International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

HERBAL DRUG USED IN TREATMENT OF DIABETES MELLITUS

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ABSTRACT:

Diabetes mellitus is a prevalent metabolic disorder, affecting about 2.8% of the global population, and this number could rise to 5.4% by 2025. While oral hypoglycemic agents like sulphonylureas and biguanides remain the cornerstone of diabetes management, there's an increasing interest in herbal remedies, largely due to the side effects linked to these medications. Throughout history, herbal medicines have been highly valued as a source of treatment. Today, they are becoming an integral part of modern, advanced medicine. Numerous medicinal plants have shown natural therapeutic benefits against various ailments, and significant research has been conducted on these plants for treating diabetes mellitus. The antidiabetic properties of these medicinal plants are attributed to their rich content of phenolic compounds, flavonoids, terpenoids, coumarins, and other beneficial constituents that help lower blood glucose levels. This review compiles and discusses several herbal plants and their active chemical components that play a role in managing diabetes mellitus.

KEY WORDS: Medicinal plant, India, Antidiabetic, Diabetes, Acacia arabica, Allium sativum, Azadirachta indica.

INTRODUCTION

Diabetes mellitus is a chronic endocrine disorder that disrupts carbohydrate metabolism and is often associated with low blood sugar levels. This condition can lead to serious complications, including microvascular issues like nephropathy and retinopathy, as well as macrovascular problems such as peripheral vascular disease and coronary heart disease. Commonly referred to simply as diabetes, this condition was historically noted for causing “sweet urine” and muscle loss. Insulin, a hormone produced by the pancreas, plays a crucial role in regulating blood glucose levels. When blood sugar rises, the pancreas releases insulin to help maintain balance. However, in individuals with diabetes, insulin production may be insufficient or absent, leading to high blood sugar levels, or hyperglycemia. There are three main types of diabetes: Type 1, Type 2, and gestational diabetes. Type 1 diabetes, also known as insulin-dependent diabetes, results from the complete loss of function of the β cells in the islets of Langerhans in the pancreas. Type 2 diabetes, or insulin-independent diabetes, is characterized by a temporary reduction in β cell mass and is often linked to genetic factors, obesity, high blood pressure, and elevated cholesterol levels. The goal of treating Type 2 diabetes is to reduce insulin resistance and enhance insulin secretion. Gestational diabetes occurs when pregnant women experience hyperglycemia, typically affecting 2-4% of pregnancies during the second or third trimester. Symptoms of diabetes mellitus include excessive thirst, frequent urination, increased hunger, fatigue, nausea, vomiting, erectile dysfunction in men, slow-healing wounds, and blurred vision. According to a 2016 survey by the International Diabetes Federation (IDF), diabetes affects approximately 415 million people worldwide, with projections suggesting this number could rise to 642 million by 2040. In India alone, reports indicate that around 61.3 million people in the 20-79 age group are living with diabetes.

DIABETES MELLITUS

Diabetes is a long-term condition that affects how your body processes carbohydrates, fats, and proteins, leading to higher than normal blood sugar levels both when fasting and after meals. The global rate of diabetes is projected to rise, jumping from 4% in 1995 to about 5.4% by 2025. The World Health Organization (WHO) has warned that the biggest impact will be felt in developing nations. Research from India over the past ten years has shown that not only is diabetes widespread, but it's also growing quickly among urban populations. Currently, around 33 million adults in India are living with diabetes, and this figure is expected to soar to 57.2 million by 2025.

Diabetes mellitus is a complicated metabolic issue that arises from either not enough insulin or the body not using it effectively. Type I diabetes, which is insulin-dependent, occurs when the body lacks functional beta cells, meaning those affected must rely entirely on external insulin sources. On the other hand, Type II diabetes, which is insulin-independent, happens when the body can't respond to insulin properly. This type can often be managed through lifestyle changes like diet and exercise, along with medication. Type II diabetes is the more prevalent form, making up about 90% of all diabetes cases.

While we still don't fully grasp the underlying mechanisms of diabetes, research suggests that free radicals play a role in its development and the complications that can arise from it. These free radicals can harm cellular components like DNA, proteins, and lipids, which in turn disrupts normal cellular functions.Recent studies have shown that antioxidants, which can neutralize free radicals, play a significant role in preventing diabetes in animal models and in lessening the severity of complications related to diabetes. When it comes to the development of these complications, the abnormalities in lipids and proteins are key culprits. In diabetic patients, long-lasting proteins like elastin, laminin, and collagen become prime targets for free radicals.

