The Diversity Of Wild Medicinal Plants Of Lufeng In Eastern Guangdong, China

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Abstract

Backgrounds: Lufeng is located in the most backward coastal city in Guangdong, but it is a good place for medicinal plant cultivation because of the richness of plant species and the variety of land types, potential and adaptability. However, there are few comprehensive reports on the existing wild medicinal plants in Lufeng City. Relying on the fourth national census of Chinese medicine resources, this study aims to document the diversity of wild medicinal plant resources, medicinal properties, flavors, and effects, as well as the comprehensive value of key medicinal plants in Lufeng City.

Methods: By consulting literature, collecting medicinal plants specimens, and field investigation, 36 sample sites and 32 sample lines in Lufeng were studied. For each described plant species, the composition of the family and genus, life forms, medicinal properties and flavors, the part of the plant used in medicine, and the medicinal uses were recorded. Key medicinal plants shall be determined by the catalog of the National Census of Chinese Medicinal Resources focused on the investigation of Chinese medicinal resources (Chinese herbal medicine), and the key medicinal plants with high comprehensive value in the city shall be determined by calculating the comprehensive value (SVMP).

Results: 410 species of wild medicinal plants were identified, belonging to 304 genera and 118 families. Perennial herbs and shrubs were the main life forms. In terms of medicinal parts, the most are roots and rhizomes, accounting for 49.02%. WMPs with flat property (33.17%) took the largest proportion. These medicines mainly had three medicinal flavors, including sweet (39.27%) bitter (35.37%), and pungent (31.71%). The main uses of them were clearing heat (38.29%). The comprehensive value of imperative WMPs is high, but the development and utilization rate is low.

Conclusion: Lufeng city is rich in the kinds of WMPs. In the future, in order to promote the local economic development, wild medicinal plants with high comprehensive value: *Sargentodoxa cuneata*, *Plantago asiatica*, *Mentha canadensis*, *Juncus effusus* and *Turpinia montana* should be developed. At the same time, the WMPs should be carefully considered in future development plans aimed at promoting sustainability.

Introduction

Medicinal plant resources refer to all kinds of plant resources that have been known and used to treat human diseases and animal diseases, and have the functions of killing insects and weeding (Wang et al. 2002), including Chinese medicine, herbal medicine, chemical raw materials plants, veterinary drugs and plant-based pesticides (Ou 2006) Medicinal flora play an essential function inside the prevention and remedy of human and animal sicknesses, prevention and manage of pests and sicknesses within the field, and are necessary primary substances in humans's production and life. China is wealthy in medicinal plant sources, with 11146 species belonging to 2,309 genera and 383 families, accounting for 87% of the resources of conventional chinese medicine (Ding and Xia 2005). Because of its extraordinary geographical function, Guangdong harbors a superb variety of vegetation, more than 7000 vascular plant species arise in this region (Ye and Peng 2006). Guangdong is located in the southern tropical to the

northern edge of the tropics, rich in wild natural resources and effective genuine medicinal materials. And it is one of the main origins of southern medicine in China, and is building an internationally famous brand with the strategic thought of "great Southern medicine" (Zhang and Huang 2018). Lufeng city has mild weather, ample rainfall, fertile soil, greater sorts and abundant vegetation, so there are extra wild medicinal plant assets. In the 1980s, Xiuren Wu investigated and analyzed the economic plant resources in Shantou (Wu 1981, 1982). In recent years, Shaolian Chen and Jianquan Wen et al. respectively studied the high-yield rice cultivation techniques (Chen 2016) and climate factors (Wen and Liu 2019) in Lufeng City. Guangdong Academy of Agricultural Sciences studied the natural survival popularity, collection and safety of common wild rice in Lufeng city (Fan et al. 2017). The Chinese Academy of Fishery Sciences made a comparative analysis of the phytoplankton community structure characteristics in Lufeng sea area (Su et al. 2017) and other cities. The above studies only involved individual plant groups or species in Lufeng city, and no survey of all naturally growing medicinal plants of the present study area has been reported till date. Based on the fourth national survey of traditional Chinese medicine resources in Lufeng city, the present situation of wild medicinal plant resources in Lufeng city was investigated systematically and comprehensively. The study will offer the bases for recognizing the biodiversity of flora in Lufeng city within the shape of a guide. The diversity characteristics and comprehensive value of wild medicinal plants in Lufeng city were analyzed based on the data and data obtained from the survey, in order to provide information for the development and utilization of wild medicinal plant resources and rural revitalization.

