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An ethnobotanical survey of medicinal plants used for the ailment of diabetes mellitus in Changzhi city of Shanxi province, China.

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Abstract

Ethnopharmacological relevance: Traditional practitioners in Changzhi city of Shanxi (Chinese:) province have been using the folk medicinal plants for a long time concerning various principle ailments. In this study, a lot of vital ethno pharmacological information has been provided which would be functional for further pharmacological study.

Aim of the study: The aim of this study was to collect, analyse and evaluate the deep ethnopharmacological information on medicinal plants against diabetes mellitus in Changzhi City of Shanxi (Chinese:) province and tried to sort out some indigenous species that are used by traditional practitioners.

Materials and methods: Actual fieldwork was conducted with the help of an open ended and semi-structured questionnaire. Total 169 people were interviewed, including some indigenous peoples and Traditional Health Practitioners (THPs) of different villages in Changzhi City. Documented plants are enlisted with their application, part used, mode of preparation, frequency of use and Use Value (UV).

Results: The result of the present study has showed that total 71 plant species belonging to 44 families have been reported for diabetes mellitus ailment. Roots were found to be used the major commonly plant parts and the method of preparation was the powder. The most frequent mode of administration was orally intake.

Conclusion: The current study shown that some of the medicinal plants are largely used for representing an efficient ethnobotanical practice in this survey area. Plants, which achieved low UV's also need to bioactive screening to validate their utilization for the reported disease. This could be considered as well sign of prospective plants for finding out new drugs.

Keywords: Diabetes, Medicinal plants, Changzhi city, Shanxi province, China.

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Introduction

Diabetes mellitus (DM) is one of the most familiar chronic diseases in almost all countries. A survey finds recently that above 439 million people will suffer in future from DM by 2030 [1]. DM is occurred due to defective insulin secretion, insulin action, or both [2]. The continuing high glucose level in the blood is the main reason to cause some diabetic complications such as diabetic neuropathy [3], diabetic ketoacidosis [4], diabetic cardiopathy [5], diabetic nephropathy [6] and diabetic retinopathy [7]. The highest diabetes epidemics finds in China, and it grows continuously at a fearsome pace. According to latest data, among adults 11.6% of Chinese have diabetes. Perhaps more ominously, another study also found that half had pre-diabetes (Abnormal blood glucose levels but not far above for a diabetes diagnosis) by surveying 99,000 people. This study suggests that there are 493.3 million with pre-diabetes. This health crisis of Chinese people would be a heavy economic burden in near future [8,9].

Due to expensive medication as well as availability of traditional Chinese natural medicine, Ethnomedicinal plants is regarded an important option in the treatment of DM. China, has a long famous history of traditional medicine, and developed a distinctive medicinal treatment system. Practicing of medicinal plants is based on a traditional knowledge that has been conceded orally from generation to generation in humans and not many written documents are accessible [10]. Total 4,20,000 flowering plants accounted from the world further than 50,000 are used intended for medicinal principles [11,12]. In accordance with the World Health Organization (WHO), with reference to 4 billion people in developing countries trust in the healing properties of medicinal plant species and moreover utilize them routinely [13]. Ethnopharmacology and natural drug discovery remains a considerable optimism in the

humanizing the underprivileged incomes of countryside populations [14].

From the ancient time, not a single medicinal plant based work has been recorded on Changzhi. Therefore, we strived in broadly compilation of medicinal plants of Changzhi against DM. In this survey study, we tried to bring together ethnobotanical knowledge's from different Traditional Health Practitioners (THPs) and from local informants in Changzhi City. From this survey, report we tried to make out most frequently used medicinal plants for diabetes with their mode of preparation and different part used for different therapeutic uses. From the data analysis, we showed the most valuable species and extent usable species for a given ailment. Therefore, this work presents a complete summary of ethnobotanical practices in Changzhi City. Rural peoples surviving here mainly depend on conventional medicinal healers for healing of their diseases: one cause is trustworthiness to the treatment also another cause is need of access new medicinal capabilities [15].

As a result, evaluation or exploration as well as documentation of information of indigenous group on the employ and management of medicinal plants would fill up the gap of indigenous information on medicinal plants [16]. It may help to provides further conservation of medicinal plant based knowledge and make it possible to discover ethnopharmacological based novel drug.

