

An Ethnobotanical and Ethnomedicinal Investigation of Phytomedical Knowledge and Practice of Medicinal Plants in Lingchuan County, Shanxi, China

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Abstract

Background

Lingchuan County is the main producing area of Chinese medicinal materials in Shanxi Province, rich in medicinal plant resources. The aboriginal residents of Lingchuan County have certain traditional knowledge and experience in the use of medicinal plants and can effectively use medicinal plants to treat common diseases.

Methodology

A field survey in 53 villages was carried out over one year, i.e., November 2017–August 2018. Ethnomedicinal data was collected through designed questionnaires/interviews by involving 180 informants familiar with medicinal plants utilization. Documented data were evaluated using the quantitative indices.

Results

A total of 138 traditional medicinal plants were investigated, belonging to 123 genera of 60 families. Among them, Asteraceae was the dominant plant family with 19 species. Roots were the most commonly used plant parts, and the dominant life form was herbs. Quantitative analysis revealed that *Forsythia suspensa* was with higher (0.33) RFC value, and *Scutellaria baicalensis* was recorded with higher (0.91) UV. Treated diseases were categorized in 12 groups and evaluated by their F_{IC} value, in which gynecological diseases having higher (0.93) F_{IC} value followed by urinary system diseases. The most medicinal plants are used to clear away heat and relieve the surface. At the same time, people use boiled water to use medicinal plants. Most of the plants investigated are non-toxic.

Conclusion

This study reported traditional herbal medicines for the first time to be used against various disorders in Lingchuan County, China and are still practiced by the local communities. Some of the new ethnobotanical claims documented in this investigation should need to be further explored clinically. The medicinal plants with the highest use values recorded in this study may signpost the probable existence of valuable phytochemical compounds that requires a search for prospective new drugs to cure many human disorders.

1. Background

With social development and population growth, some diseases have become more and more complex and incurable, which greatly endangers people's health. Although modern synthetic drugs have solved some problems, but they are also difficult to develop in-depth due to the high cost of research in the development of new drugs as well as have higher side effects [1]. Therefore, "green" traditional drugs are more and more favored by scientists and are an important part of medicines [2]. It has received widespread attention, and at the same time, it has become a trend to discover new drugs from the folk and expand the resources of folk medicinal plants. China is one of the countries with the richest medicinal plants in the world, with more than 12,000 kinds of medicinal plants. However, in many remote areas of China, due to various factors such as living in poverty and a large number of people turning to cities, coupled with the lack of special records of traditional medicinal plant knowledge, and the impact of the modern medical system and new medical culture, some medicinal plant resources have suffered [3]. Due to the continuous destruction, the knowledge of traditional medicinal plants cannot be protected and passed on and, is rapidly disappearing. Therefore, the collection, arrangement, and inheritance of traditional folk knowledge of medicinal plants is very important [4].

The research of traditional medicinal plants as ethnobotany's content is regional; however, China has a vast territory and complex topography; therefore, plant types, medicinal plant names, and methods of use are not the same in each region. Traditional medicinal knowledge is closely related to local culture, history, economy, politics, and natural conditions. In recent years, some scientific researchers have conducted a certain degree of research on traditional medicinal knowledge in the northwest and southwest of China and most of the research objects are ethnic minorities, while the central area (Han nationality) has not been well explored regarding traditional knowledge of medicinal plants. However, the Han nationality is the most populous ethnic group in China. In the course of historical development, it has also accumulated valuable medicinal knowledge and experience [5]. Therefore, the research site selected was the central area with a large Han population.

Lingchuan County is located in the Southeast of Shanxi Province and has a long history. According to records, humans lived here as early as the Paleolithic era. It is the main producing area of Chinese medicinal materials in Shanxi Province and is rich in medicinal plant resources. In the process of production and life, local residents use plants in the surrounding environment to treat diseases and have accumulated a lot of knowledge and experience of medicinal plants. In addition, many villages in this area are located in remote mountainous areas, and modern medical conditions are poor, which to a large extent cannot satisfy people's needs. Therefore, local barefoot doctors may convince them to collect medicinal plants, and to use them for basic health needs, so that traditional medical knowledge can be preserved, which has certain research values [6]. Therefore, it is necessary to investigate traditional knowledge of medicinal plants in Lingchuan County, Shanxi Province, using the ethnobotanical methods.

2. Methodology

2.1 Study area

Lingchuan County is located in Jincheng City with a higher altitude in the southern section of Taihang Mountain (Fig. 1). It has 12 towns and villages under its jurisdiction, with a population of more than 250,000, and the total area of the county is 1,751 square kilometers. The average elevation is about 1058 m. It is a rocky, hilly area. It is mainly divided into three different terrain areas: the rocky mountainous area in the east, the rocky, hilly area in the middle, and the Pingchuan area in the southwest. The east and south have large elevation differences and steep terrain. The relative height difference is generally between 600 and 1000 m, which is high in the northeast and low in the southwest. The local plant diversity corresponds to the topography. The area has a continental monsoon climate with a cool climate and abundant rainfall. The annual average temperature is 7°C–9°C, and the annual precipitation is 700–1000 mm. The county has a frost-free period of 160 days throughout the year, and the average sunshine duration is 2380–2730 h [7]. The forest coverage rate in Lingchuan County is 51.07%, and the timber stock volume is 1.48 million cubic meters. There are not only natural forests and artificial forests but also unique tree species and *Taxus Chinensis*. More than 400 kinds of wild medicinal materials have provided a material basis for the formation of knowledge of Lingchuan traditional medicinal plants. However, in recent years, due to environmental changes and human activities, many rivers in Lingchuan County have dried up, reducing the diversity of medicinal plants [8].

2.2. Ethnobotanical field survey and data collection

Ethnomedicinal information about the use of plant species for the treatment of various disorders in the study area were documented from 53 localities. This survey was carried out from November 2017 to August 2018, following the protocols for ethnobotanical data documentation [9]. Mainly adopt key person interview method, structured interview method, and free enumeration method, ask according to the previously designed questions, record the local name, use part, use method, efficacy, etc. of medicinal plants and ethnographical information of the total informants (180) such as age, class, gender, experience, and educational background (Table 1, Fig. 2) [10].

Table 1
Demographic categories of local respondents

Variables	Demographic categories	Number of people	Percentage
Gender	Male	113	63
	Female	67	37
Education	Primary school	73	42
	Junior high school	39	22
	High school	6	3
	Technical secondary school	6	3
	Junior college	8	4
	Undergraduate	4	2
	Uneducated	44	24
	Profession	Farmer	127
Barefoot doctor		12	7
Chinese Medicine		14	8
Vendor		11	6
Village cadre		10	6
Forest keeper		2	1
Teacher		4	2
Age group		25–45	38
	46–60	47	26
	above 60	95	53

Barefoot doctor	Chinese Medicine
Farmer	Farmer
<i>Pinellia ternata</i> (Thunb.) Makino (Araceae)	<i>Pteris cretica</i> L. (Pteridaceae)

Figure 2 Ethnomedicinal data (interviews) and plants collection

2.3. Plant specimens collection and preservation

Plant species used to treat various disorders were collected, dried, preserved, and mounted on herbarium sheets [11]. Subsequently, with the help of plant taxonomists at Changzhi University, the number of the voucher specimen was assigned and determined and compared with the specimens in the herbarium of

the school. The plant name and family are determined by the Flora of China. These specimens are stored in the herbarium of the Department of Biology, Changzhi University, Shanxi, China [12].

2.4. Quantitative analysis of the ethnomedicinal information

Relative frequency Citation (RFC)

The RFC was calculated without taking into account the use categories by following the formula [13].

$$RFC = FC/N(0 < RFC < 1)$$

RFC shows the importance of each species in the study area given by the FC (FC is the number of local informants reported the uses of the species) divided by the total number of informants (N).

Use value (UV) of plant species

Use value (UV) determines the relative importance of plant species uses. It was calculated using the following formula [14].

$$UV = UR/N$$

Where "UV" indicates the use-value of individual species for a given disease range from 0 to 1, "UR" is the number of uses for particular disease of a given species by each informant, and "N" represents the number of informants who reports the given species.

Information consensus factor (F_{IC})

The knowledge of medicinal ethnobotany will vary to a certain extent due to different investigators and interviewees in the survey process. Therefore, in order to examine the distribution of information and find plants with biological activity, the consistency index can be used for evaluation [15].

$$F_{IC} = (n - nt) / (n - 1)$$

Where: F_{IC} is the information provider's information consistency index (informant consensus factor); n is the number of a certain information provider using plants to treat a certain type of disease; nt is the amount used by all information providers to treat the disease Number of plant species.

F_{IC} is between 0 and 1. The larger the value, the higher the consistency between herbalists. In other words, the greater the F_{IC} value, the more concentrated the plant species used by herbalists to treat a certain disease.

Regression analysis and Pearson correlation

Regression analysis was performed between demographic variables in response to gender (male, female) variables using SAS 9.4. Pearson's correlation, SPSS (ver. 16) tested correlation analysis between the RFC and UV

3. Results And Discussion

3.1. Medicinal plants survey, documentation and ethno-demography of the inhabitants

The present study reported the uses of 138 species of medicinal plants disseminated in 123 genera belonging to 60 families for the treatment of various types of diseases (Table 2). By querying the IUCN red list of plants, one of the plants (*Daucus carota*) amongst the total 138 plants is data deficient, and the others are not present in the list. The degree of people's use is related to the distribution of plants, so most of the plants used by local residents are plants that grow more locally, and most of them are not on the IUCN red list. A total of 180 informants were interviewed and categorized into different demographic categories (Table 1). Among the total 180 interviewed, it was noted that older people have a better grasp of traditional medicinal knowledge, while younger generations know less. Locals also said that young people spend a long time working and studying in other places and have little demand for traditional medicinal plants. Therefore, fewer people know about traditional medicinal plants. The reason why men know more about medicinal knowledge may be because they work more in the field compared to women and have more experience accumulated. Most of the local residents are farmers with low education levels, mainly uneducated and elementary school. It also shows that lower educated people dependent on traditional medicinal plants, while those with higher education levels are not so dependent. Most of young educated people believe on modern medical treatment [16]. According to theory, the older people have more traditional knowledge. However, the 75–91 age group has a smaller population base, results less contribution to the documentation of traditional knowledge. It was noted in regression analysis that all the demographic category were significant in response to gender group except age group (Table 3).

