

Full Length Research Paper

Ethnobotanical survey of medicinal plants and their utilization in Shaanxi Province, China

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The investigation focuses on medicinal plants knowledge among ethnic populations in Shaanxi Province, China. Shaanxi Province is well known for its rich plant diversity and ethnic groups, but no ethnobotanical study has been conducted up to now. Field work was conducted from 2008 to 2009, using the methods of informant depiction, semi-structured interviews and informal discussions to obtain traditional medicinal knowledge from local ethnic residents and plant specialist. 94 species belonging to 86 genera in 46 families were used to treat various daily diseases in ethnic populations. 19 species included in 15 families were found only endemic to Shaanxi. Leguminosae (7 species), Compositae and Liliaceae (each 6 species) are predominant species used, followed by Ranunculaceae, Berberidaceae and Umbelliferae. Roots (46 species) were the most frequently used parts of plant, followed by fruit (7 species), seed (6 species) and bark (5 species). Among recorded 94 medicinal plant species, the wild made up 31.9% (30 species) and 68.1% (64 species) were the cultivated from farmers' land. The 30 wild species out of all 94 are multi-use involving many daily diseases, among which 18 are only endemic to Shaanxi that shows the abundance of ethnobotanical knowledge in ethnic populations of this province. Except for wild indigenous plant species, planting various medicinal plant species in farm land with higher economic value and/or regularly applied in family is an alternative choice to cure disease and at the same time to get income.

Key words: Shaanxi, traditional Chinese medicine, ethnobotany, medicinal plants.

INTRODUCTION

Shaanxi Province is known for its rich vegetation and plant biodiversity, due to its geographical and climatic conditions and located in the center of mainland of China. It stretches from northern Ordos Desert to southern Qinba Mountains including three transitional districts: Temperate zone, warm temperate zone and subtropics zone. Qinba Mountains are the integrated region of the Palaeartic realm and the Oriental realm and the boundary of Changjiang River and Yellow River.

Based on recent researches on the flora of Shaanxi Province, more than 3000 spermatophyte species around

(13% of total species in China), 40 gymnosperm species (22% of total in China), 300 fern species (13% of total in China) were recorded, in which 2271 plant species were found to have medicinal values (Shaanxi Development Committee of Traditional Chinese Medicine and Shaanxi Academy of Science, 2004). Moreover, 53 spermatophyte genera are endemic to Shaanxi, among which 21 have medicinal value (Shaanxi Development Committee of Traditional Chinese Medicine and Shaanxi Academy of Science, 2004). The unique ecological environment, a long history of geological formation and various biological resources in Shaanxi make it become one of the richest provinces in China and it has been termed as "biological resources pool" and "natural medicinal stock" (Science and Technology Office of Shaanxi, 2003).

Fifty-four ethnic groups were officially recognized by

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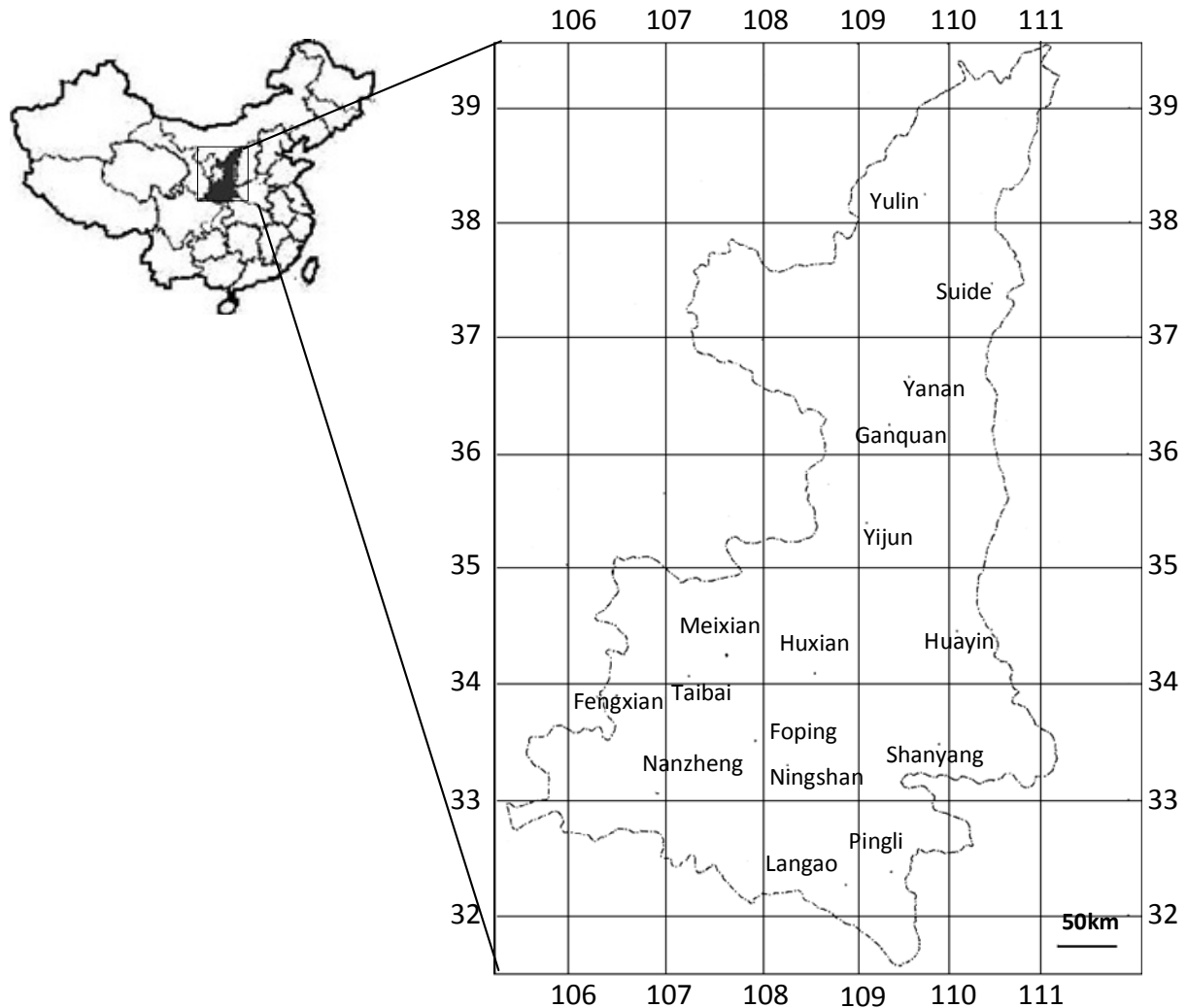


Figure 1. Location of sixteen study areas in Shaanxi Province.

