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Antidiabetic Medicinal Plants: An updated Review

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Abstract*— *Hyperglycemia is the primary symptom of diabetes, a metabolic condition caused by impaired insulin production, insulin action, or both. There are two main subtypes of diabetes: type I and type II. Genetic predisposition, excess body fat, high blood pressure, and other similar variables all contribute to the development of diabetes. Many diabetic medications, including biguanides, sulfonylureas, meglitinides, etc., are now available for conventional use. However, we have yet to reach the point where we can cure people effectively. This is why scientists are actively seeking for new methods of treating diabetes. The study and application of medicinal plants holds great promise for the future of complementary treatment. Traditional diabetes treatment and management in India often include the use of medicinal herbs. Herbs with potentially beneficial effects on diabetes are discussed in this review article.

Keywords*— *Diabetes, alternative therapy, herbs, hyperglycaemia.

I. INTRODUCTION

Diabetes mellitus, defined by hyperglycemia and resulting from abnormalities in insulin production, insulin action, or both, is a widespread metabolic illness affecting people all over the globe. Long-term damage, malfunction, and failure of organs including the kidneys, eyes, nerves, heart, and blood vessels are all caused by chronic hyperglycemia, a frequent outcome of uncontrolled diabetes. Type-I and type-II diabetes are the two most common forms of the disease.

Type I diabetes, sometimes called insulin-dependent diabetes since it is treated with insulin injections on a daily basis, is characterized by inadequate insulin production. This is because pancreatic b cells become victim to cellular-mediated autoimmune damage.

Non-insulin dependent diabetes, or type 2 diabetes, is caused by the body's inability to properly utilise insulin. Type II diabetes is often caused by a combination of hereditary factors, excess body fat, unhealthy eating habits, lack of exercise, becoming older, high blood pressure, and other causes. Gestational diabetes is a kind of diabetes that develops during pregnancy and is characterized by increased glucose tolerance. Although this is a short-term problem, it may eventually lead to diabetes.

In 2014, 422 million individuals had diabetes, as reported by the World Health Organization. Type II diabetes is the most common form of diabetes, and it is responsible for 1.5 million fatalities worldwide in 2012. Type II diabetes was formerly only identified in adults, but recent studies have shown that it may also affect youngsters. Increased free radical generation and weakened antioxidant defenses contribute to oxidative stress, a well-established pathogenic mechanism in the onset and progression of diabetes.

Conventional treatments for diabetes include a wide range of pharmaceuticals, including sulfonylureas, biguanides, meglitinides, PPAR- agonists (glitazones), DPP-4 inhibitors, SGLT2 inhibitors, dopamine-2 agonists, and -glucosidase inhibitors. However, a cure for diabetes has not yet been discovered. Researchers are working to find better ways to treat diabetes. Plants used for medical purposes were an important part of our study since they are such a reliable medication

resource. The treatment of diabetes using herbs has a long history in India. According to the ethnobotanical data, over 800 plants have possible anti-diabetic properties.

We may be able to find new medications that are both therapeutically active and less expensive thanks to our research and understanding of medicinal plants. The use of herbs in therapy has a number of benefits, including the fact that they are readily accessible, have few negative effects, etc. By conducting a comprehensive literature search, this study provides a description of the antidiabetic medicinal plants that have been found to have excellent therapeutic efficacy.

II. REVIEW

Pubmed, Google scholar, Science direct, etc. were used to look for relevant research publications and patents for this review. The literature on plants with proven anti-diabetic properties is also included..

***Pterocarpus santalinus* (Fabaceae)**

Red sandalwood, often called saunderswood, is a widespread plant in southern India. There are several different chemical components in it, including sugars, steroids, anthocyanins, saponins, tannins, phenols, triterpenoids, flavonoids, and glycosides. Santalin is the primary bioactive component of the plant. In addition to -eudeslol and cryptomeridol, it also contains pterocarpol, pterocarptriol, ispterocarpolone, and pterocarpo-diolones. It's a tonic, aphrodisiac, astringent, and effective against diabetes and worms. Inflammation and ulcers are two other conditions it is used to treat. The plant's antidiabetic properties have been shown in several research. Traditional diabetic care involves using the plant's heartwood cups for drinking water. At a dosage of 0.25 g/kg body weight/day, the ethanolic fraction of the plant exhibited hypoglycemic effect, as described by Rao et al. Co-administering 250 mg/kg of the plant's aqueous extract with vitamin E in streptozotocin-induced diabetic rats resulted in a considerable reduction in blood pressure, as discovered by Halim and Mishra.

