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Review Article

MEDICINAL PLANTS FOR DIABETES MELLITUS: A REVIEW

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ABSTRACT

Diabetes mellitus is one of the major health problems in the world, the incidence and associated mortality are increasing. Fourth leading causes of death in the most advanced countries and there, in other emerging and recently industrialized nations, still controlled the epidemic. Inadequate control of blood sugar has significant consequences for well-being. Ayurveda and other Indian writing referenced the utilized of plants in the treatment of different diseases. Medicinal plant with antidiabetic potential has been recent area of research. The efficiency of these medicinal plants may regulate the diabetic metabolic abnormalities. This work would help researchers to choose potential herbal for diabetic treatment.

Keywords: Diabetes mellitus, Ayurveda, Medicinal plants, Hypoglycemic.

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INTRODUCTION

Diabetes mellitus is an evolving metabolic disease that affects about 143 million people [1] and is estimated to exceed 366 million people in the world by 2030 [2]. Diabetes mellitus is attributed to an irregular absorption of carbohydrates coupled with reduced blood volume of insulin. Diabetes mellitus metabolic disease caused by insulin secretions deficiency. It causes long-term damage in multiple organ systems, deterioration, and failure. Diabetes can contribute to heart failure, renal disease, vascular and neurological complications, and rising death rates. Anti-diabetic herbal therapy may now be commercially developed as a modern drug, although it is accepted that it has medicinal properties in the conventional medicine systems.

Diabetes of type 2 typically develops in obese people and is related to elevated blood pressure and dyslipidemia. The therapy thus aims at reducing the resistance to insulin and promoting insulin secretion. Type 1 Diabetes results in a lack of secretion of insulin to the muscles and the adipose tissue, resulting in poor levels of glucose uptake [3]. Natural medicine (herbal medicine) is used for diabetes care in developed nations, where patients are affected by the expense of conventional medicine [4].

Diabetes and its secondary effects prove to be a significant medical concern through incorporation of hypoglycemic agents in natural and synthetic sources. Many Indian plants have proved useful for controlling diabetes effectively. One of the main benefits of medicinal plants is that they are available conveniently and with relatively low side effects. Plants have always been an example source of medications, many of which are now available directly or indirectly.

The ethnobotanical knowledge has a possible antidiabetic potential of approximately 800 plants [5]. Several plants have shown antidiabetic behavior in their assessment using experimental techniques currently available [6]. This review article lists several medicinal plants with antidiabetic activity and clarifies their action mechanisms including *Alangium lamarckii, Albizia odoratissima, Acanthopanax senticosus, Acorus calamus, Berberis vulgaris, Butea monosperma, Bryophyllum pinnatum, Cocos nucifera, Canarium schweinfurthi, Costus speciosus, Centaurium erythrea, Diospyros peregrine, Dillenia indica, Dolichandrone falcata, Eugenia jambolana, Fructus coini, Grewia asiatica, Gymnema sylvestre, Heinsia crinata, Helicteres isora* L., *Hypericum perforatum L., Irvingia gabonensis, Juglans regia L, Lawsonia inermis, Lithocarpus polystachyus, Momordica charantia, Murraya koenigii L., Myristica fragrans, Nelumbo nucifera, Nyctanthes arbor-tristis* L., *Olea europaea* L., *Ocimum sanctum, Opuntia streptacantha, Pandanus odorus, Persea americana* Mill., *Piper betle* L, *Psidium guajava, Raphanus sativus, Ricinus communis, Salacia reticulata* W., *Senna auriculata, Strychnus potatorum* L, *Terminalia chebula*, *Tinospora cordifolia, Triticum aestivum, Urtica ardens, Vitis vinifera, Withania somnifera* (L.), *Xanthium strumarium*, *Zizyphus sativa Gaertn, and Zygophyllum geslini* Coss.

ANTIDIABETIC EFFECT OF FOLKLORE MEDICINAL PLANTS

A. lamarckii

Antidiabetic effect of alcoholic extract of *A. lamarckii*. Alcoholic leaves extract 250 and 500 mg/kg b.w. was used for these studies. *A. lamarckii* have significant antidiabetic activity in STZ nicotinamide-induced diabetic rat [7].