China Central Government, of which 55 inhabit Shaanxi Province (Shaanxi Government, 2010). Till now, only a few references in Chinese deal with medicinal plant use among local people in Shaanxi (Li and Su, 2003; Xiao, 2003; Wang et al., 2007) and English paper is lacking. Li and Su (2003) reviewed the past references related on the conservation of diversity of wild medicinal plants in Qinba Mountains. Xiao (2003) provided the status of medicinal plants in Shaanxi and suggestions on their utilization. Wang et al. (2007) investigated the species diversity of medicinal plants of Liliaceae in Qinling Mountain and provided conservation suggestions according to investigation results.

Shaanxi Provinces is one of the less studied regions of China for its ethnobotanical values and therapeutic importance. In this paper we report the ethnobotanical work regarding medicinal plants species in Shaanxi and their pharmaceutical importance.

MATERIALS AND METHODS

Study area

Shaanxi is situated in northwest China at 31°42'-39°35'N and 105°29'-111°15'E, making up a total area of 205.6 thousand km² (Figure 1). Its diverse topography includes three marked regions characterized as loess plateau, plain of Wei River and Qinba Mountains from the North to South Shaanxi (Table 1). In this study, sixteen counties distributed in three regions (Table 1) were chosen to investigate, representing wide range of ethnic populations and climate zones (Figure 1).

Ethnobotanical methods

This survey was carried out during different seasons from 2008 to 2009. Interviews were conducted in 16 counties (Figure 1). Information was obtained by semi-structured interviews with officials (one county society leader of medicinal plants in each county; one village leader in each village), farmers and medicinal plant

Table 1. Sixteen study areas in three regions of Shaanxi Province.

Three regions of Shaanxi	Topographic character	Study area	Location	Altitude (m)	Annual mean temperature (°C)
North	Loess Plateau	Yulin, Suide, Yanan, Ganquan, Yijun	From northern border to Beiling, Yaowang and Huanglong Mountains.	800 – 1200	7 – 10
Central	Plain of Wei River	Huayin, Huxian, Meixian, Taibai, Fengxian	From east Tongguan County to west Baoji region.	325 – 800	11 – 13
South	Qinba Mountains	Shanyang, Foping, Ningshan, Nanzheng, Langao, Pingli	Including Qinling Mountain and Daba Mountain.	1500 – 3000	13 – 15

specialists (three persons in each village; medicinal plant knowledge and use). These key informants were over 40-year old and defined as people who are recognized as knowledgeable within the population and as such treat other people with medicinal plants. Of the 48 specialists, 37 were men and 11 women, aged 40-75 years, with an average age of 55 years.

Local name, parts used and medical use were carefully documented during each interview. Voucher specimens were collected under the guide of specialists and habitat was recorded at the same time. The plant specimens were identified at the herbarium of Northwest A and F University (WUK), where herbarium specimens have been deposited.

RESULTS AND DISCUSSION

Medicinal plants in Shaanxi Province

Total 94 species belonging to 86 genera in 46 families of plants were reported to have medicinal use (Table 2). Leguminosae was the family with the largest number of medicinal species (7; 15.2%), followed by Compositae and Liliaceae (each 6; 13.0%), Ranunculaceae (5; 10.9%), Berberidaceae and Umbelliferae (each 4; 8.7%). These six families represented 34.4% of all species and the rest 65.6% belonging to 40 families included less than 4 species in each. Among all, 19 species included in 15 families are found only endemic to Shaanxi. This result is corresponding to the report that spermatophyte flora is dominant families with wide range of distribution in Shaanxi (Shaanxi Development Committee of Traditional Chinese Medicine and Shaanxi Academy of Science, 2004). In addition, 117 species belonging to 29 genera in Liliaceae have been recorded in Qinling Mountain, among which 69 species contained in 26 genera have medicinal values and the latter occupies 11.5% of total species and 43.3% of total genera in China (Wang et al., 2007). Although it is still unknown there are how many medicinal genera and species in Leguminosae existing in Shaanxi, this family has been found the largest third in the world and 1120 species contained in 149 genera has been

documented in China with wide distribution (Northwest Institute of Botany, 1981). The other Compositae, Ranunculaceae, Berberidaceae and Umbelliferae need further investigation because of lacking information in this province.

In this investigation, most of the documented species are herbs (61; 64.9%), followed by shrubs (13; 13.8%), trees (12; 12.8%), lianas or vines (6; 6.4%). This result may be attributed to the fact that herbs are easier to be domesticated than both shrubs and trees and the growth season is shorter. Therefore, many herb species confirmed having important medicinal values have been cultivated, such as *Cornus officinalis*, *Eucommia ulmoides*, *Salvia miltiorrhiza*, *Gynostemma pentaphyllum*. Due to over exploitation, some root herb species have been extinct. Till to the end of 2005, total production area of all cultivated medicinal plants in Shaanxi was over 320 thousand hectare, and the cultivated plant species reached 75 when estimated at 2000 year (Zhang et al., 2007).

