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ANTI-DIABETIC PHARMACOTHERAPEUTIC POTENTIALS OF SOME INDIAN MEDICINAL PLANTS: INSIGHTS INTO THE NATURAL ARMAMENTARIUM

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ABSTRACT

Herbal medication has grown exponentially in popularity in recent years, gaining popularity in both emerging and industrialized countries due to its natural origins and lack of side effects. To compile knowledge regarding medicinal plants used to cure diabetes mellitus, a systematic study was performed. It is a metabolic disease of the endocrine system that affects about 10% of the world's population, with the number of people afflicted growing by the day. The profiles provide details on the scientific and family names of the plants, plant sections and research models used, hypoglycemic behavior, and active chemical agents. The vast number of plants mentioned in this analysis exemplified the role of herbal plants in diabetes care. These plants' effects can help to delay the onset of diabetic complications and correct metabolic imbalances. This study encourages researchers to do further studies into the possible usage of medicinal plants with anti-diabetic properties.

Keywords: Diabetes, Herbal, Natural, Plants, Mechanisms, Products

INTRODUCTION

Medicinal plants remain an effective medicinal help in the treatment of human ailments. Over the last 2500 years, very large western medical systems such as Chinese, Ayurvedic, and Unani have been born and studied, mostly on the eastern continent. These practices are also alive and well, since nearly 80% of citizens in developed countries depend on these medical services for their primary health care. These plants produce compounds that can be used for medicinal purposes, including precursors for drug synthesis. A great deal of study has been done on medicinal plants, and it has been discovered that they have a distinct effect on the nervous, circulatory, respiratory, digestive, and urinary processes, as well as the sexual organs, skin, vision, hearing, and taste. Diabetes mellitus is a category of metabolic disorders marked by hyperglycemia caused by insulin secretion, intervention, or both. Type-I diabetes, also known as juvenile diabetes, is an insulin-dependent condition that affects just about 5% of diabetics. Adults over the age of 40 are more likely to have Type-II diabetes, which is non-insulin related. Chronic hyperglycemia caused by diabetes has been linked to long-term injury, deterioration, and eventually organ failure, particularly in the eyes, kidneys, nerves, heart, and blood vessels. It disrupts glucose, lipid, and protein metabolism, resulting in persistent hyperglycemia and lipid profile abnormalities. Polyurea, polyphagia, ketosis, retinopathy, and cardiovascular disease are among the secondary complications. Despite the introduction and widespread use of hypoglycemic agents, diabetes and its complications remain a major health problem worldwide, affecting nearly 10% of the global population. Over the next 25 years, it is expected to become one of the world's most powerful disablers and murderers. Predisposing or risk factors are a group of factors that lead to the onset of diabetes. Diabetes is increased by environmental causes such as nutrition, obesity, and a sedentary lifestyle. High family accumulation, insulin tolerance, dietary condition, size, and lifestyle transition due to urbanization are all significant risk factors. Diabetes control has been a global issue until now, and a viable cure has yet to be found (Rai,1995).

Insulin and other oral hypoglycemic agents such as sulfonylureas, metformin, glucosidase inhibitors, troglitazone, and others are currently eligible for diabetes treatment. However, severe side effects such as liver complications, lactic acidosis, and diarrhea have been identified. It presently affects about 143 million people, and the amount of people affected is the everyday; by 2030, the global population is expected to hit 366 million. There are approximately 800 plant species that have been confirmed to have anti-diabetic properties. Native Americans, Chinese, South Americans, and Asian Indians have also used various plant species to avoid or treat diabetes. According to the report, the Asian and African continents account for 56 percent and 17 percent of the global distribution of medicinal herbal plants, respectively. Biological activities of the plants are linked to chemical structure, with phenolics, alkaloids, flavonoids, terpenoids, coumarins, and glycosides showing beneficial results. On the other side, certain traditional diabetes medications, such as metformin, are secretagogues derived from plants. Diabetes is treated with traditional medications that improve

