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Antidiabetic Herbal Drugs and Polyherbal Formulation Used For Diabetes: A Review

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Abstract

This 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.

Keywords: Plant, Glucose, Diabetes, Herbal, Insulin, Blood.

Introduction

Diabetes mellitus is a systemic metabolic disease characterized by hyperglycemia, hyperlipidemia, hyperaminoacidemia, and hypoinsulinaemia it leads to decrease in insulin, secretion and insulin action. Currently available therapies for diabetes include insulin and various oral antidiabetic agents such as sulfonylureas, biguanides, α -glucosidase inhibitors and glinides. In developing countries products are expensive and not easily accessible.¹ Diabetes is a heterogeneous metabolic disorder characterized by altered carbohydrate, lipid, and protein metabolism which causes hyperglycemia resulting from insufficient insulin secretion, insulin action or both.² It is one of the refractory diseases identified by Indian Council of Medical Research for which an alternative medicine is a need for the treatment. Diabetes mellitus has become a growing problem in the contemporary world. India has today become the diabetic capital of the world with over 20 million diabetes and this number is likely to increase to 57 million by 2025.³ A number of medicinal plants, traditionally used for over 1000 years named Rasayana are present in herbal preparations of Indian traditional health care systems. The current review focuses on herbal drug preparations and plants used in the treatment of diabetes mellitus, a major crippling disease in the world leading to huge economic losses.⁴

How do herbs work?

For most herbs, the specific ingredient that causes a therapeutic effect is not known. Whole herbs contain many ingredients, and it is likely that they work together to produce the desired medicinal effect. The type of environment (climate, bugs, soil

quality) in which a plant grew will affect its components, as will how and when it was harvested and processed.⁴

What is herbal medicine good for?

Herbalists treat many conditions such as asthma, eczema, premenstrual syndrome, rheumatoid arthritis, migraine, menopausal symptoms, chronic fatigue, and irritable bowel syndrome, among others. Herbal preparations are best taken under the guidance of a trained professional. Be sure to consult with your doctor or an herbalist before self-treating. Some common herbs and their uses are discussed below. Please see our monographs on individual herbs for detailed descriptions of uses as well as risks, side effects, and potential interactions.⁴

Herbal Drugs with antidiabetic properties

***Wattakaka volubilis* (L.f.) Stapf. (Asclepiadaceae)**

Local Name: Perun-kurinjan

The plant is a fleshy and very large climber found throughout the plains with papery leaves. Leaf powder is taken orally along with cow's milk. Dosage: 50-75 ml of mixture is taken twice a day after food for 90 days.



Figure 1: Herbal Plant *Perun kurinjan* Used For Antidiabetic

***Abrus precatorius* L. (Fabaceae)**

Local Name: Kundumani

The plant is a climber commonly known as Wild Liquorice and found through the plains of India.⁴ Leaf of this plant is mixed with the leaves of *Andrographis paniculata*, *Gymnema sylvestre* and seeds of *Syzygium cumini*. The mixture is shade dried and ground into powder and taken orally along with cow's milk. Dosage: About 50 ml of mixture is taken twice a day before food for 120 days.⁵



Figure 2: Herbal Plant Kundumani Used For Antidiabetic

***Trigonella foenum graecum*: (fenugreek)**

It is found all over India and the fenugreek seeds are usually used as one of the major constituents of Indian spices. 4-hydroxyleucine, a novel amino acid from fenugreek seeds increased glucose stimulated insulin release by isolated islet cells in both rats and humans. Oral administration of 2 and 8 g/kg of plant extract produced dose dependent decrease in the blood glucose levels in both normal as well as diabetic rats. Administration of fenugreek seeds also improved glucose metabolism and normalized creatinine kinase activity in heart, skeletal muscle and liver of diabetic rats. It also reduced hepatic and renal glucose-6-phosphatase and fructose -1, 6-biphosphatase activity. This plant also shows antioxidant activity.⁶



Figure 3: Herbal Plant Fenugreek Used For Antidiabetic

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.⁶ *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 in alloxanized diabetic rats. Single as well as chronic doses of bitter principle of the same plant also showed hypoglycemic effect in diabetic rats. 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 diabetic mice.⁷



Figure 4: Herbal Plant Aloe Vera Used For Antidiabetic

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.⁷



Figure 5: Herbal plant mango used for antidiabetic

Tinospora cordifolia: (Guduchi)

It is a large, glabrous, deciduous climbing shrub belonging to the family Menispermaceae. It is widely distributed throughout India and commonly known as Guduchi. Oral administration of the extract of *Tinospora cordifolia* (*T. 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