Parts of the plant used

Roots (46; 48.9%) were the most frequently used parts of plant, followed by fruit (7; 7.4%), seed (6; 6.4%), and bark (5; 5.3%). Tuber, flower bud, subterranean parts, stem, the whole plant, fruiting body and leaves were used in minor percentages. Given that the highest use of roots is harmful to local vegetation, most of species have been cultivated in Shaanxi, such as *S. miltiorrhiza*, *Pueraria lobata*, *Polygonatum sibiricum*, *Astragalus membranaceus*, *Scutellaria baicalensis*.

Species distribution and their cultivation

Medicinal plants, living in sand region of North Shaanxi along great wall, often have drought- and low temperature

Table 2. List of 94 medicinal plant species used by ethnic populations of Shaanxi Province, China.

Scientific name	Botanical family	Specimen number	Local name	Habitat	Parts used	Medical use
<i>Cornus officinalis</i> Sieb. Et Zucc.	Cornaceae	0358038	Shanzhuyu	Live in fertile, loose, weak acid soil, like cool, humid climate with altitude ranging from 600 to 800 m	Fruiting body	Anti-inflammation, support immune system, against high blood sugar
<i>Gastrodia elata</i> Bl. f. elata	Orchidaceae	0163151	Tianma	Live under forest or bamboo forest, like humid and cool climate with altitude 1400-1700 m	Tuber	Against headache, vertigo, body anaesthesia, epileptic twitch
<i>Eucommia ulmoides</i> Oliv.	Eucommiaceae	0493540	Duzhong	Live in -33 – 44°C (proper 9-20°C) environments, like sunshine, better in fertile, acid soil, with altitude 100-1500 m	Bark	Liver tonic, against joint pain, high blood pressure, genitourinary system disorders
<i>Salvia miltiorrhiza</i> Bge.	Labiatae	0377759	Danshen	Live in tussock, beside chimb, forest edge, like humid and temper climate, better in deep, good drainage soil	Subterranean parts	Against women's disease, heart disease
<i>Ziziphus jujuba</i> Mill. var. <i>spinosa</i> (Bunge) Hu ex H. F. Chow	Rhamnaceae	0399948	Suanzaoren	Live in stone gaps and eutropic hillside, like sunshine and disadvantageous environment tolerant, better in habitat with altitude 250-500 m	Seed	Against self-sweating, palpitation and too much dream; leave: against heart disease; fruiting body: body tonic
<i>Polygala tenuifolia</i> Willd.	Polygalaceae	0362832	Yuanzhi	Live in tussock, beside road, like cool climate with altitude 400-1000 m	Root	Phlegm resolving, against flu, cold, ulcer, breast pain, kidney tonic
<i>Pueraria lobata</i> (Willd.) Ohwi	Leguminosae	0286890	Gegen	Live in hillside tussock, beside road, sparse forest, like sunshine, warm and humid climate with altitude less than 1700 m	Root	Against headache and back pain, diarrhoea, heart disease; flower use: alcohol resolving; leaves and stem use: as fertilizer
<i>Tussilago farfara</i> L.	Compositae	035911	Kuandongha	Like cool and humid climate, better in loose, fertile soil with good drainage	Flower bud	Against pulmonary disease

Table 2. Contd.

<i>Gynostemma pentaphyllum</i> (Thunb.) Mak.	Cucurbitaceae	0356121	Jiaogulan	Live in sunless hillside, beside chimb, like shadow and humid environment, better in fertile, acid soil with good drainage	Whole plant	Anti-inflammatory, tumor growth inhibiting, against high blood fat and high blood pressure, brain tonic, supports immune system; other uses: as supplements in cosmetic, drink or functional food
<i>Rubia cordifolia</i> L.	Rubiaceae	0119201	Qiancao	Live in tussock beside chimb, like cool and humid environment, better in fertile, deep, loose soil	Subterranean parts	Against bloody disease, women's rare menstruation, joint pain, injury, phlegm resolving; other use: as dye
<i>Sophora japonica</i> L.	Leguminosae	0027924	Huaimi	Like sunshine, dry and cool environment, better in intermediate sandy soil	Flower bud Flower	Against bloody disease, headache, high blood pressure; bark use: as making paper or rope; seed use: oil extraction; fruit use: as material producing alcohol
<i>Polygonatum sibiricum</i> Delar ex Redoute	Liliaceae	0170216	Huangjing	Like humid and shady environment, better in fertile, sandy soil	Subterranean part	Support immune system, water-alcohol extracts as pigment, anti-aging
<i>Astragalus membranaceus</i> (Fisch.) Bge.	Leguminosae	0434401	Huangqi	Live in plain, tussock beside forest, like cool climate, better in deep, fertile soil with good drainage	Root	Against body weakness, diuretic, against digestive system disorder; as supplement in cosmetic; stem and leaves use: as animal feed
<i>Scutellaria baicalensis</i> Georgi	Labiatae	0120227	Huangqin	Live in eutropic hillside, tussock, wasteland, like cool, semi-humid environment, better in intermediate or weak alkaline soil with good drainage, altitude 600-2000 m		Anti-fungi, skin rashes, diarrhea, bloody vomiting, as supplements in cosmetics, leaves use: as tea

Table 2. Contd.

