



Herbal Aqueous Extract Used For Treatment Of Diabetes Mellitus (Type-2).

Nitin Prajapati^{1*}, Nadim Chhipa², Pragnesh Patani³

^{1*}Department of Pharmacy, Khyati College of Pharmacy, Palodia, Ahmedabad.

²Associate Professor, Department of Pharmaceutical Chemistry, Khyati College of Pharmacy, Palodia, Ahmedabad

³Principal and Professor, Department of Pharmacology, Khyati College of Pharmacy, Palodia, Ahmedabad

***Corresponding Author:** Nitin Prajapati

**Department of Pharmacy, Khyati College of Pharmacy, Palodia, Ahmedabad.*

<p>Article History</p> <p>Received: 1 Dec 2023 Revised: 25 Dec 2023 Accepted: 4 Jan 2024</p> <p>CC License CC-BY-NC-SA 4.0</p>	<p>Abstract:</p> <p>Diabetes is a lifelong (chronic) disease and is a group of metabolic disorders characterized by a high level of sugar in the blood [Hyperglycemia]. It is caused due to deficiency of insulin (diabetes insipidus) or resistance to insulin (diabetes mellitus). Insulin is secreted by β-cells of the pancreas to control blood sugar level. Both diabetes insipidus and diabetes mellitus can be treated with a variety of herbal plants, such as <i>Tinospora cordifolia</i>, <i>Withania somnifera</i>, <i>Momordica charantia</i>, <i>Cinnamomum zeylanicum</i>, <i>Allium sativum</i>, <i>Panax ginseng</i>, <i>Gymnema sylvestre</i>, <i>Trigonella foenum graecum</i>, and <i>Azadirachta indica</i>. Each of these medicinal plants has an anti-diabetic action, and their aqueous extracts are used to treat diabetes.</p> <p>Keywords: <i>Diabetes mellitus type-2, herbal aqueous extract, Hyperglycemia, Insulin, Tinospora cordifolia, Momordica charantia, Azadirachta indica.</i></p>
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Introduction

Diabetes mellitus (also known as type 2 diabetes) is a chronic disease that affects the way your body metabolizes carbohydrates, fats and proteins. A defective or inadequate insulin secretory response results in poor use of carbohydrates (glucose) and hyperglycemia.^[1] Insulin is the hormone responsible for regulating blood glucose levels. When diabetes is not controlled, it can lead to hyperglycemia or high blood glucose levels. Over time, high blood glucose levels can cause severe damage to many parts of the body, including nerve cells and blood vessels.^[2]

The American Diabetes Association further explained the two types of diabetes mellitus. i.e.

1. Diabetes Mellitus 1
2. Diabetes Mellitus 2

1. Diabetes Mellitus 1 : Diabetes mellitus is a condition in which the beta cells in the body don't produce insulin. Because of the lack of insulin in the body, the levels of glucose in the body rise, which is main cause diabetes mellitus.

2. Diabetes Mellitus 2 : Diabetes mellitus is a condition in which the body does not use insulin properly. When insulin is not used properly, the levels of glucose in the body decrease, which is main cause diabetes mellitus.^[3]

Risk factors

Type 2 diabetes risk factors include the following:

