Traditional uses of medicinal plants to prevent and treat diabetes; an updated review of ethnobotanical studies in Iran

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ABSTRACT

Background: Obesity and physical inactivity are currently on the rise due to industrialization of the communities, which has recently led to increased incidence of different diseases such as diabetes. Epidemiological studies and figures have demonstrated the growing incidence of diabetes. Relevantly, the side effects of chemical drugs have led patients to use medicinal plants and traditional approaches despite advances in development of chemical drugs. The aim of this review article is to report the medicinal plants and their traditional uses to prevent and treat diabetes according to the findings of ethnobotanical studies conducted in different regions of Iran.

Evidence Acquisitions: The search terms including ethnobotany, ethnomedicine, ethnopharmacology, phytopharmacology, phytomedicine, Iran, and traditional medicine in combination with diabetes, blood sugar and hyperglycemic were searched from scientific databases.

Results: The results of this article can be a comprehensive guideline, based on ethnobotany of different regions of Iran, to prevent and treat diabetes. According to this review article, certain plant species such as Urtica dioica L., popularly called nettle, in eight regions, Teucrium polium L., popularly called poleigamander, in five regions, and Trigonella foenum-graecum L., Citrullus colocynthis (L.), Schrad., and Juglans regia L. in four regions, were reported to be frequently used to prevent and treat diabetes.

Conclusions: The introduced medicinal plants in this review can be investigated in further research and produce new drugs with limited side effects.

Implication for health policy/practice/research/medical education: The introduced medicinal plants in this review paper can be new options, based on ethnobotany of different regions of Iran, to use in subsequent laboratory research and clinical trials for discovering and producing herbal drugs for prevention and treatment of diabetes.

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1. Context

Diabetes is a metabolic and multifactorial disorder which is characterized by chronically increased levels of blood sugar and develops due to disturbed secretion and/or function of insulin (1,2). From clinical perspective, diabetes mellitus is considered to be one of the most important risk factors for certain disorders such as nephropathy, retinopathy, neuropathy, and cardiovascular disease, and according to projections, its prevalence will be increasing in human communities in the future (3-5). Different severities of insulin deficiency and resistance are seen in patients with diabetes mellitus, and when these patients are not treated by diet, physical activity,
and hypoglycemic drugs, it is necessary to treat them by other approaches. Although use of insulin and hypoglycemic drugs is currently considered to be the main and effective treatment for diabetes mellitus, they may cause different complications such as increased lipid reserves, shrinkage of lipid at injection site, and hypoglycemic shock. In addition, insulin and hypoglycemic drugs affect pathogenesis of debilitating complications due to diabetes (6). Since diabetes mellitus is one of the oxidative stress-associated diseases (7), use of antioxidants can be a therapy approach to control diabetes and reduce associated complications (8-10).

Recently efforts have been increasingly made to use alternative medicine such as herbal drugs. Actually use of medicinal plants has caused a decrease in incidence of different diseases because of their effects in protecting against oxidative damage and decreasing inflammation (11-22). In this regard, recent studies have sought to investigate traditional uses and in vitro effects of medicinal plants, and to identify and isolate their active compound to develop herbal drugs (23-29). Therefore, the aim of this study is to identify medicinal plants and their traditional uses to prevent and treat diabetes according to the findings of the ethnobotanical studies conducted in different regions of Iran to offer some strategies to produce new and more effective herbal drugs to researchers.

2. Evidence Acquisition

In this review article, the words ethnobotany, ethnomedicine, ethnopharmacology, phytopharmacology, phytomedicine, Iran, and traditional medicine in combination with diabetes, blood sugar and hyperglycemic were used to retrieve relevant articles from scientific databases. Duplicate articles and the articles without accessible full text were not included in final analysis.

3. Results

The present study indicated that Iran’s people of different cultures and in various regions use 49 species of medicinal plants from 25 families based on traditional medicine to specifically treat blood sugar. Most of the identified plants were from Lamiaceae, Asteraceae and Apiaceae family with eight, six and six species respectively (Figure 1). Table 1 gives further data on the medicinal plants effective on kidney stone disease.

According to the findings, some of the plant species are used to treat diabetes in more than one region. For example, *Urtica dioica* L., popularly called nettle, is used in eight regions, *Teucrium polium* L., commonly called poleigamander, in five regions, *Trigonella foenum graecum* L., *Citrullus colocynthis* (L.) Schrad., and *Juglans regia* L., in four regions, and *Capparis spinosa* in three regions are used to treat diabetes (Table 1; 30-44).

