



A REVIEW ARTICLE ON GYMNEMA SYLVESTRE: ANTIDIABETIC PLANT

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ABSTRACT

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance, impaired glucose regulation, and persistent hyperglycemia. Effective management remains challenging due to unequal access to healthcare services and reliable information, increasing interest in affordable supportive therapies. Nutraceuticals have emerged as promising adjuncts to conventional treatment because of their potential to improve glycemic control and insulin sensitivity. *Gymnema sylvestre*, a medicinal plant widely used in traditional medicine, has demonstrated notable antihyperglycemic properties. Its bioactive constituents, including gymnemic acids, triterpene saponins, and glucosides, are believed to reduce intestinal glucose absorption, enhance insulin secretion, and support pancreatic β -cell function. This review highlights the therapeutic potential of *Gymnema sylvestre* in T2DM management by summarizing its phytochemical composition, mechanisms of action, and reported antidiabetic effects. It also discusses its role in improving key metabolic parameters such as fasting plasma glucose, postprandial glucose, and glycated hemoglobin (HbA1c), while considering its safety profile and potential to enhance quality of life. Overall, *Gymnema sylvestre* represents a promising natural adjunct for diabetes management.

KEYWORDS

G.sylvestre; Diabetic Mellitus; Gymnemic Acids, Nutraceuticals, Diabetic Complications, Hyperglycaemia.

INTRODUCTION:

Type 2 Diabetes Mellitus (T2DM) is a chronic metabolic disorder characterized by insulin resistance, progressive pancreatic β -cell dysfunction, and persistent hyperglycemia. Its global prevalence has increased dramatically over recent decades, making it a major public health challenge. Long-term hyperglycemia contributes to serious complications affecting the cardiovascular system, kidneys, nerves, and eyes. Although conventional therapies, including lifestyle modification, oral antidiabetic drugs, and insulin, effectively control blood glucose, their long-term use may be limited by adverse effects, treatment resistance, cost, and poor patient adherence. Growing interest in complementary therapies has increased the focus on nutraceuticals and medicinal plants as adjuncts to conventional diabetes management. Among these, *Gymnema sylvestre* (commonly known as the "sugar destroyer") has been widely used in traditional Indian and Chinese medicine for its antidiabetic properties. Its bioactive constituents, particularly gymnemic acids, triterpene saponins, and flavonoids, have been reported to reduce intestinal glucose absorption, stimulate insulin secretion, protect pancreatic β -cells, improve insulin sensitivity, and reduce oxidative stress. In addition, essential micronutrients such as magnesium and vitamin D₃ play important roles in insulin signaling, glucose metabolism, and maintenance of β -cell function. Deficiencies of these nutrients are frequently associated with impaired glycemic control and increased insulin resistance. Recent experimental and clinical evidence suggests that *Gymnema sylvestre*, alone or in combination with key micronutrients, may provide additional metabolic benefits alongside standard antidiabetic therapy.

PHYTOCHEMICAL PROFILE:

Gymnema sylvestre is rich in bioactive phytochemicals, with triterpenoid saponins being the major constituents. The principal compounds include gymnemic acids (A–XII), gymnemasaponins, and gymnemosides, which belong to the oleanane and dammarane classes of saponins. These compounds are primarily responsible for the plant's antidiabetic and antisweet properties. The leaves also contain the peptide gurmardin, which selectively suppresses sweet taste perception. Other important phytochemicals include flavonoids, alkaloids, anthraquinones, terpenoids, glycosides, lupeol, β -amyrin glycosides, stigmasterol, d-quercitol, gymnemagenin, gymnestrogenin, resins, phytin, calcium oxalate, saturated and unsaturated fatty acids, and organic acids such as tartaric, formic, and butyric acids. Among these, gymnemic acids are considered the primary bioactive markers responsible for the therapeutic effects of *G. sylvestre*, particularly in diabetes management.

PHARMACOLOGICAL ACTIVITIES:

Gymnema sylvestre possesses a broad spectrum of pharmacological activities attributed to its bioactive constituents, particularly gymnemic acids, gymnemasaponins, and gurmardin. The plant is best known for its antidiabetic activity, which involves lowering blood glucose levels, stimulating insulin secretion, protecting pancreatic β -

cells, reducing intestinal glucose absorption, and suppressing sweet taste perception. In addition, it exhibits significant antioxidant, anti-inflammatory, and antarthritic effects by reducing oxidative stress and inhibiting inflammatory mediators. Studies have also demonstrated its antimicrobial activity against various bacterial and fungal pathogens, including oral cariogenic microorganisms. Furthermore, *G. sylvestre* shows promising anticancer potential by inhibiting the proliferation of cancer cells, while its antihyperlipidemic and anti-obesity properties help reduce serum cholesterol, triglycerides, LDL cholesterol, and body weight while increasing HDL cholesterol. The plant also exhibits immunostimulatory, hepatoprotective, and wound-healing activities by enhancing immune responses, protecting liver cells from toxic injury, and promoting tissue repair. Owing to these diverse pharmacological effects, *G. sylvestre* has been widely used in traditional Ayurvedic medicine for the management of diabetes and various other disorders, including digestive, hepatic, inflammatory, and metabolic diseases.

