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Review

Antidiabetic Effects of Herbal Drugs: A Review of Traditional Remedies in the Management of Type 2 Diabetes

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|  | Abstract |
| Published on: 17 Nov 2024 | <p>Herbal drugs have gained significant attention for their potential role in managing Type 2 diabetes due to their natural bioactive compounds that can modulate key aspects of the disease, such as insulin resistance, hyperglycemia, and dyslipidemia. Plants like <i>Gymnema sylvestre</i>, <i>Nigella sativa</i>, <i>Cinnamomum zeylanicum</i>, <i>Fenugreek</i>, and <i>Bauhinia variegata</i> have shown promising antidiabetic effects through mechanisms such as improving insulin sensitivity, stimulating insulin secretion, enhancing glucose metabolism, and reducing oxidative stress. The active compounds in these herbs—such as flavonoids, saponins, alkaloids, and polyphenols—have been identified as key contributors to their antidiabetic properties. Clinical studies have provided evidence of their efficacy in lowering blood glucose levels, improving lipid profiles, and promoting overall metabolic control. However, while the therapeutic potential of herbal drugs is encouraging, their use should be approached with caution. Variations in the quality, standardization, and dosage of herbal preparations require further investigation. Additionally, more clinical trials are needed to fully assess the long-term safety, efficacy, and optimal use of these herbal treatments. In conclusion, herbal drugs offer a complementary approach in diabetes management, and when used in conjunction with conventional therapies and lifestyle changes, they may enhance glycemic control and contribute to better overall health outcomes for individuals with diabetes.</p> |
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|  | <p>Keywords: Herbal drugs, Type 2 diabetes, <i>Gymnema sylvestre</i>, <i>Nigella sativa</i>, <i>Cinnamomum zeylanicum</i>, Fenugreek, <i>Bauhinia variegata</i>, insulin sensitivity, blood glucose, metabolic control.</p> |
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INTRODUCTION

Diabetes mellitus, commonly referred to as diabetes, is a chronic metabolic disorder characterized by elevated blood glucose (sugar) levels. This condition results from the inability of the body to produce or effectively use insulin, a hormone produced by the pancreas that regulates blood sugar levels. When blood sugar levels are chronically high, they can lead to various health complications affecting the heart, kidneys, eyes, nerves, and other organs ^[1]. According to the World Health Organization (WHO), diabetes has reached epidemic proportions globally, with significant implications for public health. As of the latest estimates, over 422 million adults worldwide are living with diabetes, with prevalence rates increasing rapidly in recent decades ^[2]. In 1980, the global prevalence of diabetes was approximately 4.7%, but by 2014 it had risen to around 8.5%. In 2021, diabetes was directly responsible for approximately 1.5 million deaths, with many more lives affected by diabetes-related complications. Additionally, 2.2 million deaths are linked annually to high blood glucose, further underscoring the significant burden of this condition on global health ^[3].

Type 2 diabetes accounts for about 90% of all diabetes cases and has become increasingly common due to rising rates of obesity, poor diet, and sedentary lifestyles. This form of diabetes is especially prevalent in low and middle-income countries, where urbanization, economic transitions, and changes in lifestyle contribute to increased risk factors. Furthermore, the increase in diabetes prevalence is not confined to older adults; cases of Type 2 diabetes are rising among younger age groups, including children and adolescents.

Diabetes is a global health concern, with millions of people affected worldwide, and its prevalence continues to rise owing to lifestyle factors, genetic predispositions, and an aging population. There are three main types of diabetes: Type 1, Type 2, and gestational diabetes, each with distinct causes and management approaches.

Type 1 Diabetes

Type 1 diabetes is an autoimmune disease often diagnosed in children, teenagers, and young adults. This occurs when the body's immune system mistakenly attacks and destroys insulin-producing beta cells in the pancreas. As a result, individuals with type 1 diabetes cannot produce insulin and rely on daily insulin injections or insulin pumps to manage their blood glucose levels. The exact cause of type 1 diabetes remains unknown; however, genetic factors and environmental triggers, such as certain viruses, are believed to play a role.

Type 1 diabetes requires strict monitoring of blood sugar levels and careful planning of meals and physical activity to avoid dangerous spikes or drops in glucose levels. Currently, there is no cure, but advancements in insulin delivery and blood glucose monitoring technologies have significantly improved the quality of life of patients with this condition ^[4].

Type 2 Diabetes

Type 2 diabetes is the most common form of diabetes, accounting for approximately 90% of all diabetes cases. It typically occurs in adults, although it is increasingly observed in younger individuals due to rising rates of obesity and sedentary lifestyles. Unlike Type 1 diabetes, individuals with type 2 diabetes can produce insulin, but their bodies do not produce enough insulin or are resistant to it, resulting in elevated blood glucose levels.

