HYPOGLYCAEMIC ACTIVITY OF DIFFERENT EXTRACTS OF VARIOUS HERBAL PLANTS

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ABSTRACT
The hypoglycaemic or anti-diabetic activity of various extracts of various plants have been evaluated in Alloxan induced diabetic rats. In our experiments 30 medicinal plants have been selected for thorough studies from various plants like- Pterocarpus marsupium, Azadirachta indica, Allium sativum, Brassica juncea etc many of them seem to act directly on pancreas and stimulate insulin level in blood. This paper aims to provide a comprehensive review on various plant species from Indian biosphere, which have been shown to display potent hypoglycaemic activity.

KEYWORDS: Hypoglycaemic activity, Alloxan induced diabetic rat, Medicinal plants

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INTRODUCTION

Hyperglycaemia or diabetes mellitus is caused by inherited or acquired deficiency in production of insulin by the pancreas or by the ineffectiveness of the insulin produced. Such a deficiency results in increased concentration of glucose in the blood, which in turn damage many of the body systems in particular the blood vessels and nerves. Chronic hyperglycaemia during diabetes causes glycation of body proteins that in turn lead to secondary complications effecting eyes, kidneys, nerves and arteries. A part from currently available therapeutic options many herbal medicines have been recommended for the treatment of diabetes medicinal plants have the advantage of having no side-effects. Some of them are be used in traditional systems of medicines from hundreds of the years in many countries of the world. Till today met forming is the only ethical drug approved for the treatment of NIDDM patient which is derived from a medicinal plants Galega officinalis historically used for treatment of Diabetes in medieval Europe.

According to WHO more than one million people rely on herbal medicines to some extants. The WHO has listed 21,000 plants have reported medicinal uses around the world. India has rich medicinal plant flora of some 25,000 species of these 150 species is commercially used for extracting medicines or drug formulation. In India the medicines the use of medicinal herbs is as old as 1500 BC, underline the medical culture of India both folk traditions as well as codified knowledge system is a deep understandings of the medicinal value of the plants starting with the references in the Atharveda. We have textual evidence of a tradition of use of medicinal plants that is more than 3000 years old.

Over the last few years, researchers have aimed at identifying and validating plants derived substances for the treatment of various diseases. Interestingly, it is estimated that more than 25% of modern medicines are directly or indirectly derived from plants.

In this context, it worth mentioning that Indian plants are considered a vast source of several pharmacologically active principles and compounds that are commonly used in home remedies against multiple ailments. Neem and turmeric are quite popular among these important medicinal plants and several pharmacologically active compounds have been isolated and extracted from these plants\(^{(1-10)}\). Pterocarpus marsupium (commonly known as vijaysar) is another Indian plant, which has enormous traditional uses against various diseases and bioactive compounds have been isolated from this plant also. In hilly regions throughout the Deccan Peninsula, and extending to Gujarat, Madhya Pradesh, Uttar Pradesh, Bihar and Orissa. In India, it grows wild especially in dry forest, outer Himalayas Shivaliks, South Indian plateau with altitudes ranging from 250-1200m and also cultivated throughout Indian subcontinent. In a clinical study, oral administration of 2, 3 and 4gm of aqueous study of Vijaysar has been given per day to control fasting and post-prandial glucose levels by 12 weeks in 73, 16 and 10 % respectively of the 67 out of 97 patients who responded to therapy\(^{(11)}\). Leaves, stem and roots of this plant are used as ethno-medicines against various human ailments. Extensive chemical investigations on various part of the tree have been carried out and more than 50 compounds have been isolated, which are biologically active against various major and minor diseases including Diarrhea, dysentery, leucoderma, elephantiasis etc.

Therefore in this article comparison between different medicinal plants having hypoglycaemic and anticitract activities are illustrated. This article will enhance the existing knowledge of medicinal plants, and also create the awareness of possible new therapeutic uses for the development of pharmaceutical entities or dietary adjuncts for better health care in the near future.
