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Medicinal Plants with Anti-Diabetic Potential

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Abstract: ***Diabetes is a chronic disease characterized by an elevation of glucose level in blood either due to decrease in the ability of body to respond to insulin or decrease in the insulin produced by the pancreas. If the disease is not regulated it may lead to disruption of normal carbohydrates, fat and protein metabolism and the overtime development of micro-vascular and macro-vascular complications and neuropathies. Diabetes medications and medical devices largely contribute to the significant financial expense. Long term diabetes medications may lead to kidney damage and cancer. As an alternative, herbal treatment, like, use of Aloe vera, fenugreek, jambolan, bitter gourd, insulin plant, garlic and other herbs, have been preferred as these are cheaper and without any side effect. The present paper reviews the plants with anti-diabetic property.***

Key words: herbal treatment, anti diabetic property, insulin, diabetes

1. Introduction

Diabetes is a chronic disease characterized by hyperglycemia. This condition occurs either due to damage of pancreatic β-cells, reducing the supply of blood sugar regulating hormone insulin to the circulation (Type I) or due to peripheral insulin resistance in which insulin sensitivity is decreased to the adipose tissues, skeletal muscles and liver due to which the body does not respond to the effects of insulin properly (Type 2) (Choudhury *et al*., 2018). Type 2 diabetes is more common in people over 40 years of age while type 1 diabetes often starts in childhood or the teenage years. Symptoms include increased thirst, blurred vision, frequent urination, and unexplained weight loss. Chronic hyperglycemia causes damage to eyes, kidneys, nerves, heart and blood vessels (Mayfield, 1998). Treatment for diabetes includes exercise, weight control, meal planning, taking medication and/or lifestyle changes but it is the fact that no one had recovered totally from diabetes (Li *et al.,* 2004). The management of diabetes is a global problem until now and successful treatment is not yet discovered. Insulin injection or anti-diabetic agents are used for the treatment of diabetes. But these are less acceptable by the patients due to the side effects, unequal distribution or unaffordability. Therefore, different indigenous plant and herbal formulations with antidiabetic properties can be a better alternative therapy (Satyanarayana *et al.,* 2006). In the present paper plants with anti-diabetic potential and their active constituents are discussed. These herbal remedies may provide new alternatives for the clinical management of type II diabetes as they have no side effect, easier availability, low cost and easy acceptance by the people.

The present paper is based on a systemic literature review (SLR) method.

***Plants with anti-diabetic properties*:**

Fenugreek *(Trigonella foenum-graceum)* (Family: Fabaceae):
Trigonella is 0.3–0.8 m, erect, annual herb that is morphologically characterized by trifoliate leaves with stipules adnate to the stem. The axillary, sessile, raceme flowers produce 10–15 cm long, thin, slender, sword-shaped, yellow to brown pods with a curved beak-like tip. About 10–20 brown-colored, oblong or square-shaped hard seeds are produced from each mature pod (Singh *et al.,* 2022). The antidiabetic properties of fenugreek seeds are attributed due to sapouins, 4-hydroxyisoleucin [4-OHlle], galactomannan and trigonelline (Kavita *et al.,* 2022). The study conducted by Geberemeskel *et al., (*2019) on type II diabetic patients who consumed 25 g *Trigonella foenum-graecum* seed powder solution orally twice a day for one month showed pronounced effects in improving lipid metabolism in type II diabetic patients with no adverse effects.

Aloe vera *(Aloe barbadensis* L.) (Family: Asphodelaceae)
Aloe vera is a stemless or very short stemmed perennial succulent plant. The stem is short and stout, forming a rosette of thick, fleshy, lanceolate leaves with serrated margins. Roots are fibrous and fleshy. The flowers are produced in summer on a slender loose spike. Each flower is pendulous, 25-35cm in length with a yellow tubular corolla. Stamens frequently project beyond the perianth tube (Gangwar *et al.,* 2016). Aloe vera has been utilised for centuries as an anti-hyperglycemic drug that may be helpful in the treatment of pre-diabetes and diabetes (Ezuruike and Prieto, 2014). In an experiment conducted on albino rats *Aloe* extracts significantly decreased serum glucose and increased serum insulin levels (Abo-Youssef and Messiha, 2013). Recent approaches suggest that treatment of diabetes should also focus on antioxidant protection of the β-cell, which may facilitate the repair of β-cells undergoing damage by oxidative stress. **(**Robertson, 2010). By enhancing the activities of antioxidant enzymes and glutathione levels Aloe vera can inhibit oxidative stress (Haghani *et. al.,* 2022). Anthraquinones derived from Aloe vera are shown to have anti-diabetic property. These biologically active compounds are believed to ameliorate insulin resistance through diverse pathways, encompassing activation of the AMP-activated protein kinase (AMPK) signaling pathway, restoration of insulin signal transduction, attenuation of inflammatory pathways, and modulation of gut microbiota (Xia et al.2023).