Materials and Methods

Study area

Shanxi (Chinese:), one of the coastal province of the People's Republic of China, which is located in the northern part of China, with an area of 156000 km^2 and a population of 35,712,111. Changzhi, one of the major cities of Shanxi (Chinese:) province (36° 11′N 113° 06′E), is a part of the North China region as shown in Figure 1. The city is located in the north part of that province at between 36° 11′ northern latitude and 113° 06′ east of Greenwich. The city was one of the 36 administrative extant under the reign of the first emperor of a unified China. It has a continental monsoon climate. Its population and metropolitan area are 3,234,100 and 13,864 km^2, respectively. The annual precipitation is near about 350-700 millimetres. Currently, Changzhi is a transportation centre in Shanxi. Convenient transportations are facilitated by 4 controlled-access highways (Taiyuan-Changzhi, Changzhi-Jincheng, Changzhi-Linfen, Changzhi-Handan), 2 railways (Taiyuan-Jiaozuo Railway and Handan-Changzhi Railway), 3 national highways (China National Highway 207, 208 and 309) and 1 airport (Changzhi Wangcun Airport, ITAT Code: CIH, ICAO Code: ZBCZ). Internal transportation is also built with bus and taxi network.

Sampling of informants

This study was performed by the permission from the authority of Changzhi, Shanxi 046000. This ethnopharmacological survey was performed during January 2016 to May 2016. Three ground visits consisting of 6 days for each survey were performed. The focus of this study was traditional medicinal plant practitioners and local people with empirical knowledge on medicinal plants. Total 169 peoples were interrogated for this survey. During interview, the selection process is done by in the basis of informants, age, sexual category, as well as skill on practice of medicinal plants in various ailments.

Ethnomedicinal data collection

The data was collected with the help of a semi-structured questionnaire and the guided field-walk process. The record questionnaires dealt with individual information with age, sex, and educational conditions, skills on medicinal plants. It is also included subsequent information: (a) the name of the plants, (b) plants part/s used, (c) the mode of preparation, (d) plant types, (e) relative plenty at the region, (f) habitation of the plant species, (g) mode of application and (h) therapeutic uses of particular plant. In the guided field-walk method, interviews were conducted in Chinese, which was the language spoken and understood by traditional healers and the local peoples. Interviews are conducted during daytime and plant samples are collected, preserved, and later identified by the experts.

Data analysis

Current species information was organized in alphabetical order by scientific names along with the family, plant types, plant part used, mode of function, and mode of process, habit, habitat, and frequency of use.

Use value (UV)

Use Values (UV) are analysed for individual plants to provide a quantitative assess of its comparative importance to the informants purposely [17]. UV was calculated by this equation:

$$UV_S = \Sigma_i UV_{is}/n_s$$

where 'UV_s' indicates to the use value of a particular species, 'UV_{is}' indicates to the number of use information mentioned by the informants for that particular medicinal plant species and 'n_s' indicates to the entire number of informants that are interviewed. Usually *UV* is calculated to find out the level of therapeutic use for a particular plant species. Plant with wide healing uses or those that are broadly granted for the treat of a particular disease will gain a high *UV*.

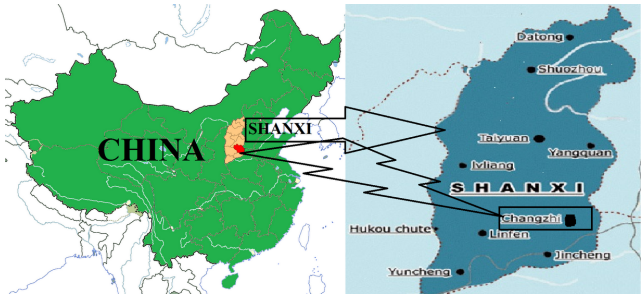

Figure 1. *Location of study area (Changzhi City) in China map.*

Results and Discussion

Informants

There are total 169 informants are interviewed among them 39 were THPs and 130 were Indigenous people. Major informants were found male 59.13% compare to the 40.83% female. Considering the age major part of the informants were 51-60 years (29.58%) old and the other informants were 41-50 years (28.40%) old, followed by 30-40 years (22.48%) old, respectively as shown in Table 1.

Many THPs cultivated medicinal plants in front of their house. They collect the plants in a particular time or season. Some knowledgeable THPs also preserve their personal formulations in written documents. Now days, some literate THPs have been following the formulation book containing official herbal formularies published by China as well as India. THPs does not want to disclose their experienced as well as ethnopharmacological knowledge to public as a way of not to place their profession under risk by more practitioners. The knowledge of the THPs is inter-generational and perhaps has been gathered over the centuries and passed on from one generation to another generation [18]. However, the knowledge is transfer from parent to children, in many other societies around the world most of the practitioners prefer their son to convey their ethnopharmacological knowledge [16,19-23]. Practicing of medicinal plants by THPs is found in many families where their knowledge is being passed to their family members or generation by only seeing the seniors doing it.

