

A review on medicinal plants for the management of diabetes mellitus

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Abstract

Diabetes is a metabolic disorder in which there are high levels of sugar in the blood, a condition called hyperglycemia. Under normal conditions, food is broken down to glucose which then enters the bloodstream and acts as fuel for the body. The pancreas produces a hormone called insulin which helps to carry glucose from the bloodstream into muscle, fat and liver where it can be used as fuel. Diabetics are not able to move this sugar out of the bloodstream because of two primary reasons as their pancreas does not produce enough insulin and/or their cells do not respond normally to insulin, a condition called insulin resistance. This is why people with diabetes have high blood sugar levels. Diabetes mellitus can induce life-threatening health problems such as blindness, heart disease, kidney damage, and stroke. Although the cure of DM has improved over the past decades, its morbidity and mortality rates remain high. Hence, new therapeutic strategies are needed to overcome the burden of this disease. One such prevention and treatment strategy that is easily accessible to diabetic patients at low cost is the use of medicinal plants. The research objective of this review article is to study DM and explore its treatment modalities based on medicinal plants. Results of numerous scientific investigations revealed that chemical constituents present in some medicinal plants possess anti-hypoglycemic activities and show promise for the prevention and/or control of DM.

Keywords: Diabetes Mellitus; Insulin; HBA1C; DM

1. Introduction

Diabetes mellitus is a chronic endocrine disorder, characterized by hyperglycemia resulting from absolute or relative insulin deficiency. There are a number of different causes of diabetes but by far the majority of cases are classified as either type 1 or type 2 diabetes. The pathophysiology of type 1 diabetes derives from the autoimmune destruction of insulin-secreting pancreatic β -cells, resulting in insulin deficiency and subsequent hyperglycemia. Type 1 diabetes accounts for about 10-15% of all diabetics. Type 2 diabetes is characterized by abnormal insulin secretion due to peripheral resistance and accounts for 85-90% of all persons with diabetes. While type 1 diabetes usually manifests itself in childhood or adolescence and type 2 diabetes at a later stage, clinical manifestation and progression vary considerably and some patients might not be clearly classified as having either type 1 or 2 initially. Type 1 diabetes may occur at any age and with late onset usually shows slower progression, and type 2 manifests itself more and more often earlier in life, even in childhood and adolescence, sometimes allowing for accurate diagnosis only over time. [1] The treatment strategies for DM have improved over the last few decades. However, Medicinal plants are used by the mankind since its origin on the earth for the maintenance of general health. Since ancient times medicinal plants remains major natural resources in the world. Many tribes provided the knowledge base regarding medicinal properties of the medicinal plants and these medicinal plants have a great demand in a both developed and developing countries. World health organisation estimated that 80% World population relies on traditional medicines to meet their primary health care needs. Most types of which used remedies from plants. Even the modern pharmacopoeia Still consist at least 25% of drug derived from medicinal plants and many others which are semi synthetic built on prototype compounds isolated

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from plants. This is studies size that over 9000 herbs have non medicinal application among various cultures and countries. In India traditional medicinal plants have been used in the various treatments of diseases save the time of charka and shusrutha. India has a special position in the area of herbal medicines[2]. The World countries use medicinal plants for the treatment of metabolic diseases such as DM. Therefore, medicinal plants with anti-hypoglycemic properties remain essential for the management of diabetes. Scientific showed that medicinal plants have been successfully used to lower the blood sugar level in the shape of pre-clinical and clinical studies. For example a study showed that garlic provides a protective effect against diabetic retinopathy in adult albino rats. A number of phytochemicals that have anti-diabetic properties present in medicinal plants have been discovered based on differences in chemical structure and have been classified as major groups. The major groups of phytochemicals are alkaloids, aromatic acids, carotenoids, coumarins, essential oils, flavonoids, glycosides, organic acid, phenols and phenolics, phytosterols, protease inhibitors, saponins, steroids, tannins, terpenes, and terpenoids. Recent pharmacological studies have revealed the anti-diabetic properties of medicinal plants anti-hyperglycemic, anti-lipidemic, hypoglycemic, and insulin mimicking. However, anti-diabetic drugs have serious effects such as hypoglycemic coma and liver and kidney disorders. The World Health Organization (WHO) recommends the use of medicinal plants in food items for the treatment of DM [3].

