



“AN EVALUATION ON MEDICINAL PLANT FOR MANAGEMENT OF DIABETES.”

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Abstract :

The aim of this study is to evaluate various medicinal plants for their antidiabetic properties. Diabetes mellitus is one of the most prevalent non-communicable diseases worldwide and is the fourth leading cause of death in many developed nations. It has reached epidemic proportions in several developing and newly industrialized countries, posing a significant threat in the 21st century. Plants have long been a vital source of medicine, with Ayurveda and other ancient Indian texts highlighting their use for treating various health conditions. Of the estimated 250,000 higher plants, less than 1% have undergone pharmacological screening, with only a few studied for their effects on diabetes. Natural products, including those from plants, animals, and microorganisms, have demonstrated health benefits for both animals and humans. According to the World Health Organization (WHO), 80% of the population in developing countries still relies on traditional or folk medicines, primarily derived from plants, for disease prevention and treatment. Traditional plant-based medicines are often more affordable, clinically effective, and associated with fewer side effects compared to modern pharmaceuticals.

IndexTerms – Antidiabetic, diabetes , microorganism, ayurveda

INTRODUCTION

Diabetes Mellitus, a prevalent endocrine disorder, is one of the major global health concerns today (Rohilla and Ali, 2012). It is a condition characterized by the impaired metabolism of carbohydrates, proteins, and fats, resulting from a complete or relative deficiency in insulin secretion and/or its action (Ivorra et al., 1989). The number of individuals affected by this disease is rising rapidly, with the WHO estimating that over 180 million people worldwide currently have diabetes, and this number is expected to double by 2030 (Wild et al., 2004). The increasing prevalence of diabetes is closely linked to urbanization, lifestyle changes, and notably, the adoption of a Western-style diet. The highest rise in cases is anticipated in Asia and Africa, where the majority of diabetes patients will likely be located by 2030. Diabetes occurs when blood sugar (glucose) levels are too high, either because the pancreas produces insufficient or no insulin, or the body does not respond effectively to insulin. Diabetes affects individuals of all ages, and while most forms are chronic, they can be managed through medication and/or lifestyle modifications.

Types Of Diabetics

A) On the basis of blood Sugar Levels

- 1) Hyperglycemia
- 2) Hypoglycemia

1)Hyperglycemia:-

When the pancreas fails to produce enough insulin or the body does not use it effectively, glucose accumulates in the bloodstream, leading to high blood sugar levels (hyperglycemia). Persistently elevated blood glucose levels can result in serious health complications, such as heart disease, nerve damage, and eye problems. Hyperglycemia typically does not cause noticeable symptoms until blood sugar levels rise above 180 to 200 milligrams per deciliter (mg/dL), or 10-11.1 millimoles per liter.

Symptoms of hyperglycemia include:-

1. increased thirst and a dry mouth, needing to pee frequently, tiredness.
2. blurred vision, unintentional weight loss.
3. recurrent infections, such as thrush.

2) Hypoglycemia:-

Hypoglycemia occurs when blood sugar (glucose) levels fall below the normal range, which is considered unhealthy. Also known as low blood sugar, it is particularly common among individuals with diabetes, especially those with Type 1 diabetes. Hypoglycemia is defined as having a blood sugar level below 70 milligrams per deciliter (mg/dL) or 3.9 millimoles per liter (mmol/L).

Symptoms can include:-

1. Sweating
2. An irregular or fast heartbeat.
3. Irritability or anxiety.
4. Headache
5. Fatigue

On the basis of insulin

- 1) Diabetes mellitus
- 2) Diabetes insipidus

1) Diabetes mellitus:

Type 1 diabetes accounts for 5 to 10% of all diabetes cases and is the most commonly diagnosed form in individuals under 20. However, the term "juvenile-onset diabetes" is no longer used, as the disease can also begin in adulthood. It is characterized by the loss of insulin-producing beta cells in the pancreas, resulting in severe insulin deficiency. Type 1 diabetes can be classified as either immune-mediated or idiopathic (with no known cause). Most cases are immune-mediated, where an autoimmune attack involving T cells destroys beta cells, leading to insulin deficiency. Patients often experience unpredictable and fluctuating blood sugar levels due to very low insulin and a reduced ability to counteract hypoglycemia.

