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Plant Taxa Used in the Treatment of Diabetes in Van Province, Turkey

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Abstract: Despite the richness of local flora and medicinal plant utilization, there is no any report on documentation of antidiabetic botanicals used in Van province. Therefore, the present study aimed to record accumulation of the traditional antidiabetic medicinal plants of Van province in order to preserve the valuable local medicines knowledge, which has been threatened by urbanization. Antidiabetic folk medicines were determined via field surveys conducted in 1065 settlements during the period of 2014-2017 through medicinal plants questionnaire and structured face-to-face interviews (600 informants) with local people who are well known in the province for their long practice in traditional medicine. 69 plant taxa (35 species with undocumented antidiabetic medicinal use in scientific literature for Turkey) including five endemic and one rare to Turkey belong to 16 families (principally Asteraceae and Lamiaceae) were recorded for their traditional antidiabetic use. 52 different vernacular names were detected which were mainly indicate morphological characteristics. Infusion prepared from leaf and flower organs were found as the most common preparation method of local medicines in the province. Use value analysis showed that *Rheum ribes*, *Urtica dioica*, *Scutelleria orientalis* subsp. *pichleri*, *Diplotenia cachrydifolia*, *Teucrium polium*, *Rosa canina*, *Campanula glomerata* subsp. *hispida*, *Rumex scutatus*, *Helichrysum plicatum* subsp. *plicatum* and *Tanacetum balsamita* subsp. *balsamita* might serve promising pharmaceutical agents for diabetes treatment.

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1. INTRODUCTION

Diabetes is among metabolic disorders that characterized by hyperglycaemia resulting from defects in insulin secretion, insulin action, or both [1]. The total number of diabetic patients estimated to rise from 171 million in 2000 to 366 million in 2030 across the world and through its long-term effects; it is a cause of highest morbidity rate around the globe [2, 3]. Acarbose, metformin, miglitol and voglibose are among commercially available synthetic antidiabetic drugs commonly used in the management of diabetes, which have potentially hazardous side effects such as liver problems and diarrhoea. Phytotherapeutics and/or phytopharmaceuticals are accepted as complementary medicines or an alternative to conventional medicines with fewer side effects. Phytochemicals identified from traditional medicinal plants present an exciting opportunity for the development of newer antidiabetic

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agents. Some natural herbal sources that have extraordinary antidiabetic potential are tea polyphenols, pine bar extract, ginsenosides, condensed tannins, epigenine, charantin, and kotalanol [3].

Local people of Van province have been used various medicinal plants in the treatment of diabetes for a long time. Antidiabetic preparations have been used as valuable alternative and/or complementary agents to conventional medicines in the province. Though the richness of local flora and common medicinal plant utilization, there is no any report on documentation of antidiabetic botanicals used in Van province in the scientific literature. Hence, the present study was aimed to (i) document plant taxa used in the treatment of diabetes by local people of Van province for centuries which has been threatened by urbanization, (ii) analyse data via determining the most efficient plant taxa for diabetes in order to make contribution to antidiabetic drug discovery, (iii) analyse the local names, plant part(s) used, preparation and utilization methods of these folk medicines since local names, formulation of traditional remedies and methods of their preparation can assist to pharmaceutical studies such as the proper extraction method, therapeutic effect, pharmacological dose and body intake form [4].

2. MATERIAL AND METHODS

2.1. The study area

The study area is located in the Eastern Anatolia Region of Turkey at an approximate altitude of 1.800 m above sea level and with an area of 19,069 km^2. It is surrounded by Iran to the east, Ağrı to the north, Van Lake, Bitlis and Ağrı to the west, Siirt, Şırnak and Hakkari to the south (Figure 1). The study area consisted of 1065 settlements (counties, villages and hamlets), belong to the Iran-Turan Plant Geography Region, and situated in B9 and C9 grid square, which is one of the main endemism centres in Turkey [5]. The dominated climate is continental characterized by cold, long and snowy winters, short and rainy springs, and hot and dry summers.

Figure 1. The study area

The study area is surrounded by chains of high mountains from north, south and east which represents mountainous fields with numerous highlands (Nordiz, Sündüs, Abaza, Tirşîn, Nebirnav etc.) that contribute to a rich biodiversity. There are several mountains (Başet, Artos, Kavuşşahap, Karadağ), stream and rivers (Karasu, Zilan, Güzelsu, Özalp, Müküs, Bendimahi,

Bahçesaray, Çatak), valleys (Bendimahi, Zilan, Hoşap, Memedik, Çatak and Havasor), lake (Van gölü, Erçek gölü, Keşiş gölü, Akgöl, Zernek), lowland (Gürpınar, Erciş, Muradiye and Hoşap), gateways (Güzeldere, Kerapet, Kurubaş) and wetlands (Bendimahi, Çelebibağ, Çaldıran, Edremit) in the province. The geomorphological differences in the field contribute to the natural vegetation. Van province has been an important settlement from ancient times. Several instances of historical and cultural settlements are located in the province because of being homeland of various civilizations including Urartians, Persians and Ottomans, which contributed the province in terms of culture, civilization and agriculture. The economy of the province largely depends on stockbreeding and agriculture.

