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Anti-Diabetic Medicinal Plants: Exploring Pharmacotherapeutic Potentials

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ABSTRACT

Due to its natural roots and absence of side effects, herbal medicine has increased in popularity tremendously in recent years, garnering acceptance in both developing and developed nations. A thorough research was conducted to assemble information on medicinal plants used to treat diabetes mellitus. It is an endocrine metabolic disorder that affects roughly 10% of the world's population, with the number of persons affected increasing every day. Plant scientific and family names, plant parts and study models employed, hypoglycemic behavior, and active chemical compounds are all included in the profiles. The large number of plants cited in this study demonstrated the importance of herbal plants in diabetes treatment. The properties of these plants may assist to prevent diabetes complications and rectify metabolic abnormalities. Researchers should do further research into the potential use of medicinal plants with anti-diabetic effects, as a result of this study.

Key Words: Diabetes, Herbal, Natural, Plants, Mechanisms, Products

INTRODUCTION

Medicinal plants continue to be a valuable resource in the treatment of human illnesses. Very big western medical systems, such as Chinese, Ayurvedic, and Unani, have been born and researched largely on the eastern continent during the previous 2500 years. Because approximately 80% of individuals in affluent nations rely on these medical services for their main health care, these practises are still alive and thriving. These plants generate chemicals that may be utilised in medicine, including drug synthesis precursors. Diabetes mellitus is a group of metabolic illnesses characterised by hyperglycemia brought on by insulin secretion, intervention, or a combination of the two. Type I diabetes, often known as juvenile diabetes, is a type of insulin-dependent diabetes that affects roughly 5% of diabetics. Type-II diabetes, which is not caused by insulin, is more common in adults over the age of 40. Diabetes-induced chronic hyperglycemia has been associated to long-term harm, deterioration, and organ failure, especially in the eyes, kidneys, nerves, heart, and blood vessels. It causes prolonged hyperglycemia and lipid profile abnormalities by disrupting glucose, lipid, and protein metabolism. Secondary consequences include polyurea, polyphasia, ketosis, retinopathy, and cardiovascular disease. Diabetes and its consequences remain a serious health concern globally, affecting almost 10% of the global population, despite the advent and widespread usage of hypoglycemic medications. It is anticipated to become one of the world's most powerful disablers and killers during the next 25 years. A collection of variables that contribute to the establishment of diabetes is known as predisposing or risk factors. Environmental factors such as diet, obesity, and a sedentary lifestyle all contribute to the development of diabetes. Significant risk variables include high family accumulation, insulin tolerance, dietary condition, size, and lifestyle shift owing to urbanisation. Controlling diabetes has been a worldwide problem until now, and no effective solution has been discovered [1].

Insulin, as well as other oral hypoglycemic medicines such sulfonylureas, metformin, glucosidase inhibitors, troglitazone, and others, are now approved for the treatment of diabetes. Severe adverse effects have been reported, including liver problems, lactic acidosis, and diarrhoea. It now affects around 143 million people, and the number of persons afflicted is increasing on a daily basis; by 2030,

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the worldwide population is predicted to reach 366 million. There are over 800 plant species with anti-diabetic effects that have been verified. Various plant species have also been utilised by Native Americans, Chinese, South Americans, and Asian Indians to prevent or cure diabetes. The Asian and African continents, according to the survey, account for 56 percent and 17 percent of worldwide medical herbal plant distribution, respectively. The chemical structure of plants is connected to their biological functions, with phenolics, alkaloids, flavonoids, terpenoids, coumarins, and glycosides showing promise. Traditional diabetic treatments like metformin, on the other hand, are secretagogues derived from plants. Traditional drugs for diabetes are used to enhance insulin sensitivity, boost insulin production, and reduce blood glucose levels. Many medicinal plants have been discovered as potential sources of anti-diabetic principles that are frequently employed for the treatment of diabetes mellitus in many traditional medical systems across the globe, and many of them are thought to be effective against diabetes. The hypoglycemic action of a pharmacologically active section of the plant diminishes the influence of -amylase, as well as the direct and indirect impacts of numerous blood parameters associated to the creation of diabetes. There are various anti-diabetic drugs available on the market to treat diabetes and associated complications; nevertheless, there is still no cure for the disease. However, owing to unforeseen side effects, the efficacy of these medications is still questionable, and novel molecules for diabetes treatment are needed. In recent years, there has been an increase in interest in herbal therapy for the diagnosis and treatment of diabetes in both developing and developed nations, owing to their natural origins and fewer adverse effects. In this review article, an attempt has been made to compile the published hypoglycemic plants available in various research publications, which may be useful to health practitioners, scientists, and academics working in the field of pharmacology and therapeutics in developing evidence-based alternative medications to treat various types of diabetes in humans and animals. This research highlights the importance and fascination with medicinal plants in the attempt to show their anti-diabetic properties and the bioactive chemicals responsible. This research includes the general name of a plant, the components that are often used as remedy sources, extracts, dosages, and a test model [2].

