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## An Exploring Medicinal Chemistry For Effective Diabetes Management Through Traditional Herbs

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### **Abstract:**

*Diabetes mellitus is a common metabolic disease that poses a serious threat to world health. Traditional herbal medicines are becoming more and more popular as adjunct or alternative therapy, even if mainstream pharmaceuticals are still essential in controlling illness. In order to better understand the mechanisms of action and therapeutic potential of regularly used traditional medicines for diabetes treatment, this study investigates their medicinal chemistry. Numerous plants, including cinnamon, ginseng, fenugreek, and bitter melon, have demonstrated encouraging anti-diabetic effects via comprehensive study. We go over their main phytochemical components and pharmacological properties, which include raising insulin sensitivity and preventing the breakdown of carbohydrates. Despite their promise, further investigation is required to guarantee safety, standardize dose, and prove efficacy through clinical studies. Incorporating traditional herbal medicine into diabetes care is a viable approach, especially in places with limited resources. This highlights the significance of combining traditional knowledge with cutting-edge scientific techniques to maximize diabetes control and enhance global health outcomes.*

**Keywords:** *Diabetes Mellitus, Managing Diabetes, Antidiabetic Herbs, Polyherbal Remedies, Alternative Medicine, and Toxic Adverse Effects.*

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### **Introduction:**

Diabetes mellitus, which is characterized by dysregulated glucose levels brought on by impaired insulin synthesis or use, is a significant global health concern. Despite advancements in conventional pharmaceutical medications, the prevalence of diabetes continues to rise, leading to a search for complementary and alternative treatment approaches. Recently, traditional homegrown remedies

have gained popularity as viable solutions for effective diabetes care. These spices, which have long been used in many social and medicinal contexts, provide a wealth of bioactive combinations that are probably anti-diabetic. This study delves into the field of restorative science to elucidate the mechanisms of action and potential benefits of traditional spices in managing diabetes. Through an examination of the chemical composition

and pharmacological trials of these spices, we want to shed light on their feasibility and prepare the way for the development of new and accessible therapeutic options. By using this multidisciplinary approach, which blends traditional knowledge with contemporary logical understanding, we want to improve diabetic treatment practices and contribute to the advancement of global wellness outcomes.

### 1. Diabetes Mellitus Diagnosis:

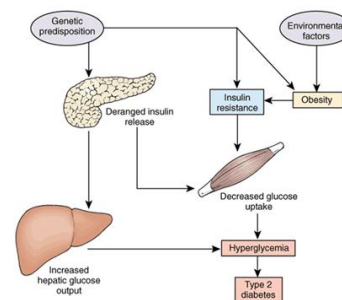
By looking at the glucose levels, one can evaluate the presence of diabetes. Normal glucose level of 80 mg/dl while fasting and 160 mg/dl when postprandial. Several tests are used at research facilities to assess diabetes, including the finger-prick glucose test, fasting glucose test, glucose resilience analytic test, and glycohemoglobin test.

### 2. Pathogenesis Of Diabetic Mellitus:

Oxidative pressure plays a major role in the pathogenesis of diabetes. Oxidative pressure is the imbalance between the production of reactive oxygen species (ROS) and the limit of enzymatic or non-enzymatic cell reinforcement. Low-density lipoprotein cholesterol is oxidized when it comes into contact with reactive oxygen species, which are then absorbed by the tracker receptor in the forager cell. This results in the formation of foam cells and plaques associated with blood vessel sclerosis. These ROS have the ability to activate many harmful pathways that are important in the development of diabetes. The sorbitol aldose reductase course, the electron transport chain, the glucosamine pathway, and the protein kinase C

inclination are a couple of significant pathways. Empowering these pathways and their method of activity can prompt the development of amylin, pancreatic  $\beta$  cell disappointment, lipid peroxidation, customized cell passing, atherosclerosis, and significant level glycation final result (Ages). It is shown to have a considerable cell assurance technique of action against oxidative pressure when combining explicit DNA restricting element (atomic variable erythroid determined like with their negative controller (kelch like ECH related protein).

### Pathophysiology of Diabetes Mellitus Type 2



**Figure 1:** The pathophysiology of Diabetes Mellitus

### Literature Review:

Lankatillake et.al (2019). A thorough analysis of glycaemic control mechanisms and screening techniques for naturally occurring antidiabetic compounds made from medically supported medicinal plants. They explore the molecular mechanisms behind glucose metabolism and emphasize how crucial glycaemic control is to the management of diabetes. The authors highlight the necessity for rigorous scientific procedures to identify prospective candidates for further research as they describe several in

vitro and in vivo screening methods used to evaluate the antidiabetic potential of natural compounds.

