

ROLE OF HERBAL MEDICINES AND DIABETES MELLITUS

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Author****Jayant Shiv Kumar**
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Diabetes mellitus is a metabolic disorder in the endocrine system. This dreadful disease is found in all over the world and is becoming a serious threat to mankind health. Diabetes mellitus is a chronic disease caused by inherited deficiency in production of insulin by the pancreas. Traditional medicines derived from medicinal plants are used by about 50% of the world's population. Present studies focus on herbal drugs and plants used in the treatment of diabetes. 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 and low cost.

KEYWORDS: Diabetes, Herbal medicine, Antidiabetic drugs, Action of herbal.**INTRODUCTION**

Diabetes mellitus (DM) is an endocrine disorder resulting in hyperglycemia due to insulin deficiency, insulin resistance or both. This heterogeneous disease which runs an insidious course may result from a complex interplay of metabolism, environmental and genetic factors.^[1] Diabetes mellitus is associated with reduced quality of life and increased risk factors for mortality and morbidity. The long-term hyperglycemia is an important factor in the development and progression of micro and macro-vascular complications.^[2] Currently available therapies for diabetes include insulin and various oral antidiabetic agents such as sulfonylureas, biguanides, α -glucosidase inhibitors and glinides. In developing countries as products are expensive and not easily accessible.

Polyphenols constitute a large group of naturally occurring substances in the plant kingdom, which include the flavonoids. The plant phenolics are commonly present in fruits, vegetables, leaves, nuts, seeds, barks, roots and in other plant parts. These substances have considerable

interest in the field of food chemistry, pharmacy and medicine due to a wide range of favorable biological effects including antioxidant properties. The antioxidant property of phenolics is mainly due to their redox properties. They act as reducing agents (free radical terminators), hydrogen donors, singlet oxygen quenchers and metal chelators.^[3] Evidence suggests that high intake of antioxidant nutrients from food sources offers health advantages.^[4]

DIAGNOSIS OF DIABETES

Diabetes is a disease characterized by abnormal metabolism of blood glucose and defective insulin production. Blood glucose levels are an important parameter for the diagnosis, treatment and prognosis of diabetes. Blood glucose level is the level of glucose circulating in blood at a given time. Some factors that affect blood glucose level are body composition, age, physical activity etc.

1. **Fasting plasma glucose test (FPGT):** more than 126 mg/dl
2. **Oral glucose tolerance test (OGTT):** -more than 200 mg/dl
3. **Post prandial glucose test (PPGT):** more than 140 mg/dl

CLASSIFICATION

Type I of diabetes mellitus/insulin dependent diabetes mellitus (IDDM), it is prevalent in 10% of diabetic patients, and islet β -cell destruction usually leads to absolute insulin deficiency.^[5] Patients are completely reliant upon exogenous insulin to prevent ketosis and thereby preserve life.^[6]

Type 2 diabetes (Non insulin-dependent diabetes), Accounts for more than 85% of cases worldwide. It is a heterogeneous type, ranging from insulin resistance to insulin deficiency.^[6,7] Also type 2 diabetes (T2D) is a multifactorial disease with both a genetic component and important non genetic components.^[8]

Gestational diabetes, Diabetes diagnosed in pregnancy, including pre-existing diabetes and diabetes which develops during pregnancy.^[6,9]

MECHANISM ACTION OF HERBAL DRUGS

The antidiabetic activity of herbs depends upon variety of mechanisms. The mechanism of action of herbal anti-diabetic could be grouped as-

- Adrenomimeticism, pancreatic beta cell potassium channel blocking, cAMP (2nd messenger) stimulation Inhibition in renal glucose reabsorption.
- Stimulation of insulin secretion from beta cells of islets or/and inhibition of insulin degradative processes.
- Reduction in insulin resistance.
- Providing certain necessary elements like calcium, zinc, magnesium, manganese and copper for the beta cells.
- Regenerating and/or repairing pancreatic beta cells.
- Increasing the size and number of cells in the islets of Langerhans.
- Stimulation of glycogenesis and hepatic glycolysis.
- Improvement in digestion along with reduction in blood sugar and urea.
- Prevention of pathological conversion of starch to glucose.
- Inhibition of β -galactocidase and α -glucocidase.
- Cortisol lowering activities.
- Inhibition of alpha-amylase.

HERBAL REMEDIES

As per ancient literature, more than 800 plants are reported to have antidiabetic properties.^[10] Ethanopharmacological surveys indicate that more than 1200 plants are used in traditional medicine for their allied hypoglycemic activity.^[11] Indian Materia Medica has mentioned numerous dravyas have been reported effective in Madhumeha.^[12]

Plants based products have been popular all over the world for the centuries. In diabetes, some herbal alternatives are proven to provide symptomatic relief and assist in the prevention of the secondary complications of the disease. Some herbs have also been proven to help in the regeneration of β cells and in overcoming resistance. In addition to maintaining normal blood sugar level, some herbs are also reported to possess antioxidant activity and cholesterol lowering action.

