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REVIEW ARTICLE

REVIEW ON SOME MEDICINAL PLANTS WITH ANTIDIABETIC ACTIVITY

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ABSTRACT

In the last few years there has been an exponential growth in the field of herbal medicine and these drugs are gaining popularity both in developing and developed countries because of their natural origin and less side effects. Many traditional medicines in use are derived from medicinal plants, minerals and organic matter. The World Health Organization (WHO) has listed 21,000 plants, which are used for medicinal purposes around the world. Among these 2500 species are in India, out of which 150 species are used commercially on a fairly large scale. India is the largest producer of medicinal herbs and is called as botanical garden of the world. The current review focuses on herbal drug preparations and plants used in the treatment of different chronic diseases in the world. The use of Ayurvedic medicines is common in both adults and children and is increasing in many areas of the world. This paper will discuss the benefits with use of herbal medicines as Antidiabetic activity.

Keywords: Medicinal plant, Antidiabetic activity, Diabetes mellitus

INTRODUCTION

Diabetes mellitus (DM) is the most common endocrine disorder which currently affects more than 100 million people worldwide and the number of people with diabetes is increasing due to population growth, aging and increasing prevalence of obesity and physical inactivity¹⁻². India is the world's second most populous country, having more people with type 2 diabetes than in any other nation as the disease prevails in both genders and all age groups³⁻⁴.

According to recent estimates, approximately by the year 2030, 438 million people (7.8%) of the adult population, is expected to have diabetes⁵. Some reasons like stress, rapid development of cities, and substantial increase in purchase power, lifestyle ease and metro life have lead to health issues and higher number of people suffering from these diseases⁶. The cost of treating diabetes and associated complications exceeds \$100 billion per year and complications are far less common and less severe in people who have well controlled blood sugar levels⁷. The treatment of diabetes with synthetic drugs is generally not preferred because of its high cost and side effects for this reason, it is necessary to develop traditional and alternative medicine. Herbal drugs constitute an important part of traditional

medicine and literature shows that there are more than 400 plant species showing antidiabetic activity⁸.

MEDICINAL PLANTS WITH ANTIDIABETIC ACTIVITY

Various medicinal plants have been reported for their antidiabetic which is categorized on the basis of plant's part as follows.

LEAVES

Aframomum melegueta

Drugs which are used presently for the management of pain and inflammatory conditions are either steroidal like corticosteroids or non steroidal like aspirin. All of these drugs possess more or less side and toxic effects like renal failure, allergic reactions, hearing loss or they may increase the risk of haemorrhage by affecting platelet function⁹. On the contrary many medicines of plant origin had been used since ages without any adverse effects.

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It is therefore essential that efforts should be made to introduce new medicinal plants to develop more effective and cheaper drugs. Plants represent a large natural source of useful compounds that might serve as lead for the development of novel drugs.¹⁰ In the present review, an attempt has been made to summarize the various medicinal plants having antidiabetic and analgesic activity which can be beneficial for the mankind.

Crude leaf extract of *Aframomum melegueta* (Zingiberaceae) are used in West Africa, as an antidiabetic drug. The hypoglycaemic effects of crude leaf extract were evaluated on the alloxan induced diabetic male and non diabetic rats (control). Oral administration of leaf extract in dose of 50, 100 and 200 mg/kg significantly reduce blood glucose level¹¹.

***Aloe barbidensis* (Southakathalai, Ghikanvar)**

Aloe vera (Liliaceae) is a cactus like plant with green dagger shaped leaves that are fleshy tapering, spiny and filled with clearly viscous gel. The aqueous extract of *Aloe vera* has the hypoglycemic property which was given orally at a dose of 150mg/kg of body weight. Whole study was performed on the alloxan induced male albino rats¹²⁻¹³.

Azadirachta indica

Azadirachta indica (Meliaceae) is an indigenous plant widely available in India and Burma. Effect of *Azadirachta indica* leaf extract on serotonin inhibition in glucose mediated insulin release in rat pancreas was studied in vitro to elucidate the possible mechanism of antihyperglycemic effect¹⁴.

