MEDICINAL PLANTS FOR DIABETES MELLITUS: A REVIEW

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INTRODUCTION

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 utilization 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.

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 utilization 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.

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 ethno-botanical 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 Ailangium lamarckii, Albizia odoratissima, Acanthopanax senticosus, Acorus calamus, Berberis vulgaris, Butea monosperma, Bryophyllum pinnatum, Cocos nucifera, Canarium schweinfurthii, Costus speciosus, Centaurium erythrea, Diosypros peregrine, Dillenia indica, Dolichandrone falcata, Eugenia jambolana, Fructus coss, Grewia asiatica, Gymnema sylvestre, Heinsia crinata, Helicteres isora L, Hypericum perforatum L, Irvingia gabonensis, Juglans regia L, Lawsonia inermis, Lithocarpus polystachyons, Monodora chiranta, Muraya 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, Urgica ardens, Vitis vinifera, Withania somnifera (L.), Xanthium strumarium, Ziziphus sativa Gaertn, and Zygophyllum gelsinii 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 TBAES 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 hyperglycemic in rats and normalized it in 4 days in comparison to 10 days in untreated rats [21-23].

H. crinata
Alloxan-induced diabetic rat hypoglycemic 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-anthaquinones, 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 mehdil, 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].

**Table 1: Medicinal plants having antidiabetic activity**

| S. No | Plant Name          | Family             | Part used       | Type of extract | Activity                  |
|-------|---------------------|--------------------|-----------------|-----------------|---------------------------|
| 1     | *Alangium lamarkii* | 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         | Hypoglycemic              |
| 6     | *Butea monosperma*  | Fabaceae           | Fruit           | Aqueous         | Antidiabetic effect       |
| 7     | *Bryophyllum pinnatum* | Grassulaceae     | Leaf            | Alcoholic       | Antidiabetic activity     |
| 8     | *Coca nucifera*     | Arecaceae          | Leaf            | Hydro-methanol  | Antihyperglycemic effect  |
| 9     | *Canarium schweinfurthii* | Burseraceae    | Stem bark       | Methanolic      | Antidiabetic effect       |
| 10    | *Costus speciosus*  | Costaceae          | Rhizome         | Hexane          | Antidiabetic effect       |
| 11    | *Centaurium erythrea* | Gentianaceae     | Leaf            | Aqueous         | Antidiabetic activity     |
| 12    | *Diospyros kaki*    | Ebenaceae          | Fruit           | Aqueous         | Antidiabetic activity     |
| 13    | *Dillenia indica*   | Dilleniaceae       | Leaves          | Methanolic      | Antidiabetic              |
| 14    | *Dolichandrone falcata* | Bignoniaceae    | Leaves          | Aqueous         | Antidiabetic Potential    |
| 15    | *Eugenia jambolana* | Astereaceae        | Seed            | Ethanol         | Hypoglycemic activity     |
| 16    | *Fructus coini*     | Cornaceae          | Leaves, Seeds   | chiroform       | Hypoglycemic activity     |
| 17    | *Grewia asiatica*   | Malvaceae          | Fruit, Leaves   | Ethanol         | Antihyperglycemic activity |
| 18    | *Gymnema sylvestre* | Asclepiadaceae     | Leaves          | Ethanol         | Hypoglycemic activity     |
| 19    | *Heinsia crinata*   | Rubiaceae          | Root            | Methanolic, hexane | Hypoglycemic activity     |
| 20    | *Helicteres isoru*  | 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    | *Morinda citrifolia* | Rubiaceae          | Whole plant     | Ethanolic       | anti-hyperglycemic effect |
| 27    | *Murraya koenigii*   | Rutaceae           | Leaf            | Aqueous         | Anti-diabetic Activity    |
| 28    | *Myristica fragrans* | Myristicaceae      | Seeds           | Petroleum ether | Hypoglycemic activity     |
| 29    | *Nelumbo nucifera*  | Nymphaeaceae       | Rhizomes        | Ethanolic       | Anti-diabetic activity    |
| 30    | *Nyctanthes arbor-tristis L.* | Oleaceae     | Root            | Methanol        | Anti-diabetic activity    |
| 31    | *Olea europaea L.*   | Oleaceae           | Leaf            | Alcoholic       | Anti-diabetic activity    |
| 32    | *Ocimum sanctum*    | Lamiaceae          | Leaves          | Ethanolic       | Anti-diabetic effect      |
| 33    | *Opuntia streptacantha* | Cactaceae       | Leaves          | Ethanol         | Antihyperglycemic effect  |
| 34    | *Pandanus odorus*   | Pandanaceae        | Root            | Aqueous         | Anti-diabetic effect      |
| 35    | *Persea americana Mill.* | Lauraceae       | Seed            | Ethanol         | Antidiabetic activity     |
| 36    | *Piper betle L.*     | Piperaceae         | Leaf            | Aqueous & Ethanol | Antidiabetic effect       |
| 37    | *Psidium guajava*   | Myrtaceae          | Fruits          | Ethanol         | Antihyperglycemic         |
| 38    | *Raphanus sativus*  | Brassicaceae       | Leaves, Rhizomes | Aqueous         | Anti-diabetic activity    |
| 39    | *Ricinus communis*  | Euphorbiaceae      | Leaf            | Aqueous         | Anti-diabetic property    |
| 40    | *Salacia reticulata W.* | Hippocrataceae | Leaf            | Aqueous         | Anti-diabetic activity    |
| 41    | *Senna auriculata*  | Fabaceae           | Flowers         | Aqueous         | Hypoglycemic activity     |
| 42    | *Strychnus potatorum L.* | Loganiaceae      | Seeds           | Aqueous & Ethanol | Anti-diabetic activity    |
| 43    | *Terminalia chebula* | Combretaceae       | Fruits          | Ethanolic       | Anti-diabetic activity    |
| 44    | *Tinospora cordifolia* | Menispermaceae    | Roots           | Aqueous         | Anti-diabetic activity    |
| 45    | *Triticum aestivum*  | Poaceae            | Husk            | Ethanolic       | Anti-diabetic activity    |
| 46    | *Urtica ardens*     | Urticaceae         | Leaves          | Hydro-alcoholic | Antidiabetic activity     |
| 47    | *Vitis vinifera*    | Vitaceae           | Leaves          | Ethanolic       | Anti-diabetic activity    |
| 48    | *Withania somnifera* | Solanaceae         | Leaf & Root     | Ethanolic       | Anti-diabetic activity    |
| 49    | *Xanthium strumarium* | Asteraceae        | Stem            | Methanolic      | Hypoglycemic effect       |
| 50    | *Zizyphus sativa gaertn* | Rhamnaceae       | Leaf            | Alcohol         | Anti-diabetic activity    |
| 51    | *Zygophyllum geslinii* | 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
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 post prandial 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 (WSRRE) and leaf (WSLER). The amounts of total flavonoids found in WSRREt 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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