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MEDICINAL PLANTS: NATURAL REMEDIES FOR VARIOUS DISEASE TREATMENTS

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ABSTRACT

This study aims to evaluate medicinal plants for antidiabetic activity. Diabetes mellitus, a leading non-communicable disease, has reached epidemic levels globally, posing a significant health challenge. Traditional medicine, documented in Ayurveda and other texts, has long used plants for treating various ailments. Of approximately 250,000 plant species, less than 1% have been pharmacologically studied, with few focused on diabetes. According to WHO, 80% of people in developing countries rely on plant-based remedies, which are often more affordable, effective, and safer than modern medicines.

KEYWORDS: Medicinal plants, antidiabetic activity, diabetes mellitus, traditional medicine, plant-based remedies.

INTRODUCTION

Diabetes Mellitus is a global health crisis caused by insufficient insulin secretion or action, leading to hyperglycemia and severe complications such as cardiovascular disease, kidney failure, and neuropathy. As of 2004, over 180 million people were affected, with the number expected to double by 2030 due to urbanization, sedentary lifestyles, and unhealthy diets (WHO).

Diabetes significantly impacts quality of life and places economic strain on healthcare systems. Addressing this epidemic requires lifestyle changes, early diagnosis, improved healthcare access, and advanced technologies like glucose monitors and insulin pumps. Research into regenerative medicine and beta-cell replacement also shows promise for long-term solutions, with the highest prevalence increases projected in Asia and Africa.

TYPE OF DIABETES

Hyperglycemia, caused by insufficient insulin or ineffective use, can lead to complications like cardiovascular disease, nerve damage, and vision issues. Symptoms appear when blood glucose exceeds 180–200 mg/dL (10–11.1 mmol/L).

Hypoglycemia, or low blood sugar, occurs when blood glucose levels drop below 70 mg/dL (3.9 mmol/L). It is common in individuals with diabetes, particularly Type 1.

SYMPTOMS OF DIABETES

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

DIABETES MELLITUS

Type 1 diabetes, comprising 5–10% of cases, typically develops before age 20 but can occur at any age. It results from the loss of pancreatic beta cells, primarily due to an autoimmune attack, leading to severe insulin deficiency. Genetic factors, particularly HLA genotypes, and environmental triggers like infections may contribute. A slower-onset form in adults, called latent autoimmune diabetes of adults (LADA), is also recognized.

DIABETES INSIPIDUS

Type 2 diabetes, comprising 95% of cases, results from insulin resistance and reduced insulin secretion. Often preceded by prediabetes, its progression can be slowed or reversed through lifestyle changes or medications.

Key risk factors include obesity, inactivity, poor diet, stress, and genetics. Excess body fat, particularly abdominal fat, significantly increases risk, as do sugary drinks and unhealthy fats like saturated and trans fats.

HISTORY

Diabetes treatment aims to restore metabolic balance, with diet as the foundation since the 18th century and insulin discovery marking a breakthrough. Oral therapies like sulfonylureas (SU), which stimulate insulin secretion, were developed in the 1940s and 1950s, with metformin being the main biguanide still used.

PATHOPHYSIOLOGY OF DIABETES MELLITUS AND OXIDATIVE STRESS

Oxidative stress, caused by reactive oxygen species (ROS), contributes to diabetes complications, including atherosclerosis and beta-cell dysfunction. ROS activates harmful pathways such as glucosamine and protein kinase C, leading to advanced glycation end products (AGEs) and beta-cell failure. Antioxidants and the Nrf2-Keap1 pathway play protective roles against oxidative damage.

Oxidative stress, caused by an imbalance between reactive oxygen species (ROS) and antioxidants, plays a crucial role in diabetes progression. ROS damages LDL cholesterol, promotes atherosclerosis, and activates harmful pathways like glucosamine, sorbitol, and protein kinase C, leading to complications such as atherosclerosis, AGE formation, and beta-cell dysfunction.

Nrf2, a protective DNA-binding factor, and its regulator Keap1, are key in defending against oxidative stress, offering potential therapeutic targets for diabetes management.