Type 1 diabetes has a genetic component, with multiple genes, including specific HLA genotypes, influencing the risk. In genetically predisposed individuals, environmental factors such as viral infections or diet can trigger the onset of the disease. Although several viruses have been suggested as potential triggers, there is no definitive evidence to support this in humans. Type 1 diabetes can develop at any age, and a significant number of cases are diagnosed in adulthood. When it appears in adults, it is referred to as Latent Autoimmune Diabetes in Adults (LADA), which progresses more slowly than in children. Due to this slower onset, the condition is sometimes called "type 1.5 diabetes." Adults with LADA are often initially misdiagnosed with type 2 diabetes, as the diagnosis is often based on age rather than the underlying cause. People with LADA produce more insulin than those with classic type 1 diabetes, but still not enough to maintain normal blood sugar levels.

2) Diabetes Insipidus:

Type 2 diabetes is characterized by insulin resistance, often accompanied by a relative reduction in insulin secretion. The impaired response of body tissues to insulin is thought to involve defects in the insulin receptor, although the specific mechanisms are not yet fully understood. Cases of diabetes mellitus caused by a known defect are classified separately. Type 2 diabetes is the most common form, accounting for 95% of all diabetes cases. Many individuals with type 2 diabetes show signs of prediabetes, such as impaired fasting glucose or impaired glucose tolerance, before meeting the full criteria for diabetes. With lifestyle changes or medications that enhance insulin sensitivity or reduce the liver's glucose production, the progression from prediabetes to full-blown type 2 diabetes can be delayed or even reversed.

The development of type 2 diabetes is primarily influenced by lifestyle factors and genetics. Several lifestyle factors contribute to its onset, including obesity (defined by a body mass index greater than 30), lack of physical activity, poor diet, stress, and urbanization. Excess body fat is linked to 30% of cases in people of Chinese and Japanese descent, 60–80% of cases in individuals of European and African descent, and 100% of cases in Pima Indians and Pacific Islanders. Even individuals who are not obese may have a high waist-to-hip ratio, which can also increase risk. Certain dietary factors, such as the consumption of sugar-sweetened beverages, have been associated with a higher risk of developing type 2 diabetes. The type of fats consumed is also important, as diets high in saturated and trans fats are known to increase the risk.

LIST OF INDIAN MEDICINAL PLANTS AND ANTI DIABETIC ACTIVITY

Sr. No.	Plant Name	Family	Common Name	Part Used	Active Constituent	Uses
1.	<i>Aegle marmelos</i>	Rutaceae	Bael	Leaves,Fruits	Aegle marmelosine	Anti Inflammatory, Anti diarrheal [12]
2.	<i>Allii Cepa Bulbus</i>	Liliaceae	Onion	Stems,Bulbs	Dipropyl disulphide oxide, Allicin	Antidiabetic, [20],[21]
3.	<i>Asparagus racemosus</i>	Asparagaceae	Satawari	Flowers,Tuberous Roots	Shatavaroside A,Shatavaroside B	Antidiabetic, lactation,[14] [15]
4.	<i>Eucalyptus globulus</i>	Myrtaceae	Sugand Hapatra	Leaves	Cryptone,Spathulenol	Antimicrobial, Antiviral, [18] [19]
5.	<i>Eugenia jambolana</i>	Myrtaceae	Jamun	Fruits, Seeds	Oleanolic acid, Ellagic acid	Antihypertensive, Anti Diabetics,[22] [24]
6.	<i>Ficus religiosa</i>	Moraceae	Peepal	Barks	β -sitosterol-D-glucoside	Antidiabetic,Antitumor [3], [6],[8]
7.	<i>Momordica charantia</i>	Cucurbitaceae	Karela	Fruits,Seeds	Sterol, Charantin	Antidiabetic,Antioxidant,[11] [29]
8.	<i>Ocimum sanctum</i>	Lamiaceae	Tulsi	Leaves	Rosmarinic Acids,Apigenin	Antimicrobial, Gastroprotective [1],[9]
9.	<i>Trigonella foenum-graecum</i>	Fabaceae	Methi	Seed,Leaves	Diosgenin,Galactomannan	Improve Digestion,antidiabetic ,[7] [28]
10.	<i>White Mulberry</i>	Moraceae	Kalpavruksha	Leaves ,Barks	Xanthophylls,Betasitosterol	Antidiabetics ,[4] [32]

