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A review: Anti diabetic medicinal plants used for diabetes mellitus

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ABSTRACT

Aim of the present study is evaluated various medicinal plants used for antidiabetic activity. Diabetes mellitus is one of the most common non-communicable diseases globally. It is the fourth leading causes of death in the most developed countries and there in substantial evendiced that it in epidemic in many developing and newly industrialized nations. This posing a serious threat to be met within 21st century. Since ancient time plants have been exemplary source of medicine. Ayurveda and other Indian literature mentioned the used of plants in treatment of various ailments. Out of an estimated 250 000 higher plants, less than 1% have been screened pharmacologically and very few in regard to diabetes mellitus. Systematic studies on the folklore medicinal plants that combat diabetes mellitus are scanty.

1. Introduction

Diabetes mellitus is a common and very prevalent disease affecting the citizens of both developed and developing countries. It is estimated that 25% of the world population is affected by this disease. Diabetes mellitus is caused by the abnormality of carbohydrate metabolism which is linked to low blood insulin level or insensitivity of target organs to insulin[1]. Despite considerable progress in the treatment of diabetes by oral hypoglycemic agents, search for newer drugs continues because the existing synthetic drugs have several limitations. The herbal drugs with antidiabetic activity are yet to be commercially formulated as modern medicines, even though they have been acclaimed for their therapeutic properties in the traditional systems of medicine[2]. Type 2 diabetes usually occurs in obese individuals and is associated with hypertension and dyslipidemia. Thus the treatment aims to reduce insulin resistance and to stimulate insulin secretion. Diabetes is a metabolic disorder where in human body does not produce or properly us insulin, a hormone that is required to convert sugar, starches, and other food into energy. Diabetes mellitus is characterized by constant high levels of blood glucose (sugar). Human body has to maintain the blood glucose levels at a very narrow range which is done with insulin and glucagon. The function of glucagon is causing the liver to release glucose from its cells into the blood for the production of energy. Type 1 Diabetes leads to inability to release insulin results in low rates of glucose uptake into muscles and adipose tissue[3]. Traditional medicine (herbal) is used for treatment of diabetes in developing countries where the cost of conventional medicines is a burden to the population[4]. Despite the introduction of hypoglycemic agents from natural and synthetic sources, diabetes and its secondary complications continue to be a major medical problem. Many indigenous Indian medicinal plants have been found to be useful to successfully manage diabetes. One of the great advantages of medicinal plants is that these are readily available and have very low side effects. Plants have always been an exemplary source of drugs and many of the currently available drugs have been derived directly or indirectly from them.

The ethnobotanical information reports about 800 plants that may possess antidiabetic potential[5]. Several herbs have shown antidiabetic activity when assessed

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using presently available experimental techniques[6]. This review article enumerates some medicinal plants possessing antidiabetic activity and elucidating their mechanisms of action such as *Brassica juncea* (*B. juncea*), *Combretum micranthum* (*C. micranthum*), *Elephantopus scaber* (*E. scaber*), *Gymnema sylvestre* (*G. sylvestre*), *Liriope spicata* (*L. spicata*), *Parinari excelsa* (*P. excelsa*), *Ricinus communis* (*R. communis*), *Sarcopoterium spinosum* (*S. spinosum*), *Smallanthus sonchifolius* (*S. sonchifolius*), *Swertia punicea* (*S. punicea*), *Vernonia anthelmintica* (*V. anthelmintica*) etc. and method of experiment on animals and therapeutic efficiency of plant extracts were exploited. Some of the important anti-diabetic potential herbal plants sources are given in the Table 1.

2. Antidiabetic effect of folklore medicinal plants

2.1. Brassica juncea

It is commonly used spice in various food items in Tamilnadu. *B. juncea* is a traditional medicinal plant which belongs to family Cruciferae. *B. juncea* aqueous seed extract has a potent hypoglycemic activity which was investigated in STZ induced diabetic male albino rat. Doses which have hypoglycemic activity was reported as 250, 350, 450 mg/kg[7].

2.2. Eugenia jambolana

Eugenia jambolana (*E. jambolana*) popularly known as Jamun or Indian blackberry has been indicated in

Table 1

Medicinal plants having antidiabetic activity.