Pengelly (2020) provides a basic synopsis of the chemical makeup and medicinal qualities of medicinal plant ingredients. Essential subjects covered in the book include plant secondary metabolites that support the pharmacological effects of herbal remedies, such as terpenoids, flavonoids, and alkaloids. It sheds light on the range of chemical compositions found in medicinal plants and their possible uses in the treatment of a number of illnesses, including diabetes.

Alam et.al (2022) emphasize the potential of phytochemicals with antidiabetic properties that come from medicinal plants as novel drug development and discovery prospects. The writers talk about the bioactive substances present in several plant species, including ginseng, fenugreek, and bitter melon, that are recognized to have antidiabetic qualities. In order to provide insights into these phytochemicals' therapeutic potential for managing diabetes, they examine the mechanisms of action of these compounds, including how they affect insulin sensitivity, glucose metabolism, and pancreatic  $\beta$ -cell activity.

Kasole et.al (2019) The use of traditional medicine in the treatment of diabetes mellitus is examined by from the viewpoints of both patients and herbalists. The study investigates the use of conventional herbal treatments for managing diabetes, emphasizing the

practices' cultural importance and level of community acceptability. It offers perspectives and experiences of patients and herbalists about the effectiveness, security, and availability of conventional medicine in the treatment of diabetes.

Rahman et al. in 2022. A thorough study investigating plant-derived bioactive compounds as possible antidiabetic medicines is presented. The authors go over the molecular makeup and pharmacological characteristics of many plant-derived substances that have been shown to have anti-diabetic effects, including flavonoids, alkaloids, and polyphenols. The mechanisms of action of these bioactive compounds are emphasized, highlighting their potential for the development of new therapies for diabetes by affecting insulin signaling, glucose absorption, and inflammatory pathways.

### **Role of Medicinal Plants in Management of Diabetes Mellitus:**

The role of medicinal plants in the management of diabetes mellitus has been a subject of significant interest due to their potential therapeutic benefits and relatively fewer side effects compared to conventional medications. Medicinal plants, also known as herbal medicine or phytotherapy, have been used for centuries in various cultures worldwide to treat a wide range of ailments, including diabetes.

- **Insulin Regulation:** It has been discovered that a few healing herbs contain hypoglycemic qualities, which means they can help lower blood sugar

levels. The disagreeable melon (*Momordica charantia*), for example, has compounds that mimic insulin and aid in the digestion of carbohydrates, hence lowering blood glucose levels. Furthermore, the seeds of fenugreek (*Trigonella foenum-graecum*) provide soluble fiber and various combinations that can help control blood sugar levels by reducing sugar intake and increasing insulin sensitivity.



**Figure 2:** Advantages Of Herbal Formulation

- **Pancreatic Function:** It has been demonstrated that certain medicinal herbs maintain pancreatic function, which is crucial for producing insulin. *Gymnema sylvestre*, for example, is referred to as "Gurmar" in Ayurvedic medicine and has long been used to enhance pancreatic beta cell insulin output. Furthermore, research indicates that *Panax ginseng*, or ginseng root, may support the regeneration of pancreatic beta cells and improve insulin production.
- **Improvement of Insulin Sensitivity:** An inherent characteristic of type 2

diabetes is insulin resistance, a condition in which the body's cells lose their sensitivity to insulin. It has been shown that several medicinal herbs increase insulin sensitivity, which facilitates the body's better utilization of insulin. For instance, the chemicals in cinnamon (*Cinnamomum verum*) promote insulin signaling and cell absorption of glucose, hence decreasing blood sugar levels.

- **Antioxidant and Anti-inflammatory Effects:** The onset, course, and consequences of diabetes mellitus are significantly influenced by oxidative stress and chronic inflammation. Antioxidant and anti-inflammatory qualities found in many medicinal plants can aid in reducing these processes. For example, curcumin, a strong antioxidant and anti-inflammatory found in turmeric (*Curcuma longa*), may help lower insulin resistance and save pancreatic beta cells from harm.
- **Protection Against Diabetic Complications:** Numerous problems, including retinopathy, nephropathy, and neuropathy, can result from diabetes. Studies have been conducted to see whether some medicinal plants can stop or lessen certain problems. For instance, studies have demonstrated that ginkgo biloba extract can alleviate the symptoms of diabetic neuropathy by increasing blood flow and lowering oxidative stress in the nerves.