PLANT DESCRIPTION

Indian Medicinal Plants with Antidiabetic Potential

1. *Aegle marmelos* :-

Aegeline 2, an alkaloidal-amide extracted from the leaves of *Aegle marmelos*, has been shown to possess antihyperglycemic activity. In a study using sucrose-challenged, streptozotocin-induced diabetic rats (STZ-S), Aegeline 2 significantly reduced blood glucose levels by approximately 12.9% at 5 hours and 16.9% at 24 hours, when administered at a dose of 100 mg/kg body weight. Additionally, Aegeline 2 notably decreased plasma triglyceride (Tg) levels by 55% ($P < 0.001$), total cholesterol (TC) by 24% ($P < 0.05$), and free fatty acids (FFA) by 24%. It also increased high-density lipoprotein cholesterol (HDL-C) by 28% and the HDL-C/TC ratio by 66% in a dyslipidemic hamster model at a dose of 50 mg/kg body weight, as reported in the literature.

2. *Allii Cepa Bulbus*:

It is commonly known as onion, this widely consumed vegetable exhibits strong anti-diabetic properties. Studies have demonstrated that onion consumption can improve metabolic health in diabetic conditions, likely due to its hypoglycemic and hypocholesterolemic effects. The plant extract has also shown promise in treating diabetic nephropathy by reducing blood cholesterol levels and decreasing lipid per-oxidation. Research into its active compounds has revealed that allyl propyl disulfide and S-methyl cysteine sulfoxide possess both anti-diabetic and anti-hyperlipidemic effects, with the latter showing effects comparable to glibenclamide and insulin.

3. *Asparagus racemosus*:-

This study investigates the effects of *Asparagus racemosus* wild extracts on α -amylase and α -glucosidase, enzymes involved in carbohydrate digestion. Diabetes mellitus is a condition characterized by hyperglycemia, where excess glucose circulates in the blood. α -amylase and α -glucosidase inhibitors are commonly used to manage hyperglycemia in type 2 diabetes. The aim of this research is to explore the potential of *Asparagus racemosus* wild as a natural treatment for diabetes. To evaluate its digestive enzyme inhibitory activity, extracts were obtained from the roots of *Asparagus racemosus* wild using solvents such as n-hexane, chloroform, ethyl acetate, methanol, and water. The inhibitory effects of these extracts on α -amylase and α -glucosidase were then tested. The ethyl acetate and aqueous extracts showed significant inhibitory activity, comparable to the well-known diabetic medication acarbose. Major phytochemicals such as flavonoids, tannins, phenolics, saponins, amino acids, and proteins were identified as key constituents contributing to the α -amylase inhibitory activity.

4. *Eucalyptus globulus*:-

Eucalyptus globulus is a flowering tree or shrub belonging to the Myrtaceae family. The genus *Eucalyptus* includes over 700 species, which have been used for various purposes by humans for thousands of years. Although native to Tunisia and Australia, *Eucalyptus* species can also be found in Africa, as well as in tropical and southern temperate regions of the Americas. The genus *Eucalyptus* is further divided into four subspecies: *Eucalyptus biostatic*, *Eucalyptus pseudoglobulus*, *Eucalyptus*

globulus, and *Eucalyptus maiden*. *Eucalyptus globulus*, a medium to large evergreen species, has been extensively studied for its phytochemical properties. Analysis of its leaves reveals that the essential oil contains compounds such as 1,8-cineole, α -pinene, p-cymene, crypto, and spathulenol. Additionally, essential oils extracted from the buds, branches, and fruits of the plant are found to primarily contain α -thujene, 1,8-cineole, and aromadendrene

5. *Eugenia jambolana*:-

Eugenia jambolana (black plum or jamun) is a tree belonging to the Myrtaceae family. The plant's seeds, leaves, fruit, and bark are the most commonly used parts. *Eugenia jambolana* is an evergreen tropical tree that can reach a height of 8 to 15 meters, with smooth, glossy leaves that have a turpentine-like smell. The bark is scaly and gray, and the trunk is often forked. The tree produces fragrant white flowers in branched clusters at the stem tips, followed by purplish-black, oval, edible berries that contain a single seed. The berries have a generally acidic to slightly sweet but astringent taste. This plant is widely used in traditional medicine, particularly for treating diabetes and other ailments. It is rich in bioactive compounds such as anthocyanins, glucosides, ellagic acid, quercetin, kaempferol, myricetin, and hydrolysable tannins (like 1-O-galloyl castalagin and casuarinin). The seeds contain the alkaloid jambosine and the glycoside jamboline, which help slow the conversion of starch into sugar.

