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Herbal Plants with Anti: Diabetic Properties

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Abstract

Diabetes mellitus (DM), both insulin dependent (IDDM) and non insulin dependent (NIDDM), is a worldwide metabolic condition. Traditional plant therapies for diabetes mellitus have been utilized all over the world. Several herbs have been found to treat and control diabetes, and they have no adverse effects. Hyperglycemia is a devastating illness that causes millions around the world and is quickly becoming a significant public health concern to mankind. Diabetes mellitus is a heterogeneous of autoimmune problems marked by high blood glucose levels due to insulin secretion, action, or both. As a result, products have the ability to be a part of the anti medications, as demonstrated by ethnopharmacological reporting requirements on 800 species with anti diabetic properties. Although, synthetic oral hypoglycemic agents/insulin is the common treatment of diabetes and successful in managing hyperglycemia, meanwhile, they have adverse reactions and do not major role in causing the trajectory of insulin dependent problems. This is now the principal cause why is it that a significant number of people are seeking for alternative medicines with minimal instead of no adverse effects. This section focuses on the different known antihyperglycemic herbal medicines (including their botanical family, common name, constituents, and antihyperglycemic mode of action) as well as plant-based commercialized herbal extracts medicinal preparations.

Keywords: Diabetes; Medicinal plants; Diabetes mellitus; Glucose; Polyherbal plants.

Introduction

"Diabetes" come from Greek Word for "Siphon", and implies that a lot of urine is made. The second term, "mellitus" comes from Latin word, " Mel" which means "honey", The pee was used because it was clean. Diabetes is a metabolic condition marked by alterations in glucose, lipid, and protein metabolism, culminating in hyperglycemia due to inadequate Insulin production, insulin action, or a combination of the two.[1,2] It is among the most challenging illnesses to treat identified by the Indian Council of Medical Research as requiring treatment with a substitute drug. In today's world, diabetes is becoming a more serious problem.[3] The herbal extracts formulation's physiological characteristics were determined (The herbal extracts formulation's physiological characteristics were determined (plasma lipid, plasma triglycerides, high density lipoprotein, low density lipoprotein, sugar, ammonia, creatinine, serum cholesterol, serum triglyceride, hemoglobin, and glycosylated hemoglobin). In a glucose tolerance test (ogtt, the medication responded effectively, since it had no effect on serum concentration. The product

significantly improves the biochemical parameters of diabetic rats. This product's use as an anti diabetic is being investigated in the current study.[4] The number of people who is suffering from diabetes is increasing day by day. Ageing, globalization, as well as the rise in prevalence of obesity rates are the major culprits of this epidemic. Estimate the curator of diabetes and the number of people affected by diabetes, now and in the future it is important to have logical planning and amusement of resources towards treatment and interception of the disease. Hyperglycemia is a physiological illness in which the human species fails to generate or even use insulin, a hormone necessary for transforming sugar, starches, and some other carbohydrate into energy.[5]

Diabetes causes abnormal glucose levels in the bloodstream. Herbal plants are widely used in our everyday lives. These herbs are ingested by both patients and healthy people, either as a nutrient or as a source of food. Herbal remedies are the monarch of all accessible therapies due to their easy availability, raw ingestion, few side effects, and inexpensive cost.[6] The vast majority of cases of diabetes fall into two broad etiopathogenic categories The a etiology of one type of diabetes, type 1, is an entire lack of insulin secretion. The cause of type 2 diabetes, that is far more common, is just a combination of insulin sensitivity and an insufficient compensatory insulin sensitivity. The American Diabetes Association (ADA) published a report in 2005. Insulin and oral antihyperglycemic medicines such as sulfonylurea, biguanides, and glinides are currently available treatments for diabetes.[7] Because so many of them have substantial withdrawal symptoms, amongst the most important areas of research is to find more effective and safer hypoglycemic medications. In diabetes, hyperglycemia generates reactive oxygen species (ROS), Those free radicals serve a crucial role in the growth of subsequent problems in metabolic syndrome by causing lipid peroxidation and cellular degradation(kidney, eye, blood vessel, and nerve damage).[8,9] Antioxidants have been shown to prevent the destruction of ß-cells by inhibiting the peroxidation chain reaction and thus they may provide protection against the development of diabetes.

