
REVIEW

Gymnema sylvestre: A medicinal plant with versatile therapeutic applications

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ABSTRACT

Gymnema sylvestre, an Indigenous medicinal plant native to India and S.E Asia, has attracted a lot of interest in recent years for its potential therapeutic benefits. The plant is abundant in bioactive substances, particularly gymnemic acids, and triterpene saponins that have a variety of pharmacological actions. It has been utilized for centuries in traditional Ayurveda medicine for its health benefits particularly in managing blood-sugar levels and supporting weight management. It can reduce blood sugar levels by several mechanisms, including increased insulin secretion, improving insulin sensitivity, and inhibiting sugar absorption in the intestine. Additionally, *Gymnema sylvestre* has been reported to stimulate the regeneration of pancreatic beta-cells, which are responsible for insulin production, suggesting potential long-term benefits in managing diabetes. *Gymnema sylvestre* possesses

antioxidant and anti-inflammatory properties. This critical review examines the pharmacological properties and therapeutic applications of *Gymnema Sylvestre*, highlighting its efficacy in managing various diseases. With the medicinal prowess of *Gymnema sylvestre*, home remedies offer diverse health benefits. Gurmar Tea, brewed from crushed leaves, has potential to regulate blood sugar, Gurmar Leaf Paste aids wound healing when applied topically. The Gurmar Vinegar Tonic, infused with apple cider vinegar, supports digestion. *Gymnema* Infused Oil, derived from carrier oils, soothes the skin. Notably, *Gymnema* Herbal curd, incorporating *Gymnema* leaf extracts, exhibits promising activity against liver cancer during fermentation. Embracing *Gymnema* in home remedies exemplifies its holistic healing applications. To summarize this article aims to provide insights into the medicinal potential and clinical relevance of *Gymnema sylvestre* in modern healthcare

Key Words: *Gymnema sylvestre*; Holistic healing; Bioactive substances; Pharmacological actions. Insulin sensitivity

INTRODUCTION

G *ymnema sylvestre* is a perennial woody vine native, slow-growing, woody climber with yellow flowers in umbels, reaching a height of 8 m-10 m, commonly known as "Gurmar" or "the sugar destroyer". Its name is derived from the Sanskrit word "Gur" meaning sugar and "mar" meaning destroyer. The plant has long history of use in traditional healing practices, where its leaves were chewed or brewed into teas to control blood sugar levels. It has a long history of medicinal use in medicine such as Siddha, Unani, and Ayurveda due to its anti-diabetic properties [1,2]. The leaves of the plant are used in Type II Diabetes Mellitus which grows in the tropical forest of the Central, Western, and Southern parts of India and in the tropical areas of Africa, Australia, and China. This medicinal plant has anti-diabetic properties as well as anti-inflammatory and hepatoprotective activities. At a time when metabolic diseases, especially diabetes and obesity, have reached a global epidemic, the search for effective, safe, and effective health effects is increasing [3,4]. The microscopic examination of *Gymnema*

sylvestre reveals key characteristics. The plant, belonging to the Apocynaceae family, features elliptical leaves, small yellowish flowers, vascular bundles with collateral xylem and phloem, stomata, and glandular trichomes. These microscopic details aid in the plant's identification. The various parts of *Gymnema sylvestre* find application in traditional medicine. Notably, the leaves are a primary source of therapeutic compounds. Additionally, roots and stems also contribute to the plant's medicinal properties, with each part harbouring unique bioactive constituents that enhance its overall efficacy. *Gymnema sylvestre* has gained recognition for its notable medicinal properties. Traditionally employed in managing diabetes, it influences insulin secretion and aids in regulating blood sugar levels. Beyond glycemic control, the plant exhibits anti-inflammatory, antioxidant, and anti-obesity effects. Its leaves, rich in bioactive compounds, are incorporated into herbal formulations and supplements for their holistic health benefits [5-8]. The various other species and substitutes *Gymnema sylvestre* takes center stage, there are other *Gymnema* species with similar properties, including *Gymnema montanum* and *Gymnema inodorum*. *Gymnema*