1. Weight: Obesity or being overweight is a major risk.
2. Fat distribution: A higher risk is indicated if most of the body fat is stored in the abdomen rather than the hips and thighs. Men with a waist measurement above 40 inches and women with a waist measurement over 35 inches are more likely to develop type 2 diabetes.
3. Inactivity: The risk increases when one becomes less active. Exercise reduces body weight, burns glucose as fuel, and increases insulin sensitivity in cells.
4. Family History: If a parent or sibling has the disease, the risk of developing type 2 diabetes rises.
5. Race and ethnicity: People of specific races and ethnicities, such as Black, Hispanic, Native Americans, Asians, and Pacific Islanders, are more prone than white people to develop type 2 diabetes, while it is unknown why this is the case.
6. Blood lipid Levels: Low levels of the "good" cholesterol, high-density lipoprotein (HDL), and high levels of triglycerides are linked to an increased risk.
7. Age: Type 2 diabetes risk rises with age, especially beyond the age of 35.
8. Prediabetes: When blood sugar levels are above normal but not high enough to be considered diabetic, the condition is called prediabetes. Prediabetes frequently develops into type 2 diabetes if left untreated.
9. Pregnancy-related risks: People who have gestational diabetes have an increased risk of developing type 2 diabetes. when they were expecting, as well as in women who gave birth to children who weighed more than 4 kilograms.
10. Polycystic ovary syndrome: The risk of developing diabetes rises in people who have polycystic ovarian syndrome, a disorder characterized by irregular menstrual cycles, excessive hair growth, and obesity.^[4]

Pathophysiology

T2DM is an insulin-resistant disease with concomitant beta-cell dysfunction. Initial compensatory increases in insulin secretion keep glucose levels within the usual range. As the illness worsens, beta cells alter, and insulin secretion is unable to maintain glucose homeostasis, leading to hyperglycaemia. Most T2DM patients are obese or have a greater body fat percentage, which is primarily distributed in the abdomen area. Through a variety of inflammatory processes, such as increased FFA release and dysregulated adipokines, this adipose tissue itself encourages insulin resistance. Lack of exercise, past GDM in people with hypertension, or dyslipidaemia all raise the risk of developing T2DM. Changing evidence points to a role for adipokine dysregulation, inflammation, aberrant incretin biology with reduced incretins such as glucagon-like peptide-1 (GLP-I), or incretin resistance.^[5]

These are various herbal plant which are used in treatment of diabetes mellitus type-2:

➔ *Tinospora cordifolia* (Giloy):



Fig.1 *Tinospora cordifolia* leaves and bark

Tinospora cordifolia is known as Giloy, Guruch, and Guduchi. It's a member of the *Menispermaceae* family. The plant is a climbing shrub with heart-shaped, greenish-yellow leaves that is found higher up. Due to its many health advantages, Giloy is also known as Amrita, which translates to "Root of Immortality."^[6] Anti-diabetic as well as antioxidant action is caused by these active components, either singly or in combination.

Protein, Ca, and P content are also moderately high in giloy leaves.^[7] Diabetes mellitus is cured by a variety of phytoconstituents which are isolated from various sections of *T. cordifolia*. Alkaloids, tannins, and cardiac glycosides are some of these phytochemicals.^[8,9] It has the miraculous ability to reduce people's blood sugar levels.^[10] The stem extracts are efficient at lowering blood sugar levels. According to reports, it functions as an anti-diabetic medication by inhibiting gluconeogenesis and glycogenolysis and explaining oxidative stress, which promotes insulin production.^[11] It also makes the liver's glycogen synthase more active and makes hepatocytes store more glucose. Giloy's root extract has natural hypoglycemic and pancreatoprotective effects.^[12]

➔ ***Momordica charantia* (bitter melon):**



Fig.2 *Momordica charantia* fruit

Momordica charantia is a flowering vine in the *Cucurbitaceae* family, also known as bitter melon or bitter gourd. It is a tropical plant that is widely grown in Asia, India, East Africa, and South America for its incredibly bitter fruits, which are frequently used in cooking and as a natural diabetic treatment.^[13] *Momordica charantia* has hypoglycemic properties because it includes a variety of biologically active plant compounds, including triterpenes, proteins, steroids, alkaloids, saponins, flavonoids, and acids.^[14] For diabetic and prediabetic people, bitter gourd may be used as a food or dietary supplement.^[15] Aqueous extracts of bitter melon appear to have a considerable hypoglycemic impact, and the glucose tolerance of 73% of the patients studied was shown to be greatly improved by *M. charantia* fruit juice.^[16,17]