Plants contain natural antioxidants (tannins, flavonoids, vitamins C and E, etc.) that can preserve ß-cell function and prevent diabetes induced ROS formation. In this present review article an attempt was made to list out the herbal plants possessing antidiabetic activity by one or the other possible mechanisms.[10,11] Hyperglycemia is a significant medical condition that affects millions of people worldwide. with continuously increasing rates of incidence and mortality. Hyperglycemia is classified by high plasma glucose levels caused by inadequate insulin or insulin resistance, or even both, culminating in carbohydrates, lipid, and protein metabolic disorders. This can develop to immediate or persistent complications such as impaired glucose tolerance, microangiopathy, and other ailments if not treated or controlled. Different types of reported diabetes mellitus can be classified under following two categories:

Type 1 Insulin dependent Diabetes Mellitus is a kind of Diabetes that is caused by a lack of Insulin (IDDM), or juvenile onset diabetes mellitus in which the body does not produce any Insulin. This usually affects children and adolescents. Kind 1 diabetes is the most common type of diabetes for 5–10% of Diabetes. Type 1 diabetes is caused by a T cell mediate autoimmune destruction of the pancreatic beta cells.

Type 2 is Noninsulin dependent Diabetes Mellitus (NIDDM), or adult onset diabetes in which the body does not produce enough, or A most prevalent form of diabetes is incorrect utilisation of produced glucose, which accounts for 90–95 percent of cases. Due to a rise in the number of senior individuals, as well as a higher rate of obesity and reduced physical activity, type 2 diabetes is approaching epidemic proportions.

Epidemiology

- At the beginning of the century, the overall amount of diabetics in the globe were anticipated to be around 151 million and 171 million, with 366 million expected by 2030.
- Diabetes is more common in emerging countries due to unhealthy lifestyles, with India and China contributing the most to the global diabetic burden.
- Prolonged hyperglycemia and metabolic dysregulation have been linked to secondary damage in a variety of organ systems, including the kidneys, eyes, nerves, and blood vessels.
- Hyperglycemia is the main cause of end-stage renal disease, adult-onset blindness, and amputations of the lower extremities that are

not caused by trauma.

Basis of Diabetes Mellitus treatment[12,13]

- Patient education concerning the disease.
- Physical exercise.
- Diet and nutrition.
- Oral hypoglycaemic therapy.
- Insulin Theapy.
- Monitoring.

Diabetes results in blood glucose levels that are abnormally high. Herbal plants are commonly found in our daily life. Both patients and healthy people consume these herbs, either as a nutrition or as a food source. Herbal medicines are the king of all accessible therapies because of their ease of use, raw intake, lack of side effects, and low cost. The treatment of each of such disease can be done by exploiting the herbal integrity of India. The herbs, in part or whole, can be utilised to treat diabetes mellitus related disorders. Furthermore, in the some situations, medicinal plants are capable of treating related disorders such as polyuria, polydipsia, glucosuria, and others, as well as healing chronic diseases like diabetes mellitus.

Advantages[14,15]

- Herbal medicines are generally well tolerated by patients, have fewer unintended consequences andtraditional medicine's side effects, and are potentially safer to use.
- Herbal medicines are more effective for long-term health problems that don't respond to conventional therapy.
- Herbal medicines are substantially less expensive than prescription meds. The cost of prescription drugs is significantly increased by research, testing, and marketing. Herbs are generally less expensive than pharmaceuticals.
- Herbs can be purchased without a doctor's prescription. Simple herbs like peppermint and chamomile can be grown in the house.

Life style for patient[16,17]

- Some of the home and herbal remedies prescribedby Ayurveda are described below.