Table 1. *Classification of informants according to various factors.*

Factor	Categories	No. of person	% Of informants
Gender	Male	100	59.17
	Female	69	40.83
Age	31-40 yr	38	22.48
	41-50 yr	48	28.4
	51-60 yr	50	29.58
	61-70 yr	22	13.02
	More than 70 yr	11	6.51
Class	Indigenous people	130	76.92
	Traditional Health Practitioners (THPs)	39	23.08
Experience of Traditional Health Practitioners	Less than 3 yr	3	7.69
	3-6 yr	5	12.82
	6-10 yr	6	15.38
	10-15 yr	12	30.77
	15-20 yr	5	12.82
	More than 20 yr	8	20.51

Medicinal plants recorded

Through this current study, 71 plant species belonging to 44 families were documented which are used for the healing of various diseases in the study area. The maximum number of species (4 species) be member of Leguminosae and Rubiaceae afterward Lamiaceae, Apiaceae, Asparagaceae, Rosaceae, Orchidaceae, Cucurbitaceae, Asteraceae belongs to (3 species) as shown in Table 2.

Table 2. *Distribution of medicinal plant species of according to their family.*

Family	No. of species	Family	No. of species
Leguminosae	4	Cornaceae	1
Rubiaceae	4	Hypoxidaceae	1
Lamiaceae	3	Convolvulaceae	1
Apiaceae	3	Dioscoreaceae	1
Asparagaceae	3	Ebenaceae	1
Rosaceae	3	Berberidaceae	1
Orchidaceae	3	Eucommiaceae	1
Cucurbitaceae	3	Polygonaceae	1
Asteraceae	3	Caprifoliaceae	1
Fabaceae	2	Asclepiadaceae	1
Liliaceae	2	Oleaceae	1
Rutaceae	2	Sapindaceae	1
Ranunculaceae	2	Solanaceae	1
Lauraceae	2	Moraceae	1
Araliaceae	2	Paeoninacaeae	1
Gentianaceae	2	Gramineae	1
Amaranthaceae	1	Polyporaceae	1
Alismataceae	1	Orobanchaceae	1
Anthericaceae	1	Schisandraceae	1
Aristolochiaceae	1	Selaginellaceae	1
Buddleiaceae	1	Typhaceae	1

Campanulaceae	1	Poaceae	1

In the present study, high UVs observed for *Gymnema sylvestre* (1.92), *Astragalus membranaceus* (1.89), *Zea mays* (1.71), *Salviae miltiorrhiza* (1.70), and *Rehmannia glutinosa* (1.66) indicates their broad usage in the ethnobotanical practices in the survey area. Low UVs observed for *Curculigo orchioides* (0.18), *Flos lonicerae* (0.27), *Buddleja officinalis* (0.29), *Asparagus cochinchinensis* and *Cinnamomum cassia* (0.30) shown in Table 3. Those plants are enlisted as high UVs may be growing extensively in the study area that is why indigenous people and THPs of this region always use these plants in many ailment categories. Most of the cases roots are poured in water and taken orally in morning. The diabetic patients suggested by the THPs take fruits orally. In some cases, Meshed soup, and decoction of bark in the following morning on an empty stomach are taken orally. Having high UVs are an expression of the resourceful use of these plant species for the mentioned ailments [24].

Table 3. *List of medicinal plants used as traditional Chinese health care medicine in the treatment of diabetes by local residents of Changzhi.*