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montanum another member of the *Gymnema* genus is commonly found in various parts of India and other regions with a tropical to subtropical climate. The plant is distributed across different states in India, including Karnataka, Maharashtra, Tamil Nadu, Kerala, and Andhra Pradesh, and shares similarities with *Gymnema sylvestre*. While less studied it is occasionally used in traditional medicine, particularly in regions where it is native. *Gymnema inodorum* is another species known for its bitter taste. *Gymnema inodorum* is often found in the wild, growing in diverse habitats such as forests, grasslands, and hilly terrains. In India, *Gymnema inodorum* may be spotted in states like Karnataka, Maharashtra, Tamil Nadu, and Kerala, among others. It may be employed in local traditional medicine practices. However, their usage may be less widespread, and research on their medicinal potential may not be as extensive. Bitter-tasting plants are sometimes utilized as substitutes, but caution is advised to ensure therapeutic equivalence. The procurement of *Gymnema sylvestre* is susceptible to adulteration, where genuine plant material may be mixed with other substances to increase volume or weight. To address this concern, stringent quality control measures, including proper authentication and analysis, are crucial. Ensuring the purity and authenticity of *Gymnema* containing products is paramount for maintaining its therapeutic efficacy. In this search, *Gymnema sylvestre* emerged as a successful candidate, providing many bioactive compounds with therapeutic benefits. It is a well-studied drug in humans and animals. In summary, *Gymnema sylvestre* stands as a valuable botanical with a rich history in traditional medicine.

History

Gymnema sylvestre, known as Gurmar in Sanskrit, carries an illustrious history deeply embedded in the roots of Ayurveda, stretching back centuries. Its very name, "sugar destroyer," alludes to its unique ability to suppress the sensation of sweetness, a characteristic integral to its historical applications. This plant, as referenced in revered ayurvedic texts such as the Charaka Samhita and Sushruta Samhita, has played a prominent role in traditional Indian medicine. Acknowledged by ancient ayurvedic scholars, *Gymnema sylvestre* gained acclaim for its diverse therapeutic applications, including its effectiveness in supporting diabetes management, alleviating sugar cravings, and enhancing digestive well-being. As time progressed, *Gymnema sylvestre* became a subject of modern scientific exploration. In the late 20th and early 21st centuries, researchers delved into the bioactive compounds within the plant, particularly focusing on gymnemic acids. These investigations aimed to unravel the mechanisms underlying *Gymnema sylvestre* anti-diabetic and taste-modifying effects, contributing to a more comprehensive understanding of its medicinal properties. In contemporary times, *Gymnema sylvestre* has earned widespread recognition as a valuable botanical in both traditional and modern medicinal practices. It serves as a common ingredient in dietary supplements and herbal formulations designed to support glucose metabolism and effectively manage diabetes. Beyond its anti-diabetic properties, *Gymnema sylvestre* finds application in promoting overall health and well-being, illustrating the enduring bridge between ancient wisdom and the evolving landscape of modern healthcare [9,10].

Botanical description

Gymnema sylvestre, belonging to the family *Asclepiadaceae*, is a woody climbing plant with slender, twining branches and elliptical leaves. The plant produces small, yellow flowers and elongated, paired fruits. It thrives in tropical and subtropical climates, preferring well-drained soils and partial shade. *Gymnema sylvestre* is characterized by its distinctive taste, with leaves containing bioactive compounds responsible for its medicinal properties. The plant is native to the tropical forests of India, Australia, and Africa. Thrives in diverse habitats, including forests, hilly areas, and rocky slopes. Leaves are opposite arrangements along the stem and oval or elliptical-shaped leaves around 5 cm in length, with prominent lateral veins, and smooth surfaces with a glossy appearance. Flowers are Small, yellowish-green flowers grouped in umbellate cymes. Flowering season typically occurs during the monsoon months. Fruits produce paired follicles containing seeds. Fruits are slender and elongated, approximately 3 cm-5 cm in length. The root system is well-developed, aiding the plant in climbing. The stem is often slender, with adventitious roots along its length. Special characteristics of *Gymnema sylvestre* are renowned for its unique property of temporarily suppressing the taste of sweetness. The bioactive compounds gymnemic acids is responsible for the plant's medicinal properties. Microscopic examination reveals characteristics such as collateral vascular bundles, stomata, and glandular trichomes. Below is table 1 showing the taxonomical characterization of the plant. Figure 1 shows *Gymnema sylvestre* plant.

TABLE 1
Taxonomy of *Gymnema sylvestra*

Kingdom	Plantae
Phylum	Vascular Plant
Class	Oleanane
Order	Gentianales
Family	Apocynaceae
Genus	<i>Gymneama</i>
Species	<i>Sylvestre</i>



Figure 1) *Gymnema sylvestre*

Collection and cultivation

The collection and cultivation are important for ensuring sustainable utilization of this valuable medicinal plant [11,12]. The collection methods are:

Selective harvesting: Selective harvesting involves the careful collection of mature leaves from wild *Gymnema sylvestre* plants while

leaving younger leaves and stems intact. This method helps ensure the sustainability of wild populations by allowing the plants to regenerate.

Ethical harvesting practices: Ethical harvesting practices emphasize respect for the natural environment and adherence to local regulations. Harvesters are trained to minimize ecological impact, avoid damage to surrounding vegetation, and only collect from areas with abundant *Gymnema sylvestre* populations.