Table 2
Ethnomedicinal plants used for the management of diseases in Lingchuan County, Shanxi, China

S.no	Taxonomic name, Family, Voucher No.	Local name	Life form	parts used	Mode of utilization	Types of diseases	Toxicity
1.	Paris verticillata M.Bieb. Melanthiaceae YZW0011	Peng lou	Herb	Ro	External application, With other medicines	Animal bites	Small poison
2.	Allium fistulosum L. Amaryllidaceae YZW0023	Chong	Herb	Ro	Boil water	Under fire,Cold,Abdominal pain	Non-tox
3.	Aletris spicata (Thunb.) Franch. Nartheciaceae YZW0016	Mai dong	Herb	Ro	Boil water	Detoxification,Cough,Nourishing	Unknow
4.	Lilium brownii var. viridulum Baker Liliaceae YZW0031	Hong dianhua	Herb	Ro	Edible	Cough,Nourishing	Non-tox
5.	Asparagus cochinchinensis (Lour.) Merr. Asparagaceae YZW0064	Tian mendong	Herb	Ro	Boil water	Detoxification,Under fire,Cough	Non-tox
6.	Allium ramosum L. Amaryllidaceae YZW0139	Jiu cai	Herb	Fl	Edible	Nourishing	Unknow
7.	Polygonatum multiflorum (L.) All. Asparagaceae YZW0145	Yu zhu	Herb	Ro	With other medicines	Nourishing	Unknow
8.	Allium macrostemon Bunge Amaryllidaceae YZW0070	Xiao suan	Herb	Wh,Ro	Edible,External application	Skin diseases	Non-tox
9.	Polygonatum sibiricum Redouté Asparagaceae YZW0094	Ji tou shen	Herb	Ro	Boil water,Edible	Nourishing	Non-tox
10.	Platycladus orientalis (L.) Franco Cupressaceae YZW0055	Bai shu	Tree	Se,St	Boil water,External application	Gynecological diseases,Laxative,Skin diseases	Non-tox
11.	Patrinia scabiosifolia Link Caprifoliaceae YZW0137	Bai jiang	Herb	Wh	Boil water	Cough,Detoxification,Cold	Non-tox
12.	Plantago asiatica L. Plantaginaceae YZW0019	Che erzi	Herb	Ro, L, Se, Wh	Soaking in water, Boil water	Diuretic,Under fire,Anti- inflammatory,Hemostasis,Cure diarrhea	Non-tox

S.no	Taxonomic name, Family, Voucher No.	Local name	Life form	parts used	Mode of utilization	Types of diseases	Toxicity
13.	<i>Mentha canadensis</i> L. Lamiaceae YZW0052	Bo he	Herb	L,Ab	Soaking in water,Edible	Detoxification,Cold	Non-tox
14.	<i>Scutellaria baicalensis</i> Georgi Lamiaceae YZW0058	Huang qin	Herb	Ro, L	Soaking in water	Detoxification,Cold,Under fire,Anti- inflammatory,Tuberculosis	Unknow
15.	<i>Agastache rugosa</i> (Fisch. & C.A.Mey.) Kuntze Lamiaceae YZW0061	Huo xiang	Herb	Ab	Boil water	Cold,Prevent heatstroke	Non-tox
16.	<i>Nepeta tenuifolia</i> Benth. Lamiaceae YZW0080	Jing jie	Herb	Ab, Ro, Wh, Fl	External application, Boil water, Edible	Animal bites,Detoxification,Cough,Cold,Gynecological diseases,Under fire,Hemostasis,Hypotensive	Unknow
17.	<i>Salvia rosmarinus</i> Lamiaceae YZW0090	Xue shen	Herb	Ro, Wh	Soaking in water,Boil water,Sparkling wine,Edible	Nourishing,Hypotensive,under fire,Activating blood to remove blood stasis	Non-tox
18.	<i>Leonurus japonicus</i> Houtt. Lamiaceae YZW0043	Yi mucao	Herb	Wh,Ab	Boil water	Gynecological diseases,Treat hematuria,Diuretic	Non-tox
19.	<i>Perilla frutescens</i> (L.) Britton Lamiaceae YZW0047	Zi shu	Herb	Se,St,L	Boil water	Cold,Cough	Non-tox
20.	<i>Isodon rubescens</i> (Hemsl.) H.Hara Lamiaceae YZW0154	Dong lingcao	Herb	Wh	Soaking in water	Sore throat, Under fire	Unknow
21.	<i>Stellera chamaejasme</i> L. Thymelaeaceae YZW0096	Lang du	Herb	Ro	Wash outside	Deworming,Skin diseases	Poisonc
22.	<i>Lablab purpureus</i> subsp. <i>purpureus</i> Fabaceae YZW0103	Bian dou	Vine	Ro,Fr	Wash outside,Edible	Deworming,Prolactin	Non-tox
23.	<i>Glycyrrhiza uralensis</i> Fisch. ex DC. Fabaceae YZW0156	Gan cao	Herb	Ro	Soaking in water	Detoxification	Non-tox
24.	<i>Glycine max</i> (L.) Merr. Fabaceae YZW0159	Hei dou	Herb	Se	Boil water	Nourishing	Non-tox

S.no	Taxonomic name, Family, Voucher No.	Local name	Life form	parts used	Mode of utilization	Types of diseases	Toxicity
25.	<i>Caragana rosea</i> Turcz. ex Maxim. Fabaceae YZW0066	Jin jier	Herb	Ro,Fl	With other medicines	Cough	Unknow
26.	<i>Sophora flavescens</i> Aiton Fabaceae YZW0071	Ku ahen	Shrub	Ro	Wash outside, Boil water	Detoxification,Treat waist and leg pain,Reduce swelling,Activating blood to remove blood stasis,Skin diseases	Non-tox
27.	<i>Lespedeza bicolor</i> Turcz. Fabaceae YZW0131	Shan dougwn	Shrub	Ro	With other medicines	Detoxification	Non-tox
28.	<i>Styphnolobium japonicum</i> (L.) Schott Fabaceae YZW0148	Tu huai tiao	Tree	St	Wash outside, Boil water	Skin diseases	Non-tox
29.	<i>Robinia pseudoacacia</i> L. Fabaceae YZW0098	Yang huaishu	Tree	Fl	Edible	Treat hemorrhoids,Cure stool bleeding,Cold	Unknow
30.	<i>Pteris cretica</i> L. Pteridaceae YZW0038	Ji zhuacao	Herb	Wh	With other medicines	Numbness	Unknow
31.	<i>Imperata cylindrica</i> (L.) P.Beauv. Poaceae YZW0144	Bai maocao	Herb	Ro	Soaking in water	Detoxification,Stop nosebleeds	Unknow
32.	<i>Taxus wallichiana</i> Zucc. Taxaceae YZW0152	Hong doushan	Tree	L	Boil water	Under fire	Unknow
33.	<i>Juglans regia</i> L. Juglandaceae YZW0141	He tao	Tree	Fr	Edible,Boil water	Nourishing,Heart disease	Non-tox
34.	<i>Trichosanthes kiriowii</i> Maxim. Cucurbitaceae YZW0149	Gua lou	Vine	Ro,Fr,Se	Edible,Boil water	Detoxification,Laxative,Cough	Unknow
35.	<i>Cucurbita moschata</i> Duchesne Cucurbitaceae YZW0054	Nan gua	Herb	Fr,Se	Edible	Deworming,Nourishing	Non-tox
36.	<i>Tribulus terrestris</i> L. Zygophyllaceae YZW0155	Ji li	Herb	Fr	Boil water	Headache,Eyesight,Vitiligo	Non-tox

S.no	Taxonomic name, Family, Voucher No.	Local name	Life form	parts used	Mode of utilization	Types of diseases	Toxicity
37.	<i>Viola philippica</i> Cav. Violaceae YZW0051	Gong jihua	Herb	Ro	Soaking in water	Under fire, Anti-inflammatory, Skin diseases	Non-tox
38.	<i>Orostachys fimbriata</i> (Turcz.) A. Berger Crassulaceae YZW0127	wa wei	Herb	Wh	External application	Skin diseases, Insomnia	Unknow
39.	<i>Hylotelephium erythrosticktum</i> (Miq.) H. Ohba Crassulaceae YZW0133	wuducao	Herb	L	External application	Animal bites	Unknow
40.	<i>Platycodon grandiflorus</i> (Jacq.) A. DC. Campanulaceae YZW0158	Bai yao	Herb	Ro	Boil water, Edible	Under fire, Anti-inflammatory, Cold, Cough, Sore throat	Small poison
41.	<i>Codonopsis pilosula</i> (Franch.) Nannf. Campanulaceae YZW0173	Wu huashen	Herb	Ro, St	Boil water, Sparkling wine, Wash outside	Nourishing, Black hair	Unknow
42.	<i>Adenophora remotiflora</i> (Siebold & Zucc.) Miq. Campanulaceae YZW0177	Ling danghua	Herb	Ro	Boil water	Nourishing, Cough, Reduce swelling	Non-tox
43.	<i>Bidens pilosa</i> L. Asteraceae YZW0147	gui ge zhen	Herb	Wh	Boil water	Appendicitis, Diuretic, Cold	Non-tox
44.	<i>Artemisia umbrosa</i> (Besser) Turcz. ex Verl. Asteraceae YZW0193	Ye aihao	Herb	Wh, L, Ab	Cupping, External application, Wash outside, Boil water, Soaking in water	Joint pain, Headache	Non-tox
45.	<i>Chrysanthemum × morifolium</i> (Ramat.) Hemsl. Asteraceae YZW0187	Bai juhua	Herb	Fl	Soaking in water	Eyesight, Headache, Detoxification	Non-tox
46.	<i>Xanthium strumarium</i> Asteraceae YZW0182	Chang er	Herb	Fr	Boil water	Sinusitis, Cold	Small poison
47.	<i>Atractylodes lancea</i> (Thunb.) DC. Asteraceae YZW0168	Chang zhu	Herb	Ro	Boil water	Headache, Diuretic	Non-tox

S.no	Taxonomic name, Family, Voucher No.	Local name	Life form	parts used	Mode of utilization	Types of diseases	Toxicity
48.	<i>Cirsium arvense</i> (L.) Scop. Asteraceae YZW0162	Ci ercai	Herb	Ab	External application, Boil water	Traumatic bleeding,Stomach ulcer,Cure diarrhea,Skin diseases	Non-tox
49.	<i>Cirsium japonicum</i> DC. Asteraceae YZW0153	Da cijiao	Herb	Ab, Ro, L, Wh	External application	Traumatic bleeding,Detoxification,Under fire,Reduce swelling,Hemostasis,Diuretic	Non-tox
50.	<i>Carthamus tinctorius</i> L. Asteraceae YZW0054	Hong hua	Herb	Fl	Soaking in water	Hypotensive,Gynecological diseases,Treat waist and leg pain	Non-tox
51.	<i>Artemisia scoparia</i> Waldst. & Kit. Asteraceae YZW0146	Huang hao	Herb	Ro,Fr	Edible,Boil water	Nourishing	Unknow
52.	<i>Artemisia capillaris</i> Thunb. Asteraceae YZW0060	Huang huamiao	Herb	Wh,Ab	Boil water,Edible	Liver disease,Detoxification,Scars	Non-tox
53.	<i>Ixeris polycephala</i> Cass. Asteraceae YZW0069	Ku maicai	Herb	Ab	Edible	Under fire,Cold	Non-tox
54.	<i>Tussilago farfara</i> L. Asteraceae YZW0067	Kuai donghua	Herb	Fl	Boil water	Cough,Anti-inflammatory	Non-tox
55.	<i>Leuzea uniflora</i> (L.) Holub Asteraceae YZW0062	Lou lu	Herb	Ro	Boil water	Bone and tendon	Non-tox
56.	<i>Artemisia verlotiorum</i> Lamotte Asteraceae YZW0136	Nan aihao	Herb	Wh	Boil water	Burn	Unknow
57.	<i>Taraxacum mongolicum</i> Hand.- Mazz. Asteraceae YZW0074	Bu buying	Herb	Wh, L	Edible, Soaking in water, Boil water	Anti-inflammatory,Detoxification,Under fire,Cold,Breast pain	Non-tox
58.	<i>Sonchus arvensis</i> L. Asteraceae YZW0095	Qu qucai	Herb	Ab, Wh	External application, Edible	Traumatic bleeding,Anti- inflammatory,Appendicitis,Hypotensive,Activating blood to remove blood stasis	Non-tox
59.	<i>Inula japonica</i> Thunb. Asteraceae YZW0210	Xuan fuhua	Herb	Fl	Boil water	Cough	Unknow