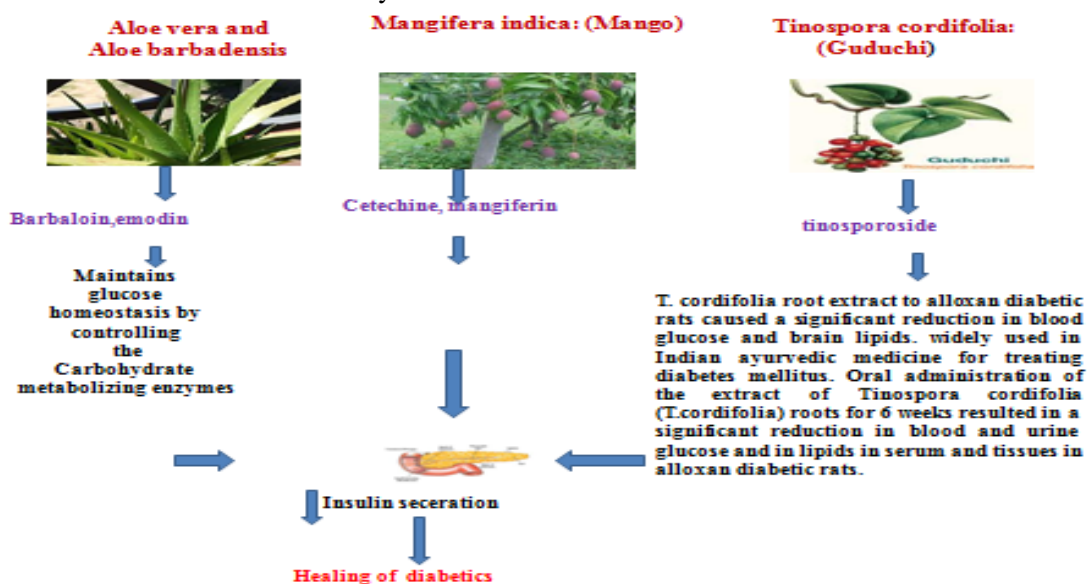


Figure 6: Aloe, Magifera and Guduchi Used For Antidiabetic Activity

Acacia arabica: (Babhul)

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. 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.⁷



Figure 7: Herbal Plant Acacia Used For Antidiabetic

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.^[5] 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.⁷



Figure 8: Herbal Plant Onion Used For Antidiabetic

Allium sativum: (garlic)

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.⁶ This effect is thought to be due to increased hepatic metabolism, increased insulin release from pancreatic beta cells and/or insulin sparing effect. Aqueous homogenate of garlic (10 ml/kg/day) administered orally to sucrose fed rabbits (10 g/kg/day in water for two months) significantly increased hepatic glycogen and free amino acid content, decreased fasting blood glucose, and triglyceride levels in serum in comparison to sucrose controls.⁷

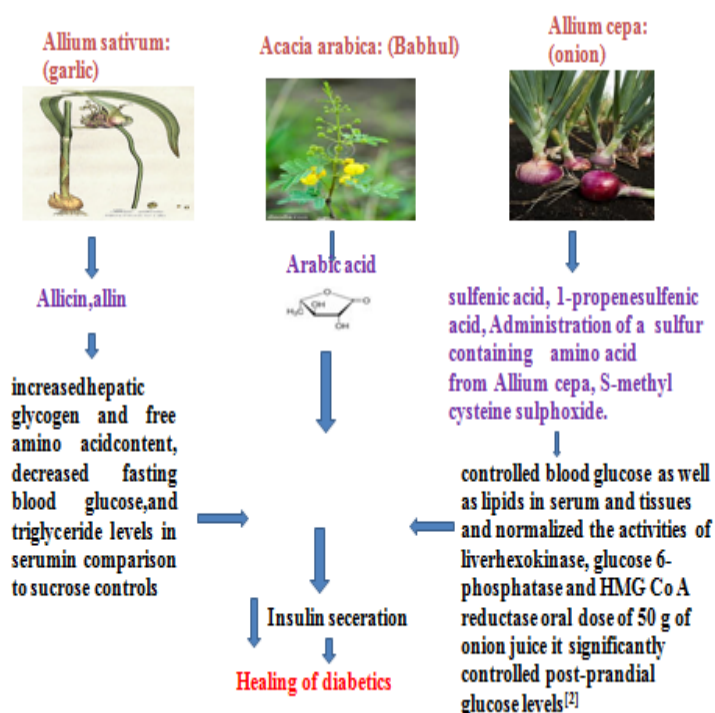


Figure 9: Garlic, Babhul, Allium Cepa Used For Antidiabetic

Ocimum sanctum: (holy basil)

