



## AN OVERVIEW OF DIABETES AND ITS NATURAL HERBAL REMEDIES

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### ARTICLE INFO

#### Review Article History

Received: 20<sup>th</sup> July, 2020

Accepted: 23<sup>rd</sup> July, 2020

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### ABSTRACT

Worldwide peoples are productively using and unquestioning herbal medicine for the treatment of various health problems. Many of the diabetic patients are receiving side effect due to allopathic medication so now patients are relying on substitute therapies with anti-hyperglycemic effects. This comes as no surprise since alternative treatments have been most broadly used in chronic diseases, which may be only incompletely alleviated by conventional treatment. Herbal medications are the most commonly used alternative therapy for lowering blood sugar. However, their safety and efficacy need to be further evaluated by well-designed, controlled clinical studies. Actual aim of this article was to compile all the plants having some anti-hyperglycemic effects and all of them must be from natural herbal source.

**KEYWORDS:** Herbal remedy, anti diabetic therapy, traditional medicine, marked formulations.

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### INTRODUCTION

Plants are very useful to mankind. Many of them are used exclusively for medicinal purposes. According to the World Health Organization (WHO), "a medicinal plant is a plant which, in one or more of its organs, contains substances that can be used for therapeutic purposes, or which are precursors for chemo-pharmaceutical semi-synthesis." Such plants are in great demand by pharmaceutical companies for their active ingredients [1,2].

Diabetes mellitus is one of the most common disorders affecting almost 6% of the world population and the dynamics of the diabetes are changing rapidly in low- to middle-income countries [3]. According to International Diabetes Federation's (IDF) estimates, 80% of the world diabetic population will be from low- and middle-income countries in 2030. As per IDF 2011 report, China, India, and the United States of America have a diabetic population of 90.0, 61.3, and 23.7 million, which may be increased up to 129.7, 101.2, and 29.3 million, respectively, in 2030 [4]. Globally, diabetes is one of the six major causes of death and also causing various systemic complications. Diabetes mellitus is treated by hormone therapy (insulin) or by administering glucose-lowering agents such as alpha-glucosidase inhibitors, sulfonylureas, biguanides, and thiazolidinediones. Development of an adverse event is one of the complications in the treatment of any systemic disorder; hence, many of the research institutes and pharmaceutical companies are involved in drug development to find the molecules with good therapeutic potential and less adverse events [5].

In the USA, 10-25% of patients experience an adverse drug reaction and these adverse drug reactions are responsible for 3.4-7.0% of hospital admissions [6].

World health organization (WHO) has defined diabetes mellitus (DM) as a chronic disease caused by inherited and/or acquired deficiency in the production of insulin by the pancreas, or by the ineffectiveness of the insulin produced [7-10].

It is a metabolic disorder of endocrine system which is characterized by hyperglycemia or hypoglycemia. Diabetes is categorized into two types i.e. insulin-dependent (type 1) and insulin independent (type 2). Type 1 diabetes (insulin dependent) is caused due to the failure of the pancreas to produce insulin. This form develops most frequently in children and adolescents. On the other hand, Type 2 diabetes (insulin independent) results from the impaired action of insulin in the body. This type is more prevalent in adults in comparison to type 1 diabetes [11] and contributes to about 90 percent of the adult cases worldwide. Diabetes is a major risk factor for morbidities like blindness, kidney failure, heart attacks and limb amputation. It was the direct cause for 1.2 million deaths in 2015 [12]. In India, the number of diabetic patients has increased from 31.7 million in 2000 to 69.1 million in 2016 [13]. A record increase of 117% has been noticed in diabetic patients in last 16 y and India has now been declared as "Diabetic Capital" of the world [14-16].

Actual aim of this article was to compile all the plants having some anti-hyperglycemic effects and available marketed herbal formulations for the same.

## **DIABETES MELLITUS:**

It is a metabolic disorder in the endocrine system. Diabetes is a chronic disorder in the metabolism of carbohydrate, proteins, and fat due to an absolute or relative deficiency of insulin secretion with/without a varying degree of insulin resistance. Also, it may be defined as a disease where the body produces little insulin / ceases to produce insulin or becomes progressive resistance to its actions [8, 9]. It occurs worldwide, and the incidences of both type 1 and type 2 diabetes are rising; it is estimated that in the year 2000, 171 million people had diabetes, and this is expected to double by 2030 [7,8].

