A REVIEW ON MEDICINAL PLANTS AND HERBAL DRUG FORMULATIONS USED IN DIABETES MELLITUS

V. V. Rajesham¹*, Ravindernath. A², D. V. R. N. Bikshapathi¹.

¹Vijaya college of Pharmacy, Munganoor, Hyathnagar, Hyderabad.
²University college of technology, Department of Pharmacy, Osmania University, Hyderabad.

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ABSTRACT
Diabetes mellitus is a metabolic disorder in the endocrine system. 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 hypoglycemic 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. Among these 2500 species are in India, out of which 150 species are used commercially on a fairly large scale. India is the largest producer of medicinal herbs and is called as botanical garden of the world. This paper focuses mainly on diabetes, plants used as Antidiabetic in various traditional medicines, constituents isolated from these plants, various mechanisms through which herbs act against diabetes and few examples of antidiabetic formulations available in the market.

Corresponding author

Mr. V. Venkata Rajesham.
Email: vvrajesham@gmail.com
Department of pharmacology, Vijaya college of pharmacy, Munganoor (V), Hayathnagar (M), Ranga reddy (Dist), Hyderabad.

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INTRODUCTION

Diabetes mellitus is a systemic metabolic disease characterized by hyperglycemia, hyperlipidemia, hyperaminoacidemia, and hypoinsulinaemia it leads to decrease in both insulin secretion and insulin action. It is frequently associated with the development of micro and macro vascular diseases which include neuropathy, nephropathy, cardiovascular and cerebrovascular diseases. The disease 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 macrovascular complications. The worldwide prevalence of diabetes for all age groups was estimated to be 2.8% in 2000 and it is projected to be 5.4% in 2025.

Diabetes mellitus is now recognized as a serious global health problem. Westernized cultures and populations experiencing rapid acculturation are showing a sharp rise in non-insulin dependent diabetes mellitus. The prevalence of NIDDM is increasing exponentially. 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.

Allopathic drugs used for the treatment of diabetes have their own side effect & adverse effect like hypoglycaemia, nausea, vomiting, hyponatremia, flatulence, diarrhea or constipation, alcohol flush, headache, weight gain, lactic acidosis, pernicious anaemia, dyspepsia, dizziness, joint pain. So instead of allopathic drugs, herbal drugs are a great choice which is having more or less no side effect & adverse effects. Ethno botanical information identified about 800 Indian plants which may have antidiabetic potential. All the herbs formulation were procured from local, authentic herbs supplier shops, specialized in sale of medicinal plants & run by the Ayurvedic specialist as OTC Ayurvedic medicines. Though complementary & alternative medicine (CAM) treatments are popular, scientific evidence support their application to diabetes care is scare. Previous CAM diabetes research has generally focused on single modalities but CAM practitioners more commonly prescribed complex, multi dietary intervention. Ayurvedic interventions may benefits patients with higher base line HbA1c value, warranting further research.

Diabetes and Insulin

Most of the food we eat is broken down into simple sugar called glucose. This glucose is the main source of fuel to get energy for the body. After digestion, the glucose reaches our blood stream where it is available for body cells to utilize for energy, but insulin is needed for the glucose to get into cells. Insulin is a hormone secreted by the pancreas to transport glucose from blood into different cells of the body. If the pancreas does not produce enough insulin or the produced insulin does not work properly, the glucose cannot enter the body cells. So glucose stays in the blood cells, which makes the blood sugar level high. Diabetes is initially characterized by a loss of glucose homeostasis. The major effects of insulin on glucose, fatty acid, and amino acid metabolism and onion flux are initiated by the attachment of the insulin molecule to a specific insulin receptor on the cell surface. This hormone receptor interaction is reversible, and the insulin molecule is not chemically altered during this contact. The hormone receptor complex is then internalized by an endocytotic mechanism.

