

A Brief Review on Medicinal Plants Shows Antidiabetic Activity

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Abstract: *Diabetes mellitus is one of the common metabolic disorders acquiring around 2.8% of the world's population and is anticipated to cross 5.4% by the year 2025. Since long back herbal medicines have been the highly esteemed source of medicine therefore, they have become a growing part of modern, high-tech medicine. In view of the above aspects the present review provides profiles of plants (65 species) with hypoglycaemic properties, available through literature source from various database with proper categorization according to the parts used, mode of reduction in blood glucose (insulinomimetic or insulin secretagogues activity) and active phytoconstituents having insulin mimetics activity. From the review it was suggested that, plant showing hypoglycemic potential mainly belongs to the family Leguminosae, Lamiaceae, Liliaceae, Cucurbitaceae, Asteraceae, Moraceae, Rosaceae and Araliaceae. The review describes some new bioactive drugs and isolated compounds from plants such asroside, epigallocatechin, epicatechin, mangiferin.⁽¹⁾*

Keywords: Diabetes mellitus, medicinal plants, antidiabetic, hypoglycemic, antihyperglycemic

I. INTRODUCTION

Diabetes mellitus (DM) is a serious, chronic, and complex metabolic disorder of multiple etiologies with profound consequences, both acute and chronic [1]. Also known only as diabetes, DM and its complications affect people both in the developing and developed countries, leading to a major socioeconomic challenge. It is estimated that 25% of the world population is affected by this disease [2]. Genetic and environmental factors contribute significantly to the development of diabetes [3]. Diabetes mellitus is a group of metabolic alterations characterized by hyperglycemia resulting from defects in insulin secretion, action or both. It is made up of two types: Type I and Type II. Type I diabetes often referred to as juvenile diabetes, is insulin dependent and known to affect only 5% of the diabetic population. The Type II, which is non-insulin dependent, usually develops in adults over the age of 40. It has already been established that chronic hyperglycemia of diabetes is associated with long term damage, dysfunction and eventually the failure of organs, especially the eyes, kidneys, nerves, heart and blood vessels [4]. Many drugs are used conventionally for the prevention and management of diabetes such as biguanides, sulfonylureas, meglitinides, PPAR- γ agonists (glitazones), α -glucosidase inhibitors, DPP-4 inhibitors, SGLT2 inhibitors, dopamine-2 agonists etc. But still effective treatment against diabetes yet to be achieved (5). Research is going on for establishing alternative effective therapies against diabetes. The medicinal plants played an important role in this research as they always are an exemplary source of drugs. In India many herbs are found to be useful for the management of diabetes. From the ethnobotanical information it is found that approximately 800 plants may possess antidiabetic potential. (6)

II. REVIEW

1. Aloe vera (Liliaceae):

Aloe vera extract was evaluated in streptozotocin-induced diabetic mice and in mouse embryonic NIH/3T3 cells. (7) In a more recent study, Aloe vera extract (300 mg/kg) exerted antidiabetic effects by improving insulin secretion and pancreatic β -cell function by restoring pancreatic islet mass in streptozotocin-induced diabetic rats (8)

2. Acacia arabica (Leguminosae)

Two doses of chloroform extracts of Acacia arabica (250 and 500 mg/kg, p.o. (orally) for two weeks) were evaluated in alloxan-induced diabetic albino rats (9). The results of this study showed an antidiabetic effect in the two doses tested,

decreasing serum glucose level and restoring TC, TG, and high-density lipoprotein (HDL) and low-density lipoprotein (LDL) levels. Additionally, in this study chloroform extracts of *Benincasa hispida* fruit, *Tinispora cordifolia* stem, *Ocimum sanctum* aerial parts, and *Jatropha curcus* leaves were evaluated, showing similar effects.

In another study performed in streptozotocin-induced diabetic rats, the extract of *Acacia arabica* (100 and 200 mg/kg, p.o. for 21 days) provoked a significantly decrease in serum glucose, TC, TG, LDL, and malonyldialdehyde (MDA) levels and a significantly increase in HDL and coenzyme Q10 in a dose-dependent manner (10)

3. *Tamarindus indica* (Fabaceae):

In vitro assays of an alcoholic extract made from *Tamarindus indica* stem bark showed significant antioxidant activity in DPPH, nitric oxide, and hydroxyl radical (11). Alloxan-induced diabetic rats were treated orally with the alcoholic extract from *Tamarindus indica* at 250 and 500 mg/kg doses for 21 days, and a significant decrease of blood glucose levels was observed. In another study, hydroethanolic seed coat extract of *Tamarindus indica* significantly reduced blood glucose levels in normoglycaemic, glucose loaded, and alloxan-induced diabetic rats (12).

4. *Terminalia catappa* (Combretaceae) :

The antidiabetic potential of petroleum ether, methanol, and aqueous extract of *Terminalia catappa* fruits in alloxan-induced diabetic rats was performed (13). All three extracts reduced FBG levels.