Serial No.	Scientific name	Family	Plant type	Parts used	Mode of administration	Frequency of usage	Use value
1	*Achyranthes bidentata* Bl.	Amaranthaceae	W, C, H	Root	(O)	58	0.69
2	*Agrimonia pilosa* Ledeb.	Rosaceae	W, H	Whole plant	(O)	95	1.12
3	*Alisma orientalis* (Sam.) Juzep.	Alismataceae	W, C, H	Tuber	(O)	68	0.8
4	*Anemarrhena asphodeloides* Bge.	Anthericaceae	W, H	Rhizome	(O)	48	0.57
5	*Angelica sinensis* (Oliv.)Diels	Apiaceae	W, H	Root	(O)	150	1.6
6	*Asarum sieboldii* Miq.	Aristolochiaceae	W, H	Rhizome	(O)	20	0.36
7	*Asparagus cochinchinensis* (Lour.) Merr.	Asparagaceae	W, H	Tuber	(O)	17	0.3
8	*Astragalus membranaceus* (Fisch) Bge.var.mongholicus (Bge.) Hsiao	Leguminosae	W, H	Root	(O)	169	1.89
9	*Atractylodes lancea* (Thunb.) DC.	Asteraceae	W, H	Rhizome	(O)	23	0.41
10	*Atractylodes macrocephala* Koidz.	Asteraceae	W, H	Rhizome	(O)	58	0.69
11	*Buddleja officinalis* Maxim	Buddleiaceae	W, S	Flower	(O)	15	0.27
12	*Bupleurum chinese* DC.	Apiaceae	W, H	Root	(O)	112	1.33
13	*Caragana intermedia kuang* et H. C. Fu	Leguminosae	W, S	Root	(O)	34	0.4
14	*Cinnamomum cassia* Nees ex Blume	Lauraceae	G, H	Dry Bark	(O)	25	0.3
15	*Citrus medica* L.	Rutaceae	G, H	Fruit	(O)	38	0.44
16	*Clematis chinensis* Osbeck	Ranunculaceae	W, H	Root, Rhizome	(O)	40	0.47
17	*Codonopsis pilosula* Nannf.	Campanulaceae	G, H	Root	(O)	29	0.34
18	*Coptis chinensis* Franch	Ranunculaceae	W, H	Rhizome	(O)	54	0.64
19	*Cornus officinalis* Sieb. et Zucc	Cornaceae	W, S	Fruit	(O)	105	0.65
20	*Crataegus pubescens* C. Presl	Rosaceae	W, C, T	Ripe fruit	(O)	17	0.31
21	*Curculigo orchioides* Gaertn	Hypoxidaceae	G, H	Rhizome	(O)	10	0.18
22	*Cuscuta chinensis* Lam.	Convolvulaceae	C, H	Seed	(O)	27	0.32
23	*Dendrobium moniliforme* (L.) Sw.	Orchidaceae	G, H	Whole plant	(O)	132	1.56
24	*Dendrobium chrysanthum* Wall.	Orchidaceae	W, H	Stem	(O)	61	0.72

25	*Desmodium gangeticum*	Fabaceae	W, S	Stem	(O)	42	0.5
26	*Dioscorea opposita* Thumb	Dioscoreaceae	W, H	Root	(O)	118	1.4
27	*Diospyro skaki* L.	Ebenaceae	W, T	Leaves, Fruit	(O)	67	0.79
28	*Elephantopus scaber* L.	Asteraceae	W, H	Whole plant,	(O)	32	0.38
29	*Entada phaseoloides* (L.) Merr	Leguminosae	W, V	Seed	(O)	98	1.16
30	*Epimedium brevicornum* Maxim	Berberidaceae	W, H	Leaves	(O)	22	0.39
31	*Eucommia ulmoides* Oliv.	Eucommiaceae	C, T	Bark	(O)	19	0.34
32	*Fagopyrum cymosum* (Trev.) Meisn.	Polygonaceae	W, H	Seed	(O)	23	0.41
33	*Flos lonicerae*	Caprifoliaceae	W, C, H	Flower	(O)	12	0.23
34	*Gardenia jasminoides* J. Ellis.	Rubiaceae	W, S	Fruit	(O)	19	0.42
35	*Gymnema sylvestre* (Retz.) Schult	Asclepiadaceae	W, H	Leaves	(O)	169	1.92
36	*Gynostemma pentaphyllum* (Thunb.) Mak.	Cucurbitaceae	W, H	Stem, Leaves,	(O)	43	0.51
37	*Ligusticum chuanxiong* Hort.	Apiaceae	W, H	Root	(O)	124	1.47
38	*Ligustrum lucidum* W. T. Ait.	Oleaceae	W, T	Fruit	(O)	25	0.31
39	*Litchi chinensis* Sonn.	Sapindaceae	C, G, T	Seed	(O)	137	1.62
40	*Liriope spicata* (Thunb.) Lour.	Asparagaceae	W, H	Tuber, Root	(O)	37	0.44
41	*Lycium barbarum* L.	Solanaceae	W, S	Fruit	(O)	84	0.99
42	*Malus toringoides* (Rehd.) Hughes	Rosaceae	W, C, T	Leaves	(O)	29	0.51
43	*Momordica charantia* L.	Cucurbitaceae	C, G, V	Fruit	(O)	38	0.45
44	*Morus alba* L.	Moraceae	W, S	Fruit, Leaves and Root	(O)	47	0.56
45	*Ophiopogon japocicus* (Thunb.) Ker-Gawl.	Liliaceae	W, H	Root	(O)	68	0.8
46	*Paeonia lactiflora* Pall.	Paeoninacaeae	W, H	Root	(O)	92	1.09
47	*Panax ginseng* C. A.Meyer	Araliaceae	W, H	Root	(O)	151	1.61
48	*Panax quinquefolium* L.	Araliaceae	W, S	Root, Rhizome	(O)	80	0.95
49	*Phellodendron amurense* Rupr.	Rutaceae	W, T	Bark	(O)	20	0.36
50	*Phragmites communis* Trin.	Gramineae	W, H	Rhizome	(O)	37	0.43
51	*Polygonatum odoratum* (Mill.) Druce.	Liliaceae	W, H	Rhizome	(O)	49	0.58
52	*Polygonatum sibiricum* Redoute	Asparagaceae	G, W, H	Rhizome	(O)	35	0.41
53	*Poria cocos* (Schw.) Wolf	Polyporaceae	C, H	Bark	(O)	138	1.64
54	*Prunella vulgaris* L.	Lamiaceae	W, H	Whole plant	(O)	111	1.31
55	*Pueraria lobata* (Willd.) Ohwi	Fabaceae	C, V	Root	(O)	87	1.03
56	*Ramulus cinnamomi*	Lauraceae	W, H	Twig	(O)	74	0.88
57	*Rehmannia glutinosa* (Gaertn.) Li-bosch.	Orobanchaceae	C, H	Root	(O)	140	1.66
58	*Salviae miltiorrhiza* Bge.	Lamiaceae	C, H	Root	(O)	159	1.7