1. Include turmeric and cinnamon diets.
2. Stay away from fatty, fried, and starchy foods.
3. Coffee, sugar, processed flour, and alcoholic beverages should all be avoided.
4. Rather than three substantial meals a day, eat smaller meals five to six times a day (low fat diet).
5. Increase your diet of spinach, cucumber, tomatoes, onion, sprouts, beans, and garlic, among other vegetables.
6. Don't let stress get the best of you.
7. Exercise on a consistent basis At least 40 minutes of walking each day is recommended.
8. During your meals, stay away from red meat and too much salt. Because of their high protein content, fish and soy can be consumed.
9. White bread, grains, potatoes, and sugary and sweet foods should all be avoided.

Recent Regulatory Developments

Traditional medicines that predominantly use medicinal plant preparations for therapy are defined as herbal pharmaceuticals by regulatory procedures. Traditional medicine (including herbal medications) has lately been characterized by the World Health Organization as therapeutic techniques that have existed for hundreds of years or more before the invention and spread of modern medicine, as well as those that are currently in use. In recent years FDA and EMEA have took keen interest and also have reviewed the regulatory frameworks governing the development and use of botanical drug. This burgeoning interest has given the organic ingredients industry a major boost, lowering the restrictions for phytochemicals and allied items. Moreover crucially, these proposed regulations guarantee marketing authorization for botanicals and the adoption of combinatorial pairings of plant derived having been reported products.India and China, both developing as well as developed countries, have an inherent advantage over the rest of the world.[18,19]

Mechanism of Action of Herbal Antidiabetic[20,21]

Herbal anti-diabetic properties are based on a number of processes. Herbal anti-diabetic drugs work in a variety of ways:

- Adrenomimeticism, potassium channel blockade in pancreatic beta cells, and cAMP

(2nd messenger) activation.

- Inhibition of glucose reabsorption in the kidneys.
- Regulation of glucose metabolising processes or augmentation of insulin production from islet beta cells.
- Insulin rate is reduced.
- Calcium, zinc, magnesium, manganese, and copper are all essential nutrients for beta-cell health.
- Pancreatic islet cells regeneration and/or repair.
- In the islets of Langerhans, enhancing the volume and quantity of cells.
- Blood glucose is stimulated.
- Glycogenesis and hepatic glycolysis are both stimulated in this study.
- It has a beneficial impact against beta-cell death.
- Digestion is improved, and blood sugar and urea levels are decreased.
- Prevention of pathological conversion of starch to glucose.
- Inhibition of β-galactocidase and α–glucocidase.
- Cortisol lowering activities.
- Alpha amylase potent inhibitor.

Antdiabetic and other Effective Features of Ethnomedicinal

Acacia arabica (Mimosaceae)

It grows wild in India as well as being cultivated. Normal rats on a 94 percent seed diet had a substantial hypoglycemia effect when compared to controls. However, in alloxanized rats (175 mg/kg SC), the identical meal had no hypoglycemic effect, demonstrating that the plant operates through insulin release. Powdered seeds of Acacia Arabica administered in doses of 2, 3 and 4 gm/kg body weight exerted a significant (PB/0.05) hypoglycemic effect in normal rabbits by initiating the release of insulin from pancreatic beta cells. At these levels, there was no acute toxicity or behavioural abnormalities. It is found all over India.Through functioning as little more than a secretagouge to leads to insulin resistance, the crude extracts functions as an anti diabetic medication. Supervision rats develop hypoglycemia, whereas inalloxanized rats do not. When pulverized kernels of A. arabica are given to healthy rabbits (2, 3 or 4 g/kg body weight), they cause hypoglycemia via triggering insulin response from pancreatic islets.[22,23]

Fig1: Acacia Arbaica.

Achyranthes Aspera (Amaranthaceae)

It is distributed throughout the tropical world. In both healthy and diabetic rabbits, oral administration of A. aspera powder results in a strong dose dependent hypoglycemic effect. In both healthy and alloxan diabetic rabbits, the water and methanol extracts reduce blood glucose levels. At oral dosages of up to 8 g/kg, the acute toxicity trial in rabbits found no severe or side effects. The plant could work by supplying some essential nutrients such as calcium, zinc, and iron, magnesium, manganese and copper to the beta-cells.[24,25]

Fig. 2: Achyranthes aspera.