2.2. Antidiabetic herbal medicine data collection

This study conducted in 1065 settlements bounded to Van city between the periods of 2014-2017. In order to obtain comprehensive antidiabetic folk medicine data of Van province, the extensive ethnobotanical surveys (Appendix) and face-to-face interviews were carried out with 600 different local people who are well known in the province for their long practice in traditional medicine. The interviews were conducted in accordance to the requirements of the International Society of Ethnobiology Code of Ethics. Interviews were generally conducted in the fields, gardens, teahouses, highlands and village houses. During data collection surveys, demographic characteristics of the local people, vernacular/local names of plant species, preparation and utilization methods in traditional medicine were recorded. Moreover, live plant samples were collected from wild by help of those local people in order to identify their scientific names.

2.3. Plant materials

The field studies were carried out over a period of 4 year (2014-2017). Collector and herbarium numbers, family names, scientific plant names, endemism and risk categories, local names, plant part(s) used, preparation and utilization methods of antidiabetic plant materials collected were recorded properly and presented in Table 2. During this period, 69 taxa belong to 16 family (Spermatophyta (Angiospermae)) were collected from wild areas with no apparent physical damage at vegetation time (flowering, fruit and seed periods) for proper botanical nomenclature analysis (Table 2).

Herbarium samples were prepared from fresh plant materials through standard herbarium techniques. Scientific identities (family and species names) were determined according to the plant identification literatures: Flora of Iran [6], Flora of Iraq [7], Flora of Turkey [5, 8-9] and comparison with the specimens of Van Pharmaceutical Herbarium (VPH). Scientific names of plant samples were confirmed by using The Plant List (www.theplantlist.org) and International Plant Name Index (IPNI: http://www.ipni.org) and alphabetically ordered (Table 2). Herbarium samples prepared from plant materials have been stored at Van Pharmaceutical Herbarium, Faculty of Pharmacy, Van Yuzuncu Yil University, Turkey and collector and herbarium numbers were given properly (Table 2). The endemism and risk categories were specified properly [10-11] as presented in Table 2.

2.4. Statistical analysis

Statistical analysis of this study was performed by using Use Value (UV) as described previously [12]. Use value is a quantitative method that demonstrates the relative importance of species utilization locally, was calculated according to the following formula: UV = U/N, where UV refers to the use value of a species; U to the number of citations per species; and N to the number of informants. The UV values of the antidiabetic plant taxa were presented in Table 2.

3. RESULTS

3.1. Demographic characteristics of informants

As presented in Table 1, 600 local people were interviewed during field surveys. The majority of the respondents were male, low educated (literate and / or primary school) and ≥ 31 aged group. The local knowledge of herbal medicines had the lowest level in female, university educated and ≤ 30 aged groups. The number of male respondents were approximately 1.75 fold that of the female respondents (Table 1).

Table 1. Demographic characteristics of the informants (n=600)

	Number	%
Age		
20-30	110	18
31-49	200	33
50 and above	290	48
Sex		
Male	380	63
Female	220	36
Educational level		
Literate	210	35
Primary school	140	23
Secondary school	110	18
High school	80	13
University	60	10

3.2. Demographic characteristics of informants

Table 2. Database of plant taxa used in the treatment of diabetes in Van province

Plant species, endemism-rare IUCN [a]	Voucher specimen/ Herbarium Numbers [b]	Vernacular or Local Name(s)	Plant part(s) used	Preparation Method	Utilization Method [c]	NI [d]	UV [e]	Recorded Ethnobotanical Antidiabetic Use	
								Eastern Anatolia	Turkey (except E.Anatolia)
APIACEAE									
1. *Diplotaenia cachrydifolia* Boiss. (R-VU)	AD671 /VPH260	Sîyabo	Leaf, Root	Raw eaten Decoction	RAW, DOGBM	218	0.36	[12, 13]	-
2. *Eryngium bornmuelleri* Nab. (END-NT)	AD672/ VPH261	Tusî	Leaf	Infusion	DOGE	32	0.05	[13]	-
3. *Ferula orientalis* L.	AD673/ VPH262	Heliz	Leaf	Infusion	DOGAM	78	0.13	[13, 14]	-
4. *Ferula rigidula* DC.	AD674/ VPH263	Heliz	Leaf	Infusion	DOGAM	49	0.08	[15]	-
5. *Heracleum persicum* Desf.	AD675/ VPH264	So(y)	Leaf	Infusion	DOGESM	37	0.06	[13]	-