insulin sensitivity, increase insulin output, and lower blood glucose levels. Many medicinal plants have been identified as a possible source of anti-diabetic principles that are commonly used for the treatment of diabetes mellitus in different conventional systems of medicine around the world, and many of them are considered to be successful against diabetes. The hypoglycemic effect of a pharmacologically active portion of the plant reduces the impact of -amylase, as well as various direct and indirect effects of various blood parameters linked to diabetes production. There are several anti-diabetic medications available on the market for diabetes and its complications; however, there is still no suitable treatment available to cure the condition. However, the efficacies of these drugs remain debatable due to unintended side effects, and there is a need for new compounds for the management of diabetes. Thanks to their natural sources and fewer side effects, there has been an increasing interest in herbal medication in the diagnosis and treatment of diabetes in both developing and industrialized countries in recent years. An effort has been made in this review article to compile the published hypoglycemic plants accessible in various research publications, which could be useful to health practitioners, scientists, and academics employed in the field of pharmacology and therapeutics to establish evidence-based alternative medication to treat various types of diabetes in humans and animals. This study demonstrates the significance and curiosity in medicinal plants in the quest to prove their anti-diabetic effects and the bioactive agents responsible. The general name of a plant, the parts that are widely used as cure origins, extracts, doses, and a test model are all included in this study (Preethi, 2013)

Diabetes mellitus

Diabetes mellitus is spreading at an unprecedented rate across the globe, affecting three-quarters of the global population, and is seen as a significant cause of high economic decline, which may stymie nation-building. Furthermore, untreated diabetes causes a slew of long-term problems, including blindness, coronary attack, and renal failure, to name a few. As a result, treatments based on the ideals of western medicine (allopathic) are often ineffective, carry the risk of side effects, and are prohibitively expensive, especially in developing countries. As a result, curing diabetes mellitus with plant-derived compounds that are readily available and do not need time-consuming medication synthesis seems to be quite appealing (Rao *et.al.,* 2010).

Types Of Diabetes Mellitus

There are three main types of diabetes mellitus (T Mamun-or-Rashid *et. al.,* 2011).

These are the following:

- **Type-I diabetes mellitus:** Type-I diabetes is caused by the body's inability to contain insulin. Insulin-dependent diabetes mellitus (IDDM) or "juvenile diabetes" is the name given to this category. Diabetes Type-I is the most common type of diabetes.
- **Type-II diabetes mellitus:** Insulin tolerance, a disease in which cells refuse to utilize insulin correctly, causes type-II diabetes mellitus, which may often be accompanied by an absolute insulin deficiency.
- **Gestational diabetes mellitus:** The third most common form, gestational diabetes, is a type of diabetes that affects certain women during pregnancy and is distinguished by elevated blood sugar levels.

Symptoms Of Diabetes

The below are the signs and symptoms of diabetes mellitus (Malvi *et.al.,* 2011):

1. High blood sugar levels and glucose excretion in the urine. Increased urine production and dehydration may result from high glucose levels in the urine. Thirst and water intake rise as a result of dehydration.

2. Despite an uptick in appetite, insulin deficiency ultimately contributes to weight loss.

3. Fatigue, nausea, and vomiting are common side effects.

4. Diseases of the bowel, skin, and genital regions are more likely.

5. Perception that is hazy. Extremely high glucose levels can cause drowsiness and coma.

Natural Anti-Diabetic Resources

According to the findings, more than 100 plant species from 50+ families are commonly used to control diabetes. The majority of the studies found that medicinal plants with hypoglycemic properties are beneficial in the treatment of diabetes mellitus. *Annona squamosa, Momordica charantia,* Egyptian *Morus alba, Lycium barbarum, Allium sativum*, and *Aegle marmelos* seem to be the most popular plants used to manage diabetes, and they are widely available. The comprehensive natural plants are not only used to cure diabetes, but also to treat a variety of other ailments. Other plant sections (leaf, root, stem, bark, flower, and whole plant) were often useful for curing. The streptozotocin and alloxan-induced diabetic mouse or rodent, on the other hand, was the most widely utilized diabetic model. The STZ rat was the most widely used animal model in this research. Alloxan mice, glucose resistance mice, KK-Ay diabetic mice, and diabetic patients were all used as models throughout certain instances. Hereditary diabetic mice, such as the KK-Ay mice, have been used as a model of type-II diabetes with

hyperinsulinemia by some researchers. Flavonoid, Tannin, Phenolics, and Alkaloid are the most often involved active constituents. For these plant extracts, a variety of modes of action have been suggested. Any theories revolve around their impact on pancreatic ß cell function (synthesis, release), as well as the rise in insulin sensitivity or insulin-like activity of plant extracts. All of these acts can play a role in reducing or eliminating diabetic complications (Mishra *et al*., 2011).