B. vulgaris

Hypoglycaemic effect of *B. vulgaris* L. in streptozotocin-induced diabetic rats *B. vulgaris* is a traditional medicinal plant which belongs to family Berberidaceae. The results indicated that water extract and saponins show significant hypoglycemic effect. The serum cholesterol and serum triglycerides levels were significantly increased [8-11].

C. erythrea

A single dose of STZ (65 mg/kg) was given intraperitoneally to induce diabetes. By tissue malondialdehyde, oxidative stress was measured. Antioxidant pancreatic enzymes such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx) are predicted. A substantial decrease in pancreatic tissue TBARS levels has been documented in rats treated with diabetes compared to normal animals. Activity levels of antioxidant resistance enzymes for the pancreas, viz. In the diabetic animals treated, SOD, CAT GPx, and GST were substantially increased. The antioxidant effect of the extract of *C. erythrea* aqueous leaf [12-17].

E. jambolana

In Ayurveda, an ancient system of Indian medicine, *E. jambolana*, popularly known as Jamun or Indian blackberry, is suggested for use in DM. In accordance with its anti-diabetic effect claimed in conventional medicine, *E. jambolana* has been documented in both experimental models and clinical trials to have hypoglycemic effects [18-20].

G. sylvestre

The effect was reflected in the activity of gluconeogenetic enzymes and reversal of pathological changes in the liver initiated during the hyperglycemic phase. Oral feeding of powdered leaves of *G. sylvestre* (500 mg/kg body weight) for 10 days significantly prevented IV beryllium nitrate-induced hyperglycaemic in rats and normalized it in 4 days in comparison to 10 days in untreated rats [21-23].

H. crinata

Alloxan-induced diabetic rat hypoglycaemic effect of *H. crinata.* It is a common medicinal plant belongs to Rubiaceae family. The result shows that by decreasing blood glucose and promoting peripheral glucose use, methanol extract and flavonoids, hydroxy-anthraquinones, saponins, steroids, tannins, and glycoside exhibit substantial hypoglycemic behavior [24].

L. inermis

A common plant in Asia, *L. inermis* Linn (Lythraceae), commonly referred to as mehndi, has been widely used as a remedy for diabetes in traditional medicine. A research was thus initiated to evaluate the effect of *L. inermis* leaves extract on the level of blood glucose in diabetic mice induced by alloxan. The result showed that feeding 0.8 gm per kg of leaf extract body weight lowered the glucose concentration from 194 mg per dilution to normal after day 14 [25-29].

M. charantia

In different animal models, extracts from fruit pulp, seeds, leaves, and whole plants were shown to have a hypoglycemic effect. Polypeptide p, isolated from fruit, seeds, and tissue of *M. charantia*. In subcutaneous administration to langurs and humans showed significant hypoglycaemic effect. Ethanolic extracts of *M. charantia* (200 mg/kg) exhibited anti-hyperglycemic and hypoglycemic effects in rats with normal and STZ diabetes [30,31].

M. koenigii

In alloxan-induced diabetic rats (200, 300, and 400 mg/kg), the aqueous extract of *M. koenigii* leaf significantly decreased blood glucose levels and was shown to have a beneficial effect on the metabolism of

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Table 1: Medicinal plants having antidiabetic activity