DIABETES MELLITUS

Diabetes mellitus is expanding at an unprecedented pace over the world, impacting three-quarters of the world's population and being seen as a major source of high economic loss, which might hinder nation-building. Furthermore, uncontrolled diabetes leads to a plethora of long-term complications, such as blindness, heart attack, and kidney failure, to mention a few. As a consequence, therapies based on western medicine's principles (allopathic) are often inefficient, risky, and prohibitively costly, particularly in poor nations. As a consequence, treating diabetes mellitus using easily accessible plant-derived chemicals that do not need time-consuming drug production seems to be highly interesting [3].

TYPES OF DIABETES MELLITUS

There are three main types of diabetes mellitus [4]. These are the following:

- Type-I diabetes mellitus is caused by the body's inability to control insulin levels. This condition is known as insulin-dependent diabetes mellitus (IDDM) or "juvenile diabetes." The most frequent kind of diabetes is diabetes Type I.
- Insulin tolerance, a disorder in which cells refuse to properly use insulin, produces type-II diabetes mellitus, which is often accompanied by an absolute insulin deficit.
- Gestational diabetes mellitus, the third most prevalent kind of diabetes, gestational diabetes, is a type of diabetes that affects pregnant women and is characterized by high blood sugar levels.

SYMPTOMS OF DIABETES

The below are the signs and symptoms of diabetes mellitus [5]:

1. High blood sugar levels and urine glucose excretion High glucose levels in the urine might cause increased urine output and dehydration. As a consequence of dehydration, thirst and water consumption increase.
2. Despite an increase in hunger, insulin insufficiency leads to weight reduction in the long run.
3. Common side effects include fatigue, nausea, and vomiting.
4. Intestinal, skin, and genital diseases are more probable.
5. Uncertainty in perception. Drowsiness and coma may result from very high glucose levels.

NATURAL ANTI-DIABETIC RESOURCES

More than 100 plant species from 50+ families are routinely used to manage diabetes, according to the data. The majority of research concluded that medicinal herbs with hypoglycemic effects are helpful in the treatment of diabetes. The most common plants used to control diabetes seem to be *Annonasquamosa*, *Momordicacharantia*, Egyptian *Morusalba*, *Lyciumbarbarum*, *Allium sativum*, and *Aeglemarmelose*, and they are readily accessible. The many natural herbs are utilised not only to treat diabetes, but also a number of other disorders. For curing, other plant parts (leaf, root, stem, bark, flower, and entire plant) were often used. The diabetic mouse or rat produced by

streptozotocin and alloxan, on the other hand, was the most extensively used diabetes model. In this study, the STZ rat was the most often utilized animal model. In certain cases, alloxan mice, glucose resistance mice, KK-Ay diabetic mice, and diabetic individuals were employed as models. Some researchers have employed hereditary diabetic mice, such as the KK-Ay mice, as a model of type II diabetes with hyperinsulinemia. The most often engaged active ingredients are flavonoid, tannin, phenolics, and alkaloid. A number of mechanisms of action have been proposed for these plant extracts. Plant extracts' influence on pancreatic ß cell function (synthesis, release), as well as the increase in insulin sensitivity or insulin-like activity, is the focus of any hypotheses. All of these actions may help to prevent or reduce diabetes complications [6].