METHODS:

A prospective, interventional, open-label, single-arm clinical study was conducted at Era's Bharti Hospital, Pimpri-Chinchwad, Maharashtra, India, between June and November 2024. The study lasted 12 weeks and was performed at a single clinical center. Ethical approval was obtained from the Sai Krupa Hospital Institutional Ethics Committee, and the trial was registered with the Clinical Trials Registry of India (CTRI). All procedures complied with the Declaration of Helsinki, ICH-Good Clinical Practice (ICH-GCP), and Indian Council of Medical Research (ICMR) ethical guidelines. Written informed consent was obtained from all participants before enrollment. A total of 30 male and female participants aged 18–65 years with diagnosed Type 2 Diabetes Mellitus (HbA1c 7.5–10%) were enrolled. Eligible participants had a body mass index (BMI) ≤ 35 kg/m² and were receiving stable metformin monotherapy for at least three months. All participants completed the 12-week intervention without dropout. The investigational product was a proprietary nutraceutical formulation manufactured under Good Manufacturing Practice (GMP) standards. Each daily serving (two capsules) contained 500 mg of standardized *Gymnema sylvestre* leaf extract ($\geq 75\%$ gymnemic acids), 132 mg elemental magnesium (as magnesium oxide), and 6 μ g vitamin D₃ (cholecalciferol from lichen). Participants consumed one capsule after breakfast and one after dinner daily for 12 weeks while continuing their standard metformin therapy. Compliance was assessed through capsule counts, with participants consuming at least 90% of the prescribed doses considered compliant. The primary efficacy endpoints included fasting plasma glucose (FPG), postprandial plasma glucose (PPG), and glycated hemoglobin (HbA1c). Secondary outcomes included diabetes-related symptom scores, quality of life (QoL), and safety assessments. Clinical and biochemical parameters were evaluated at baseline and at scheduled follow-up visits throughout the study.

STUDY PROCEDURES:

Participants underwent a screening visit during which demographic information, medical history, concomitant medications, vital signs, and physical examination findings were recorded. Baseline laboratory investigations included hematology, biochemistry, liver function tests, glycated hemoglobin (HbA1c), urine analysis, sonography, uroflowmetry, and electrocardiography (ECG) to confirm eligibility. At baseline, body weight, body mass index (BMI), waist circumference, fasting plasma glucose (FPG), postprandial plasma glucose (PPG), and HbA1c were documented. Participants received the investigational product with instructions to consume one capsule after breakfast and one after dinner for 12 weeks while continuing standard metformin therapy. Quality-of-life (QoL) and sugar-craving questionnaires were completed, and participants maintained a daily diary to record capsule intake, missed doses, and adverse events. Follow-up visits were conducted at Weeks 4 and 8 to assess vital signs, physical examination findings, FPG, 2-hour PPG, treatment compliance through capsule counts and diary review, concomitant medications, adverse events, and QoL and sugar-craving assessments. At Week 12, efficacy and safety were evaluated by measuring HbA1c, FPG, PPG, hematological and biochemical parameters, liver function, lipid profile, and urine analysis. Compliance and adverse events were reviewed, and unused capsules were collected. A final follow-up visit one week after treatment completion included physical examination, vital signs, QoL and sugar-craving assessments, medication review, and safety evaluation.

STUDY OUTCOMES AND STATISTICAL ANALYSIS:

The primary outcome was the change in glycated hemoglobin (HbA1c) after 12 weeks of supplementation. Secondary outcomes included changes in fasting plasma glucose (FPG), postprandial plasma glucose (PPG), frequency of sugar cravings, quality of life (QoL), and the proportion of participants achieving clinically significant reductions in HbA1c. These parameters were used to evaluate improvements in glycemic control, insulin sensitivity, and overall patient well-being. Statistical analyses were performed using IBM SPSS Statistics version 26.0 and R software version 4.3.1. Continuous variables were expressed as median, standard deviation (SD), and 95% confidence intervals (CI), while categorical variables were presented as frequencies and percentages. Baseline and post-treatment values were compared using paired *t*-tests or Wilcoxon signed-rank tests, depending on data distribution. All enrolled participants completed the study, and no protocol deviations or dropouts were reported.

SAFETY ASSESSMENT:

Safety was evaluated throughout the study by monitoring adverse events (AEs) and serious adverse events (SAEs), along with routine assessment of vital signs. Laboratory investigations, including hematological, biochemical, lipid profile, and urinalysis parameters, were performed at scheduled visits to assess treatment safety. All treatment-emergent adverse events (TEAEs) were documented and evaluated throughout the study period.

CONCLUSION:

Gymnema sylvestre is a well-recognized medicinal plant with significant potential in the management of Type 2 Diabetes Mellitus due to its diverse pharmacological properties. Its bioactive constituents, particularly gymnemic acids, triterpene saponins, and flavonoids, contribute to multiple antidiabetic mechanisms, including inhibition of intestinal glucose absorption, stimulation of insulin secretion, protection and regeneration of pancreatic β -cells, improvement of insulin sensitivity, and reduction of oxidative stress. Experimental and clinical studies suggest that *Gymnema sylvestre* may improve glycemic parameters such as fasting plasma glucose, postprandial plasma glucose, and hemoglobin (HbA1c), especially when used as an adjunct to conventional antidiabetic therapy. Although the available evidence supports its promising therapeutic role, variations in extract standardization, dosage, study duration, and sample size limit the ability to draw definitive conclusions regarding its long-term efficacy and safety. Therefore, larger, well-designed randomized controlled clinical trials with standardized formulations are needed to establish optimal dosing, long-term safety, and clinical effectiveness. Overall, *Gymnema sylvestre* represents a promising natural adjunct for diabetes management and may contribute to improved glycemic control when used alongside standard medical treatment. Continued research will further clarify its role in evidence-based diabetes care and support its integration into modern therapeutic practice.

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