<i>Bupleurum chinense</i> DC.	Umbelliferae	0112521	Chaihu	Live in eutropic hillside, beside road, tussock, under sparse forest, like warm and humid climate with altitude less 2300 m, better in sandy soil	Root	Clear fever heat, against chest pain, irregular menstruation, uterus prolapsus, support effect of other medicines, overground parts use: against pulmonary disease
<i>Gentiana macrophylla</i> Pall.	Gentianaceae	0062918	Qinjiao	Live in tussock, like warm and humid climate, better in deep, fertile soil, altitude 600-4500 m	Root	Against joint pain, stretch tendons, support digestive system, alcohol extract: fungi inhibiting, pain inhibiting, flower use: as medicine in folk medicine, against pulmonary disease
<i>Fraxinus chinensis</i> Roxb.	Oleaceae	0059806	Qinpi	Live in eutropic hillside, broadleaf woodland	Bark	Against diarrhoea, chronic bronchitis, anti-fungi, diuretic, against psoriasis
<i>Platycladus orientalis</i> (L.) Franco	Cupressaceae	0101391	Baiziren	Live in hill, low mountain, altitude less than 1000 m	Seed kenel	Heart tonic, against night sweat, constipation; leaves use: raw eaten to blackening hair, fried with carbon: against bleeding
<i>Corydalis yanhusuo</i> W. T. Wang	Papaveraceae	0499765	Yanhusuo	Live in tussock under sparse forest, forest edge, like warm and humid climate, better in sandy soil with good drainage	Tuber	Against chest pain, high blood pressure, rare menstruation, injury, gastric tonic, hypnagogue
<i>Aconitum carmichaeli</i> Debx.	Ranunculaceae	0412166	Fuzi	Live at hillside, sparse forest, river bank, beside road, shrub, like warm, humid and sunshine, better in deep, loose, fertile sandy soil with altitude 1000-1800 m	Root branch	Anti-inflammation, against cold air, rheumatism, heart tonic, pains inhibiting, braized with meat: as gastric tonic, expel cold
<i>Ziziphus jujuba</i> Mill.	Rhamnaceae	0356266	Dazao	Live in plain, hill and valley, better in loess, sandy soil, drought-tolerant	Fruit	Heart tonic, support digestive system, muscular power, against diarrhoea, fatigue

Table 2. Contd.

<i>Prunus armeniaca</i> L.	Rosaceae	0120307	Kuxinren	Cultivated in low mountain area, hill	Seed	Against cough and phlegm, phlegm resolving, constipation, cooked as food: skin tonic
<i>Prunus persica</i> (L.) Batach	Rosaceae	0294710	Taoren	Like cool, temperate climate and sunshine, better in loose, sandy soil with good drainage (proper pH 4.5 – 7.5)	Seed	Against rare and aching menstruation, injury, oil, soap, fruit use: drink, food; young leaves use: as animal feed, insecticide
<i>Rhus chinensis</i> Mill.	Anacardiaceae	0418788	Wubeizi	Live under sparse forest, shrub, brook bank, like warm and humid climate, altitude 530-1650 m, better in sandy soil	Insect gall	Against bleeding, burns, pulmonary system disorders, skin rashes, anti-fungi, pain inhibiting, other uses: as supplements in food, industry, forage
<i>Toxicodendron vernicifluum</i> (Stokes) F. A. Barkl.	Anacardiaceae	0281409	Ganqi	Live eutropical hillside, mainly distributed in Shangluo, Ankang and Hanzhong	Lacquer sediment	Against inactive menstruation, expel worms
<i>Euphorbia kansui</i> T. N. Liou ex T. P. Wang	Euphorbiaceae	0294714	Gansui	Live in tussock, roadside, like cool and semi-humid climate with altitude less than 800 m, better in deep, loose, fertile soil with good drainage	Root	Against dropsy, chest tympanites, cough and asthma caused by much phlegm, urinary passage
<i>Anemone altaica</i> Fisch.	Ranunculaceae	0395163	Jiujiechangpu	Live under hill forest, beside chimb, shrub, like cool climate with altitude 1000-2000 m	Root	Phlegm resolving, against epilepsy, support digestive system, ear disease, chest inflation
<i>Psoralea corylifolia</i> L.	Leguminosae	0168224	Buguzhi	Like warm and humid climate, better in sandy soil with good drainage	Fruit	Against male impotence, genitourinary system disorder, kidney tonic, external use: against calvities; other use: as supplement in shampoo; leaves and stem use: as animal feed

Table 2. Contd.

<i>Astragalus complanatus</i> R. Br.	Leguminosae	0448228	Shayuanzi	Live hill, roadside, river bank, tussock, like sunshine and warm climate, sandy soil with good drainage, cold- and drought-tolerant	Seed	Support immune system, liver tonic, anti-inflammation, against high blood pressure, hematoblast agglomeration, increase blood flow in brain; other uses: as skin tonic, supplements added in drink, milk and food
<i>Forsythia suspense</i> (Thunb.) Vahl.	Oleaceae	0364949	Lianqiao	Live in eutropic hill, like warm and humid climate, sandy soil with good drainage and enough sunshine	Fruit	Against skin disease, thirst and rare urine caused by high fever; plant uses: as ornamental plant, fix sand; leaves use: anti-oxidation, against aging, as tea to prevent flu
<i>Lonicera japonica</i> Thunb.	Caprifoliaceae	0354962	Jinyinhua	Like warm and slightly humid climate and enough sunshine, proper growth temperature 12 - 26°C, drought-tolerant	Flower bud	Against skin carbuncle, throat pain, other uses: as supplement in drink, functional food, cosmic, toothpaste, antidote for poisonous mushroom, against sulfureted hydrogen
<i>Panax quinquefolium</i> L.	Araliaceae	0120806	Xiyangshen	Live in tussock under broadleaf forest, like cool and humid climate, dispersion sunshine, loose, fertile acid soil with good drainage	Root	Support immune system, against body weakness, oxygen absence, high temperature, fatigue, cough, lung disease and thirst
<i>Akebia trifoliata</i> (Thunb.) Koidz.	Lardizabalaceae	0496664	Mutong	Live hillside, shrub and chimb edge, like shady and humid climate with altitude 250-2000 m, better in weak acid soil	Stem	Against throat and joint pain, support urination and milk passage, root, fruit uses: same as stem, fruit use: as food and vintage, seed use: oil
<i>Inula japonica</i> Thunb.	Compositae	0418456	Xuanfuhua	Live in hill, chimb edge, roadside mash, like warm and humid climate, fertile and sandy soil	Capitulum	Against cold, flu, phlegm resolving, vomit inhibiting

Table 2. Contd.