Controlling glycemia completely by use of chemical drugs without causing the complications due to these drugs remains the concern in health-related studies and practice. It seems that other approaches should be sought out to treat hypoglycemia which is known as a hidden epidemic. Traditional medicine and use of medicinal plants is a supplementary and auxiliary method which has offered an effective approach to prevent and treat diseases (45-52).

It is believed that oxidative stress contributes to development of vascular complications in patients with diabetes. Increased reactive oxygen species (ROS) levels
A review of ethnobotanies to treat diabetes

Table 1. Medicinal plants effective on diabetes in different subcultures and regions of Iran

| No. | Scientific name                      | Family          | Local name                | Used organs         | Preparation      | Regions                                                                 | Ref.                      |
|-----|--------------------------------------|-----------------|---------------------------|---------------------|------------------|-------------------------------------------------------------------------|---------------------------|
| 1   | Centaurea bruguieriana Hand. Mzt.     | Asteraceae      | Badverd, Bad Bord         | Leaves, flowers     | Infusion         | Northeast Latrine Zone of Persian Gulf and Arjan, Fars Province        | (30,31)                  |
| 2   | Citrullus colocynthis (L.) Schrad.   | Cucurbitaceae   | Gorjey-e Abu jahl, khar gorgu, Hendevaney e sangi | Seeds              | Powdered ripen seeds | Kohghiluyeh va Boyer Ahmad province; Northeast Latrine Zone of Persian Gulf; Khuzestan province and Arjan, Fars province | (30-33)                  |
| 3   | Ocotea persica (Burm.) Boiss.        | Lamiaceae       | Shekar Shafa             | Fruit               | Decoction        | Arjan, Fars province and Mobarakhe, Isfahan province                  | (31,34)                  |
| 4   | Teucrium polium L.                   | Lamiaceae       | Alpe, Chez Koohi, Kalporeh | Aerial parts        | Infusion, Decoction | Arjan, Fars province; Chaharmahal va Bakhtiary province; Mashhad, Razavi Khorasan province; Northeast Latrine Zone of Persian Gulf and Khuzestan province | (30-32,35,36)            |
| 5   | Coriandrum sativum L.                | Apiaceae        | Gishniz                   | Leaves, Seed, stems | Edible, Decoction | Arjan, Fars province and Mobarakhe region, Isfahan province          | (31,34)                  |
| 6   | Capparis spinosa L.                  | Capparidaceae   | Kewerak-Lagin             | Stems, fruit, flowers, leaves, roots, seed | Edible           | Arjan, Fars province; Turkmen Sahra, north of Iran and Northeast Latrine Zone of Persian Gulf | (30,31,37)              |
| 7   | Tanacetum polycephalum (L.) Schultz-Bip. | Asteraceae   | Mokhalesheh             | Leaves, flowers     | internal         | Chaharmahal va Bakhtiary province                                    | (35)                     |
| 8   | Urtica dioica L.                     | Utricaceae      | Gazane, Chichiti odghin, Gazgazuk | Root, aerial parts | Decoction, Infusion | Hezar Mountain, South East of Iran; Khuzestan province; Maraveh Tappeh Region, North of Iran; Kohghiluyeh va Boyer Ahmad province; Turkmen Sahra, north of Iran; Zarivar, Kordestan province; Chaharmahal va Bakhtiary province and Northeast Latrine Zone of Persian Gulf | (30,32,33,35,37-40)    |
| 9   | Levisticum officinale W. D. Koch.    | Apiaceae        | Karafse kuhi             | Leaf, root, seed    | Infusion, Flavoring with yogurt, use as vegetable                   | Hezar Mountain, South East of Iran | (38) |
| 10  | Arctium lappa L.                     | Asteraceae      | Baba adam                | Root, leaves        | Decoction, Oral        | Hezar Mountain, South East of Iran and Khuzestan province            | (32,38)                  |
| 11  | Cichorium intybus L.                 | Asteraceae      | Kasni, Kashni            | Whole plant         | Orally, cooked and taken with yogurt, powdered flower, Arrack, Decoction | Hezar Mountain, South East of Iran and Kohghiluyeh va Boyer Ahmad province | (33,38)             |
| 12  | Berberis integerrima Hort. ex K.Koch. | Berberidaceae   | Zereshk                   | Flower, fruit, root | Decoction,            | Kohghiluyeh va Boyer Ahmad province and Hezar Mountain, South East of Iran | (33,38)                  |
| 13  | Ingusus regia L.                     | Juglandaceae    | Gerdoo, Ghoz              | Leaves, bulb, fruit, root | Infusion, Aromatic water and powder, Edible                       | Hezar Mountain, South East of Iran; Sirjan, Kerman province; Mobarakhe region, Isfahan province and Zarivar, Kordestan province | (34,38,40,41) |