In another study it was shown that hydro alcoholic extracts of this plant has antihyperglycemic activity in streptozotocin treated rats and this effect is because of increase in glucose uptake and glycogen deposition in isolated rat hemi diaphragm. This plant also has antibacterial, antimalarials, antifertility, hepatoprotective and antioxidant effects¹⁵.

***Aegle marmelos* (Bael leaves)**

Bael is the medium sized, armed, deciduous tree, belongs to the family Rutaceae. It showed the antidiabetic effect which was more effective along with the oral hypoglycemic therapy. Bael leaves can be combined in high dose with oral hypoglycemic agents to bring the blood glucose to normal levels in patients whose diabetes is not in control with these agents or in those patients in whom these drugs produce adverse effects on dose increments¹⁶.

***Anacardium occidentale* (Cashew plant)**

Methanolic leaf extract of *Anacardium occidentale* (Anacardiaceae) was investigated in streptozotocin induced diabetic rats. Oral administration of methanolic extracts at doses of 35, 175 and 250 mg/kg significantly reduce blood glucose levels in diabetic rats. Hexane and ethyl acetate fractions showed the most prominent actions suggesting the presence of non polar and polar hypoglycemic compounds in the plant¹⁷. In another

study it was investigated that methanolic stem bark extract of cashew plant shows antidiabetic activity in fructose-fed (diabetic) rats¹⁸.

Basella rubra

Basella rubra (Basellaceae) is known as Malabar spinach or cyclone spinach. The leaf pulp has antihyperglycemic effect which was studied on STZ induced diabetic rats. It was found that after ingestion, fasting blood glucose levels were remarkably reduced to normal and liver glycogen content was remarkably increased¹⁹.

***Bougainvillea glabra* (B.G.)**

Bougainvillea glabra is also called Glorey of the garden which belongs to family Nyctaginaceae. It has originated from South America and is a popular plant in California and Florida. Aqueous and methanolic leaf extract has antidiabetic potential studied on alloxan induced diabetes mellitus in male albino rats. The phytochemical screening shows the presence of alkaloids, flavonoids, saponin, and cardiac glycoside. 100 mg/kg and 400 mg/kg extract of B.G. has significantly reduced the blood glucose level in diabetic animals²⁰.

Cajanus cajan is commonly known as pigeon pea which belongs to family Fabaceae. Findings showed that methanolic leaves extract of *Cajanus cajan* has antidiabetic activity which was studied in alloxan induced diabetic and oral glucose loaded rats. It was investigated that the extract (400 and 600 mg/kg) significantly reduced fasting blood sugar of alloxan induced diabetic rats in a dose-related manner, with maximum hypoglycemic effect at 4-6 hr. The extract also significantly suppressed the peak postprandial rise in blood glucose of normal rats by 101.8 and 57.40% respectively²¹.

Coccinia indica

Coccinia indica (Cucurbitaceae) is a creeper that grows wild and is found in abundance in Bengal. The plant has been used since ancient time for treating diabetes mellitus in the Indian system of medicine known as ayurveda. It was shown that oral administration of an aqueous suspension of ethanolic extract of leaves to 18 hr-fasted rats, lowered the blood glucose level of both normal and streptozotocin-diabetic rats and depressed the activity of the liver gluconeogenic enzyme glucose-6-phosphatase²².

Cassia occidentalis

Cassia occidentalis (Caesalpinaceae) is extensively used in the indigenous and folklore medicine systems to treat several illnesses. Methanolic fraction of leaves was tested against streptozotocin induced diabetic rats. Treatment with this plant extracts at different doses and times following in normal and diabetic rats significantly reduced blood glucose level to normal in diabetic rats. Histopathological examination showed that methanolic extract protects the pancreatic tissue from STZ induced damage²³.

BARK**Ficus racemosa**

Ficus racemosa (Moraceae) is used in traditional system of medicine for the treatment of several disorders including diabetes mellitus. Ethanolic extract of bark showed antihyperglycemic and hypolipidemic activities in alloxan induced diabetic rats. The dose of 100-500 mg/kg of extract showed significantly lowered blood glucose level²⁴.