OXIDATIVE STRESS: DEFINITION AND ROLE

Oxidative stress in diabetes results from excess ROS production due to hyperglycemia, overwhelming the body's antioxidant defenses. Key contributors include:

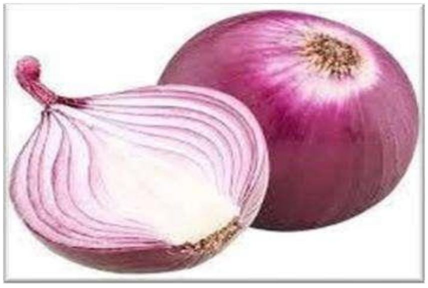
- Mitochondrial Dysfunction: Increased oxidative phosphorylation elevates ROS.
- Glucose Autoxidation: High glucose reacts with oxygen, producing ROS.
- AGEs: Hyperglycemia accelerates AGE formation, promoting ROS and inflammation.
- PKC Activation: Hyperglycemia activates PKC, exacerbating oxidative stress.
- Hexosamine Pathway: Excess glucose enhances oxidative damage.

ROS damages lipids, proteins, and DNA, contributing to diabetes complications.

Aegle marmelos: Aegeline 2 from *Aegle marmelos* lowers blood glucose (12.9% at 5h, 16.9% at 24h) and improves lipid profiles, reducing triglycerides by 55%, cholesterol by 24%, and free fatty acids by 24%, while increasing HDL-C by 28% in diabetic and dyslipidemic models.

Aegle Marmelos

Allii Cepa Bulbus (Onion): Onion improves diabetes by lowering blood glucose and cholesterol. Its extract, containing allyl propyldisulfide and S-methyl cysteine sulfoxide, helps manage diabetic nephropathy and exhibits effects similar to glibenclamide and insulin.



Allii Cepa Bulbus

Asparagus racemosus: Root extracts of *Asparagus racemosus* inhibit α-amylase and α-glucosidase, helping manage type 2 diabetes. Ethyl acetate and aqueous extracts showed significant effects, attributed to phytochemicals like flavonoids, tannins, and saponins.

Asparagus racemosus

Ceylon Cinnamon: Derived from the bark of *Cinnamomum verum* in the Lauraceae family, Ceylon cinnamon contains 0.5–4% essential oil, primarily cinnamaldehyde (65–75%), cinnamyl acetate, eugenol, and β-caryophyllene. It also includes polysaccharides, phenolic acids, and proanthocyanidins. Traditionally used in Chinese medicine for colds and flu, it is valued for its antibacterial, antifungal.

Ceylon cinnamon

Coccinia Indica: (Ivy Gourd) is native to Asia and Africa and contains alkaloids, glycosides, flavonoids, and phenolics. Traditionally, it is used for its antidiabetic, anti-inflammatory, and antimicrobial properties, with some studies supporting its antidiabetic effects using crude extracts.

Coccinia Indica

Eucalyptus globulus: A Myrtaceae family evergreen, native to Tunisia and Australia, also found in Africa and the U.S. Its leaves contain 1,8-cineole, α-pinene, and spathulenol. Essential oils are derived from its buds and branches.

Eucalyptus globulus

Eugenia jambolana: Known as jamun, this tree from the Myrtaceae family has edible berries and is used for diabetes treatment. It contains anthocyanins, glucoside, ellagic acid, isoquercetin, kaempferol, myricetin, and hydrolyzable tannins.

Eugenia jambolana

Ficus religiosa: Peepal tree bark, rich in tannins and flavonoids, is used in Ayurveda for diabetes. It exhibits hypoglycemic, antioxidant, and anti-inflammatory effects.

Ficus religiosa

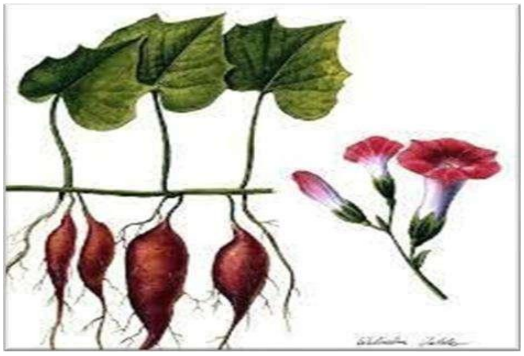
Ficus bengalensis: Banyan tree bark extracts show hypoglycemic activity. Other parts, like fruits and roots, may also hold antidiabetic potential.

