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HERBAL PLANTS AND THE AYURVEDIC PREPARATION FOR THE TREATMENT OF DIABETES: A REVIEW

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ABSTRACT:

"Diabetes mellitus (DM) poses a significant health challenge worldwide, with increasing prevalence and related health issues. This article offers an overview of the epidemiology, underlying mechanisms, and management complexities of DM, focusing on the Indian subcontinent, where the disease burden is high. DM involves multiple factors, including insulin resistance, impaired insulin secretion, and metabolic dysfunctions, necessitating individualized treatment approaches. Traditional medicinal systems, like Ayurveda, provide a wealth of plant-based remedies for managing diabetes. Many of these plants contain bioactive compounds that regulate carbohydrate metabolism, boost insulin secretion, and enhance insulin sensitivity. The article reviews the potential of various medicinal plants commonly used in Indian traditional medicine for treating diabetes, highlighting their mechanisms and therapeutic benefits. It also discusses herbal drugs formulated with these plant extracts, increasingly incorporated into integrative diabetes care. Exploring plant-based therapies offers promising prospects for developing cost-effective treatments for DM, addressing the pressing need for better therapeutic options in tackling this global health challenge."

KEYWORD**:-** pathophysiology, multi-factorial, traditional, plant-derived, therapeutic effects

INTRODUCTION:

Diabetes mellitus poses a substantial global health challenge, with escalating prevalence rates and associated economic burdens. According to the International Diabetes Federation (IDF), in 2011, the worldwide count of diabetes cases surpassed 366 million, with an alarming annual death toll of 4.6 million. Notably, the Indian subcontinent has emerged as a hotspot for this epidemic, with prevalence rates as high as 8.31% in India, 9.85% in Bangladesh, 3.03% in Nepal, 7.77% in Sri Lanka, and 6.72% in Pakistan among adults aged 20 to 79.

This chronic endocrine disorder, primarily stemming from defects in insulin secretion, insulin resistance, or both, ranks as the third leading cause of morbidity and mortality globally, trailing only heart disease and cancer. By 2015, the global diabetes tally soared to 415 million, with a staggering 78 million cases concentrated in the Southeast Asia (SEA) region. Projections suggest that by 2040, the SEA region alone will harbor 140 million cases. India stands at the forefront of this pandemic, reporting 69.1 million cases in 2015.

The multifaceted nature of diabetes complicates treatment efforts, necessitating a personalized, multimodal approach tailored to each individual's unique physiological and genetic makeup. Indians, in particular, exhibit a heightened predisposition to age-related diabetes, often characterized by elevated insulin levels and peripheral insulin resistance, even at comparable body mass index (BMI) levels. Factors such as increased body fat percentage, particularly abdominal fat distribution, low muscle mass, and genetic predisposition, amplify the risk of hyperinsulinemia and type 2 diabetes among Asian Indians.

Type 1 diabetes (T1DM) and type 2 diabetes (T2DM) represent the two primary classifications of diabetes. While T1DM entails the cessation of insulin production due to pancreatic β cell destruction, T2DM manifests as progressive insulin secretion impairment and reduced tissue sensitivity to insulin. Additionally, T2DM heightens susceptibility to cardiovascular disorders, nephropathy, neuropathies, and infections, exacerbating the economic strain on individuals and healthcare systems worldwide.

Amid the escalating diabetes burden, identifying personalized approaches to enhance glycemic control emerges as a pressing challenge. Traditional medicinal systems, such as Ayurveda, leverage a diverse array of plant-based remedies with potential for mitigating diabetes complications. These herbal interventions offer promising avenues for diabetes management, boasting fewer side effects and lower costs compared to conventional pharmacotherapies.

Harnessing the hypoglycemic properties of medicinal plants presents a viable strategy for augmenting insulin secretion, enhancing glucose uptake, and inhibiting glucose production and absorption. While conventional therapies like insulin and oral hypoglycemic agents remain cornerstone treatments, ongoing research endeavors aim to unveil more potent anti-diabetic agents derived from natural sources.

CARBOHYDRATE METABOLISM: PROBLEM STATEMENT

"In living organisms, metabolism regulates the utilization of cellular resources, including complex molecules such as carbohydrates, lipids, and proteins. Following a regular meal, the temporary rise in plasma glucose, amino acids, triglycerides, and chylomicrons triggers increased insulin secretion from pancreatic islet cells. This, in turn, promotes the synthesis of triglycerides, glycogen, and protein. During this period, most tissues primarily utilize glucose as an energy source. Cultures adhering to a primitive diet low in refined foods, starches, and sugars rarely encounter issues with glucose and carbohydrate metabolism. However, factors such as hereditary predispositions, pancreatic infections, and autoantibodies targeting pancreatic islets contribute to disorder development, with diet, lifestyle, and obesity being the most significant risk factors."