***Brassica juncea* (Brassicaceae)**

Chinese mustard, often known as brown mustard, is a plant that may be found all over the world. Triterpenes, Saponins, Alkaloids, Flavonoids, and a Hodgepodge of Other Chemicals Make Up Its Makeup. Medicinally, it's utilized for a variety of conditions, including as an antiscorbutic, diuretic, stimulant, stomachic, antihelmintic, antidysentric, diaphoretic, and antiarthritic. In a study using a streptozotocin-induced diabetic male albino rat model, Thirumalai T et al. found that 250, 350, and 450 mg/kg of the plant's aqueous seed extract had significant hypoglycemic action.

***Swertia punicea* (Gentianaceae)**

The plant is widely accessible in many Asian nations, including India, Pakistan, China, Japan, and others. The plant's xanthonoids, terpenoids, flavonoids, alkaloids, irridoid glycosides, etc., make up an essential class of active ingredients. The majority of these chemicals are xanthonoids. Hypoglycemic, antihepatotoxic, anti-inflammatory, anti-malarial, antioxidant, antibacterial, etc. are some of the medicinal uses for it. The herb's antidiabetic properties have been the subject of several investigations. Pen and Fang report on a research showing that this herb significantly lowers blood sugar levels. Both the ethanol extract and the ethyl acetate soluble fractions of the plant demonstrated a hypoglycemic effect in streptozotocin-induced type-II diabetic mice (Wen L., Chen J.C). Methylswertianin and Bellidifolin, two xanthone derivatives derived from the plant, had a strong antidiabetic effect at a dosage of 200mg/kg body wt. /day in Streptozotocin (STZ)-induced type 2 diabetic male BABL/c mice.

***Gymnema sylvestre* (Asclepiadaceae)**

It is a woody vine that lives for many years and thrives in the warm climates of tropical regions like India, Africa, and Australia. The plant's principal medicinal component is gymnemic acid. Flavones, anthraquinones, hentri-acontane, pentatria contane, beta and gamma chlorophylls, phytin, resins, d-quercitol, tartaric acid, formic acid, etc. are some of the other active ingredients. In a dosage and time dependent manner, crude extracts of the plant and its isolated component dihydroxy gymnemic triacetate had a strong hypoglycemic impact in streptozotocin induced diabetic rats, as discovered by Daisy et al. The aqueous extract of the leaves of the plant and isolated human islets in vitro enhanced insulin production from mouse cells at dosages of 0.06-2 mg/ml and 0.125 mg/ml, respectively, without affecting cell viability, as reported by Liu et al.

***Ricinus communis* (Euphorbiaceae)**

Perennial blooming plant of the genus is common throughout India. Steroids, Saponins, Alkaloids, Flavonoids, Glycosides, and Other Chemicals are

Present. Glycosides of ricinoleic, isoricinoleic, stearic, and dihydroxystearic acids make up 45% of the fixed oil found in the seeds and fruits. There are several pharmacological applications for it, including those in the treatment of cancer, inflammation, ulcers, diabetes, asthma, and other chronic diseases. Initial screening investigations conducted with a dosage of 250 mg/kg on albino rats revealed hypoglycemic action in the plant's root, stem, and leaves, as reported by Dhar ML et al. Blood glucose levels in alloxan-induced diabetic rats were significantly reduced by 500 mg/kg of the ethanolic extract of the plant's roots, as reported by Poonam Shokeen et al.

***Combretum micranthum* (Combretaceae)**

Northern Nigeria, Senegal, Mali, and the Gambia are all typical locations for this species. There are several chemical groups present, including alkaloids, flavonoids, tannins, terpenoids, and more. Antioxidant, anti-inflammatory, antibacterial, etc. are only few of its many pharmacological applications. In diabetic and sub-diabetic rats, Aminu Chika et al. found that 100mg/kg of the plant's aqueous leaf extract had an antidiabetic effect.