Spices Useful In Diabetes Mellitus

Herbs are plants that have medicinal properties. Spices have a number of positive pharmacological and physiological consequences, including hypoglycemia. Cinnamon, garlic, onion, fenugreek, turmeric, mustard, black pepper, ginger, and other spices used in rural areas have been experimentally identified to have possible hypoglycemic activity, according to reports. Anti-hyperglycemic properties have also been identified for coriander, cumin seeds, sumac, and curry leaves (Saravanamuttu and Sudarsanan, 2012).

Cinnamon (*Cinnamomum zeylanicum* and *C. verum*)

In Hindi, cinnamon is referred to as "Dalchini." Cinnamon (*C. zeylanicum*) phenolic extract has an insulin potentiating effect. As a result, supplementation is important for human glucose balance and insulin sensitivity in vivo. Another species (*C. verum*) has hypoglycemic properties by increasing insulin production. It also indicates an improvement in lipid metabolism and antioxidant status. Alkaloids, proteins, tannins, cardiac glycosides, and saponins are also contained in them. In fructose-fed diabetic rats, an aqueous extract of *C. verum* bark increased insulin tolerance and avoided lipid abnormalities.

Cumin seeds (*Cuminum cyminum*) and Black Cumin (*Bunium persicum*)

In preclinical trials, oral administration of these seeds showed anti-obese and hypoglycemic behavior, according to a 65-week analysis in rats. It is more successful than glibenclamide in the treatment of diabetes. Cumin seeds have a hypoglycemic effect in typical rabbits. Black cumins have been shown to be anti-obesity and hypoglycemic in clinical trials.

Curry leaves (*Murraya koenigii*)

Curry leaves are the leaves of the *Murraya koenigii* plant. In India and the subcontinent, it is commonly used as a seasoning and condiment. Preclinical trials have shown that the aqueous extract has an immediate hypoglycemic impact. The clinical research conducted by Iyer and Mani in 1990, which showed a decrease in blood glucose levels, was also effective. Experimental mice with leaf extract supplementation have lower serum cholesterol and blood glucose levels, as well as lower body weight. The glucose-lowering impact of *M. koenigii* aqueous leaf extract was also shown to be greater in alloxan-induced diabetic animals than in normoglycemic animals.

Fenugreek (*Trigonella foneum graecum*)

Trigonella foneum, also known as Fenugreek or Methika, is a plant that is used for both fruit and medicine. Many basic elements, such as copper, phosphorus, and sulfur, are abundant in them. It's a well-known hypoglycemic agent that's been used in conventional Indian medicine for centuries. Methika extract made from various sections of the plant has an important hypoglycemic function. Fenugreek contains a new amino acid called 4-hydroxyleucine, which is said to improve glucose-induced insulin tolerance. It lowers blood glucose levels while also lowering TC and TG levels, but it has no effect on HDL.

Garlic (*Allium sativum*)

It has long been used and recognized as a strong carminative and anti-obese seasoning. Garlic, also known as "Lahsun," is an important dietary spice ingredient grown all over India and known for its many uses. Garlic includes S-allyl cysteine sulphoxide, a sulfur-containing amino acid that has been shown in animal tests to reduce blood glucose levels significantly. It has been documented to have antihypertensive and atherosclerosis properties in addition to its hypoglycemic impact. *Allium sativum* has the ability to stimulate insulin synthesis through pancreatic beta cells, which helps to maintain diabetes under check.

Ginger (*Zingiber officinale*)

Zingiber officinale, also known as ginger, is a dietary spice ingredient that is commonly cultivated and used in India and has hypoglycemic properties. Ginger has been shown to have an important anti-diabetic function in animals with type-I diabetes. In diabetic rats, it often causes a large rise in insulin levels and a reduction in fasting glucose levels. In India, ginger is a widely used spice in tea preparation.