Insulin molecule eventually is metabolized, and the insulin receptor is recycled into the membrane for re usage. Thus, the body loses its main source of fuel for energy even though the blood contains high amount of glucose. The insulin resistance mainly happens in cell membrane where glucose is not transported to the cells for oxidation. Since glucose is not metabolized, high amount of glucose circulates in the blood. To keep the normal level of glucose in the blood, the kidney removes the extra sugar from the blood and excretes it in the urine. Since body does not utilize glucose, the body is under
constant impression of hunger and that is why diabetics feel increased appetite (polyphagia) and eat more frequently. Symptoms of insulin resistance include a decreased stimulation of muscle glycogen synthesis, defects in glycogen synthesis activity, hexokinase activity and glucose uptake.[13]

Classification

Type I diabetes (Insulin-dependent diabetes)

It is prevalent in 10% of diabetic patients, islet β-cell destruction usually leads to absolute insulin deficiency.[14] Patients are completely reliant upon exogenous insulin to prevent ketosis and thereby preserve life.[15]

Type 2 diabetes (Non insulin-dependent diabetes)

It is a heterogeneous type, ranging from insulin resistance to insulin deficiency.[15,16] Also type 2 diabetes (T2D) is a multifactorial disease with both a genetic component and an important non-genetic component(s).[17]

Other specific forms, these include:

✓ Genetic defects of β-cell function, e.g. MODY syndromes
✓ Genetic defects in insulin action e.g. leprechaunism
✓ Diseases of the exocrine pancreas, e.g. pancreatitis
✓ Secondary to endocrinopathies, e.g. acromegaly
✓ Drug- or chemical-induced, e.g. glucocorticoids
✓ Infections, e.g. congenital rubella
✓ Uncommon forms of immune-mediated diabetes, e.g. ‘Stiff Man’ syndrome
✓ Other genetic syndromes associated with diabetes, e.g. Down’s syndrome[15]
✓ Gestational diabetes, Diabetes diagnosed in pregnancy, including pre-existing diabetes and[15,18]

Herbal medicines

Herbal medicines are often used as therapeutic remedies in combination with allopathic drugs.[19] Most of the doctors did not report any complication, but nausea, vomiting, gastric problems were the common adverse effects reported with PHFs (Poly-herbal formulations). Usually ayurvedic drugs are being used due to their minimum toxicity.[20] The basis prescription of ayurvedic drugs was mainly found to be past experience of the patients. Practicing physicians expected that controlled clinical trials of the herbal antidiabetic should be conducted in humans at different hospitals to substantiate the efficacy claim. Ginger, jamun, karela, methi are being used as home remedies in diabetes mellitus due to their proved antihyperglycemic activity. Many of the pharmacists are interested in providing counseling to all their customers (patients) regarding herbal products.[21] Herbal medicines can be relevant today only if they are applied and tested within the framework of modern sciences and subjected to the rigorous criteria for quality, safety and efficacy. Only then, herbal products can be comparable with modern medicines and can bring necessary confidence in prescribing doctors. In present investigation attempts have been made to study the indigenous plants which show inhibitory effect of glucose utilization and are in use as antidiabetic agents in traditional system of medicine. Hence, the present study was performed with the aim of producing an inventory of the plants used to treat diabetes, simultaneously also included those plants which are scientifically justified as antidiabetic agents.

Ayurvedic Remedies

According to the unique assessments of ayurvedic concepts diabetes is the disease which occurs when toxins get accumulated in the tissue and result in circulation blockage. The various root causes of diabetes that ayurveda enlists are poor nutrition and poor digestion, inequity of nervous system, physical and mental stress, and disturbance in natural biological cycle.

The ayurvedic practitioners suggest a variety of natural remedies. Exercise and yoga forms the most effective ayurvedic treatment for diabetes. Ayurveda also prescribes use of certain herbs which can help in curing diabetes. The most important herbs are shilajit, turmeric, neem, amalaki etc. These are considered to be nutritional supplements. They restore balance of those that cause imbalance in your body. In order to control
the functions of liver and pancreas; it is preferable that you take turmeric with aloe Vera, in the early stages of the disease.

**Ayurvedic Herbal Remedies for Diabetes**

- Intake of bitter gourd or bitter lemon juice daily, in empty stomach.
- Intake of 2 turmeric capsules daily thrice a day.
- Intake of rose apple stones powder twice daily.
- Intake of small amounts of fenugreek, musta, Arjuna, triphala, ajwan, haritaki mixed with ghee.
- Intake of amlaki powder, haldi powder with honey, twice daily.
- Intake of fenugreek, white pepper and turmeric powder with a glass of milk, twice daily.
- Intake of a mixture of bay leaf, turmeric and aloe vera gel, twice daily, before lunch and dinner.