5. *Mangifera indica* (Anacardiaceae)

This plant is commonly known as mango which is native to Indian subcontinent. It contains numerous chemical constituents among them polyphenolics, flavonoids and triterpenoids are specific. The main bioactive constituent is mangiferin, which is a xanthone glycoside. The other active constituents present in this plant are isomangiferin, tannins etc.⁽¹⁴⁾ It has several pharmacological uses such as antioxidant, antidiabetic, antiviral, anthelmintic, anti-allergenic, antiparasitic, anti-diarrhoeal etc. Aderibigbe AO et al reported that the aqueous extract of the leaves of the plant showed significant hypoglycemic activity in normoglycaemic and glucose-induced hyperglycaemic mice.⁽¹⁵⁾

6. *Allium sativum* (Amaryllidaceae)

This plant commonly known as garlic is native to Central Asia and northeastern Iran and widely found in India. It mainly contains essential oil which consists of sulphur compounds such as trisulfides and disulfides⁽¹⁶⁾. It is pharmacologically beneficial as an antibacterial, antifungal, antiparasitic, antiviral, antihypertensive, antithrombotic etc. A study reported by Eidi A et al states that for the future studies on diabetes mellitus the plant should be considered. Because at the doses of 0.1, 0.25 and 0.5g/kg in streptozotocin-induced diabetic rats⁽¹⁷⁾

7. *Ricinus communis* (Euphorbiaceae)

This plant is a species of perennial flowering plant and widely available in India. It contains several chemical constituents such as steroids, saponins, alkaloids, flavonoids and glycosides etc. The seeds and fruits contain 45% of fixed oil which contains glycosides of ricinoleic, isoricinoleic, stearic, dihydroxystearic acids.⁽¹⁸⁾ Pharmacologically it is used as an anticancer, antioxidant, anti-ulcer, antimicrobial, antidiabetic, hepatoprotective, central analgesic, antiasthmatic etc. Dhar ML et al reported that the root, stem and leaves of the plant showed hypoglycemic activity in the albino rats at the dose of 250 mg/kg in the initial screening studies.⁽¹⁹⁾ Poonam Shokeen et al reported that the ethanolic extract of the roots of the plant showed potent blood glucose lowering activity in alloxan induced diabetic rats at a dose of 500 mg/kg.⁽²⁰⁾

8. *Pterocarpus santalinus* (Fabaceae)

The plant is commonly known as red sandalwood and Saunderswood is widely found in South India. It contains several chemical constituents, such as carbohydrates, steroids, anthocyanins, saponins, tannins, phenols, triterpenoids, flavonoids, glycosides.⁽²¹⁾ The main active constituent of the plant is santalin. It also contains pterocarpol, pterocarptriol, ispterocarpolone, pterocarpo-diolones with β -eudesmol and cryptomeridol.⁽²²⁾ It is used as antidiabetic, anthelmintic, aphrodisiac and astringent tonic. It is also used in the treatment of inflammation and ulcer. Several studies are reported which show about the antidiabetic property of the plant. The heartwood cups for drinking water is the traditional use of the plant in the treatment of diabetes.⁽²³⁻²⁴⁾ Rao et al reported that the hypoglycemic activity at a dose level of 0.25 g/kg body weight/day was shown by the ethanolic fraction of the plant⁽¹⁸⁾. Halim and Mishra found that when the 250 mg/kg of aqueous extract of the plant is coadministered with vitamin E to the streptozotocin induced diabetic rats then it caused significant lowering of blood pressure.⁽²⁵⁾

9. *Murraya koenigii* (Rutaceae)

This plant is commonly known as curry patta is widely available In India. The major chemical constituents present in this plant are A-pinene (51.7%), sabinene (10.5%), β -pinene (9.8%), β -Caryophyllene (5.5%), limonene (5.4%), bornyl acetate (1.8%), Terpinen-4-ol (1.3%), γ -terpinene (1.2%) and α -humulene (1.2%)⁽²⁶⁾. It has several therapeutic activities such as antibacterial, Antifungal, antiprotozoal etc. Arulselvan P et al found that the Plant extract is more effective than glibenclamide in the treatment Of diabetes because ethanolic extract of this plant possesses potent Hypoglycaemic activity in streptozotocin induced diabetic rats.⁽²⁷⁾ A study reported by S.Vijayanand states that leaf extracts of the Plant showed significant hypoglycaemic effect in alloxan induced Diabetic albino rats at the doses of 250 and 500 mg/kg.⁽²⁸⁾

10. *Helicteres isora* (Malvaceae)

This plant is widely distributed throughout the India. It contains Important pharmaceutically active chemical constituents such asAntioxidants, proteins, phenols, flavonoids, alkaloids, glycosides, Carotenoids, tannins etc.⁽²⁹⁻³⁰⁾ It is used therapeutically as an Expectorant, antidiarrhoeal, antidiabetic, antispasmodic, Haemostatic etc. Chakrabarti R et al reported that the ethanolic Extract of the plant has the potentiality for the treatment of type-II diabetes as it showed significant antidiabetic effect in diabetic C57BL/KsJdb/db mice at the dose of 300 mg/kg.⁽³¹⁾