# List of Comparative Study of the Various Medicinal/Herbal Plants for Hypoglycaemic and Anticataract Ailment

<table>
<thead>
<tr>
<th>PLANT NAME/ FAMILY</th>
<th>COMMON NAME</th>
<th>PART OF PLANT USED</th>
<th>TYPE OF EXTRACT</th>
<th>DOSE PARAMETER</th>
<th>OBSERVED RESULTS</th>
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<tbody>
<tr>
<td><em>Aegle marmelos</em> (L.) Correa ex Roxb. (Family: Rutaceae)</td>
<td>Holy Fruit Tree</td>
<td>Leaf</td>
<td>Aqueous leaf extract</td>
<td>Antihyperglycemic activity of aqueous leaf extract in streptozotocin induced diabetic rats. Each group of animals was treated daily over 14 days orally by different doses by means of a catheter under mild ether anaesthesia</td>
<td>Increases utilization of glucose; either by direct stimulation of glucose uptake or via the mediation of enhanced insulin secretion</td>
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<tr>
<td><em>Allium cepa</em> L. [Family: Liliaceae]</td>
<td>Onion</td>
<td>Bulb</td>
<td>Ether soluble fraction of onion</td>
<td>Hypoglycemic activity of ether soluble fraction of onion (0.25 mg/kg p.o.) in normal rabbits</td>
<td>Lowers blood glucose level and has potent antioxidant activity, which may account for the hypoglycemic potential</td>
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<tr>
<td><em>Allium sativum</em> L. [Family: Alliaceae]</td>
<td>Garlic</td>
<td>Whole Plant</td>
<td>Ethanol, petroleum ether and ethyl acetate extract in alloxanized rabbits</td>
<td>Antihyperglycemic activity of ethanol, petroleum ether and ethyl acetate extract in alloxanized rabbits at a dose of 0.25 mg/kg, orally</td>
<td>It has been found that the ethyl ether extract from garlic is the most potent and active principle producing maximum hypoglycaemic activity due to increased insulin like activity of plasma.</td>
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<tr>
<td><em>Aloe vera</em> (L.) Burm.f. [Family: Aloaceae]</td>
<td>Aloe</td>
<td>Whole Plant leaves pulp extracts</td>
<td>Hypoglycemic activity of the plant (200 and 300 mg/kg p.o.) on normal fasted rats, oral glucose-loaded rats and streptozotocin-induced diabetic rats</td>
<td>Maintains glucose homeostasis by controlling the carbohydrate metabolizing enzymes.</td>
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<tr>
<td><em>Artemisia pallens</em> Wall. ex DC. (Family: Compositae)</td>
<td>Davana</td>
<td>Aerial parts</td>
<td>Methanolic extract of the aerial parts</td>
<td>Antihyperglycemic activity of aerial parts (100 mg/kg, orally) in glucose-fed hyperglycemic and alloxan-induced diabetic rats. Moderate hypoglycaemic effect (1000 mg/kg) in fasted normal rats.</td>
<td>Inhibits glucose re-absorption or increase in peripheral glucose utilization</td>
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<td>Plant Name</td>
<td>Part Used</td>
<td>Extract Type</td>
<td>Activity Description</td>
<td>Effect</td>
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<tr>
<td><em>Annona squamosa</em> L.</td>
<td>Sugar apple</td>
<td>Leaf ethanolic extract (19)</td>
<td>Hypoglycemic and antihyperglycemic activities of ethanolic leaf-extract (350 mg/kg, orally) in normal, streptozotocin (STZ)-diabetic rats and alloxanized rabbits (19)</td>
<td>Lowers blood glucose level</td>
<td></td>
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<tr>
<td><em>Andrographis paniculata</em> Nees (Family: Acanthaceae)</td>
<td>King of Bitter.</td>
<td>Whole Plant Aquous extract</td>
<td>Hypoglycemic and antihyperglycemic activity in normal and streptozotocin induced diabetic rats, orally. Its hypoglycaemic effect has been tried in various way. scan prevent induction of hyperglycaemia significantly (P &lt;0.001) induced by oral administration of glucose 2 mg/kg body weight (20)</td>