Apart from the above easy and affordable measure there is also another ayurvedic remedy and that is preparation of vasant kusumakar ras. This is quite costly but daily intake of this mixed with honey or cream, checks your blood sugar level.

Following the above medications will definitely lower your blood sugar level. People who depend on insulin will realize that their need for insulin has minimized to a great extent.

**The correct diet prescribed by ayurvedic practitioners which would help in reducing your blood sugar level**

- It is necessary that you avoid intake of excessive sweets, carbohydrates and diary products.
- You should eat more fresh vegetables and bitter fruits and herbs.
- You must include fried barley, cornflower, porridge, ghee, in your diet.
- Eat more orange and lemons.
- Eat a lot of green vegetables, black gram, soy, fish etc.

Therefore if you want to keep your diabetes under control then you must eliminate those foods from your diet like rice, wheat, sugarcane etc. and also you should not eat too much fat.

**Other Ayurvedic Methods to Reduce Diabetes**

- Exercise
- Oil massage
- Use of dry ginger and cardamom while taking bath
- Drinking water which is preserved in a copper vessel overnight.

**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/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 Langerhan's
- 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 -galactocidase and α–glucocidase
- Cortisol lowering activities
- Inhibition of alpha-amylase
- Preventing oxidative stress that is possibly involved in pancreatic β-cell dysfunction found in diabetes
Hence, the wide range of plant constituents could have different sites of action within the body, herbs exerts different mechanism of actions including the mechanism of actions of synthetic oral hypoglycemic drugs.

Indian Medicinal Plants with Antidiabetic and Related Beneficial Effects

There are many herbal remedies suggested for diabetes and diabetic complications. Medicinal plants form the main ingredients of these formulations. A list of medicinal plants with antidiabetic and related beneficial effects is given in Table 1\[^{35}\]. A list of such formulations is given in Table 2.

**Acacia arabica:** (Babhu)

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\[^{36}\].

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

Administration of aqueous extract of leaves improves digestion and reduces blood sugar and urea, serum cholesterol in alloxanized rats as compared to control. Along with exhibiting hypoglycemic activity, this extract also prevented peak rise in blood sugar at 1h in oral glucose tolerance test\[^{37}\].

**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. Administration of a sulfur containing amino acid from Allium cepa, S-methyl cysteine sulfoxide (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\[^{38,39}\]. When diabetic patients were given single oral dose of 50 g of onion juice, it significantly controlled post-prandial glucose levels\[^{40}\].

**Allium sativum:** (garlic)

This is a perennial herb cultivated throughout India. Allicin, a sulfur-containing compound is responsible for its pungent odor and it has been shown to have significant hypoglycemic activity \[^{41}\]. This effect is thought to be due to increased hepatic metabolism, increased insulin release from pancreatic beta cells and/or insulin sparing effect\[^{42}\]. 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\[^{43}\].

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\[^{44}\]. Apart from this, Allium sativum exhibits antimicrobial, anticancer and cardioprotective activities.

**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\[^{45}\]. 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\textsuperscript{[46]}. This plant also has an anti-inflammatory activity in a dose dependent manner and improves wound healing in diabetic mice \textsuperscript{[47]}.

\textbf{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\textsuperscript{[48,49]}. Apart from having anti-diabetic activity, this plant also has anti-bacterial, antimalarial, antifertility, hepatoprotective and antioxidant effects\textsuperscript{[50]}.

\textbf{Caesalpinia bonducella}

\textit{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\textsuperscript{[51]}. Two fractions BM 169 and BM 170 B could increase secretion of insulin from isolated islets. The aqueous and 50\% ethanolic extracts of \textit{Caesalpinia bonducella} seeds showed antihyperglycemic and hypolipidemic activities in streptozotocin (STZ)-diabetic rats\textsuperscript{[52]}. 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\textsuperscript{[53]}.