6. *Ficus religiosa*:-

Ficus religiosa (peepal) belongs to the Moraceae family and is widely used in Ayurveda for managing diabetes. This plant has demonstrated a broad range of pharmacological effects, including antidiabetic, hypolipidemic, anticonvulsant, anti-inflammatory, analgesic, antimicrobial, antiviral, antioxidant, and antitumor properties. A decoction made from its bark is commonly used to treat diabetes. The plant contains bioactive compounds such as tannins, saponins, polyphenols, flavonoids, and sterols. Sitosterol-d-glucoside found in the bark has shown hypoglycemic activity in animal studies. Other bioactive compounds in *Ficus* include leucocyanidin-3-O-beta-d-galactosylcellobioside and leucopelargonidin-3-O-alpha-L-rhamnoside, which are believed to contribute to its antidiabetic effects. *Ficus* also contains phytosterols, flavonoids, tannins, and furanocoumarins like bergapten.

7. *Momordica charantia*:-

Momordica charantia (bitter melon or karela), part of the Cucurbitaceae family, is frequently used in treating diabetes and cardiovascular diseases in Asia, South America, and East Africa. Both the fruit and seeds have therapeutic benefits. Bitter melon is rich in bioactive compounds, including vicine, charantin, and triterpenoids, all of which have antidiabetic potential. Numerous studies have highlighted its hypoglycemic effects and its ability to improve metabolic syndrome, particularly diabetes. A study on Taiwanese adults found significant improvements in waist circumference, diabetes control, and symptoms of metabolic syndrome following consumption of bitter melon.

8. *Ocimum sanctum* :-

Ocimum sanctum (holy basil or tulsi), belonging to the Lamiaceae family, has therapeutic properties across various diseases. The plant grows widely and contains bioactive compounds like eugenol, flavonoids, saponins, tannins, triterpenoids, rosmarinic acid, and apigenin. The leaves and stems of tulsi contain eugenol, which is responsible for many of its health benefits. Tulsi oil also contains ursolic acid, carvacrol, and linalool, while its seeds are rich in fatty acids and sitosterol. The plant is abundant in vitamins, minerals, chlorophyll, and other phytonutrients, contributing to its medicinal properties

9. *Trigonella foenum-graecum* :-

Trigonella foenum-graecum (fenugreek or methi), from the Fabaceae family, is cultivated widely in India and other parts of the world. Both the seeds and leaves are used for their therapeutic effects. Fenugreek has a pungent aroma and is used in both cooking and as a spice. Research has shown that fenugreek has strong antidiabetic properties, helping to lower blood glucose and lipid levels. Studies have demonstrated its beneficial effects on intestinal and renal disaccharidase activity in diabetic rats, as well as its role in reducing renal toxicity when incorporated into the diet of diabetic rats.

10. *White Mulberry* :-

White mulberry is a small to medium-sized tree found in subtropical and temperate climates across Asia. The fruit, which can be white or light pink and resembles blackberries, is mildly sweet and used in jams, wines, and flavor additives. White mulberry leaves are vital in the silk industry as they are the primary food for silkworms. In traditional Chinese medicine, the fruit, leaves, and bark of white mulberry are used to treat conditions like fever, liver damage, high blood pressure, and joint pain.

CONCLUSION

This review has outlined various medicinal plants used to treat diabetes mellitus. Many of these plant-based remedies hold potential for cost-effective diabetes management through dietary interventions, nutrient supplementation, and combination therapies with synthetic drugs. Over the long term, some of these plants could serve as the sole treatment. The bioactive compounds in these plants are primarily responsible for their antidiabetic effects, although many of these active agents are still not fully understood. Further research is needed to explore the mechanisms by which these medicinal plants exert their antidiabetic effects.

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