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 diabetic rats. 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 diabetic rats. Oral administration of plant extract (200 mg/kg) for 30 days led to decrease in the plasma glucose level by approximately 9.06 and 26.4% on 15 and 30 days of the experiment respectively. Renal glycogen content increased 10 fold while skeletal muscle and hepatic glycogen levels decreased by 68 and 75% respectively in diabetic rats as compared to control.⁶



Momordica charantia: (bitter gourd)

Cucurbitaceae). Local Name: Kaattu pagar-kai. The plant is commonly known as Bitter guard and has many varieties. *Momordica charantia* is commonly used as an antidiabetic and antihyperglycemic agent in India as well as other Asian countries. Extracts of fruit pulp, seed, leaves and whole plant was shown to have hypoglycemic effect in various animal models. Polypeptide p, isolated from fruit, seeds and tissues of *M. charantia* showed significant hypoglycemic effect when administered subcutaneously to langurs and humans. Ethanolic extracts of *M. charantia* (200 mg/kg) showed an antihyperglycemic and also hypoglycemic effect in normal and STZ diabetic rats. This may be because of inhibition of glucose-6-phosphatase besides fructose-1, 6-biphosphatase in the liver and stimulation of hepatic glucose-6-phosphate dehydrogenase activities.^[4] The plant is climbing shrub and generally cultivated everywhere in India. Unripe fruits are taken orally along with food. Dosage: 2-3 fresh unripe fruits are taken at any time per day for three months.⁵



Figure10: Herbal plant bitter gourd used for antidiabetic

Azadirachta indica: (Neem)

Hydroalcoholic extracts of this plant showed anti-hyperglycemic activity in streptozotocin treated rats and this effect is because of increase in glucose uptake and glycogen deposition in isolated rat hemidiaphragm. Apart from having anti-diabetic activity, this plant also has anti-bacterial, antimalarial, antifertility, hepatoprotective and antioxidant effects.²

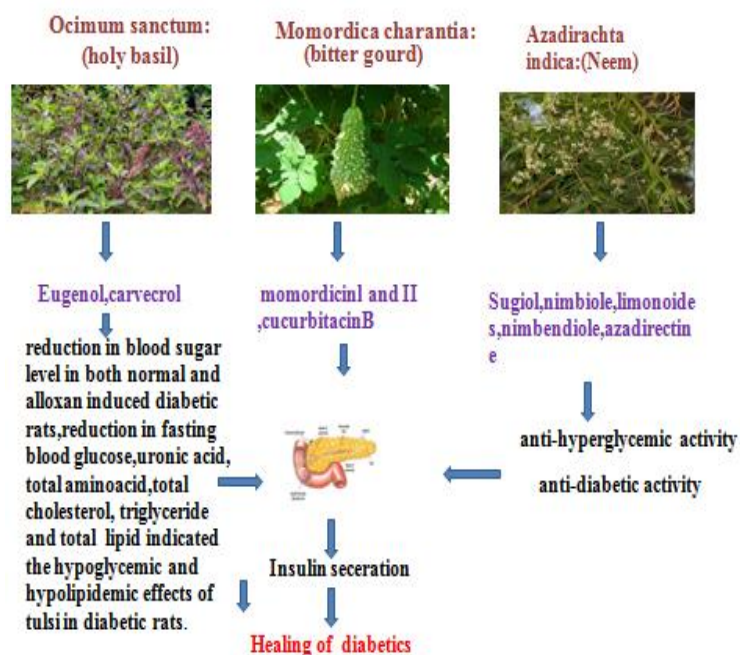


Figure 11: Holy Basil, Biter Gourd, Neem Used For Antidiabetic

Mechanism of Action of Herbal Antidiabetics

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 insulin secretion
- Stimulation of glycogenesis and hepatic glycolysis
- Protective effect on the destruction of the beta cells
- Improvement in digestion along with reduction in blood sugar and urea
- Prevention of pathological conversion of starch to glucose
- Inhibition of β -galactosidase and α -glucosidase
- Cortisol lowering activities
- Inhibition of alpha-amylase⁶

Herbal drug formulation

Diabecon manufactured by 'to increase peripheral utilization of glucose, increase hepatic and muscle glucagon contents, promote B cells repair and regeneration and increase c peptide level.⁶