Materials And Methods

Study area

The region investigated in this study is located in the coastal area of eastern Guangdong, and is one of the poorest and most remote regions in Shanwei. Lufeng is placed in Jieshi Bay at 22.45°-23.09°N latitude, 115.25°-116.13°E longitude and it is a southern subtropical maritime monsoon weather with sufficient light, heat and water sources. It is one of the 3 well-known rainstorm centers in Guangdong province. In winter, it is regularly one of the warmest regions in Guangdong Province, with the yearly rainfall of 2106.6 mm and the average annual temperature of 22.7°C. The full number of sunshine hours per year is 1892.9 hours (Xie and Chen 2021). The town has a complete area of 1687.7km², the soil is mainly granite, sand shale and quaternary impact gravel. The topography is diverse, which includes mountains, hills, terraces, plains, mudflats, and many others. The entire terrain is oriented north-south, except for the southern Wufeng Mountains, which are oriented east-west, with the peak elevation of 980.3m, and the terrain is relatively flat. Chaoshan area is rich in medicinal plant resources. According to statistics, there are 1161 species (Li and Zhan 2010). The total area of Lufeng only accounts for 10.55% of Chaoshan region, but wild medicinal plants account for 35.31% of the total number of species of medicinal plants in Chaoshan area, which shows that Lufeng is rich in medicinal plant species. Common wild medicinal plants include *Psychotria asiatica*, *Melastoma sanguineum*, *Tadehagi triquetrum*, *Schefflera heptaphylla*, *Ilex asprella*, etc.

Vegetation Survey

The fieldwork in this study was conducted over a period of eight weeks from 2019 to 2020. There were 36 sample plots and 32 sample lines surveyed using the sample plot survey method and the sample line survey method by literature retrieval, photo taking, specimen collection and identification, and medicinal materials collection, especially for the basal source plants of imperative herbs.

According to the Technical Specification of National Census of Chinese Medicine Resources (Huang and Wang 2015), combined with the topography and vegetation distribution characteristics of the survey site, and according to the requirement that the natural ecological environment characteristics are as consistent as possible, and the natural ecological environment characteristics vary among the representative areas. Three representative areas of grass, scrub and coniferous forest were selected in Lufeng City. A total of 36 sample plots were selected by mechanical sample selection method from the 43 sample plots automatically and randomly generated by the Information management system of national General Survey of Traditional Chinese Medicine Resources, excluding 7 sample plots No.2, No.3, No.6, No.7, No.8, No.17 and No.29 (Fig. 1). The sample plot survey method (Tong et al. 2010) was adopted, and the sample plot was set within 2 km from the center point of the sample plot through GPS positioning. Each sample plot was set with 5 sets of 10 m×10 m quadrats, i.e., 10×10m sample set. Six samples were set up in each sample set, including one 10m×10m sample set for investigating tree medicinal plants, numbered 1, one 5m×5m sample set for investigating shrub medicinal plants, numbered 2, and four 2m×2m sample sets for investigating herb medicinal plants, numbered 3, 4, 5 and 6, respectively. Geographical information, such as latitude, longitude and altitude, as well as the names and numbers of different species of wild medicinal plants in each sample square were recorded, the overall, medicinal parts and habitats of each plant were photographed, and voucher specimens were collected. There were 36 sample plots, 180 sample squares, and 1080 sample sets completed by repeatedly conducting field sample surveys.