Alliumcepa, onion (Liliaceae)

Only the cultivar Allium cepa is known, however comparable native species are listed throughout Central Asia. In diabetic rabbits, several ether soluble fractions as well as insoluble fractions of dried onion powder show anti hyperglycemic effect.[26] Antioxidant and antihyperlipidemic properties also have been discovered in A. cepa. S-methyl cysteine sulphoxide (SMCS) (200 mg/ kg for 45 days) was given to derived exosomes hypoglycemic effect and was found to considerably regulate blood glucose and lipids in plasma and tissue samples.Hexokinase, glucose 6-phosphatase, and HMG Co A reductase activity in the hepatic are all normalised.[27,28] Once people with diabetes were given a single effective dose of 50 g onion juice, their post-prandial glucose levels were dramatically reduced.[29,30]

Fig. 3: Allium cepa.

Allium Sativum, Garlic (Liliaceae)

It is indeed a herbaceous herb that is found abundantly in India and utilised as a condiment. In alloxandiabetic rabbits (150 mg/kg IV), orally administering 0.25 gm/kg of ethanol, petroleum ether, or ethyl ether isolate from Allium sativum reduces blood sugar by 18.9%, 17.9%, and 26.2 percent, respectively. On moderately stz-induced diabetic rats (glucose levels tend to range between 180 to 300 mg percent), oral bioavailability of 0.25 gm/kg allicin (isolated from A. sativum) caused hyperglycemia equivalent to tolbutamide, but it had no impact in profoundly diabetic mice (blood sugar 350 mg/percent). Oral administration of garlic aqueous homogenate (10 ml/kg/day) to sucrose fed rabbits (10 gm/kg/day in water for 2 months) As comparison to sucrose controls, there would be a considerable rise in hepato glycogen and free amino acid composition, as well as a lowering in fasting blood sugar, serum triglyceride levels, liver triglyceride levels, and serum and liver protein levels. As compared to the antihyperglycemic medication glibenclamide, oral bioavailability of garlic extract reduces glucose tolerance, total cholesterol, triglycerides, urea, uric acid, creatinine, AST, and ALT levels despite increasing plasma insulin in hypoglycemic effect but not in normal rats. The extraction proved to be more efficient than glibenclamide in lowering blood sugar levels.The plant should be evaluated as a great possibility for prospective diabetic mellitus research, according to the researchers.[31,32]

Fig. 4: Allium sativum.

Aloe barbadensis, Aloe gibberellins (Liliaceae)

It thrives in arid settings and is found throughout Africa, India, and other desert regions. In diabetic rats, aloe vera gel at 200 mg/kg has strong antidiabetic and cardioprotective effect, reducing elevated TBARS and maintaining normal Superoxide dismutase and Catalase activity, as well as increasing reduced glutathione by four times.[33] In contrast to glibenclamide, the leaf pulp extract had greater hypoglycemic action in IDDM and NIDDM rats. In STZ diabetic animals, both Aloe vera and (at doses ranging from 2-100 mg/ kg) suppress inflammatory and promote healing. Both epidemiological and clinical studies have revealed that the desiccated sap of the plant (half a teaspoonful daily for 4-14 weeks) seems to have a strong hyperglycemia impact.[34]

Aloe vera (Liliaceae)

It really is a cactus like plant having succulent, tapering, spiky leaflets that also are packed with sticky gel. The cytotoxic activity of Aloe vera aqueous leaf extract was administered orally at a dose of 150mg/kg of body weight. A entire investigation was conducted on alloxan-induced male albino rats. Medication of chronic but not single doses of metabolic byproducts of Aloe barbadensis leaves had a hypoglycemic activity

in alloxan-induced diabetic rats. In hypoglycemic effect, acute and chronically administrations of the very same plant's bitterness component used to have a hypoglycemic impact.This one is accomplished by potentiating production and/or release from pancreatic islets.[35,36]

Fig. 5: Aloe vera.