Epinsulin

Marketed by Swastik formulations, contains epicatechin, a benzopyran, as an active principle. Epicatechin increases the cAMP content of the islet, which is associated with increased insulin release. It plays a role in the conversion of proinsulin to insulin by increasing cathepsin activity. Additionally it has an insulin-mimetic effect on osmotic fragility of human erythrocytes and it inhibits Na/K ATPase activity from patient's erythrocytes. It corrects the neuropathy, retinopathy and disturbed metabolism of glucose and lipids. It maintains the integrity of all organ systems affected by the disease. It is reported to be a curative for diabetes, Non Insulin Dependent Diabetes Mellitus (NIDDM) and a good adjuvant for Insulin Dependent Diabetes Mellitus (IDDM), in order to reduce the amount of needed insulin. It is advised along with

existing oral hypoglycemic drugs and is known to prevent diabetic complications. It has gentle hypoglycemic activity and hence induces no risk of being hypoglycemic.⁷

Pancreatic Tonic (ayurvedic herbal supplement):

Pancreas Tonic is a botanical mixture of traditional Indian Ayurvedic herbs currently available as a dietary supplement.

Bitter gourd powder marketed by garry and sun It lowers blood & urine sugar levels. It increases body's resistance against infections and purifies blood. Bitter Gourd has excellent medicinal virtues. It is antidotal, antipyretic tonic, appetizing, stomachic, antibilious and laxative. The bitter Gourd is also used in native medicines of Asia and Africa. The Bitter gourd is specifically used as a folk medicine for diabetes. It contains compounds like bitter glycosides, saponins, alkaloids, reducing sugars, phenolics, oils, free acids, polypeptides, sterols, 17-amino acids including methionine and a crystalline product named p-insulin. It is reported to have hypoglycemic activity in addition to being antihaemorrhoidal, astringent, stomachic, emmenagogue, hepatic stimulant, anthelmintic and blood purifier.⁷

Polyherbal Formulations for Diabetes

GRAPHICAL ABSTRACT OF POLYHERBAL FORMULATIONS FOR DIABETES AND ETC

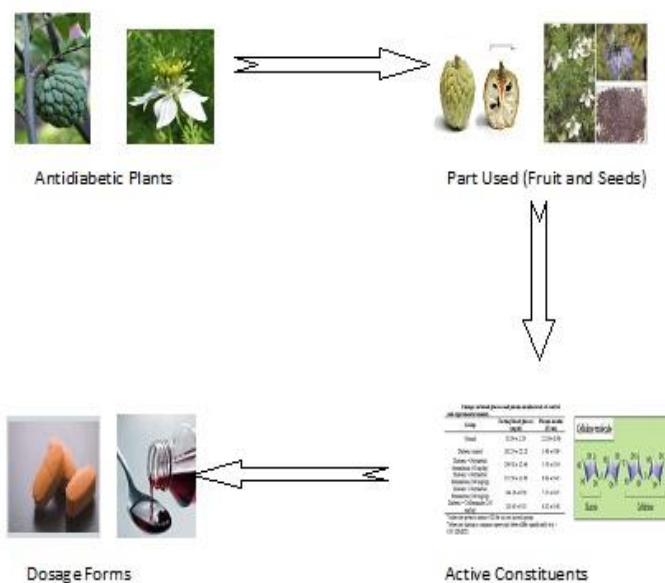


Figure 12: Poly herbal drug used for antidiabetic

Plant formulation and combined extracts of plants are used a drug of choice rather than individual. Various herbal formulations such as diamed, coagent db, Diasulin. .Polyherbal formulation of *Annona squamosa* and *Nigella sativa* on blood glucose, plasma insulin, tissue lipid profile, and lipidperoxidation in streptozotocin induced diabetic rats. Aqueous extract of Polyherbal formulation of *Annona squamosa* and *Nigella sativa* was administered orally (200 mg/kg body weight) for 30 days. The different doses of Polyherbal formulation on blood glucose and plasma insulin in diabetic rats were studied and the levels of lipid peroxides and tissue lipids were also estimated in streptozotocin induced diabetic rats. The effects were compared with tolbutamide. Treatment with Polyherbal formulation and tolbutamide resulted in a significant reduction of blood glucose and increase in plasma insulin [8]



Figure 13: Herbal plant *Annonasquamosa* (Sugar–Apple) used for antidiabetic



Figure 14: Herbal plant *nigella sativa* used for antidiabetic

Conclusion

Herbal therapy for diabetes has been followed all over the World successfully. Herbs are used to manage Type 1 and

Type II diabetes and their complications. For this, therapies developed along the principles of western medicine (allopathic) are often limited in efficacy, carry the risk of adverse effects, and are often too costly, especially for the developing world. The above-mentioned plants have been considered for their possible hypoglycemic actions and the researchers have carried out some preliminary investigations. Scientific validation of several Indian plant species has proved the efficacy of the botanicals in reducing the sugar level could be considered as of possible therapeutic value. Thus many different plants have been used individually or in formulations for treatment of diabetes.

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