# Medicinal Plants Traditionally used for Blood Sugar Lowering in the Kabul and Parwan regions of Afghanistan

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## Abstract

Diabetes is one of the biggest public health problems in our days, considered as silent epidemic of the 21st century. The number of diabetes cases in the world is increasing, and according to official statistics, this disease accounts for 3% of all deaths in Afghanistan. Before the discovery of insulin, medicinal plants were widely used to treat diabetes.

To collect data regarding the use of medicinal plants in the treatment of diabetes, experienced people who dealt with medicinal plants were interviewed using a structured questionnaire.

This survey showed that 53 medicinal plants belonging to 30 different plant families are used in the management of diabetes in the study area. The plants used as antidiabetic agent were mainly represented by Lamiaceae (>13%), Asteraceae (>9%), Solanaceae (>7%), Apiaceae, Fabaceae, and Rosaceae (each, >5%). The most often used parts of the plants were fruits and seeds (39%), and the most common method of preparation was infusion (24%). A literature review of the plants showed that most of them have antidiabetic potential proved in preclinical or even clinical studies.

To validate the therapeutic effects of medicinal plants and to introduce new medicinal natural product candidates for pharmaceuticals, phytochemical and pharmacological studies are needed to elucidate the effective biomarkers and their safety and efficacies as well as their mechanism of action.

**Keywords**

Afghanistan medicinal plants, antidiabetic activity, traditional use, Kabul province, Parwan province.

## 1. INRODUCTION

Diabetes is a chronic disease that progressively threatens various body organs and gradually the symptoms appear several years after the onset of this disease. It leads to several problems such as hypertension, hypercholesteremia, and a

obesity ("metabolic syndrome"), which contribute to the pathogenesis of cardiovascular diseases. It is estimated that the risk of cardiovascular diseases increases twice for patients who have both diabetes and hypertension. In addition, most diabetic patients have hyperlipidemia, which is more related to early coronary heart disease. Insulin resistance is typically increased in patients with hyperlipidemia. In addition, obesity is also associated with insulin resistance as an important risk factor for heart disease. Moreover, diabetes complications lead to higher financial charges and reduce the quality of life for patients and their families. Therefore, awareness of the symptoms and risk factors could reduce mortality. Type 2 diabetes is the most common form, accounting for about 90%-95% of all diabetes cases. It has dramatically increased in recent decades worldwide. With the progress and emergence of complications such as kidney and eye damage, patients become aware of their condition (WHO, "Diabetes," 8 7 2021. [Online] ; B. Ahmadi *et al*., 2016).

According to the statistics of the World Health Organization (WHO), 422 million people in the world are suffering from diabetes, which causes the death of 1.6 million people every year, most of whom are from countries with low and medium economic levels(WHO, "Diabetes," 8 7 2021. [Online]). Based on the official statistics in Afghanistan, the number of deaths caused by diabetes contributes 3% of the total number of deaths in the country (WHO, *WHO,* Geneva: WHO, 2018.), but since the disease and death registration system in Afghanistan is very poor and incomplete, the statistics maynot mirror reality and data are suggested to be too low.

Medicinal plants are used traditionally all over the world. Many of these plants used in the treatment of diabetes have considerable blood sugar-lowering effects and are considered useful for the treatment of type 2 diabetes. New research on the antidiabetic effects of medicinal plants has led to an increase in their use to control diabetes, and so far, more than 1200 medicinal plant species have been identified with regard to antidiabetic efects (B. Ahmadi *et al*., 2016).