S.No	Plant name	Family	Parts used	Type of extract	Activity	References
1	*Alangium lamarckii*	Alangiaceae	Leaves	Alcoholic	Antidiabetic	[15]
2	*Albizia odoratissima*	Mimosaceae	Bark	Methanol	Antidiabetic	[19]
3	*Axonopus compressus*	Poaceae	Leaves	Methanol	Antidiabetic	[13]
4	*Berberis vulgaris*	Berberidaceae	Root	Aqueous	Hypoglycaemic	[14]
5	*Brassssica juncea*	Cruciferae	Seed	Aqueous	Hypoglycemic	[7]
6	*Caesalpinia digyna*	Fabaceae	Root	Methanol	Antidiabetic	[10]
7	*Catharanthus roseus*	Apocynaceae	Leaf	Methanol	Hypoglycemic	[16]
8	*Centaurium erythrea*	Gentianaceae	Leaf	Aqueous	Antidiabetic	[17]
9	*Chaenomeles sinensis*	Rosaceae	Friuts	ethyl acetate	Antidiabetic	[18]
10	*Cocos nucifera*	Arecaceae	Leaf	hydro-methanol	Antihyperglycemic	[20]
11	*Costus speciosus*	Costaceae	rhizome	hexane	Antidiabetic	[21]
12	*Cyclocarya paliurus*	Cyclocaryaceae	Bark	Aqueous, PE, chloroform, ethyl acetate & *n*-butanol	Hypoglycemic	[22]
13	*Dillenia indica*	Dilleniaceae	Leaves	Methanolic	Antidiabetic	[23]
14	*Embelia ribes*	Myrsinaceae	Berries	Hexane	Antidiabetic	[24]
15	*Hybanthus enneaspermus*	Violaceae	Whole plant	Alcholic	Antidiabetic	[25]
16	*Lippa nodiflora*	Verbenaceae	Whole plant	Methanol	Antidiabetic and Hypolipidemic	[26]
17	*Lithocarpus polystachyus*	Fagaceae	Leaves	Ethanol & Aqueous	Hypoglycemic	[27]
18	*Marrubium vulgare*	Lamiaceae	Aerial part	Methanol	Hyperglycemia anddyslipidemia	[28]
19	*Ocimum sanctum*	Lamiaceae	Aerial part	Hydroalcholic	Antidiabetic	[29]
20	*Opuntia streptacantha*	Cactaceae	Leaves	Ethanol	Antihyperglycemia	[30]
21	*Psidium guajava*	Myrtaceae	Fruits	Ethanol	Antihyperglycemic	[31]
22	*Semecarpus anacardium*	Anacardiaceae	nut	Milk	Antidiabetic	[32]
23	*Prosopis glandulosa*	Fabaceae	Whole plant	Gelatine/Jelly	Antidiabetic	[33]
24	*Ophiopogon japonicus*	Asparagaceae	Root	Ethanol	Hypoglycemic	[34]
26	*Setaria italica*	Poaceae	Seed	Aqueous	Antihyperglycemic	[35]
25	*Solanum torvum*	Solanaceae	Friut	Methanol	Antihyperglycemic	[36]
26	*Cassia auriculata*	Caesalpiniacae	Leaves	Aqueous	Antihyperglycemic	[37]
27	*Zygophyllum album*	Zygophyllaceae	Whole plant	Ethanol	Antidiabetic	[38]
28	*Vitex negundo*	Lamiaceae	Leaves	Methanol	Antihyperglycemic	[39]
29	*Viscum schimperi*	Viscaceae	aerial parts	Methanolic	Antihyperglycemic & Hypolipidaemic	[40]
30	*Symplocos cochinchinensis*	Symplocaceae	Leaves	Hexane	Antidiabetic	[41]
31	*Enicostemma littorale*	Gentianaceae	Whole plant	aqueous	Antidiabetic	[42]
32	*Vaccinium arctostaphylos*	Ericaceae	Fruit	Ethanolic	antidiabetic	[43]
33	*Solanum xanthocarpum*	Solanaceae	Leaves	Aqueous and Methanol	Antihyperglycemic	[44]

Ayurveda, an ancient system of Indian medicine, for use in DM. In accordance to its claimed anti-diabetic effect in traditional medicine, *E. jambolana* has been reported to have hypoglycemic effects both in experimental models and clinical studies[8].

2.3. Coccina grandis

Hypoglycemic activity was evaluated in alcoholic extracts of *Coccinia grandis* (*C. grandis*) leaves. Alcoholic extract 600 mg/kg bw was injected orally to mice. Oral administration of alcoholic extract of leaves of *C. grandis* showed significant hypoglycemic effect on blood glucose level in normal fasted rats[9].

2.4. Alangium lamarckii

Antidiabetic effect of alcoholic extract of *Alangium lamarckii* (*A. lamarckii*). Alcoholic leaves extract 250 and 500 mg/kg bw was used for these studies. *A. lamarckii* have significant antidiabetic activity in STZ-nicotinamide induced diabetic rat[10].