2. Medicinal Plants and Their Anti-Diabetic Properties.

2.1. *Allium sativum*

Allium sativum is the scientific name for garlic, which is a plant species in the family of Amaryllidaceae. Garlic is known to have various health benefits such as lowering cholesterol, improving blood pressure, and boosting the immune system. Garlic has also been shown to have potential benefits for individuals with diabetes. Research has suggested that garlic may help lower blood sugar levels and improve insulin sensitivity, which can be beneficial for diabetes. The major phytochemicals present in garlic include allicin, which is one of the most well-known phytochemicals in garlic and is responsible for its pungent odor; sulfur compounds, including diallyl disulfide and diallyl trisulfide, which have antioxidant, anti-inflammatory, anti-diabetes, and anti-cancer properties flavonoids, including quercetin and kaempferol, which are known for their antioxidant properties; saponins, which are natural detergents that have cholesterol-lowering properties; and fructans, which are a type of carbohydrates that can act as prebiotic candidates. The beneficial health effects of garlic include its anti-inflammatory, immunomodulatory, cardioprotective, hypolipidemic, hypoglycemic, antioxidant, antibiotic, antifungal, antimicrobial, antiseptic, anticancer, and antiviral activities. It has been demonstrated clinically that garlic supplementation with standard anti-diabetic drugs provides diabetic control in type 2 diabetes. In addition, clinical trials have demonstrated that garlic and garlic derivatives reduce insulin resistance effectively. Furthermore, garlic component acts as hydrogen sulfur donors that control type 2 diabetes. Another study has demonstrated garlic reduces lipid profile and glucose parameters such as fasting glucose levels and hemoglobin A1c (HbA1C) in diabetic patients [3].

2.2. *Pterocarpussantalinus* (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. The main active constituent of the plant is santalin. It also contains pterocarpol, pterocarptriol, ispterocarpolone, pterocarpo-diolones with β -eudesol and cryptomeridol. It is used as antidiabetic, antihelminthic, aphrodisiac and astringent tonic. It is also used in the treatment of inflammation and ulcer. Several studies are reported which shows about the antidiabetic property of the plant. The heartwood cups for drinking water are the traditional use of the plant in the treatment of diabetes. [4]

2.3. *Achyranthes aspera*

Achyranthes aspera is an Amaranthaceae-family plant commonly known as Devil's horsewhip. The plant's root is known to be used as a cure for jaundice. The plant contains phytochemicals such as alkaloids, oleanolic acid, β -sitosterol, saponins, D-glucuronic acid, quercetin-3-O- β -D-galactosidedihydroxy ketones, aliphatic alcohol, benzoquinone, hydroquinone, asarone, eugenol, etc. It is reported to have hepatoprotective, laxative, antiasthmatic and anti-allergic properties. In a study conducted by Vijayaraj et al.[6], the administration of 300 mg/kg and 600 mg/kg body weight of the ethanolic seed extract of *A. aspera* in STZ-induced diabetic rats for 28 days significantly reduced blood glucose levels ($p < 0.001$) compared to the standard drug, glibenclamide (5 mg/kg body weight) . Furthermore, *A. aspera* may have antidiabetic effects by either reducing glucose absorption from the gut or increasing glucose transport from the blood . Sadashiv and Krishna [7] investigated the acute toxicity of leaf powder and a methanolic extract from the leaves of *A. aspera* in Swiss albino mice according to OECD guidelines. The powder was administered to the rats in doses of 2, 4, 6 and 8 gm/kg body weight and the extract was administered in doses of 2, 4, 6 and 8 mg/kg body weight. The rats were

observed for signs of toxicity or mortality for the first 24 h and the next 14 days. No signs of toxicity or mortality were observed, which confirmed that the leaf powder and methanolic extract were safe. [5]

2.4. *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. It is pharmacologically used as antiscorbutic, diuretic, stimulant, stomachic, antihelminthic, antidysentric, 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 [4].