<i>Fallopia multiflorum</i> (Thunb.) Harald	Polygonaceae	0063239	Heshouwu	Live in shrub, eutropic hillside, forest edge, roadside, like warm climate and humid environment, better in deep, loose, fertile soil	Root	Blood tonic, increase hair formation, immune system, blacken hair, against skin carbuncle and rashes, high blood fat, other uses: as supplements in cosmic, functional drink, food, tea, feed
<i>Aesculus chinensis</i> Bge.	Hippocastanaceae	0364552	Souluozi	The wild is very scarce, cultivated in Hanzhong and Ankang	Seed	Anti-inflammation, against gastric pain, high blood fat, tumefaction removing, heart tonic
<i>Schisandra sphenanthera</i> Rehd. Et Wils.	Magnoliaceae	0133324	Nanwuweizi	Live on forest edge, shrub beside brook, like humid, shady, cool climate with altitude less 2200 m	Fruit	Anti-oxidation, liver tonic, against pulmonary system disorder, heart disease, bark and pericarp use: spice, vintage, natural pigment; leaves use: as tea, aromatics
<i>Isatis tinctoria</i> L.	Cruciferae	0399626	Banlangen	Live on forest edge, beside chimb, like sunshine, humid climate, better in fertile, sandy soil with pH 6.5-8.0	Root	Against empurpling in tongue, throat pain, skin carbuncle, flu, parotitis, hepatitis, support medicinal effects with other medicines; seed use: oil
<i>Daphne giraldii</i> Nitsche	Thymelaeaceae	0378716	Zushima	Live in eutropic hillside, shrub, mountain area, like cool, shady environment with good aeration, better in weak acid soil with good drainage	Bark	Against joint pain, pain removing
<i>Glycyrrhiza uralensis</i> Fisch.	Leguminosae	0363759	Gancao	Live in plateau, mountain area, valley, like sunshine, rare rainfall, hot summer, cold winter, better in sandy soil	Root	Support digestive system, against hepatitis, bronchus asthma, urticaria, anti-HIV, other uses: as supplement added in food, drink, tobacco, cosmic, fix sandy, natural spice, feed
<i>Magnolia officinalis</i> Rehd. Et Wils.	Magnoliaceae	0416506	Houpu	Like sunshine, cool and humid climate, better in fertile, loose, intermediate or weak acid soil with pH 6-7	Bark, root skin	Against digestive system disorder, all parts used as medicine; seed use: oil added in cosmic; stem use: limber as materials for technical products; plant use: as ornamentals, fix sand, water conservation

Table 2. Contd.

<i>Codonopsis pilosula</i> (Franch.) Nannf.	Campanulaceae	0137094	Dangshen	Like sunshine, temperate and cool climate, better in deep, fertile soil with pH 6.0-7.5	Root	Support immune system, digestive system, against diarrhea; leaves uses: support immune system, forage.
<i>Juglans regia</i> L.	Juglandaceae	0395271	Hetaoren	Cultivated in plateau or hillside, better in humid, fertile soil	Seed	Haemostatic, kidney and skin tonic, dejecta passage, blacken hair, against heart disease, other use: food
<i>Trichosanthes kirilowii</i> Maxim.	Cucurbitaceae	0288110	Tianhuafen	Live in tussock, forest edge, brook bank, roadside, like warm, shady environment with low altitude less 1000 m, better in eutropic, deep, loose, fertile soil	Root	Against skin carbuncle, malignant hydatidiform mole, induced labor in intermediate pregnant period, anti-cancer, against HIV virus; fruit use: heart tonic, against tomentum cancer cells propagation, HIV virus
<i>Pinellia ternate</i> (Thunb.) Breit.	Araceae	0399996	Banxia	Live in tussock, wasteland, sparse forest, like warm and humid climate, better in fertile, loose, humidity with 40-50% sandy soil, pH 6-7	Tuber	Phlegm resolving, against vomiting, cough, headache, external use: skin carbuncle
<i>Arisaema erubescens</i> (Wall.) Schott	Araceae	0360694	Tiannanxing	Live in humid and shady environment under forest, shrub, wasteland, tussock with altitude less than 2300 m	Root	Phlegm resolving, convulsion and pain inhibiting, against cervical carcinoma, parotitis, acute mastitis, tetanus, external use of poultice mixing powder and alcohol or vinegar: skin carbuncle, insect bite
<i>Atractylodes lancea</i> (Thunb.) DC.	Compositae	0165994	Cangzhu	Grassland in dry land, like cool and dry climate, live in loose, fertile and sandy soil; Live in tussock on hillside, like cool, dry climate, better in loose, fertile, sandy soil with good drainage	Root	Support digestive system, bile secretion, against joint pain, high blood sugar, low blood pressure, anoxia, flu, cold
<i>Atractylodes macrocephala</i> Koidz.	Compositae	0395898	Baizhu	Like cool climate, cold- and drought-resistant, better in sandy soil, crop rotation, proper last crop Poaceae	Root	Support digestive system, gastric juice secretion, muscular power, diuretic, against high blood sugar, self sweating, liver tonic, increase body weight

Table 2. Contd.

