production and centralized processing would enhance the quality and safety of these foods, enabling broader commercialization (Johns and Eyzaguirre, 2006). This approach would preserve and showcase local cultural heritage while boosting Taishan County's economy through sustainable, marketable products. Such initiatives would integrate traditional knowledge into modern markets, promoting both cultural preservation and economic growth (Berkes et al., 2000).

4.2.3 Research on the component value of WEPs

While WEPs are widely valued for their nutritional and medicinal benefits and are dietary staples in many regions, their safety has not been systematically studied. Little is known about the chemical composition and nutritional profiles of many WEPs (Bharucha and Pretty, 2010). For instance, in Taishan County, species used in herbal teas or Cantonese soups lack validated data on their pharmacological effects (Pyšek and Richardson, 2010). To address these knowledge gaps, priority should be given to systematic phytochemical screening and nutritional profiling of high-consumption species. Modern analytical techniques, including High Performance Liquid Chromatography–Mass Spectrometry (HPLC–MS) for non-volatile and high-molecular-weight compounds, and Gas Chromatography–Mass Spectrometry (GC–MS) for volatile and thermally stable analytes, should be employed to identify bioactive constituents and evaluate their stability under traditional processing conditions. Prioritize invasive species with dual dietary-ecological impacts, integrating ethnobotanical data with metabolomics to establish evidence-based safety thresholds. Such scientific validation would establish evidence-based usage guidelines while preserving the nutritional integrity of these plants.

This lack of data is especially problematic for invasive species, whose chemical profiles are rarely studied and may pose health risks if overconsumed. Additionally, some plants contain natural toxins: unripe *Pandanus tectorius* fruit, for example, harbors calcium oxalate crystals that irritate mucous membranes when consumed raw (Thomson et al., 2006). Traditional processing methods like fermentation and boiling have proven effective in neutralizing such hazards (Pejchar and Mooney, 2009; Kuhnlein and Turner, 2020), but require standardization through modern scientific validation. A dual approach combining laboratory analysis of toxin degradation pathways with community-based documentation of traditional detoxification practices would optimize safety protocols. Particular attention should be given to species with known toxic constituents and those exhibiting invasive characteristics.

Implementation of a comprehensive safety framework necessitates multidisciplinary collaboration. Key components include: (1) development of standardized processing protocols validated through scientific testing, (2) establishment of community monitoring systems for adverse effect reporting, and (3) creation of targeted education programs focusing on proper identification and preparation techniques. Regulatory measures should mandate safety assessments and clear labeling for commercial WEP products, while technological innovations like mobile identification apps can support proper utilization (Reyes-García et al., 2019). This

integrated approach ensures the sustainable use of WEPs while mitigating potential health risks through the synergy of traditional knowledge and modern science.

5 Conclusion

Taishan County exhibits rich biodiversity of WEPs, with 131 documented species spanning 117 genera and 59 families. By applying the CFSI, we systematically identified the most culturally important WEPs, which primarily function as tea substitutes, wild vegetables, and spices.

Current WEP consumption patterns in Taishan County are shaped by both geographical and socio-cultural influences. Notably, local communities preserve traditions of preparing herbal teas and Cantonese-style soups, embodying the traditional Chinese principle of 'Medicinal and Edible Homology'. A distinctive cultural preference for bitter-tasting plants is also evident, likely rooted in traditional medicinal practices.

This study provides the first comprehensive documentation of WEP-related traditional knowledge and utilization methods in Taishan County, establishing a scientific foundation for their conservation and sustainable use. However, rapid urbanization threatens this knowledge system. Of concern, WEP expertise is now predominantly held by middle-aged and elderly residents, with limited engagement from younger generations. This intergenerational knowledge gap risks irreversible cultural erosion. Urgent preservation strategies are needed to safeguard this intangible heritage and ensure its continuity.

Data availability statement

The original contributions presented in the study are included in the article/[Supplementary material](#), further inquiries can be directed to the corresponding authors.

Author contributions

SZ: Methodology, Investigation, Data curation, Software, Writing – original draft, Formal analysis, Writing – review & editing. CH: Supervision, Conceptualization, Validation, Investigation, Resources, Writing – review & editing, Funding acquisition. LS: Writing – review & editing, Data curation. HW: Writing – review & editing, Funding acquisition, Resources. JL: Writing – review & editing, Visualization. YL: Funding acquisition, Conceptualization, Resources, Validation, Supervision, Writing – review & editing, Investigation.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2025.1606420/full#supplementary-material>

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