2.5. *Syzygiumcumini*

Jamun's pharmacological activities in the Unani system of medicine include astringent, hemostatic, urinary incontinence, antidiabetic, sexual tonic, and many others. Various portions of the Jamun have been claimed to have antidiabetic, antioxidant, hypolipidemic, ulcer onset prevention, nitric oxide scavenging, free radical scavenging, or radioprotective properties. The medication has been demonstrated to have antidiabetic action both in vivo as well as in vitro It has astringent, carminative, stomachic, diuretic, antidiabetic, anti-diarrheal, anti-inflammatory, radioprotective, gastroprotective, antioxidant, anti-allergic, anticancer, antibacterial, and cardioprotective effects, among other things. The numerous chemical ingredients present in seeds create glycosides, a trace of pale yellow essential oil, fat, resin, albumin, chlorophyll, an alkaloid-jambosine, gallic acid, 1-galloylglucose, 3-galloylglucose, quercetin, and metals such as zinc, chromium, vanadium, potassium, and sodium. Diabetic individuals can gain benefits from its fruit and leaves. The fruit aids in the conversion of carbohydrates to energy and regulates blood sugar levels. Because of its low glycemic index, diabetic patients should consume Jamun during the summer. It alleviates diabetic symptoms such as excessive urination or pushing. The extracts of the leaves, seeds, and bark are very successful in treating diabetes. Intermediate hyperglycemia (prediabetes) is a metabolic disease in which blood glucose levels rise slightly beyond normal but do not rise to the threshold of diabetes. It has been linked to a variety of micro- and macro-vascular problems. There are many Unani medications with antihyperlipidemic properties, and one of them is Jamun. It is a suitable source of iron and ascorbic acid, and it can even help with heart and liver problems. The dried and powdered seed of the Jamun is frequently used in India to manage diabetes. For years, Jamun seed powder has been used as a natural way to maintain a healthy blood sugar level, as well as treat cardiovascular and gastrointestinal problems. Jamun is among the most perishable small fruits, yet it is also the most nutritious. It is mostly employed in the pharmaceutical industry, especially by diabetic patients. It contains many anthocyanins, which have anti-analgesic qualities. [8]

2.6. *Momordicacharantia*

Momordicacharantia, locally known as Korola or bitter gourd, is a member of the Cucurbitaceae family. It is a climber, with its flowering time spanning from January to December. The juice made from the plant's leaves is used to treat chickenpox and rheumatism, while the unripe fruit is used to treat diabetes. The plant contains biologically active phytoconstituents, such as saponins, alkaloids, triterpenes, proteins and steroids. In addition, it contains several phytochemicals, such as diosgenin (a compound that alleviates hypoglycemia), momorcharins, momordenol, momordicin, charantin, charine, cucurbitin, gentisic acid, etc. Since the hypoglycemic chemicals in the plant are concentrated in its fruits, these fruits have significant hypoglycemic properties. [9]

2.7. *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. [10]

2.8. *Axonopuscompressus*

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 *Axonopuscompressus* (*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. [10]

3. Discussion

From many years as ancient times medicinal plants are used for the treatment of many diseases like as diabetes mellitus. These medicinal plants are widely used in the treatment because they are considered as more safe and more effective without any side effects. By utilizing pharmacological knowledge we came to know about the medicinal plants which have potent antidiabetic activity. This review article described some of the medicinal plants which are commonly used for the treatment of diabetes. The parts of the plant such as leaf, root and the specific extract are more effective are also described here. It is also seen that several researches are also carried out for the desire of establishing an effective treatment against diabetes in India as well as abroad also.

4. Conclusion

In India from ancient times many medicinal plants are used traditionally in many forms in the treatment of diabetes like metabolic disorders. Current scenario of research for the antihyperglycemic or antidibetic activity of the medicinal plants helps to develop effective herbal therapies for such purpose. For the discovery of new antidiabetic molecules, suitable information about medicinal plants are needed. This article is prepared for providing proper information regarding the medicinal plants having antidiabetic property. The informations which are discussed here regarding the medicinal plants might be helpful for further research on diabetes.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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