S. No	Plant Name	Family	Part used	Type of extract	Activity
1	*Alangium lamarckii*	Alangiaceae	Leaves	Alcoholic	Antidiabetic activity
2.	*Albizia odoratissima*	Mimosaceae	Bark	Menthol	Antidiabetic activity
3	*Acanthopanax senticosus*	Araliaceae	Whole plant	Aqueous	Antidiabetic activity
4.	*Acorus calamus*	Acoraceae	Rhizome	Methanol	Antidiabetic activity
5.	*Berberis vulgaris*	Berberidaceae	Root	Aqueous	Hypoglycaemic
6	*Butea monosperma*	Fabaceae	Fruit	Aqueous	Antidiabetic effect
7	*Bryophyllum pinnatum*	Crassulaceae	Leaf	Alcoholic	Antidiabetic effect
8	*Cocos nucifera*	Arecaceae	Leaf	Hydro-methanol	Antihyperglycemic effect
9	*Canarium schweinfurthi*	Burseraceae	Stem bark	Methanolic	Antidiabetic effect
10	*Costus speciosus*	Costaceae	Rhizome	Hexane	Antidiabetic effect
11	*Centaurium erythrea*	Gentianaceae	Leaf	Aqueous	Antidiabetic activity
12	*Diospyros peregrine*	Ebenaceae	Fruit	Aqueous	Antidiabetic activity
13	*Dillenia indica*	Dilleniaceae	Leaves	Methanolic	Antidiabetic
14	*Dolichandrone falcata*	Bignoniaceae	Leaves	Aqueous	Antidiabetic Potential
15	*Eugenia Jambolana*	Asteraceae	seed	Ethanol	Hypoglycemic activity
16	*Fructus coini*	Cornaceae	Leaves, Seeds	chloroform	Hypoglycemic activity
17	*Grewia asiatica*	Malvaceae	Fruit, Leaves	Ethanol	Antihyperglycemic activity
18	*Gymnema sylvestre*	Asclepiadaceae	Leaves	Ethanol	Hypoglycemic activity
19	*Heinsia crinata*	Rubiaceae	Root	Methanol, hexane	Hypoglycemic activity
20	*Helicteres isora* L.	Malvaceae	Fruit	Aqueous	Anti-diabetic activity
21	*Hypericum perforatum* L.	Hypericaceae	Leaf	Ethyl acetate	Hypoglycemic activity
22	*Irvingia gabonensis*	Irvingiaceae	Seeds	Aqueous	Anti-diabetic activity
23	*Juglans regia* L	Juglandaceae	Leaf	Methanol	Anti-diabetic activity
24	*Lawsonia inermis*	Lythraceae	Leaves	Aqueous	Hypoglycemic activity
25	*Lithocarpus polystachyus*	Fagaceae	Leaves	Ethanol & Aqueous	Hypoglycemic activity
26	*Momordica Charantia*	Cucurbitaceae	Whole plant	Ethanolic	anti-hyperglycaemic effect
27	*Murraya koenigii* L.	Rutaceae	Leaf	Aqueous	Antidiabetic Activity
27	*Myristica fragrans*	Myristicaceae	Seeds	petroleum ether	Hypoglycaemic activity
28	*Nelumbo nucifera*	Nymphaeaceae	Rhizomes	Ethanolic	Antidiabetic activity
29	*Nyctanthes arbor-tristis* L.	Oleaceae	Root	Methanol	Antidiabetic activity
30	*Olea europaea* L.	Oleaceae	Leaf	Alcohol	Antidiabetic activity
31	*Ocimum sanctum*	Lamiaceae	Leaves	Ethanolic	Antidiabetic effect
32	*Opuntia streptacantha*	Cactaceae	Leaves	Ethanol	Antihyperglycemic effect
33	*Pandanus odorus*	Pandanaceae	Root	Aqueous	Antidiabetic effect
34	*Persea americana* Mill.	Lauraceae	Seed	Ethanol	Antidiabetic effect
35	*Piper betle* L.	Piperaceae	Leaf	Aqueous & Ethanol	Antidiabetic effect
36	*Psidium guajava*	Myrtaceae	Fruits	Ethanol	Antihyperglycemic
37	*Raphanus sativus*	Brassicaceae	Leaves, Rhizomes	Aqueous	Anti-diabetic activity
38	*Ricinus communis*	Euphorbiaceae	Leaf	Aqueous	Anti-diabetic property
39	*Salacia reticulata* W.	Hippocrateaceae	Leaf	Aqueous	Anti-diabetic activity
40	*Senna auriculata*	Fabaceae	Flowers	Aqueous	Hypoglycaemic effects
41	*Strychnus potatorum* L.	Loganiaceae	Seeds	Aqueous and Ethanol	Anti-diabetic activity
42	*Terminalia chebula*	Combretaceae	Fruits	Ethanolic	Anti-diabetic activity
43	*Tinospora cordifolia*	Menispermaceae	Roots	Aqueous	Antidiabetic activity
44	*Triticum aestivum*	Poaceae	Husk	Ethanolic	Antidiabetic activity
45	*Urtica ardens*	Urticaceae	Leaves	Hydro-alcoholic	Antidiabetic activity
46	*Vitis vinifera*	Vitaceae	Leaves	Ethanolic	Antidiabetic activity
47	*Withania somnifera* (L.)	Solanaceae	Leaf & Root	Ethanolic	Anti-diabetic activity
48	*Xanthium strumarium*	Asteraceae	Stem	Methanolic	Hypoglycemic effect
49	*Zizyphus sativa gaertn*	Rhamnaceae	Leaf	Alcohol	Anti-diabetic activity
50	*Zygophyllum geslini* Coss	Zygophyllaceae	Aerial parts extract	Aqueous	Anti-diabetic activity

carbohydrates. In addition, this plant's ethanol extract in mice increases dexamethasone-induced hyperglycemia and insulin tolerance in part by increasing the disposal of glucose into the skeletal muscle [32].