<i>Arctium lappa</i> L.	Compositae	0361624	Niubangzi	Live in hill, roadside, like warm, humid climate, better in low mountain area, cold- and drought-tolerant	Fruit	Against high blood sugar and high blood pressure, parotitis, throat pain, skin rashes, kidney tonic, anti-tumor, leaves and root uses: diuretic, support blood flow, root as food, leaves as forage; external use: anti-inflammation, pain removing
<i>Scrophularia ningpoensis</i> Hemsl.	Scrophulariaceae	0500763	Xuanshen	Like warm and humid environment in hill, forest edge and shrub under 400 m altitude, better in deep, fertile, loose sandy soil with good drainage	Root	Against high blood pressure, high blood sugar, cancer cells propagation inhibiting, anti-fungi, other uses: as supplement in cosmic, forage
<i>Rehmannia glutinosa</i> (Gaert.) Libosch.	Scrophulariaceae	0483180	Dihuang	Live in eutropic hill, roadside, plain, like sunshine, better in intermediate and weakly alkaline sandy soil, need crop rotation	Root	Against bloody disease, hepatitis, joint pain, rheumatoid arthritis, apoplexy and coprostasis caused by high blood pressure, skin rashes, other uses: as supplement added in drink, food, comic
<i>Ginkgo biloba</i> L.	Ginkgoaceae	0495664	Baiguo	Low temperature (-32°C) tolerant, adapt humid and high temperature, like sunshine, better in fertile sandy soil with good drainage	Fruit, leaves	Phlegm resolving, genitourinary system disorder, other use: as supplement added in functional food, drink; leaves use: against heart disease, anti-UV
<i>Platycodon grandiflorum</i> (Jacq.) A. DC.	Campanulaceae	0173319	Jiegeng	Live in hillside, tussock, beside chimb, like temper climate, cold-tolerant, better in eutropic, deep, sandy soil with good drainage	Root	Phlegm resolving, throat pain, against pulmonary system disorder, high blood fat, high blood pressure, anti-arteriosclerosis, other use: as food, extract as insecticide; stem, leaves, flower and fruit uses: phlegm resolving
<i>Zanthoxylum bungeanum</i> Maxim.	Rutaceae	0397645	Huajiao	Like sunshine and warm climate, suitable in plain and low hill with 400-700 mm rainfall	Fruit body	Support digestive system, expel worm, external use: against toothache, pruritus, oil as food: seed use: oil; leaves use: pesticide

Table 2. Contd.

<i>Phellodendron amurense</i> Rupr.	Rutaceae	0284710	Huangbo	Live in broadleaf forest with annual temperature 18-19°C and air humidity 80% around altitude 1000 m	Bark	Against diarrhea, night sweating, genitourinary system disorder, crura pain, skin rashes, lumber as furniture material, leaves and fruit use: volatile oil; whole plant extract as natural pesticide
<i>Coptis chinensis</i> Franch.	Ranunculaceae	0127996	Huanglian	Live in humid and cool environment under forest, better in good drainage with altitude ranging from 1000 to 1900 m	Root	Against vomiting, diarrhea, bloody vomiting, toothache, skin carbuncle, eye disease, flower stem use: food; stem and root palpus use: medicine for fish, poultry and animal
<i>Dictamnus dasycarpus</i> Turcz.	Rutaceae	0095560	Baixianpi	Live in hillside, shrub and plain with altitude 200-500 m	Root	Against skin carbuncle, external use: against skin disease, propagation of cancel cells, remove fever heat
<i>Glehnia littoralis</i> Fr. Schmidt ex Miq.	Umbelliferae	0482185	Beishashen	Like sunshine, humid, cold- and salt-tolerant, better in deep, loose sandy soil	Root	Against bloody cough, heart disease, other use: food
<i>Bletilla striata</i> (Thunb.) Rchb. F.	Orchidaceae	0140500	Baiji	Like humid and cool environment, fertile and loose sandy soil with good drainage	Tuber	Against bloody vomiting, cough, injury, ulcer and phthisis, pulmonary tonic, external use: against bleeding, skin carbuncle, burn, extract as industrial material
<i>Paeonia lactiflora</i> Pall.	Ranunculaceae	0028609	Chishao	Live in shady and humid environment under forest or valley with altitude between 2200 and 2900 m, like sunshine, cold- and drought- tolerant	Root	Against blood silt in tongue, bloody vomiting, eye pain, convulsion inhibiting, heart tonic, other use: polysaccharide as food or vintage
<i>Angelica dahurica</i> (Fisch. Ex Hoffm.) Benth. Et Hook. F.	Umbelliferae	0499886	Baizhi	Live in deep, loose, fertile sandy soil, suitable germination temperature around 20°C	Root	Against headache caused by cold, toothache, nose frowst, anti-UV, as supplement added in cosmic
<i>Polygonatum odoratum</i> (Mill.) Druce	Liliaceae	0171175	Yuzhu	Live in sparse forest, shrub, like cool, humid climate, better in deep, sandy soil	Root	Against cough, rare urine caused by high fever, heat disease, high blood sugar, injury, disperse chronic skin disease

Table 2. Contd.

<i>Paris polyphylla</i> Smith.	Liliaceae	0304879	Zhonglou	Live in humid and shady environment under forest or shrub, better in fertile and sandy soil, cold-tolerant	Root	Against parotitis, tonsillitis, throat pain, mastitis, cough inhibiting, anti-fungi, flu virus
<i>Magnolia biodii</i> Pamp.	Magnoliaceae	0406017	Xinyi	Like warm and humid climate, better in weak acid or acid soil with good drainage	Flower bud	Against cold, headache, nose disorder, other use: extract added in dentifrice, functional food, cosmic
<i>Hippophae rhamnoides</i> L.	Elaeagnaceae	0392976	Shaji	Cold -, drought -, salt-tolerant, wide range of adaption ability, like sunshine, better in neutral or weak alkaline soil	Fruit	Cough inhibiting, phlegm resolving, support blood flow, against digestive system disorder, heart disease, other use: as supplement added in food, drink, tea, lumber as good firewood, furniture materials
<i>Sinomenium acutum</i> (Thunb.) Rehd. et Wils.	Menispermaceae	0399394	Qingfengteng	Live in hillside, forest edge and shrub	Stem	Anti-inflammation, pain inhibiting, against joint pain, cough inhibiting, anti-hypersusceptibility
<i>Artemisia scoparia</i> Waldst et Kit.	Compositae	0347235	Yinchen	Live in hill, roadside and brook, like warm and humid climate, better in deep, loose sandy soil with good drainage	Overground parts	Increase bile secretion, against high blood pressure, high blood fat, icterus hepatitis, diuretic, anti-fungi, other use: as food, facilitate urination
<i>Reynoutria japonica</i> Houtt.	Polygonaceae	0356238	Huzhang	Live beside chimb, river and brook bank, forest edge, like warm and humid climate, better in loose, fertile soil	Root	Against joint pain, cancer cell formation, dispersion of tumor, increase blood flow, pain removing, chronic bronchitis, burn, injury, high blood fat, other use: as vintage for arthritis; whole plant as animal medicine, insecticide
<i>Anemarrhena asphodeloides</i> Bge.	Liliaceae	0133338	Zhimu	Live in eutropic hill, grassland or plain as a population, better in loose, fertile soil with good drainage	Root	Anti-fungi, anti-inflammation, diuretic, cough inhibiting, phlegm resolving, against tumor, skin disease, other use: as supplement added in cosmic

Table 2. Contd.