ASTERACEAE										
6.	*Achillea arabica* Kotschy	AD720/ VPH265	Bovîjan	Flower	Infusion	DOGAM	53	0.09	-	-
7.	*Achillea millefolium* L. subsp. *millefolium*	AD721/ VPH266	Bovîjan	Aerial parts	Decoction	DOGD	47	0.07	-	-
8.	*Anthemis cretica* L. subsp. *anatolica* (Boiss.) Grierson	AD72/ VPH267	Kulîlîk	Leaf , Flower	Infusion	DOGAM	26	0.04	-	-
9.	*Artemisia absinthium* L.	AD723, VPH268	Granguruh, Tahlişk, Bevüjana kuvî	Leaf Flower	Infusion	DOGD	82	0.14	[12-14]	[16-18]
10.	*Centaurea iberica* Trev. ex Spreng.	AD72 VPH269	Tahliş	Leaf	Infusion	DOGD	21	0.03	-	[19]
11.	*Centaurea glastifolia* L.	AD725/ VPH270	Tahliş	Leaf	Infusion	DOGD	13	0.02	-	-
12.	*Centaurea pterocaula* Trautv.	AD726/ VPH271	Tahliş	Leaf	Infusion	DOGD	19	0.03	-	-
13.	*Centaurea saligna* (K.Koch.) Wagenitz (END- LC)	AD727/ VPH272	Tahlişa spi	Leaf, Flower	Infusion	DOGD	27	0.05	-	-
14.	*Crepis hakkarica* Lamond (END- EN)	AD728/ VPH273	Tahliş	Leaf, Flower	Decoction	DOGD	7	0.01	-	-
15.	*Helianthus tuberosus* L.	AD729/ VPH274	Sevik	Tuber	Raw eaten	FC			[12,13, 15]	[20, 21]
16.	*Helichrysum arenarium* (L.) Moench subsp. *aucheri* (Boiss.) P.H.Davis & Kupicha (END--LC)	AD730/ VPH275	Herdemcan	Aerial parts	Decoction	DOGTD	62	0.1	[13]	-
17.	*Helichrysum armenium* DC. subsp. *armenium*	AD731/ VPH276	Herdemcan	Aerial parts	Decoction	DOGTD	74	0.12	[13]	-
18.	*Helichrysum pallasii* (Sprengel) Ledeb.	AD732/ VPH277	Herdemcan	Leaf, Flower	Infusion	DOGTT	41	0.07	[13]	-
19.	*Helichrysum plicatum* DC. subsp. *plicatum*	AD733/ VPH278	Herdemcan	Aerial parts	Decoction	DTGAM	157	0.26	[13,15, 22, 23]	-
20.	*Gundelia colemerikensis* Fırat (END-VU)	AD734/ VPH279	Kengerzer	Whole parts	Raw eaten	DOGD	52	0.09	-	-

21.	*Onopordum acanthium* L.	AD735/ VPH280	Kivar	Seed	Decoction	DTGD	58	0.1	-	-
22.	*Psephellus karduchorum* (Boiss.) Wagenitz (END- VU)	AD736/ VPH281	Giya brînok	Leaf, Flower	Infusion	DOGAM	15	0.02	-	-
23.	*Scorzonera latifolia* (Fisch. & C.A.Mey.) DC. var. *latifolia*	AD737/ VPH282	Nermend	Leaf	Raw eaten	EFLDEW	109	0.18	[24]	
24.	*Tanacetum balsamita* L. subsp. *balsamita*	AD738/ VPH283	Papatya	Leaf, Flower	Infusion	DTCTDTW	134	0.22	-	-
ARACEAE										
25.	*Arum rupicola* Boiss. var. *virescens* (Stapf) P.C	AD681/ VPH284	Kahrî	Tuber	Decoction	DOCDOW	8	0.01	[15]	
BERBERIDACEAE										
26.	*Berberis vulgaris* L.	AD682/ VPH285	Êmîş	Fruit	Raw eaten	CPDTM	37	0.06	[15]	-
CAMPANULACEAE										
27.	*Campanula glomerata* L. subsp. *hispida* (Witasek) Hayek	AD683/ VPH286	Nojda	Aerial parts	Decoction	DOCBS	176	0.29	-	-
CUCURBITACEAE										
28.	*Bryonia multiflora* Boiss. & Heldr.	AD684/ VPH287	Jurî ruvî	Fruit	Raw eaten	CFDFW	11	0.02	-	-
FABACEAE										
29.	*Astragalus gummifer* Lab.	AD714/ VPH288	Gunîzer	Root	Decoction	DOCDTW	69	0.12	[13, 15]	-
30.	*Astragalus longifolius* Lam. (END)	AD715/ VPH289	Girgunî	Root	Decoction	DOCDTW	31	0.05	[13]	-
31.	*Astragalus amblolepis* Fischer	AD716/ VPH290	Girgunî	Root	Decoction	DOCDTW	6	0.01	-	-
32.	*Astragalus halicacabus* Lam.	AD717/ VPH291	Çekçekok	Root	Decoction	DOCDTW	17	0.03	-	-
33.	*Astragalus pycnocephalus* Fischer	AD718/ VPH292	Gunî	Root	Decoction	DOCDTW	5	0.01	-	-
34.	*Lathyrus tuberosus* L.	AD719/ VPH293	Xenc	Tuber	Raw eaten	CFTDTW	95	0.16	[13, 14]	