MEDICINAL PLANTS WITH ANTIDIABETIC AND RELATED BENEFICIAL PROPERTIES:

"In many developing nations, traditional medicine and the use of medicinal plants are commonly practiced for maintaining good health. Numerous herbal remedies are recommended for managing diabetes and its complications, with medicinal plants being the primary components of these treatments. Plants from various families have been identified for their anti-diabetic properties."

- **Babul: (Acacia arabica)**

"Found predominantly in the wild habitat across India, the plant extract serves as an antidiabetic agent by acting as a secretagogue, stimulating insulin release. It induces hypoglycemia in normal rats but not in alloxan-treated animals. Administering powdered seeds of Acacia arabica to normal rabbits at doses of 2, 3, and 4 g/kg body weight triggers a hypoglycemic effect by stimulating insulin release from pancreatic beta cells."

- **Bengal Quince, Bel or Bilva: (Aegle marmelos)**

Administration of aqueous extract of leaves improves digestion and reduces blood sugar and urea, serum cholesterol in alloxanized rats as compared to the control. Along with exhibiting hypoglycemic activity, this extract also prevented a peak rise in blood sugar at 1h in the oral glucose tolerance test.

- **Onion: (Allium cepa)**

Various components of dehydrated onion powder, both soluble and insoluble in ether, demonstrate blood sugar-lowering effects in diabetic rabbits. Onion, known for its antioxidant and cholesterol-lowering properties, contains S-methyl cysteine sulphoxide (SMCS), which, when administered to diabetic rats, regulates blood glucose and lipid levels and normalizes liver enzyme activities. In diabetic individuals, consuming onion juice reduces post-meal glucose levels.

- **Neem: (Azadirachta indica)**

"The hydroalcoholic extracts of this plant demonstrate anti-hyperglycemic activity in streptozotocin-treated rats by increasing glucose uptake and glycogen deposition in isolated rat hemidiaphragm. In addition to its anti-diabetic properties, this plant also exhibits antibacterial, antimalarial, antifertility, hepatoprotective, and antioxidant effects."

- **Aloe vera:**

Aloe, a widely used indoor plant with a rich history as a multipurpose folk remedy, produces two main products: gel from leaf pulp and latex, termed "aloe juice," from bitter yellow exudate. Aloe gum extracts improve glucose tolerance in rats, while chronic Aloe barbadensis leaf treatment shows hypoglycemic effects in diabetic rats. Both single and chronic doses of the plant's bitter principle exhibit similar effects. Aloe vera stimulates insulin production from pancreatic beta cells and displays dose-dependent anti-inflammatory properties, enhancing wound healing in diabetic mice.

- **Jamun: (Eugenia jambolana)**

In India, a common home remedy for diabetes involves using a decoction from Eugenia jambolana kernels, a key ingredient in herbal diabetes treatments. Various extracts and powders from this plant effectively lower blood glucose levels, with reductions ranging from 73.51% in mild diabetes to 17.72% in severe cases. Jamun pulp extract shows rapid hypoglycemic effects in diabetic mice, while seed extract acts within 24 hours. These extracts elevate serum insulin levels and inhibit insulinase activity in the liver and kidney.

- **Mango: (Mangifera indica)**

In Nigerian folk medicine, Mangifera indica leaves serve as an antidiabetic treatment. Though its oral aqueous extract initially didn't impact blood glucose levels, administering it concurrently with glucose or pre-treating rats with the extract exhibited antidiabetic effects, indicating potential glucose absorption reduction in intestines.

- **Bitter gourd: (Momordica charantia)**

Bitter melon, scientifically known as Momordica charantia, is a popular antidiabetic remedy in India and across Asia. Extracts from its fruit, seeds, leaves, and whole plants exhibit hypoglycemic effects in various animal models. Polypeptide p, isolated from different parts of M. charantia, demonstrates significant hypoglycemic effects when administered subcutaneously to langurs and humans. Ethanol extracts of M. charantia, at a dose of 200 mg/kg, show both antihyperglycemic and hypoglycemic effects in normal and streptozotocin-induced diabetic rats. This may occur due to the inhibition of liver enzymes such as glucose-6-phosphatase and fructose-1,6-bisphosphatase, along with the stimulation of hepatic glucose-6-phosphate dehydrogenase activities.

- **Tulsi: (Ocimum sanctum)**

Tulsi, scientifically named Ocimum sanctum, renowned for its medicinal virtues since ancient eras, showcases substantial blood sugar reduction in both normal and alloxan-induced diabetic rats when administered as an aqueous leaf extract. Moreover, Tulsi demonstrates hypoglycemic and hypolipidemic effects, evidenced by significant reductions in various metabolic markers in diabetic rats. Oral ingestion of the extract at 200 mg/kg for 30 days notably lowers plasma glucose levels by around 9.06% on day 15 and 26.4% on day 30. Additionally, Tulsi exhibits diverse therapeutic properties, including antiasthmatic, antistress, antibacterial, antifungal, antiviral, antitumor, gastric antiulcer, antioxidant, antimutagenic, and immunostimulant effects.