Antidiabetic potential of methanolic stem bark extract of *Adansonia digitata* (Bombacaceae) was carried out in streptozotocin induced diabetic wistar rats. Dose of the plant extract was given as 100, 200 and 400 mg/kg intraperitoneally to the rats. Results shows that bark extract reduced the hyperglycemia with a great extent²⁵.

Afzelia africana

The antidiabetic properties of aqueous extract of stem bark of *Afzelia africana* (leguminosae) and its beneficial effect on hematological parameters reported on streptozotocin induced diabetic rats. The extract was given at a dose of 200 mg/kg that significantly reduced blood glucose level. In addition of hyperglycemia, it also prevents various complication of diabetes²⁶.

Berberis aristata

Berberis aristata (Berberidaceae) is used in Indian traditional medicine for treating diabetes mellitus. Antidiabetic activity of methanolic extract of this plant has been observed in streptozotocin induced diabetes in adult male wistar rats. Unlike antidiabetic it is also used in antibacterial, antiperiodic, antiarrhoeal, ophthalmic, skin diseases etc²⁷.

Elaeodendron glaucum

Elaeodendron glaucum (Celastraceae) is a medium sized tree which is distributed throughout India, Australia America, South Africa & Tropical Asia. Methanolic extract of this plant shows antidiabetic activity in normal and alloxan induced Inbred adult male Charles-Foster (CF) albino rats²⁸.

Terminalia arjuna

Stem bark of *Terminalia arjuna* has the antidiabetic activity which was studied on alloxan induced diabetic rats. Ethanolic extract of bark was given at a dose of 250 and 500mg/kg which significantly decrease the blood glucose and decrease in the activities of glucose-6-phosphatase, fructose-1, 6-disphosphatase, aldolase and an increase in the activity of phosphoglucoisomerase and hexokinase in tissues²⁹.

Ougeinia oojainensis

Ougeinia oojainensis (Leguminosae) bark has been found to have hypoglycemic and hypolipidemic property which was evaluated on alloxan induced diabetic rats. Bark extract was given orally at a dose of 200mg/kg for the hypoglycemic activity. Extract also reduce the elevated biochemical parameters like triglyceride, low density lipoprotein, total cholesterol etc³⁰.

Thespesia populnea

Thespesia populnea (Malvaceae) is a reputed ever green tree, commonly known as Indian tulip tree. The plant is distributed in tropical regions and coastal forest in India. The ethanolic extract of the plant bark and leaf shows hypoglycemic activity which was evaluated against the streptozotocin (STZ) induced diabetic rats and compared it with standard drug glibenclamide. It was supposed that free radical generation is inhibited by the extract³¹.

ROOT**Ipomoia digitata**

The antidiabetic effect of various fractions of *Ipomoia digitata* was studied on alloxan induced diabetic rats. Extract was used in the dose of 100 mg/kg, medium dose 200 mg/kg, high dose 400 mg/kg of body weight. Glibenclamide (10mg/kg body weight) was used as a standard reference³².

Tectona grandis

Methanolic extract of *Tectona grandis* (Verbenaceae) roots has antidiabetic activity which was performed on alloxan induced diabetic albino rats. Its hypoglycemic action was compared with glibenclamide and hypoglycemic activity has been reported at the dose of 500mg/kg³³.

Pseudarthria viscida

Ethanolic extract of the roots of *Pseudarthria viscida* (Fabaceae) was evaluated for anti diabetic activity against alloxan induced diabetes in albino rats. The ethanolic extracts showed significant activity as compare to standard glibenclamide³⁴.

Ginseng

Methanol extract of root of *Nyctanthes arbortristis* (Oleaceae) possess safe and strong antidiabetic activity which was investigated in alloxan induced diabetic rat. The antidiabetic activity was compared with the standard drug as glibenclamide. It was found that the methanolic extract at 500 mg/kg dose level exhibited significant hypoglycemic activity³⁵.

