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Plant Used in the Management of Diabetes

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Abstract

This review focuses on herbal medicines and plants that are utilized, to treat diabetes. Diabetes is a serious illness that affects many people worldwide from all areas of life. It is proven to be a serious health issue in India, particularly in the urban area. Although there are several ways to lessen diabetes' negative effects and its subsequent complications, herbal formulations are favored since they have less side effects and are less expensive. A list of medicinal plants having established antidiabetic properties, as well as herbal medications used to treat diabetes, is compiled. These include *Acacia Arabic, Aegle marmelose, Allium cepa, Allium sativum, Biophytum sensitivum, Hibiscus rosa sinensis, Momordica charantia, Murraya koenigii, Ficus bengalenesis, and Eucalyptus globulus*. Environmental factors, obesity, Stress, smoking, alcohol, and Genetic are etiologic factors that contribute to the development of diabetes and its consequences.

Keywords: Medicinal plant; Diabetes; Anti-diabetic

Introduction

According to the International Diabetes Federation (IDF), 387 million people worldwide were diagnosed with diabetes in 2014, with that figure expected to rise to 592 million by 2035 [1]. Diabetes mellitus is likely one of society's earliest diseases. It was first written over 3000 years ago in an Egyptian text [2]. Diabetes mellitus is a group of metabolic diseases characterized by chronic hyperglycemias resulting from defects in insulin secretion, insulin action, or both [3]. It is divided into several categories, the most frequent of which being type 1 and type 2 DM [4]. The distinction between type 1 and type 2 diabetes mellitus was determined in 1936 [2]. Type 1 diabetes (T1DM) is characterised by an inability to produce insulin as a result of beta cell damage caused by autoimmunity. Type 2 diabetes, on the other hand, is marked by insulin resistance and a decrease in insulin production. The causes of T1DM are environment, viruses [5], genetic [6] and T2DM are obesity [7], stress [8], life style factors includes diet, smoking and alcohol consumption [9] Environmental factors include air pollution, which is a potential mechanism for causing T1DM in susceptible persons through the creation of free radicals. Ozone, for example, produces free oxygen radicals. Because free radicals are known to have a role in beta cell destruction in vitro, a big study of an antioxidant (nicotinamide) to prevent T1DM was conducted in Europe. Through free radicals produced by air pollution, ozone may cause beta cell damage. In the event of a virus Several microorganisms have been suggested as T1DM triggers. Pathogens can cause T1DM by infecting pancreatic beta cells and producing direct cytoxicity or by generating an autoimmune reaction against beta cells, according to theory [5]. The genetic factors are known as 'susceptibility genes,' since they influence the risk of diabetes, but they are not essential nor sufficient for the illness to develop [6]. Insulin resistance has been linked to obesity and physical inactivity, and many mechanisms that mediate this relationship have been discovered. Adipocytes produce a variety of circulating hormones, cytokines, and metabolic fuels, including non-esterified (free) fatty acids (NEFA), which affect insulin activity. Increased triglyceride storage, particularly in visceral or deep subcutaneous adipose depots, results in big adipocytes that are resistant to insulin's capacity to regulate lipolysis. This results in increased release and circulating levels of NEFA and glycerol, both of which aggravate insulin resistance in skeletal muscle and liver [10]. Stress may play a role in diabetes-related persistent hyperglycemia. Stress has been demonstrated to have a significant impact on metabolic activity for a long time. The fight or flight reaction causes an increase in energy mobilisation. Stress causes the release of a variety of hormones, which can lead to an increase in blood sugar levels [11]. The Nurses' Health Study (NHS) found that diet quality is crucial in the development of diabetes, regardless of BMI or a number of other risk factors. Higher dietary glycemic load and trans-fat intake, in particular, are linked to an increased risk of diabetes, but higher consumption of cereal fibre and polyunsaturated fat is linked to T2DM. Smokers tend to be thinner than non-smokers or former smokers, but smokers tend to gain weight when they quit smoking, and heavier smokers tend to gain more weight than light smokers. Smokers have a higher risk of abdominal obesity than non-smokers, even if their BMI is normal. This is because smoking has an anti-estrogenic effect, which can disrupt hormonal balance and lead to abdominal obesity. Obesity in general and abdominal obesity are both linked to the development of T2DM [9]. Both alcoholism and diabetes impact a huge population worldwide, and DM is recognised clinically as a consequence of drinking. Chronic, heavy alcohol drinking, which is an independent risk factor for T2DM, disturbs glucose homeostasis and is linked to insulin resistance development [12]. The most common diabetes symptoms are Frequent urination, Disproportionate thirst, Intense hunger, Weight gain, Unusual weight loss, Increased fatigue, Irritability, Blurred vision, Cuts and bruises don't heal properly or quickly, Numbness or tingling, especially in your feet and hands [13].