AYURVEDIC HERBAL TREATMENT OF DIABETES

Diabetes mellitus in Ayurveda is known as Madhumeha. Several Ayurvedic formulations have been used in the treatment of Diabetes mellitus. In addition to herbs, minerals find wide application in Ayurvedic prescription for diabetes. Some of the important anti-diabetic potential herbal plants source and their active principles showed in the table 1.

***Aegle marmelos* (Beal)**

Das, Padayatil and Paulose^[13] studied the hypoglycemic activity of leaf extract of *Aegle marmelos* in the diabetes. The extract significantly reversed altered parameters in tissue of the experiment rats. According to authors, the drug seems to repair the injured pancreas.^[13]

***Allium Sativum* (Lahsun)**

It contains a wealth of sulphur compounds; most important for the taste is Allicin, which is produced enzymatically from allin. It also contain 65% water, 28% carbohydrate, 2.3% organosulphur compound, 2% proteins, 2% free amino acid (mainl arginine), 1.5% fiber, 0.15% lipids, 0.08% phytic acid, 0.07% saponins. 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 is 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.

***Azadirachta Indica* (Neem)**

It also contains nimbin, nimbinin, nimbidinin, nimbolide, nimbilic acid. Gedunin obtained from neem's seed. It also contains mahmoodin, Azadirachtin. It also contains some tannin like, Gallic acid. There are also present of Margolonon, Polysaccharide. Researchers at India's University of Madras in the early 1990s found that high doses (40 gm of dried herb daily) of *Azadirachta Indica* extracts may actually help to repair or regenerate the pancreas's beta cells, which play a crucial role in the production and secretion of insulin. Few other substances, synthetic or natural, offer such promise for reversing beta cell damage and at least partially reducing diabetics' need for insulin and other drugs. On the other hand, studies indicate that animals that do not have diabetes do not produce more insulin after consuming *Azadirachta Indica*.

***Momordica charantia* (Karvellaka)**

Ahmed, et al.^[14] studied the mechanism of action of juice in rats. Rats were rendered diabetic by single injection (60 mg/kg body weight) of streptozocin. One week after injection, treated animals were fed with juice of *Momordica charantia* (10 ml/kg) daily for three in glucose uptake and it attenuated the insulin induced increase in glucose uptake.^[14]

***Ocimum sanctum* (Tulsi):** Agrawal, Rai and Singh^[15] in randomized, placebo-controlled, single-blind, crossover trial studied the effects of *Ocimum sanctum* (dried leaf 2.5g daily) on fasting and postprandial blood glucose and serum cholesterol levels in patients diagnosed with non-insulin dependent diabetes mellitus. The results showed that *Ocimum sanctum* treatment caused a significant decrease in both fasting and postprandial blood glucose levels compared with placebo. A mild reduction in total cholesterol levels was also observed.

***Bauhinia forficata* (Pata de Vaca)**

Bauhinia forficata is the most widely used herbal medicine for control of diabetes. The fresh leaves are the essential part of the plant which showed the hypoglycemic activity in rats.^[16] *Bauhinia forficata* decoction was prepared by boiling 150 g of fresh leaves in 1 litre of water for 5 min, allowed the decoction to stand for 30 min, filtered and filtered extract used for diabetic treatment.

Gymnema sylvestre

Gymnema sylvestre is a plant used in India and parts of Asia as a natural treatment for diabetes. The hypoglycemic action of *Gymnema* leaves was first documented in the late 1920s.^[17] The *Gymnema sylvestre* crude extracts and its isolated compound dihydroxy gymnemic triacetate shows hypoglycaemic effect against diabetic rats in dose and time dependent manner.^[18] This hypoglycaemic effect was due to the ability of gymnemic acids to delay the glucose absorption in the blood. Dihydroxy gymnemic triacetate had the ability to release the insulin by the stimulation of a regeneration process and revitalization of the remaining beta cells.^[19, 20, 21] patients were given 400 mg *Gymnema sylvestre* extract daily along with their oral hypoglycemic drugs.

Sarcopoterium spinosum

Sarcopoterium spinosum species is a common medicinal plant in the Mediterranean region, and it is widely used as an antidiabetic drug by Bedouin healers. The ethnobotanical surveys reported as a medicinal plant, used by traditional Arab and Bedouin medicine for the management of diabetes, digestive problems, pain relief or cancer. The aqueous root extract of *Sarcopoterium spinosum* was prepared by cutting the 100gms of fresh roots into small pieces and roots were boiled in 1 Litre of water for 30 min. The aqueous extract was used to carry out experiment in 0.001–10 mg/ml concentrations.

***Allium cepa* (onion)**

Various ether soluble fractions as well as insoluble fractions of dried onion powder show anti-hyperglycemic activity in diabetic rabbits. *Allium cepa* is also known to have antioxidant and hypolipidaemic activity.^[22] 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.^[23]

***Mangifera indica* (Mango)**

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 diabetic rats. However, antidiabetic activity was seen when the extract and glucose were administered simultaneously and also when the extract was given to the rats 60 min before the glucose. The results indicate that aqueous extract of *Mangifera indica* possess hypoglycemic activity. This may be due to an intestinal reduction of the absorption of glucose.^[23]

Herbal products

Today, up to 1400 traditional plant medicines has been reported in India for diabetes. Following are few preparations available in the market for the treatment of diabetes that contains drug in powder form or as extracts. Only the names of the herbs added in the preparations are reported, along with these herbs some preparations may contain animal derived products and minerals.