➔ ***Trigonella foenum graecum* (Fenugreek):**



Fig.3 *Trigonella foenum graecum* seeds and leaves

Trigonella foenum graecum, also known as fenugreek, is a member of the *Fabaceae* family and was given the name "little triangle" in Latin for its yellowish-white triangular flowers.^[18] Alkaloids, saponins, and flavonoids are present in very high concentrations in fenugreek. The two main components of fenugreek seed are alkaloids and volatiles.^[19] Fenugreek is an herb that is frequently used to treat T2DM. Fenugreek's hypoglycemic effect is linked to its ability to prevent glucose uptake.^[20] Long used in both Ayurvedic and

Chinese medicine to manage diabetes, fenugreek seeds and leaves are now becoming more popular in both systems.^[20] Fenugreek seeds are a great source of fiber and offer several advantages for diabetic patients.^[21] For diabetic people, fenugreek powder helps reduce blood sugar levels. It might be caused by fenugreek's method of action and increased serum insulin levels.^[22]

➔ ***Azadirachta indica* (Neem):**



Fig.4 *Azadirachta indica* leaves

Neem, also known as *Azadirachta indica*, is a plant that belongs to the *Meliaceae* family and is well known for its therapeutic benefits. There are numerous uses for the tree's various parts, including the seeds, leaves, flowers, and bark.^[23] Numerous bioactive substances, including quercetin, nimbidiol, azadirachtin, nimbin, and nimbidin, have been identified in neem leaves. The hypoglycemic efficacy of neem extracts produced using various solvents has been shown in several in vitro and in vivo studies.^[24] Before the discovery of insulin, neem leaf extract was helpful to manage hyperglycemia by lowering blood glucose levels. The main anti-diabetic ingredients in neem leaves are limuloids.^[25] To treat type 2 diabetes mellitus, *Azadirachta indica* leaf extract stabilizes blood glucose, serum insulin, lipid profile, and enhanced insulin signaling molecules, as well as GLUT4 proteins.^[26]

➔ ***Gymnema sylvestre* (Gurmar):**



Fig.5 *Gymnema sylvestre* leaves

Gymnema sylvestre is a member of the *Asclepiadaceae* family, also referred to as Gurmar or Madhunashini. It is one of India's most significant medicinal plants. It has been used successfully to treat diabetes for more than 2000 years in the Indian Ayurvedic medical system.^[27] *Gymnema sylvestre* has a variety of secondary metabolites. Oleanane and dammarane saponins, which have anti-diabetic activities, are examples of such metabolites.^[28] Gymnemic acids can also slow down the absorption of glucose into the blood and stop the intestines from absorbing sugar molecules, both of which lower blood sugar levels.^[29] Gymnemic acids have hypoglycemic effects that include: (i) increasing insulin secretion; (ii) promoting islet cell regeneration; (iii)

enhancing glucose utilization; and (iv) inhibiting the intestine's ability to absorb glucose. ^[30] It is a perennial plant that inhibits the absorption of sugar by attaching to the receptor found in the tongue's taste buds. ^[31]

→ ***Withania somnifera* (Ashwagandha):**



Fig.6 *Withania somnifera* leaves

Withania somnifera (WS), commonly referred to as ashwagandha, Indian ginseng, or winter cherry, has been a crucial herb in the Ayurvedic and indigenous medical systems for more than three thousand years. ^[32] Alkaloids (such as ashwagandha, cuscohygrine, anahygrine, tropine, etc.) and steroidal compounds, such as ergostane type steroidallactones, withaferin A, withanolides, etc., are the chemical components that are biologically active. ^[33] Ayurvedic doctors frequently use ashwagandha (*Withania somnifera*) as a Rasayana medication to treat diabetes mellitus and reduce stress. ^[34] Patients with diabetes who regularly use *W. somnifera* root powder experience diuretic effects while saving potassium. ^[35] The therapeutic potential of *W. somnifera* as a supplementary treatment for diabetes mellitus linked to endothelial dysfunction could be further investigated. ^[36] *Withania somnifera* root extract, which contains withaferin-A and withaferin-A-like phytochemicals, may lower insulin resistance and provide pancreatic protection in type 2 diabetes patients. ^[37]