\textbf{Capparis decidua}

This is found throughout India, especially in dry areas. Hypoglycemic effect was seen in alloxanized rats when the rats were fed with 30\% extracts of \textit{Capparis decidua} (C. decidua) fruit powder for 3 weeks. This extract also reduced alloxan induced lipid peroxidation significantly in erythrocytes, kidney and heart. C. decidua was also found to alter superoxide dismutase and catalase enzyme levels to reduce oxidative stress\textsuperscript{[54]}. C. decidua additionally showed hypolipidaemic activity\textsuperscript{[55]}.

\textbf{Coccinia indica}

Dried extracts of \textit{Coccinia indica} (C. 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\textsuperscript{[56]}. 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.

\textbf{Eugenia jambolana: (Indian gooseberry, jamun)}

In India decoction of kernels of \textit{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. In mild diabetes (plasma sugar >180 mg/dl) it shows 73.51\% reduction, whereas in moderate (plasma sugar >280 mg/dl) and severe diabetes (plasma sugar >400 mg/dl) it is reduced to 55.62\% and 17.72\% respectively [21].

The extract of jamun pulp showed the hypoglycemic activity in streptozotocin induced diabetic mice within 30 min of administration while the seed of the same fruit required 24 h. The oral administration of the extract resulted in increase in serum insulin levels in diabetic rats. Insulin secretion was found to be stimulated on incubation of plant extract with isolated islets of Langerhans from normal as well as diabetic animals. These extracts also inhibited insulinase activity from liver and kidney\textsuperscript{[57]}.

\textbf{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 [58].

Momordica charantia: (bitter gourd)

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 [59]. 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 [60].

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 [61]. 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 [62]. 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 [63]. This plant also showed antiasthemitic, antistress, antibacterial, antifungal, antiviral, antitumor, gastric antiulcer activity, antioxidant, antimitagenic and immunostimulant activities.

Phyllanthus amarus: (bhuiawala)

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 diabetic rats [64]. The plant also shows antiinflammatory, antimutagenic, anticarcinogenic, antidiarrhoeal activity.

Pterocarpus marsupium:

It is a deciduous moderate to large tree found in India mainly in hilly region. Pterostilbene, a constituent derived from wood of this plant caused hypoglycemia in dogs [65,66] 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 [67]. Marsupin, pterosupin and liquiritigenin obtained from this plant showed antihyperlipidemic activity [68]. (−) Epicatechin, its active principle, has been found to be insulinogenic, enhancing insulin release and conversion of proinsulin to insulin in vitro. 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 manne [69].

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 [70]. 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 [71]. 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. [72] This plant also shows antioxidant activity [73,74].
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. [75] T. cordifolia is widely used in Indian ayurvedic medicine for treating diabetes mellitus[76–78]. Oral administration of an aqueous T. cordifolia root extract to alloxan diabetic rats caused a significant reduction in blood glucose and brain lipids. 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[79]. 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[80].

Herbal Drug Formulations

Many formulations (see Table 2) 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 has antioxidant properties and protects B cells from oxidative stress. It exerts an insulin like action by reducing the glycated haemoglobin levels, normalizing the microalbuminuria and modulating the lipid profile. It minimizes long term diabetic complications.

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.

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.

Dia-Care manufactured by Admark Herbals Ltd. is claimed to be effective for both Type 1, Type 2 diabetes within 90 days of treatment and cures within 18 months. Persons taking insulin will eventually be liberated from the dependence on it. The whole treatment completes in 6 phases, each phase being of 90 days. Approx. 5 grams (1 tea spoon) powder is mixed with 1/2 glass of water, stirred properly and kept overnight. Only the water and not the sediment must be taken in the morning on empty stomach. To the
remaining medicine fresh water is added and kept for the whole day and is consumed half an hour before dinner. The taste of the drug is very bitter. It is a pure herbal formula without any side effects.

**Diabetes-Daily Care manufactured by Nature’s Health** Supply is a Unique, Natural Formula, which effectively and safely Improves Sugar Metabolism. Diabetes Daily CareTM was formulated for type 2 diabetics and contains all natural ingredients listed in Table 2 in the proportion optimal for the body’s use.

