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Review of Ayurvedic medicinal plants recommended for the treatment and management of diabetes mellitus

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Abstract

Diabetes mellitus (Madhumeha) is a well-known disease of endocrine disorder. People of ancient India well knew about this disease. In Ayurveda Diabetes mellitus is classified under a category of 'Prameha' (Urine disorders) and termed as 'Madhumeha'. Madhumeha is a condition of passing excessive turbid urine which is sweet in nature. Ayurvedic texts have mentioned many medicinal plants for the treatment and management of diabetes mellitus such as Guduchi, Amla, Jamun, ash-gourd, Pippali, Castor, Devdaru, Onion, Fenugreek, Makoi, etc. Various parts of these plants such as leaves, stems, roots, fruits, and seeds are used for curative purposes. The names of these medicinal plants were collected from 'Dravyaguna Vijnana' of Sastry, J.L.N (2010), and the related supporting literature was collected from various online databases viz. Google Scholar, PubMed, etc.

Keywords: Diabetes mellitus, medicinal plants, hypoglycemia, Ayurveda

Introduction

Diabetes is a long-term metabolic illness affecting the metabolism of carbs, lipids, and proteins. A spike in blood glucose following any kind of meal is how it is defined. Diabetes is caused by an excess of or malfunctioning insulin. Diabetes necessitates early detection, intervention, and lifestyle modifications (Kooti *et al.*, 2016) [16]. Medicinal plants contain phytochemicals that have therapeutic value, that offer great potential for treating a wide range of illnesses. Diabetes is a critical metabolic condition for which there are several licensed drugs to treat the symptoms. Nevertheless, these over-the-counter medications are costly and linked to several issues. Herbal remedies are becoming more and more popular because they are less expensive and have better therapeutic results with fewer adverse effects (Bindu & Narendhirakannan, 2019) [7].

Materials and Methods

Names of these medicinal plants that have benefits in diabetes have been collected from 'Dravyaguna Vijnana' of Sastry, J.L.N (2010) and the related supporting literature have been collected from various online databases viz. Google Scholar, PubMed, etc.

Result

Research on the antidiabetic mechanisms of medicinal plants has revealed that the majority of them produce hypoglycemic activity by upregulating or elevating translocation of glucose transporter type 4 (GLUT-4), stimulating insulin secretion, augmenting peroxisome proliferator-activated receptors (PPARs), inhibiting α -amylase or α -glucosidase, glucagon-like peptide-1 (GLP-1) secretion, advanced glycation end product (AGE) formation, free radical scavenging plus antioxidant activity (against reactive oxygen or nitrogen species (ROS/RNS)), and preventing the development of insulin resistance (Nazarian-Samani *et al.*, 2018) [22]. The description of these plants is given further.

Guduchi (*Tinospora Cordifolia*): Ayurvedic system of medicine uses Giloy or Guduchi to treat diabetes and related disorders like Hyperglycaemia and Hyperlipidemia but its use in Gestational Diabetes is not well known. A study conducted by Rani *et al.* (2023) on streptozotocin-induced diabetes in pregnant mice model by giving intervention of water

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extract, essential oil, and hydroalcoholic (HA) extract found that *Tinospora cordifolia* preparation preserved pancreatic beta cells, increased insulin production, decrease insulin resistance and improve beta cell function hence prevent GDM. A dose of Stem Powder 3-6 g, Decoction 50-100 ml can be given.

Bael (*Aegle marmelos*): A study conducted on 150 type II Diabetic patients found that Bael is effective in controlling hyperglycemia and blood pressure level of the patient without any adverse effects (Sharma & Sharma, 2013) [25]. A dose of Decoction 50-100 ml, powder 3-5 g, and leaf juice 10-20 ml can be given.

Cutch tree (*Khaira/Acacia catechu willd*): Its usable parts are stem, bark, heartwood, flowers, and dosages of bark powder 1-3 g, bark decoction 50-100ml, heartwood 0.5-1g can be given. A study conducted on alloxan-induced diabetic rats insoluble fraction of ethanolic extract of *Acacia catechu* willd restored the elevated biochemical parameters significantly to the normal level and proved to have a hypoglycaemic effect.