S.no	Taxonomic name, Family, Voucher No.	Local name	Life form	parts used	Mode of utilization	Types of diseases	Toxicity
60.	Arctium lappa L. Asteraceae YZW0181	You bangzi	Herb	Se	Edible, Boil water	Sore throat,Under fire,Detoxification,Skin diseases	Non-tox
61.	Chrysanthemum indicum L. Asteraceae YZW0195	Ye juhua	Herb	Fl	Wash outside, Soaking in water	Foot pain, Cold	Small poison
62.	Selaginella tamariscina (P.Beauv.) Spring Selaginellaceae YZW0076	Juan bai	Herb	Wh	Boil water	Activating blood to remove blood stasis	Unknow
63.	Ailanthus altissima (Mill.) Swingle Simaroubaceae YZW0129	Chun shu	Tree	Ro,St	Boil water, Edible	Activating blood to remove blood stasis,Sore throat	Unknow
64.	Gastrodia elata Blume Orchidaceae YZW0097	Tian ma	Herb	St,Ro	Boil water	Anti-inflammatory,Diuretic	Unknow
65.	Bassia scoparia (L.) A.J.Scott Amaranthaceae YZW0093	Sao zhoumiao	Herb	Fr,Wh	Edible,Boil water	Diuretic,Skin diseases	Non-tox
66.	Dysphania ambrosioides (L.) Mosyakin & Clemants Amaranthaceae YZW0024	Hui huicai	Herb	L,Fr	Edible	Detoxification,Liver disease	Poisonc
67.	Toona sinensis (Juss.) M.Roem. Meliaceae YZW0082	Xiang cun	Tree	L	Edible	Digestion,Detoxification	Unknow
68.	Polygonum aviculare L. Polygonaceae YZW0160	Bian xu	Herb	Wh, Fl	Soaking in water	Eyesight,Digestion,Cough,Gynecological diseases	Unknow
69.	Reynoutria multiflora (Thunb.) Moldenke Polygonaceae YZW0169	He shouwu	Vine	Ro, St	Wash outside, Boil water	Black hair,Fixed tooth,Cough,Laxative,Nourishing,Lower blood lipids,Insomnia	Non-tox
70.	Cyrtomium fortunei J.Sm. Polypodiaceae YZW0171	Guan zhong	Herb	Ro	Soak directly into the water tank	Cold,Plague prevention,Detoxification	Non-tox

S.no	Taxonomic name, Family, Voucher No.	Local name	Life form	parts used	Mode of utilization	Types of diseases	Toxicity
71.	Vincetoxicum auriculatum (Royle ex Wight) Kuntze Apocynaceae YZW0178	Lao wabutirang	Shrub	Ws	Drip on the wart	Skin diseases	Unknow
72.	Periploca sepium Bunge Apocynaceae YZW0089	Yang getaoye	Shrub	Ro,L	Edible,Boil water	Skin diseases	Unknow
73.	Ephedra sinica Stapf Ephedraceae YZW0143	Ma huang	Shrub	St	Boil water	Cold	Non-tox
74.	Portulaca oleracea L. Portulacaceae YZW0092	Wu Rocao	Herb	Ab	External application,Edible	Skin diseases,Reduce swelling,Anti- inflammatory,Hypotensive,Abdominal pain	Non-tox
75.	Aristolochia clematitis L. Aristolochiaceae YZW0206	Mu tong	Vine	Ro	Boil water	Laxative,Diuretic,Detoxification	Unknow
76.	Asarum sieboldii Miq. Aristolochiaceae YZW0157		Herb	Ro	Boil water, With other medicines	Joint pain	Small poison
77.	Aristolochia contorta Bunge Aristolochiaceae YZW0028		Vine	Fr	Soaking in water	Tuberculosis,Abdominal pain	Non-tox
78.	Aconitum carmichaeli Debeaux Ranunculaceae YZW0163	Cao wu	Herb	Ro	Boil water	Heart disease, Tuberculosis	Poisonc
79.	Pulsatilla chinensis (Bunge) Regel Ranunculaceae YZW0138	Bai touweng	Herb	Ro	With other medicines	Cure diarrhea,Sore throat	Non-tox
80.	Coptis chinensis Franch. Ranunculaceae YZW0086	Huang lian	Herb	Ro	Soaking in water	Under fire,Reduce swelling	Non-tox
81.	Paeonia × suffruticosa Andrews Paeoniaceae YZW0083	Mu dan	Shrub	Ro	Boil water	Nourishing	Unknow
82.	Schisandra chinensis (Turcz.) Baill. Schisandraceae YZW0166	Wu weizi	Vine	Fr	Edible,Boil water	Cough,Nourishing,Under fire	Non-tox

S.no	Taxonomic name, Family, Voucher No.	Local name	Life form	parts used	Mode of utilization	Types of diseases	Toxicity
83.	<i>Forsythia suspensa</i> (Thunb.) Vahl Oleaceae YZW0123	Qing qiao	Shrub	Fr, Fl	Soaking in water	Detoxification, Cold, Under fire	Non-tox
84.	<i>Pueraria montana</i> var. <i>lobata</i> (Willd.) Maesen & S.M.Almeida ex Sanjappa & Predeep Fabaceae YZW0077	Gi gen	Vine	Ro	Edible, Soaking in water	Eyesight, Ear disease	Non-tox
85.	<i>Cotinus coggygria</i> Scop. Anacardiaceae YZW0102	Huang lu	Shrub	St	Grinding fine water suit	Skin diseases	Non-tox
86.	<i>Rubia cordifolia</i> L. Rubiaceae YZW0196		Herb	Ro	Sparkling wine, Boil water	Traumatic bleeding, Skin diseases, Hemostasis, Joint pain	Non-tox
87.	<i>Agrimonia pilosa</i> Ledeb. Rosaceae YZW0189	Xian hecao	Herb	L, Fl, Ro	With other medicines	Hemostasis, Deworming	Non-tox
88.	<i>Prunus persica</i> (L.) Batsch Rosaceae YZW0225	Tao	Tree	Fr	Boil water, Edible	Cold, Activating blood to remove blood stasis, Headache, Insomnia	Poisonc
89.	<i>Potentilla discolor</i> Bunge Rosaceae YZW0151	Fan baicao	Herb	Wh	External application	Traumatic bleeding	Non-tox
90.	<i>Dasiphora glabra</i> (G.Lodd.) Soják Rosaceae YZW0044	Guan yincha	Shrub	Ab	Soaking in water	Detoxification	Unknow
91.	<i>Akebia trifoliata</i> (Thunb.) Koidz. Lardizabalaceae YZW0142	Mu gua	Shrub	Fr	Edible	Edema	Non-tox
92.	<i>Prunus davidiana</i> (Carrière) Franch. Rosaceae YZW0056	Qi tao	Tree	Se	Boil water, Edible	Headache, Activating blood to remove blood stasis, Detoxification	Unknow
93.	<i>Crataegus monogyna</i> Jacq. Rosaceae YZW0216	Hong guo	Tree	Fr	Boil water, Edible, Soaking in water	Nourishing, Digestion, Lower blood lipids	Non-tox

S.no	Taxonomic name, Family, Voucher No.	Local name	Life form	parts used	Mode of utilization	Types of diseases	Toxicity
94.	Rosa xanthina Rosaceae YZW0072	Xiang lihua	Shrub	Fl	Soaking in water	Detoxification, Under fire, Reduce swelling,	Unknow
95.	Potentilla indica (Andrews) Th.Wolf Rosaceae YZW0046	Jia caomei	Herb	St, L	Boil water	Detoxification	Poisonc
96.	Prunus armeniaca L. Rosaceae YZW0048	Heng	Tree	Se	Edible, Boil water	Detoxification,Cough,Activating blood to remove blood stasis	Small poison
97.	Datura stramonium L. Solanaceae YZW0084	Mai tuoluo	Herb	Ws	Put the juice on the towel and apply externally	Anesthesia	Poisonc
98.	Alkekengi officinarum Moench Solanaceae YZW0164	Hong denglong	Herb	Fr	Soaking in water, Edible, Boil water	Hemostasis, Cough,Detoxification,Reduce swelling	Non-tox
99.	Lycium chinense Mill. Solanaceae YZW0079	Di gu pi	shrubs	Ro, Fr	Soaking in water,Sparkling wine,Edible,Boil water	Bone and tendon,Nourishing,Eyesight,Under fire,	Non-tox
100.	Solanum melongena L. Solanaceae YZW0073	Qie	Herb	Fr	Boil water	Cough	Non-tox
101.	Lonicera japonica Thunb. Caprifoliaceae YZW0045	Yin yanghua	Vine	Fl	Soaking in water,Boil water	Detoxification	Non-tox
102.	Saposhnikovia divaricata Apiaceae YZW0161	Pang feng	Herb	Ro	Boil water	Cold,Headache	Non-tox
103.	Kitagawia praeuptora (Dunn) Pimenov Apiaceae YZW0134	Qian hu	Herb	Ro	Boil water,Soaking in water,External application	Cough,Cold,Reduce swelling,Anti- inflammatory,Asthma	Non-tox
104.	Cnidium monnieri (L.) Cusson Apiaceae YZW0057	She chuangzi	Herb	Fr	With other medicines	Skin diseases	Non-tox
105.	Bupleurum chinense DC. Apiaceae YZW0063	Chai hu	Herb	Ro	Soaking in water,Boil water,Edible	Cold,Detoxification,Digestion	Non-tox