Due to high blood sugar levels, these proteins undergo modifications, turning into glycoproteins. Such changes in proteins found in tissues like the lens of the eye, blood vessel walls, and basement membranes are linked to various diabetes-related complications, including cataracts, microangiopathy, atherosclerosis, and nephropathy. During diabetes, free radicals also oxidize lipoproteins, leading to several metabolic issues with very low-density lipoprotein (VLDL), low-density lipoprotein (LDL), and high-density lipoprotein (HDL). The oxidative stress in diabetic conditions heightens lipid peroxidation. Additionally, advanced glycation end products (AGEs) form through the non-enzymatic glycosylation of proteins, accumulating on long-lived molecules in tissues and disrupting normal cell and tissue functions. AGEs also increase vascular permeability in both micro and macrovascular structures by binding to specific receptors on macrophages, which leads to the production of free radicals and endothelial dysfunction. Moreover, AGEs can form on nucleic acids and histones, potentially causing mutations and altering gene expression. Diabetes is a complex disease that can lead to a range of complications, which is why it requires a multifaceted treatment approach. For those with diabetes, the issue often lies in either insufficient insulin production or the body's cells not responding properly to insulin. When there's a complete lack of insulin, patients typically need insulin injections. On the other hand, for those whose cells aren't responding to insulin, a variety of medications have been developed to address potential issues in carbohydrate metabolism. For instance, to tackle post-meal high blood sugar levels, glucosidase inhibitors like acarbose, miglitol, and voglibose are commonly used. These medications work by slowing down the breakdown of carbohydrates, which helps reduce glucose absorption in the cells. To boost glucose uptake in peripheral cells, biguanides such as metformin are prescribed. Sulphonylureas, like glibenclamide, stimulate insulin secretion from the pancreas. While there are several treatment options available, they do come with certain drawbacks, including high costs and side effects like hypoglycemia, weight gain, gastrointestinal issues, and liver toxicity. Recent research has also highlighted the role of oxidative stress in complicating diabetes, prompting efforts to discover effective antidiabetic and antioxidant therapies. There's a renewed interest in medicinal plants for diabetes treatment, as many traditional medications have been derived from these natural sources. For example, Metformin is a well-known oral medication for lowering blood sugar, originally developed from the plant Galega officinalis, which is rich in guanidine, a compound that lowers blood sugar levels. However, guanidine itself is too toxic for clinical use, leading to the introduction of alkyl biguanides like synthalin A and synthalin B as oral antidiabetic agents in Europe during the 1920s, although they were eventually phased out once insulin became more widely accessible. The journey to develop metformin was inspired by earlier experiences with guanidine and biguanides. So far, more than 400 traditional plant remedies for diabetes have been documented, but only a handful have undergone scientific and medical scrutiny to truly evaluate their effectiveness. Some herbal extracts have shown a hypoglycemic effect in both human and animal studies related to type 2 diabetes. The World Health Organization's Expert Committee on diabetes has suggested that we delve deeper into the potential of traditional medicinal herbs. One of the biggest challenges in integrating herbal medicine into modern healthcare is the lack of scientific and clinical evidence supporting their effectiveness and safety. There's a pressing need for clinical research on herbal drugs, the creation of straightforward bioassays for biological standardization, and thorough pharmacological and toxicological assessments. Additionally, developing various animal models to evaluate toxicity and safety is crucial. It's also vital to identify the active components in these plant extracts.

INDIAN MEDICINAL PLANTS WITH ANTIDIABETIC EFFECT

1.Aloe vera and Aloe barbadensis

Figure 1.Aloe vera and Aloe barbadensis

Aloe, a beloved houseplant, has been cherished for ages as a versatile folk remedy. This plant can be broken down into two main products: gel and latex. Aloe vera gel is the gooey pulp found in the leaves, while aloe latex, often called "aloe juice," is a bitter yellow substance that oozes from the pericyclic tubules just under the leaves' outer skin. Research shows that extracts from aloe gum can significantly boost glucose tolerance in both healthy and diabetic rats. When chronic doses of Aloe barbadensis leaf exudates were administered, they demonstrated a hypoglycemic effect in diabetic rats, but single doses didn't have the same impact. Interestingly, both single and chronic doses of the plant's bitter components also exhibited hypoglycemic effects in diabetic rats. This action seems to work by stimulating the synthesis and/or release of insulin from the pancreatic beta cells. Additionally, this plant has anti-inflammatory properties that depend on the dose and can enhance wound healing in diabetic mice.