The traditional use of medicinal plants in Afghanistan has played a crucial role in the healthcare system for centuries. Afghanistan is home to a diverse range of flora with medicinal properties, and its people have developed an extensive knowledge of their uses. However, the ongoing conflict in the country, coupled with a lack of formal regulation and documentation, has led to a decline in the availability and quality of medicinal plants. Therefore, there is a need for increased efforts to conserve and sustainably use medicinal plants in Afghanistan, while also ensuring that traditional knowledge is preserved and passed on to future generations. By doing so, the country can promote its cultural heritage, provide affordable health care to its people, and contribute to the global knowledge of medicinal plants. As mentioned traditional ethnomedicinal knowledge and inventory of medicinal plants in the country have poorly been investigated and data regarding the traditional use of medicinal plants for the management of diabetes is lacking.The complete inventory of the medicinal plants of Kabul and Parwan regions of Afghanistan is given in Karimi & Keusgen (A. Karimi and M. Keusgen., 2022).This paper includes an inventory of medicinal plant species that have traditionally been used by local people in the management of diabetes.

### 1.1. Data collection

**Study area**

Kabul and Parwan provinces cover an ar-

ea of 10, 239 km$^2$ and lie between 34°322 to 35° North latitude and 69° to 69°10' East longitude in the southern parts of the Hindukush Mountains. Their climate is arid continental with annual precipitation of approximately 400 mm and an average temperature of 32°C in summer and -5°C in winter (A. Karimi and M. Keusgen., 2022). The study area is inhabited by18.3% of the whole population of the country. Ghorband Valley, which forms almost two-thirds of Parwan province, is a mountainous area. Here dependence on medicinal plants is very high.

## 2. MATERIALS AND METHODS

Data were collected from the informants through structured ethnobotanical interviews conducted from 2015 – 2019. Plants were primarily identified by the author or with the help of informants, and the identified species were verified using relevant literature (S. W. Breckle *et al.,* 2013 ; S. W. Breckle *et al*., 2010 ; M. Alam *et al*., 2011). Then specimens were matched and compared with authentic virtual specimens at Kabul University, the Faculty of Sciences (KUFS) Herbarium, and the virtual herbarium of the Royal Botanical Gardens (R. Kew *et al*., 2021). Finally, the doubtful specimens were confirmed by professional botanists; Prof. S.-W. Breckle, University Bielefeld, Germany, and Dr. R. M. Fritsch, IPK Gatersleben, Germany, using photographs or live specimens. Nomenclature and taxonomy were confirmed using the Plants of the World Online database. Voucher specimens are kept at the Herbarium of the Faculty of Pharmacy, Kabul University, Afghanistan.

## 3. RESULTS AND DISCUSSION

The survey of traditionally used medicinal plants in Kabul and Parwan regions of Afghanistan focused on identifying plants that have been traditionally utilized for their medicinal properties medicinal properties. Out of 271 medicinal plants recorded, a total of 53 species reveald antidiabetic use. These species belonging to 30 different families are listed in Table 1 along with their scientific name, plant family, local name, parts used, modes of preparation, and frequency of citation (mentoin in brackets).

**Table1. Medicinal plants applied for the treatment of diabetes in the regions of Kabul and Parwan of Afghanistan**.

| # | ***Family/Scientific name*** | ***Local name*** | ***Parts used[1]*** | ***Preparations[2] and frequency of citation*** |
|---|---|---|---|---|
| 1 | *Anacardiaceae/ Ziziphus jujuba Mill.* | *Unab* | *FU* | *Dy (2)* |
| 2 | *Apiaceae/ Anethum graveolens L.* | *Shibit* | *FU* | *Pw (2), In (1)* |
| 3 | *Apiaceae/ Ferula sp. (not further identified)* | *Burbu* | *RO* | *Pw (3)* |
| 4 | *Apiaceae/ Levisticum officinale W.D.J. Koch.* | *Karafs* | *HE, RO* | *Pw (1), De (1)* |