| No. | Plant Name                                      | Family         | Common Names                      | Part(s) Used          | Administration | Location                        |
|-----|------------------------------------------------|----------------|-----------------------------------|-----------------------|----------------|-----------------------------------|
| 14  | Centaurium tenuifolium (Hoffm. & Link) Fritsch | Gentianaceae   | Ghontorion                        | Flower, leaves        | Brew fresh organ | Hormozgan province                |
| 15  | Bienteria cycloptera Bunge                     | Chenopodiaceae | Andere, samsil, samsul           | Leaves                | Decoction       | Hormozgan province                |
| 16  | Salsola mirzayanii Rech. F. & Esfand           | Lamiaceae      | Moortalkh, marve tahl, shir ghanam, mor porzu | Leaves                | Powder decoction | Hormozgan province                |
| 17  | Haussknechtia ehydactilla Boiss.               | Apiaceae       | Kelos-e kuhi                      | Aerial part           | Orally          | Kohgiluyeh va Boyer Ahmad province |
| 18  | Achillea wilhelmi K.Koch.                      | Asteraceae     | Berenjast                         | Flower                | Powder and infusion of dried flowers | Kohgiluyeh va Boyer Ahmad province |
| 19  | Astragalus fasciculifolius Boiss.              | Fabaceae       | Gineh, Ginja                      | Flower, root, gum     | Decoction       | Kohgiluyeh va Boyer Ahmad province |
| 20  | Trigonella foenum graecum L.                   | Fabaceae       | Shanbalileh                        | Aerial part, seed     | Infusion        | Mashhad, Razavi Khorasan province and Khuzestan province |
| 21  | Thymus daenensis 'Celak.'                     | Lamiaceae      | Halpeh                            | Aerial part           | infusion, extract of fresh plant, | Kohgiluyeh va Boyer Ahmad province |
| 22  | Dysphania botrys (L.) Mosyakin & Clements      | Amaranthaceae  | Dermaneh Torki                    | Aerial parts          | -               | Mashhad, Razavi Khorasan province |
| 23  | Rhus vuriaria L.                               | Anacardiaceae  | Somagh                            | Fruit                 | -               | Mashhad, Razavi Khorasan province |
| 24  | Nasturtium officinale R. Br.                   | Brassicaceae   | Alafe cheshmeh, bulag ote         | Aerial parts          | infusion        | Mashhad, Razavi Khorasan province and West Azerbaijan province |
| 25  | Vaccinium arctostaphyloides L.                 | Ericaceae      | Gharch Ghat                       | Fruit                 | -               | Mashhad, Razavi Khorasan province |
| 26  | Securigera securidacta (L.) Degen & Dorfl.     | Fabaceae       | Gandeh Talkheh                    | Seed                  | -               | Mashhad, Razavi Khorasan province and Khuzestan province |
| 27  | Ribes khorasanicum Saghati & Assadi            | Grossulariaceae| Gharch Ghat                       | Fruit                 | -               | Mashhad, Razavi Khorasan province |
| 28  | Salsola leriifolia Benth.                      | Lamiaceae      | Noruzak                           | Aerial parts          | -               | Mashhad, Razavi Khorasan province |
| 29  | Syringium aromatizum (L.) Merr. & L.M.Perry    | Myrtaceae      | Mihak                             | Flower                | -               | Mashhad, Razavi Khorasan province |
| 30  | Polygonum aviculare L.                         | Polygonaceae   | Alaf Hafiband                     | Aerial parts          | -               | Mashhad, Razavi Khorasan province |
| 31  | Rheum turkestanicum Janisch.                   | Polygonaceae   | Eshghan                           | Root                  | -               | Mashhad, Razavi Khorasan province |
| No. | Scientific Name  | Family       | Common Name     | Part Used          | Location(s)                                                                 |
|-----|------------------|--------------|-----------------|--------------------|----------------------------------------------------------------------------|
| 32  | Toddalia asiatica (L.) Lam. | Rutaceae   | Dahan baz-Dahan basteh | Aerial parts, leaves, essence | Mashhad, Razavi Khorasan province (36)                                      |
| 33  | Mentha spicata L. | Lamiaceae    | Nana            | -                  | Mobarakeh region, Isfahan province (34)                                     |