SPICES USEFUL IN DIABETES MELLITUS

Plants with therapeutic characteristics are known as herbs. Spices provide a variety of beneficial pharmacological and physiological effects, including as hypoglycemia. According to studies, cinnamon, garlic, onion, fenugreek, turmeric, mustard, black pepper, ginger, and other spices often used in rural regions have been tested for hypoglycemic action. Coriander, cumin seeds, sumac, and curry leaves have also been shown to have anti-hyperglycemic effects [7].

Cinnamon (*Cinnamomumzeylanicum* and *C. verum*)

Cinnamon is known as "Dalchini" in Hindi. The phenolic extract of cinnamon (*Cinnamomumzeylanicum*) has an insulin-potentiating action. As a consequence, supplementation is critical for in vivo human glucose homeostasis and insulin sensitivity. Another species (*C. verum*) increases insulin production and so has hypoglycemic effects. It also shows that lipid metabolism and antioxidant levels have improved. They also include alkaloids, proteins, tannins, cardiac glycosides, and saponins. An aqueous extract of *C. verum* bark improved insulin tolerance and prevented lipid abnormalities in fructose-fed diabetic rats.

Cumin seeds (*Cuminumcyminum*) and Black Cumin (*Buniumpersicum*)

According to a 65-week research in rats, oral treatment of these seeds demonstrated anti-obese and hypoglycemic activity in preclinical experiments. In the treatment of diabetes, it is more effective than glibenclamide. In ordinary rabbits, cumin seeds produce a hypoglycemic impact. Clinical researches have indicated that black cumins are anti-obesity and hypoglycemic.

Curry leaves (*Murrayakoenigii*)

The leaves of the *Murrayakoenigii* plant are used to make curry. It is widely used as a spice and condiment in India and the subcontinent. The aqueous extract has been proven in preclinical testing to have an immediate hypoglycemic effect. Iyer and Mani's clinical study from 1990, which revealed a reduction in blood glucose levels, was similarly successful. Leaf extract administration resulted in decreased serum cholesterol and blood glucose levels, as well as a reduction in body weight in experimental mice. In alloxan-induced diabetic rats, the glucose-lowering effect of *M. koenigii* aqueous leaf extract was also shown to be larger than in normoglycemic animals.

Fenugreek (*Trigonellafoneumgraecum*)

Trigonellafoneum, widely known as Fenugreek or Methika, is a fruiting and medicinal plant. They include a lot of fundamental elements including copper, phosphorus, and sulfur. It's a well-known hypoglycemic drug that's been utilized for ages in traditional Indian medicine. Methika extract, which is derived from several parts of the plant, has a significant hypoglycemic effect. Fenugreek includes 4-hydroxyleucine, a novel amino acid that is thought to enhance glucose-induced insulin tolerance. It decreases blood glucose levels as well as TC and TG levels, but has no impact on HDL.

Garlic (*Allium sativum*)

It has long been known as a powerful carminative and anti-obese seasoning. Garlic, also known as "Lahsun," is a popular dietary spice that is cultivated all throughout India and has a wide range of applications. S-allyl cysteine sulphoxide, a sulfur-containing amino acid found in garlic, has been proven in animal studies to drastically lower blood glucose levels. In addition to its hypoglycemic effects, it has been shown to have antihypertensive and anti-atherosclerosis characteristics. *Allium sativum* has the capacity to promote insulin manufacturing in pancreatic beta cells, which aids in the control of diabetes.

Ginger (*Zingiberofficinale*)

Zingiberofficinale, generally known as ginger, is a dietary spice component with hypoglycemic characteristics that is frequently farmed and consumed in India. In mice with type-I diabetes, ginger has been demonstrated to have a significant anti-diabetic effect. It induces a significant increase in insulin levels and a decrease in fasting glucose levels in diabetic rats. Ginger is a commonly used spice in tea brewing in India.

Mustard (*Brassica nigra*)

Brassica nigra is a tiny herb spice that is commonly used as a vegetable additive in a range of recipes. It is cultivated in India. "Rhai" is a frequent nickname for it. When taken orally, mustard has a significant hypoglycemic impact. The activation of glycogen synthase and inhibition of

various glycogenic enzymes are assumed to be responsible for Rhai's hypoglycemic impact.