<i>Viola philippicas</i> Cav.	Violaceae	0072653	Zihuadiding	Like sunshine, warm and cool climate, live in good drainage soil, reproduced by seeds	Whole plant	Both internal and external uses: against skin carbuncle, snake bite; young leaves use: as food
<i>Periploca sepium</i> Bge.	Asclepiadaceae	0218159	Xiangjiapi	Live in dry hill with sandy soil	Root bark	Against rheumatism, crura edema, heart tonic, diuretic, other use: secticide
<i>Cyperus rotundus</i> L.	Cyperaceae	0409648	Xiangfu	Live in roadside, river and brook bank, marsh under altitude 600 m, like warm, humid and loose soil	Root	Against distensible pains of flank, gastric and lung, digestive system disorder, irregular and rare menstruation
<i>Viscum coloratum</i> (Komar.) Nakai	Loranthaceae	0363621	Hujisheng	Parasitize on <i>Ulmus pumila</i> , <i>Pterocarya stenoptera</i> , <i>Betula platyphylla</i> , <i>Pyrus sorotina</i>	Branch, leaves	Against rheumatism pain, support immune system, easy infection and diarrhea for HIV patient, ceaseless quickening
<i>Epimedium brevicornum</i> Maxim.	Berberidaceae	0348456	Yinyanghuo	Live in shady hillside at broadleaf forest edge and shrubs, better in fertile and humid soil	Overground parts	Increase sexual function and blood flow to heart, reduce blood pressure, anti-tumor, against artery induration; other use: as supplement added in forage
<i>Notholirion hyacinthinum</i> (Wils.) Stapf	Liliaceae	0295399	Taibaimi	Live in hillside tussock with altitude around 3000 m	Bulb	Against digestive system disorder, cough and vomiting inhibiting
<i>Fritillaria taipaiensis</i> P. Y. Li	Liliaceae	0304233	Taibaibeimu	Live in hillside hassock, like cool and humid climate with altitude 2200-2480 m, better in deep, loose sandy soil	Bulb	Cough inhibiting, phlegm resolving, bloody vomiting
<i>Thamnolia vermicularis</i> (Ach.) Asahina	Thamnoliaceae	0490993	Taibaicha	Live in jokul, grassplot or rock surface with altitude 3000-5000 m	Lichen	Against cough caused by pulmonary inflammation, high blood pressure, other use: tea
<i>Pedicularis decora</i> Franch.	Scrophulariaceae	0289823	Taibaishen	Live in waste tussock and sparse forest with altitude 1700-3200 m	Root	Against dizziness mixed with <i>Codonopsis pilosula</i> root, <i>Asarum sieboldii</i> , joint pain

Table 2. Contd.

<i>Physochlaina infundibularis</i> Kuang	Solanaceae	0355048	Huashanshen	Live in hillside, beside ditch and hassock	Root	Support body power, against diarrhea, self and night sweating, asthma inhibiting
<i>Hedysarum polybotrys</i> Hand.-Mazz.	Leguminosae	0324092	Hongqi	Live in tussock or stone aperture with altitude 1500-3300 m	Root	Against fatigue, diarrhea, self sweating, dropsy, kidney tonic, diabetes, high blood pressure
<i>Cocculus orbiculatus</i> (L.) DC.		0131744	Mufangji	Live in hill, beside road, shrubs and sparse forest	Root	Pain removing, diuretic, dropsy inhibiting, against high blood pressure, acute nephritis, arrhythmia, external use: snake bite
<i>Panax japonicus</i> C. A. Mey. var. <i>major</i> (Burk.) C. Y. Wu et K. M. Feng	Menispermaceae		Zhuzishen	Live under bamboo forest, brook bank, like warm climate but not direct irradiation, better in intermediate or weak acid sandy soil with rainfall less 800 mm	Root	Against cough caused by body weakness, injury, joint pain, bloody vomiting and cough, irregular menstruation, high blood pressure, support immune system,
<i>Aconitum szechenyianum</i> Gay.	Araliaceae Ranunculaceae	0478610	Tiebangchui	Live in hill tussock or shrubs with altitude 1400-3700 m	Root	Against rheumatism, joint pain, headache, injury, irregular and rare menstruation, toothache, external use: against chilblain, carbuncle
<i>Podophyllum emodi</i> Wall. var. <i>chinense</i> Sprague	Berberdiaceae	0395151	Taoerqi	Live in valley, under good euphotic forest, forest edge, hassock, like cool and humid climate, better in calcified soil	Root	Against rheumatism, cough and asthma, gastric pain, injury, cancer, chronic bronchitis
<i>Bergenia scopulosa</i> T. P. Wang	Saxifragaceae	0494554	Panlongqi	Live in humid, stone gaps with altitude 1500-2800 m	Root	Against digestive system disorder, bloody vomiting, diarrhea, external use: against psoriasis
<i>Fallopia cillinerve</i> (Nakai) Ohwi	Polygonaceae	0403846	Zhushaqi	Live hillside, beside chimb, gaps among rocks with altitude 700-1300 m	Root	Convulsion inhibiting, pain removing, against ulcer; processed by salt: kidney tonic; processed by vinegar: against bleeding; processed by alcohol: gastric tonic

Table 2. Contd.