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|---|---|---|---|---|
| 5 | Asteraceae/ *Helianthus petiolaris* Nutt.* | Kachaluimisry | RO | Co (2) |
| 6 | Asteraceae/ *Cousinia buphthalmoides* Regel* | Laruk | RO | De (1) |
| 7 | Asteraceae/ *Artemisia absinthium* L.* | Mastar | HE | In (23) |
| 8 | Asteraceae/ *Centaurea pulchella* Ledeb.* | Talkhak-alaf | FL | In (12) |
| 9 | Asteraceae/ *Artemisia sieberi* Besser | Shulukbuteh | INF | In (1), Pw (2) |
| 10 | Brassicaceae/ *Brassica rapa* L. subsp. *rapa* | Shalgham | RO | Co (4) |
| 11 | Cactaceae/ *Opuntia stricta* (Haw.) Haw. var. *dillenii* (Ker Gawl.) L.D. Benson* | Anari zamini | FU | Fr (1) |
| 12 | Cucurbitaceae/ *Citrullus colocynthis* (L.) Schrad.* | Tarbozi Abojihl | FU | De (1), Pw (5) |
| 13 | Cucurbitaceae/ *Momordica charantia* L.* | Karileh | FU | Co (1) |
| 14 | Elaeagnaceae/ *Elaeagnus angustifolia* L. | Sinjid | FU | Dy (3) |
| 15 | Ericaceae/ *Vaccinium macrocarpon* Aiton* | Qaraqat Syah | FU | In (1) |
| 16 | Fabaceae/ *Alhagi pseudalhagi* (M. Bieb.) Desv. | Shutur Khar | RO | Mc (4) |
| 17 | Fabaceae/ *Cassia fistula* L. | Flus | FU | Mc (1) |
| 18 | Fabaceae /*Trigonella foenum-graecum* L. | Hulbeh | FU | Pw (5) |
| 19 | Grossulariaceae/ *Ribes orientale* Desf.* | Qaraqat | FU | De (1) |
| 20 | Juglandaceae/ *Juglans regia* L. | Charmaghz | FU | Dy (9) |
| 21 | Lamiaceae/ *Lavandula angustifolia* Mill. | Astukhudus | HE | In (1) |
| 22 | Lamiaceae/ *Mentha longifolia* (L.) L. | Podineh | HE | Pw (3) |
| 23 | Lamiaceae/ *Nepeta bracteata* Benth. | Kakuti | HE | Pw (1) |
| 24 | Lamiaceae/ *Nepeta glutinosa* Benth. | Ahzdum | FL | In (2) |
| 25 | Lamiaceae/ *Salvia rhytidea* Benth. | Ganda Baghal | HE | Pw (1) |
| 26 | Lamiaceae/ *Stachys parviflora* Benth. | Paduleh | HE | De (2) |

| | | | | |
|---|---|---|---|---|
| 27 | Lamiaceae/ *Ziziphora tenuior* L. | Kakuti | HE | Pw (1) |
| 28 | Lauraceae/ *Cinnamomum verum* J.Presl | Darchini | BA | Pw (1) |
| 29 | Iridaceae/*Crocus sativus* L. | Saffron | FL | In (1) |
| 30 | Iridaceae/ *Iris germanica* L. | Zanbaq | RO | De (1) |
| 31 | Malvaceae/*Abelmoschus esculentus* (L.) Moench | Bameh | FU | Co (3) |
| 32 | Moraceae/*Morus alba* L.* | Toot | FU | Dy (1), Fr (1) |
| 33 | Moraceae/ *Morus nigra* L. | Shah toot | FU | Fr (1) |
| 34 | Myrtaceae/ *Eucalyptus globulus* Labill. | Gaitis | LE | In (1) |
| 35 | Myrtaceae/ *Syzygium aromaticum* (L.) Merrill & Perry | Mikhak | FL | De (2) |
| 36 | Oleaceae/ *Olea europaea* L. | Zaitone | LE | In (3) |
| 37 | Poaceae/ *Agropyron repens* (L.) P. Beauv. | Kabal | RO | De (1) |
| 38 | Poaceae/ *Zea mays* L. | Jawari | ST | In (3) |
| 39 | Polygonaceae/ *Rheum ribes* L. | Chukri | SM, PE | Fr (3) |
| 40 | Portulacaceae/ *Portulaca oleracea* L. | Khurfeh | HE | Co (1) |
| 41 | Punicaceae/ *Punica granatum* L. | Anar | FU | Fr (1) |
| 42 | Ranunculaceae/ *Nigella sativa* L. | Syahdaneh | SE | Pw (7) |
| 43 | Rosaceae/ *Amygdalus koelzii* Browicz * | Qarghaneh | FO | Co (2) |
| 44 | Rosaceae/ *Fragaria* × *ananassa* (Duchesne) Duchesne* | Tooti-zamini | FU | Fr (1) |
| 45 | Rosaceae/ *Amygdalus communis* L. var. *amara* (Duhamel) Willd. | Badam Talkh | FO | Co (1) |
| 46 | Rutaceae/ *Citrus* × *aurantium* L. [var. *amara* (Link) Kostel.] | Naronj | FU | Fr (1) |
| 47 | Scrophulariaceae/ *Verbascum thapsus* L. | Goshi Kharak | FL | In (1) |
| 48 | Solanaceae/ *Capsicum annuum* L.* | Murch | FU | Fr (1), Pw (2) |
| 49 | Solanaceae/ *Solanum lycopersicum* L. | Badinjanirumi | FU | Fr (1) |