Bitter gourd *(Momordica charantia* L.*)* *(*Family: Cucurbitaceae)
Momordica charantia is an annual to perennial climbing, broad-leaved herb with tap root. Stem is a herbaceous,

branched, tendril-bearing vine. Flowers are pale to deep yellow. Male flowers are larger than female flowers with slender basal swelling. Female flowers have a distinct warty swelling well below the base of the sepal tube with three stigmas. Fruits are egg-sharped and covered with longitudinal ridges and warts (Sesan, 2020).

The plant has the potential of being an important dietary ingredient for diabetic patients due to its remarkable hypoglycemic properties (Wang *et al.,* 2017). Vicine, charantin, glycosides, karavilosides, polypeptide-p and plant insulin are some of the effective anti-diabetic bioactive compounds extracted from *Momordica (*Joseph and Jini, 2013). Charantin, momordenol and momordicilin are important active compounds possessing insulin-like chemical structure and properties (Hazarika *et al.,* 2012).

Jambolan (*Syzygium cumini* (L.) Skeels) (Family: Myrtaceae)

Jambolan is an evergreen tree with obovate-elliptic leaves. The panicles are axillary or terminal having scented, greenish-white flowers. The calyx is funnel shaped. The stamens are numerous and about as long as the calyx. The fruit is dark-purple or nearly black fleshy edible berry with single large seed. The seed contain alkaloid jambosine, and glycoside jambolin or antimellin, which is reported to halt the diastatic conversion of starch into sugar (Ayyanar and Subash-Babu, 2012). Experiment conducted by Sharma *et al.* (2012) in HFD-STZ-induced type 2 diabetic rats demonstrated the beneficial effect of *Syzygium cumini* seed extract on insulin resistance and β-cell dysfunction. Perera *et al., (*2017) prepared the ready to serve drink from dried bark of *S. cumini* and confirmed the presence of antidiabetic compounds such as gallic acid, umbelliferone, and ellagic acid in it. Their findings scientifically prove the efficacy of using *S. cumini* bark in herbal formulations used in the treatment of diabetes mellitus in Ayurveda medicine.

Garlic (*Allium sativum* L.) (Family: Liliaceae)

Allium sativum is an annual, herbaceous, erect or prostrate, bulbous plant. The underground bulb has a central woody stalk surrounded by the succession of leaves covered by the leaf sheaths. Depending on the variety, the leaves may grow from a short, hard stem or a softer pseudostem. The small white flowers of garlic are hermaphrodite. The root system is adventitious. The bulbs can be of variety of shapes and sizes. The inflorescences, when present, are umbel (Agbo So *et al.,* 2021).

Garlic, used as a spice in various food preparations, has been reported to have antidiabetic activity. Flavonoids and saponins are the phytochemicals found in garlic that function by deferring the absorption of carbohydrates so that glucose levels within the blood diminish (Adi *et al.,* 2023). On investigation of antidiabetic effect of garlic ethanolic extract in normal and streptozotocin-induced diabetic rats by Eidi *et al. (*2006), the diabetic rats showed significant decrease in serum glucose, total cholesterol, urea, uric acid, triglycerides, creatinine, AST and ALT levels, with increased serum insulin. In this study the antidiabetic effect of the extract was more effective than that observed with glibenclamide, the known antidiabetic drug.

Insulin plant *(Chamaecostus cuspidatus* (Nees & Mart.) C. Specht & D. W. Stev.) (Family: Costaceae)

Chamaecostus cuspidatus, common name fiery costus or spiral flag, is a species of herbaceous plant. It has an underground rhizome, producing new fibrous roots out of their nodes, down into the soil and erect branched stem. The leaves of *Chamaecostus cuspidatus* are simple, alternately arranged, lanceolate, entire, petiolate, large and fleshy. They are consumed raw or as a tea to help control blood sugar levels. *Chamaecostus* plant produces capituli of orange tubular, epigynous, perfect and zygomorphic flowers. Ovary with bilocular, inferior, anatropous ovule and axile placentation. The fruits are inconspicuous capsules. The habit of this plant is sub terrestrial (Rout *et al*, 2022). In India, it is known as insulin plant for its anti-diabetic properties. B-sitostirol, corosolic acid, diosgenin, oleic acid, quercetin and catechine are the secondary metabolites of this plant that show anti-diabetic activity. This plant has also been reported to have diuretics, antioxidant, anti-inflammatory, anti-proliferative, anti-urolithiasis, hypolipidemic, neuroprotective antimicrobial and anti cancerous activities (Jyothi *et al.,* 2015, Shinde *et al*., 2022).

2. Conclusion

Diabetes is an endocrine disease with high blood glucose level. The disease is non-curable but herbal medications can make the life easy and healthy. Although synthetic anti-diabetic medications are available but hypoglycemic agents from natural sources are greatly needed as they are safer, more effective and have no side-effects. Many active ingredients having hypoglycemic activity has been extracted from herbal plants while many more are yet to be discovered.

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