HERBAL DRUGS ARE USED AS ANTIDIABETIC: A REVIEW

Mohd Saidurrahman*1, Anayatullah1, Md Tahir1, Azeemuddin1, Md Tarique1, Mohammad Zishan2

1Department of Pharmacology Integral University Kursi Road Lucknow U.P. India.
2Department of Pharmaceutics Integral University Kursi Road Lucknow U.P. India.

ABSTRACT
Diabetes mellitus (DM) is the commonest endocrine disorder that affect more than 100 million people worldwide (6% of the population). It is caused by the absence or ineffective production of insulin by pancreas which results in increase or decrease in concentrations of glucose in the blood. It is found to harm many of the body systems, particularly the blood vessels and nerves both insulin-dependent DM (IDDM) and non-insulin dependent DM (NIDDM) is a common and serious metabolic disorder throughout the world. In India, diabetes has been known for a long time, but its incidence is not of the same magnitude across the subcontinent. The wide range of structures of the plant constituents, which appear to be the active hypoglycaemic principles, suggests different sites of action within the body. Traditional Medicines have been derived from the medicinal plants which are used by the 60% of the world’s population. This research mainly focuses on the various Indian Herbal drugs and plants used in the treatment of diabetes, particularly in India. Diabetes is very significant health issue being faced by the majority of people of different countries. In India it is proving to be a major health hazard, especially in the urban areas. Though there are various treatments to reduce the effects of diabetes and its other secondary complications, herbal formulations are preferred due to low cost, lesser side effects and longer shelf life.

KEYWORDS: Diabetes mellitus, Ayurveda, Herbal medicine.

INTRODUCTION
Herbal medicine, also called botanical medicine or phytomedicine, refers to the use of any plant’s seeds, berries, roots, leaves, bark, or flowers for medicinal purposes. Long practiced
outside of conventional medicine, herbalism is becoming more mainstream as up analysis and research show their value in the treatment and prevention of disease. These drugs are gaining popularity both in developing and developed countries because of their natural origin and less side effects.[1,2] 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.[3,4] India is the largest producer of medicinal herbs and is called as botanical garden of the world. The World Health Organization (WHO) has listed 21,000 plants, which are used for their medicinal properties around the world. Among these 2500 species are in India, out of which 150 species are used commercially on a fairly large scale.[5] The disease is associated with reduced quality of life and increased risk factors for mortality and morbidity. Diabetes mellitus, commonly referred to as diabetes was first identified as a disease associated with “sweet urine,” and excessive muscle loss in the ancient world. Elevated levels of blood glucose lead to spillage of glucose into the urine, hence the term sweet urine. Normally, blood glucose levels are tightly controlled by insulin, a hormone produced by the pancreas. Insulin lowers the blood glucose level. When the blood glucose elevates, insulin is released from the pancreas to normalize the glucose level[6,7] 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 research focusses 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.[8]

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.[8]

What is herbal medicine good for?
Herbalist 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.[8]

**IMPORTANT MEDICINAL PLANTS HAVING ANTIDIABETIC POTENTIAL:**

*Allium cepa* L: (onion)

*Allium cepa* Family Liliaceae is known only in cultivation but related wild species occur in Central Asia. Various ether soluble fractions as well as insoluble fractions of dried onion powder show anti-hyperglycemic activity in diabetic rabbits. *A. cepa* also known to have antioxidant and hypolipidemic activity. Administration of a sulfur containing amino acid, 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. It normalizes the activities of liver hexokinase, glucose 6-phosphatase and HMG Co A reductase.[9]

![Image of onion](image-url)

**Figure: 1. Herbal plant onion used for antidiabetic.**

*Allium sativum*: (garlic)

*Allium Sativum* Family liliaceae. 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.[10] 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 (10ml/kg/day) administered orally to sucrose fed rabbits (10g/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.[11]
Figure 2: Herbal plant Allium sativum used for antidiabetic.

Momordica charantia (bitter gourd)
Bitter gourd Family 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 (200mg/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.[8] 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.[12]

Figure 3: Herbal plant Bitter gourd used for antidiabetic.
**Aloe vera (L): Burm**

Aloe vera grows in arid climates and is widely distributed in Africa, India and other arid areas. *Aloe vera* gel at 200 mg/kg possesses significant antidiabetic, cardioprotective activity, reduces the increased TBARS, maintains the Superoxide dismutase and Catalase activity up to the normal level and increases reduced glutathione by four times in diabetic rats.\(^{[3,14]}\)

![Figure 5: Herbal plant Burm used as antidiabetic.](image)

**Azadirachta indica: Neem (Hindi)**

*Azadirachta indica* Family: Meliaceae. Whole plants parts are used. Nimbidin is major source from seed oil, It is crude bitter principle. It also contain nimbin, nimbinin, nimbidinin, nimbolide, nimbilic acid. Gedunin obtained from neem’s seed. It also contain mahmoodin, Azadirachtin. It also contains some tannin like, Gallic acid. There are also present of Margolonon, Polysaccharide.\(^{[15]}\) 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.\(^{[16]}\)