11. *Swertia punicea* (Gentianaceae)

The plant is commonly available in India, Pakistan, China, Japan And other Asian countries. It contains important group of Constituents such as xanthonoids, terpenoids, flavonoids, Alkaloids, irridoid glycosides etc. Among them xanthonoids are The most abundant class of compounds.⁽³²⁾ It is therapeutically used As a hypoglycemic, antihepatotoxic, anti-inflammatory, anti-Malarial, antioxidant, antimicrobial etc. There are numerous Studies are reported about the antidiabetic property of the herb. A Study which is reported by Pen and Fang clearly states that this Plant has a potent hypoglycemic effect.⁽³³⁾ Wen L., Chen J.C Reported that the hypoglycemic effect was showed by the ethanol Extract and ethyl acetate soluble fractions of the plant in Streptozotocin induced type-II diabetic mice.⁽³⁴⁾ A study reported By L.Y. Tian et alstates that the significant antidiabetic effect was Showed by the xanthone derivatives Methylswertianin and Bellidifolin isolated from the plant at the dose of 200mg/kg body Wt. /day in the Streptozotocin (STZ)-induced type 2 diabetic male BABL/c mice.⁽³⁵⁾

12. *Nigella sativa* (Ranunculaceae)

This plant is also known as black cumin and native to the south And southwest Asia. It contains several chemical constituents Such as fixed oil, proteins, alkaloid, saponin, essential oil. The Fixed oil contains unsaturated fatty acids such as arachidonic acid, Linoleic acid, linolenic acid etc., volatile oil contains saturated Fatty acids such as nigellone. The alkaloids are present in thisPlant are nigellicimine, nigellidine etc.⁽³⁶⁾The main active Constituent is thymoquinone. It is pharmacologically used as Antibacterial, antifungal, antioxidant, antidiabetic, anticancer, Immunomodulatory, hepatoprotective etc. Pari L et al reported That thymoquinone, the main active constituent of the plant Showed significant antidiabetic activity at a dose of 80 mg/kg in Streptozotocin-nicotinamide induced diabetic rats.⁽³⁷⁾ Najmi A et Al reported that the N.sativa oil showed significant antidiabetic Effect in a group of 30 patients. This clinical study was conducted At a tertiary health care center in North India.⁽³⁸⁾

13. *Agrimonia eupatoria* (Rosaceae)

This plant is commonly known as agrimony is available Throughout the Europe. It contains many important Pharmaceutically active constituents such as terpenes, phenolic Compounds, tannins, flavonoids, proteins, carbohydrates and Vitamins.⁽³⁹⁾It is therapeutically used as an antiviral, antibacterial, Antitumour, analgesic, immunomodulatory, antioxidant, Hepatoprotective etc. Gray AM et al reported that the aqueous Extract of the plant showed significant antihyperglycaemic effect In streptozotocin induced diabetic mice at the doses of 1 mg/ml And 0.25-1 mg/ml.⁽⁴⁰⁾

14. *Liriope spicata* (Asparagaceae)

It is an herbaceous flowering plant which is native to East Asia. It contains numerous phytochemical constituents such as steroidal Saponins, polysaccharides etc.⁽⁴¹⁾ Pharmacologically it is used as an anti-inflammatory, anti-asthmatic, anticancer etc. Xianghong Chen et al reported that the aqueous extract of the plant showed significant hypoglycemic effect in streptozotocin (STZ)-induced type 2 diabetic male BABL/c mice at the doses of 200 and 100 mg/kg.⁽⁴²⁾

15. *Brassica juncea* (Brassicaceae)

This plant is commonly known as brown mustard, Chinese mustard is widely found in Europe, Africa, North America and Asia. It contains several important chemical constituents such as triterpenes, Saponins, alkaloids, flavonoids etc.(43) It is pharmacologically used as antiscorbutic, diuretic, stimulant, stomachic, antihelminthic, antidyseric, diaphoretic, antiarthritic. Thirumalai T et al reported that the aqueous seed extract of the plant showed potent hypoglycemic activity at a dose level of 250, 350 and 450 mg/kg in streptozotocin induced diabetic male albino rat.(44)

16. *Combretum micranthum* (Combretaceae)

This plant is commonly found in Northwestern Nigeria, Senegal, Mali and Gambia. It contains several classes of compounds such as alkaloids, flavonoids, tannins, terpenoids etc.(45)It has several pharmacological uses such as antioxidant, anti-inflammatory, antimicrobial etc. Aminu Chika et al reported about the potential antidiabetic property of the aqueous leaf extract of the plant at a dose level of 100mg/kg in diabetic and sub-diabetic rats.(46)

III. CONCLUSION

The present review has presented comprehensive details of Antidiabetic plants used in the treatment of diabetes mellitus. Current research of the Antidiabetic activity of the herbs helps to develop effective herbal Therapies for such purpose. For the discovery of new potential Antidiabetic compounds suitable information about medicinal Plants are needed. This article is prepared for providing proper Information regarding the medicinal plants having antidiabetic Property.

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