→ ***Cinnamomum zeylanicum* (cinnamon):**



Fig.7 *Cinnamomum zeylanicum* leaves

The *Lauraceae* family includes cinnamon (*Cinnamomum zeylanicum* and *Cinnamomum cassia*), the perennial tree of tropical medicine. One of the most essential spices that people use every day is cinnamon. The primary components of cinnamon include essential oils and various derivatives such as cinnamaldehyde, cinnamic acid, and cinnamate. ^[38] One of the first herbs used in naturopathic treatment is cinnamon, which was mentioned in Chinese texts 4,000 years ago. ^[39] And diabetes is historically treated using Ayurvedic and Chinese medicine. ^[40] Cinnamon has gained popularity as a natural product due to theories that it provides health advantages, including the capacity to reduce blood sugar. ^[41] Cinnamon can be used successfully to

lower blood glucose and cholesterol levels in people with type 2 diabetes mellitus (T2DM) because cinnamon may have potentially beneficial pharmacological effects for the treatment of diabetes mellitus. ^[42]

➔ ***Panax Ginseng* (Ginseng):**



Fig.8 *Panax Ginseng* leaves

Not only in ancient China but also now, ginseng is one of the most expensive and widely used Chinese remedies. ^[43] Ginseng contains phenols, alkaloids, polysaccharides, saponins, and more. Ginseng saponins, sometimes referred to as ginsenosides, are a significant class of naturally occurring triterpene saponins and are assumed to be the cause of ginseng's anti-diabetic effects. ^[44] Since the 1980s, ginseng extract and its active components have been known to have hypoglycemic properties. Panaxans and quinquefolans were two glycanes that were identified in Asian ginseng in the 1980s and were recognized as hypoglycemic components. ^[45] Increased insulin release from pancreatic beta cells was induced by ginseng administration, which is likely due to increased beta cell stimulation and insulin production. ^[46] the impact of ginseng or ginsenoside Re in raising insulin sensitivity and glucose homeostasis in type-2 diabetics. ^[47]

➔ ***Allium sativum* (Garlic):**



Fig.9 *Allium sativum* leaves

Since ancient times, people have utilized the herb garlic (*Allium sativum*), which belongs to the Liliaceae family, for both medicinal and dietary uses. ^[48] Aqueous garlic extract contains three significant sulfur-containing compounds: allyl methyl thiosulfonate, 1-propenyl allyl thiosulfonate, and L-glutamyl-S-alkyl-L-cysteine. ^[49] Garlic's combined effects on type 2 diabetes patients' fasting blood glucose (FBS) levels ^[50] Compared to metformin and placebo, garlic was found to significantly lower fasting blood glucose and HbA1C, suggesting that it would be a useful addition to the family of antidiabetic drugs. ^[51] In Europe, India, and the Middle East, garlic has been recorded as being used as a folk remedy for diabetes. ^[52] In T2DM, garlic helps with blood glucose management in just one to two weeks as well as after 24 weeks. ^[53]

Discussion:

Diabetes is a chronic metabolic disorder that requires special attention for treatment and cure. Though there are many synthetic agents available for it, they still have their own side effects, so the discovery of safer options is important, and this article summarizes the herbs that can be used in the treatment as aqueous extract. These herbs have been used for years for the treatment of diabetes, but due to their slow effect, they are still not so much in use or used as a last option in many cases. So, it is important to study the phytoconstituents of these drugs, which can be potent anti-diabetic agents, and explore the new area of research in the field of hypoglycemic agents.

Conclusion:

This article focused on the herbal aqueous extract for the treatment of type-2 diabetes, which can be a safer and more effective option for this chronic disorder. So further deep investigation is required in this field to obtain the most potent natural anti-diabetic agent out of these plants.

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