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ANTIDIABETIC PROPERTIES OF GREWIA ASIATICA L.

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ABSTRACT

Diabetes is a chronic metabolic disorder that affects the body's ability to regulate blood glucose levels. Medically referred to as *Diabetes Mellitus* (DM), it encompasses a group of metabolic diseases characterized by persistent hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Under normal physiological conditions, the pancreas secretes insulin, a hormone that facilitates the uptake and utilization of glucose and lipids derived from dietary sources. However, diabetes develops when the pancreas produces insufficient insulin or when body cells exhibit resistance to insulin's action, leading to impaired glucose metabolism and elevated blood sugar levels. *Grewia asiatica* L., commonly known as Phalsa, is a species native to tropical regions of Asia, including India, Nepal, Thailand, Pakistan, Bangladesh, Myanmar, Cambodia, China, Laos, and Vietnam, among others. It is extensively cultivated for its edible fruit and its wide range of nutraceutical and medicinal applications. The composition of the fruit pulp per 100 g includes water (80.8 g), protein (1.3 g), fat (0.9 g), carbohydrates (14.7 g), fiber (1.2 g), and minerals such as calcium, phosphorus, and iron (1.1 g). The fruit and seeds of *Grewia asiatica* contain 18 amino acids, with aspartic acid, glutamic acid, and leucine being the most abundant. The fruit is also rich in vitamins A and C. Additionally, the plant contains a variety of bioactive compounds, including anthocyanins, tannins, phenolics, and flavonoids. Pharmacologically, *G. asiatica* exhibits a broad spectrum of biological activities such as antibacterial, antiviral, antifungal, anticancer, antioxidant, antidiabetic, analgesic, anti-inflammatory, antipyretic, antiemetic, radioprotective, hepatoprotective, antihyperlipidemic, immunomodulatory, sedative, hypnotic, and nootropic properties. Due to these multifaceted therapeutic potentials, *Grewia asiatica* has recently gained significant scientific and commercial interest, with several pharmaceutical and nutraceutical companies utilizing its extracts to develop safe, cost-effective, and readily available health-promoting products.

KEYWORDS: Diabetes, Hyperglycemia, Hypoglycemia, Diabetes Mellitus, Grewia, Nutraceutical.

INTRODUCTION

Diabetes Mellitus (DM) is an endocrinological disorder comprising a group of heterogeneous metabolic conditions that arise due to abnormalities in insulin secretion, insulin action, or both. It is one of the oldest diseases known to humankind, with the earliest description found in an Egyptian manuscript dating back approximately 3000 years. Historically, during the 14th century, it was also referred to as the "Black Death." Patients with diabetes are primarily classified into two categories: Type 1 Diabetes Mellitus (T1DM), characterized by an almost complete deficiency in insulin secretion, and Type 2 Diabetes Mellitus (T2DM), which results from a combination of insulin resistance and impaired insulin secretion. The distinction between T1DM and T2DM was first clearly established in 1936, while T2DM was later recognized as a key component of metabolic syndrome in 1988.

The presence of DM significantly increases the risk of numerous complications, including cardiovascular disease, peripheral vascular disease, stroke, neuropathy, nephropathy, retinopathy, blindness, and limb amputations. Individuals with T2DM, in particular, are

more susceptible to both acute and chronic complications, often leading to premature mortality. The primary objective of therapeutic intervention in diabetes is to preserve life and alleviate symptoms, while secondary goals include the prevention of long-term complications, reduction of associated risk factors, and improvement of overall life expectancy.

Grewia asiatica L. (Phalsa) has been scientifically reported to possess antidiabetic properties, supported by several preclinical and biochemical studies. There are a few studies on Grewia which demonstrates its low Glycemic Index (GI) value of 5.34. Due to its hypoglycemic effect, it helps in reducing blood sugar levels and is highly nutritive in managing diabetes. The fruit also has polyphenols which helps in reducing the high blood sugar levels in diabetes patients.



Grewia asiatica fruits



Grewia asiatica leaves



Grewia asiatica flowers

Antidiabetic Properties of *Grewia asiatica L.*

Several parts of the plant — including the fruit, leaves, and bark — exhibit antidiabetic and antihyperglycemic effects in experimental models of diabetes (mostly alloxan- or streptozotocin-induced diabetic rats).

1. Mechanisms of Action

The antidiabetic potential of *Grewia asiatica* has been attributed to multiple mechanisms:

- **Enhancement of insulin secretion** from pancreatic β-cells.
- **Improvement of peripheral glucose utilization** and insulin sensitivity.
- **Inhibition of carbohydrate-digesting enzymes** such as α-amylase and α-glucosidase, thereby reducing postprandial hyperglycemia.
- **Antioxidant activity**, which protects pancreatic β-cells from oxidative stress–induced damage.
- **Modulation of lipid metabolism**, improving dyslipidemia often associated with diabetes.

2. Experimental Evidence

- **Leaf extract studies:** Ethanolic and aqueous leaf extracts have demonstrated significant reductions in fasting blood glucose, total cholesterol, and triglycerides, while increasing HDL levels in diabetic rats.
- **Fruit extract studies:** The fruit extract has been shown to restore antioxidant enzyme levels (SOD, CAT, GPx) and improve hepatic glycogen content.
- **Seed extract studies:** Certain reports also indicate α-glucosidase inhibitory activity, suggesting a role in postprandial glucose control.

3. Bioactive Constituents Responsible

The major bioactive compounds linked to the antidiabetic activity include:

- **Flavonoids** (quercetin, catechin)
- **Phenolic acids** (gallic acid, ferulic acid)
- **Anthocyanins**
- **Tannins and triterpenoids**

These phytochemicals contribute to free radical scavenging, pancreatic β-cell protection, and glucose metabolism regulation.

4. SUMMARY OF EFFECTS

Extract Type	Model	Observed Effects
Ethanolic leaf extract	Alloxan-induced rats	↓ Blood glucose, ↓ TC & TG, ↑ HDL, improved antioxidant enzymes
Fruit extract	STZ-induced rats	Restored hepatic glycogen, improved insulin secretion
Methanolic bark extract	In vitro enzyme inhibition	Inhibited α-glucosidase and α-amylase enzymes

CONCLUSION

Grewia asiatica L. exhibits significant antidiabetic potential supported by preclinical studies, primarily due to its flavonoid- and phenolic-rich composition and antioxidant capacity. However, while the animal and in vitro studies are promising, clinical trials in humans are still limited, so further research is needed to confirm its efficacy and safety for therapeutic use.

Preclinical studies consistently report that extracts of *Grewia asiatica* (fruit, bark, leaves, and seed/kernel) produce antihyperglycemic effects in rodent models of diabetes, improve antioxidant status, reduce pro-inflammatory markers, and correct dyslipidemia. Key experimental reports include Khatune et al. (2016) — showing glucose- and lipid-lowering effects and pancreatic protection with bark extract — and Khattab et al. (2015) and Akram et al. (2021), which demonstrate antihyperglycemic, antioxidant and anti-inflammatory effects of fruit extracts in STZ models. Mechanistic studies indicate insulinotropic effects, α-glucosidase/α-amylase inhibition, and oxidative stress reduction as likely contributors.

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