| | | | | |
|---|---|---|---|---|
| 50 | Solanaceae/ *Withania coagulans* (Stocks) Dunal | Panirband | FU | De (1) |
| 51 | *Solanaceae/ Capsicum annuum* (another cultivar group) | Murchishirin | FU | Fr (2) |
| 52 | Theaceae/ *Camellia sinensis* (L.) Kuntze | Chai Sabz | LE | In (1) |
| 53 | Urticaceae/ *Urtica dioica* L. | Sokhtanak | LE | In (3) |

[1]BA: bark; FU: fruit; FL: flower; FO: fatty oil; He: herb; INF: inflorescence; Le: leaves; PE: petiol; RO: roots; Se: seeds; SM: stem; ST: stigmat.
[2]Be: beverage; Co: cooked; De: decoction; Dy: dry eat; Fr: fresh eat; In: infusion; Mc: maceration; Pw: powder.

*The most important traditionally antihyperglycemic plants.

Diabetes is the seventh leading cause of death in the world, killing more than 1.5 million people every year (WHO, "Diabetes," 8 7 2021). Today, interest in the use of medicinal plants has increased and medicinal plants are considered the main part of alternative and complementary medicine. A wide range of medicinal plants are used to treat diabetes in different regions of the world.

In this study, we found that the local inhabitants used 53 medicinal plant species for the management of highblood sugar. These medicinal plants not only used for high blood sugar but offer a wide range of traditional uses, with 13 species including *Helianthus petiolaris*, *Cousinia buphthalmoides*, *Artemisia absinthium*, *Centaurea pulchella*, *Cactus dillenii*, *Citrullus colocynthis*, *Momordica charantia*, *Vaccinium macrocarpon*, *Ribes orientale*, *Amygdalus koelzii*, *Fragaria* × *ananassa*, and *Capsicum annuum* are being particularly recognized for their potential in managing diabetes in the study area. The rich diversity of these plants, combined with their long history of use in traditional medicine, highlights their importance in providing alternative approaches to diabetes management. Species such as *Nigella sativa*, *Citrullus colocynthis*, *Anethum graveolens*, *Juglans regia*, *Mentha longifolia*, *Cinnamomum verum*, *Urtica dioica*, and *Ziziphora*, have also been reported to be used for the treatment of diabetes in the traditional medicine of Iran (B. Ahmadi *et al*.,2016), which are consistent to our study.

A literature review on phytochemical and pharmacological investigations of all these species shows that the anti-diabetic effects of the majority of medicinal plants recommended for the treatment of diabetes in our study area have been investigated and proven by modern pharmacological studies that are discussed in the following paragraphs.