Ficus bengalensis

Gymnema sylvestre: Known as gurmar, this herb reduces sugar absorption and boosts insulin secretion, aided by gymnemic acids. Widely used in Ayurveda for diabetes management.

Gymnema sylvestre

Ipomoea batatas:- *Ipomoea batatas* (L.) Lam., a perennial of the Convolvulaceae family, is grown annually for its tuberous roots, varying in color from purple to yellow. It is valued for its dietary, medicinal, and antidiabetic uses, containing phenolics, flavonoids, anthocyanins, and carotenoids.



Ipomoea batatas

Mangifera indica L. (cultivar Anwar Ratol) of the *Anacardiaceae* family is valued for its sweet fruit. The bark is traditionally used to treat infections, diarrhea, cancer, diabetes, and coughs, with hepatoprotective, antibacterial, and astringent properties. Studies show its analgesic, anti-inflammatory, and immunomodulatory effects.

Mangifera indica

Momordica charantia:- (bitter gourd) of the Cucurbitaceae family is used medicinally for its antidiabetic, hypoglycemic, and cardioprotective properties. Its bioactive compounds, including vicine and charantin, offer antibacterial, antiviral, and anticancer benefits.

Momordica charantia

Mechanisms of Action in Diabetes Management

1. **Insulin Secretion**: Stimulates pancreatic insulin production.
2. **Glucose Absorption**: Inhibits enzymes (α-amylase, α-glucosidase) to reduce glucose uptake.
3. **Glucose Uptake**: Activates GLUT4 transporters in muscles and fat.
4. **Oxidative Stress**: Antioxidants protect pancreatic beta cells.
5. **Insulin Sensitivity**: Compounds like charantin enhance receptor sensitivity.
6. **Lipid Regulation**: Lowers LDL and triglycerides.

Ocimum sanctum:- *Ocimum sanctum L.* (holy basil) of the *Lamiaceae* family is a medicinal plant rich in eugenol, flavonoids, tannins, and triterpenoids. Its leaf oil contains eugenol, ursolic acid, and caryophyllene, while the seed oil is a source of fatty acids and sitosterol.

Ocimum sanctum

Spergula arvensis :- *Spergula arvensis* (corn spurry) is rich in potassium, calcium, vitamins A and C, antioxidants, and essential amino acids like leucine and histidine. It is low in fat and sugar, with no toxic heavy metals detected.

Spergula arvensis

***Tridax procumbens*:-** Asian Ayurvedic plant Tridax procumbens L. (T. procumbens) is a member of the Asteraceae family and has been used traditionally. In traditional medicine, T. procumbens has been used since ancient times to treat wounds, skin conditions, and blood clotting.

Tridax procumbens

***Trigonella foenum-graecum*:-** *Fabaceae* family includes *Trigonella foenum-graecum*, also known as fenugreek or methi. The components of the plant that are used the most are the seeds and leaves. It is a semi arid crop that is grown all across India and several other countries. In India, it is used as a spice & vegetable. Fenugreek, a food flavoring agent, is well known for its strong, aromatic qualities. It is demonstrated to have potential antidiabetic effects of fenugreek. It also lowers cholesterol and glucose. By strengthening the decrease in maltase activity during diabetes, a study on intestinal and renal disaccharidase activity in rats with STZ-induced diabetes demonstrated the positive effects of fenugreek seed mucilage.

Trigonella foenum-graecum

White Mulberry:- China, Japan, Korea, India, Pakistan, and other Asian nations have subtropical or temperate temperatures where white mulberry trees can be found (Hocking 1993). The white mulberry is a small to medium-sized tree that bears blackberry-shaped fruit that is either white or light pink. White mulberry fruit has been used in a wide range of cuisines, including jams, wine, and flavoring additions, because of its mild sweetness. However, because the leaves are the main source of food for silkworm larvae, the silk industry has historically had the highest demand for white mulberry leaves. White mulberry fruit, leaves, and bark are used in traditional Chinese medicine for therapeutic purposes in addition to food use.

White mulberry

CONCLUSION

This review covers antidiabetic plants for diabetes treatment. Some plant-derived medications offer potential as long-term natural therapies or cost-effective short-term care through diet, supplements, and combination treatments. Their antidiabetic effects stem from bioactive compounds, though many lack proper characterization. Further research is needed to understand their mechanisms.

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