HYPERICACEAE										
35.	*Hypericum perforatum* L.	AD685/ VPH294	Sîc	Flower	Infusion	DOGTHD	40	0.07	-	[17, 25]
36.	*Hypericum scabrum* L.	AD686/ VPH295	Sîc	Flower	Infusion	DOGTHD	83	0.14	-	-
LAMIACEAE										
37.	*Nepeta betonicifolia* C.A. Mey. subsp. *betonicifolia*	AD692/ VPH296	Nojda	Leaf, Flower	Infusion	DOCD	19	0.03	-	-
38.	*Nepeta lamiifolia* Willd.	AD693/ VPH297	Nojda	Leaf, Flower	Infusion	DOCD	7	0.01	-	-
39.	*Salvia limbata* C.A.Mey.	AD694/ VPH298	Bareşa spî	Leaf, Flower	Infusion	DOCD	56	0.09	-	-
40.	*Salvia macrohlamys* Boiss. & Kotsch	AD695/ VPH299	Çirçirk	flower	Infusion	DOCDTW	48	0.08	-	-
41.	*Salvia poculata* Nab.	AD696/ VPH300	Bareş	flower	Infusion	DOCDTW	71	0.12	-	-
42.	*Salvia trichoclada* Bentham	AD697/ VPH301	Bareş	Leaf, Flower	Infusion	DOCDTW	13	0.02	-	-
43.	*Salvia verticillata L.* subsp. *verticillata*	AD698/ VPH302	Bareş	Leaf, Flower	Infusion	DTCBS	104	0.17	-	-
44.	*Scutelleria orientalis* L. subsp. *pichleri* (Stapf.) Edmondson	AD699/ VPH303	Qêsêlmehmud	Leaf, Flower	Infusion Raw eaten	DTCBS	253	0.42	-	-
45.	*Stachys lavandulifolia* Vahl var. *lavandulifolia*	AD700/ VPH304	Bareş	Leaf, Flower	Infusion	DTCBS	20	0.03	-	-
46.	*Teucrium chamaedrys* L. subsp. *syspirense* (C.Koch) Rechf	AD701/ VPH305	Neman	flower	Infusion	DTCD	9	0.02	-	[19, 24]
47.	*Teucrium orientale* L. var. *puberulens* Ekim	AD702/ VPH306	Neman	Leaf, Flower	Infusion	DTCD	5	0.01	-	-
48.	*Teucrium polium* L.	AD703/ VPH307	Qeselmehmuda şin	Leaf, Flower	Infusion	DOGTES	202	0.34	[13, 15, 22, 23, 26, 27]	[24, 25, 28-30]
49.	*Thymus kotschyanus* Boiss. & Hohen. subsp. *kotschyanus*	AD704/ VPH308	Catir	Leaf, Flower	Infusion	DOCAMTM	51	0.09	-	-

