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Exploring Herbal Therapies for Diabetes: A Review of Promising Medicinal Plants

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Abstract:

Diabetes is a metabolic disorder characterized by elevated blood sugar levels, which occurs as a result of defects in insulin secretion or action, or both. There are two main categories of diabetes, namely type 1 and type 2. Risk factors for diabetes include genetics, obesity, hypertension, and others. Although conventional drugs like biguanides, sulfonylureas, and meglitinides are commonly prescribed for treatment, achieving desired effectiveness can still be challenging. Hence, researchers are exploring alternative therapies for diabetes. Medicinal plants have shown promise and are extensively used in India for the prevention and treatment of diabetes. This review article focuses on highlighting herbs that have been reported to possess significant antidiabetic properties.

Key words: Diabetes, Medicinal plants, antidiabetic property

Introduction:

Diabetes mellitus is a widespread metabolic disorder affecting people globally, characterized by high blood glucose levels known as hyperglycaemia. This condition arises from impaired insulin secretion, action, or both [1]. Prolonged uncontrolled hyperglycaemia associated with diabetes can lead to chronic damage, dysfunction, and organ failure in various areas of the body such as the kidneys, eyes, nerves, heart, and blood vessels. There are two primary types of diabetes: type 1 and type 2. Recent projections indicate that by 2030, around 438 million adults (7.8% of the adult population) worldwide are anticipated to be living with diabetes. [2].

There are different treatment options available for diabetes mellitus (DM), such as insulin therapy and oral antidiabetic medications like sulfonylureas, biguanides, and alpha-glucosidase inhibitors. These medications can be used alone or combined to improve blood sugar control. However, they may cause side effects like dizziness, drowsiness, heartburn, nausea, vomiting, increased urination, and more. Seeking more effective and safer hypoglycemic agents, researchers have turned to medicinal plants, which have shown promise in managing diabetes. India has identified numerous herbs with potential in diabetes management.

General Mechanism for Anti diabetic Property of Medicinal Plants

Numerous methods have been thoroughly investigated to comprehend the mechanisms by which medicinal plants exert their anti-diabetic effects.

These mechanisms include:

Some medicinal plants can help prevent the reabsorption of glucose by the kidneys, thereby reducing blood sugar levels [3]. Certain plants have the ability to stimulate the release of insulin from beta cells in the pancreas [4]. This helps in regulating blood sugar levels. Some plants can inhibit the breakdown of insulin, allowing it to remain active in the body for a longer period. This helps in maintaining optimal blood sugar control [5]. Certain medicinal plants have been found to improve insulin sensitivity in cells, reducing insulin resistance and promoting better glucose utilization [6]. Some plants have the potential to regenerate and repair damaged beta cells in the pancreas. This can lead to an increase in the size and number of cells in the islets of Langerhans, where insulin is produced [7]. Some plants have been shown to improve digestion and reduce the levels of urea, a waste product of protein metabolism that can accumulate in the blood when blood sugar is high [8]. Some plants can inhibit the activity of enzymes such as β-galactosidase, α-glucosidase, and alpha amylase, which are involved in the breakdown of complex carbohydrates [9]. This can lead to slower digestion and absorption of carbohydrates, resulting in better blood sugar control. Antidiabetic plants often possess antioxidant properties, protecting pancreatic beta cells from oxidative stress, which can impair their function [10]. It is important to note that the effectiveness and specific mechanisms of action can vary among different medicinal plants with anti-diabetic properties.

Methodology

The review process included a thorough search for research articles and patents from online journals like Pubmed, Google Scholar, and Science Direct. Furthermore, scientifically proven plants with beneficial antidiabetic qualities were collected from reputable sources in the literature.

Coccinia indica

Coccinia indica, a member of the Cucurbitaceae family, is a wild creeper commonly found in abundance in Bengal. This plant has been utilized in ancient times within the Indian system of medicine, known as ayurveda, for managing diabetes mellitus [11}. Research has indicated that administering an aqueous suspension of the ethanolic leaf extract orally to 18-hour fasted rats resulted in decreased blood glucose levels in both normal and streptozotocin-diabetic rats. Additionally, it was observed that the activity of the liver gluconeogenic enzyme, glucose6-phosphatase, was suppressed [12].

Azadiechta indica

Several studies have explored the antihyperglycemic properties of Azadirachta indica, a plant native to India and Burma. One study delved into how the leaf extract of Azadirachta indica inhibits serotonin in glucose-induced insulin release in rat pancreas, shedding light on its potential mechanisms of action. Meanwhile, another study showcased that hydroalcoholic extracts of this plant have antihyperglycemic effects in rats treated with streptozotocin by enhancing glucose uptake and glycogen deposition in isolated rat hemi diaphragm. Moreover, Azadirachta indica is known for its antibacterial, antimalarial, antifertility, hepatoprotective, and antioxidant properties [13].

Momordica charantia (Bitter Gourd)

The Momordica charantia plant, also known as bitter melon, belongs to the Cucurbitaceae family and is widely cultivated in various tropical and subtropical regions, especially in South Asia. Studies have shown that extracts from various parts of this plant possess hypoglycemic properties in diabetic rats induced with streptozotocin (STZ) [14] This research indicates that the oral consumption of bitter melon fruit juice may contribute to beta cell regeneration in STZ-induced diabetic rats, potentially assisting in the repair of partially damaged beta cells [15].

Ficus religiosa.