- **Amla: (Emblica Officinalis)**

"Various solvent extracts of Emblica officinalis demonstrate inhibitory effects on α-amylase and α-glucosidase enzymes, suggesting potential as diabetes treatments. These extracts also exhibit significant

antiglycation activity, further supporting their therapeutic potential against diabetes. Methanol extracts notably inhibit the oxidation of low-density lipoprotein (LDL) under in vitro conditions."

- **Vijayasar: (Pterocarpus marsupium)**

The Indian Kino Tree, scientifically known as Pterocarpus marsupium, thrives in India's mountainous terrain. Derived from its wood, pterostilbene induces hypoglycemia in dogs. Tannates in the extract contribute to its hypoglycemic effects, while flavonoids aid pancreatic β cell regeneration. Compounds like marsupin, pterosupin, and liquiritigenin exhibit antihyperlipidemic properties. Its active component, epicatechin, enhances insulin release and oxygen uptake in fat cells.

Name of plant	Common name	Effect of Plant
Annona squamosa	Sugar apple	Ethanolic leaf extract exhibits hypoglycemic and antihyperglycemic effects, along with an increase in plasma insulin levels.
Artemisia pallens	Davana	Demonstrates hypoglycemic properties, either by enhancing peripheral glucose utilization or inhibiting glucose reabsorption.
Areca catechu	Supari	Shows hypoglycemic effects.
Beta vulgaris	Chukkander	Enhances glucose tolerance in Oral Glucose Tolerance Test (OGTT).
Boerhavia diffusa	Punarnava	Increases hexokinase activity, reduces glucose-6-phosphatase and fructose bisphosphatase activity, elevates plasma insulin levels, and acts as an antioxidant.
Butea monosperma	Palasa	Demonstrates antihyperglycemic effects.
Camellia sinensis	Tea	Displays anti-hyperglycemic activity and acts as an antioxidant.
Capparis decidua	Karir or Pinju	Possesses hypoglycemic, antioxidant, and hypolipidemic properties.
Caesalpinia bonducella	Sagarghota, Fevernut	Shows hypoglycemic effects, acts as an insulin secretagogue, and exhibits hypolipidemic properties.
Coccinia indica	Bimb or Kanturi	Demonstrates hypoglycemic effects.
Emblica officinalis	Amla	Reduces lipid peroxidation, acts as an antioxidant, and exhibits hypoglycemic effects.
Enicostema littorale	Krimihrita	Increases hexokinase activity, decreases glucose 6-phosphatase and fructose 1,6 bisphosphatase activity, and demonstrates dose-dependent hypoglycemic activity.

Gymnema sylvestre	Gudmar or Merasingi	Exhibits anti-hyperglycemic effects and possesses hypolipidemic properties.

Table: Formulated Herbal Drugs with antidiabetic properties

Drug	Company	Ingredients
Diabecon	Himalaya	Contains a blend of herbal ingredients including Gymnema sylvestre, Pterocarpus marsupium, Glycyrrhiza glabra, Casearia esculenta, Syzygium cumini, Asparagus racemosus, and others, aimed at managing diabetes.
Diasulin		Consists of Cassia auriculata, Coccinia indica, Curcuma longa, Emblica officinalis, Gymnema sylvestre, Momordica charantia, Scoparia dulcis, Syzygium cumini, Tinospora cordifolia, and Trigonella foenum graecum.

CONCLUSION:

Concluding up, it's evident that exploring various plants and herbal concoctions unveils a promising avenue for diabetes management. These natural remedies, including plants like Gymnema sylvestre and Emblica officinalis, have long been integral to traditional medicine practices, serving as effective tools in addressing diabetes and its associated complications. When combined in formulations such as Diabecon and Diasulin, these botanical ingredients synergize to offer a multifaceted approach to combating diabetes.

The historical use of these plants not only underscores their cultural significance but also underscores their continued relevance in contemporary healthcare. With documented properties such as hypoglycemic, antioxidant, and hypolipidemic effects, these botanicals present themselves as valuable assets in the fight against diabetes.

Moreover, the presence of active compounds like flavonoids, tannins, and polypeptides in these plants elucidates their pharmacological mechanisms and supports their efficacy in managing diabetes. Their holistic approach addresses various aspects of the condition, including blood sugar regulation, oxidative stress reduction, and lipid profile improvement.

While these traditional remedies offer promise, further research is essential to establish their safety, efficacy, and optimal dosing regimens. Collaboration between traditional medicine practitioners, researchers, and healthcare providers is crucial in bridging the gap between traditional knowledge and modern evidence-based medicine. This collaborative effort can pave the way for integrating botanical interventions into mainstream diabetes care, offering individuals a broader range of options for managing their condition effectively.

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