S.no	Taxonomic name, Family, Voucher No.	Local name	Life form	parts used	Mode of utilization	Types of diseases	Toxicity
106.	<i>Humulus scandens</i> (Lour.) Merr. Cannabaceae YZW0018	La lateng	Vine	Wh	Soaking in water	Treat hemorrhoids	Non-tox
107.	<i>Cannabis sativa</i> L. Cannabaceae YZW0065	Ma zi	Herb	Se	External application,Boil water	Laxative	Poisonc
108.	<i>Morus alba</i> L. Moraceae YZW0068	Sang bai pi	Shrub	Ro, St, Fr, L	Soaking in water,Sparkling wine,Boil water	Cough,Asthma,Under fire,Detoxification,Diuretic,Laxative	Non-tox
109.	<i>Sinapis alba</i> L. Brassicaceae YZW0105	Bai jiezi	Herb	Fr	Edible	Cough	Non-tox
110.	<i>Isatis tinctoria</i> L. Brassicaceae YZW0075	Bai lanRo	Herb	Wh,Ro,Fl	Boil water	Cold,Detoxification	Non-tox
111.	<i>Raphanus raphanistrum</i> subsp. <i>sativus</i> (L.) Domin Brassicaceae YZW0117	Bai luobo	Herb	Ro, Fr	Edible, Boil water	Cure diarrhea, Cold	Non-tox
112.	<i>Punica granatum</i> L. Lythraceae YZW0191	Shi liupi	Tree	Fr	Edible,Soaking in water	Cure diarrhea,Nocturnal emission	Non-tox
113.	<i>Gypsophila vaccaria</i> (L.) Sm. Caryophyllaceae YZW0207	Wang buliuxing	Herb	Se	With other medicines	Prolactin	Non-tox
114.	<i>Dianthus chinensis</i> L. Caryophyllaceae YZW0176	Shi zhu	Herb	Fl	Boil water	Detoxification	Non-tox
115.	<i>Dianthus superbus</i> L. Caryophyllaceae YZW0183	Qu mai	Herb	Wh	Boil water	Diuretic	Non-tox
116.	<i>Diospyros kaki</i> L.f. Ebenaceae YZW0041	Shi	Tree	Fr	Boil water	Hiccup	Non-tox
117.	<i>Ziziphus jujuba</i> Mill. Rhamnaceae YZW0037	Suai zao	Shrub	Fr,Ro	Edible,Soaking in water,Boil water	Insomnia	Non-tox
118.	<i>Dioscorea nipponica</i> Makino Dioscoreaceae YZW0184	Chuan dilong	Vine	Ro,Fr	Edible	Nourishing	Unknow

S.no	Taxonomic name, Family, Voucher No.	Local name	Life form	parts used	Mode of utilization	Types of diseases	Toxicity
119.	<i>Dioscorea esculenta</i> (Lour.) Burkill Dioscoreaceae YZW0124	Hong shu	Vine	Ro,L	Edible	Nourishing,Hypotensive	Non-tox
120.	<i>Pinus tabuliformis</i> Carrière Pinaceae YZW0006	Xiong xu	Tree	Fl, Fr	Apply oil from the stick stove, Soaking in water	Skin diseases, Lower blood lipids, Insomnia, Nourishing, Bone and tendon	Non-tox
121.	<i>Sauromatum giganteum</i> (Engl.) Cusimano & Hett. Araceae YZW0198	Bai fu zi	Herb	Ro	Boil water	Skin diseases	Unknow
122.	<i>Daucus carota</i> Apiaceae YZW0125	Bai xia	Herb	Ro	Boil water	Cough	Poisonc
123.	<i>Typha orientalis</i> C.Presl Typhaceae YZW0205	Mao la	Herb	Fl	External application	Traumatic bleeding	Non-tox
124.	<i>Arisaema erubescens</i> (Wall.) Schott Araceae YZW0188	Tian nanxing	Herb	Ro	With other medicines	Reduce swelling	Non-tox
125.	<i>Pinellia ternata</i> (Thunb.) Makino Araceae YZW0199	Xiao baixia	Herb	Wh	With other medicines	Mouth ulcers	Poisonc
126.	<i>Phryma leptostachya</i> L. Phrymaceae YZW0165	Tou gucao	Herb	L,Wh,Ro	External application,Wash outside,Boil water	,Reduce swelling, Bruises, Numbness, Activating blood to remove blood stasis, Anti- inflammatory, Stop nosebleeds	Poisonc
127.	<i>Opuntia dillenii</i> (Ker Gawl.) Haw. Cactaceae YZW0081	Xian renzhang	Shrub	L	External application	Reduce swelling, Skin diseases	Non-tox
128.	<i>Berberis amurensis</i> Rupr. Berberidaceae YZW0104	Shi dagonglao	Shrub	Fl	With other medicines	Detoxification, Under fire	Unknow
129.	<i>Epimedium brevicornu</i> Maxim. Berberidaceae YZW0035	Yin yanghuo	Herb	Wh	Boil water	Nourishing, Abdominal pain	Non-tox

S.no	Taxonomic name, Family, Voucher No.	Local name	Life form	parts used	Mode of utilization	Types of diseases	Toxicity
130.	<i>Ipomoea purpurea</i> (L.) Roth Convolvulaceae YZW0078	Hei baichou	Herb	Se	Boil water	Digestion, Diuretic	Poisonc
131.	<i>Cuscuta chinensis</i> Lam. Convolvulaceae YZW0174	Fen tiao	Herb	Se	Boil water	Nourishing	Non-tox
132.	<i>Ginkgo biloba</i> L. Ginkgoaceae YZW0203	Bai guo	Herb	Fr	Edible	Cough	Poisonc
133.	<i>Corydalis repens</i> Mandl & Muhldorf Papaveraceae YZW0179	Yan husuo	Herb	Ro	With other medicines	, Activating blood to remove blood stasis, Bruises	Unknow
134.	<i>Zea mays</i> L. Poaceae YZW0192	Yu mi xu	Herb	Fl	Boil water	Diuretic	Non-tox
135.	<i>Iris domestica</i> (L.) Goldblatt & Mabb. Iridaceae YZW0185	She gan	Herb	Wh	Boil water	Headache,Under fire,Detoxification	Poisonc
136.	<i>Polygala tenuifolia</i> Willd. Polygalaceae YZW0172	Yuan zhi	Herb	Ro	With other medicines,Boil water	Insomnia,Under fire,Anti-inflammatory	Non-tox
137.	<i>Zanthoxylum bungeanum</i> Maxim. Rutaceae YZW0175	Hua jiao	Tree	Fr,L	Wash outside	Reduce swelling,,Cure diarrhea	Non-tox
138.	<i>Hemionitis michelii</i> (Christ) Christenh. Pteridaceae YZW0186	Qu feng cao	Herb	Wh	Wash outside	Gynecological diseases, Pediatric shock	Unknow

Table 3
Regression analysis of demographic variables in
response to gender

Variable	DF	Likelihood	Chi-Square	Sig.
Education	6	84.496	14.932	0.021
Profession	6	90.096	20.533	0.002
Age	2	70.861	1.297	0.523
Over-all	14	69.564	27.735	0.015

3.2. Description and life form of folk traditional medicinal plants

Amongst the plant families, Asteraceae was the dominant with 19 plant species, followed by Rosaceae (10 spp.), Fabaceae (9 spp.), and Lamiaceae with eight species and so on (Fig. 3A). The other plant families were recorded with only one species (Fig. 3B). The recorded medicinal plants are categorized according to their life form (Fig. 5A). Among them, herbs (96 spp.) were dominant, followed shrubs and trees (15 spp. each), and vines with 12 species only. The domination of herbs in utilization over other life form may not only because the efficacy of medicinal plants but also because the density of the distribution of herbs is

higher, the growth cycle is fast, and the yield is higher [17]. They are determined by the characteristics of the collection [18]. Some of the medicinal plant materials collected by local inhabitants for medicinal purposes are shown in Fig. 4.

3.3. Parts used of folk traditional medicinal plants

The recorded traditional medicinal plants in Lingchuan County are classified according to their parts utilization (Fig. 5B). Among them, the most used parts were roots, with 58 species, accounting for 42%, followed by whole plant and fruit (28 spp., 20% each), flower (20 spp., 14.4%), leaves (19 spp., 13.7%), seeds (14 spp., 10%), above ground (12 spp., 8.6%), stem (11 spp., 8%), and watery sap with two species accounting for 1.4%. The same plant has different medicinal parts, and its medicinal effects are quite different. For example, *Trichosanthes kirilowii* can be used as medicine in multiple parts. Such as, the root is called "Tian hua fen" which can be used to clear away heat and detoxify, and the fruit can be used as a medicine for a laxative, and the seeds can be used to treat coughs. The same part of the plant collected at different times has different efficacy. For example, *Artemisia capillaris* collected in March can be used to treat liver disease, but it cannot be used at other times. People are needed to distinguish correctly when using medicinal plants.

Most of the medicinal plants in the study area are perennial herbs, and roots as widely used part as medicine. It may be because the roots can be collected in all seasons and are easier to preserve compared to other parts. At the same time, plants co-exist with a variety of microorganisms in the soil, and the secondary metabolites of microorganisms may have important medicinal effects compared to the aboveground parts [19]. It has certain timeliness and is not easy to collect and store. Therefore, in order to obtain medicines in time, people are looking for more plant roots with medicinal value as medicine.

3.4. Mode of utilizations of folk traditional medicinal plants

The most traditional medicinal plant use method recorded as boil water, that were used 77 times for different plant parts account for 38% of the total used methods frequency. Forty-two plant parts were utilized as edible took second place, accounting for 20.68%, followed by soaking in water (31, 15.20%), external application (17, 8.37%), kinds of plants with other medicine (15 7.38%), wash outside plants (11, 5.4%), sparking wine (5, 2.46%), and the other used method such as cupping with six times for different plant parts account for 3% of the total (Fig. 6). The use of medicinal plants is closely related to the type of disease. For example, the common method of medicinal plants used to treat colds, coughs, and other diseases are to boil in water. The usual methods for treating traumatic bleeding, skin diseases, and other diseases are external application and external washing. The medicinal plants that have the effects of clearing away heat, detoxifying, and nourishing are to eat and soak in water. Among them, edible wild fresh medicinal plants are usually boiled in hot water before eating. Hot water boiling can decompose some toxic substances in the plant and also dissolve some fibers, making the plant softer when eating [20, 21]. People will choose the most effective method of use according to the severity of the disease and other symptoms [22]. At the same time, it is also related to the medicinal parts of plants. Boiling water is the simplest and most effective way to extract the medicinal ingredients of plant roots.