- **Weight Management:** Type 2 diabetes is significantly exacerbated by obesity, and controlling one's weight is essential to managing the disease. Studies have looked at the potential of several medicinal herbs, such as *Garcinia cambogia* and green tea (*Camellia sinensis*), to help with weight reduction by decreasing hunger and speeding up metabolism.

#### **Antidiabetic Drugs:**

By managing blood sugar levels with a range of drugs, starting a new exercise routine, receiving yoga instruction, or adhering to a certain diet, diabetes mellitus can be prevented. Insulin is now used to treat type 1 diabetes, and sulphonylureas, thiazolidinediones, and peptide analogs are among the oral hypoglycemic drugs used to treat type 2 diabetes.

#### **Herbal Remedy:**

The biggest question facing clinical practitioners at the moment is how to treat diabetes mellitus with almost no side effects. According to the World Ethnobotanical 1000, medicinal herbs are used to prevent diabetes mellitus. It has been clinically shown that 20 medicinal plants have the whole mechanism of action out of the 550 restorative plants, which contain anti-diabetic qualities. In the past, both experts and laypeople used traditional medicinal plants with their active ingredients and qualities to treat a variety of ailments, including diabetes, cancerous growths, and heart problems. India and

China have a long history of using traditional herbs to manage diabetes. Several texts are available, such as *Susruta Samhita* and *Charaka Samhita*, which explain the negative effects of diabetes and its phytopharmacology components. Engineered medications used to treat diabetes have been linked to a variety of adverse effects, including headaches, enlargement, hazardous paleness, loose stools, vomiting, and fainting. Because they have fewer negative effects and side effects than produced pharmaceuticals, homegrown drugs have shown to be a better option. Without a solution, homegrown formulations are practically available.

These domestically produced medications are used for dangerous infections. These drugs are also used in situations where compound drugs are not enough to address a patient's illness. For instance, they are normal, safe drugs with no harmful side effects. Natural remedies have always been able to diagnose and treat patients, but manufactured pharmaceuticals do not permanently cure illnesses. Homegrown formulas include common spices and distinct soil products that are beneficial in the treatment of many ailments without causing adverse effects. However, substance medications are manufactured and also have adverse effects. Comparing natural formulations to allopathic treatments, they are rather modest. Formulations made at home are environmentally friendly. While all herbal medications are made from synthetic and intentionally altered regular goods,



homegrown formulations are made from ordinary items. All herbal drugs are available with a remedy, whereas natural formulations are only available without one.

### 1. TRADITIONAL HERBAL ANTI-DIABETIC DRUGS



Currently, medicinal herbs and spices are used in complex structures to counteract the effects of diabetes. Several clinical studies confirmed that medicinal plant extracts exhibit anti-diabetic effects and restore pancreatic  $\beta$ -cell function.

#### **Allium sativum:**

It is referred to locally as garlic and has a place with the *Allium sativum* family Liliaceae. Garlic ethanol focus (12 ml/kg/day) infrequently shows hypoglycemia development. Garlic concentrate worked better compared to glibenclamide, a treatment for diabetes. In STZ-induced animals, the synthesis of ethanol, oil ether, and acetic acid was seen to have antagonistic effects on diabetic mobility. Garlic has a number of medicinal benefits, including antimicrobial, antiplatelet, slowing the heartbeat, and lowering cholesterol levels.

#### **Aloe borbadensis:**

Ghikanvar is the name given to it, and it belongs to the Liliaceae family. It has all the earmarks of being a plant local to the desert, with robust, confining, bristly, green state of the art leaves that are loaded with clear, gooey gel. The organization of 160 mg/kg of body weight of watery aloe vera concentrate orally essentially brings down blood glucose levels. Aloe Vera gel has a variety of therapeutic benefits. It is anti-diabetic and a cancer preventive agent. It also increases glutathione abatement levels in diabetic animals by several times.

#### **Azadirachta indica:**

Locally known as neem, it has a place with the Meliaceae family. It is accessible in Burma and India. High parcels of *Azadirachta indica* ethanolic and watery concentrate show a decrease in blood glucose levels. In people with type 2 diabetes whose diabetes isn't sufficiently overseen by allopathic medications, it is commonly utilized with them. Neem pills are utilized to treat countless individuals consistently. Its concentrate assists the blood with streaming by augmenting the veins and is helpful for bringing down the body's blood glucose level.

#### **Brassica juncea:**

It is referred to as Rai and is located in the cruciferae family. It is often used as a flavouring in various culinary items. Fluid seed extract has a glucose-lowering effect that was shown in diabetic animals given alloxan.