The sample line survey was mainly to collect plant specimens with flowers and fruits on the way to the sample sites, record the plant species not seen in the sample sites, and record their habitats, elevations and distribution locations. In addition, for special habitats, such as valleys, peaks and rivers, another sample line was set up for centralized survey and recording, and a total of 32 routes were completed.

The survey focused on the lowland broadleaf evergreen forests, which have received less attention but are the most widely distributed in the area (mostly wind and water forests located in front of village houses), and also surveyed other vegetation types in the area, such as tropical monsoon rainforests, plantation forests, tropical coastal scrub and hilly scrub, hilly grass and wet grass, etc. More than 2000 specimens were collected. Identification of these plants is based on the flora of the region (Kachroo et al. 1977; Polunin and Stainton 1984; Aswal and Mehrotra 1994; Murti 2001). Furthermore, the collected voucher specimens were organized, relevant books were consulted, experts were asked for identification, and the medicinal property and flavors, the part of the plant used and the uses of each plant seen were

queried through literature to compile the "List of Wild Medicinal Plants in Lufeng", and the diversity of wild medicinal plant resources in the study area was analyzed.

Results

Species composition

According to the "List of Wild Medicinal Plants in Lufeng City" compiled by the city, there are a total of 410 species of WMPs in 304 genera of 118 families and 381 genera of 100 families of angiosperms, including 333 species in 245 genera of 86 families of dicotyledons, 48 species in 37 genera of 14 families of monocotyledons, 24 species in 18 genera of 14 families of pteridophytes 4 families of gymnosperms 4 genera and 5 species, mainly dicotyledonous angiosperms, whose families, genera and species account for 72.88%, 80.59% and 81.22% of the total families, genera and species of wild medicinal plants in Lufeng City, respectively (Fig. 2). There are three species of rare medicinal plants (Qin et al. 2017): *Spatholobus suberectus*, *Aquilaria sinensis*, and *Litchi chinensis*.

Fig. 2 Species composition of wild medicinal plant resources in Lufeng City, Guangdong, China

Composition Of The Family And Genera

There are 57 species of monocotyledonous family and 53 species of oligocotyledonous family, which together account for 93.22% and 66.1% of the total number of families and species; there are 5 families and 72 species of middle family, and 3 large families containing more than 20 species, namely Papilionaceae (23 species), Euphorbiaceae (22 species) and Asteraceae (22 species), accounting for 2.54% of the total number of families and 67 species. Euphorbiaceae (22 species), Asteraceae (22 species), accounting for 2.54% of the total number of families, and 67 species, accounting for 16.34% of the total number of species, which indicates that the wild medicinal plant species in Lufeng tend to be within a limited number of families, and the phenomenon of dominant family is very obvious.

At the genus level, among the 304 genera of wild medicinal plant resources in Lufeng, the most genera are monospecific, with 236 genera and 236 species, accounting for 77.63% and 57.56% of the total genera and species, such as *Cibotium*, *Adinandra*, *Schima*, *Plantago*, and so on. There are 67 genera and 163 species of oligotrophic genera, accounting for 22.04% and 39.76% of the total number of genera and species, and only one species and 11 genera of intermediate genera, i.e., *Ficus*, and the phenomenon of dominant genera is not obvious.

Table 1
Composition of families and genera of wild medicinal plant in Lufeng City, Guangdong, China

Type ^a (Number of species)	Number	Percent	Type ^b (Number of species)	Number	Percent
l.f(> 20)	3	2.54	l.g(> 20)	0	0
m.f(11–20)	5	4.24	m.g(11–20)	1	0.33%
se.f(2–10)	53	44.91	se.g(2–10)	67	22.04%
Si.f(1)	57	48.31	Si.g(1)	236	77.63%
^a l.f large family (family with more than 20 plant species), m.f middle family(family with 11–20 plant species),se.f several family(family with 2–10 plant species), si.f single family(family with only 1 species)					
^b l.g large genera (genera with more than 20 plant species), m.g middle genera (genera with 11–20 plant species),se.g several genera(genera with 2–10 plant species), si.g single genera(genera with only 1 species)					

Life Types Diversity

The wild medicinal plants in the study area have a diversity of life types and are divided into two categories: herbs and woody plants. Herbs subdivided into annual herbs, perennial herbs and herbaceous vines, and woody plants subdivided into woody vines, shrubs and trees (Fig. 3).