50.	*Thymus kotschyanus* subsp. *kotschyanus*	AD705/ VPH309	Catir	Leaf, Flower	Infusion	DOCAMTM	23	0.04	[15]	-
51.	*Ziziphora tenuior* L.	AD706/ VPH310	Catira kuvî	Leaf, Flower	Infusion	DOCD	39	0.07	-	-
ORCHIDACEAE										
52.	*Dactylorhiza umbrosa* (Kar. & Kir.) Nevski	AD676/ VPH311	Sahlep	Tuber	Decoction	DOCDTW	51	0.09	-	-
PAPAVERACEAE										
53.	*Fumaria schleicheri* Soy. Will. subsp. *microcarpa* (Hausskn) Liden	AD677/ VPH312	Nişatir	Aerial parts	Decoction	DOCD	12	0.02	-	-
54.	*Papaver bracteatum* Lindl.	AD678/ VPH313	Xişxaş	Seed	Raw eaten	DC	44	0.07	-	-
PLANTAGINACEAE										
55.	*Plantago lanceolata* L.	AD679/ VPH314	Giyamembel	Leaf	Raw eaten	DC	71	0.12	[12]	-
56.	*Plantago major* L. subsp. *major*	AD680/ VPH315	Belghevîzar	Leaf	Infusion	DOGBM	30	0.05	-	[31]
POLYGONACEAE										
57.	*Rheum ribes* L.	AD687/ VPH316	Rêvas	Root	Decoction	DOGTDES	322	0.54	[12-15, 23, 27]	[32]
58.	*Rumex acetosella* L.	AD688/ VPH317	Tirşok	Sap	Decoction	DOGD	124	0.21	[26]	[18, 33]
59.	*Rumex scutatus* L.	AD689/ VPH318	Tirşka tirş	Leaf	Raw eaten	DC	159	0.27	[34]	[32, 35]
60.	*Rumex tuberosus* L. subsp. *horizontalis* (Koch) Rech.	AD690/ VPH319	Tirşok	Leaf	Infusion	DTGD	76	0.13	[13, 27]	[32]
PRIMULACEAE										
61.	*Primula auriculata* Lam.	AD691/ VPH320	Belg sîsîn	Leaf	Infusion	DOGD	13	0.02	-	-
ROSACEAE										
62.	*Cerasus avium* (L.) Moench	AD707/ VPH321	Helhelok	Dry fruit	Decoction	DOGESM	24	0.04	-	-
63.	*Crataegus monogyna* Jacq. subsp. *monogyna*	AD708/ VPH322	Guhîş	Fruit	Decoction	DOGTD; DC	67	0.11	-	[16, 17]
64.	*Malus sylvestris* Mill. subsp. *orientalis* (A.Uglitzkich) Browicz var. *orientalis*	AD709/ VPH323	Sevtirşk	Dry fruit	Decoction	DOGAM	108	0.18	[15]	-
65.	*Rosa canina* L.	AD710/ VPH324	Şîlank	Fruit	Decoction Raw eaten	DOGBM; DC	161	0.29	[22, 26]	[24, 29, 33, 36]

66.	*Rosa heckeliana* Tratt. subsp. *vanheurckiana* (Crépin) Ö.Nilsson	AD711/ VPH325	Şîlank	Fruit	Decoction Raw eaten	DOGBM; DC	18	0.03	-	-
67.	*Rosa pisiformis* (Christ) D. Sosn. (END-NT)	AD712/ VPH326	Şîlank	Fruit	Decoction Raw eaten	DOGBM; DC	42	0.07	-	-
68.	*Rubus sanctus* Schreber	AD713/ VPH327	Tutirik	Fruit	Raw eaten	DC	9	0.02	-	[24]
URTICACEAE										
69.	*Urtica dioica* L.	AD670/ VPH328	Gezînk	Aerial parts	Decoction	DOGTHD	289	0.48	[13-15, 22, 26, 34]	[24, 36, 37]

[a] **END:** Endemic**, R:** Rare**; EN**: Endangered, **LC**: Least concern, **NT**: Near Threatened, **VU**: Vulnerable; [b] **AD:** Abdullah Dalar**; VPH:** Van Pharmaceutical Herbarium [c] CFDFW: Consuming 4-5 fruits daily during 4-5 weeks; CFTDTW: Consuming 4-5 tubers daily during 2-3 weeks; CPDTM: Consuming 5-6 pieces daily during 2 months; DC: Directly consuming; DOCDOW: Drinking one tea cup daily during one week; DOCDTW: Drinking one tea cup daily during 2-3 weeks; DOCBS: Drinking one tea cup before sleeping; DOCD: Drinking one tea cup daily; DOGAM: Drinking one tea glass after meal; DOCAMTM: Drinking one tea cup after meals during two months; DOGBM: Drinking one tea glass before meal; DOGE: Drinking one glass in the evening; DOGESM: Drinking one glass on empty stomach in the morning; DOGD: Drinking one tea glass daily; DOGTD: Drinking one tea glass twice daily; DOGTES: Drinking one tea glass twice daily on empty stomach; DOGTHD: Drinking one tea glass thrice daily; DOGTT: Drinking one tea glass thrice daily; DTCBS: Drinking two tea cups before sleeping; DTCD: Drinking two tea cups daily; DTCTDTW: Drinking two tea cups 3 times a daily during 3 weeks; DTGAM: Drinking three tea glasses after meal; DTGD: Drinking two tea glasses daily; EFLDEW: Eating four leaves daily during eight weeks; FC: Freshly consuming; RAW: The plant is eaten raw on an empty stomach in the morning.[d] **NI:** Number of informants, [e] **UV**: Use value.