| 34  | Allium cepa L.   | Alliaceae    | Sir             | Bulb, Aerial parts | Mobarakeh region, Isfahan province (34)                                     |
| 35  | Cucurbita pepo Mill. | Cucurbitaceae | Kado halvai     | Seed, fruit        | Mobarakeh region, Isfahan province (34)                                     |
| 36  | Petroselinum crispum Mill. | Apiaceae | Jafari          | Root, leaves fruit, Essence | Mobarakeh region, Isfahan province (34)                                     |
| 37  | Hordeum vulgare L. | Poaceae      | Jo dosar        | Seed, bran         | Mobarakeh region, Isfahan province and Sardasht, Western Azerbaijan (34, 44) |
| 38  | Althaea officinalis L. | Malvaceae | Hero            | Flowers, roots, leaves | Sardasht, Western Azerbaijan province (44)                                  |
| 39  | Anethum graveolens L. (dill) | Apiaceae | Toragh          | Leaves             | Sardasht, Western Azerbaijan (44)                                            |
| 40  | Brassica Napus L. | Brassicaceae | Kolza           | Root, seed, leaves | Sardasht, Western Azerbaijan and Khuzestan province (44)                    |
| 41  | Lamium album L.   | Lamiaceae    | Gaz gaz         | Leaves             | Sardasht, Western Azerbaijan (44)                                            |
| 42  | Suaeda altissima Pall. | Chenopodiaceae | mangak       | Leaves, stems      | Northeast Latrine Zone of Persian Gulf (30)                                |
| 43  | Hediantus tuberosus L. | Asteraceae | -               | Tuber and leaves    | Zarivar, Kordestan province (40)                                            |
| 44  | Kelussia odoratissima Mozaff. | Apiaceae | Keluss          | Whole plant        | Khuzestan province (32)                                                     |
| 45  | Salsola officinalis L. | Lamiaceae | Chilaver        | Leaves, fruit      | Khuzestan province (32)                                                     |
| 46  | Ranunculus sarvensis L. | Ranunculaceae | Zard gad      | Flowers            | Khuzestan province (32)                                                     |
| 47  | Amygdalus scoparia Spach. | Rosaceae | Baym            | Gum                | Khuzestan province (32)                                                     |
| 48  | Cerasus mahaleb L. | Rosaceae    | Mahlou          | Fruit              | Khuzestan province (32)                                                     |
| 49  | Solanum nigrum L. | Solanaceae  | Hava            | Aerial parts, fruit | Khuzestan province (32)                                                     |
in diabetes may be due to decreased destruction and/or increased production of catalase (CAT—enzymatic/non-enzymatic), superoxide dismutase (SOD) and glutathione peroxidase (GSH–Ps) antioxidants. The variations in the levels of these enzymes cause the tissues to become susceptible to oxidative stress, leading to development of diabetic complications (53). The results of this review indicated the majority of the reported plants are from families Lamiaceae (eight species), Asteraceae and Apiaceae (six species) that have high concentrations of phenolic compounds (54,55). Anti-diabetic effects of phenolic compounds have already been confirmed (56,57). Phenolic compounds may have a protective effect against hyperglycemia-induced chronic diseases through both protection of antioxidants and inhibition of starch digestion. Co-application of phenolic compounds and synthetic enzyme inhibitors may decrease the effective dose of synthetic enzyme inhibitors that are needed to control postprandial glycemia (56).

4. Conclusions
The present study indicated that Iranian people from different cultures and in different regions consume 49 species of medicinal plants from 25 families based on traditional medicine to treat hyperglycemia. This demonstrates that Iran’s traditional medicine is rich. Iran’s traditional medicine has long addressed use of nature-based resources to prevent and treat diabetes. The availability of various approaches to use plants to treat diseases, including hyperglycemia, in Iranian traditional medicine conforms to geographical and vegetational conditions of this country. The findings of this study can be a comprehensive guideline, based on ethnobotany of different regions of Iran, to prevent and treat diabetes.

Authors’ contribution
MTM, SA, LM, and FAS searched the databases. MAS, MTM, SA, and FAS wrote the draft. MAS and TL edited the manuscript. All authors read and approved the final version.

Conflicts of interest
There is not conflicts of interest to declare.

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