**Carica Papaya:**

It belongs to the caricaceae family and is referred to as papaya. Extraction of seeds and leaves in alloxan-induced diabetic rats demonstrates lowering blood glucose levels, lowering lipid levels in the body, and recovering from twisting exercise.

**Catharanthus roseus:**

Vinca roseus is its scientific name, and it belongs to the Apocynaceae family. In the alloxan-induced diabetic rats, methanolic concentrate of leaves and twigs demonstrates a decrease in glucose levels. Oral administration of 500 mg/kg of extracted leaves and twigs proved beneficial for lowering blood glucose levels in animals. The mechanism of action of Catharanthus roseus is to increase the amount of insulin produced by Langerhans  $\beta$  cells.

**Coriandrum sativum:**

A great many people allude to it as coriander, and it has a place with the Apiaceae family. It is broadly utilized as zest in an assortment of cooking things. In alloxan-actuated diabetic creatures, 220 mg/kg of seed extricate routinely builds the movement of Langerhans  $\beta$  cells, brings down glucose, and mixes insulin from the pancreatic  $\beta$  cells. Coriandrum sativum remove exhibits insulin union and glucose-bringing down properties.

**Eugenia jambolana:**

It belongs to the Myretaceae family and is referred to as jamun. Dried seeds and mature Eugenia jambolana products are included. Ferulic corrosive and malvidin 3-laminaribiosidea are its

dynamic components. Dried seed concentrate (200 mg/kg) used to treat diabetic patients.

**Gymnema sylvestre:**

The normal name for it is Gudmar, and that signifies "sugar destroying" and has a place with the Asclepidaceae family. In mice given streptozotocin, a leaf concentrates of G. sylvestre (3.4/13.4 mg/kg) altogether decreased the degree of glucose. Most frequently, it is utilized to treat diabetes in Indian ayurvedic medicines. G. Sylvester has alkaloids, flavonoids, saponins, and carbs as its dynamic fixings. It is likewise utilized in the treatment of different microbial contaminations, bothering, and threatening development treatment.

**Mangifera indica:**

It belongs to the Anacardiaceae family and is commonly referred to as mango. The leaves exhibit a hostile response to diabetes (250 mg/kg); but, oral administration of a watery concentrate did not alter the blood glucose level in diabetic mice induced by alloxan.

**Momordica charantia:**

Usually referred to as rough melon (karela), it belongs to the Cucurbitaceae family of plants. Momordica charantia's active ingredients include cucurbitacin B, momordic I, and momordic II. It's used to treat diabetic conditions. It contains lectin, which functions similarly to insulin. A non-protein that binds to insulin receptors is called lectin. Through its subsequent action on peripheral tissues, this lectin lowers the glucose level. M. charantia

natural product concentration (200 mg/kg) has hypoglycemic effect.

### **The Challenges of Herbal Medicines in India:**

Homegrown medications have a long history in Indian social customs and historical heritage, playing a crucial role in the country's medical care system. However, despite their widespread use, there are still obstacles preventing their integration into current medical care practices. One important test is the lack of standardized fabrication cycles and quality control procedures, which leads to variations in the strength and quality of natural products due to inconsistent methods of procurement, processing, and finishing. This raises questions about their effectiveness and security. There is little scientific evidence to support the safety and feasibility of many homegrown remedies since doing comprehensive clinical preliminary research and pharmacological analyses is expensive and strategically challenging. This leads to a limited understanding of the therapeutic benefits and possible risks associated with natural medicines, which exacerbates mistrust between healthcare professionals and consumers.

Uncontrolled homegrown product growth in the commercial core exacerbates concerns about viability, quality, and safety, with serious risks to public health posed by defilement and debasement. Additionally, the commercialization of natural remedies may exploit biodiversity

and traditional knowledge, creating ethical and practical issues.

### **Conclusions:**

Overall, the exploration of restorative science for effective diabetes control with traditional spices offers a viable path for advancing medical service practices. Traditional home remedies, deeply ingrained in many cultures and traditions, provide an abundant source of bioactive blends with anti-diabetic qualities. We have gained insight into the mechanisms of action and pharmacological properties of common spices like severe melon, fenugreek, ginseng, and cinnamon by thoroughly evaluating the restorative science concealed behind their sufficiency. It is certain that incorporating traditional homegrown medicine into routine medical care procedures would enhance glycemic control, lessen complications, and improve overall quality of life for those with diabetes. Through breaking down any barriers between traditional knowledge and modern, rational methods, we may improve diabetes treatment approaches and contribute to the continued improvement of global health outcomes. Advancement, continued research, teamwork, and innovation are essential to unlocking the full therapeutic potential of traditional spices and advancing diabetic treatment.



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