<td>Prevents glucose absorption from gut (20)</td>
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<tr>
<td><em>Azadirachta indica</em> A. Juss. (Family: Meliaceae)</td>
<td>Neem Leaf</td>
<td>Leaf extract (21)</td>
<td>Hypoglycemic and antihyperglycemic activities of leaf extract in normal and streptozotocin-induced diabetic rat. Blood sugar lowering unit (BLU) of activity of each leaf extract and tolbutamide was calculated by ED50 values. Statistical analysis revealed significant (P&lt;0.05) variation among the treatments as well as doses with regard to their blood sugar lowering capacity (21)</td>
<td>Exhibits hypoglycaemic activity without altering the serum cortisol concentration (21)</td>
<td></td>
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<tr>
<td><em>Biophytum sensitivum</em> (L.) DC</td>
<td>Life Plant</td>
<td>Whole plant leaf (22)</td>
<td>Hypoglycemic activity of the plant on glucose homeostasis in rabbits (22)</td>
<td>Stimulates pancreatic beta cells to release insulin (23)</td>
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<tr>
<td><em>Brassica juncea</em> (L.) Czern. (Family: Brassicaceae)</td>
<td>Brown mustard Whole plant</td>
<td></td>
<td>Hypoglycemic activity of <em>Brassica juncea</em> diet (10%, w/w) in normal rats upon oral administration for 60 days (25)</td>
<td>Increases the concentration of hepatic glycogen and glycogenesis and suppressed the activity of glycogen phosphorylase and gluconeogenic enzymes, lead to reduction in glycogenolysis and gluconeogenesis (25)</td>
<td></td>
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<tr>
<td><em>Boerhavia diffusa</em> L. (Family: Nyctaginaceae)</td>
<td>Tar vine Leaf</td>
<td>Aquous leaf extract (26-28)</td>
<td>Hypoglycemic and antihyperglycemic activity of aqueous leaf extract (200 mg/kg p.o., daily for 4 weeks) in normal and alloxan induced diabetic rats (26,27)</td>
<td>Increases plasma insulin levels and improves glucose tolerance, produced significant antioxidant activity (26,27)</td>
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<td>Plant Name</td>
<td>Part Used</td>
<td>Extract Type</td>
<td>Activity Details</td>
<td>Additional Activity Details</td>
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<tr>
<td><em>Cassia auriculata</em> L. (Family: Leguminosae)</td>
<td>Flower</td>
<td>Aqueous flower extract</td>
<td>Hypoglycemic activity of aqueous leaf extract at a dose of 100, 200 and 400 mg/kg in alloxan induced diabetic rats</td>
<td>Suppresses enhanced gluconeogenesis during diabetes and enhance utilization of glucose through increased glycolysis in addition to pronounced alpha-glucosidase inhibitory actions resulting in a significant and potent lowering of blood glycemic response</td>
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<tr>
<td><em>Caesalpinia bonducella</em> (L.) Roxb. (Family: Cesalpinaeae)</td>
<td>Seed</td>
<td>The aqueous and 50% ethanolic seed extracts</td>
<td>Hypoglycemic and antihyperglycemic activities of the aqueous and 50% ethanolic seed extracts in normal and streptozotocin-diabetic rats</td>
<td>Increases the release of insulin from pancreatic cells</td>
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<tr>
<td><em>Cajanus cajan</em> (L.) Millsp. (Family: Fabaceae)</td>
<td>Leaves and stem</td>
<td>Aqueous leaf and stem extract</td>
<td>Glucose tolerance enhancing activity of aqueous leaf and stem extract in oral glucose tolerance test</td>
<td>Leaf juice is used against diabetes. Seed paste is used as energy stimulant. It lowers plasma glucose level.</td>
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<tr>
<td><em>Citrus colocynthis</em> L. Schrad. (Family: Cucurbitaceae)</td>
<td>Seed</td>
<td>Aqueous extract, glycosidic and saponin extract</td>