### **Types of Diabetes:**

There are three main types of diabetes: Type 1 Diabetes: Insulin - dependent diabetes (IDDM; Type I diabetes) is one of the most serious metabolic disorders, It has an autoimmune basis and is characterized by destruction of the pancreatic beta cells. Genetic and environmental factors play a part, and it is no surprise that HLA-DR3 and HLA-DR4 confer susceptibility to Type 1 diabetes mellitus [9]. Type 2 Diabetes: It formerly referred to as non-insulin-dependent diabetes mellitus, NIDDM for short, and adult-onset diabetes. Type 2 diabetes mellitus consists of an array of dysfunctions characterized by hyperglycemia and resulting from the combination of resistance to insulin action, inadequate insulin secretion, and excessive or inappropriate glucagon secretion [10]. Gestational Diabetes: Gestational diabetes mellitus (GDM) affects ~ 7% of all pregnancies and is defined as carbohydrate intolerance during gestation. It is crucial to detect women with GDM because the condition can be associated with several maternal and fetal complications, such as macrosomia, birth trauma, cesarean section, and hypocalcemia, hypoglycemia & hyperbilirubinemia in newborns [11].

### **Causes of Diabetes:**

In many cases, genetics, habits, and environment may all contribute to a person's diabetes. Type 1 Diabetes: Type 1 diabetes is believed to be an autoimmune disease. The body's immune system specifically attacks the cells in the pancreas that produce insulin.

- A predisposition to developing Type 1 diabetes may run in families, but genetic causes (a positive family history) are much more common for Type 2 diabetes.
- Environmental factors, including common, unavoidable viral infections, may also contribute to Type 1 diabetes.
- Type 1 diabetes is most common in people of Non-Hispanic, Northern European descent, followed by African Americans, and Hispanic Americans.
- Type 1 diabetes is slightly more common in men than in women.

### **Type 2 Diabetes:**

- High blood pressure.
- High blood triglyceride (fat) levels.
- Gestational diabetes or giving birth to a baby weighing more than 9 pounds.
- High-fat diet.
- High alcohol intake.
- Sedentary lifestyle.
- Obesity or being overweight.
- Aging. [12, 13]

Scientists advocate that animal research cannot be replaced by models such as cell cultures or biometric computer modeling because these cannot predict complex interactions that occur between molecules, cell transport and signaling in response to a host of factors, tissue interactions, organ-specific mass action and whole organisms in their environment [17].

In their classic chapter on pharmacometrics in 1964, Paget and Barnes [18] detailed the evaluation of drugs in animals and the steps that should be taken to obtain evidence of unexpected toxic effects. They recognized the need for humane supervision and proper regulation of animals and the potential for medical progress to actually be held back by misleading animal models that do not reliably predict effects in humans.

Anti-diabetic drugs treat diabetes mellitus by lowering glucose levels in the blood. Traditional Medicines derived from medicinal plants are used by about 60% of the world's population. This review focuses on Indian Herbal drugs and plants used in the treatment of diabetes, especially in India. Diabetes is an important human ailment afflicting many from various walks of life in different countries. In India it is proving to be a major health problem, especially in the urban areas. Though there are various approaches to reduce the ill effects of diabetes and its secondary complications, herbal formulations are preferred due to lesser side effects, low cost and because of their natural origin. Diabetes mellitus is a metabolic disorder characterized by hyperglycemia resulting from increased hepatic glucose production, diminished insulin secretion and impaired insulin action. Diabetes mellitus (DM), both insulin-dependent DM (IDDM) and non-insulin dependent DM (NIDDM) is a common and serious metabolic disorder throughout the world. Traditional plant treatments have been used throughout the world for the therapy of diabetes mellitus. Among many medications and polyherbal plants, several herbs have been known to cure and control diabetes; additionally they have no side effects. Diabetes mellitus is a dreadful disease found in all parts of the world and is becoming a serious threat to mankind health. Diabetes mellitus is a group of metabolic diseases characterized by high blood sugar (glucose) levels that result from defects in insulin secretion, or action, or both. Thus, plants are a potential source of anti-diabetic drugs which can be proved by the ethnobotanical information reports about 800 plants that may possess anti-diabetic potential. Although, synthetic oral hypoglycemic agents/insulin is the mainstream treatment of diabetes and effective in controlling hyperglycaemia, they have prominent side effects and fail to significantly alter the course of diabetic complications. This forms the main reason for an increasing number of people finding alternating therapies that may have less severe or no side effects. This article presents a review on some reported antidiabetic medicinal plants (with their botanical name, common name, constituent and mechanism of action for antidiabetic action) and plant based marketed polyherbal herbal formulations [19].