The use of herbal medicinal products and supplements has increased tremendously over the past three decades with not less than 80% of people worldwide relying on them for some part of primary healthcare. Although therapies involving these agents have shown promising potential with the efficacy of a good number of herbal products clearly established, many of them remain untested

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and their use are either poorly monitored or not even monitored at all [14]. Up to 90% of the population in poor nations uses plants and their products as traditional medicine for basic health care, according to the World Health Organization (WHO) [15]. The World Health Organization (WHO) has compiled a list of 21,000 medicinal plants used around the world. India has 2500 species, with 150 of them being used economically on a considerable basis. India is the world's largest producer of medicinal herbs and is known as the world's botanical gardens [16]. According to ethnobotanical data, about 800 plants may have anti-diabetic properties [17]. Herbal drugs are proved to be a better choice over synthetic drugs because of less side effects and adverse effects. Herbal formulations are widely available and can be obtained without a prescription. These herbal medications are used to treat life-threatening illnesses. Herbal formulations are made up of natural herbs, fruits, and vegetable extracts that are effective in the treatment of a variety of disorders while causing no side effects [18].

Plants with Anti-Diabetic Potential

Momordica charantia

Momordica charantia, commonly known as bitter melon, karela, balsam pear, or bitter ground, is a well-known plant that is used to cure diabetes. The seed, fruit pulp, leaves, and complete plant of *momordica charantia* have been proven in several animal tests to have a hypoglycemic impact in normal animals. In rats, *M. charantia* extract enhances insulin sensitivity and suppresses postprandial hyperglycemia, and *M. charantia* improves glucose tolerance and suppresses postprandial hyperglycemia. Some investigations indicated that *M. charantia's* hypoglycaemic impact was comparable to those of oral drugs such tolbutamide, chlorpropamide, and glibenclamide. The stimulation of the AMP-activated protein kinase pathway has been a recurring topic in the biochemical evidence for *M. charantia's* anti-diabetic actions.

Brassica juncea

Brassica juncea L. is a traditional medicinal plant from the Cruciferae family. Diabetes was induced in male albino rats by intraperitoneal injection of streptozotocin, which counteracted the antidiabetic activity of the aqueous seed extract. Normal rats developed diabetes 48 hours after receiving STZ injections. When compared to normal (Placebo) rats, the STZ injected rats' blood glucose levels were much higher (+343%), indicating that they were diabetic (Control). At I hr, II hr, and IV hr of time intervals, diabetic mice fed *B. juncea* seed extract had significantly reduced blood glucose levels of 291, 185, and 103 mg/dL, respectively.

Eucalyptus globulus

Eucalyptus globulus Labill belonging to family Myrtaceae, known locally as Kalitous, is an indigenous tree of Tasmania and cultivated in Morocco. In nations such as South America, Africa, India, and China, the plant's leaves, blossoms, and gum are commonly utilised as hypoglycemic agents. The largest dose of Eucalyptus globulus extract (300 mg/kg) resulted in the most significant reduction in blood glucose levels. After nine days of treatment, blood sugar levels in diabetic rats treated with *Eucalyptus globulus* leaf extract at 150 and 300 mg/kg were normalised.