Perennial herbs and shrubs accounted for the highest proportion, with 110 species of perennial herbs in 46 families, accounting for 25.14% and 26.83% of the total families and species, and 118 species of shrubs in 40 families, accounting for 23.5% and 19.51% of the total families and species. The least is herbaceous vines, with only 7 families and 10 species.

Figure 3 The diversity of life types of WMPs in Lufeng city, Guangdong, China

Medicinal Parts, Properties, Flavors And Uses Diversity

Based on the "Identification of Chinese Medicine" (Zhang 2002), the medicinal parts of WMPs in Lufeng were classified and counted according to root and rhizome, stem and wood, bark, leaf, flower, fruit and seed, whole herb and other combinations. The properties of the herbs are classified according to great cold, cold, slightly cold, cool, flat, slightly warm, warm and hot; and the medicinal flavors are classified according to bitter, pungent, sweet, astringent, light, sour and salty. The medicinal functions are classified according to the Chinese Pharmacopoeia (Zhong 2016) as relieving exterior syndrome, clearing heat, diarrhea, dispelling wind-damp, resolving dampness, relieving dampness, warming the lining, promoting qi, promoting digestion, expelling worms, activating blood circulation to dissipate blood stasis, stopping

bleeding, resolving phlegm, cough and asthma, softening liver for calming endogenous wind, relieving uneasiness of body and mind, tonifying deficiency, collecting astringency, and other 18 categories. Based on the Pharmacopoeia of the People's Republic of China (National Pharmacopoeia Commission 2015), the Dictionary of Traditional Chinese Medicine (Nanjing University of Chinese Medicine 2006), and the National Compilation of Chinese Herbal Medicines (National Compilation of Chinese Herbal Medicines Preparation Group 1975), the medicinal parts, herbal properties and uses of each plant were clarified.

Analysis of medicinal parts

the most wild medicinal plants with roots or rhizomes as medicinal parts, 200 species, accounting for 48.78% of the total number of species, include *Liriope spicata*, *Cibotium barometz*, *Manihot esculenta*, etc.; followed by whole herbs (151 species) and leaves (145 species) The whole herbs include *Alysicarpus vaginalis*, *Hypserpa nitida*, *Cheilanthes tenuifolia*, etc.; The stems and vines have 71 species of medicinal plants, accounting for 17.32% of the total number of species. The main species are *Alyxia sinensis*, *Ficus pumila*, *Tetracera sarmentosa* and so on. The other four medicinal plants that account for the least number of species are *Oryza sativa* with grain buds, *Cunninghamia lanceolata* with nodes on branches, *Dioscorea bulbifera* with bead buds in the axils of leaves, and sandalwood *Santalum album* with resin in the heartwood.

The composition of Chinese medicinal properties and flavors

medicinal properties and flavors is one of the important signs of drug performance, and it is of practical significance to clarify the commonality and individuality of various drug properties and flavors for clinical use(National Compilation of Chinese Herbal Medicines Preparation Group 1975). In terms of medicinal taste, the wild medicinal plants in Lufeng have the most bitter medicinal plants, 217 species, accounting for 52.93% of the total number of species, followed by more sweet and pungent medicinal plants, accounting for 39.27% and 31.71% of the total number of species, respectively, while the least salty medicinal plants. In terms of medicinal properties, this belief of cold and hot foods is used as a guiding principle when making medicinal soups(Luo et al. 2019). The most number of medicinal plants (140 species) were flat nature, accounting for 34.15%, followed by cool and warm medicinal plants, while the least proportion of hot and cold medicinal plants. To some extent, it verified the findings of Fang Tian et al. (Tian et al. 2010) that there was a strong negative linear correlation between warm and flat medicines and altitude, which means that the lower the altitude, the more warm and flat medicines.