Table 2 presents plant species, endemism and rare status, risk categories, voucher numbers, vernacular name(s), plant part(s) used, preparation and utilization methods, number of informants, use values and recorded ethnobotanical antidiabetic use of these species according to scientific literature. A total of 69 antidiabetic plant taxa belong to 16 family (Spermatophyta (Angiospermae)) were determined in the study area. All antidiabetic botanicals used in the province were detected as wild, which were gathered during the vegetation time by local people. No any complication occurred based on the utilization of plant species used as traditional antidiabetic medicine in Van province was recorded during ethobotanical field surveys.

Among these antidiabetic botanicals, 35 of them including *Achillea arabica*, *Achillea millefolium* subsp. *millefolium*, *Anthemis cretica* subsp. *anatolica*, *Centaurea glastifolia*, *Centaurea pterocaula*, *Centaurea saligna*, *Crepis hakkarica*, *Gundelia colemerikensis*, *Onopordum acanthium*, *Psephellus karduchorum*, *Tanacetum balsamita*, subsp. *balsamita*, *Campanula glomerata* subsp. *hispida*, *Bryonia multiflora*, *Astragalus amblolepis*, *Astragalus halicacabus*, *Astragalus pycnocephalus*, *Hypericum scabrum*, *Nepeta betonicifolia* subsp. *betonicifolia*, *Nepeta lamiifolia*, *Salvia limbata*, *Salvia macrohlamys*, *Salvia poculata*, *Salvia trichoclada*, *Salvia verticillata* subsp. *verticillata*, *Scutelleria orientalis* subsp. *pichleri*, *Stachys lavandulifolia* var. *lavandulifolia*, *Teucrium orientale* var. *puberulens*, *Thymus kotschyanus* subsp. *kotschyanus*, *Ziziphora tenuior*, *Dactylorhiza umbrosa*, *Fumaria schleicheri* subsp. *microcarpa*, *Papaver bracteatum*, *Primula auriculata*, *Cerasus avium*, *Rosa heckeliana* subsp. *vanheurckiana* and *Rosa pisiformis* were reported for the first time for their traditional antidiabetic use for Turkey according to recorded scientific literature presented in Table 2.

Among antidiabetic folk medicines, 5 of them were identified as endemic (*Eryngium bornmuelleri*, *Centaurea saligna*, *Crepis hakkarica*, *Psephellus karduchorum* and *Rosa pisiformis*) and one as rare (*Diplotenia cachrydifolia*) (Table 2). According to risk categories, there are one taxa (*Crepis hakkarica*) as endangered, two taxa (*Diplotenia cachrydifolia* and *Psephellus carduchorum*) in vulnerable, two taxa (*Eryngium bornmuelleri* and *Rosa pisiformis*) in near threatened and two taxa (*Centaurea saligna* and *Helicrysum arenarium*) in least concern (Table 2).

With regards to the local names, 52 local plant names corresponded to 69 plant species used by local population detected in the study area. The local names were used generally for expressing morphological characteristics (herdemcan, kengerzer, gunizer, belghevizar) or taste (tahliş, tirşok, tirşkatirş) (Table 2).

Some local names assigned by the locals to the medicinal plants refer to more than one taxa such as tahliş that is used for naming four different taxa, herdemcan (4), bares (4) and şilank (3) (Table 2). The genus taxa distribution showed that *Astragalus* and *Salvia* were the most represented taxa (5 taxa each) in the province in terms of diabetes treatment followed by *Centaurea* (4 taxa), *Helichrysum* (4 taxa), *Teucrium* (3 taxa), *Rumex* (3 taxa), *Rosa*, (3 taxa), *Ferula*, *Achillea*, *Hypericum*, *Nepeta*, *Thymus* and *Plantago* (2 taxa each) (Table 2).