**Gurmar powder manufactured by Garry and Sun** is an anti-diabetic drug, which suppresses the intestinal absorption of saccharides, which prevents blood sugar fluctuations. It also correlates the metabolic activities of liver, kidney and muscles. Gurmar stimulates insulin secretion and has blood sugar reducing properties. It blocks sweet taste receptors when applied to tongue in diabetes to remove glycosuria. It deadens taste of sweets and bitter things like quinine (effects lasts for 1 to 2 hours). Besides having these properties, it is a cardiac stimulant and diuretic and corrects metabolic activities of liver, kidney and muscles.

**DIABETA**, a formulation of Ayurvedic Cure, available in the capsule form is an anti-diabetic with combination of proven anti-diabetic fortified with potent immunomodulators, antihyperlipidemics, anti-stress and hepatoprotective of plant origin. The formulation of Diabeta is based on ancient ayurvedic references, further corroborated through modern research and clinical trials. Diabeta acts on different sites in differing ways to effectively control factors and pathways leading to diabetes mellitus. It attacks the various factors, which precipitate the diabetic condition, and corrects the degenerative complications, which result because of diabetes. Diabeta is safe and effective in managing Diabetes Mellitus as a single agent supplement to synthetic anti-diabetic drugs. Diabeta helps overcome resistance to oral hypoglycemic drugs when used as adjuvant to cases of uncontrolled diabetes. Diabeta confers a sense of well -being in patients and promotes symptomatic relief of complaints like weakness giddiness, pain in legs, body ache, polyuria and pruritis.

**Syndrex manufactured by Plethico** Laboratory contains extracts of germinated fenugreek seed. Fenugreek is used as an ingredient of traditional formulations over 1000 years. We are currently studying the mechanism of this Antidiabetic drug using animal model on one hand and cultured islet cells on the other.

Thus many different plants have been used individually or in formulations for treatment of diabetes and its complications. One of the major problems with this herbal formulation is that the active ingredients are not well defined. It is important to know the active component and their molecular interaction, which will help to analyse therapeutic efficacy of the product and also to standardize the product. Efforts are now being made to investigate mechanism of action of some of these plants using model systems.

**References:**

5. Bennett, PH, Knowler, WC. Increasing prevalence of diabetes in Prima Indians over a ten year period.


70. Sauvare Y., Petit P., Broca C., Manteghetti M., Baisac Y., Fernandez-Alvare J., Gross R., Roy M., Leconte A., Gomis R., Ribes G. 4-


Table 1: Indian Medicinal Plants with Antidiabetic property.

<table>
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<tr>
<th>S. No.</th>
<th>Common name</th>
<th>Botanical Name</th>
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<td>Sea pea</td>
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<td>13</td>
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<td>Orliza sativum</td>
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<td>14</td>
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<td>Tinospora cardifolia</td>
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<td>Menispermaceae</td>
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<tr>
<td>15</td>
<td>bitter gourd</td>
<td>Momordica charantia</td>
<td>fruit</td>
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<td>16</td>
<td>Indian Kino Tree</td>
<td>Pterocarpus marsupium</td>
<td>bark</td>
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<td>17</td>
<td>ginger</td>
<td>Zingiber officinale</td>
<td>rhizome</td>
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<td>Grewia asiatica</td>
<td>Fruit</td>
<td>Malvaceae</td>
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<td>20</td>
<td>Indian Gum Arabic</td>
<td>Acacia arabica</td>
<td>seeds</td>
<td>Leguminoscce</td>
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<tr>
<td>21</td>
<td>Holy Fruit Tree</td>
<td>Aegle marmelos</td>
<td>Root bark</td>
<td>Rutaceae</td>
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<tr>
<td>22</td>
<td>Aloe</td>
<td>Aloe vera</td>
<td>Leaf pulp extract</td>
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<td>23</td>
<td>Davana</td>
<td>Artemisia pallens</td>
<td>aerial parts</td>
<td>Compositae</td>
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<td>24</td>
<td>King of Bitter</td>
<td>Andrographis paniculata</td>
<td>plant extract</td>
<td>Anacardiaceae</td>
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<tr>
<td>25</td>
<td>Neem</td>
<td>Azadirachta indica</td>
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<td>Life Plant</td>
<td>Biophytyum sensitum</td>
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<td>27</td>
<td>Tanner’s</td>
<td>Cassia Cassia auriculata</td>
<td>flower extract</td>
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<td>28</td>
<td>Ivy gourd</td>
<td>Coccinia indica</td>
<td>Leaf extract</td>
<td>Cucurbitaceae</td>
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<tr>
<td>29</td>
<td>Carilla Fruit</td>
<td>Casearia esculenta</td>
<td>Root extract</td>
<td>Flacourtiaeae</td>
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<td>30</td>
<td>Mango</td>
<td>Mangifera indica</td>
<td>leaf extract</td>
<td>Anacardiaceae</td>
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Table 2: Formulated Herbal Drugs with Antidiabetic properties