Ginseng (Araliaceae) is a well known medicinal plant used in traditional oriental medicine. In recent decades, Ginseng root has gained popularity as a dietary supplement in the United States. It has also been commonly used in medicine to treat diabetes like conditions. The mechanism behind this action is reported as Ginseng increased insulin release from pancreatic β -cells, which is probably caused by increased β -cell stimulation and increased insulin synthesis³⁶.

Anthocephalus indicus

It has been reported that root extract of *Anthocephalus indicus* (Rubiaceae) has hypoglycemic, lipid lowering and antioxidant activities in alloxan induced diabetic rats. Oral administration of ethanol extract of root (500mg/ kg body weight) for 21 days significantly decreased the levels of blood glucose, triglycerides, total cholesterol, phospholipids and free fatty acids³⁷.

Ceiba pentandra

Ceiba pentandra Hypoglycemic effect of the root and bark extract of *Ceiba pentandra* (Bombacaceae) has been reported in normal and streptozotocin induced diabetic rats. Doses were selected as 40,75,150 and 300 mg/kg of the extract in fasted normal and diabetic groups. It was reported that the dose at lower level produce hypoglycemic effect rather than with the high dose³⁸.

Annona squamosa

The aqueous extract of roots of *Annona squamosa* (Annonaceae) at a dose of 250 mg/kg and 500 mg/kg body weight respectively was reported for antidiabetic activity in Streptozotocin (STZ) induced hyperglycemic rats. It reduces the blood glucose level and effects were compared with the glibenclamide³⁹.

Calotropis procera

The root extracts of *Calotropis procera* were investigated for its anti-diabetic effect in streptozotocin induced diabetic male wister albino rats. The different extracts like ether, methanolic and aqueous extracts of roots were tested for antidiabetic activity on rats⁴⁰.

SEED

Abrus precatorius

The antidiabetic effect of chloroform methanol extract of *Abrus precatorius* (Leguminosae) seed was studied in alloxan induced diabetic rabbits. Its antidiabetic property was found to be similar to that of chlpropamide⁴¹.

Eugenia jambolana (EJ)

Ethanol extract of dried seed of *Eugenia jambolana* (Myrtaceae) has been reported to have antidiabetic effects on streptozotocin induced diabetes. Extract was given orally in the doses of 100–400 mg/kg and it showed dose dependent decrease in blood glucose level in diabetic rats. Apart from hypoglycemic effect, seed has been reported to have anti-inflammatory, neuropsychopharmacological, antibacterial, anti-HIV and antiarrhoeal effects⁴².

Brassica juncea

Brassica juncea is a traditional medicinal plant which belongs to family Cruciferae. Its 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/kg⁴³.

Hypoglycemic activity was seen in aqueous seed extract of *Carica papaya* (Caricaceae) in normal male wistar rats. It was found that crude extract significantly and progressively lowered fasting blood sugar (FBS), triglyceride (TG), total cholesterol (TC), LDL-c, and VLDL-c dose-dependently. In addition to hypoglycemic effect it also has cardio protective and hypolipidemic⁴⁴.

FRUIT

Opuntia dillenii

Opuntia dillenii is a Haw fruit which has been used in folk medicine as an antidiabetic agent in STZ induced diabetic rats. It is a rich source of fiber, carbohydrates, and vitamins B1, B2 and C, in addition to the minerals. Oral administration of *O. dillenii* juice to diabetic rats reduced blood glucose level and MDA levels. It may also improve the insulin receptors of β -cells⁴⁵.

Phyllanthus emblica

Phyllanthus emblica commonly known as Amla is widely distributed in Asia and Africa. The aqueous fruit extract of *Phyllanthus emblica* showed effect on type-II diabetes, triglycerides (TG) and liver specific enzyme, alanine transaminase (ALT). It was shown that aqueous fruit extract in a dose of 200mg/kg body weight, significantly decreased the blood glucose level after its intraperitoneally administration in alloxan induced diabetic rats. The aqueous extract also induced hypotriglyceridemia by decreasing TG levels in diabetic rats. In addition, the extract was also found to improve liver function by normalizing the activity of liver specific enzyme alanine transaminase (ALT)⁴⁶

Syzygium cumini (SC)

Syzygium cumini (Myrtaceae) has been widely used as a traditional system of medicine to treat diabetes in India. Seed extract of SC has shown the antidiabetic activity against streptozotocin (STZ) induced diabetic rats. The compound 'Mycaminose' and ethyl acetate and methanol extract was found to reduce the blood glucose level⁴⁷.