***Arbutus unedo* (Ericaceae)**

It is an evergreen plant that may be found in its natural habitat in both France and Ireland. Terpenoids, a-tocopherol, essential oils, phenolic compounds, and organic acids are just some of the kinds of substances that may be found in this plant. It's used to treat a wide range of conditions, including heart disease, diabetes, inflammation, hypertension, skin issues, and digestive issues. The plant's aqueous extract, as reported by Mrabti H et al., significantly improved metabolic alternations and had an in-vitro and in-vivo antidiabetic impact in streptozotocin-nicotinamide (STZ-NA) produced diabetic mice at the dosage of 500 mg/kg.

***Cocos nucifera* (Arecaceae)**

Coconuts are easily accessible in the coastal areas of India, thus the name. Polyphenols, tannic acids, leucoanthocyanidins, flavonoids, triterpenes, steroids, and alkaloids are only some of the many useful chemicals found in it. It has a wide range of pharmacological applications, including pain relief, inflammation reduction, infection prevention, antioxidant activity, parasite and malaria prevention, heart protection, and more. At a dosage of 300 mg/kg, S. Saranya et al. discovered that the plant's floral extract had considerable antidiabetic efficacy in streptozotocin-induced diabetic rats. At dosages of 200 mg/kg and 400 mg/kg, ethanolic extract of this plant exhibited strong antidiabetic action in streptozotocin-induced diabetic rats, as reported by Nidhi Tyagi et al.

***Sarcopoterium spinosum* (Rosaceae)**

The Mediterranean and Middle Eastern regions are rich in this plant's natural habitat. Quercetin, hesperidin, naringin, rutin, gallic acid, catechol, protocatechuic acid, etc. are just some of the flavonoids and phenolics chemicals found in this plant. Historically, it was utilized as a remedy for diabetes. It is also effective in reducing inflammation and relieving pain. According to a research by Dafni et al., the plant's root extract was utilized in traditional Muslim medicine to cure diabetes. The plant's root extract, as described by Polina Smirin et al., had strong hypoglycemia action in diabetic KK at a concentration of 0.01 mg/ml.Hey rodents.

***Vernonia anthelmintica* (Asteraceae)**

Wild cumin is an annual herbaceous plant that may be found all throughout India. Delta7avenasterol, a steroidal molecule found in the seeds, is the plant's primary active ingredient. Additional components include the flavan glycosides p-hydroxybenzoyl vernovan and vernovan, the sterols 4-alpha-methylvernosterol and vernosterol, the bitter principle demanolide lactone, and so on. Inflammation, arthritis, diabetes, cancer, and many other diseases may all be alleviated with its help. At a dosage of 100 mg/kg, the ethanolic extract of the plant demonstrated strong antihyperglycemic action in streptozotocin-induced diabetic rats, as reported by Shaik Sameena Fatima et al.

***Elephantopus scaber* (Asteraceae)**

The tropical regions of Africa, Asia, the Indian subcontinent, Southeast Asia, and northern Australia are all home to this flowering plant species. Sesquiterpene lactones, phenolic acids, and flavonoids make up the bulk of the plant's chemical make-up. It has several pharmacological applications, including as an anticancer, antitumor, anti-inflammatory, antibacterial, antifungal, anticoagulant, hepatoprotective, etc. The acetone extract of the plant revealed a strong hypoglycemic impact in streptozotocin-induced diabetic rats, as reported by Daisy P et al.

***Liriope spicata* (Asparagaceae)**

Its native range includes East Asia, where it grows as a herbaceous flowering plant. It's loaded with beneficial

phytochemicals including saponins and polysaccharides. It has pharmacological use as a pain reliever, asthma remedy, cancer treatment, etc. In male BABL/c mice with type 2 diabetes caused by streptozotocin (STZ), Xianghong Chen et al. found that the plant's aqueous extract had a substantial hypoglycemic impact at dosages of 200 and 100 mg/kg.

***Mangifera indica* (Anacardiaceae)**

The mango fruit comes from a tree that is native to the Indian subcontinent. Among its many chemical components are polyphenolics, flavonoids, and triterpenoids. Mangiferin, a xanthone glycoside, is the primary bioactive component. Isomangiferin, tannins, etc. are also contained in this plant and contribute to its medicinal properties. Antioxidant, antidiabetic, antiviral, anthelmintic, antiallergenic, antiparasitic, antidiarrheal, etc. are only a few of its many pharmacological applications. The hypoglycemic effect of an aqueous extract of the plant's leaves was found by Aderibigbe AO et al. in both normal and glucose-induced hyperglycemic rats.