Andrographis Paniculata (Acanthaceae)

It is indeed a perennial herb indigenous to India and Sri Lanka that's extensively grown in southern Asia. Andrographis boosts physiological efficiency of Superoxide and Catalase substantially when taken orally. Potential antioxidant effects, it moreover lowers blood sugar levels. The hydroalcoholic extract of A. paniculata has anti diabetic properties, which may well be responsible for the increase in gluconeogenesis, at least to some degree. In diabetes patients, its hypotriglyceridemic action is also useful.[37,38]

Fig. 6: Andrographis Paniculata.

Annona Squamosa (Annonaceae)

This thrives at low elevations and is a little well-branched tree or shrub. The reactive hypoglycemia rats were given 15 mg/kg/day of extracted juercetin-3-O-glucoside from A. squamosa leaves for 10 days, which reversed the consequences and inhibited the activities of hepatocellular GIucose-6-phosphatase. Once administered to STZ induced hypoglycemic effect, aqueous extract of A. squamosa root (at doses of 250 mg/kg and 500 mg/kg bw) lowered blood glucose levels from 285.52 to 208.81 mg/dl 6 hours after orally administered. It also reduces hepatocellular oxidative damage by increasing the activity of glutathione peroxidase including Catalase and Superoxide dismutase, as well as glutathione content, indicating its safe and antiperoxidative effects.[39,40]

Fig. 7: Annona Squamosa.

Azadirachta Indica (Meliaceae)

Neem is the common name for this plant. It is a subtropical and semi tropical tree that can be found in India, Burma, Bangladesh, Sri Lanka, Malaysia, and Pakistan. In type 2 people with diabetes whose diabetes is not monitored by oral medications, low (0.5g tid) and high (2g tid) dosing frequency of dry powder part, acetone extracts, and alcohol problem extract of A. indica show significant hypoglycemic

effect in large dose and can be effectively merged with all these intermediaries agents.[41,42]

Fig. 8: Azadirchata Indica.

Catharanthus Roseus (Apocynaceae)

Oral dosing of 0.5, 0.75, and 1.0 mL/kg body composition lowered hyperglycemia in healthy and diabetic rabbits to comparable levels to glibenclamide. The findings suggest that C. Roseus has a long lasting effect in controlling blood sugar levels, and that the effective compound(s)' molecular mechanism is most likely transmitted by increased insulin production from Langerhans betacells or by an extrapancreatic mechanism.[43,44]

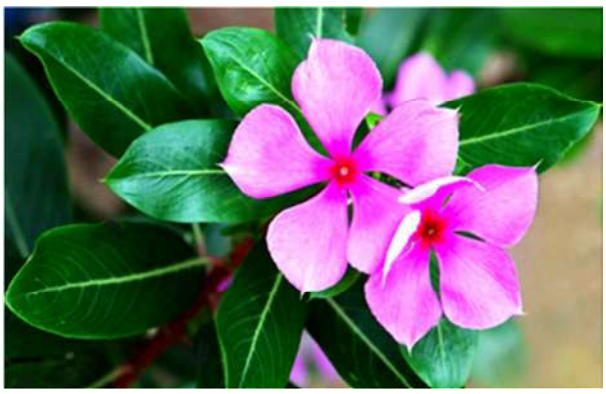

Fig. 9: Catharanthus Roseus.

Momordica Charantia L. (Cucurbitaceae)

Vegetable insulin is derived from M. charantia (bitter melon). An orally sugar endurance test reveals that extract showed (AE), methanol fractions (MF), or alcohol insoluble fraction (MIF) supplementation all significantly lower glycemia after 30 minutes when compared to untreated. Furthermore, inside the orally sugar screening test, the drug plasma level at 30 minutes after MF delivery is markedly lower, illustrating that bitter melon inhibits hepatic gluconeogenesis through inhibiting beta galactosidase action.[45]

Fig. 10: Momordica charantia L.