Risk factors for Type 2 diabetes include obesity, sedentary lifestyle, poor diet, family history, age, and ethnicity. Certain groups, such as African Americans, Hispanic Americans, Native Americans, and Asian Americans, are at a higher risk of developing type 2 diabetes. Lifestyle modifications, including healthy eating, regular physical activity, and weight management are essential for managing type 2 diabetes. Medications such as metformin and insulin may also be prescribed to help control the blood sugar levels ^[5].

Gestational Diabetes

Gestational diabetes occurs during pregnancy and affects women who have not previously experienced diabetes. This condition is caused by hormonal changes during pregnancy, which lead to insulin resistance. Although gestational diabetes usually resolves after childbirth, it increases the risk of developing type 2 diabetes later in life. Additionally, children born to mothers with gestational diabetes are at a higher risk of obesity and type 2 diabetes.

Gestational diabetes is managed through careful monitoring of blood sugar levels, healthy diet, and regular physical activity. In some cases, insulin or other medications may be required. Monitoring and management are essential to reduce the risk of complications such as preeclampsia, premature birth, and high birth weight ^[6].

Other Types and Emerging Concerns

There are also other forms of diabetes, including monogenic diabetes and secondary diabetes, which are caused by specific genetic mutations or other medical conditions, such as cystic fibrosis or pancreatitis. These forms are rare and may require specialized treatment.

Diabetes is a complex condition that has significant implications for health systems worldwide. The effective management of diabetes focuses on monitoring blood sugar levels, maintaining a balanced diet, exercising regularly, and adhering to prescribed treatments. Early diagnosis and proactive lifestyle changes can prevent or delay complications associated with diabetes, improving the quality of life and outcomes of individuals with this chronic disease [7].

Mainly, Type 2 diabetes management typically involves a combination of lifestyle changes and medications to regulate blood sugar levels, prevent complications, and improve overall health. Medications for Type 2 diabetes work through various mechanisms, such as increasing insulin sensitivity, stimulating insulin production, or reducing glucose absorption. Some common medications used to treat Type 2 diabetes are Metformin, Sulfonylureas, Thiazolidinediones, GLP-1 Receptor Agonists, SGLT2 Inhibitors, Meglitinides and Insulin Therapy. These medications stimulate rapid insulin release from the pancreas in response to meals, with a shorter duration of action which, leads to increased glucose excretion in the urine. While medications for type 2 diabetes are essential in managing the condition, they come with limitations that require careful consideration like the risk of hypoglycaemia, weight gain, short duration of action, kidney malfunction, dehydration and low blood pressure [5].

Herbal medicines have been used for centuries in various traditional systems to manage diabetes, and recent research has identified a range of plants with potential antidiabetic properties. These herbal drugs are believed to help regulate blood glucose levels through various mechanisms, such as enhancing insulin secretion, improving insulin sensitivity, and reducing glucose absorption in the intestines. This article comprises herbal medicines that have type 2 diabetes activity.

Herbal drugs on antidiabetic activity

Fenugreek (*Trigonella foenum-graecum*)

Fenugreek (*Trigonella foenum-graecum*) has been widely studied for its antidiabetic effects, largely attributed to its high content of soluble fiber, saponins, alkaloids, and flavonoids. The active components of fenugreek have been shown to improve glucose metabolism, enhance insulin sensitivity, and reduce blood glucose levels, making it a valuable herb in the management of Type 2 diabetes.

The seeds of fenugreek contain significant amounts of soluble fiber, which helps in delaying carbohydrate absorption, reducing postprandial (after-meal) blood sugar spikes. Additionally, 4-hydroxyisoleucine, a unique amino acid present in fenugreek, has been shown to stimulate insulin secretion from pancreatic beta-cells, enhancing insulin sensitivity. This action helps in lowering fasting blood glucose levels and improving overall glycemic control.

Several clinical trials have demonstrated the beneficial effects of fenugreek on glycemic control. Some studies showed that fenugreek seed powder significantly reduced fasting blood glucose and improved HbA1c levels in individuals with Type 2 diabetes. Moreover, fenugreek has been found to have cholesterol-lowering effects, improving lipid profiles by reducing total cholesterol, triglycerides, and LDL (bad) cholesterol, which are often elevated in diabetic patients.

While fenugreek may be effective as an adjunct treatment to conventional diabetes medications, it should be used with caution and under the guidance of a healthcare provider due to the possibility of interactions with other medications or excessive lowering of blood sugar [9].