*Ziziphus jujuba* is grown in the western and northern parts of Afghanistan and its dried fruits are eaten as a snack and called "Onab" or "Chilaan". Recent studies reveal that the polysaccharides from the fruits possess antioxidant, hepatoprotective, and hypoglycemic activities (X. Ji *et al*., 2017). *Anethum graveolens,* a common spice in the Shamali plain of Afghanistan, has been reported to have many useful effects, including among others hypolipide-

mic, hypoglycemic, and antioxidant activities that might reduce the risk of diabetic complications (M. Goodarzi *et al*., 2016). *Citrullus colocynthis,*a well-known traditional purgative in the country, is reported that extracts of different plant parts exhibited antidiabetic properties in animal diabetic models (W. Olejarz, *et al*., 2014). *Levisticum officinale* is native to high altitudes of the mountainous area of Parwan province and grows near the springs and rivulets. Its aerial parts are used by households as a spice for buttermilk and other dishes since ancient times. Besides this use, in recent decades its roots have also been used as a remedy for cardiovascular disorders by traditional healers. Literature data reveals that the plant contains essential oil with monoterpenes, showing also a high abundance of phthalides. Also, phenolic compounds in the decoction and hydroethanolic extracts of the plant are reported. The plant is used due to its carminative, spasmolytic, and diuretic effects. It is being approved by the German Commission E for lower urinary tract infections (R. Spréa *et al*., 2020). *Elaeagnus angustifolia* owns hypolipidemic, antioxidant, wound healing, carminative, gastroprotective, antitumor, and anti-inflammatory activities (M. Farzaei *et al*., 2015).*Cassia fistula,* used asa laxative in our study area, is reported to contain anthracene derivatives responsible for a laxative effect. Preparations from the fruit have demonstrated antimicrobial and antiviral effects in vitro. Aqueous and alcoholic extracts of the leaves exhibited hypoglycemic activities (Montvale, NJ *et al*., 2007 ; P. Sudha *et al*., 2011). The biological activitiesof *Artemisia absinthium* and *Trigonella foenum-graecum,* common spices in Shamali plain,are well documented,and their antidiabetic properties are proven Montvale, NJ- *et al*., 2007). *Juglans regia*is a common nut-producing economic plant in the study area. Its dried kernelsare used as a nutritive snack and a hypolipidemic agent in our study area. It has been reported to contain fatty oil with oleic, linoleic, and linolenic acids as its main constituents and is therefore considered a rich source of poly unsaturated fatty acids. These acids play a vital role in the prevention of beta-cell destruction and insulin resistance. Moreover, it increases insulin secretion and reduces blood lipids and glucose concentration in type II diabetes patients (A. Al-Snafi *et al*., 2018 ; H. Baynes *et al*., 2018). *Cinnamomumverum*is a well-known traditional Indian medicine used since ancient times in the study area. Scientific investigations reveal that it significantly reduces blood sugar, cholesterol, LDL, and triglycerides, and increases HDL levels (R. Allen *et al*., 2013) . *Crocus sativus,*an economic crop that is mostly cultivated in Herat province, produces the best saffron spice in the world. Its antioxidative, memory-enhancing, antidiabetic, and antitumor activities were reported (M. Keusgen *et al*., 2020) . *Abelmoschus esculentus,* besides its use in culinary, is used as an antidiabetic and lipid-lowering medicinal plant in our study area.It has been reported to have antioxidant, anti-inflammatory, gastroprotective, hypolipidemic, antidiabetic, anticancer, immunomodulatory, and neuroprotective properties (D. Esmaeilzadeh *et al*., 2020). *Morus alba*is commonly planted in the study area for its edible berries. Scientific studies reveal that the consumption of berries decreases triglycerides, cholesterol, and VLDL in animal models, and increases the â-cell number in diabetic islets (P. Sudha *et al* ., 2011). Leaves of *Eucalyptus globulus*and *Olea europaea,* cultivated and naturalized trees in the eastern part of Afghanistan,