Haritaki (*Terminalia chebula Retz*): In prameha (Diabetes) 3-6g of Haritaki powder can be used with honey. In a study on streptozotocin-induced diabetic rat effect of extract of *Terminalia chebula* seed powder examined for its antidiabetic activity. Researchers found that chloroform extract of *T. chebula* seeds produces a dose-dependent reduction in blood glucose levels in diabetic rats as comparable with that of the standard drug glibenclamide in a short-term study. *T. Chebula* seed powder has shown significant antidiabetic and Renoprotective effects.

Amla (*Phyllanthus emblica Linn.*): In diabetes amla juice can be taken with Haridra (Turmeric) and Honey. Dosage of Fresh juice 10-20 ml; Powder 3-6g can be given. A regular intake of 2-3 g of Amla powder has a hypoglycaemic effect and increases high-density lipoprotein and lowers low-density lipoprotein in diabetic subjects (Akhtar & Ramzan, 2011) [19].

Jamun (*Syzygium cumini*): Its Fruit, leaf, and stem bark can be used. The dosage of Fresh juice is 10-20 ml; powder 3-6 g can be given. The pulp, seed, bark, and stem of *S. cumini* have shown antidiabetic properties on investigation. The decoction of *S. cumini* bark powder with water in the form of a ready-to-serve herbal drink contains antidiabetic compounds such as gallic acid, umbelliferone, and ellagic acid proving its therapeutic potential for diabetes (Perera *et al.*, 2017) [24].

Ash-Gourd (*Petha/Benincasa hispida*): Its fruits, seeds, and seed oil can be used. Dosage of Fruit 10-20 g; seed powder 3-6 g; seed oil 5-10 ml can be used. Aqueous extract of *Benincasa hispida* has a significant effect on the reduction of blood glucose levels in mild and severely diabetic rats (Zakaria *et al.*, 2016) [28].

Manjistha (*Rubia cordifolia Linn*): Its root is used. Dosage of Powder 5-11 g; decoction 50-100 ml. can be used. *Rubia cordifolia* reduced diabetic neuropathy in rats through their antidiabetic and analgesic properties by decreasing apoptosis and oxidative stress (Bana *et al.*, 2023) [5].

Kutaki (*Picrorhiza kurroa*): Its root and underground stem can be used. About 0.5-1 g of kutaki powder can be used for therapeutic purposes. In alloxan-induced diabetic rats,

aqueous and methanolic extract of *P. kurroa* rhizome showed significant results by restoring the blood glucose, total hemoglobin, HbA1c, plasma insulin level, and body weight near to their normal value (Chauhan *et al.*, 2008) [10].

Malabar Nut (*Vasa/ Adhatoda vasica*): Its leaf, flower, and root can be used. The dosage of Leaf juice is 10-20 ml; root decoction 40-80 ml; flower juice 10-20 ml. can be used. *In vitro* analyses of vasicine, a potent alkaloid form of *A. vasica* showed antidiabetic activity in an α -amylase inhibition assay, α -glucosidase inhibition assay, and non-enzymatic glycosylation of hemoglobin assay.

Pippali (*Piper longum*): Its fruit and root are used. Dosage of Powder 0.5-1 g can be used. Aqueous extract of *Sclerocarya birrea*, *Nauclea latifolia*, and *Piper longum* (S.N.P.) has antidiabetic and neuroprotective activities due to the presence of active metabolites, which hereof normalized blood glucose, protected hippocampus neurons, and improved memory function in diabetic rats.

Erand (*Castor/Ricinus communis*): Roots, leaves, seed, and oil are usable parts. Dosage of Root powder 3-5 g; decoction 50-100 ml; seed 1-5 numbers; oil 5- 10 ml can be used. The ethanolic and aqueous extract of wild *Ricinus communis* leaves with the treatment dose of 300 mg/kg/BW showed a significant reverse effect on the body weight loss while Ethanol extract at 600 mg/kg/BW significantly lowered the blood glucose level. The extract of *R. communis* also improves the biochemical parameters of Diabetic rats (Gad-Elkareem *et al.*, 2019) [11].