3.5. Disease categories treated by folk medicinal plants

According to the efficacy and applicable diseases of medicinal plants, the medicinal plants in Lingchuan County are divided into 12 categories [23] (Fig. 7). I) Most plants were utilized as surface-relieving plants recorded with 70 species, generally used for the effect of clearing away heat, detoxifying, reducing heat, reducing inflammation, and reducing swelling. It is used to treat sore throat, sinusitis, ear disease, nosebleeds, eye pain, oral ulcers, colds, etc. Common plants used to treat these diseases include *Scutellaria baicalensis*, *Nepeta tenuifolia*, and *Xanthium sibiricum*, etc. II) twenty-eight kinds of plants were used as nourishing plants which has nourishing and diseases preventing properties. They are used for improving eyesight, black hair, fixing teeth, preventing heatstroke, etc. Common plants include *Reynoutria multiflora*, *Lycium barbarum*, and *Epimedium brevicornu*, etc. III) Twenty-seven kinds of plants were utilized for the management of respiratory disease, mainly for coughs, including tuberculosis, asthma, qi inversion, and other diseases. Common treatment plants include *Allium fistulosum*, *Nepeta tenuifolia*, and *Platycodon grandiflorus*, etc. IV) Twenty-six plants species were utilized for the treatment of digestive system diseases, mainly used for gastritis, appendicitis, constipation, hemorrhoids, and gastrointestinal bleeding with common plants includes *Plantago asiatica*, *Morus alba*, *Bupleurum chinense*. V) Twenty-two kinds of plants were employed for skin diseases, which were generally used for burns, vitiligo, acne, and other diseases with common plants includes *Sophora flavescens*, *Styphnolobium japonicum*, *Stellera chamaejasme*, and so on. VI) nineteen plants were utilized for circulatory system diseases; these plants have the effect of promoting blood circulation and removing blood stasis. They are used for high blood pressure, hyperlipidemia, heart disease, etc. Common therapeutic plants include *Sonchus arvensis*, *Carthamus tinctorius*, *Reynoutria multiflora*, and so on. VII) sixteen plant species were used for the treatment of nervous system diseases. They are used to treat numbness, insomnia, headaches, convulsions in children, etc. Common therapeutic plants are *Prunus persica*, *Pinus tabulaeformis*, and *Polygala tenuifolia* Wait, etc. VIII) fourteen plants species were used for the treatment of orthopedic diseases, which have the effect of connecting bones and tendons. They are used to treat traumatic bleeding, animal bites, bruises, and other diseases. Common therapeutic plants include *Potentilla discolor*, *Acorus calamus*, and *Rubia cordifolia*, etc. IX) twelve plant species used to treat urinary system diseases, commonly for the treatment of blood in urine, stones (diuresis), etc. Common treatment plants include *Plantago asiatica*, *Leonurus japonicus*, and *Bidens pilosa*, etc. X) nine plants species used for the treatment of gynecological diseases (lactation, breast pain etc.). Common therapeutic plants are *Leonurus japonicus*, *Taraxacum mongolicum*, *Gypsophila vaccaria*, etc. XI) eight plant species were used as rheumatism-removing plant, It has the effects of reducing edema, relieving pain and anesthesia. It is used to treat low back and leg pain, foot pain, joint pain, and other diseases. Common therapeutic plants include *Rubia cordifolia* and *Sophora flavescens*, and *Carthamus tinctorius*, etc. XII) seven plant species used for the treatment of infectious and functional diseases, which have insecticidal, anthelmintic, and antiviral effects. They are used to treat liver diseases, parasitic diseases, and spermatorrhea. Common therapeutic plants include *Cucurbita moschata*, *Artemisia umbrosa*, *Punica granatum*, etc.

3.6 Toxicity of medicinal plants

According to the toxicity level of plants, plants are divided into four types: non-toxic, unknown, small-toxic, and toxic (Fig. 8). The non-toxic plants are the most, with 84 species, accounting for 61% of the total recorded plant species, followed by unknown toxicity (35 spp., 25%), poisonous plants (13 spp., 10%), and less poisonous plants (6 spp., 4%). These findings demonstrated that people are using mostly non-toxic plants. However, for some toxic drugs, people use them for

external washing to treat skin diseases or for sale, and there are strict conditions when they are taken internally. It shows that people are very cautious about medication.

3.7 Quantitative Analysis of folk traditional medicinal plants

3.7.1 Relative Frequency citation (RFC)

The RFC value of the recorded species range from 0.04 to 0.33, where more plant species (66 species) were recorded in range $0.1 \leq 0.13$, and 45 plant species were recorded < 0.1 , the other remaining plant species (27 species) RFC values were ≥ 1 . Among the plant species, *Forsythia suspensa* were recorded with the highest RFC value 0.33, followed by *Nepeta tenuifolia*, and *Codonopsis pilosula* with RFC value 0.27 each, *Salvia rosmarinus* (RFC=0.26), followed by *Scutellaria baicalensis* and *Taraxacum mongolicum* with RFC value 0.25 each. Furthermore, *Polygonatum multiflorum* L. and *Dianthus chinensis* L. were recorded with lowest (0.04 each) RFC value (Fig.9). The higher RFC value demonstrated that informants contribution were more for a particular plant species, and they have knowledge of particular plant uses. In fact, the plants with low RFC value are not medicinally less important but the informants may not know about the uses of these plants or the plants may not be common to an area. In addition, it was observed during survey that young generations were less familiar with the traditional utilization of medicinal plants, alarming threats to indigenous knowledge of medicinal plants.

3.7.2 Use value (UV)

Use value determines the importance of each species for particular diseases. The present study recorded the UV range (0.08 to 0.9 value) of the total recorded species. Among them, most of the plant species (79 spp.) were recorded at the range of 0.01 to < 0.2 , followed by UV range 0.2 to < 0.3 with 34 plant species. Thirty-five plants species were recorded with UV value ≥ 0.3 (Fig.10). The highest UV (0.91 value) was recorded for *Scutellaria baicalensis*, followed by *Platycodon grandifloras* (UV=0.83), *Taraxacum mongolicum* (UV=0.82), and *Codonopsis pilosula* with 0.8 UV value. The lowest UV (0.08 value) was recorded for *Hylotelephium erythrostictum* plant species. Plants species with higher UV demonstrated that their informants have more common knowledge of plant uses, and frequently reported for the same uses. However, those diseases were included in the results which have been commonly reported (more than one time) to be treated by particular plant species, thus influences the UV values. It's demonstrated that plant species with lower UV have been reported for multiple disease treated, defining a variation in traditional medicinal knowledge. In contrast, UV are dynamics and can be change with informant traditional knowledge or an area to area [17,24]. Use values were significant correlated to RFC ($R^2=0.52$), demonstrated that UV can be define 50% by RFC value (Fig.11). These findings revealed that the number of informants for given species reported 50% similar uses.

3.7.3 Disease categories with F_{IC} value

The results of F_{IC} value of the disease categories of recorded medicinal plants are given in Table 4. The higher F_{IC} value was recorded for the treatment of gynecological diseases ($F_{IC}=0.93$) with total of 109 citation. The plants that cause this high consensus are *Nepeta tenuifolia* and *Taraxacum mongolicum*, which has 37 citation each. *Nepeta tenuifolia* is mainly used to treat colds, coughs, hypertension, and other diseases. The fresh leaves of *Nepeta tenuifolia* are mixed with flour, kneaded into cakes, and deep-fried; it becomes a refreshing food that can prevent colds [25]. After frying, *Nepeta* forms a black powder called "Nepeta Carbon", which can be used to treat rhinitis with the fruits of burdock and mint. *Nepeta tenuifolia* has a glandular point and can volatilize a special fragrance. Therefore, this characteristic of *Nepeta tenuifolia* can be used to extract flavors as food additives or cosmetics. *Taraxacum mongolicum* is locally known "Bubuying", "Wooden Pueraria", "Diding", and have widespread growth in the study area, it can be collected except in winter. The informants claims that it has anti-inflammatory effect is equivalent to penicillin. As a traditional remedy, it only needs to be washed and soaked in water, and used as a wild vegetable, but it can be eaten after boiling. Modern studies have shown that dandelion has antibacterial, anti-oxidant, and anti-tumor effects. The dual-purpose of Dandelion, such as a medicine and food, will have broad research prospects [26].

The 2nd highest F_{IC} value was recorded for the treatment of the urinary system ($F_{IC}=0.91$). Among the total of 123 citations, *Plantago asiatica* were cited 29 times, and *Atractylodes lancea* with 28 citations by informants. *Plantago asiatica* is a plant of the *Plantago* genus, from which more than 60 compounds have been discovered, which can treat a variety of diseases. This single plant has a good therapeutic effect, and multiple parts can be used. such as the leaves of plantain can be eaten directly by washing [27].

The 3rd highest F_{IC} value was recorded for the treatment of respiratory diseases ($F_{IC}=0.90$). The more contribution was by *Scutellaria baicalensis* species which appeared 41 times. Its main medicinal part is root, and it takes at least 2 years of growth to have the effect of curing colds, reducing fire, and reducing inflammation. After 5 years, the root of *Scutellaria baicalensis* become hollow. The locals call it "Bitter Qin" which has anti tuberculosis potential. The aerial part of *Scutellaria baicalensis* is distilled, dried, and soaked in tea, further use it for colds prevention. Shen et al demonstrated that *Scutellaria baicalensis* mainly contains flavonoids, volatile oils, polysaccharides, and other compounds, which have obvious anti-virus, anti-tumor, and anti-oxidation activities [28].

Digestive system diseases were found with 0.9 F_{IC} value, *Nepeta tenuifolia* and *Atractylodes lancea* were the plants frequently used for diseases management in the study area. Moreover, for the surface-resolving plants (F_{IC} value = 0.89), the most important plants are *Scutellaria baicalensis* with 41 citations, and *Forsythia suspense* with 39 citations. The fruit of *Forsythia suspense*, locally called "fu pimple" is effective in colds. The best time of its collection is summer, and thought to more effective against disease than other seasons. However, because of its high price, people often collect in advance in pursuit of economic benefits, which has brought undesirable consequences.

For the treatment of orthopedic diseases ($F_{IC}=0.89$), the most important plant is *Nepeta tenuifolia*. For nourishing plants ($F_{IC}=0.87$), the most important plant is *Codonopsis pilosula*. it is one of the commonly used bulk medicinal materials in China, and well-known species throughout the country for their uses (wine and drink) as an authentic medicinal material and is cultivated in large scale, but most of the its medicinal materials are purchased, and only a small part is used by people. Modern research has shown that *Codonopsis pilosula* contains many essential substances for the human body, which can protect some internal injuries and enhance the body's immunity [29].

Another disease category is dispelling rheumatism having F_{IC} value 0.85, with frequently used plants *Sophora flavescens* 15 citation and *Artemisia umbrosa* 16 citation. During our investigation, local people in Lingchuan County used *Sophora flavescens* to for skin diseases. In modern research, it has been found that *Sophora flavescens* has anti-inflammatory, analgesic, anti-tumor, and antibacterial effects [30, 31]. For the treatment of skin diseases ($F_{IC}=0.81$), the most important plant is *Arctium lappa*, which has active ingredients are inulin and polyphenols. *Arctium lappa* seeds are proceeds to deep-fry, grinded and take with water for the treatment of sore throat [32]. For the treatment of infectious and functional diseases ($F_{IC}=0.65$), the plants used by people are relatively inconsistent. This type of disease has a relatively large impact and requires timely medical treatment. However, most of the informants did not share relevant information or may feel shy to mention such diseases and generally they had not share treatment experience, which may lead to low consistency of medicinal plants to treat such diseases.

Table 4
Disease categories with their F_{IC} value

Types of diseases	Nt	Nur	F_{IC}
Surface-relieving plant	70	621	0.89
Nourishing plants	28	206	0.87
Respiratory diseases	27	249	0.90
Digestive system diseases	26	260	0.90
Skin diseases	22	113	0.81
Circulatory system diseases	19	192	0.91
Nervous system diseases	16	158	0.90
Orthopedic diseases	14	118	0.89
Urinary system diseases	12	123	0.91
Gynecological diseases	9	109	0.93
Rheumatism-removing plan	8	47	0.85
Infectious and functional diseases	7	18	0.65

4. Cultural Significance And Recommendation

Among the medicinal plants purchased, the economic value of the medicinal materials is significantly higher than the self-use value. Therefore, people may choose the most effective plants to keep a little bit to prevent and treat diseases. However, for their own benefit, people often go up to the mountain to collect immature plants, which reduces the efficacy of the medicine. Predatory logging also destroyed the local medicinal plant resources to a certain extent. Therefore, professionals need to calculate the diversity and universality of traditional medicinal plants, stipulate the collection time and quantity, and facilitate people to collect them in time so as to protect traditional medicinal plants and ensure people's sustainable use and strengthen detection by using sophisticated instruments. Efforts needs to ensure that every medicinal plant has a good effect. At the same time, it is necessary to strengthen the domestication and large-scale planting of wild species to relieve the pressure on wild medicinal plant resources and bring economic income to local people.