59	*Schisandra chinensis* (Turcz.) Baill.	Schisandraceae	W, V	Fruit	(O)	35	0.41
60	*Scutellaria baicalensis* Georgi	Lamiaceae	C, H	Root	(O)	25	0.29
61	*Selaginella tamariscina* (Beauv.) Spring	Selaginellaceae	W, H	Whole plant	(O)	42	0.49
62	*Sophora flavescens* Ait.	Leguminosae	W, S	Root	(O)	59	0.69
63	*Spiranthes sinensis* (Pers.) Ames	Orchidaceae	C, H	Whole Plant, Root	(O)	23	0.41
64	*Swertia kouitchensis* Franch.	Gentianaceae	W, H	Whole plant	(O)	77	0.91
65	*Swertia macrosperma* C.B. Clark	Gentianaceae	W, H	Whole plant	(O)	92	1.08
66	*Trichosanthes kirilowii* Maxim.	Cucurbitaceae	C, V	Root	(O)	68	0.45
67	*Typha angustifolia* L.	Typhaceae	W, S	Pollen	(O)	21	0.37
68	*Uncaria cordata* (Lour.) Merr	Rubiaceae	W, H	Hook	(O)	43	0.47
69	*Uncaria laevigata* Wall.ex G. Don	Rubiaceae	W, H	Stem, Bark, Hook	(O)	68	0.71
70	*Uncaria tomentosa* DC.	Rubiaceae	W, V	Bark	(O)	94	1.11
71	*Zea mays* L.	Poaceae	C, G, H	Tuber	(O)	169	1.71

Information regarding the preparation

A variety of plant parts including root, leaf, seed, fruit, stem, flower, bark, tuber, whole plant twig, hook, pollen, and rhizome were found to be extensively used for the healing of different types of ailments. The most commonly used plant parts were roots (27%), followed by rhizome (14%), fruit (12%) and others are given in Figure 2. Ethnomedicinal practice has also been widely used and enlisted into several other ethnobotanical survey reports [25-28].