Gymnema Sylvestre

Gymnema Sylvestre is an useful herb that is extensively distributed in India, Malaysia, Sri Lanka, Australia, Indonesia, Japan, Vietnam, and tropical Africa, and belongs to the Asclepiadaceae family. The plant is commonly known as Periploca of the woods (English); Gurmar (Hindi); Meshashringi, madhunashini (Sanskrit); Kavali, kalikardori (Marathi); Dhuleti, mardashingi (Gujrathi); Adigam, cherukurinja (Tamil); Podapatri (Telgu) and Sannagerasehambu (Kannada). Gymnema is derived from the Hindu term "Gurmar," which means "sugar killer," and it is said to neutralise the excess sugar present in the body in Diabetes mellitus. G. Sylvester leaves have been shown to cause hypoglycemia in laboratory animals and to be useful in the treatment of diabetes mellitus in adults in herbal therapy. Some of the ways by which G.*Sylvester's* leaves extract or (Gymnemic acid) exerts its hypoglycemic acid effects include: 1) It promotes islet cell regeneration, 2) It increases insulin secretion, 3) It inhibits glucose absorption from the intestine, and 4) It increases glucose utilisation by increasing the activities of enzymes involved in glucose utilisation by insulin-dependent pathways, such as phosphorylase activity, gluconeogenic enzymes, and sorbitol dehydrogenase.

Ocimum sanctum

Tulsi (*Ocimum sanctum Linn*), usually known as Holy Basil, is a herbaceous plant native to the Indian subcontinent. Ayurveda and siddha medicine use different parts of plants to prevent and heal a variety of ailments. *Ocimum sanctum* extract promotes insulin production by increasing intracellular calcium in beta islet cells of the pancreas.

Lantana camara

Lantana camara belongs to the Verbenaceae family. Unnicceti (Tamil), pulikampa (Telugu), and caturang (Hindi) are common names for this weed that can be found all over India. In alloxan-induced diabetic rats, oral treatment of the methanol extract of Lantana camara leaves (200 and 400 mg/kg body weight) leaves resulted in a considerable reduction in blood glucose concentration in a dose-dependent manner.

Musa sapientum

Musa sapientum syn , Musa paradisiacal Linn. (kela in Hindi, banana in English) is a herbaceous plant of the Musaceae family. he flowers, unripe fruits, and fruit peel of the *Musa sapientum* plant have all been studied for their anti-diabetic properties. β-Sitosterols, leucocyanidin, sryngin, quercetin, sterylglycosides, aminoacids, and other compounds have been found in Musa sapientum. In experimental animals, β-sitosterols and the dimethoxy derivative of leucocyanidin, leucocyanidin 3-O-beta-D-galactosyl cellobioside, showed hypoglycemic effects. In alloxan-diabetic rats, terpenoids extracted from the fruit pulp of Musa *sapientum Linn*. Were found to exhibit significant hypoglycemic effects.

Vinca rosea

The herbaceous subshrub *Vinca rosea* (C. roseus) Linn. (Apocynaceae) is also known as Madagascar periwinkle, *Vinca rosea*, or *Lchnera rosea*. Leaf extracts (hydroalcoholic or dichloromethane-methanol) have been shown to have anti hyperglycemic action in laboratory animals. *C. roseus* leaf juice has been shown to lower blood glucose levels in both normal and alloxan diabetic rabbits. *Catharanthus roseus* leaves and twigs were found to have hypoglycaemic action in streptozotocin-induced diabetic rat.

Salacia oblonga

Salacia reticulata Wight (Hypocrataceae) is a woody climbing shrub with greenish-brown bark native to India and Sri Lanka, with other species such as *S. chinensis* and *S. oblonga* distributed across Asia

and the world. For 16 weeks, streptozotocin-diabetic Wistar rats were given a hydroalcoholic extract of *S. oblonga* at doses of 50 and 100 mg/kg. Both doses dramatically reduced random blood glucose levels (by about 45 percent) and HbA1c levels while raising serum insulin levels. Blood glucose levels in streptozotocin (STZ)-induced diabetic rats were considerably lower after oral administration of *S.oblonga* root extract, according to a rat study.

Swertia chirayita

Swertia chirayita, also known as "chirayata" or "chirayit," is a species of *Swertia*. *Swertia chirayita* is a well-known plant that is most known for its anti-hyperglycemic properties. The Gentianaceae family includes the genus *Swertia*. Because the plant extract contains natural chemicals such as flavonoids and secoiridoids, it is particularly efficient in preventing hyperglycemic problems. Insulin secretion from monolayers of BRIN-BD11 clonal pancreatic cells was studied in the presence of an aquatic bark extract of *Swertia chirayita* to see if it has antidiabetic characteristics. In the presence of the extract, such cell lines showed stimulated concentration-dependent insulin production and improved insulin action. . Inhibition of protein glycation may also help to prevent diabetic complications, according to their findings. Swerchirin, the most powerful xanthone derived from the same plant extract, has remarkable blood sugar reducing activity, which has been proven in experiments using various experimental models.