Mustard (*Brassica nigra*)

Brassica nigra is a small herb spice grown in India that is widely used as a vegetable supplement in a variety of dishes. It is commonly referred to as "Rhai." Mustard has a major hypoglycemic effect when taken orally. Rhai's hypoglycemic effect is thought to be due to the activation of glycogen synthase and the inhibition of multiple glycogenic enzymes.

Onion (*Allium cepa*)

Onion stimulates insulin synthesis, which results in

hypoglycemic behavior. S-methylcysteine sulphoxide, one of the sulfur-containing amino acids found in onions, has a hypoglycemic influence and increases insulin synthesis by stimulating pancreatic cells.

Pippali (*Piper nigrum* and *Piper longum*)

In India, black pepper is known as "Pippali" and is commonly used as a seasoning in a variety of food preparations due to its flavor and carminative effects. It is used in different anti-diabetic polyherbal formulas in conjunction with other herbs. Piperine, the active alkaloid in *Piper nigrum*, was studied for its ability to regulate blood glucose levels, and regular oral administration for 15 days reduced blood glucose levels and hepatic glucose-6-phosphatase enzyme function.

Turmeric (*Curcuma longa*)

It inhibits the action of enzymes involved in the conversion of dietary carbohydrates to glucose, resulting in a drop in blood glucose levels. Curcumin has been shown in laboratory research to lower blood glucose, hemoglobin, and glaciated hemoglobin amounts. Turmeric contains ferulic acid, also known as 4-hydroxy-3-methoxy-cinnamic acid, and has hypoglycemic properties of both type-I and type-II diabetes. Insulin secretion from pancreatic beta cells has been demonstrated using an amide compound obtained from ferulic acid.

Herbs Useful In Diabetes Mellitus

Diabetes, hypertension, eczema, premenstrual syndrome, rheumatoid arthritis, migraine, menopausal symptoms, persistent weakness, and irritable bowel syndrome are only a few of the diseases that herbalists handle (Chauhan *et al*., 2010).

Abrus precatorius

The plant is a climber that grows in the plains of India and is classified as Wild Liquorice. This plant's leaves are combined with *Andrographis paniculata*, *Gymnema sylvestre*, and *Syzygium cumini* seed. The combination is sun-dried and powdered before being consumed orally with cow's milk. Dosage: For 120 days, take about 50ml of the mixture orally twice a day before food.

Aloe vera* and *Aloe barbadensis

The gel and latex of the aloe plant may be divided into two categories. The bitter theory of Aloe vera stimulates the production and/or release of insulin from pancreatic beta cells, which is how it works.

Andrographis lineate

The plant is an annual herb that grows in hedgerows throughout the plains of India and is often cultivated in gardens. The leaf is dried in the shade, powdered, and taken orally with cow or goat milk. Dosage: Take 2 teaspoons of powder twice a day, following meals, for 2-3 months.

Andrographis paniculata

The plant is an annual herb (commonly known as "King of Bitters") that can be found in hedgerows around India's plains and grown in gardens. The leaf is sun-dried, powdered, and taken orally with boiled rice and cow's milk. Dosage: For 120 days, 50ml of the formulation is taken three times a day with meals.

Azadirachta indica

In streptozotocin-treated rats, hydroalcoholic extracts of this plant exhibited anti-hyperglycemic action, which was due to an improvement in glucose absorption and glycogen deposition in isolated rat hemidiaphragm. This plant also has antibacterial, antimalarial, antifertility, cardioprotective, and antioxidant properties in addition to its anti-diabetic properties.

Canthium parviflorum

The plants are perennial herbs (also known as "king of bitters") that can be found in hedgerows in India's plains and planted in gardens. The leaf is sun-dried, powdered, and taken orally with boiled rice and cow's milk. Dosage: For 120 days, take 50 ml of the mixture three times a day after food.

Costus specious

A tuberous fleshy herb abundant in north India, with the plant growing in hilly areas in the Ghats. Orally, the fresh rhizome is ground into a paste and consumed. Dosage: 20-25 grams three times a day following meals for two months.