Diaveda capsule, *Trigonella foenum graecum*, *Embllica officinalis*, *Curcuma longa*, *Melia azadiracta*, *Gymnema sylvestris*, *Tribulus terrestris*, *Tinospora cordifolia*, *Syzygium cumuni*, *Azadirachta indica*, *Terminalia belerica*, *Terminalia chebula*, *Piper nigrum*, *Piper longum*, *Zingiber officinalis*.

GlucoCare, *Glycyrrhiza glabra*, *Asparagus racemosus*, *Pterocarpus marsupium*, *Gymnema sylvestris*, *Momordica charantia*, *Commiphora mukul*.

Glucomap tablets, *Enicostema littorale*, *Phyllanthus niruri*, *Eugenia jambolana*, *Melia azadiracta*, *Terminalia arjuna*, *Asphaltum*, *Aegle mermelos*, *Momordica charantia*.

Glucova, *Pterocarpus marsupium*, *Enicostema littorale*, *Eugenia jambolana*, *Tinospora cordifolia*.

Pancreas tonic, *Tinospora cordifolia*, *Syzigium cumini*, *Melia azadiracta*, *Momordica charantia*, *Gymnema sylvestra*, *Pterocarpus marsupium*, *Aegle mermelos*, *Cinnamomum zeylanicum*.

Tincture of Panchparna, *Coccinia indica*, *Cocculus villosus*, *Catharanthus roseus*, *Gymnema sylvestre* and *Momordica charantia*.

DWN-12, *Strychnos potatorum*, *Terminalia chebula*, *Emblica officinalis*, *Terminalia belerica*, *Salacia reticulata*, *Pterocarpus marsupium*, *Piper longum*, *Coscinium fenestratum*, *Tribulus terrestris*, *Syzigium cumini*, *Rhabdia lyuoides*, *Elettaria cardamomum*.

Herbovedics mahantak churna, Nai, Kadu, Kariyatu, Kalijeeri, Methi, Kalumbo, Kakach, Indrajav, Karela, Haldi, Jeshthimadha.

Madhuhari powder, Gudmar, Karela beej, Jamun, Babul ki chhal, Amba haldi, Gudwel, Bilva patra, Neem patra, Shilajeet, Trivang bhasm.

Dianex, *Gymnema sylvestre*, *Eugenia jambolana*, *Momordica charantia*, *Azadirachta indica*, *Cassia auriculata*, *Aegle marmelos*, *Withania somnifera* and *Curcuma longa*.

Diamed, *Azadirachta indica*, *Cassia auriculata* and *Momordica charantia*.

Aavirai kudineer, *Cassia auriculata*, *Cassia fistula*, *Salacia prinoides*, *Cyperus rotundus*, *Saussurrea lappa*, *Eugenia jambolana* and *Terminalia arjuna*.

Madhumeha churna, *Azadirachta indica*, *Cassia auriculata*, *Cassia auriculata*, *Gymnema sylvestre*, *Eugenia jambolana*, *Eugenia jambolana*, *Zizyphus mauritiana*, *Curculigo orchoides*, *Melochia corchorifolia*, *Michelia champaca*, *Cynodon dactylon*, *Murraya koenigii*, *Acacia catechu*, *Cassia fistula*, *Salacia oblonga* and *Momordica charantia*.

Table 1: Anti-diabetic potential of some herbal plants, part of source and their active principles components.

SNo.	Botanical name	Family	Part used	Main active components
1.	<i>Allium sativum</i>	Alliaceae	Bulbs	Allyl propyl disulphide, allicin
2.	<i>Ocimum sanctum</i>	Labiatae	whole plant	Eugenol
3.	<i>Azadirachta indica</i>	Meliaceae	Leaves, flowers & seed	Azadirachtin and nimbin
4.	<i>Trigonella foenum graecum</i>	Fabaceae	Leaves and seeds	4-hydroxy isoleucine
5.	<i>Momordica charantia</i>	Cucurbitaceae	Leaves	Charantin, sterol
6.	<i>Sarcopoterium spinosum</i>	Rosaceae	Root	Catechin and epicatechin
7.	<i>Gymnema sylvestre</i>	Asclepiadaceae	Leaf	Dihydroxy gymnemic triacetate
8.	<i>Bauhinia forficata</i>	Leguminosae	Leaf	Astragalins, kaempferitric acid
9.	<i>Pterocarpus marsupium</i>	Leguminosae	Whole plant	Kenotannic acid, pyrocatechin
10.	<i>Capparis decidua</i>	Capparidaceae	Fruit	Spermidine Isocodonocarpine
11.	<i>Cinnamomum Zeylanicum</i>	Lauraceae	Bark	Cinnamaldehyde, eugenol
12.	<i>Agle marmolus</i>	Rutaceae	Leaf, Fruit	Tannins, Mucilage, Mucilage

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