**HERBAL DIABETES CURE:****Table 1: Some Plants Having Hypoglycemic Activities [19]**

S. no.	Common name	Botanical name and family	Parts used	Therapeutic action
1	Asiatic ginseng	<i>Panax ginseng</i> (Araliac)	Roots	Lowers blood glucose by decreasing the rate of carbohydrate absorption, increasing glucose transport and modulation of insulin secretion
2	Ashwagandha, winter cheery	<i>Withania somnifera</i> (Solanaceae)	Roots	Decrease in blood sugar level
3	Asiatic sweet leaf	<i>Symplocos Paniculata</i> (Symplocaceae)	Leaves/ stems	Inhibit protein tyrosine phosphatase 1B (PTP1B) 1 and 2
4	Banana	<i>Musa sapientum</i> Kuntz (Musaceae)	Fruits/flowers	Decreases blood glucose and glycosylated haemoglobin level
5	Banyan tree	<i>Ficus bengalensis</i> (Moraceae)	Bark	Inhibits insulinase activity from liver and kidney, stimulates insulin secretion
6	Barbados	<i>Aloe barbadensis</i> Mill. (Liliaceae)	Leaves	Stimulate synthesis and release of insulin
7	Betal, betal wine	<i>Piper betle</i> (Piperaceae)	Leaf	Antihyperglycemic, glucose metabolism
8	Bilwa, bael fruit	<i>Aegle marmelos</i> (Rutaceae)	Leaf Extract	Decrease blood urea and cholesterol
9	Bitter kola, false kola	<i>Garcinia kola</i> (Clusiaceae)	Seed	Hypoglycaemic and Hypolipidemic
10	Black tea	<i>Camellia sinensis</i> L. (Theaceae)	Leaves	L. (Theaceae) Leaves Decreases blood glucose level

**HOME REMEDIES FOR DIABETES [20-27]**

Herbs for diabetes treatment are not new. Since ancient times, plants and plant extracts were used to combat diabetes. Here are some herbs that have been confirmed by scientific investigation, which appear to be most effective, relatively non-toxic and have substantial documentation of efficiency.

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Diabetes mellitus is a dreadful disease found in all parts of the world and is becoming a serious threat to mankind health. Diabetes mellitus is a group of metabolic diseases characterized by high blood sugar (glucose) levels that result from defects in insulin secretion, or action, or both. Thus, plants are a potential source of anti-diabetic drugs which can be proved by the ethnobotanical information reports about 800 plants that may possess anti-diabetic potential. Although, synthetic oral hypoglycemic agents/insulin is the mainstream treatment of diabetes and effective in controlling hyperglycaemia, they have prominent side effects and fail to significantly alter the course of diabetic complications. This forms the main reason for an increasing number of people finding alternating therapies that may have less severe or no side effects.

This article presents a review on some reported antidiabetic medicinal plants (with their botanical name, common name, constituent and mechanism of action for antidiabetic action) and plant based marketed polyherbal herbal formulations

#### **Cinnamon:**

Cinnamon is the inner bark of a tropical evergreen tree native to India and Sri Lanka. It has insulin-like properties, which able to decrease blood glucose levels as well as triglycerides and cholesterol, all of which are important especially for type 2 diabetes patients.

The study on people published in 2003 conducted in the Department of Human Nutrition, NWFP Agricultural University, Peshawar, Pakistan concluded: The results of this study demonstrate that intake of 1, 3, or 6 g of cinnamon per day reduces serum glucose, triglyceride, LDL cholesterol, and total cholesterol in people with type 2 diabetes and suggest that the inclusion of cinnamon in the diet of people with type 2 diabetes will reduce risk factors associated with diabetes

#### **Pterocarpus marsupium: (Indian kino tree)**

Pterocarpus marsupium is a large deciduous tree. Pterocarpus marsupium demonstrates to reduce the glucose absorption from the gastrointestinal tract, and improve insulin and pro-insulin levels.

Pterostilbene, a constituent derived from wood of this plant caused hypoglycemia in dogs showed that the hypoglycemic activity of this extract is because of presence of tannates in the extract. Flavonoid fraction from *Pterocarpus marsupium* has been shown to cause pancreatic beta cell regranulation. Marsupin, pterosupin and liquiritigenin obtained from this plant showed antihyperlipidemic activity. Like insulin, (-) epicatechin stimulates oxygen uptake in fat cells and tissue slices of various organs, increases glycogen content of rat diaphragm in a dose-dependent manner.

#### **Bitter melon (Momordica charantia):**

Studies suggested that Asian Bitter Melon may lower blood glucose concentrations. Several compounds have been isolated from bitter melon that is believed to be responsible for its blood-sugar-lowering properties. These include charantin and an insulin-like protein referred to as polypeptide-P, or plant insulin. It is believed that bitter melon acts on both the pancreas and in nonpancreatic cells, such as muscle cells.

#### **Gynema Sylvestre:**

To treat diabetes, dried leaves are powdered together with Coriander fruit juice is extracted and given orally. These remedy has been used in India for treating diabetes for about 2000 years. Today in India it is being used to treat primarily type II diabetes and type I as well. Gymnema also improves the ability of insulin to lower blood sugar in both type I and type II diabetes. This herb is showing up in more and more over the counter weight loss products and blood sugar balancing formulas.