<td>Blood glucose lowering activity of aqueous seed extract(300 mg/kg) in normal and streptozotocin (STZ)-induced diabetic rats upon daily oral administration for 2 weeks</td>
<td>The oral administration of plant extract reduced the plasma level of AST and LDH significantly. The oral administration of aqueous extract of the plant can ameliorate some of the toxic effect of streptozotocin.</td>
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<tr>
<td><em>Coccinia indica</em> Wight &amp; Arn. (Family: Cucurbitaceae)</td>
<td>Leaves</td>
<td>Alcoholic leaf extract</td>
<td>Antihyperglycemic activity of dried extract (500 mg/kg p.o., for 6 weeks) in 30 diabetic patients</td>
<td>Suppresses glucose synthesis, through depression of the key gluconeogenic enzymes glucose-6-phosphatase and fructose-1,6-bisphosphatase and enhances glucose oxidation by shunt pathway through activation of its principal enzyme glucose-6-phosphate dehydrogenase. Also has an insulin secretagogue effect and acts like insulin by correcting elevated enzymes in glycolytic pathway and...</td>
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<td>Plant Name</td>
<td>Part Used</td>
<td>Extract Type</td>
<td>Description</td>
<td>Actions</td>
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<tr>
<td>Casearia esculenta Roxb. (Family: Flacourtia ceae)</td>
<td>Root</td>
<td>Root aqueous extract</td>
<td>Root extract (300 mg/kg p.o. for 45 days) in normal and streptozotocin-induced diabetic rats</td>
<td>Exhibits significant reduction in blood glucose level, a decrease in the activities of glucose-6-phosphatase and fructose-1,6-bisphosphatase and an increase in the activity of liver hexokinase, resulting in potent hypoglycemic activity</td>
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<tr>
<td>Catharanthus roseus (L.) G. Don. (Family: Apocynaceae)</td>
<td>Leaf &amp; twigs</td>
<td>Ethanol extract, dichloromethane: methanol extract of leaves and twigs in streptozotocin (STZ) induced diabetic rat (500 mg/kg p.o., for 7 and 15 days) The extract (500 mg/kg) in streptozotocin rats and in oral glucose tolerance test</td>
<td>Increases metabolism of glucose</td>
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<tr>
<td>Camellia sinensis Kuntze (Family: Theaceae)</td>
<td>Leaves</td>
<td>Hot water extract of green tea</td>
<td>In streptozotocin (STZ)-diabetic rats</td>
<td>Epigallocatechin gallate, present in tea increases insulin activity and prevent oxidative damages, responsible for the hypoglycemic activity</td>
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<tr>
<td>Enicostemma littorale Blume (Family: Gentiaceae)</td>
<td>Whole plant</td>
<td>Whole plant aqueous extract</td>
<td>Whole plant aqueous extract (1 and 2 g/kg) in alloxanized rats upon oral administration for 45 days Insulin enhancing activity of a single dose of aqueous extract of plant (15 g dry plant equivalent extract per kg) in alloxan-induced diabetic rats Glucose lowering activity of aqueous extract (2 g/kg p.o.) daily for 6 weeks in neonatal non-insulin-dependent diabetes mellitus (NIDDM) rats along with a decrease in the elevated cholesterol, triglyceride and creatinine levels</td>
<td>Enhances glucose-induced insulin release from isolated rat pancreatic islets, mediated through K (+)-ATP channel-dependent pathway</td>
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<tr>
<td>Eugenia jambolana Lam. (Family: Myrtaceae)</td>
<td>Seed powder,</td>
<td>Ethanol whole seeds &amp; seed coat extracts</td>
<td>Hypoglycemic activity of ethanolic whole seeds, kernel (100 mg/kg of body weight) and seed coat extracts in streptozotocin-induced diabetic rats</td>
<td>It exhibits normoglycemia and better glucose tolerance</td>
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<tr>
<td>Ficus bengalensis L. (Family: Moraceae)</td>
<td>Bark</td>