5. Conclusion

The present study reported the important ethnomedicinal plants of Lingchuan County, Shanxi, China. Indigenous people still practice medicinal plants for their healthcare needs. It was noted that roots were most widely used parts in the study area, which may threaten the survival of plants if over collected compared to the collection of other plant parts. Plants with high quantitative indices value, demonstrated that the plants have been practiced widely by inhabitants, which maybe because it is more common to an area or its traditional knowledge have been transferred generation after generation due to its efficacy against diseases. Thus, better understanding is required thorough scientific investigation of these recorded medicinal plants considering their traditional utilization. Sustainable utilization and scientific collection awareness of medicinal plant among communities is the need of the time. Government must ensure the conservation of these medicinal plants for future human development.

6. Declarations

Ethics approval and consent to participate

This study was authorized by the Faculty of Biological Science and Technology, Changzhi University, Shanxi, China. Informed consent was obtained from each participant prior to the interview process.

Consent for publication

All authors read and approved the final manuscript for publication

Availability of data and materials

All the data are in manuscript and supporting documents

Conflict of interest

The authors do not have any conflict of interests to declare.

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Author Contributions

SJ carried out ethnobotanical studies, performed the formal analysis and drafted the manuscript. SZ participate in field survey and manuscript writing. NS and AN performed the statistical analysis, and manuscript writing – review & editing. YY and SW participated in investigation and data curation.

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Figures

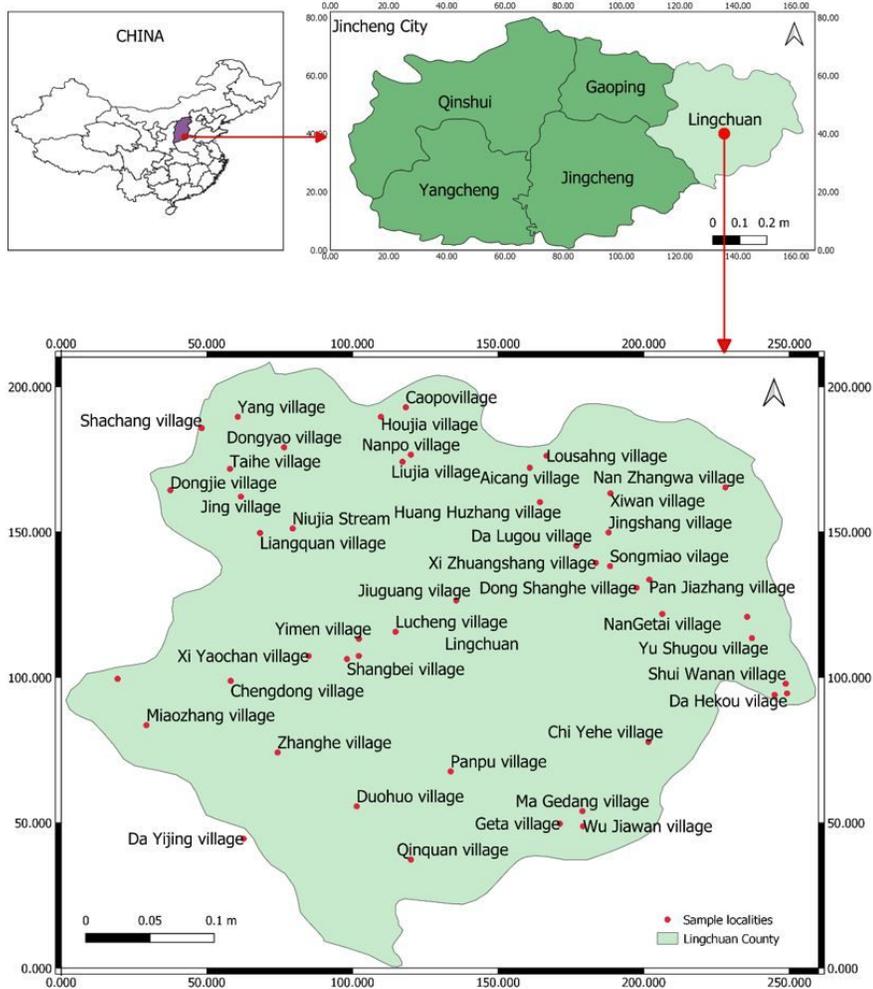


Figure 1

Map of the study area (Lingchuan County, Shanxi, China).



Figure 2

Ethnomedicinal data (interviews) and plants collection

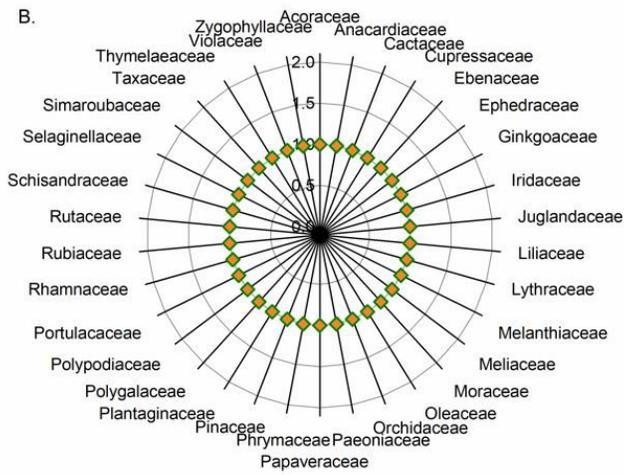
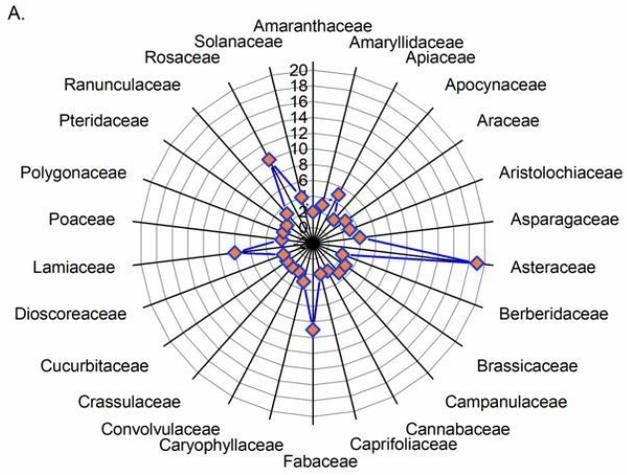