Some medicinal plants can be used as multiple herbs and thus have multiple tastes. The leaves and stalks of *Nelumbo nucifera* have a bitter taste and flat medicinal properties; the lotus room has a bitter, astringent taste and warm medicinal properties; the seeds have a sweet, astringent taste and flat medicinal properties. *Morus alba's* mulberry bark is sweet and cold; the mulberry branch is bitter and flat; the mulberry leaf is sweet and cold, and the mulberry is sweet, sour, and warm. *Lonicera japonica* has a sweet, slightly bitter taste, and cold medicinal properties.

Composition of medicinal efficacy

the largest proportion of wild medicinal plants with efficacy in dispelling rheumatism in Lufeng, with a total of 75 families and 135 genera and 176 species, accounting for 42.93% of the total number of species, the main families of such plants are Rutaceae (9 species), Euphorbiaceae (8 species), Rubiaceae (8 species); followed by medicinal plants of the heat-clearing class (170 species), and the families containing more heat-clearing plants are mainly Asteraceae (13 species), Poaceae (10 species), Rubiaceae (10 species), and Rubiaceae (10 species). The least is the tonic and laxative medicinal plants, with only *Sida acuta* and *Wahlenbergia marginata*, the only laxative medicinal plants are *Triadica cochinchinensis*.

One medicinal plant can correspond to different herbs, and different herbs have different medicinal effects. The seeds of *Nelumbo nucifera* benefit the kidneys and strengthen the spleen; the plumule clears heart fire and lowers blood pressure; the stamen benefits the essence and astringency; the leaves and stalk of *Nelumbo nucifera* can be drunk in decoction to relieve summer heat and thirst and diarrhea; the root has the effect of dispersing bruises and stopping bleeding. The leaves of *Morus alba* treats wind-heat colds and coughs, *Cortex Mori* diarrhea lung and water, branch treats rheumatic arthritis, back and leg pain, and mulberry treats chronic hepatitis anemia and neurasthenia.

Table 2
Characteristics of WMPs occurring in Lufeng city, Guangdong, China

Feature	Number	Percent	Feature	Number	Percent
<i>A. medicinal parts^a</i>			light	61	14.88
roots and rhizome	200	48.78	sour	30	7.32
stem and wood	71	17.32	salty	2	0.49
bark	145	35.37	<i>D. uses^d</i>		
leaves	22	5.37	dispelling wind-damp	176	42.93
flowers	32	7.80	clearing heat	170	41.46
fruits and seeds	42	10.24	activating blood circulation to dissipate blood stasis	76	18.54
whole plant	151	36.83	stopping bleeding	75	18.29
other combinations	4	0.97	promoting qi	53	12.93
<i>B. properties^b</i>			relieving dampness	48	11.71
flat	140	34.15	resolving phlegm, cough and asthma	39	9.51
cool	120	29.27	other uses	27	6.59
warm	90	21.95	expelling worms	19	4.63
cold	75	18.29	relieving exterior syndrome	14	3.41
slightly warm	19	4.63	softening liver for calming endogenous wind	13	3.17
slightly cold	9	2.20	collecting astringency	11	2.68
hot	2	0.49	promoting Digestion	9	2.20
great cold	1	0.24	resolving dampness	7	1.71
<i>C. flavors^c</i>			relieving uneasiness of body and mind	4	0.98

^a Do not match to total percentage since a plant may make many kinds of herbs

^b Do not match to total percentage since a plant may have multiple medicinal properties

^c Do not match to total percentage since a plant may have multiple medicinal flavors

^d Do not match to total percentage since a plant may have multiple medicinal uses