Blighia sapida

The fruit of *Blighia sapida* (Sapindaceae) have been shown to induce hypoglycemia in rabbits, monkeys, rats and mice upon intravenous venous injection. The two chemical compounds as hypoglycin A and hypoglycin B among which A is more potent than compound B. It was found that hypoglycin A is effective by mouth in rats. The blood sugar of alloxanized rats also falls after intake of hypoglycin A⁴⁸.

Lycium barbarum

Fruit of *Lycium barbarum* of family Solanaceae is well known in traditional Chinese herbal medicine and now a days has been widely used as a popular functional food, with a large variety of beneficial effects, such as reducing blood glucose and serum lipids, anti-aging, immuno-modulating, anticancer, anti-fatigue, and male fertility-facilitating. The hypoglycemic effects of *Lycium barbarum* fruit, crude polysaccharide extracts and purified polysaccharide fractions was investigated in alloxan induced diabetic rabbits through designed sequential trials and by measuring blood glucose level⁴⁹.

WHOLE PLANT /BULB/ AERIAL PART

Catharanthus roseus

Catharanthus roseus belongs to family Apocynaceae which is known with various names in India and all over the world. Dichloromethane: methanol extract (1:1) of leaves and twigs shows hypoglycemic effect on streptozotocin (STZ) induced diabetic rats. The dose of

this extract (500 mg/kg) was given orally to the animal for its hypoglycemic activity. Enzymic activities of glycogen synthase, glucose 6-phosphate-dehydrogenase, succinate dehydrogenase and malate dehydrogenase were decreased in liver of diabetic animals in comparison to normal⁵⁰.

Allium cepa

Allium cepa belongs to family Liliaceae and probably native of South West Asia which is widely cultivated throughout the world. It is commonly known as onion, pyaz etc. It is an herbaceous biennial plant having an edible bulb. Bulb or whole plant is used for its therapeutic effect. Its ethenolic extract show hypoglycemic effect which was carried on alloxan induced male albino rats. The most effective percentage reduction in blood glucose level, total serum lipids and cholesterol is observed at 300 mg/kg⁵¹.

Allium sativum

Allium sativum commonly known as garliac is a species of the onion, family Liliaceae. Hypoglycemic study was performed on the STZ induced diabetic rats. Simple garliac extract and ethanolic extract shows significantly antidiabetic activity. Raw garlic possesses a beneficial potential in reversing proteinuria in addition to reducing blood sugar, cholesterol and triglycerides in diabetic rats⁵². In another study petroleum ether, ethyl acetate, chloroform portion of methanolic extract was also

reported to show anti hyperglycemic effect on alloxan induced diabetic rats⁵³.

Phyllanthus niruri

Methanol extract (ME) of aerial parts of Phyllanthus niruri (Euphorbiaceae) has antidiabetic activity. It was evaluated in normal and alloxan diabetic rats. It is shown that ME significantly reduced the fasting blood sugar in a dose-related manner and suppressed the postprandial rise in blood glucose after a heavy glucose meal in normoglycaemic rats. Chronic oral administration of ME caused a significant dose related reduction in blood glucose levels as well as total cholesterol and triglycerides levels in diabetic and normoglycaemic rats⁵⁴.

Salacia oblonga

Salacia oblonga belongs to family Celastraceae having antidiabetic activity, investigated on the L6.C11 rat skeletal muscle myoblast cell culture. Plant extract are mediated not only by inhibiting intestinal α glycosidases but also by enhancing glucose transport in muscle and adipose cells. Extract increased 2-deoxy-D-glucose uptake by 50% in myotubes and adipocytes. Extract and mangiferin (bioactive compound) may exert their antidiabetic effect by increasing GLUT4 expression and translocation in muscle cells. These effects are probably mediated through two independent pathways that are related to 50-AMP-activated protein kinase and PPAR- γ ⁵⁵.