Gymnema sylvestre

A climbing shrub that can be found in central and southern India's plains. The fine powder produced by pounding the dried leaves is taken orally with milk. Dosage: To cure diabetes, about 50 ml is taken twice a day after eating for 120 days.

Mangifera indica

In Nigerian folk medicine, the leaves of this plant are used as an anti-diabetic agent. Since glucose absorption in the intestine is reduced, the aqueous extract of *Mangifera indica* has a hypoglycemic operation.

Memecylon umbellatum

A bushy small tree located in the Western Ghats' hilly region. Shade dry leaf powder is combined with a cup of water and boiled rice, and taken orally overnight. Dosage: Take one teaspoon first thing in the morning for forty days or before you feel better.

Momordica charantia

Bitter guard is the popular name for this herb, which comes in a variety of colors. In India and other Asian countries, *Momordica charantia* is widely used as an anti-diabetic and antihyperglycemic agent. When polypeptide p, derived from the berries, seeds, and tissues of *M. charantia*, was administered subcutaneously to langurs and humans, it had a substantial hypoglycemic impact. In regular and STZ diabetic rats, ethanolic extracts of *M. charantia* (200 mg/kg) had an antihyperglycemic and hypoglycemic impact. This may be due to inhibition of glucose6-phosphatase in the liver, in addition to fructose-1, 6-biphosphatase, and activation of hepatic glucose-6-phosphate dehydrogenase activities.

Ocimum sanctum

Tulsi is the traditional name for it. In both regular and alloxan-induced diabetic rats, an aqueous extract of leaves of *Ocimum sanctum* reported a substantial decrease in blood sugar levels. The hypoglycemic and hypolipidemic results of tulsi in diabetic rats were shown by significant reductions in fasting blood glucose, uronic acid, total amino acid, total cholesterol, triglyceride, and total lipid. On 15 and 30 days of the trial, oral administration of plant extract (200 mg/kg) resulted in a decrease in plasma glucose of approximately 9.06 percent and 26.4 percent, respectively. When diabetic rats were compared to control rats, renal glycogen content increased ten-fold, while skeletal muscle and hepatic glycogen amount decreased by 68 percent and 75 percent, respectively.

Syzygium cumini

The plant is a big tree that grows in the plain and is classified as Jambolan or black plum. The leaf juice is combined with honey or cow's milk and fresh fruits are consumed orally. Dosage: Take 2 teaspoons of juice a day after meals for 3 months. It is a significant anti-diabetic plant with a long history of usage in a variety of pharmacological practices, primarily diabetes. Numerous folk medicine and experimental papers on this plant's anti-diabetic influence have been quoted in the literature over the last four decades. Different sections of plants, especially fruits, seeds, and stem bark, have been shown to have promising activity against diabetes mellitus in clinical and experimental studies. *S. cumini* has a dual influence, combining the sulfonylurea and biguanide mechanisms of action, and may trigger hypoglycemia by stimulating the remaining cells of the islets of Langerhans to produce further insulin.

Tinospora cordifolia

It's a big, glabrous deciduous climbing shrub in the Menispermaceae family. Guduchi is the generic name for it. In alloxan diabetic rats, oral administration of *Tinospora cordifolia* root extract for 6 weeks resulted in a substantial decrease in blood and urinary glucose, as well as lipids in serum and tissues. The extract even stopped people from losing weight. In Indian Ayurvedic medicine, *Tinospora cordifolia* is commonly used to treat diabetes mellitus.

Wattakaka volubilis

The plant is a fleshy, big climber with papery leaves that can be found in the plains. Orally, leaf powder is taken with cow milk. Dosage: Take 50-75 mL of the mixture twice a day for 90 days.