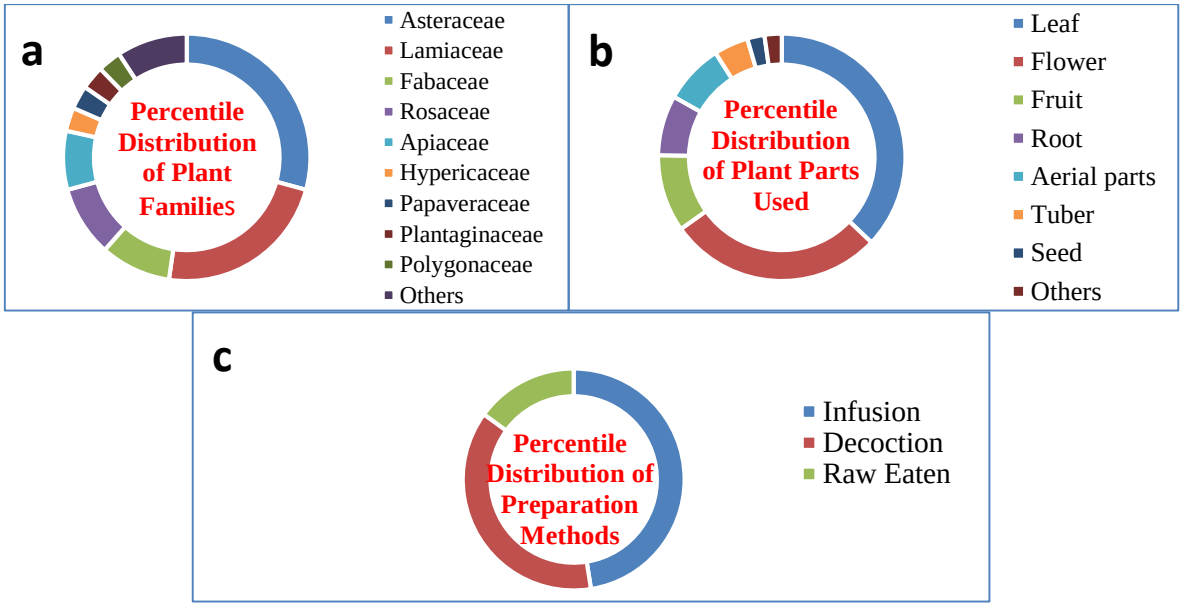

Figure 2. Percentile distribution of a) Plant families, b) Plant parts used and c) preparation methods.

The percentile distribution of plant families was presented in Figure 2a. Asteraceae was found as the most utilized plant family represented by 19 taxa (30%) and followed by Lamiaceae (15 taxa; 23%) (Figure 2a). The other most utilized plant families were Fabaceae (6 taxa; 9%), Rosaceae (6 taxa; 9%), Apiaceae (5 taxa, 8%). Leaf (37%) and flower (28%) parts were found as the major plant parts utilized in antidiabetic folk remedies followed by fruit (10%) and root (8%) (Figure 2b). With regards to preparation methods (Figure 2c), only 3 methods including infusion, decoction and raw eaten were detected with the superiority of infusion (47%).

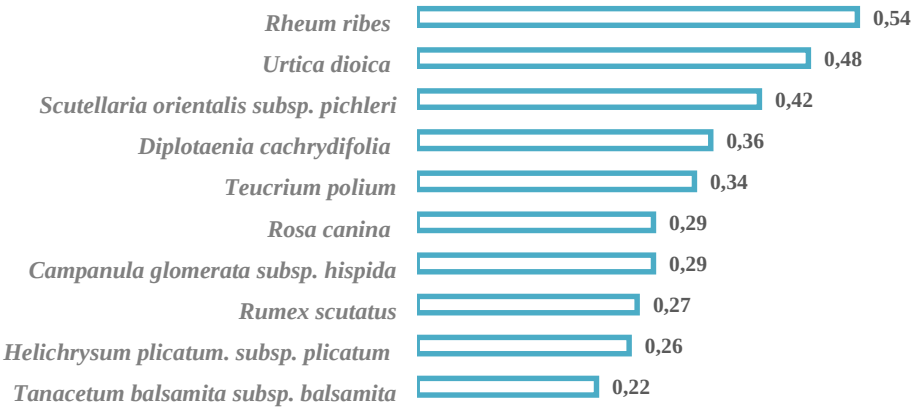

Figure 3. Plant taxa had the highest UV

Figure 3 presents the plant taxa with high use values of antidiabetic botanicals of Van province. The highest use value was detected in *Rheum ribes*, followed by *Urtica dioica*, *Scutelleria orientalis* subsp. *pichleri*, *Diplotenia cachrydifolia*, *Teucrium polium*, *Rosa canina*, *Campanula glomerata* subsp. *hispida*, *Rumex scutatus*, *Helichrysum plicatum* subsp. *plicatum* and *Tanacetum balsamita* subsp. *balsamita* (Figure 2). The lowest use value was found in *Crepis hakkarica*, *Arum rupicola*, *Astragalus amblolepis*, *Nepeta lamiifolia*, *Teucrium orientale* var. *puberulens* (UV: 0.01) (Table 2).