***Aloe vera* (Asphodelaceae)**

A perennial plant used for its useful therapeutic properties, it thrives in tropical regions all over the globe. Aloe-emodin, barbaloin, isobarbaloin, and other anthraquinone glycosides predominate in this plant. Aloe leaf gel extract has a positive impact as an antidiabetic medication, according to a study by Ayse Can et al. At a dosage of 200 mg/kg, aloe vera gel demonstrated considerable antidiabetic efficacy in streptozotocin-induced diabetic rats, as reported by Jain N et al.

***Allium sativum* (Amaryllidaceae)**

The garlic plant is native to Central Asia and northern Iran, and it is extensively cultivated in India. Sulfur compounds like trisulfides and disulfides make up the bulk of its essential oil. Antibacterial, antifungal, antiparasitic, antiviral, antihypertensive, antithrombotic, etc. are only few of the pharmacological benefits. Research by Eidi A. et al. suggests this plant warrants further investigation in the fight against diabetes mellitus. Because in streptozotocin-induced diabetic rats at 0.1, 0.25, and 0.5 g/kg.

***Nigella sativa* (Ranunculaceae)**

This plant, found naturally only in the southern and western parts of Asia, is also known as black cumin. Fixed oil, proteins, alkaloids, saponins, and essential oils are only some of the chemical components found in it. Saturated fatty acids like nigellone are found in volatile oil, whereas unsaturated fatty acids like arachidonic acid, linoleic acid, linolenic acid, etc. are found in the fixed oil. This plant contains the alkaloids nigellicimine, nigellidine, and so on. Thymoquinone is the primary bioactive ingredient. Antibacterial, antifungal, antioxidant, diabetic, anticancer, immunomodulatory, hepatoprotective, etc. are only few of the pharmacological uses. Thymoquinone, the plant's primary active ingredient, was shown to have considerable antidiabetic effect in streptozotocin-nicotinamide induced diabetic rats at a dosage of 80 mg/kg, as reported by Pari L et al. The antidiabetic efficacy of N.sativa oil was found to be substantial in a group of 30 individuals by Najmi A et al. The medical facility where this investigation was carried out was a tertiary care facility in Northern India.

***Psidium guajava* (Myrtaceae)**

The guava tree, as the plant is more often called, is a ubiquitous sight all throughout India. Cineol, tannins, triterpenes, flavonoids, resin, eugenol, malic acid, and many more compounds may be found in the essential oil found in the plant's leaves. Tannins (12-30%) and calcium oxalate crystals may be found in the bark. Antioxidant, hepatoprotective, anti-allergic, antibacterial, anti-plasmodial, cytotoxic, antispasmodic, cardioactive, etc. are only few of the pharmacological uses for it. Oh WK et al. indicate that a 10 mg/kg dosage of the plant's leaf extract has antidiabetic action in a mouse model of type II diabetes.

***Fraxinus excelsior* (Oleaceae)**

The European ash tree is easily accessible all throughout the continent. Iridoids, secoiridoids, flavonoids, triterpenes, alkanes, etc. are only some of the chemical components found in this plant. It may help with conditions including arthritis and diarrhea. At a dosage of 10 mg/kg, Eddouks M. et al. found that glucose reabsorption was significantly inhibited in both normal and streptozotocin-induceddiabetic rats.

***Cyamopsis tetragonoloba* (Fabaceae)**

Guar, also known as cluster bean, has extensive cultivation in India. Carbohydrates, proteins, fibers, ascorbic acid, flavonoids like quercetin, kaemferol, etc. are only some of the chemical components found in this plant. Diabetes, ulcers, hemolysis, asthma, inflammation, etc. are only some of the medical conditions that may be helped by using this drug. Blood

glucose levels in alloxan-induced diabetic rats were shown to be lowered by 800 mg/kg of the plant's aqueous extract, as discovered by Mahomed IM et al.

***Origanum vulgare* (Lamiaceae)**

This blooming plant is native to the Mediterranean area and the western and southwestern regions of Eurasia. The phenolics, phenolic acids, esters, glycosides, flavonoids, steroids, etc., ect. are all present. Antioxidant, antifungal, antibacterial, antithrombin, etc. are only few of the pharmaceutical uses for it. Lemhadri A observed that normal rats given 20 mg/kg of the plant's aqueous extract had considerable anti-hyperglycemic effects.