Mechanism Of Action Of Herbal Anti-Diabetics

Herbal anti-diabetic action is focused on a number of mechanisms (Patel *et.al*., 2012). Herbal anti-diabetic mechanisms of action can be classified as follows:

- Pancreatic beta-cell potassium channel blocking, adrenomimeticism
- Inhibition of glucose reabsorption in the kidneys.
- Insulin release from islet beta cells is stimulated, and insulin degradative pathways are inhibited.
- Insulin tolerance is reduced.
- Providing the beta-cell with essential elements such as calcium, zinc, magnesium, manganese, and copper.
- Pancreatic beta-cell regeneration and repair
- In the islet of Langerhans, increasing the scale and the amount of cells.
- Insulin secretion stimulation.
- Glycogenesis and hepatic glycolysis stimulation.
- Protective effect against beta-cell death.
- Improvement of metabolism, as well as a decrease in blood sugar and urea levels.
- Preventing the transfer of starch to glucose in a pathological way.
- Beta-galacidase and Alpha-glucosidase inhibition.

- Activities that lower cortisol levels.
- The alpha-amylase enzyme is inhibited.
- Defending toward oxidative stress.

Scientifically Validated Medicinal Plants

Just a few of the common plants used for diabetes have been scientifically and medically evaluated (Table 1), as follows (Kumar *et al*., 2011):

Table 1. List of scientifically validated anti-diabetic plants.

Botanical Name	Family
Acacia Arabica	Mimosaceae
Allium sativum	Liliaceae
Alluvium cepa	Liliaceae
Anacardium occidentalis	Anacardiaceae
Anana senegalensis	Anonaceae
Angeissus leiocarpus	Combretaceae
Azadirachata indica	Meliaceae
Balanites aegyptiaca	Zygophyliaceae
Bauhinia reticulate	Casalpiniaceae
Citrus medica	Rutaceae
Correa Roxb.	Rutaceae
Euphorbia convuludiodes	Euphobiaceae
Fiscus thonnigii	Moraceae
Gossypium hirsutum	Malvaceae
Khaya senegalensis	Meliaceae
Mangifera indica	Anacardiaceae
Moringa oleifera	Mringaceae
Parkta filicoidea	Mimosaceae
Psidium guajava	Myrtaceae
Vernonia amygdalina	Asreraceae
Vitillarta paradoxa	Sapotaceae
Zizyphus sativa	Rhamnaceae

Marketed Products

In India, up to 600 conventional plant medicines for diabetes have been registered. Ayurvedic medicine uses a variety of medicines to treat diabetes. These medicines are prescribed in a variety of ways; the most popular are choorna, vati, arka, quath, and others. These formulations can include aqueous extracts or powders from various plant parts used in the treatment of diabetes. All anti-diabetic formulations on the market include 3 to 25 herbs, with the most commonly used herbs being *Coccinia indica, Tragia involucrate, Gymnema sylvestre, Pterocaprus marsupium, Trigonella foenum-graceum, Moringa oleifera, Eugenia jambolana, Tinospora cordifolia, Swertia chirayita, Momordica charantia*. The following are a few diabetes-treatment preparations on the market that produce the medication in powder or extract form (Table 2). Only the names of the herbs used in the preparation are mentioned, and certain preparations can also include animal-derived products and minerals (Dwivedi and Daspaul, 2013).

Table 2. List of marketed herbal anti-diabetic products.

Herbal Anti-Diabetic Products	Ingredients
Hyponid Tablets	*Momordica charantia, Swertia chirata, Melia azadiracta, Tinospora cordifolia, Gymnema sylvestra, Enicostemma littorale, Emblica officinalis, Eugenia jambolana, Cassia auriculata, Curcuma longa*
Mersina Capsules	*Gymnema sylvestra, Momordica charantia, Cassia auricualata, Syzigium cumini, Phyllanthus emblica, Melia azadiracta, Trigonella foenum graecum, Coccinia indica, Tinospora cardifolia*
Herbovedice Mahantak Churna	*Nai, Kadu, Kariyatu, Kalijeeri, Methi, Kalumbo, Kakach, Indrajav, Karela, Hladi, Jeshthimsdha*
Madhuhari Powder	*Gudmar, Karela beej, Jamun, Babool ki chhal, Amba halad, Gudwel, Bilva patra, Neem patra, Shilajeet, Trivang bhasma*
Dianex	*Gymnema sylvestre, Eugenia jambolna, Momordica charantia, Azadirachta indica, Cassia auriculata, Aegle marmelos, Withania somnifera, Curcuma longa*

Continued..