2.Azadirachta indica: (Neem)

Figure 2 Azadirachta indica: (Neem)

Hydroalcoholic extracts from this plant have shown anti-hyperglycemic effects in rats treated with streptozotocin, likely due to an increase in glucose uptake and glycogen storage in isolated rat hemidiaphragm. Beyond its anti-diabetic benefits, this plant also boasts antibacterial, antimalarial, antifertility, hepatoprotective, and antioxidant properties.

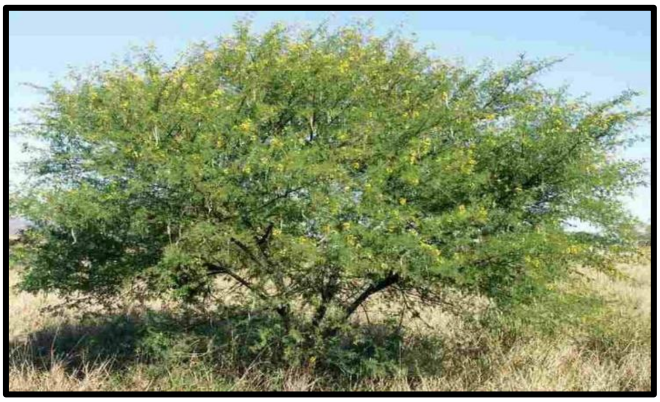
3.Mangifera indica: (Mango)

Figure 3.Mangifera indica: (Mango)

In Nigerian folk medicine, the leaves of this plant are used as a remedy for diabetes. However, when the aqueous extract was given orally, it didn't seem to change blood glucose levels in either healthy or streptozotocin-induced diabetic rats. That said, the antidiabetic effects were observed when the extract was administered alongside glucose or an hour before the glucose was given. These findings suggest that the aqueous extract of Mangifera indica has hypoglycemic properties, possibly by reducing the intestinal absorption of glucose.

4.Acacia arabica:(Babhul)

Figure 4.Acacia arabica:(Babhul)



Acacia arabica, commonly known as Babhul, is a plant that thrives across India, particularly in wild habitats. Its extract has been recognized for its antidiabetic properties, functioning as a secretagogue to stimulate insulin release. While it can induce hypoglycemia in normal rats, this effect isn't observed in alloxanized animals. When powdered seeds of Acacia arabica were given to normal rabbits at doses of 2, 3, and 4 g/kg body weight, they triggered a hypoglycemic response by promoting insulin release from pancreatic beta cells.

5.Allium cepa:(onion)

Figure 5.Allium cepa:(onion)

Various ether-soluble and insoluble fractions of dried onion powder have demonstrated anti-hyperglycemic effects in diabetic rabbits. Additionally, Allium cepa is recognized for its antioxidant and hypolipidemic properties. When diabetic rats were administered S-methyl cysteine sulfoxide (SMCS), a sulfur-containing amino acid from onions at a dose of 200 mg/kg for 45 days, it significantly regulated blood glucose and lipid levels in both serum and tissues, while also normalizing the activities of liver hexokinase, glucose 6-phosphatase, and HMG CoA reductase. Interestingly, when diabetic patients consumed a single oral dose of 50 g of onion juice, it effectively controlled their post-prandial glucose levels.

6.Allium sativum: (garlic)

Figure 6.Allium sativum: (garlic)

A perennial herb widely cultivated throughout India. The compound allicin, which gives garlic its distinctive smell, has been shown to possess notable hypoglycemic effects. This is believed to stem from enhanced liver metabolism, increased insulin release from pancreatic beta cells, and/or an insulin-sparing effect.

CONCLUSION

Diabetes mellitus is one of the most prevalent endocrine disorders, impacting over 300 million people around the globe. Unfortunately, treatments based on traditional Western medicine (allopathic) often fall short in effectiveness, can lead to unwanted side effects, and tend to be quite expensive, particularly in developing countries. This makes the idea of using plant-based compounds—those that are more accessible and don't require complex pharmaceutical processes—very appealing. In this review article, we aim to gather information on various hypoglycemic plants from both India and other countries. This compilation could be beneficial for health professionals, scientists, and scholars in the fields of pharmacology and therapeutics, as they work towards developing evidence-based alternative medicines to treat different types of diabetes in both humans and animals. The isolation and identification of active ingredients from these plants, along with the preparation of standardized doses and dosage regimens, could significantly enhance their hypoglycemic effects.

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