***Agrimonia eupatoria* (Rosaceae)**

The agrimony plant is widely distributed throughout Europe. Terpenes, phenolic compounds, tannins, flavonoids, proteins, carbs, and vitamins are only some of the numerous pharmaceutically active components found in it. Therapeutically, it is used for a wide variety of purposes, including as an antiviral, antibacterial, antitumor, analgesic, immunomodulatory, antioxidant, hepatoprotective, etc. The antihyperglycemic activity of the plant aqueous extract was reported by Gray AM et al. to be substantial at 1 mg/ml and 0.25-1 mg/ml in streptozotocin-induced diabetic mice.

***Emblica officinalis* (Euphorbiaceae)**

The amla plant is abundant in its native India. Tannins, gallic acid, ellagic acid, chebullagic acid, vitamin C, and more may all be found in this plant. It has a variety of medicinal purposes, including those of an astringent, anti-aging agent, amnestic, anti-cancer agent, anti-fungal agent, anti-viral agent, anti-venom agent, anti-ulcerogenic agent, etc. The seeds' aqueous extract was shown to have significant hypoglycaemic action in streptozotocin-induced type-II diabetic rats at a dosage of 300 mg/kg, as reported by Shikha Mehta et al.

***Acacia arabica* (Fabaceae)**

Its cultivation spans the whole Indian subcontinent. Phenoxanthin, tannin, gallic acid, protocatechuic acid, pyrocatechol, catechin, epigallocatechin-7-gallate, quercetin, isoquercetin, etc. are some of the compounds found in it. Pharmaceutically, it is used in the treatment of a wide variety of conditions, including those related to bacteria, fungi, viruses, parasites, diarrhea, inflammation, ulcers, and even abortion. This plant extract exhibited considerable hypoglycaemic action in albino rats when given at dosages of 100 mg/kg and 200 mg/kg, according to a research published by Hegazy GA et al. Researchers Mohammad Yasir et al. observed both diabetic and normal rats had greater antihyperglycemic activity when given 400 mg/kg of the plant's cold aqueous extract.

***Murraya koenigii* (Rutaceae)**

Curry patta is the popular name for this plant in India. Its primary chemical components are -pinene (51.7%), sabinene (10.5%), -pinene (9.8%), -caryophyllene (5.5%), limonene (5.4%), bornyl acetate (1.8%), terpinen-4-ol (1.3%), -terpinene (1.2%), and -humulene (1.2%). It may be used as an antibacterial, antifungal, antiprotozoal, and other therapeutic agent. Arulselvan P. et al. discovered that the ethanolic extract of this plant displays strong hypoglycaemic action in streptozotocin induced diabetic rats, making it a more effective therapy for diabetes than glibenclamide. In alloxan-induced diabetic albino rats, leaf extracts of the plant demonstrated a substantial hypoglycaemic impact at the dosages of 250 and 500 mg/kg, as reported by S.Vijayanand.

***Helicteres isora* (Malvaceae)**

The seeds of this plant may be found all throughout India. The antioxidants, proteins, phenols, flavonoids, alkaloids, glycosides, carotenoids, tannins, etc. found in it make it a valuable therapeutic ingredient. Medical professionals use it for its expectorant, antidiarrheal, anti-diabetic, anti-spasmodic, hemostatic, and other beneficial properties. The plant's ethanolic extract shows considerable antidiabetic activity in diabetic C57BL/KsJdb/db mice at the dosage of 300 mg/kg, as reported by Chakrabarti R et al.

III. DISCUSSION

Many ailments, including diabetes, have traditionally been treated using medicinal herbs. Herbal remedies are often employed since they are seen as safer and more effective than other options. We were able to learn about medicinal plants with strong antidiabetic action by drawing on both ethnobotanical and ethnopharmacological information. This article provided a summary of the research on medicinal plants used to treat diabetes. It also details the more potent extracts and plant sections, such as the leaf and acetone extract, respectively. It is also clear that several studies are conducted in India and elsewhere with the hope of developing a viable therapy for diabetes.

IV. CONCLUSION

Several different medicinal plants are historically utilized in India to treat diabetes in a variety of ways. Recent studies on the anti-diabetic properties of herbs have contributed to the creation of useful herbal treatments for this condition. New potential antidiabetic substances may be found with the use of appropriate data on medicinal plants. This post was intended to educate readers about medicinal plants that may help control or even reverse diabetes. The data presented here on medicinal plants might be useful for future studies of diabetes.

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