Panax Ginseng (Araliaceae)

The roots are taken orally in the treatment of type II diabetes. Extracts of ginseng species shows antihyperglycemic activity associated with increased peroxisome proliferatoractivated receptor gamma expression and adenosine monophosphate-activated protein kinase phosphorylation in liver and muscle. P. ginseng root taken orally enhances insulin sensitivity and could be used as an adjunct therapy for diabetic individuals with insulin resistance.[46,47,48]

Fig. 11: Panax Ginseng.

Ocimum Sanctum L. (Lamiaceae)

Tulsi is another name for it. This plant's therapeutic virtues have been known since antiquity.[49,50] Including both conventional and alloxan induced rats treated, the aqueous leaves extract significantly reduces hyperglycemia. The anti hyperglycemic benefits of tulsi in diabetic rats were demonstrated by greater reductions in fasting plasma glucose, uronic

acid, total amino acid, total cholesterol, triglyceride, and total lipid.[51,52] The serum glucose reduction is possible after 30 days of orally administered of plant extract (200 mg/kg). When insulin dependent rats are compared to untreated rats, renal glycogen concentrations increase tenfold while skeletal system and liver glycogen levels decline by 68% and 75%, correspondingly. Additionally, the plant has antioxidants, antibacterial, antifungal, antiviral, antiasthemitic, antistress, anticancer, gastric antiulcer, antimutagenic, and antistress properties,immunostimulant activities.[53,54]

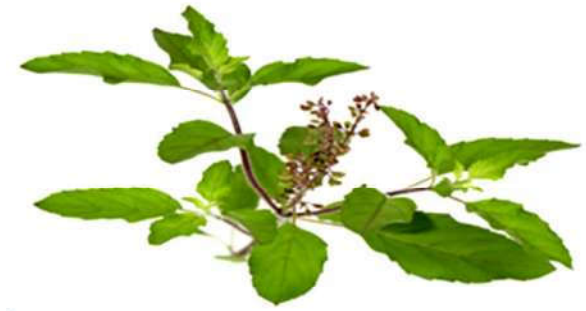

Fig. 12: Ocimum Sanctum.

Mangifera Indica (Anacardiaceae)

When comparison to something like an ingested dose of two different substances, the decoction lowers blood glucose levels in nondiabetic and glucose induced hyperglycemia mice, but it has no effect on streptozotocin induced diabetic mice under another circumstances. The findings suggest that an extract showed of M. indica leaves has hypoglycemic properties.[55,56]

Fig.13: Mangifera Indica.

Tinospora Cordifolia (Menispermaceae)

Guduchi is the generic term for a perennial plant native to India, Myanmar, and Sri Lanka's tropical regions.When alloxan induced diabetic rats are given an aqueous T. cordifolia root extract, their blood glucose and brain lipids are significantly reduced. However the extract showed at a concentration of 400 mg/kg has shown to have a considerable anti hyperglycemic impact in model organisms, its efficacy is only one unit/kg of insulin.[57,58]

Fig. 14: Tinospora Cordifolia.

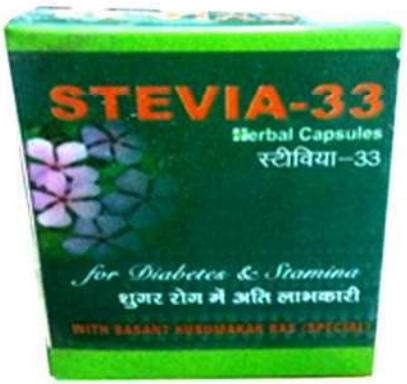

Fig. 10: Stevia 33.

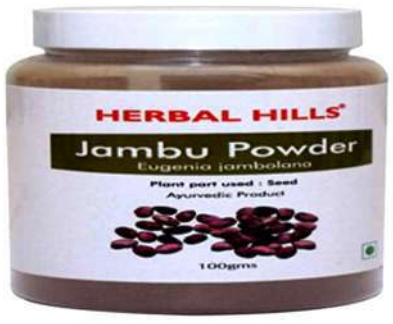

Fig11: Herbal Hills Jambu Powder.