#### **Allium cepa: (Onion)**

Various ether soluble fractions as well as insoluble fractions of dried onion powder show anti-hyperglycemic activity in diabetic rabbits. Administration of a sulfur

containing amino acid from *Allium cepa*, S-methyl cysteine sulphoxide (SMCS) (200 mg/kg for 45 days) to alloxan induced diabetic rats significantly controlled blood glucose as well as lipids in serum and tissues and normalized the activities of liver hexokinase, glucose 6-phosphatase and HMG Co A reductase. When diabetic patients were given single oral dose of 50 g of onion juice, it significantly controlled post-prandial glucose levels. Onion is a member of the lily family (Liliaceae). Experimental and clinical evidence suggests that onion consists of an active ingredient called APDS (allyl propyl disulphide). APDS has been shown to block the breakdown of insulin by the liver and possibly to stimulate insulin production by the pancreas, thus increasing the amount of insulin and reducing sugar levels in the blood. The additional benefit of the use of garlic is its beneficial cardiovascular effects. It is found to lower lipid levels, inhibit platelet aggregation and are antihypertensive. So the use of onion is recommended for diabetes patients.

#### **Fenugreek (Trigonella foenum-graecum):**

Fenugreek or foenum-graecum, is a crop plant grown as a potherb and for the spice made from its seeds. The fenugreek plant grows wild from the eastern Mediterranean area to China; it is cultivated worldwide. Fenugreek is used both as a herb (the leaves) and as a spice (the seed). Pre-clinical and clinical studies have demonstrated the antidiabetic properties of fenugreek seeds. The fiber-rich fraction of fenugreek seeds can lower blood sugar levels in people with diabetes, and to a lesser extent, for lowering blood cholesterol. Additionally, the soluble fiber content of fenugreek may play a role in aiding weight control.

#### **Blueberry (Vaccinium myrtillus):**

They are closely related to the European bilberry. There are several species of blueberries exist-including *V. pallidum* and *V. corymbosum*-and grow throughout the United States. Its leaves are the primary part of the plant used medicinally. Blueberry is a natural method of controlling or lowering blood sugar levels when they are slightly elevated - Sugar Diabetes. Results have shown the leaves have an active ingredient with a remarkable ability to get rid the body of excessive sugar in the blood. It is a good astringent and helps relieve inflammation of the kidney, bladder and prostate.

#### **Asian Ginseng:**

Asian ginseng is commonly used in traditional Chinese medicine to treat diabetes. It has been shown to enhance the release of insulin from the pancreas and to increase the number of insulin receptors. It also has a direct blood sugar-lowering effect and improves psycho-physiological performance.

#### **Ginkgo Biloba:**

Long used in traditional Chinese medicine, a species that has survived in China for more than 200 million years and now grows throughout the world. This popular herbal medicine is extracted from the fan-shaped leaves of the ancient Ginkgo biloba tree. The extract may prove useful for prevention and treatment of early-stage diabetic neuropathy. Ginkgo biloba extract improves blood flow in the peripheral tissues of the nerves in the arms, legs, hands, and feet and is therefore an important medicine in

the treatment of peripheral vascular disease. It has also been shown to prevent diabetic retinopathy.

**Banaba (*Lagerstroemia speciosa*):**

Banaba is a variety of crepe myrtle that grows in the Philippines, India, Malaysia and Australia. Banaba possesses the powerful compound corosolic acid and tannins, including lagerstroemin that lends itself to the treatment of diabetes. These ingredients are thought to stimulate glucose uptake and have insulin-like activity. The latter activity is thought to be secondary to activation of the insulin receptor tyrosine kinase or the inhibition of tyrosine phosphatase. It is a natural plant insulin, can be taken orally.

**Babhul (*Acacia arabica*):**

It is found all over India mainly in the wild habitat. The plant extract acts as an antidiabetic agent by acting as secretagogue to release insulin. The plant extract acts as an antidiabetic agent by acting as secretagogue to release insulin. It induces hypoglycemia in control rats but not in alloxanized animals. Powdered seeds of *Acacia arabica* when administered (2, 3 and 4 g/kg body weight) to normal rabbits induced hypoglycemic effect by initiating release of insulin from pancreatic beta cells.

**Bengal Quince, Bel or Bilva (*Aegle marmelos*):**

Administration of aqueous extract of leaves improves digestion and reduces blood sugar and urea, serum cholesterol. Along with exhibiting hypoglycemic activity, this extract also prevented peak rise in blood sugar at 1h in oral glucose tolerance test.

**Garlic (*Allium sativum*):**

This is a perennial herb cultivated throughout India. Allicin, a sulfur-containing compound is responsible for its pungent odour and it has been shown to have significant hypoglycemic activity. This effect is thought to be due to increased hepatic metabolism, increased insulin release from pancreatic beta cells and/or insulin sparing effect, thus decreased fasting blood glucose, and triglyceride levels in serum in comparison to sucrose controls.

S-allyl cystein sulfoxide (SACS), the precursor of allicin and garlic oil, is a sulfur containing amino acid, which controlled lipid peroxidation better than glibenclamide and insulin. It also improved diabetic conditions. SACS also stimulated In-vitro insulin secretion from beta cells isolated from normal rats. Apart from this, *Allium sativum* exhibits antimicrobial, anticancer and cardioprotective activities.