Ficus religiosa, commonly known as peepal in India, is a plant from the Moraceae family. In traditional Ayurveda, it has been used for treating diabetes. Ficus religiosa exhibits a wide range of pharmacological activities, both in vitro and in vivo, such as antidiabetic, hypolipidemic, anticonvulsant, anti-inflammatory, analgesic, antimicrobial, antiviral, antioxidant, antitumor, antiulcer, antianxiety, anthelmintic, antiasthmatic, immunomodulatory, estrogenic, endothelin receptor antagonist, apoptosis inducer, cognitive enhancer, and antihypertensive effects [16]. The bark of Ficus religiosa is used in the treatment of diabetes, and it contains various bioactive compounds including tannins, saponins, polyphenolic compounds, flavonoids, and sterols. One specific compound, sitosterol-d-glucoside, found in the bark, has been observed to have hypoglycemic activity in rabbits [17]. Other bioactive components identified in Ficus religiosa include leucocyandin-3-O-beta-d-galactosylcellobioside and leucopelargonidin-3-O-alpha-L-rhamnoside. The presence of phytoconstituents like phytosterols, flavonoids, tannins, bergapten, and bergaptol [18] in Ficus religiosa contributes to its significant antidiabetic effect. Overall, the plant holds promise for its medicinal properties and potential therapeutic use in managing diabetes.

Mangifera indica (Anacardiaceae)

The mango plant, commonly found in the Indian subcontinent, possesses a variety of chemical constituents including polyphenolics, flavonoids, and triterpenoids. Among these, the primary bioactive component is mangiferin, classified as a xanthone glycoside. Other active constituents present in this plant include isomangiferin and tannins [19]. The plant has been recognized for its numerous pharmacological properties, such as antioxidant, antidiabetic, antiviral, anthelmintic, antiallergenic, antiparasitic, and antidiarrheal effects. A study conducted by Aderibigbe AO et al demonstrated significant hypoglycemic activity in normoglycemic and glucose-induced hyperglycemic mice when administered the aqueous extract of mango leaves [20].

Psidium guajava (Myrtaceae)

Guava, scientifically known as Psidium guajava, is a plant commonly found throughout India. It contains various beneficial components in its leaves, including essential oils rich in cineol, tannins, triterpenes, flavonoids, resin, eugenol, and malic acid. The bark of the guava plant also contains tannins (12-30%) and calcium oxalate crystals [21]. Pharmacologically, guava is known for its antioxidant, hepatoprotective, anti-allergic, antimicrobial, antiplasmodial, cytotoxic, antispasmodic, and cardioactive properties. One study conducted by Oh WK et al revealed that the leaf extract of guava exhibited antidiabetic activity in a type-II diabetic mice model when administered at a dose of 10 mg/kg [22].

Phyllanthus niruri

The antidiabetic activity of the methanol extract (ME) derived from the aerial parts of Phyllanthus niruri, a plant belonging to the Euphorbiaceae family, was investigated in both normal and alloxan-induced diabetic rats. The study revealed that the ME exhibited a dose-dependent reduction in fasting blood sugar levels and effectively controlled the increase in postprandial blood glucose following a high glucose meal in rats with normal blood glucose levels. Furthermore, the chronic oral administration of ME resulted in a significant dose-dependent decrease in blood glucose levels, as well as total cholesterol and triglyceride levels, in both diabetic and normoglycemic rats [23].

Annona squamosa Linn. (Annonaceae)

Custard apple, also known as Annona squamosa Linn, is a popular fruit in India, referred to as Sharifa in Hindi. This plant is widely cultivated throughout the country. The seeds, leaves, and aerial parts of the plant contain pharmacologically active compounds. Various research studies have demonstrated that custard apple possesses both hypoglycemic and antidiabetic properties. It works by increasing insulin levels in the pancreatic islets, promoting glucose utilization in muscles, and reducing glucose production by the liver. This plant has a high margin of safety. Additionally, the extract derived from custard apple leaves plays a significant role in maintaining healthy blood sugar and cholesterol levels [24].

Syzium cumini (SC)

In India, Syzygium cumini (Myrtaceae) has been extensively utilized as a traditional medicinal treatment for diabetes. The extract derived from the seeds of Syzygium cumini has demonstrated antidiabetic properties when tested on rats induced with diabetes through streptozotocin (STZ). Further research has identified a compound called 'Mycaminose' present in the ethyl acetate and methanol extract. This compound, along with the extracts, has been shown to effectively lower blood glucose levels [25].

Cyamopsis tetragonoloba (Fabaceae)

Guar or cluster bean, scientifically known as Cyamopsis tetragonoloba, is a crop extensively grown in India. It is rich in various chemical compounds including carbohydrates, proteins, fibers, ascorbic acid, and flavonoids like quercetin and kaemferol. This plant has been used in traditional medicine for treating conditions such as diabetes, ulcers, hemolysis, asthma, and inflammation. Research conducted by Mahomed IM et al demonstrated that the aqueous extract of guar plant successfully decreased blood glucose levels in diabetic rats induced with alloxan, at a dosage of 800 mg/kg [26].

Conclusion:

The prevalence of diabetes mellitus in our contemporary society is closely linked to a lifestyle increasingly centered around materialistic pursuits. Various factors, including societal changes, stress, obesity, hormonal imbalances, and genetic factors, are fueling the widespread occurrence of this condition. With the number of people suffering from diabetes on the rise, there is a critical demand for viable solutions. An emerging strategy involves investigating traditional medicinal plants known for their anti-diabetic properties as potentially effective and widely accessible remedies for a broader demographic.

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