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<thead>
<tr>
<th>Drug</th>
<th>Company</th>
<th>Ingredients</th>
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<tr>
<td>Diabecon</td>
<td>Himalaya</td>
<td>Gymnema sylvestre, Pterocarpus marsupium, Glycyrrhiza glabra, Casearia esculenta, Syzygium cumini, Asparagus racemosus, Boerhavia diffusa, Sphaeranthus indicus, Tinospora cordifolia, Swertia chirata, Tribulus terrestris, Phyllanthus amarus, Gmelina arborea, Gossypium herbaceum, Berberis aristata, Aloe vera, Triphala, Commiphora wightii, shilajeet, Momordica charantia, Piper nigrum, Ocimum sanctum, Abutilon indicum, Curcuma longa, Rumex maritimus</td>
</tr>
<tr>
<td>Diasulin</td>
<td>Himalaya</td>
<td>Cassia auriculata, Coccinia indica, Curcuma longa, Emblica officinalis, Gymnema sylvestre, Momordica charantia, Scoparia dulcis, Syzygium cumini, Tinospora cordifolia, Trigonella foenum graecum</td>
</tr>
<tr>
<td>Pancreatic tonic</td>
<td>ayurvedic herbal</td>
<td>Pterocarpus marsupium, Gymnema sylvestre, Momordica charantia, Syzygium cumini, Trigonella foenum graecum, Azadirachta indica, Ficus racemosa, Aegle marmelos, Cinnamomum tamala</td>
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<tr>
<td>180 cp</td>
<td>herbal supplement</td>
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<tr>
<td>Ayurveda alternative</td>
<td>Chakrapani</td>
<td>Gurmar (Gymnema sylvestre) Karela (Momordica charantia) Pushkarmool (Inula racemosa) Jamun Gufi (Syzygium cumini) Neem (Azadirachta indica) Methika (Trigonella foenum graecum) Guduchi (Tinospora cordifolia)</td>
</tr>
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<td>herbal formula to</td>
<td>Ayurveda</td>
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<td>Diabetes: Dia-care</td>
<td>Admark Herbs</td>
<td>Sanjeevan Mool; Himej, Jambu beej, Kadu, Namejav, Neem chal.</td>
</tr>
<tr>
<td>Diabetes-Daily</td>
<td>Nature’s Health</td>
<td>Alpha Lipoic Acid, Cinnamon 4% Extract, Chromax, Vanadium, Fenugreek 50% extract, Gymnema sylvestre 25% extract Momordica 7% extract, Licorice Root 20% extract</td>
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<tr>
<td>Care</td>
<td>Supply Garry and</td>
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<td>Gurmar powder</td>
<td>Sun Remedies</td>
<td>Gurmar (Gymnema sylvestre)</td>
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<tr>
<td>Diabeta</td>
<td>Ayurvedic cure</td>
<td>Gymnema sylvestre, Vinca rosea (Periwinkle), Curcuma longa (Turmeric), Azadirachta indica (Neem), Pterocarpus marsupium (Kino Tree), Momordica charantia (Bitter Gourd), Syzygiumcumini (Black Plum), Acacia arabica (Black Babhul), Tinospora cordifolia, Zingiber officinale (Ginger)</td>
</tr>
<tr>
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<td>Ayurvedic Herbal</td>
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<td>Health Products</td>
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