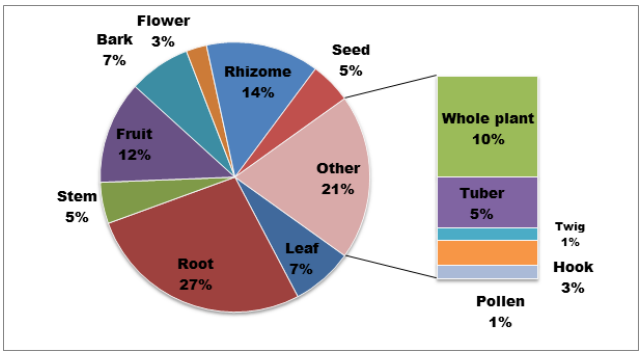

Figure 2. *Pie diagram-showing plant parts used for preparing medicines.*

In view of the mode of preparation of herbal medicines, information contains powder, juice, fruit, and decoction. Among these, the main mode of preparation is powder (36%), followed by juice (22%); decoction (16%) and rest are given in Figure 3. Powder, juice, fruit, and decoction can regularly be found as one of the chief forms of medicine preparation in ethnobotanical practice as it is simple to prepare by amalgamation through water and other ingredients [29,30]. In many cases, the preparation mode also involves drying of the plant substances afterward crushing into fine powder. Water is usually used if a solvent is needed for the preparation. A little bit milk or honey is also used as a matrix or included as an adjuvant to mask smell or to augment viscosity of the solvent. Many people of this district often habitually add sugar, salt, banana, or lemon to enhance the palatability of a drug preparation. Paste is made by grinding plant pieces via mortar and grinder.

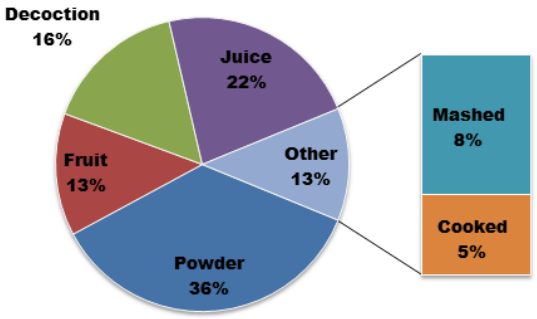

Figure 3. *Pie diagram showing the mode of preparation.*

In many cases, THPs prepare drugs with the assist of several plant species for managing of a single disease. Adjuvants are often included to get better therapeutic property or to enhance the artistic value of the preparation. Poly herbal preparations are able to give better therapeutic power as a wide variety of bioactive mixes from diverse plants is used in the preparation [31].

Habit, habitat, and nature of the plants

In the present study there are 71 identified therapeutically important plants are recorded, among them 76% are wilds.

Other species used is a member of herbs (50%), followed by cultivated plants (15%) and others are given in Figure 4. These medicinal plants can be found growing mainly in the jungle, riversides, and ponds side, roadside and homemade gardens. Therefore, the majority of the plant species documented in the present study grow up wild in that region. THPs used trees and herbs mainly as therapeutic due to their rapid accessibility in nature [22,29]. In accordance with local residents, some people supply plant materials to the herbal companies and pharmaceutical companies. They collect these plants from wild without paying any consideration to their conservation [32]. Though some of the enlisted plants are largely distributed in the present survey area, several of them are rare and reached in an extinction period due to the rapid deforestation or collecting them without any apprehension towards biodiversity protection. Therefore, rapid action from the authorities is essential for the proper cultivation and conservation of this therapeutically and commercially important and susceptible species.

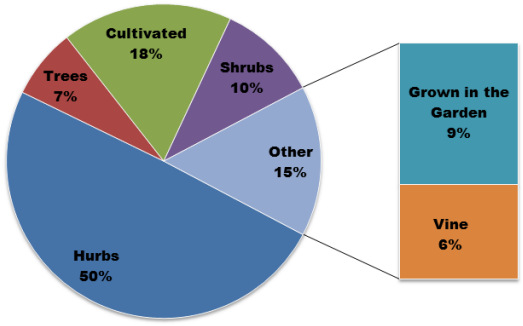

Figure 4. *Pie Chart showing the nature of the plants.*

Conclusion

The recent study gives a general expression of the medicinal plant use in Changzhi. There are 71 plant species are identified used for treating DM. There have a number of studies on medicinal plants of China, which give, emphasize such type of ethnomedicinal study in future in China [33-36]. Therefore, as this survey report will protect the medicinal plant practice of this area, some allegation can also be concluded from the study that comprises right steps for the propagation and protection of the medicinal plants containing the susceptible species, legalization of their use and proper patronization of the ethnobotanical practice to balance the less available modern medical facilities. This study finds a number of unique plant species for ethnomedicinal purposes against diabetes, which may contribute in future research, and development of new novel drugs.

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