**Aloe (*Aloe vera* and *Aloe barbadensis*):**

Aloe, a popular houseplant, has a long history as a multipurpose folk remedy. The plant can be separated into two basic products: gel and latex. Aloe vera gel is the leaf pulp or mucilage, aloe latex, commonly referred to as –aloe juice,|| is a bitter yellow exudate from the pericyclic tubules just beneath the outer skin of the leaves. Extracts of aloe gum effectively increases glucose tolerance in both normal and diabetic rats.

Treatment of chronic but not single dose of exudates of *Aloe barbadensis* leaves showed hypoglycemic effect. Single as well as chronic doses of bitter principle of the same plant also showed hypoglycemic effect. This action of

*Aloe vera* and its bitter principle is through stimulation of synthesis and/or release of insulin from pancreatic beta cells. This plant also has an anti-inflammatory activity in a dose dependent manner and improves wound healing in diabetes.

**Neem (*Azadirachta indica*):**

Hydroalcoholic extracts of this plant showed anti-hyperglycemic activity. Apart from having anti-diabetic activity, this plant also has anti-bacterial, antimalarial, antifertility, hepatoprotective and antioxidant effects.

**Caesalpinia bonducella:**

*Caesalpinia bonducella* is widely distributed throughout the coastal region of India and used ethnically by the tribal people of India for controlling blood sugar. Both the aqueous and ethanolic extracts showed potent hypoglycemic activity in chronic type II diabetic models. These extracts also increased glycogenesis thereby increasing liver glycogen content. The antihyperglycemic action of the seed extracts may be due to the blocking of glucose absorption. The drug has the potential to act as antidiabetic as well as antihyperlipidemic.

**Indian Goose Berry, Jamun (*Eugenia jambolana*):**

In India decoction of kernels of *Eugenia jambolana* is used as household remedy for diabetes. This also forms a major constituent of many herbal formulations for diabetes.

Antihyperglycemic effect of aqueous and alcoholic extract as well as lyophilized powder shows reduction in blood glucose level. This varies with different level of diabetes. The extract of jamun pulp showed the hypoglycemic activity in streptozotocin induced diabetic. These extracts also inhibited insulinase activity from liver and kidney.

**Mango (*Mangifera indica*):**

The leaves of this plant are used as an antidiabetic agent in Nigerian folk medicine, although when aqueous extract given orally did not alter blood glucose level in either normoglycemic or streptozotocin induced diabetes. The aqueous extract of *Mangifera indica* possesses hypoglycemic activity. This may be due to an intestinal reduction of the absorption of glucose.

**Holy Basil (*Ocimum sanctum*):**

It is commonly known as Tulsi. Since ancient times, this plant is known for its medicinal properties. The aqueous extract of leaves of *Ocimum sanctum* showed the significant reduction in blood sugar level in both normal and alloxan induced diabetes. Significant reduction in fasting blood glucose, uronic acid, total amino acid, total cholesterol, triglyceride and total lipid indicated the hypoglycemic and hypolipidemic effects of tulsi in diabetes. This plant also showed antiasthmatic, antistress, antibacterial, antifungal, antiviral, antitumor, gastric antiulcer activity, antioxidant, antimutagenic and immunostimulant activities.

**Bhuiawala (*Phyllanthus amarus*):**

It is a herb of height up to 60 cm, from family Euphorbiaceae. It is commonly known as Bhuiamala. It is scattered throughout the hotter parts of India, mainly Deccan, Konkan and south Indian states. Traditionally it is used in diabetes therapeutics. Methanolic extract of

Phyllanthus amarus was found to have potent antioxidant activity. This extract also reduced the blood sugar in alloxanized diabetes. The plant also shows antiinflammatory, antimutagenic, anticarcinogenic, antidiarrhoeal activity.

#### **Gymnema sylvestre:**

To treat diabetes, dried leaves are powdered together with coriander fruit juice is extracted and given orally. These remedy has been used in India for treating diabetes for about 2000 years. Today in India it is being used to treat primarily type II diabetes and type I as well. *Gymnema* also improves the ability of insulin to lower blood sugar in both types I and type II diabetes.

**This herb is showing up in more and more over the counter weight loss products and blood sugar balancing formulas.**

**Blueberry (*Vaccinium mytilus*)** and Blueberry are effective herbs that cure diabetes by lowering blood sugar and cholesterol levels.

**Bitter gourd (*Momordica charantia*)** fruit decoction in the morning in empty stomach at least for one month is helpful in bringing the blood sugar level to normal.

**Curry pâté, curry leaves (*Murraya koenigii*)** controls diabetes so is one of the important home remedies for diabetes. Hereditary diabetic patients also get the best benefit from its intake. Chewing (8-10) curry leaves in empty stomach is very effective for bringing sugar level in urine and blood to normal.