Feature	Number	Percent	Feature	Number	Percent
bitter	217	52.93	warming the lining	3	0.73
pungent	130	31.71	tonifying deficiency	2	0.49
sweet	161	39.27	diarrhea	1	0.24
astringent	84	20.49			
^a Do not match to total percentage since a plant may make many kinds of herbs					
^b Do not match to total percentage since a plant may have multiple medicinal properties					
^c Do not match to total percentage since a plant may have multiple medicinal flavors					
^d Do not match to total percentage since a plant may have multiple medicinal uses					

Synthesis Value Value Of Imperative Wild Medicinal Plants

The 4th National Census of Chinese Medicinal Resources focused on the investigation of medicinal plants mainly based on the catalog of the National Census of Chinese Medicinal Resources focused on the investigation of Chinese medicinal resources (Chinese herbal medicine) (Huang and Wang 2015), and there were 62 species of wild medicinal plants in Lufeng City, accounting for 15.12% of the total number of wild medicinal plant resources in the whole Lufeng City. Analysis was based on the evaluation criteria of medicinal plant resources from certain literature (Che and Ke 1998, Yao et al. 1997, Xue et al. 1991, Wang et al. 1992), and combining the status of wild medicinal plant resources in Lufeng and the results of this survey. Six items, namely, the value of medicine (VM), the value of taxonomy (VT), condition of Endemic(CE), range of distribution (RD), quantity of wild resource (QR), and condition of culture (CC) were selected as indicators for the evaluation of the synthesis value of medicinal plants (SVMP) in Lufeng City. The indicators of SVMP evaluation were given weights, graded, and assigned values respectively (Table 3).

Based on the indicator weights and ranks and the assignment of values in Table 3, the synthesis value of the imperative surveyed wild medicinal plants in Lufeng was evaluated according to the following formula.

$$\text{SVMP} = 0.40\text{VM} + 0.08\text{VT} + 0.15\text{RD} + 0.25\text{QR} + 0.10\text{CC} + 0.02\text{CE}$$

Eq. 1 Formula for calculating the synthesis value of wild medicinal plants

The synthesis evaluation obtained from the calculation was graded according to the criteria in Table 4.

Table 3 The weight, grades and values of the factors used in assessing synthesis value of imperative medicinal plant in Lufeng city, Guangdong, China

Facts of evaluation	Weight	Grade	Value (cent)
Value of Medicine (VM)	0.4	Level 1: Commonly used species included in the Chinese Pharmacopoeia	3
		Level 2: Species included in "Chaoshan Chinese Herbal Medicine"	2
		Level 3: Other species	1
Value of Taxonomy (VT)	0.08	Level 1: Regional monotypic families and genera	3
		Level 2: Regional lesser genera (genera with species number 2-5)	2
		Level 3: Regional multiple genera (genera containing more than 5 species)	1
Range of Distribution (RD)	0.15	Level 1: Small range species (occurring only in 1-4 sample plots)	3
		Level 2: Medium range species (occurring in 5-10 sample plots)	2
		Level 3: Large range species (occurring in more than 10 plots)	1
Quantity of Wild Resource (QR)	0.25	Level 1: Scarcity of wild resources	3
		Level 2: Small number of wild resources	2
		Level 3: High number of wild resources	1
Condition of Culture (CC)	0.1	Level 1: Not yet cultivated, all wild resources used	3
		Level 2: Cultivated, but small area	2
		Level 3: Cultivated, with a large area	1
Condition of Endemic (CE)	0.02	Level 1: Genera and species endemic to Guangdong Province	3
		Level 2: Genera and species endemic to China	2
		Level 3: Non-Chinese endemic genera and species	1

Table 4 The grades of synthesis value of medicinal plant in Lufeng city, Guangdong, China

SVMP	≥2.5	2.0~2.5	1.5~2.0	≤1.5
Grades	highest	higher	average	low
Number of species	15	33	14	0
Percent	24.59	54.10	22.95	0