Table 1: Some Plants Having Hypoglycemic Activities.[77]

Common name	Botanical name and family	Parts used	Therapeutic action
Asiatic ginseng	Panax ginseng (Araliac)	Roots	Reduces hyperglycemia through slowing carbohydrate digestion, boosting glucose uptake, and modulating insulin production.
Ashwagandha, winter cheery	Withania somnifera (Solanaceae)	Roots	Insulin levels are plummeting.
Asiatic sweet leaf	Symplocos Paniculata (Symplocaceae)	Leaves/ stems	PTP1B (protein tyrosine phosphatase 1B) 1 and 2 suppression
Banana	Musa sapientum Kuntz (Musaceae)	Fruits/ flowers	Insulin and glycosylated haemoglobin levels are diminished.
Banyan tree	Ficus bengalensis (Moraceae)	Bark	Insulinase response is characterized in the liver and kidneys, whereas insulin secretion is enhanced.
Barbados	Aloe barbadensis Mill. (Liliaceae)	Leaves	Glucose biosynthesis and distribution are enhanced.
Betal,betal wine	Piper betle (Piperaceae)	Leaf	Antihyperglycemic, glucose metabolism.
Bilwa, bael fruit	Aegle marmelos (Rutaceae)	Leaf Extract	Ammonia and lipoprotein blood levels should be reduced.
Bitter kola, false kola	Garcinia kola (Clusiaceae)	Seed	Hypoglycaemic and Hypolipidemic.
Black tea	Camellia sinensis L. (Theaceae)	Leaves	L. (Theaceae) Glucose levels in the blood are reduced when leaves are consumed.

Table 2: Marketed Herbal Antidiabetic Products.

Product	Manufacturer	Mechanism	Reference
Sharang Dyab-Tea	Plant Med lab Pvt. Ltd.	Stimulate insulin production	(81)
Herbal hills jambu	Isha Agro Developers	Reduce blood and urine sugar level	(82)
Stevia-33	Vitalize Herbs Pvt. Ltd.	Stimulate beta cells of pancreas	(83)
Diab-FIT	Herbal FIT	Maintain proper blood sugar level	(84)
Madhumar capsule	Kangrd Hills Care and Products	Control chronic care diabetes mellitus	(85)
Daya Stone Powder	Jignesh and Co.	Reduce your blood sugar levels.	(86)
Blue berry Al	Hikma FZCO	Antidiabetic	(87)
Episulin	Varuna Biocell Pvt. Ltd.	Antidiabetic	(88)

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Conclusion

Diabetes is the most common hormonal illness, impacting over 300 million people globally.As a consequence, treatments accordance with the principles of conventional medicine (allopathic) are frequently unsuccessful, contain the danger of side effects, and are prohibitively expensive, particularly in developing countries. Diabetic nephropathy is becoming more common and widespread, and treating it with oral antihyperglycemic medicines comes with a slew of negative side effects and a hefty price tag. There is increasing demand by patients to use the natural products with antidiabetic activity. A few anti diabetic herbs have been dopaminergic examined and proved to be beneficial in the management of Diabetes Mellitus in this research.Some plants' properties may help to prevent diabetes consequences and rectify biochemical imbalances.Substantial research is needed, meanwhile, to determine the molecular mechanisms of medicinal herbs that have an anti-diabetic impact.

The objective of this report is to investigate whether plants, plant parts, or extracts can be used to treat diabetes. It moreover compiles information on hypoglycemic plants that are presently accessible. Hypothesis testing on hypoglycemia plants and their phytochemical constituents are of particular relevance in the ongoing investigation. A short outline of the kind of diabetes, accompanying metabolic diseases, and herbal products that can be used for anti diabetic activity is described. In generally, the descriptions of antihyperglycaemic plants documented in the bibliography are

presented in this analysis. All of the herbal medications that have been described.

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