List of some Medicinal plants used in the treatment of Diabetes:

Sr. No.	Plant Name	Family	Useful Part
1.	<i>Abroma augusta</i> L.f.	Sterculiaceae	Bark and Flower
2.	<i>Annona squamosa</i> L.	Annonaceae	Leaves
3.	<i>Barleria cristata</i> L.	Acanthaceae	Roots
4.	<i>Beta vulgaris</i> L.	Betulaceae	Bark
5.	<i>Calamug rotang</i> L.	Arecaceae	Bark
6.	<i>Cannabis sativa</i> L.	Cannabinaceae	Resin & Leaves
7.	<i>Desmodium gyrans</i> L.	Papilionaceae	Roots
8.	<i>Dioscorea alata</i> L.	Dioscoreaceae	Rhizome
9.	<i>Eryngium foetidum</i> L.	Apiaceae	Whole plant
10.	<i>Ficus fistulosa</i> L.	Moraceae	Fruit
11.	<i>Gymnema sylvestris</i>	Asclepiadaceae	Leaves
12.	<i>Hordeum Vulgare</i> L.	Poaceae	Seed
13.	<i>Ipomoea balatus</i> L.	Convolvulaceae	Tuberus Roots
14.	<i>Juslicia adhatoda</i> L.	Acanthaceae	Leaves
15.	<i>Kyllianga bulbosa</i>	Cyperaceae	Whole plant
16.	<i>Lysium barbala</i> L.	Solanaceae	Fruits
17.	<i>Momordica charanlia</i>	Cucurbitaceae	Fruit
18.	<i>Nepeta cataria</i> L.	Lamiaceae	Leaves & Flowering
19.	<i>Oplopanax horridum</i>	Umbelliferae	Root
20.	<i>Picrorhiza kurrooa</i>	Scrophulariaceae	Herb
21.	<i>Quercuslineala</i> Blume	Fagaceae	Stem bark
22.	<i>Rotula aquatica</i> Lour.	Boraginaceae	Root
23.	<i>Swertia chirata</i>	Gentianaceae	Whole Plant
24.	<i>Trigonellafoenum graecum</i> L.	Papilionaceae	Seed
25.	<i>Bauhinia variegata</i> Linn.	Fabaceae.	Leaves

FRUIT JUICE**Momordica charantia (Bitter Gourd, Karela)**

Momordica charantia belongs to the family Cucurbitaceae. Plant is widely cultivated in many tropical and subtropical regions of the world and frequently used in South Asia. Extracts from various components of this plant have been reported to possess hypoglycaemic activity on streptozotocin (STZ) induced diabetic rats. It was suggested that oral feeding of fruit juice may have a role in the renewal of β cell in STZ diabetic rats or alternately may permit the recovery of partially destroyed β cell⁵⁶.

Ganoderma lucidum

Anti diabetic and some haematological effects of Ethylacetate and n-Butanol fractions of Ganoderma lucidum aqueous extract has been reported in alloxan-induced diabetic wistar rats. A dose of 50 mg/kg of Ethylacetate and n-Butanol fraction of G. lucidum aqueous extract was given intraperitoneally for its activity⁵⁷.

DISCUSSION

In this review we can use about all above some medicinal plants for the treatment of Diabetes mellitus. Some 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

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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.

CONCLUSION

Metabolic imbalance causing diabetes mellitus is a characteristic of materialistic world. Differences in social structure, psychic stress, obesity, hormonal imbalance and heredity are optimizing the growth of pandemic. Increasing population with diabetes has a huge requirement of effective remediation.

These efforts may provide treatment for all and justify the role of novel traditional medicinal plants having anti-diabetic.

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CONFLICT OF INTEREST STATEMENT

We declare that we have no conflict of interest.

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