<i>Diphylleia sinensis</i> H. L. Li	Berberidaceae	Woerqi	Live in mixed forest, flowering from May to June	Root	Against rheumatoid arthritis, injury, irregular menstruation, cancer cell inhibiting, external use: carbuncle, snake bite
<i>Libanotis buchtormensis</i> (Fisch.) DC.	Umbelliferae	Changchunqi	Live in eutropic hill, stone gaps, beside road and hassock with altitude 1000-3000 m	Root	Against cold, body pain, headache, toothache, joint pain, injury, cough inhibiting, phlegm resolving, detoxification of <i>Aconitum taipeicum</i> Hand.- Mazz.
<i>Triostoum pinnatifidum</i> Maxim.	Caprifoliaceae	Tianwangqi	Live in humid and shadow under forest with altitude 2000-3000 m	Root	Against rheumatic pain of waist and crura, injury, indigestion, irregular menstruation
<i>Leontice robustum</i> (Maxim.) Diels	Berberidaceae	Hongmaoqi	Live in humid and shadow under forest, better in fertile, loose soil with good drainage, altitude 800-2500 m	Root	Against joint pain, injury, rheumatism, high blood pressure, bleeding, irregular menstruation, afterpain, increase blood flow
<i>Actinidia chinensis</i> Planch.	Actinidiaceae	Tengligen	Live in forest edge and shrubs, like warm, sunshine, better in fertile, acid or weak acid soil with good drainage	Root	Against rheumatic arthritis, injury, hepatitis, anti-cancer, external use as insecticide
<i>Rodgersia aesculifolia</i> Batal	Saxifragaceae	Suogudan	Live in hillside, hassock, under forest or beside chimb with altitude 1200-2600 m	Root	Anti-fungi, against bleeding, thyroid intumescence, throat pain, bloody vomiting, diarrhea, external use: injury, skin rashe
<i>Gymnadenia conopsea</i> L. R. Brown	Orchidaceae	Shoushen	Live in tussock, shrub, like shady and humid environment, cold-tolerant, better in fertile, black soil	Root	Support weak body after sickness, against male impotence, cough, diarrhea, injury

tolerant characteristics. *Glycyrrhiza uralensis* Fisch. has been found mainly distributing in arid and semi-arid region around N 40° with rain fall less than 100 mm. *Ephedra sinica* Stapf, *Ephedra*

intermedia Schrenk et C. A. Mey. and *Ephedra equisetina* Bge., mainly distributed in dry wasteland, plain and mountain area, like sunshine, drought-, cold- and salt tolerant, which can even

survive in winter under -25°C (Shaanxi Development Committee of Traditional Chinese Medicine and Shaanxi Academy of Science, 2004). Many medicinal plant species have been found to

be cultivated, such as *G. uralensis*, *Tussilago farfara*, *Prunus armeniaca*, *A. membranaceus*, *Bupleurum chinense*, *Scutellaria baicalensis*, *Anemarrhena asphodeloides*, *Lycium chinense* in this sand region where is the main production area for the former three species. Loess Plateau in North Shaanxi is the transition zone between grassland of sandy region and forest grassland, while its southern side locates in warm temperate zone with deciduous broad-leaved forest. Medicinal plants mainly distribute in the South because of more rainfall and relative higher temperature than that of the North. It is estimated that more than 400 medicinal plant species have been recorded in the South and the representative cultivated species are *Forsythia suspense*, *Ziziphus jujuba* Mill. var. *spinosa*, *Hippophae rhamnoides*, *Polygala tenuifolia*, *Glehnia littoralis*, *Gentiana macrophylla*, *Discorea nipponica* Makino.

Central Shaanxi has long domestic history of medicinal plants where there are many cultivated species, that is, *Astragalus complanatus*, *Glehnia littoralis*, *Euphorbia kansui*, *Isatis indigotica*, *Arctium lappa*, *Paeonia lactiflora*, *Sophora japonica* and *Phellodendron chinense*. Notably, *Astragalus complanatus*, *Scutellaria baicalensis*, *Euphorbia kansui* and *Polygala tenuifolia* cultivated in Dali, Fengxiang, Heyang and Pucheng Counties, respectively, have won recognition in China.

It is estimated that about 3500 spermatophyte species have been found in Qinba Mountains, among which more than 2000 are medicinal plants. Over 580 species have been listed in China Pharmacopeia and the materials of over 400 medicinal plant species have been approved by government for sale (Shaanxi Committee of Development, 2003) and its yield occupies more than 70% of total Shaanxi Province (Shaanxi Development Committee of Traditional Chinese Medicine and Shaanxi Academy of Science, 2004). Some medicinal plant species have relatively larger production area and yield, such as *Dioscorea zingiberensis* C. H. Wright, the best plant used to extract dioscorein, its production area has reached 54 thousand hectare in Xunyang and Baihe Counties with yield more than 50% of the whole country (Shaanxi Development Committee of Traditional Chinese Medicine and Shaanxi Academy of Science, 2004); *Eucommia ulmoides* and *Cornus officinalis* have occupied 14 and 13 thousand hectare production area in Lueyang and Foping, respectively.

The yield of cultivated *Gastrodia elata* Blume have occupied 48% of total country (Shaanxi Development Committee of Traditional Chinese Medicine and Shaanxi Academy of Science, 2004). Till now, four species: *D. zingiberensis* in Lueyang County, *Gastrodia elata* in Hanzhong City, *S. miltiorrhiza* in Shangluo City and *Gynostemma pentaphyllum* in Foping County have successively passed through the confirmation of good agricultural practice (GAP) initiated by National Agricultural Department.

Conclusions

Shaanxi Province is well known for its rich plant diversity and ethnic groups which also serves as an important supply of medicinal materials for traditional medicine. Our study recorded 94 medicinal plant species of which the wild making up 31.9% (30 species) and 68.1% (64 species) have been cultivated. These 30 wild species are multi-use that involve many daily diseases, including respiratory, digestive and genitourinary system disorder, joint pain, cold, flu, among which 18 are only endemic to Shaanxi that shows the abundance of ethnobotanical knowledge in ethnic populations of this province. Unfortunately, high demand of wild medicinal plants resulted in drastic decline of wild resources in natural habitat. Except for wild indigenous plant species, planting various medicinal plant species in home garden with higher economic value and/or regularly applied in family is an alternative choice to cure disease and at the same time to get income.

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