<td>3-O-beta-d-galactosyl cellobioside isolated from the bark</td>
<td>Blood sugar lowering activity of a dimethoxy derivative of leucocyanidin 3-O-beta-d-galactosyl cellobioside isolated from the bark in normal and moderately diabetic rats along with an increase in serum insulin in the diabetic rats at a dosage of 250 mg/kg for a 2 h period upon oral administration Blood glucose lowering activity of bark extract in processes</td>
<td>Inhibits insulin degradative processes</td>
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<tr>
<td><strong>Hibiscus rosa-sinensis L.</strong> (Family: Malvaceae)</td>
<td>China Rose</td>
<td>Whole plant, leaf &amp; flower</td>
<td>Alcoholic leaf extract (51) ethanol extract of the plant (52)</td>
<td>Hypoglycemic activity of alcoholic leaf extract (250 mg/kg p.o. for seven consecutive days) in glucose induced hyperglycemia model in rats (51). Hypoglycemic activity of single dose of ethanol extract of the plant in glucose-loaded rats at 120 min and blood glucose lowering effect after repeated administration for seven consecutive days at 30, 90 and 120 min after glucose loading (52).</td>
<td>Stimulates insulin secretion from pancreatic beta cells (52) and increases utilization of glucose, either by direct stimulation of glucose uptake or via the mediation of enhanced insulin secretion (51).</td>
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<td><strong>Helicteres isora L.</strong> (Family: Sterculiaecae)</td>
<td>Screw tree</td>
<td>Root</td>
<td>Ethanolic root extract (53) butanol root extracts (54)</td>
<td>Plasma glucose lowering activity of ethanolic root extract (300 mg/kg, after 9 days of administration) in insulin resistant and diabetic C57BL/KsJ-db/db mice associated with a reduction in plasma triglyceride level (53). Antihyperglycemic activity of butanol root extracts (250 mg/kg) in glucose loaded rats (54).</td>
<td>Acts through insulin-sensitizing activity (54).</td>
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<tr>
<td><strong>Mangifera indica L.</strong> (Family: Anacardiaeae)</td>
<td>Mango</td>
<td>Leaf</td>
<td>Aqueous leaf extract (55)</td>
<td>Hypoglycemic activity of aqueous leaf extract (1 g/kg p.o.), given along with as well as 60 min before glucose administration in streptozotocin-induced diabetic rats (55). Hypoglycemic activity of Mangiferin (10 and 20 mg/kg, i.p. once daily for 28 days) in STZ induced diabetic rats and improvement in oral glucose tolerance in glucose-loaded normal rats upon chronic administration (10 and 20 mg/kg, i.p.) for 14 days (55).</td>
<td>Possibly acts through intestinal reduction of the absorption of glucose (55) as well as pancreatic and extrapancreatic mechanisms (56).</td>
</tr>
<tr>
<td><strong>Mucuna pruriens (L.) DC.</strong> (Family: Leguminosae)</td>
<td>Velvet bean</td>
<td>Whole plant (57,58) powdere d seeds (94)</td>
<td>Alcohol extract of the plant (57)</td>
<td>Antihyperglycaemic effect of alcohol extract of the plant (100, 200 and 400 mg/kg/day) in alloxanized rats and insignificant glucose lowering effect in streptozotocin (STZ) diabetic mice (57). Blood glucose lowering activity of plant extract (200 mg/kg) upon daily oral feeding for 40 days in STZ-diabetic mice (58). Blood glucose lowering activity of powdered seeds (0.5, 1 and 2 g/kg) in normal rabbits and hypoglycemic activity of the seed (1 and 2 g/kg body weight) in alloxan-diabetic rabbits (59).</td>
<td>Possibly acts through stimulation of the release of insulin and/or by a direct insulin-like action due to the presence of trace elements like manganese, zinc, etc. (59).</td>
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<tr>
<td><strong>Morus alba L.</strong> (Family: Moraceae)</td>
<td>White mulberry</td>
<td>Leaf (60)</td>
<td>Hot water extract of leaves (60)</td>