Figure 3

Taxonomic diversity of the study area



Figure 4

Collection of plant parts by local inhabitants for medicinal purposes

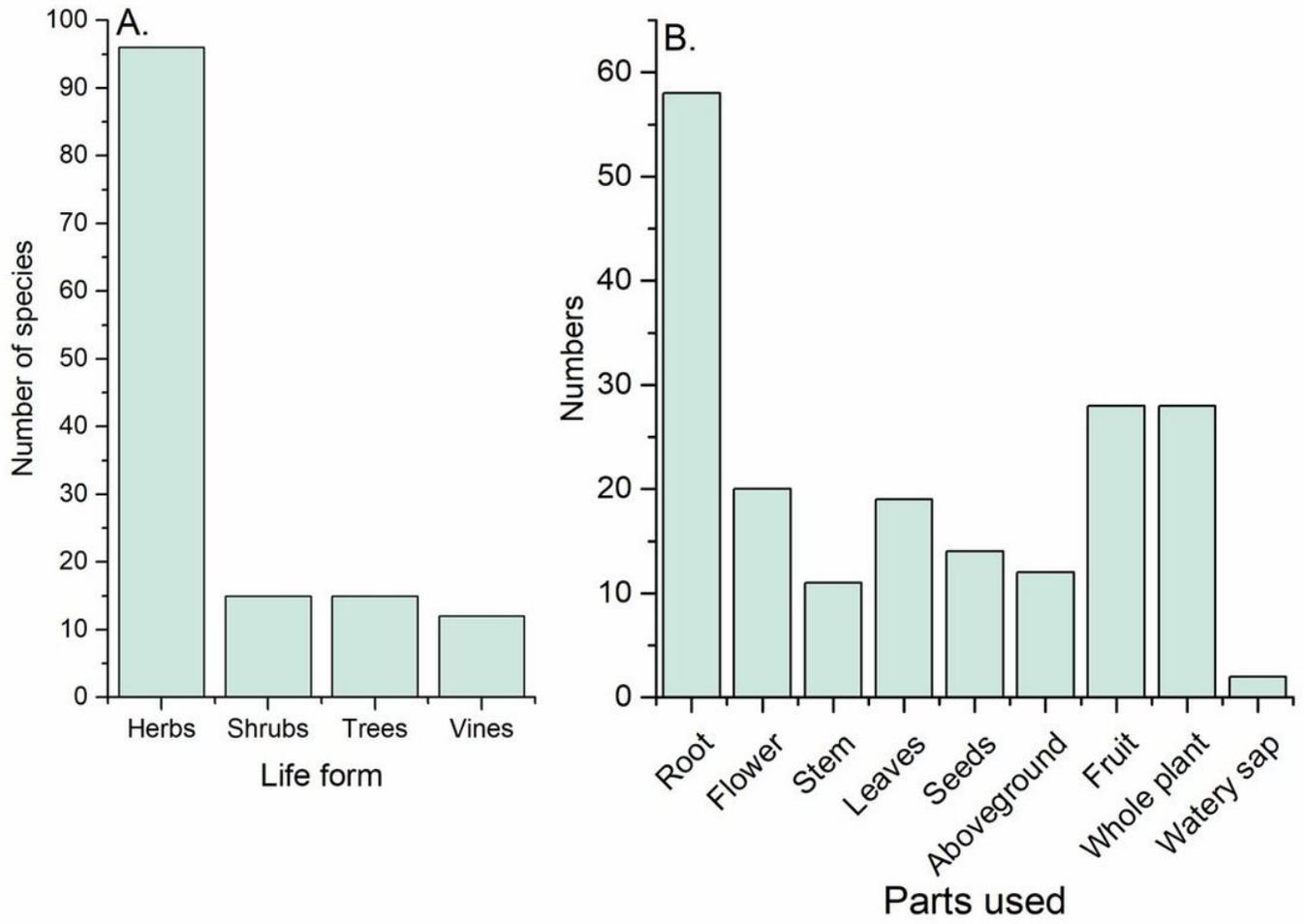


Figure 5

Description of medicinal plants (A) life form (B) parts used

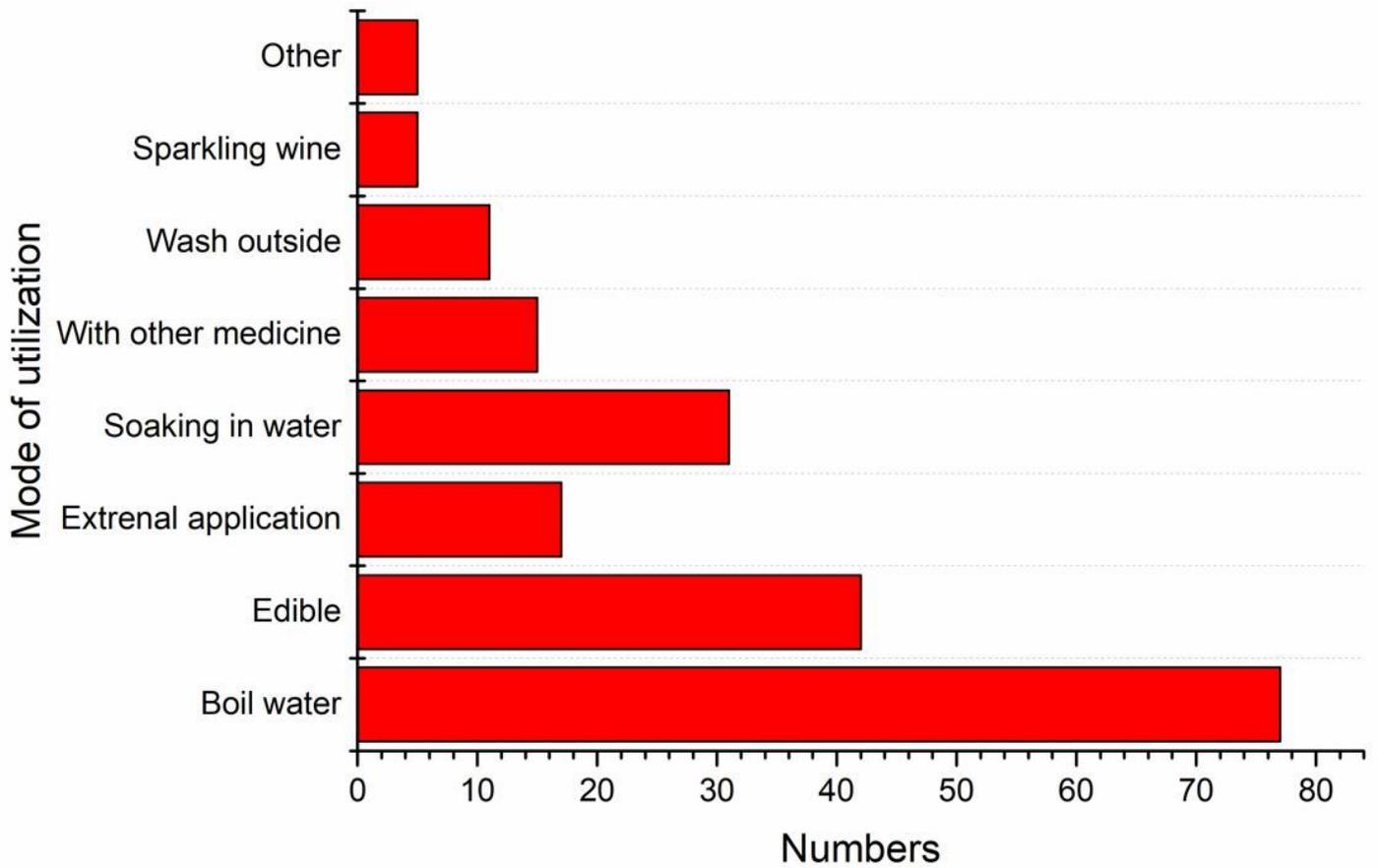


Figure 6

Mode of utilization of medicinal plants

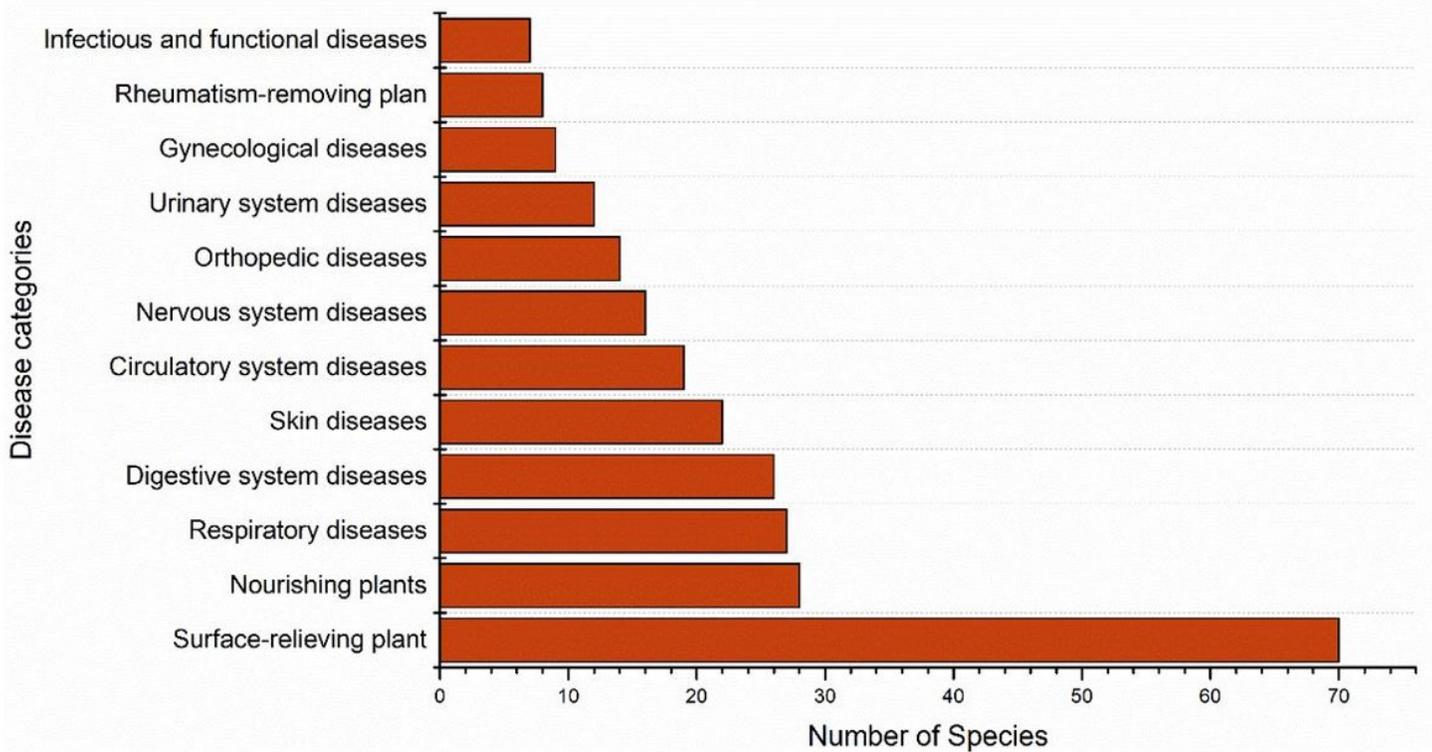


Figure 7

Major disease categories treated by a number of remedies