The evaluation results of the SVMP of imperative surveyed wild medicinal plants show that there are 15 imperative medicinal plants with higher SVMP ($SVMP \geq 2.5$) in Lufeng City, and the top 5 imperative wild medicinal plants are *Sargentodoxa cuneata*, *Plantago asiatica*, *Mentha canadensis*, *Juncus effusus*, *Turpinia montana* in order. Except for *Mentha canadensis*, the other four species are regional monocultures, especially the genus and species of *Sargentodoxa cuneata*, which are endemic to China. The wild resources of these five species are scarce, with small or no cultivation areas, such as *Mentha canadensis*, which is only found in farmers' vegetable plots. There are 33 plants with high SVMP ($2.0 \leq SVMP < 2.5$), accounting for 54.10%, and fewer plants with average SVMP ($1.5 \leq SVMP < 2.0$), with only 14 species, and no imperative medicinal plants with low SVMP ($SVMP < 1.5$).

The total number of imperative wild medicinal plant species with high and higher SVMP in Lufeng City accounts for 78.69% of the total. The survey found that the Lufeng city has high incineration of mountains for forestry and tomb construction, which is the reason for the difficulty of growth and reproduction renewal of such medicinal plants and their small distribution range, and it is urgent to carry out reasonable and effective protection.

Conclusions

According to the statistics of the third national census of Chinese medicine resources in 1986, only 124 species of wild medicinal plant resources were found in Lufeng City, which increased to 410 species in this survey. After more than 30 years of social and environmental development and changes, the WMPs resources in Lufeng City have changed greatly and the number of species has increased exponentially, mainly for two reasons: first, the protective environmental remediation and restoration since the 1990s has made Lufeng City still a relatively rich biodiversity area in Guangdong Province; second, the third census of Chinese medicine resources was led by the Chinese herbal medicine company, and the method and technology were limited. The species records are inevitably incomplete, while this Census of Chinese medicine resources adopts a more objective method of sample and sample line survey, so the results are more scientific and comprehensive.

The WMPs in Lufeng have obvious diversity in terms of species composition, family composition, life forms, medicinal parts, herbal properties and flavors, which is of great significance to the regionalized development of local Chinese medicine industry. The survey yielded 410 species of wild medicinal plants from 118 families and 304 genera in Lufeng City, with the most medicinal plants with roots and rhizomes used for medicine. The utilization of such plants generally comes at the cost of plant death, and therefore, a sustainable utilization program must be developed. The age-old tradition of gathering wild

medicinal plants is nowadays fading particularly among younger generations(Rana et al. 2012). The study also found that some of the plants in the city are poisonous: *Schima superba*, *Gelsemium elegans*, and *Strophanthus divaricatu* are highly toxic; the whole plant of *Dianella ensifolia* is toxic; the seeds and pods of *Archidendron lucidum* are toxic and can cause death by accidental ingestion, etc. They must be identified and used with special attention to medicinal safety. Through the evaluation of the synthesis value of imperative medicinal plants, it is found that the synthesis value is generally high, while the reserves of imperative medicinal plants with high value are low and need urgent protection. This bio-depletion is due to the exponential geometric growth of human population and man's technological capacity to exploit natural resources in an unsustainable way(Kumar et al. 2006). The awareness of plant protection and ecological values of local citizens should be strengthened.

Declarations

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Authors' contributions

YJ ,HJK and SHK collected the data.YJ and QXS identified the plants. YJ interpreted and analyzed data. YJ wrote the manuscript. YJ, HJK, SHK, and QXS modified the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials

The data used to support the findings of this study are available from the corresponding author upon request.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Figures

Figure 1
Geographical position of sample sets surveyed:(1) Guangdong, China. (2) Lufeng, Guangdong. (3) Lufeng 36 sample plots, 43 sample plots generated by the system, 36 completed sample plots are in red. The number represents the sample site number. (4) Each sample plot has 5 sample sets spaced 200m apart from each other. (5) The arrangement of sample set

Figure 2

Species composition of wild medicinal plant resources in Lufeng City, Guangdong, China

Figure 3