Fig 1: *Trigonella foenum* seed

Cinnamomum zeylanicum

Cinnamomum zeylanicum (Ceylon cinnamon), a widely used spice, has shown promising antidiabetic effects due to its bioactive compounds, particularly cinnamaldehyde and polyphenols. These compounds are

believed to improve insulin sensitivity and enhance glucose metabolism, making cinnamon a potential adjunct in the management of Type 2 diabetes.

Cinnamon has been shown to decrease blood glucose levels by increasing insulin sensitivity, which helps the body use insulin more effectively. Studies have demonstrated that cinnamon can reduce fasting blood glucose and postprandial blood glucose levels. It does so by mimicking insulin's effects, promoting glucose uptake into cells, and reducing insulin resistance. Additionally, cinnamon has been found to improve lipid profiles by lowering total cholesterol, LDL cholesterol, and triglycerides, while increasing HDL (good) cholesterol.

Several clinical studies have supported these findings. Some studies showed that daily consumption of cinnamon significantly reduced fasting blood glucose, triglycerides, and LDL cholesterol in Type 2 diabetes patients. Furthermore, cinnamon's antioxidant properties may contribute to reducing oxidative stress, which is elevated in diabetes and contributes to complications.

While cinnamon is a promising herbal remedy for diabetes, it should be used alongside conventional treatment and under medical supervision, particularly because high doses can have adverse effects due to coumarin content ^[10].



Fig 2: *Cinnamomum zeylanicum* bark

Nigella sativa

Nigella sativa (commonly known as black seed or black cumin) has been widely studied for its medicinal properties, including its potential antidiabetic effects. The active compound thymoquinone, found in *Nigella sativa*, is believed to play a significant role in reducing blood glucose levels and improving insulin sensitivity in individuals with Type 2 diabetes.

Research indicates that *Nigella sativa* may exert its antidiabetic effects by improving insulin resistance, increasing insulin secretion, and enhancing glucose uptake in peripheral tissues. Thymoquinone has been shown to reduce oxidative stress and inflammation, both of which are elevated in diabetic patients and contribute to insulin resistance. Additionally, *Nigella sativa* may lower blood glucose by inhibiting the activity of enzymes involved in carbohydrate digestion, thus reducing postprandial glucose spikes.

Several studies have supported the antidiabetic properties of *Nigella sativa*. A clinical trial demonstrated that supplementation with *Nigella sativa* oil significantly reduced fasting blood glucose levels, HbA1c, and lipid profiles in patients with Type 2 diabetes. Furthermore, *Nigella sativa* has been found to have a lipid-lowering effect, improving cholesterol and triglyceride levels in diabetic patients. While promising, *Nigella sativa* should be used as a complementary treatment and in consultation with healthcare providers to avoid potential interactions with conventional diabetes medications ^[11].



Fig 3: *Nigella sativa* seed

Bauhinia variegata

Bauhinia variegata, commonly known as orchid tree, is a medicinal plant used in traditional medicine for its antidiabetic properties. The leaves, bark, and flowers of *Bauhinia variegata* contain bioactive compounds such as flavonoids, tannins, and saponins, which are believed to contribute to its antidiabetic effects.

Research suggests that *Bauhinia variegata* can help manage Type 2 diabetes by enhancing insulin sensitivity and improving glucose metabolism. The plant has been shown to lower blood glucose levels by increasing the activity of insulin-secreting beta cells in the pancreas. Additionally, *Bauhinia variegata* is thought to reduce oxidative stress and inflammation, both of which play a significant role in the pathogenesis of diabetes.

Several studies have provided evidence of its antidiabetic effects.

While promising, *Bauhinia variegata* should be used cautiously, and its effectiveness should be further validated in clinical settings. It is advisable to consult with a healthcare provider before incorporating it into a diabetes management regimen ^[12].



Fig 4: *Bauhinia variegata* leaves

Gymnema sylvestre

Gymnema sylvestre, commonly known as "gurmar," is a well-known herb used in traditional medicine, particularly in the treatment of diabetes. The active compounds in *Gymnema sylvestre*, particularly gymnemic acids, are believed to have significant antidiabetic effects. These compounds help lower blood glucose levels by enhancing insulin function and increasing insulin secretion from the pancreas.

Gymnema sylvestre has been shown to exert its antidiabetic effects through multiple mechanisms. It promotes the regeneration of insulin-producing beta cells in the pancreas, improving insulin secretion and insulin sensitivity. Additionally, *Gymnema sylvestre* can reduce the absorption of sugar in the intestines by inhibiting the activity of digestive enzymes such as sucrase, which helps decrease postprandial (after-meal) blood glucose spikes. The herb also has an anti-inflammatory and antioxidant effect, which may help mitigate the oxidative stress and inflammation associated with diabetes.