2.5. Albizia odoratissima

Antidiabetic effect of methanolic bark extract of *Albizia odoratissima* (*A. odoratissima*) in alloxan induced diabetic mice. The methanolic extracts were fed to the animals at a dosage of 250 and 500 mg/kg body weight. The significant reduced in the levels of serum cholesterol, triglycerides, SGOT, SGPT, alkaline phosphatase and decrement of total proteins in alloxan induced albino mice[11].

2.6. Artemis sphaerocephala Krasch

Antioxidant effect of *Artemis sphaerocephala* (*A. sphaerocephala*) gum on STZ induced diabetic rat. Levels of serum and liver tissue thiobarbituric acid reactive substances (TBARS) and +OH were increased in STZ induced rat. The activity levels of liver and serum superoxide dismutase were decreased. After administration of extract of *A. sphaerocephala*, levels of TBARS and +OH were decreased in serum and liver tissue. The significant increments in the levels of liver and serum SOD. *A. sphaerocephala* is very good antioxidant activity[12].

2.7. Axonopus compressus

The anti-diabetic effect of the methanolic leaf extract of the plant. Diabetes was induced in the rats by injection of alloxan. Methanolic leaves extract 250, 500 and 1 000 mg/kg bw was used for these studies. Methanolic leaf extract of *Axonopus compressus* (*A. compressus*) at all the doses (250, 500 and 1 000 mg/kg) were significant reduction (by 31.5%, 19.8% and 24.5%) of the blood glucose levels in the diabetic rats when compared to the control group. *A. compressus* may possess very good antidiabetic property[13].

2.8. Berberis vulgaris

Hypoglycaemic effect of *Berberis vulgaris* (*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 shows significant hypoglycemic effect. The serum cholesterol and serum triglycerides levels were significantly increased[14].

2.9. Caesalpinia digyna

Antidiabetic effect of bergenin from the roots of *Caesalpinia digyna* (*C. digyna*). The levels of plasma total cholesterol (TC), triglycerides (TG) and LDL-C were significantly increased, whereas levels of (HDL-C) were significantly decreased in diabetic rats when compared to control. After administration of bergenin (10 mg/kg; p.o.) the lipid profile were significantly increased when compared with that of glibenclamide (10 mg/kg; p.o.). The activity levels of antioxidant enzymes such as SOD and Cat were decreased. The level of TBARS was significantly increased in diabetic rat compared to control rat. The administration of bergenin (10 mg/kg; p.o.) significantly increased the SOD and CAT respectively and reduced TBARS level. Bergenin is very good antidiabetic properties[15].

2.10. Catharanthus roseus

Hypoglycemic effect of the methanolic leaf extract of *Catharanthus roseus* (*C. roseus*) in alloxan induced diabetic rats. The levels of blood glucose were significantly decreased when compared with Control rat. The blood glucose lowering effect of *C. roseus* methanolic extract was more pronounced than Glibenclamide and Metformin[16].

2.11. Centaurium erythrea

Diabetes was induced by a single dose of STZ (65 mg/kg) administered by intraperitoneal way. The oxidative stress was measured by tissue MDA. The estimation of pancreas antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx). A significant decrement in the levels of pancreas tissue TBARS was recorded in diabetic treated rats when compared to that of normal animals. The activity levels of pancreas antioxidant defense enzymes viz. SOD, CAT,

GPx and GST were significantly increased in the diabetic treated animals. Antioxidant effect of the aqueous leaf extract of *Centaurium erythrea* (*C. erythrea*)[17].

2.12. Chaenomeles sinensis

Ethyl acetate fraction of *Chaenomeles sinensis* (*C. sinensis*) (Thouin) Koehne fruits is very good Antidiabetic effect. Chaenomeles sinensis is belongs to family Rosaceae. Doses which have antidiabetic activity were reported as 50 and 100 mg/kg body weight[18].

3. Conclusion

In this review we discussed about folklore medicinal plants for the treatment of Diabetes mellitus. Folklore medicinal plants are mostly used for rural areas; because the availability of lavish amount of medicinal plants those areas. Therefore, treating diabetes mellitus with plant derived compounds which are accessible and do not require laborious pharmaceutical synthesis seems highly attractive. In the present review an attempt has been made to investigate the antidiabetic medicinal plants and may be useful to the health professionals, scientists and scholars working in the field of pharmacology and therapeutics to develop antidiabetic drugs.

Conflict of interest statement

We declare that we have no conflict of interest.

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