Diamed	*Azardirachta indica, Cassia auriculata, Momordica charantia*
Aavirai Kudineer	*Cassia auriculata, Cassia fistula, Salacia prinoides, Cyperus rotundus, Saussurrea lappa, Eugenia jambolana, Terminalia arjuna*
Madhymeha Churna	*Azadirachta indica, Cassia auriculata, Cassia fistula, Gymnema sylvestre, Eugenia jambolana, Eugenia jambolana, Zizyphus mauritina, Curculigo orchioides, Melochia corchorifolia, Michelia champaca, Cynodon dactylon, Murraya koenegii, Acacia catechu, Salacia oblonga, Momordica charantia*
Diagon Tablets	*Eugenia jambolana, Andrograpis panicualata, Tinospora cordifoila, Cuecuma longa, Berberis aristata, Vetiveria zizanoides, Strychnospotatorum, Moimosa pudica, Gymnema sylvestre*
Glucolev Capsule	*Amalika powder, Sudha shilajeet, Jasa bhasma, Methika beej, Jambu beej, Madhunasini, Ashwagandha*
Gluco-essentials Capsules	*Vaccinium myrtillus, Gymnema sylvestris, Momordica charantia, Cinnamomum zeylanicum, Trigonella foenum graecum, Panax quinque, Panax ginseng, Visum alba, Amorphophallus konjac, Hydrastis cadensis, Ocimum basilicum, Cynara scolymus, Plantago ovate, Pfaffia paniculata, Arctostaphylos uva ursi*
Diasulin	*Cassia auricualata, Coccinia indica, Curcuma longa, Momordica charantia, Scoparia dulcis, Gymnema sylvestre, Emblica officinalis, Syzgium cumini, Tinospora cordifolia, Trigonella foenum graecum*
Glucolib	*Eugenia jambolana, Gymnema sylvestris, Aegle marmelos, Azadiracta indica, Momordica charantia, Enicostema littorale, Trigonella foenum graecum*
Diaveda Capsules	*Trigonella foenum graecum, Emblica officinalis, Curcuma longa, Melia azadiracta, Gymnema sylvestris, Tribulus terrestris, Tinospora cordifolia, Syzygium cumini, Azadirachta indica, Terminalia bellirica, Terminalia chebula, Piper nigrum, Piper longum, Zingiber officinale*
GlucoCare	*Glyzyrrhiza glabra, Asparagus racemosus, Pterocarpus marsupium, Gymnema sylvestris, Momordica charantia, Commiphora mukul*
Glucomp Tablets	*Enicostema littorale, Phyllanthus niruri, Eugenia jambolana, Melia azadiracta, Terminalia arjuna, Asphaltum, Aegle mermelos, Momordica charantia*
Glucova	*Pterocarpus marsupium, Enicostema littorale, Eugenia jambolana, Tinopora cordifoila*
Pancreatic Tonic	*Tinospora cordifolia, Syzgium cumini, Melia azadiracta, Momordica charantia, Gymnema sylvestre, Pterocarpus marsupium, Aegle marmelos, Cinnamomum zeylanicum*
Tincture of Panchparna	*Coccinia indica, Cocculus villosus, Catharanthus roseus, Gymnema sylvestre, Momordica charantia*
DWN-12	*Strychnos potatorum, Terminalia chebula, Emblica officinalis, Terminalia bellirica, Salacia reticulata, Pterocarpus marsupium, Piper longum, Coscinium fenestatum, Tribulus terrestris, Syzigium cumini, Elettaria cardamomum*

CONCLUSION

The current study has provided detailed information on anti-diabetic plants that are used to cure diabetes mellitus. However, some of these plant-derived medications have the ability to provide cost-effective diabetes treatment in the short term by nutritional interventions, vitamin supplements, and combined therapy with synthetic products, and in the long term as the only medication obtained from natural sources. This anti-diabetic effect is mostly due to the existence of bioactive chemicals. Many other active agents derived from plants, on the other hand, are yet to be fully identified. More research is needed to determine the mode of action of medicinal plants with anti-diabetic properties.

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