Onion (*Allium cepa*)

Insulin production is stimulated by onions, resulting in hypoglycemic behavior. One of the sulfur-containing amino acids found in onions, S-methylcysteinesulphoxide, has a hypoglycemic effect and stimulates pancreatic cells, increasing insulin generation.

Pippali (*Piper nigrum* and *Piperlongum*)

Due to its taste and carminative qualities, black pepper is known in India as "Pippali" and is extensively used as a condiment in a range of culinary dishes. It is used with other herbs in various anti-diabetic polyherbal formulations. Piperine, the active alkaloid in *Piper nigrum*, was researched for its capacity to control blood glucose levels, and it was shown that regular oral dosing for 15 days lowered blood glucose levels and hepatic glucose-6-phosphatase enzyme performance.

Turmeric (*Curcuma longa*)

It reduces blood glucose levels by inhibiting the function of enzymes involved in the conversion of ingested carbohydrates to glucose. Curcumin has been demonstrated to reduce blood glucose, hemoglobin, and glaciated hemoglobin levels in laboratory studies. Turmeric includes ferulic acid, also known as 4-hydroxy-3-methoxy-cinnamic acid, which is hypoglycemic in type I and type-II diabetes. An amide molecule derived from ferulic acid was used to show insulin production from pancreatic beta cells.

HERBS USEFUL IN DIABETES MELLITUS

Diabetes, hypertension, eczema, premenstrual syndrome, rheumatoid arthritis, migraine, menopausal symptoms, chronic weakness, and irritable bowel syndrome are only a few of the ailments treated by herbalists [8].

Abrusprecatorius

The plant is classed as Wild Liquorice and grows as a climber on the Indian plains. The leaves of this plant are mixed with the seeds of *Andrographispaniculata*, *Gymnemasylvestre*, and *Syzygiumcumini*. Before being eaten orally with cow's milk, the mixture is sun-dried and pulverised. Dosage: Take roughly 50ml of the mixture orally twice a day before meals for 120 days.

Aloe vera and *Aloe barbadensis*

The aloe plant's gel and latex may be split into two types. Aloe vera stimulates the production and/or release of insulin from pancreatic beta cells, according to the bitter theory.

Andrographis lineate

The plant is an annual herb that grows wild in India's plains and is often grown in gardens. The leaf is pulverized and consumed orally with cow or goat milk after drying in the shade. Dosage: For 2-3 months, take 2 tablespoons of powder twice a day, after meals.

Andrographispaniculata

The plant is an annual herb (also known as "King of Bitters") that grows in hedgerows and gardens throughout India's plains. Sun-dried and powdered, the leaf is consumed orally with boiling rice and cow's milk. Dosage: Take 50 ml of the formulation three times a day with meals for 120 days.

Azadirachtaindica

Hydroalcoholic extracts of this plant had anti-hyperglycemic effects in streptozotocin-treated rats, which were related to an increase in glucose absorption and glycogen deposition in isolated rat hemidiaphragm. In addition to its anti-diabetic benefits, this plant contains antibacterial, antimalarial, antifertility, cardioprotective, and antioxidant characteristics.

Canthiumparviflorum

The plants are perennial herbs (also known as "king of bitters") that grow in hedgerows and gardens across India's plains. Sun-dried and powdered, the leaf is consumed orally with boiling rice and cow's milk. Dosage: Take 50 ml of the combination three times a day after meals for 120 days.

Costus specious

The plant grows in steep parts of the Ghats and is a tuberous fleshy herb prevalent in north India. The raw rhizome is mashed into a paste and eaten orally. For two months, take 20-25 g three times a day after meals.

Gymnema Sylvester

A climbing shrub found in the plains of central and southern India. Pounding the dried leaves produces a fine powder that is eaten orally with milk. Dosage: For 120 days, take roughly 50 cc twice a day after eating to treat diabetes.