Tinospora cordifolia

Tinospora cordifolia (Guduchi) is a big, deciduous climbing shrub in the Menispermaceae family with a glabrous appearance. Giloe is the Hindi name for the plant, and it is frequently used in Ayurveda to cure diabetes mellitus. Various studies show improved diabetic neuropathy and gastropathy in rats, reduced blood sugar in alloxan-induced hyperglycemic rats and rabbits, significant reduction in blood glucose and brain lipids, increased glucose tolerance in rodents, increased glucose metabolism, inhibitory effect of pyrrolidine derivative on adrenaline-induced hyperglycemia, and significant hypoglycemic effect in normal and alloxan diabetic rabbits following a pyrrolidine derivative, and significant hypoglycaemic. Aqueous stem extract from another species of *'Tinospora crispa'* was similarly found to have antihyperglycemic properties, most likely due to insulin release stimulation via modification of -cell and Ca2+ concentration.

Punica granatum

Punica granatum belonging to family Punicaceae. Diabetic rats given 0.43 g/kg B.W. of aqueous peel extract for four weeks had significantly reduced blood sugar levels and a higher number of cells, which helped to intensify insulin levels. The extract's anti-diabetic effect is mediated via cell stimulation, regeneration, and increased number, as well as protection of pancreatic tissue and subsequent insulin release. It may also boost insulin receptor stimulation and activity. In alloxan-induced diabetic wistar rats, the methanolic extract of punica peel (75 and 150 mg/kg, daily) lowers glucose levels.

Mucuna pruriens

M. pruriens, also known as "velvet bean," is a plant in the Fabaceae family. The effect of the crude ethanolic seed extract of *M. pruriens* on the blood glucose level in alloxan-induced diabetic rats was shown to be that the administration of 5, 10, 20, 30, 40, 50, and 100 mg/kg of the crude ethanolic extract of *M. pruriens* seed resulted in 18.6 percent, 24.9 percent, 30.8 percent, 41.4 percent, 49.7%, 53.1 percent, and 55.4 percent reduction in blood glucose of the diabetic rats after 8 hours.

Pterocarpus marsupium

Pterocarpus marsupium Roxb is a member of the Leguminosae family. Aqueous extract of *P. marsupium* heart-wood is used in the treatment of diabetes in Ayurveda. Although there are several reports on *P. marsupium* as an anti-diabetic drug, there is no focus on the relevance of its rasayana property and anti-diabetic activity. In albino mice, *P. marsupium* was found to be non-toxic up to 8 g/kg. In rats, the drug's effective dose ranged from 100 to 250 mg/kg. In type 2 diabetic rats, aqueous extract of *P. marsupium* at both dosages, 100 mg/kg and 200 mg/kg, significantly (P 0.001) reduced fasting blood glucose.

Morus alba

Morus alba, commonly known as mulberry, is a member of the Moraceae family. In STZ-induced rats, an ethanol extract of mulberry leaf is beneficial in curing diabetes. The acetone extract is also effective, but not as effectively as the ethanolic. These studies show that the mulberry extraction procedure is important for diabetes prevention, and that each extract has varied hypoglycemic effects. In diabetic mice induced with streptozotocin (STZ), total alkaloids from mulberry leaf exhibit hypoglycemic effects. In Kunming mice, flavonoids from mulberry leaves exhibit inhibitory effects on a-glucosidase activity in vitro and can lower blood glucose levels after oral administration of starch and sucrose. Mulberry leaf polysaccharides have been demonstrated to lower blood glucose levels, enhance glucose tolerance, and increase hepatic glycogen content in diabetic mice and normal rats, thereby regulating glucose metabolism and increasing insulin production.

Conclusion

Diabetes is treated using herbal medicines all over the world. Different forms of diabetes and associated consequences are managed by using herbs. The abovementioned plants have been taken into consideration for their potential hypoglycemic effects, and the researchers have conducted some initial research. The effectiveness of the botanicals in lowering the sugar level has been scientifically verified for various Indian plant species, and this finding suggests that they may have therapeutic potential. As a result, numerous plants have been utilised individually or in diabetes therapy formulations.

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