**Gooseberry, amla (*Emblica officinalis*)** is a natural herb that cures diabetes and brings the blood sugar to normal.

**Green tea (*Camellia sinensis*)** consumption has been used traditionally to control blood sugar in the body. It is associated with prevention of type 2 diabetes, lowering fasting blood levels of glucose, reducing triglycerides and free fatty acids, and enhancing ability of adipocytes to respond to insulin and absorb blood sugar. Its consumption also increases the body's ability to utilize blood sugar. Green tea polyphenols regulates the expression of genes involved in glucose uptake and insulin signaling.

**Gurmar (*Gymnema sylvestre*)** cures diabetes by lowering high sugar level in the blood and lead to proper functioning of insulin and also minimize the urge of taking sweets in the diabetes patients.

**Ispaghula husk (*Plantago ovata*)** is natural safe for treatment of diabetes.

**Papaya (*Carica papaya*)** are boiled and made into a paste and given with a pinch of common salt and jeera powder for six months to cure diabetes.

**Sweet potato leaves (*Ipomoea batatas*)** when taken with ash gourd or when taken with any herbal tea are effective in curing diabetes.

## **TRADITIONAL PLANT TREATMENTS FOR DIABETES [20-27]**

### **Mushrooms**

Research has shown the Maitake mushroom (*Grifola frondosa*) has a hypoglycemic effect, and may be beneficial for the management of diabetes. The reason Maitake lowers blood sugar is due to the fact the mushroom naturally acts as an alpha glucosidase inhibitor. Other mushrooms like *Reishi*, *Agaricus blazei*, *Agrocybe cylindracea* and *Cordyceps* have been noted to lower blood sugar levels to a certain extent, although the mechanism is currently unknown.

#### ***Coccinia indica*: (Ivy gourd)**

Dried extracts of *Coccinia indica* (500 mg/kg body weight) were administered to diabetic patients for 6 weeks. These extracts restored the activities of enzyme lipoprotein lipase (LPL) that was reduced and glucose-6-phosphatase and lactate dehydrogenase, which were raised in untreated diabetics. Oral administration of 500 mg/kg of *C. indica* leaves showed significant hypoglycemia in alloxanized diabetic dogs and increased glucose tolerance in normal and diabetic dogs.

#### ***Eugenia jambolana*: (Indian gooseberry, Jamun)**

In India decoction of kernels of *Eugenia jambolana* is used as household remedy for diabetes. This also forms a major constituent of many herbal formulations for diabetes.

#### ***Tinospora cordifolia*: (Guduchi)**

Oral administration of the extract of *Tinospora cordifolia* roots for 6 weeks resulted in a significant reduction in blood and urine glucose and in lipids in serum and tissues in alloxan diabetic rats. The extract also prevented a decrease in body weight. *T. cordifolia* is widely used in Indian ayurvedic medicine for treating diabetes mellitus. Oral administration of an aqueous *T. cordifolia* root extract to alloxan diabetic rats caused a significant reduction in blood glucose. Though the aqueous extract at a dose of 400 mg/kg could elicit significant anti-hyperglycemic effect in different animal models, its effect was equivalent to only one unit/kg of insulin. It is reported that the daily administration of either alcoholic or aqueous extract of *T. cordifolia* decreases the blood glucose level and increases glucose tolerance in rodents.

## **MARKETED PRODUCT FOR FORMULATED HERBAL DRUGS WITH ANTI DIABETIC PROPERTIES**

Many formulations are in the market and are used regularly by diabetic patients on the advice of the physicians. Diabecon manufactured by 'Himalaya' is reported to increase peripheral utilization of glucose, increase hepatic and muscle glucagon contents, promote B cells repair and regeneration and increase c peptide level. It exerts insulin like action by reducing the glycated hemoglobin levels. It minimizes long term diabetic complications.

**Polyherbal Formulation [28-46]:**

Major formulations used in Ayurveda are based on herbs used as decoctions, infusion, tinctures, and powders. Drug formulation in Ayurveda (As mention in Ayurvedic treatise like Charaka Samhita, Sushruta Samhita) is based on two principles: (a). Use as a single drug, and (b). Use of more than two drugs. When two or more herbs are used in formulation, they are known as polyherbal formulation [27]. Different polyherbal formulations available in the market: Dihar: A polyherbal formulation containing eight different herbs *Syzygium cumini*, *Momordica charantia*, *Emblica officinalis*, *Gymnema sylvestre*, *Enicostemma*, *Azadirachta indica*, *Tinospora cordifolia* and *Curcuma longa*. Literature revealed that the combination of these eight herbs shows effective anti-hyperglycemic activity in streptozotocin (STZ, 45 mg/kg i.v single dose) induced type 1 diabetic rats. Treatment with Dihar (100 mg/kg) for 6 weeks produced a decrease in STZ induced serum glucose and lipid levels and increases insulin levels as compared to control. Dihar produced a significant decrease in serum creatinine urea level and lipid peroxidation in diabetic rats. Administration of Dihar to diabetic rats significantly increased the activity of antioxidant enzyme [28].