have been reported to have antidiabetic effects (J. Wainstein *et al*., 2012 ; M. Keusgen *et al*., 2020) *Portulacaoleracea* is reported to have anti-inflammatory, anti-diabetic, skeletal muscle relaxant, antitumor, hepatoprotective, anticancer, antioxidant, anti-insomnia, analgesic, gastroprotective, neuroprotective, wound healing, and antiseptic properties (A. Kumar *et al*., 2022). *Nigella sativa* has been reported to have a significant influence on blood glucose and insulin resistance and causes a rise in serum insulin. Researchers suggested that the plant could be used as a comedication for oral antidiabetics in diabetes control (A. Kumar *et al*., 2022). A review study on *Capsicum annum* reveals that it might be useful for the control of metabolic syndromes including obesity, lipidemia, diabetes, and its complications (S. Sanati *et al*., 2018). A recent study also supports our informant claim regarding the antidiabetic potancial of *Centaurea pulchella* (S. Fattaheian *et al*., 2021).

In addition, a review on the antidiabetic potential of medicinal plants by Salehi *et a*l. (2019) reveals that *Syzygium aromaticum*, *Citrus aurantium, Mentha longifolia, Camelliasinesis*, *Rheum ribes, Solanum lycopersicum, Withania coagulans,* and *Urtica dioica* have significant antidiabetic effects. Their pharmacological effects are proven in animal diabetic models (B. Salehi *et al*., 2019).

*Artemisia sieberi*, *Brassica rapa* subsp. *rapa, Cousinia buphthalmoides, Ferula* sp., *Vaccinium macrocarpon*, *Alhagi pseudalhagi*, *Ribes orientale*, *Lavandula angustifolia*, *Nepeta bracteata*, *Nepeta glutinosa*, *Salvia rhytidea*, *Stachys parviflora*, *Ziziphora tenuior*, *Iris germanica*, *Morus nigra*, *Zea mays*, *Punica granatum*, *Amygdalus koelzii*, *Fragaria* × *ananassa*, *Amygdalus communis*, and *Verbascum thapsus* were found to be the most uncommon species for blood sugar lowering, and scientific studies to support their claims are widely missing. Although various phytochemicals such as phenols, tannins, saponins, and alkaloids have been reported to have antidiabetic properties, flavonoids and phenolic compoundsare known as the main sources of hypoglycemic activity (B. Ahmadi *et al*., 2016). Therefore, medicinal plants with phenolic compounds and antioxidant activity might be useful for the management of diabetes. However, studies onthe mechanisms of the antihyperglycemic activity of these species are limited. Therefore, more investigations are needed to elucidate the effective pharmacologically active ingredients as well as their mechanism of action.

## 4. CONCLUSION

This study presents a large number of a medicinal plants used in the management of diabetes in the Kabul and Parwan regions of Afghanistan and is the the first of its kind for the country. The rich heritage of traditional medicine in the region has provided a wealth of knowledge and remedies that have been used for generations. These plants offer a wide range of traditional uses with some species that are marked by stars in Table 1 being particularly recognized for their potential in diabetes management. This could be the first stage in pharmaceutical bio-prospection to introduce new natural productsas candidates for the treatment of diabetes. The antidiabetic effects of the majority of thesespecies have been investigated in actual pharmacological studies, forexample, species such as *Artemisia absinthium*, *Trigonellafoenum graecum, Mimordica charantia, and Centaurea pulchella*. While scientific research is needed to fully understand and validate the effectiveness of those

plants, which are highlighted by our informants in lowering blood sugar without the support of scientific studies. It is crucial to combine this traditional knowledge with modern medical practices and consult healthcare professionals to ensure safe and effective integration into diabetes management strategies in the local context.

**Acknowledgments**

The Authors would like to thank Hessen Fonds and DAAD for thier long-lasting financial support. Thanks are due to all Afghanistan project partners, especially to Prof. S. Breckle, Bielefeld, Germany, and to Dr. R. M. Fritsch, IPK Gatersleben, Germany, for critically reading the manuscript and verifying scientific plant names.

**Authors' Contributions**

A.G. Karimi conceived and designed the study, interpreted and analyzed the data, and prepared the original draft. Prof. Keusgen provided critical revisions to the manuscript. All authors approved the final version of the manuscript.

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