Mangiferaindica

The leaves of this plant are employed as an anti-diabetic medication in Nigerian traditional medicine. The aqueous extract of *Mangiferaindica* has a hypoglycemic effect because glucose absorption in the gut is inhibited.

Memecylonumbellatum

A bushy little tree found in the mountainous area of the Western Ghats. Shade dry leaf powder is given orally overnight with a cup of water and boiling rice. Dosage: For forty days or until you feel better, take one teaspoon first thing in the morning.

Momordicacharantia

This plant, which comes in a variety of colors, is known as bitter guard. *Momordicacharantia* is commonly utilized as an anti-diabetic and antihyperglycemic medication in India and other Asian nations. Polypeptide P, produced from the berries, seeds, and tissues of *M. charantia*, demonstrated a significant hypoglycemic effect when fed subcutaneously to langurs and humans. Ethanolic extracts of *M. charantia* (200 mg/kg) demonstrated antihyperglycemic and hypoglycemic effects in normal and STZ diabetic rats. This might be attributed to the suppression of glucose-6-phosphatase, as well as fructose-1, 6-biphosphatase, and activation of hepatic glucose-6-phosphate dehydrogenase activities, in the liver.

Ocimum sanctum

The traditional name for it is Tulsi. An aqueous extract of leaves of *Ocimum sanctum* showed a significant reduction in blood sugar levels in both ordinary and alloxan-induced diabetic rats. Significant decreases in fasting blood glucose, uronic acid, total amino acid, total cholesterol, triglyceride, and total lipid were seen in diabetic rats after treatment with tulsi. Oral treatment of plant extract (200 mg/kg) resulted in a drop in plasma glucose of about 9.06 percent and 26.4 percent, respectively, on days 15 and 30 of the study. When diabetic rats were compared to control rats, the quantity of renal glycogen rose tenfold, whereas the amount of skeletal muscle and hepatic glycogen fell by 68% and 75%, respectively.

Syzygiumcumini

The plant, known as Jambolan or black plum, is a large tree that thrives on the plains. The leaf juice is mixed with honey or cow's milk and eaten with fresh fruits. Dosage: For 3 months, take 2 tablespoons of juice after each meal. It's a powerful anti-diabetic herb with a lengthy history of use in a number of pharmacological treatments, most notably diabetes. Over the past four decades, several folk medicine and experimental articles on this plant's anti-diabetic effects have been cited in the literature. In clinical and experimental trials, many parts of plants, particularly fruits, seeds, and stem bark, have been demonstrated to have potential action against diabetes mellitus. Sulfonylurea and biguanide modes of action combine in *S. cumini*, which may cause hypoglycemia by activating the surviving cells of the islets of Langerhans to release more insulin.

Tinosporacordifolia

It belongs to the Menispermaceae family and is a large, glabrous deciduous climbing shrub. The general name for it is Guduchi. Oral treatment of *Tinosporacordifolia* root extract for 6 weeks to alloxan diabetic rats resulted in a significant reduction in blood and urine glucose, as well as lipids in serum and tissues. The extract even made it impossible for some to lose weight. *Tinosporacordifolia* is often used to treat diabetes mellitus in Indian Ayurvedic medicine.

Wattakakavolubilis

The plant is a large, fleshy climber with papery leaves that grows on the plains. Leaf powder is eaten orally with cow milk. Dosage: For 90 days, take 50-75 mL of the combination twice a day.

MECHANISM OF ACTION OF HERBAL ANTI-DIABETICS

The anti-diabetic activity of herbs is based on many mechanisms [9]. The following are the several types of herbal anti-diabetic mechanisms of action:

- Blocking potassium channels in beta cells of the pancreas, adrenomimeticism
- Glucose reabsorption in the kidneys is inhibited.
- Islet beta cell insulin release is increased, while insulin degradative mechanisms are blocked.
- Insulin tolerance is compromised.
- Providing critical minerals to the beta-cell, such as calcium, zinc, magnesium, manganese, and copper.
- Beta-cell regeneration and repair in the pancreas
- Increasing the size and number of cells in the Langerhans islet.
- Stimulation of insulin secretion.
- Hepatic glycolysis stimulation and glycogenesis.
- It has a protective effect against the death of beta cells.
- A drop in blood sugar and urea levels, as well as an improvement in metabolism.
- Preventing the abnormal conversion of starch to glucose.
- Inhibition of beta-galacidase and alpha-glucosidase.
- Lowering cortisol levels activities
- The enzyme alpha-amylase is inhibited.
- Defending against the effects of oxidative stress.