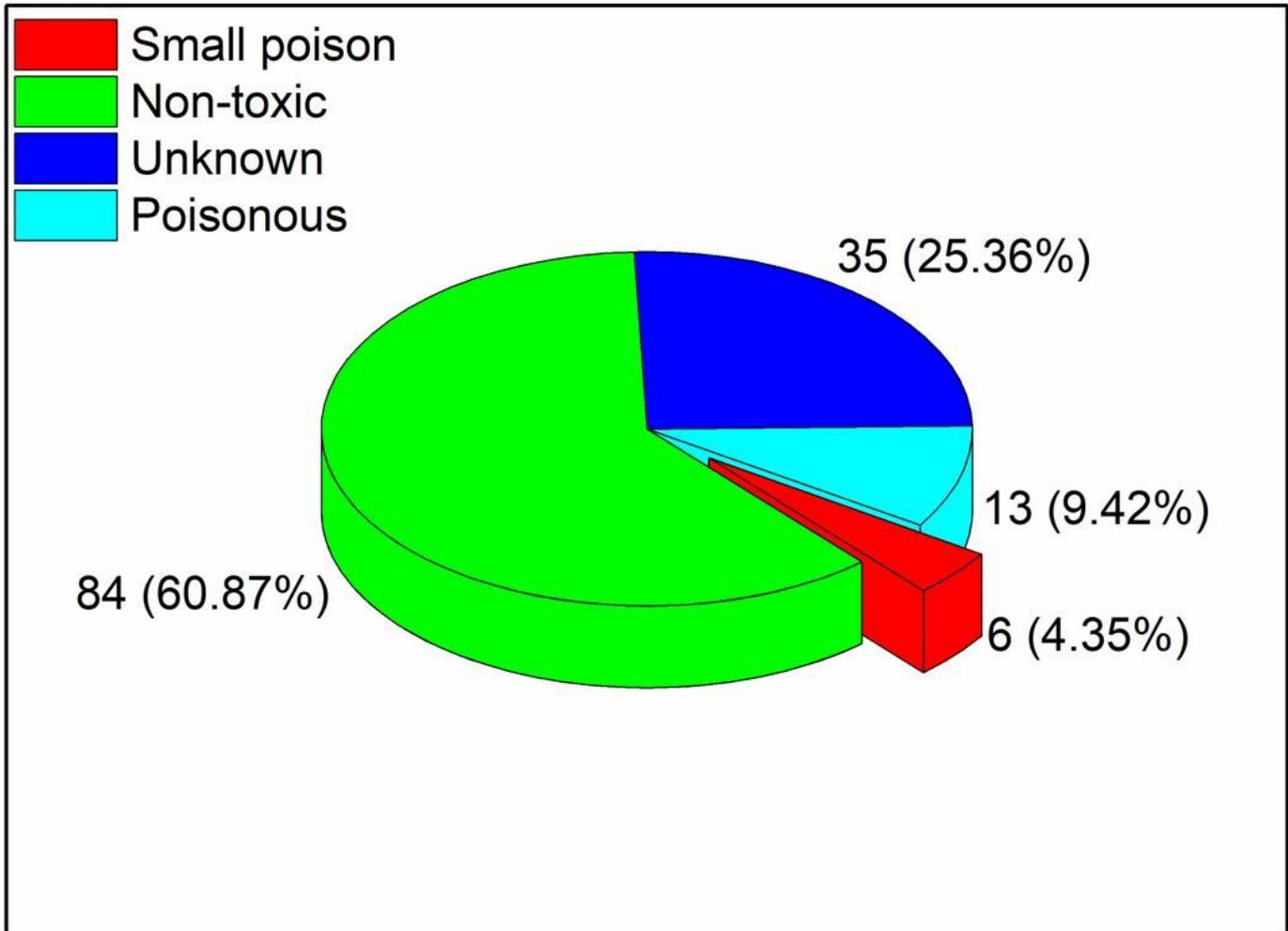


Figure 8

Toxicity level of recorded medicinal plants

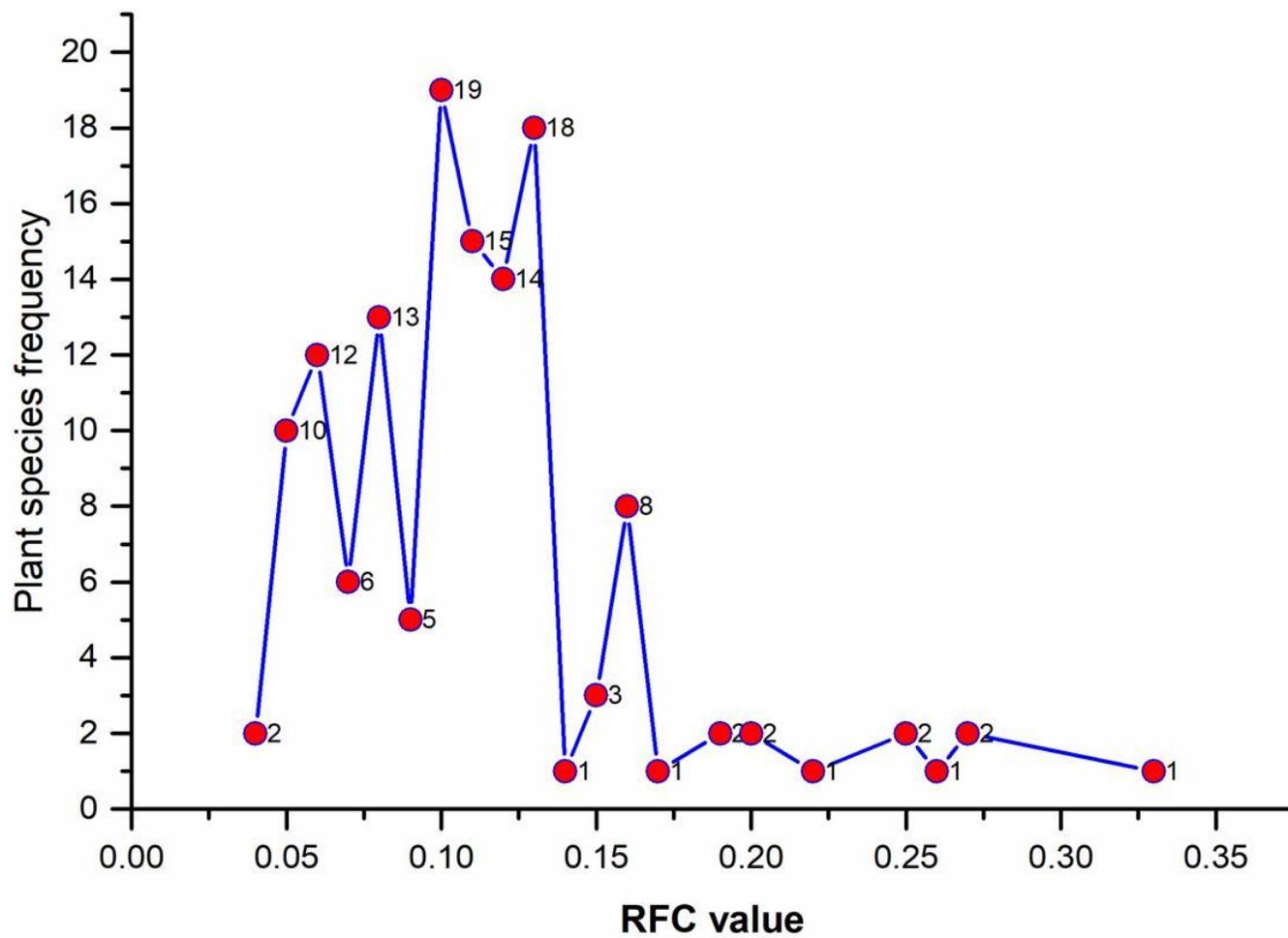


Figure 9

Relative frequency citation of the recorded medicinal plants

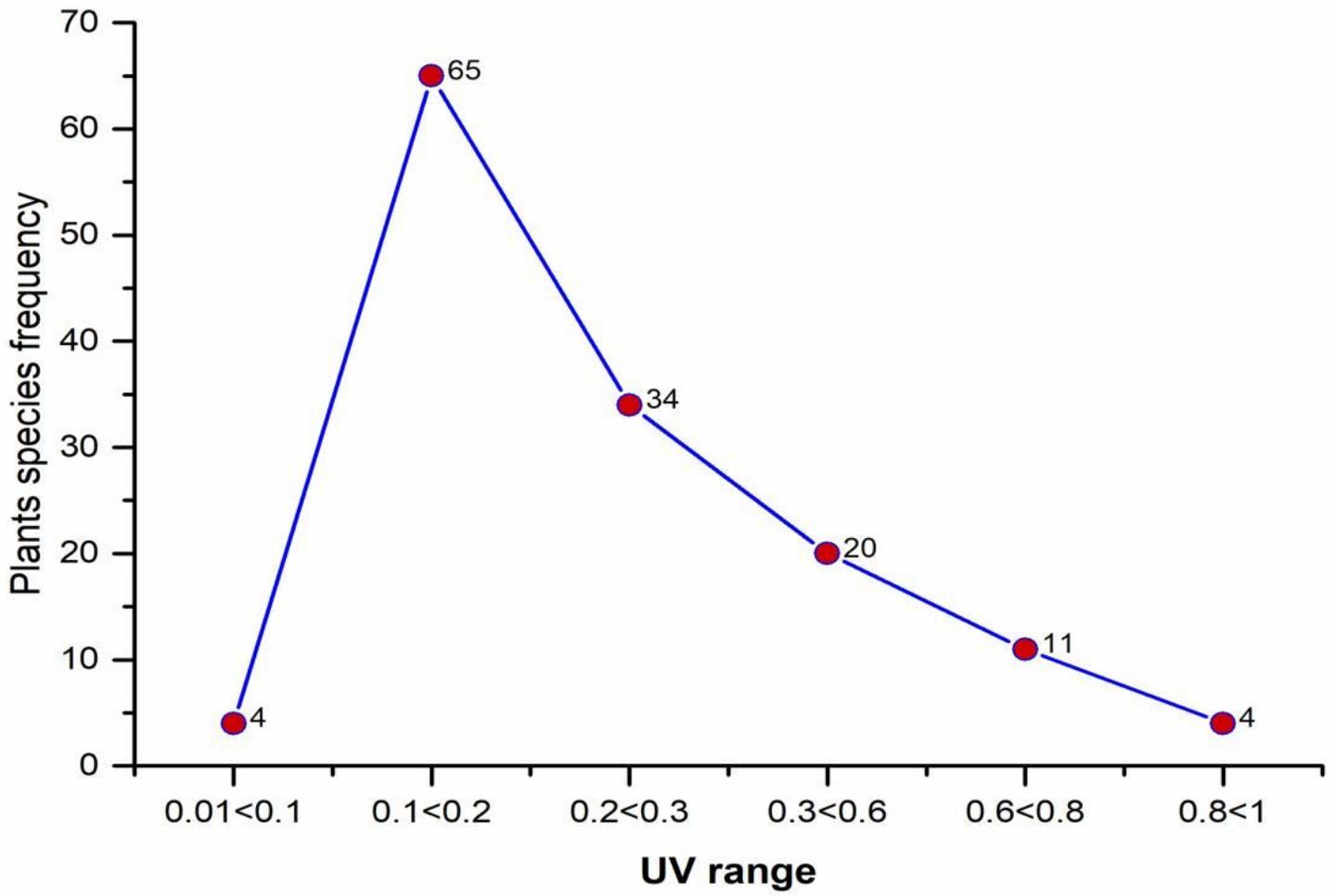


Figure 10

Use values of the recorded medicinal plants

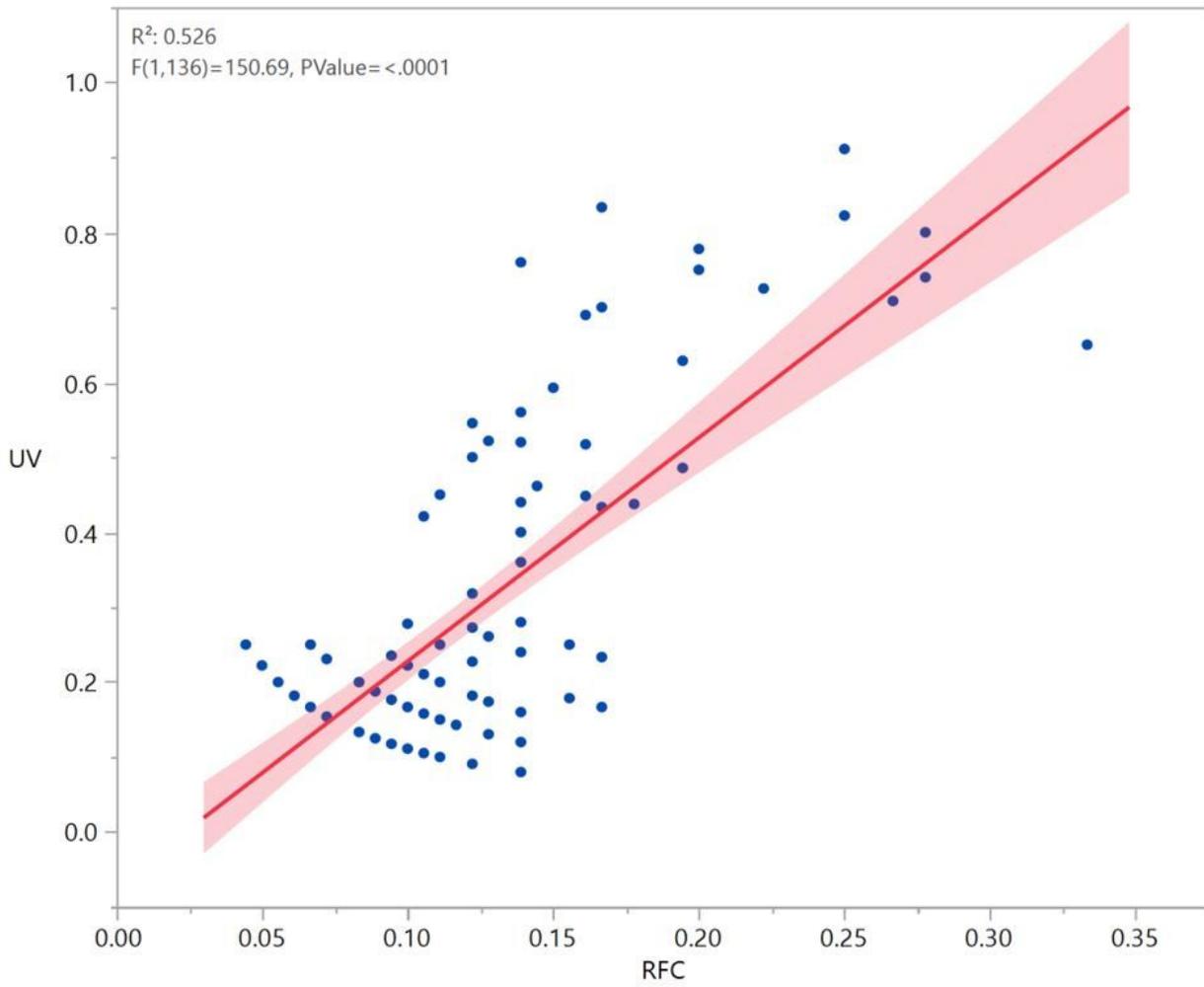


Figure 11

Correlation between Use value and Relative frequency citation