4. DICCUSSION AND CONCLUSION

Demographic characteristics of the informants findings indicate that familiarity of the local population with antidiabetic botanicals and their uses were inversely proportional with their level of education. Moreover, the number of male respondents were approximately 1.75 fold that of the female respondents (Table 1). The reason behind of this matter is probably due to the higher interaction rate of the male respondents with nature who were mostly shepherds and/or farmers.

Among all plant families, Asteraceae was found as the most utilized family for therapeutic properties, which was also reported in various ethnobotanical surveys conducted in Eastern Anatolia by several researchers [12, 15, 27]. It was reported that Asteraceae was the richest family across the world (among 452 vascular plant families) and Turkey (167 plant families) [38, 39] which have been identified by botanists until now. The prevalence of the Asteraceae family across the world including various ecological zones and different climatic conditions including our study area can be related to their wide tolerance broadness against several stress factors including Ultraviolet rays and cold, which are among the main stress factors in Van province.

The selection of proper plant part(s) or their products for targeted ailment treatment in folk medicine varies due to cultural context and as well as the ecological conditions which affect the production of bioactive compounds. Within this study, leaf and flower had superiority use compare to seed, tuber, stem, fruit and root. UV-B damage protection is one of the most significant roles of chemical compounds synthesized in plants [40]. Leaf and flower organs had the largest area in flowering plants and are the most exposed plant parts to the UV-B radiation and hence production of chemical compounds was relatively higher than those of the other plant organs such as stem, root and fruit, which can be one of the main reason of the superior usage of leaf and flower parts in Van province by local people in traditional medicine.

The vegetative plant parts of endemic plant taxa are the most utilized plant organs in Van province for antidiabetic purposes and unconscious and excessive collection of these plant

species can cause serious problems in the context of continuation of their generation. Endemic plant taxa (particularly *Psephellus karduchorum*) detected within this study are in risk categories and therefore some practises must be adopted for their conservation. For instance, these endemic plant taxa can be cultivated via plant tissue culture techniques or their populations can be scrutinized. Also local people, scientific researchers or local medicinal plant suppliers must be informed for avoiding excessive collection of these plant materials.

The main preparation methods detected in this study were infusion and decoction, which indicate that local remedies used in the treatment of diabetes in Van province mainly focused on hydrophilic compounds that might be among the major contributors of the antidiabetic effects.

A high number of plant taxa (69 species) used in the treatment of diabetes were detected within this study, which was remarkably higher than those studies conducted in Turkey. For instance, eight antidiabetic plant taxa were reported for Hakkari [12], 32 for Alaşehir (Manisa) [41], 24 for Hatay [19], 15 for Malatya [27], 9 for Espiye (Giresun) [33] and 15 for Esenli (Giresun) [42]. The higher number of antidiabetic plant taxa detected within this study can be explained by the limitation of modern medicine facilities and carbohydrate-based food habits. Pastoral farming and semi-nomadic life style, the rich local flora and abundance of mountainous fields, multiple numerous highlands, lowlands and valleys in the province let local people of Van province to utilize extensive medicinal practices on wild plants.

Use value (UV) was applied in order to detect the most used plant taxa and their effective healing potential(s) in certain disorders for therapeutic features. Namely, plant taxa with high value might have therapeutic potential since local people have used them for a long time with minimum side effects. Our findings showed that *Rheum ribes*, *Urtica dioica, Scutelleria orientalis* subsp. *pichleri, Diplotenia cachrydifolia, Teucrium polium, Rosa canina, Campanula glomerata* subsp. *hispida, Rumex scutatus, Helichrysum plicatum* subsp. *plicatum* and *Tanacetum balsamita* subsp. *balsamita* might serve promising pharmaceutical agents for diabetes treatment.

Plant taxa used in traditional medicine are based on observations of their effectiveness derived from their utilization on humans over centuries. This study presents a vast number of plant sources, selected by traditional wisdom, to cure diabetes in Van province for the first time. Until now, our knowledge regards the chemical composition and mechanism of actions of these antidiabetic folk medicines is limited. Traditional medicinal plants presented in this study may provide valuable leads for the identification of natural compounds for pharmaceutical uses. These plants, selected by generations of local people based on trial and error method, represent a vast source for the identification of novel and efficient antidiabetic agents

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Conflict of Interests

Authors declare that there is no conflict of interests.

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