Arjun (*Terminalia arjuna*): Its bark is used. Dosage of Powder 3-6 g; decoction 50-100 ml. can be used. The methanol extract of *T. arjuna* leaf (META) in Wistar rats at the dose of 100 and 200 mg/kg and dose-dependently significantly reduced and normalized blood glucose levels, restored biochemical parameters, decreased lipid peroxidation and retrieved Glutathione (GSH) levels and Catalase (CAT) activity towards normal when compared with streptozotocin-induced diabetic controls (Biswas *et al.*, 2011) [8].

Devadaru (*Cedrus deodara*): Its bark, heartwood, oil, leaves, and resin are used. The dosage of Bark powder is 1-5 g; decoction 50-100 ml; oil 20-40 drops can be used. Benzosuberene-sulfone (BSS) analogues semi-synthesized from the essential oil of *Cedrus deodara* can be developed to treat T2DM patients with R357A and V290M mutations, who do not show any response to the currently available drugs in the market (Bharti *et al.*, 2021) [6].

Onion (*Allium cepa Linn.*): Bulb and seeds are usable parts. The dosage of Juice is 10-20 ml; seed powder 1-3 g can be used. A study conducted by Jafarpour-Sadegh *et al.*, (2017) [12] found that the high onion group consuming 100- 160 g/day showed a significant reduction in serum fasting blood glucose and insulin level when compared with the low onion group receiving 30- 40 g/day in the breast cancer patient receiving Doxorubicin-based chemotherapy.

Mango (*Magnifera indica*) – Its stem bark, leaves, flower, and seed kernel are used for therapeutic purposes. The dosage of Fresh juice is 10-20 ml; decoction is 50-100 ml; powder of 3-6 g can be given. Mango seed kernel extract (MKE) alleviates the increased level of fasting blood glucose,

diabetic symptoms, glucose intolerance, total cholesterol (TL), and low-density lipoprotein cholesterol (LDL-C) in streptozotocin-induced diabetic rats (Yoopum *et al.*, 2023) [27].

Jayanti (*Sesbania sesban*): Its root, bark, flower, and seed are used. A dosage of Decoction of 50-100 ml can be given. *S. sesban* leaves show many medicinal properties such as antioxidant, antimicrobial, anti-inflammatory, antidiabetic antihyperlipidemic, etc. (Abdelgawad *et al.*, 2023) [1].

Fenugreek (*Trigonella foenum-graecum*): Its seeds and the whole plant are used as medicine. Dosage of Seed powder 1-3 g can be given. Due to their high fiber content, fenugreek seeds slow down the metabolism of carbohydrates and lower blood glucose levels by increasing the time that the stomach empties and decreasing the amount of glucose that is absorbed in the small intestine. These actions have anti-diabetic effects. Moreover, fenugreek increases the synthesis of glycogen in the muscles and liver via stimulating glycogen synthase activity. In addition to lowering pro-inflammatory cytokines and pancreatic enzymes, this also encourages the repair of depleted glycogen and modifies insulin-sensitive carbohydrate metabolic enzyme activity and serum lipid profiles. By improving insulin activity at the cellular level, fenugreek may lower HbA1c levels by utilizing glucose in peripheral tissues and preserving blood glucose levels.

Sanai (*Cassia angustifolia*): Its leaves and fruits are used for medicinal purposes. Dosage of Leaf Powder ½-2 g can be given. Senna (Sanai) macerate lowered FBS by 14.3%, it was higher than the fenugreek seeds which lowered FBS only by 12% (AL-adhal A, 2009) [3].

Babool (*Acacia nilotica*): Its stem, bark, fruits, gum, and seeds are used. The dosage of Bark decoction is 50-100 ml, fruit powder is 3-6 g; gum 5-6 g can be used. Aqueous methanol extract of *Acacia nilotica* pods significantly reduced the blood glucose level, plasma total cholesterol, triglyceride, and low-density lipids in diabetic rabbits at the dose of 400 mg/kgBW. The same dose significantly improved the plasma HDL level in the treated group (Ahmad *et al.*, 2008) [2].

Saptarangi (*Salacia reticulata* wight): Its root, and bark are used as medicine in Madhumeha. Powder can be taken 1-3 g and decoction 50-100 ml. In a mice model, *S. Reticulata* root bark ethyl acetate extract showed alleviation of blood glucose levels in a dose-dependent manner (Nimbekar *et al.*, 2021) [23].