<td>Hypoglycemic activity of hot water extract of leaves in fasted and non-fasted streptozotocin induced diabetic mice at a dose of 200 mg/kg, i.p. (60).</td>
<td>Acts by increasing glucose uptake (60).</td>
</tr>
<tr>
<td><strong>Murraya koeingii (L.) Spreng.</strong> (Family: Rutaceae)</td>
<td>curry-leaf tree</td>
<td>Leaf (61,62) leaf-powder (61,62)</td>
<td>Fasting as well as post-prandial blood sugar lowering effect of leaf-powder in Type II diabetic patients upon administration for a period of 1 month (61). Blood sugar lowering effect of the leaves in normal rats when administered as a diet (10%, v/v) for 60 days (62).</td>
<td>Increases glycogenesis and decreases glycogenolysis and gluconeogenesis (62).</td>
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<tr>
<td><strong>Ocimum sanctum L.</strong></td>
<td>Holy Basil</td>
<td>Whole plant, leaf</td>
<td>Leaf powder (64)</td>
<td>Plasma glucose lowering activity of plant extract (200 mg/kg for 30 days) in STZ induced diabetic animals revealing the effect of the extract on three</td>
<td>Its powdered leaf has produced potent hypoglycaemic and</td>
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<tr>
<td>Plant Name</td>
<td>Family</td>
<td>Part</td>
<td>Method</td>
<td>Activity</td>
<td>Notes</td>
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</table>
| Pomegranate | Punica | Flower | Powder | Fasting blood glucose level reducing activity | Administration of mention dose led to decrease in plasma glucose level by 24.6%.
| Punica granatum L. | Punicacea | Seed | Extract | Hypolipidemic effect in normal and diabetic rats | Led to significant blood glucose lowering effect in normal, glucose-fed hypoglycaemic and alloxan-induced diabetic rats.
| Salacia reticulata Wight. | Celastacea | Whole Plant | Tea | Hypoglycemic activity of plant tea in Type II diabetic patients | Inhibits alpha-glucosidase activity.
| Salacia oblonga Wall. | Celastacea | Whole Plant | Extract | Plasma glucose and serum insulin reducing activity | The given dose reduced the plasma glucose and serum insulin incremental area under the curve by 23 & 29% respectively.
| Swertia chirayita (Roxb. ex Fleming) H. Karst. | Gentianaceae | Whole Plant | Extract | Blood sugar lowering effect of Swerchirin (50 mg/kg p.o.) in healthy and streptozotocin treated (35 mg/kg i.v.) Charles Foster strain albino rats | Stimulates insulin release from islets of Langerhans by depleting aldehyde-fuchsin stained beta-granules and immunostained insulin.
| Scoparia dulcis L. | Scrophulariaceae | Sweet Broom weed | Whole Plant | Insulin secretagogue activity of the plant extracts in isolated mice pancreatic islets at a dose of 10 mg/ml | It potentiates insulin pancreatic islets release from pancreatic islets.
CONCLUSION
Diabetes is a disorder of carbohydrate, fat and protein metabolism caused due to attenuate production of insulin or due to its inhibitory action. Herbal treatments for diabetes have been used in patients with insulin dependent and non-insulin dependent diabetes, diabetic retinopathy, diabetic neuropathy etc. scientific validation of several Indian plants species have proved the efficacy of the herbs in reducing the blood sugar level. Hence extensive research is required to find out the mechanism of the action as well as the bioactivity of other compounds in crude extracts and to exploit their therapeutic potential to combat various disease. A discovery of novel efficacious drug can be developed through the extensive investigation of bioactivity of various compounds their mechanism of action pharmacotherapeutic, toxicity, standardization and clinical trails. Thus in near future the herbal plants may play very important role in modern system of medicine.

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