The polyherbal formulation *Madhumehantak churna* was studied for its efficacy at two doses using the hyperglycemia animal model of low dose streptozotocin-induced diabetic rats. The low dose *Madhumehantak churna* group of 1080 mg/kg/day was extrapolated from the typical 4 g thrice daily human dose used in Ayurveda. The high dose *Madhumehantak churna* group was 3× the low dose, equivalent to 36 g daily in humans. These groups were compared to a negative control group (non-streptozotocin-induced, non-treated), a positive control group (streptozotocin-induced, oral hypoglycemic agent-treated) and a diabetic control group (streptozotocin-induced, non-treated). Rats were fed for 28 consecutive days and monitored for plasma blood glucose. Results showed that rats with severe plasma glucose (438 and 325 mg/dl) in both low-dose *Madhumehantak churna* and high-dose *Madhumehantak churna* group re-attained almost-normal plasma glucose levels (118 and 128 mg/dl) in 28 d, reaching similar levels as the positive control, gold-standard treated group (120 mg/dl). *Madhumehantak churna* presents itself as a viable option for reversing hyperglycemia, as shown in this in vivo animal experimental study, and as a potentially more practical option for patients than oral hypoglycemic agents. In the present study, a formulation of eleven herbs recognized for its efficacy in improving diabetic symptoms, shown in Table 1, was investigated for its hypoglycemic effects in a pre-clinical animal study. The *Madhumehantak churna* (MMC) formulation is a composite of eleven individual raw plant parts, each of which is never heated or cooked (*paka*) to give any new chemical compounds. This formulation has been used only anecdotally in hundreds of patients in India, with no structured clinical documentation of its efficacy. Although each constituent has already been evaluated through ethnopharmacology to ensure safety, lack of toxicity and efficacy as an antidiabetic herb, modern pharmacologists may argue that it is still possible that a new compound to be formed in the composite, one that is less safe has arisen when these constituents have been compounded stored together?

Earlier animal studies reported by Gupta *et al.* [2] in the same research group, used a very similar formula with 14 herbs, which revealed no toxicity and found to be safe; this formulation was a subset of 11 of those herbs [47].

**Table 2: Component herbs of *madhumehantak churna* (MMC) [47]**

Sanskrit name	Botanical name	Common English/ Hindi reference
<i>Amra beej majja</i>	<i>M. indica</i>	Mango seed pulp
<i>Karavella phali</i>	<i>M. charantia</i>	Bitter gourd whole fruit/karela
<i>Jambu beej</i>	<i>S. cuminii</i>	Jamun seed
<i>Nimba beej</i>	<i>A. indica</i>	Neem seed
<i>Palandu beej</i>	<i>A. cepa</i>	Onion seed/ <i>pyaaz beej</i>
<i>Babbula phali</i>	<i>A. nilotica</i>	Babul seed pod
<i>Bala beej</i>	<i>S. cordifolia</i>	Bala seed
<i>Methika beej</i>	<i>T. foenum-gracum</i>	Fenugreek seed Gurmar leaf and stem
<i>Meshasrunji</i>	<i>G. sylvestre</i>	Turmeric rhizome/ <i>haldi</i>
<i>Haridra</i>	<i>C. longa</i>	Hareda fruit pulp
<i>Haritaki phala majja</i>	<i>T. chebula</i>	

**Antidiabetic Plants in Clinical trials:**

*Allium cepa* L., *Clerodendron phlomoides* Linn., *Casearia esculenta* Roxb., *Cinnamomum tamala* (Buch.-Ham.) T. Nees & Eberm., *Coccinia indica* Wight & Arn., *Enicostemma littorale* Blume., *Momordica charantia* L., *Pterocarpus marsupium* Roxb., *Ficus bengalensis* L., *Syzygium cumini* L., *Cyamopsis tetragonolobus* (L.) Taub., *Cannabis indica* (Lam.) E. Small & Cronq., and *Cephalandra indica* Naud. Many clinical trials have been reported on herbal medicine and they promising and provided evidences for hypoglycaemic effects of them [48-51].

**SURVEY OF SOME LITERATURES WORKED ON IT:**

*Chandraprakash Dwivedi & Swarnali Daspaal* (2013) reported about the dreadful disease is found in all parts of the world and is becoming a serious threat to mankind health. It is caused by the deficiency or ineffective production of insulin by pancreas which results in increase or decrease in concentrations of glucose in the blood. There are lots of chemical agents available to control and to treat diabetic patients, but total recovery from diabetes has not been reported up to this date. Alternative to these synthetic agents, many herbal plants with hypoglycaemic

properties are known from across the world. The World Health Organization (WHO) has listed 21,000 plants, which are used for medicinal purposes around the world. A list of medicinal plants with proven antidiabetic and related beneficial effects and of herbal drugs used in treatment of diabetes is compiled [52].