![Figure 6: Herbal plant Neem used as antidiabetic.](image)
**Aegle marmelos: Bael**

Aqueous leaf extract of *Aegle marmelos* showed antihyperglycemic activity in streptozotocin induced diabetic rats after 14 days treatment either by increasing utilization of glucose or by direct stimulation of glucose uptake through increased insulin secretion.\[^{17}\]

![Figure 7: Herbal plant Bael used as antidiabetic.](image)

**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.\[^{18}\]

![Figure 8: Herbal plant Holy basil used as antidiabetic.](image)
**Acacia Arabica: Babool**
Commonly known as Babool, is found all over India mainly in the wild habitat. The plant extract acts as an antidiabetic agent by the mechanism of acting as a secretagogue to release insulin. It induces hypoglycemia in control rats but not in the animals treated with alloxan. 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 the pancreatic beta cells.[19]

![Figure 9: Herbal plant Babool used as antidiabetic.](image)

**Mangifera indica L: Mango**
The aqueous extract produces reduction of blood glucose level in normoglycemic and glucose-induced hyperglycemia, but does not have any effect on streptozotocin-induced diabetic mice under the same conditions when compared with that of an oral dose of chlorpropamide. The result indicates that the aqueous extract of the leaves of *M. indica* possess hypoglycemic activity.[20]

![Figure 10: herbal plant Mango used as antidiabetic.](image)
**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 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.\(^{[19]}\)

![Figure 11: Herbal plant Guduchi used as antidiabetic.](image)

**Catharanthus roseus:**

Hypoglycemic effect of the methanolic leaf extract of *Catharanthus roseus* (C. roseus) in alloxan induced diabetic rats. The levels of blood glucose were significantly decreased when compared with Control rat. The blood glucose lowering effect of C. roseus methanolic extract was more pronounced than Glibenclamide and Metformin.\(^{[21]}\)

![Figure 12: Herbal plant C. roseus used as antidiabetic.](image)

**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-hydroxyxyleucine, 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. \[22\]

![Figure 13: Herbal Plant Fenugreek Used For Antidiabetic](image)

**Curcuma Longa**

*Haldi (Hindi) and Turmeric (English)*

*Curcuma longa* Family: Zingiberaceae. The effect of Aqueous Extract of Curcuma longa (AEC) on insulin secretion in pancreatic tissues with acute incubations under hyperglycaemic conditions and also chronic incubations under both basal and hyperglycaemic conditions were examined in vitro. Under hyperglycaemic culture conditions all the doses of AEC over 30 min of incubation showed an inhibited insulin release which was significantly different from the control (p < 0.05). No significant difference was observed between the 0.1, 1 and 10 mL doses of AEC (p > 0.05), but the highest dose of AEC (100 mL) was significantly different from the control and the other doses of AEC (p < 0.05). Tolbutamide, on the other hand, significantly stimulated insulin secretion. Pancreatic tissues over 15 min of incubation with various doses of AEC in hyperglycemic culture conditions were not significantly different in insulin secretion from the control. \[23\]

![Figure 14: Herbal plant Turmeric used as antidiabetic.](image)
**Liquorice**

*Liquorice* is the root of *Glycyrrhiza glabra* as well as a herbaceous perennial legume. The liquorice root is an ancient traditional herbal remedy for tackling several ailments. Scientists reveal that liquorice root from the papilionaceae family may be effective for treating type 2 diabetes which is more common with overweight or obese individuals thus leading to insulin resistance. Liquorice roots contain anti-diabetic substances known as amorfrutins, which are capable of reducing the blood sugar levels as well as preventing inflammation associated with diabetics. The name amorfrutins was derived from the Amorpha fruticosa, which is a flowering plant belonging to the leguminous family.\textsuperscript{[24]}

![Figure 15: Herbal plant Liquorice used as antidiabetic.](image)