SCIENTIFICALLY VALIDATED MEDICINAL PLANTS

Only a handful of the most prevalent diabetic plants have been scientifically and medically investigated (**Table 1**) [10]:

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

BOTANICAL NAME	FAMILY
Acacia Arabica	Mimosaceae
Allium sativum	Liliaceae
Alluvium cepa	Liliaceae
Anacardiumoccidentalis	Anacardiaceae
Ananasenegalensis	Anonaceae
Angeissusleiocarpus	Combretaceae
Azadirachataindica	Meliaceae
Balanitesaegyptiaca	Zygophyliaceae

Table 1: ***(Continued)***

BOTANICAL NAME	FAMILY
Bauhinia reticulate	Casalpiniaceae
Citrus medica	Rutaceae
Correa Roxb.	Rutaceae
Euphorbia convuludiodes	Euphobiaceae
Fiscusthonnigii	Moraceae
Gossypiumhirsutum	Malvaceae
Khayasenegalensis	Meliaceae
Mangiferaindica	Anacardiaceae
Moringaoleifera	Mringaceae
Parktafilicoidea	Mimosaceae
Psidiumguajava	Myrtaceae
Vernoniaamygdalina	Asreraceae
Vitillartaparadoxa	Sapotaceae
Zizyphus sativa	Rhamnaceae

MARKETED PRODUCTS

Up to 600 traditional plant remedies for diabetes have been registered in India. Ayurvedic medicine treats diabetes using a range of remedies. The most common choorna, vati, arka, quath, and other prescriptions are choorna, vati, arka, quath, and others. Aqueous extracts or powders from different plant components used in the treatment of diabetes may be found in these compositions. *Cocciniaindica*, *Tragia involucrate*, *Gymnemasylvestre*, *Pterocaprusmarsupium*, *Trigonellafoenum-graceum*, *Moringaoleifera*, *Eugenia jambolana*, *Tinosporacordifolia*, *Swertiachirayita*, and *Momordicacharantia* are the most often utilised herbs in anti-diabetic compositions. On the market, there are a few diabetes-treatment formulations that manufacture the drug as a powder or extract (**Table 2**). Only the names of the plants used in the preparation are given, and some formulations may additionally include animal-derived products and minerals [11].