N. nucifera

Oral administration of the ethanolic extract of rhizomes of *N. nucifera* significantly reduced the blood sugar level of normal, glucose hyperglycemic, and streptozotocin-induced diabetic rats when compared with control animals. The extract increased glucose tolerance and potentiated the action of exogenously injected insulin in normal rats [33,34].

***O. europaea* L.**

In normal and streptozotocin-induced diabetic rats, the antidiabetic activity of alcohol extract of olive (*O. europaea* L.) leaves has been investigated. Serum glucose, total cholesterol, triglycerides, urea, uric acid, creatinine, aspartate aminotransferase, and alanine aminotransferase decreased significantly during oral administration of olive leaf extract (0.1, 0.25 and 0.5 g/kg body wt.) for 14 days, while serum insulin increased in diabetic rats but not in regular rats [35,36].

P. betle

P. betle leaves have marked hypoglycemic activity (in fasted normoglycemic rats) and antihyperglycemic activity (in STZ-induced diabetic rats, by enhancing the glucose tolerance test and lowering the blood glucose level). The dose-dependent hypoglycemic effect of *P. betle* extract on fasting normoglycemic rats was up to 4 h apart from the lowest dose of hot water extract (HWE). In addition, the hypoglycemic ability of HWE and cold ethanol extract was comparable to that of tolbutamide, the sulphonyl urea-type reference hypoglycemic medication [37-41].

R. communis

In both normal and alloxan diabetic rats, the results of this plant showed a potent reduction of blood glucose activity. It was found that the effective dose of *R. communis* 500 mg/kg body weight. The administration of this ethanol extract to diabetic rats for 20 days not only substantially decreased the level of blood glucose in diabetic animals to almost normal levels but also raised the level of insulin and improved the lipid profile and body weight of diabetic animals. The design of an effective phytomedicine for diabetes seems to have a promising value, although more detailed pharmacological studies are required to elucidate the exact mechanism of the *R. communis* root extract [42-44].

S. reticulata

The effects of aqueous extract prepared from the leaves of *S. reticulata* on the absorption of sugars in normal and type 1 diabetic mice were investigated. The simultaneous oral administration of the extract at a dose of 1.0 mg/mouse with maltose or sucrose inhibited the postprandial elevation of the plasma glucose and insulin levels and intestinal alpha-glucosidase activities in mice. Hence, the water extract of the leaves of *S. reticulata* could be a beneficial food material for the prevention of diabetes and obesity because of its multiple effects [45-50].

W. somnifera

W. somnifera is an essential medicinal plant, which is used in conventional medicine to cure various diseases. Flavonoids were determined in the extracts of *W. somnifera* root (WSREt) and leaf (WSLEt). The amounts of total flavonoids found in WSREt and WSLEt were 530 and 520 mg/100 g dry weight, respectively. Hypoglycemic and hypolipidemic effects of WSR Et and WSLEt were also studied in alloxan-induced diabetic rats [51-54].

CONCLUSION

In this study, we have explored the treatment of diabetes mellitus with folk medicinal plants. Most folk medicinal plants are used in rural areas because of the vast variety of medicinal plants present in these areas. Thus, mellitus therapy with plants appeared highly desirable derived compounds that are accessible and do not need laborious pharmacological synthesis. In this study, an effort has been made to research the antidiabetic medicinal plants which can be useful in developing antidiabetic medicines for health practitioners, scientists, and scholars interested in pharmacology and therapeutics.

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AUTHOR'S CONTRIBUTION

DS performed and wrote the manuscript draft and design the concept and finalized the manuscript.

CONFLICT OF INTEREST

The authors confirm they have no conflict of interest.

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