**Table 1: Some important anti-diabetic herbal plants source and their active component.**\textsuperscript{[4,25]}

<table>
<thead>
<tr>
<th>Botanical name</th>
<th>Family</th>
<th>Parts used</th>
<th>Main Active components</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Areca catechu</em></td>
<td>Arecaceae</td>
<td>Seed</td>
<td>Arecaine and arecoline</td>
</tr>
<tr>
<td><em>Annona squamosa</em></td>
<td>Annonaceae</td>
<td>Fruits</td>
<td>Liriodenine, mupinicamide</td>
</tr>
<tr>
<td><em>Artemisia pallens</em></td>
<td>Asteraceae</td>
<td>Leaves and flowers</td>
<td>Germanacranolide</td>
</tr>
<tr>
<td><em>Allium sativum</em></td>
<td>Alliaceae.</td>
<td>Bulbs</td>
<td>Allyl propyl disulphide, alicin</td>
</tr>
<tr>
<td><em>Azadirachta indica</em></td>
<td>Meliaceae</td>
<td>Leaves, flowers &amp; seed</td>
<td>Azadirachtin and nimbin, nimbidin.</td>
</tr>
<tr>
<td><em>Camellia sinensis</em></td>
<td>Theaceae</td>
<td>Leaves</td>
<td>caffeine and catechins</td>
</tr>
<tr>
<td><em>Bauhinia forficata</em></td>
<td>Leguminosae</td>
<td>Leaf</td>
<td>Astragalalin, kaempferitin</td>
</tr>
<tr>
<td><em>Beta vulgaris</em></td>
<td>Amaranthaceae</td>
<td>Root</td>
<td>Phenolics, betacyanins</td>
</tr>
<tr>
<td><em>Boerhavia diffusa</em></td>
<td>Nyctaginaceae</td>
<td>Whole plant</td>
<td>Punarnavine and ursolic acid</td>
</tr>
<tr>
<td><em>Capparis decidua</em></td>
<td>Capparidaceae</td>
<td>Fruit</td>
<td>Spermidine Isocodonocarpine</td>
</tr>
</tbody>
</table>
### Mechanism of Action of Herbal Antidiabetics

The mechanism of action of herbal anti-diabetic could be given as:

- **Adrenomimeticism**, pancreatic beta cell potassium channel blocking, cAMP (2nd messenger) stimulation Inhibition in renal glucose reabsorption.
- Reduction in insulin resistance and Providing certain necessary elements like calcium, zinc, magnesium, manganese and copper for the beta-cells. Regenerating and repairing pancreatic beta cells.
- Increasing the size and number of cells in the islets of Langerhans.
- Stimulation of insulin secretion, glycogenesis and hepatic glycolysis from beta cells of islets and inhibition of insulin degradative processes.
- 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.

<table>
<thead>
<tr>
<th>Herb</th>
<th>Family</th>
<th>Part</th>
<th>Active Constituents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cinnamomum zeylanicum</td>
<td>Lauraceae</td>
<td>Bark</td>
<td>Cinnamaldehyde, eugenol, Cinnamaldehyde, eugenol</td>
</tr>
<tr>
<td>Gymnema sylvestre</td>
<td>Asclepiadaceae</td>
<td>Leaf</td>
<td>Dihydroxy gymnemic triacetate</td>
</tr>
<tr>
<td>Ficus bengalensis Linn</td>
<td>Moraceae</td>
<td>Bark</td>
<td>Leucodephalnindin and leucopelargonin</td>
</tr>
<tr>
<td>Combretum micranthum</td>
<td>Combretaceae</td>
<td>Leaves</td>
<td>Polyphenols</td>
</tr>
<tr>
<td>Lantana camara</td>
<td>Verbenaceae</td>
<td>Leaves</td>
<td>Lantanidine, lantanone</td>
</tr>
<tr>
<td>Momordica charantia</td>
<td>Cucurbitaceae</td>
<td>leaves</td>
<td>Charantin, sterol</td>
</tr>
<tr>
<td>Ocimum sanctum</td>
<td>Labiatae</td>
<td>whole plant</td>
<td>Eugenol</td>
</tr>
<tr>
<td>Tinospora cordifolia</td>
<td>Menispermaeae</td>
<td>Root</td>
<td>Tinosporone, tinosporic acid</td>
</tr>
<tr>
<td>Swertia punicea</td>
<td>Gentianaceae</td>
<td>Whole plant</td>
<td>Methyl swertianin and bellidifolin</td>
</tr>
<tr>
<td>Sarcopoterium spinosum</td>
<td>Rosaceae</td>
<td>Root</td>
<td>Catechin and epicatechin</td>
</tr>
<tr>
<td>Ricinus communis</td>
<td>Euphorbiaceae</td>
<td>Root</td>
<td>Ricinolic acid</td>
</tr>
<tr>
<td>Punica granatum</td>
<td>Lythraceae</td>
<td>Fruit</td>
<td>Punicalagin, punicalin</td>
</tr>
<tr>
<td>Withania somnifera</td>
<td>Solanaceae</td>
<td>Cuscohygrine and withasomnline</td>
<td></td>
</tr>
<tr>
<td>Trigonella foenum graecum</td>
<td>Fabaceae</td>
<td>Leaves and seeds</td>
<td>4-hydroxy isoleucine</td>
</tr>
</tbody>
</table>
• Inhibition of \( \beta \)-galactocidase and \( \alpha \)-glucocidase, Cortisol lowering activities and Inhibition of alpha-amylase.\textsuperscript{[10]}

CONCLUSION
Herbal plants are playing a significant role in the treatment of various diseases. Plants have been traditionally used for their various purposes. They exhibit more reliable criterias for their usage as the natural source of medicaments which are free from side effects and pertain longer shelf life. Due to these features, plant drugs are being used on larger scale nowadays for the treatment of Diabetes. They are available in the form of poly herbal formulations which are very effective in the control of Diabetes.

REFERENCES