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

HERBAL ANTI-DIABETIC PRODUCTS	INGREDIENTS
Hyponid Tablets	*Momordicacharantia, Swertiachirata, Meliaazadiracta, Tinosporacordifolia, Gymnemasylvestra, Enicpostemmalitterole, Emblicaofficinalis, Eugenia jambolana, Cassia auriculata, Curcuma longa*
Mersina Capsules	*Gymnemasylvestra, Momordicacharantia, Cassia auricualata, Syzigiumcumini, Phyllanthusemblica, Meliaazadiracta, Trigonellafoenumgraecum, Cocciniaindica, Tinosporacardifolia*
HerbovediceMahantakChurna	*Nai, Kadu, Kariyatu, Kalijeeri, Methi, Kalumbo, Kakach, Indrajav, Karela, Hladi, Jeshthimsdha*
Madhuhari Powder	*Gudmar, Karelabeej, Jamun, Baboolkichhal, Ambahalad, Gudwel, Bilvapatra, Neempatra, Shilajeet, Trivangbhasma*
Dianex	*Gymnemasylvestre, Eugenia jambolna, Momordicacharantia, Azadirachtaindica, Cassia auriculata, Aeglemarmelos, Withaniasomnifera, Curcuma longa*
Diamed	*Azardirachtaindica, Cassia auriculata, Momordicacharantia*
AaviraiKudineer	*Cassia auriculata, Cassia fistula,Salaciaprinoides, Cyperusrotundus, Saussurrealappa, Eugenia jambolana, Terminaliaarjuna*
MadhymehaChurna	*Azadirachtaindica, Cassia auriculata, Cassia fistula, Gymnemasylvestre, Eugenia jambolana, Eugenia jambolana, Zizyphusmauritina, Curculigoorchioides, Melochiacorchorifolia, Micheliacghqampaca, Cynodondactylon, Murrayakoenegii, Acacia catechu, Salaciaoblonga, Momordicacharantia*
DiagonTablets	*Eugenia jambolana, Andrograpispanicualata, Tinosporacordifoila, Cuecuma longa, Berberisaristata, Vetiveriazizanoides, Strychnospotatorum, Moimosapudica, Gymnemasylvestre*
Glucolev Capsule	*Amalika powder, Sudhashilajeet, Jasabhasma, Methikabeej, Jambubeej, Madhunasini, Ashwagandha*
Gluco-essentials Capsules	*Vacciniummyrtillus, Gymnemasylvestris, Momordicacharantia, Cinnamomumzeylanicum, Trigonellafoenumgraecum, Panaxquinque, Panax ginseng, Visum alba, Amorphophalluskonjac, Hydrastiscadensis, Ocimumbasilicum, Cynarascolymus, PKLntago ovate, Prfaffiapaniculata, Arctostaphylosuvaursi*
Diasulin	*Cassia auricualata, Cocciniaindica, Curcuma longa, Momordicacharantia, Scopariadulcis, Gymnemasylvestre, Emblicaofficinalis, Syzgiumcumini, Tinosporacordifolia, Trigonellafoenumgraecum*

Table 2: ***(Continued)***

HERBAL ANTI-DIABETIC PRODUCTS	INGREDIENTS
Glucolib	*Eugenia jambolana, Gymnemasylvestris, Aeglemarmelos, Meliaazadiracta, Momordicacharntia, Enicostemalittorale, Trigonellafoenumgraecum*
DiavedaCapsules	*Trigonellafoenumgraecum, Emblicaofficinalis, Curcuma longa, Meliaazadiracta, Gymnemasylvestris, Tribulusterrestris, Tinosporacordifolia, Syzygiumcumini, Azadieachtaindica, Terminaliabelerica, Terminaliachebula, Piper nigrum, Piper longum, Zingiberofficinalis*
GlucoCare	*Glyzyrrhizaglabra, Aspargusracemosus, Pterocarpusmarsupium, Gymnemasylvestris, Momordicacharantia, Commiphoramukul*
GlucompTablets	*Enicostemalittorale, Phyllanthusniruri, Eugenia jambolana, Meliaazadiracta, Terminaliaarjuna, Asphaltum, Aeglemermelos, Momordicacharantia*
Glucova	*Pterocarpusmarsupium, Enicostemalittorale, Eugenia jambolana, Tinoporacordifoila*
Pancreatic Tonic	*Tinosporacordifolia, sygigiumcumini, Meliaazadiracta, Momordicachaeantia, Gymnemasylvrta, Pterocarpusmarsupium, AegleMermelosa, Cinnamomumzeylanicum*
Tincture of Panchparna	*Cocciniaindica, Coculusvillosus, Catharanthusroseus, Gymnemasylvestre, Momordicacharantia*
DWN-12	*Strychospotatorum, Terminaliachebula, Emblicaofficinalis, Terminaliabelerica, Salacia reticulate, Pterocarpusmarsupium, Piper longum, Cosciniumfenestatum, Tribulusterrestris, Syzigiumcumini, Rhabdialyuoies, Elettaria cardamom*

CONCLUSION

The present research provides thorough information about anti-diabetic botanicals that are utilized to treat diabetes. Some of these plant-derived medications, on the other hand, have the potential to provide cost-effective diabetes treatment in the short term through nutritional interventions, vitamin supplements, and combined therapy with synthetic products, as well as in the long term as the only medication derived from natural sources. The presence of bioactive molecules is mostly responsible for this anti-diabetic action. On the other hand, many more active compounds produced from plants have yet to be completely discovered. The method of action of medicinal plants with anti-diabetic effects requires further investigation.

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