Taroi (*Ridged gourd/Kosataki/Luffa acutangula*): Its fruits are used. The dosage of Powder is 3-6 g; fresh juice of 10- 20 ml can be given. An interventional study of the fruits and seeds of ethanolic extract of *Luffa acutangula* on diabetic rats showed a reduction in fasting blood glucose.

Kundururu (*Bimbi/Coccinia grandis*): Its root, leaves, and fruits are used. Dosage of Fresh juice 10-20 ml can be given. *Coccinia grandis* leaves have shown sugar sugar-lowering effect in humans (Munasinghe *et al.*, 2011) [20].

Karela (Bitter Gourd / Karavellaka / *Momordica charantia*): Fruit rind is used. Dosage- Fresh juice of 10-20 ml can be used. In individuals with prediabetes, bitter melon has a glucose-lowering impact by suppressing glucagon levels

(Kim *et al.*, 2023) [15].

Gudmar (*Gymnema sylvestre*): Its leaves powder 3-6 g can be used in diabetes. Zuñiga & Ortiz (2017) [17] in their study found that *G. sylvestre* administration decreased body weight, BMI, and VLDL levels in T2DM patients without a change in insulin secretion and insulin sensitivity.

Makoi (Black nightshade/*Solanum nigrum*): Its whole plant can be used. Dosage of Fresh juice 10 – 20 ml can be given. In diabetic rats, the fruit *Solanum nigrum* Linn (SNE) may lower blood glucose levels. Furthermore, SNE was superior to insulin at regulating blood sugar. After 8 and 16 weeks of treatment, SNE may reduce creatinine (Cr) levels, blood urea nitrogen (BUN), kidney weight, and renal damage (Azarkis *et al.*, 2017) [4].

Bhandira (Titabhanta / *Clerodendrum infortunatum*): Its leaves are used as therapeutic medicine. Dosage of Powder 1- 3 g, Fresh juice 10- 20 ml can be given. In STZ-induced diabetic mice, the blood glucose level is positively impacted by the ethanolic extract of *Clerodendrum infortunatum* L. leaves.

Priyangu (*Callicarpa macrophylla*): Its root, bark, flower, and fruits are used. Dosage of Powder 3-6 g can be given Methanolic extract from *Callicarpa macrophylla* fruits has a favorable dose-dependent hypoglycaemic effect on STZ-induced diabetes (Jawaid T *et al.*, 2016) [14].

Tejpatra (Bay leaves/*Cinnamomum tamala*): Its leaves can be used in powder form 1-4 g in quantity. STZ-diabetic rats treated with aqueous extracts of *Cinnamomum tamala* (CTLEt) leaves increased glutathione and glycogen content in the hepatic tissue (Chakraborty & Das, 2010) [9].

Chilbil (*Holoptelea integrifolia*): Its bark, leaves, seed, and leaf- buds are used. The dosage of Paste of leaf buds is 10-20 g; fresh leaf juice 10-20 ml; decoction of bark 50-100 ml can be given. Stem bark extract of *Holoptelea integrifolia* (Roxb.) showed a significant decrease in blood glucose levels and prevention of loss of body weight in alloxan-induced diabetic rats (Sharma *et al.*, 2012) [25].

Supari (*Areca catechu*): Its fruit is used. Dosage of Powder 1-3 g can be used. Areca nut seeds have very potential for antidiabetic and glucose tolerance (Musdja *et al.*, 2020) [21].

Bamboo (*Bambusa arundinacea*): Its roots, nodes, leaves, and fruits are used. A dosage of Decoction of 50-100 ml can be given. *Bambusa arundinacea* root extract has antidiabetic glucose-lowering potential as its intervention has shown significant protection and maximum reduction in blood glucose levels (Macharla *et al.*, 2012) [18].

Conclusion

Several plants show therapeutic effects in diabetes mellitus and many of them are locally available, some of them we use regularly and their hypoglycaemic and antidiabetic effect have been scientifically proven. However, most of these researches have been done on animal models so there is a need for clinical research on humans to prove the therapeutic efficiency of these medicinal plants in the current scenario.

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