Several clinical studies have validated the antidiabetic effects of *Gymnema sylvestre*. Researchers have proved that supplementation with *Gymnema sylvestre* leaf extract significantly reduced fasting blood glucose levels and improved HbA1c in patients with Type 2 diabetes. Additionally, a review concluded that *Gymnema sylvestre* is effective in reducing blood glucose and improving metabolic control in diabetic patients ^[13].



Fig 5: *Gymnema sylvestre* leaves

CONCLUSION

Herbal drugs have shown promising potential in the management of diabetes, particularly Type 2 diabetes, by addressing key aspects of the disease such as insulin resistance, hyperglycemia, and dyslipidemia.

Numerous studies on plants like *Gymnema sylvestre*, *Nigella sativa*, *Cinnamomum zeylanicum*, *Fenugreek*, and *Bauhinia variegata* have demonstrated their antidiabetic effects, including the reduction of blood glucose levels, improvement in insulin sensitivity, and enhancement of metabolic control. The active compounds in these herbs—such as flavonoids, saponins, alkaloids, and polyphenols—work through various mechanisms like improving insulin secretion, reducing oxidative stress, and inhibiting glucose absorption. However, while herbal drugs offer significant benefits, they should be used cautiously and as adjuncts to conventional diabetes treatments. The evidence supporting their effectiveness is still evolving, and more clinical trials are needed to establish optimal dosages, safety, and long-term effects. Additionally, the quality and standardization of herbal preparations can vary, which may affect their reliability and safety.

In conclusion, herbal drugs represent a valuable complementary approach in diabetes management, but they should be used under medical supervision and alongside lifestyle modifications and conventional therapies for better clinical outcomes.

REFERENCES

1. International Diabetes Federation. "IDF Diabetes Atlas, 10th Edition." IDF, 2021.
2. World Health Organization. "Diabetes." WHO, 2021. Available at: <https://www.who.int/news-room/fact-sheets/detail/diabetes>
3. World Health Organization. "Global Report on Diabetes." WHO, 2016. Available at: <https://apps.who.int/iris/handle/10665/204871>
4. Gould, L; Richeson, W; and Erickson, F., 1991, "Performance Evaluation of a Camless Engine Using Valve Actuation with Programmable Timing," SAE Paper No. 910450.
5. American Diabetes Association. "Classification and Diagnosis of Diabetes: Standards of Medical Care in Diabetes." *Diabetes Care*, 2023. Available at: <https://diabetesjournals.org/care>
6. National Institute of Diabetes and Digestive and Kidney Diseases. "Types of Diabetes." NIH, 2021.
7. Saeedi, P., Petersohn, I., Salpea, P., Malanda, B., Karuranga, S., Unwin, N., ... & Williams, R. (2019). Global and regional diabetes prevalence estimates for 2019 and projections for 2030 and 2045: results from the International Diabetes Federation Diabetes Atlas, 9th edition. *Diabetes Research and Clinical Practice*, 157, 107843
8. Sun, H., Saeedi, P., Karuranga, S., Pinkepank, M., Ogurtsova, K., Duncan, B. B., Magliano, D. I. IDF diabetes Atlas: Global, regional, and country-level diabetes prevalence estimates for 2021 and projections for 2045. *Diabetes Research and Clinical Practice*, 2021; 175, 108773
9. Davies MJ, D'Alessio DA, Fradkin J, et al. "Management of Hyperglycemia in Type 2 Diabetes, 2018: A Consensus Report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD)." *Diabetes Care*, 2018
10. Sreenivasan S, Gnanapragasam A, Shyamala M, et al. Antidiabetic potential of fenugreek (*Trigonella foenum-graecum*) in Type 2 diabetic patients. *Pharmacognosy Reviews*, 2011; 5(9): 173-177
11. Blevins SM, Leyva MJ, Brown J, et al. Effect of cinnamon on glucose and lipid levels in non-insulin-dependent type 2 diabetes. *Diabetes Care*, 2007; 30(9): 2236-2237
12. Bamosa AO, Kameshwar V, Al-Saif M, et al. Effect of *Nigella sativa* seed oil on glycemic control and lipoprotein levels in Type 2 diabetes patients. *Saudi Pharmaceutical Journal*, 2010; 18(3): 171-177
13. Chatterjee P, Mishra B, Sahoo S, et al. Antidiabetic and hypolipidemic effects of *Bauhinia variegata* leaf extract in streptozotocin-induced diabetic rats. *Asian Pacific Journal of Tropical Biomedicine*, 2012; 2(2): 91-95
14. Sharma, S., Singh, A., & Tiwari, S. *Gymnema sylvestre*: A potential herbal therapeutic agent for Type 2 diabetes." *Journal of Diabetes Research*, 2013, Article ID 742114