**Amarnath Shukla & H M Shukla (2015)**, reported that traditional medicines derived from medicinal plants are used by about 60% of the world's population. This review focuses on Indian herbal drugs and plants used in the treatment of diabetes, especially in India. Diabetes mellitus have been recorded, but only a small number of these have received scientific and medical evaluation to assess their efficacy. Traditional treatments have mostly disappeared in occidental societies, but some are prescribed by practitioner alternative medicine or taken by patients as supplements to conventional therapy.

However, plant remedies are the mainstay of treatment in underdeveloped regions. A hypoglycemic action from some treatments has been confirmed in animal models and non-insulin-dependent diabetic patients, and various hypoglycemic compounds have been identified. A botanical substitute for insulin seems unlikely, but traditional treatments may provide valuable clues for the development of new oral hypoglycemic agents and simple dietary adjuncts and related beneficial effects and of herbal drugs used in treatment of diabetes is compiled. These include *Aegle marmelose jambolana*, *Momordica charantia*, *Ocimum sanctum*, *Phyllanthus amarus*, *Pterocarpus marsupium*, *Tinospora cordifolia*, *littorale Blume* [53].

*Marrubium vulgare* L. and *Cecropia obtusifolia* Bertol. produced beneficial effects on carbohydrate and lipid metabolisms when it was administered as an adjunct on patients with type 2 diabetes and reduced the blood glucose levels [54].

Rajendran Ramesh Petchi *et al.* (2014), reported that *Glycosmis pentaphylla*, *Tridax procumbens*, and *Mangifera indica* are well-known plants available throughout India and they are commonly used for the treatment of various diseases including diabetes mellitus. Polyherbal formulations enhance the therapeutic action and reduce the concentrations of single herbs, thereby reducing adverse events. The aim of the present study is to formulate a polyherbal formulation and evaluate its antidiabetic potential in animals. The polyherbal formulation was formulated using the ethanol extracts of the stem bark of *G. pentaphylla*, whole plant of *T. procumbens*, and leaves of *M. indica*. The polyherbal formulation contains the ethanol extracts of *G. pentaphylla*, *T. procumbens*, and *M. indica* in the ratio of 2:2:1. The quality of the finished product was evaluated as per the World Health Organization's guidelines for the quality control of herbal materials. The quality testing parameters of the polyherbal formulation were within the limits. Fingerprint analysis of the polyherbal formulation showed effective separation at 366 nm, and it revealed that the active compound present in the polyherbal formulation and the active compounds present in all the three extracts were the same. The acute toxicity studies of the polyherbal formulation did not show any toxic symptoms in doses up to 2000 mg/kg over 14 days. The oral antidiabetic activity of the polyherbal formulation

(250 and 500 mg/kg) was screened against streptozotocin (50 mg/kg; i.p.) + nicotinamide (120 mg/kg; i.p.) induced diabetes mellitus in rats. The investigational drug was administered for 21 consecutive days, and the effect of the polyherbal formulation on blood glucose levels was studied at regular intervals. At the end of the study, the blood samples were collected from all the animals for biochemical estimation, and the animals were sacrificed and the liver and pancreatic tissues were collected for histopathologic analysis. Polyherbal formulation showed significant antidiabetic activity at 250 and 500 mg/kg, respectively, and this effect was comparable with that of glibenclamide. The antidiabetic activity of polyherbal formulation is supported by biochemical and histopathologic analysis [55].

Kaur M and Valecha V (2014), was studied on diabetes, its cure & herbal products available in the market. Diabetes mellitus is the most common endocrine disorder, affecting 16 million individuals in the United States and 200 million worldwide. Despite the use of advanced synthetic drugs for the treatment, use of herbal remedies is gaining higher importance because of synthetic drugs have drawbacks and limitations. The herbal drugs with anti-diabetic activity are extensively formulated commercially because of easy availability, affordability and fewer side effects as compared to synthetic anti-diabetic drugs. Anti-diabetic herbal formulations (AHF) are considered to be more effective for the management of diabetes. There are around 600 herbal drug manufacturers in India of which almost all manufacturers are developing AHF in addition to others. Till date, no article is published to give detailed information about the herbal preparations on diabetes available in the market. In this, we illustrate about diabetes mellitus and its types, causes, sign, and symptoms, complications, pathophysiology, diabetic medication, diabetic treatment, herbal diabetic cure, advantages of herbal medicines over Allopathy and herbal formulations. Thus, this review article undertakes the attempt for providing updated information on the type of diabetes and herbal formulations which will enhance the existing knowledge of the researchers [56].

## CONCLUSION:

Herbal medications are the most commonly used alternative therapy for lowering blood sugar. However, their safety and efficacy need to be further evaluated by well-designed, controlled clinical studies. However, there are numerous other plants still await scientific inquiry, which have mentioned in the indigenous systems of health care all over the world. A large number of plants, screened for their antidiabetic effect, have yielded certain interesting leads as mentioned in present article, but till date many plant-based drug is remain to reached such an advanced stage of investigation or development as to substitute or reduce the need for the currently-available oral synthetic drugs.

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