Seasonal harvesting: *Gymnema sylvestre* leaves are often harvested during specific seasons when their medicinal potency is highest. Harvesting during the dry season, when the plant is in its active growth phase, can yield leaves with optimal concentrations of bioactive compounds.

Post-harvest processing: After collection, *Gymnema sylvestre* leaves may undergo post-harvest processing techniques such as drying and cleaning to preserve their quality and shelf life. Proper drying methods help prevent mold and microbial contamination while retaining the plant's therapeutic properties.

Cultivation methods

Site selection: *Gymnema sylvestre* thrives in tropical and subtropical climates with well-drained soils and ample sunlight. Site selection is crucial for successful cultivation, with areas characterized by loamy or sandy soils and moderate rainfall being ideal for cultivation.

Propagation: *Gymnema sylvestre* can be propagated through seeds or stem cuttings. Seeds are planted directly into prepared beds, while stem cuttings are planted in well-draining soil and kept moist until root development occurs. Propagation through stem cuttings is often preferred due to its higher success rate and faster growth.

Soil preparation: Before planting, the soil should be prepared by tilling and incorporating organic matter to improve fertility and soil structure. Soil pH should be maintained between 6.0 to 7.5 for optimal growth.

Planting and spacing: Seedlings or cuttings are planted at a spacing of approximately 1 m to 1.5 m between rows and 0.5 to 1 meter between plants within rows. Adequate spacing allows for proper air circulation and sunlight penetration, reducing the risk of disease and promoting healthy growth.

Water management: *Gymnema sylvestre* requires regular watering, especially during the establishment phase. However, excessive waterlogging should be avoided to prevent root rot and other water-related diseases. Drip irrigation or sprinkler systems can be used for efficient water management.

Nutrient management: Balanced fertilization is essential for promoting vigorous growth and maximizing yield. Soil nutrient deficiencies can be corrected through the application of organic or synthetic fertilizers tailored to the specific needs of *Gymnema sylvestre*.

Pest and disease control: Integrated Pest Management (IPM) strategies are recommended to control pests and diseases while minimizing reliance on chemical pesticides. Monitoring for signs of pests and diseases, practicing crop rotation, and employment of biological control agents are active. IPM approaches.

Harvesting: *Gymnema sylvestre* plants are typically ready for harvest

within 18 to 24 months after planting. Leaves are harvested manually using sharp tools, taking care to avoid damaging the stems or causing undue stress to the plants. Regular harvesting encourages bushy growth and prolongs the productive lifespan of the plantation.

Phytoconstituents

The phytoconstituents present in *Gymnema sylvestre* which contribute to pharmacological properties [13,14]. Phytoconstituents are given below in table 2 gymnemic acid is the main chemical constituent, figure 2 shows the structure of gymnemic acid.

TABLE 2
Phytoconstituent of *Gymnema sylvestre*

Phytoconstituent	Description
Gymnemic acids	Active compounds known for their anti-diabetic properties.
Gymnemagenin	A triterpene saponin is believed to contribute to the plant's medicinal properties.
Gymnemasaponins	Group of saponins with potential pharmacological effects.
Quercitol	A sugar alcohol often found in <i>Gymnema Sylvestre</i> .
Betaine	A sugar alcohol often found in <i>Gymnema Sylvestre</i> .
Flavonoids	Polyphenolic compounds with antioxidant properties.
Tannins	Polyphenolic compound known for their astringent properties.
Stigmasterol	Polysterol compound with potential health-promoting properties.
Lupeol	A triterpene compound with various biological activities.

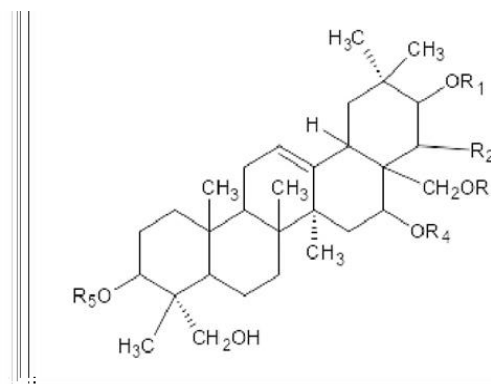


Figure2) Structure of Gymnemic Acid

Mechanism of action

Gymnema sylvestre contains bioactive compounds such as gymnemic acids, flavonoids, and triterpenoids, which contribute to its diverse pharmacological effects. gymnemic acids, particularly gymnemic acids I, II, III, and IV, are structurally similar to glucose molecules. They have a remarkable ability to bind to taste receptors on the tongue, specifically the sweet taste receptors, thereby blocking the sensation of sweetness. This unique property makes *Gymnema Sylvestre* a valuable natural remedy for managing sugar cravings and controlling blood sugar levels [15-17]. Below figure 3 shows the competitive inhibition of receptors in the intestine by Gymnemic acid [18].

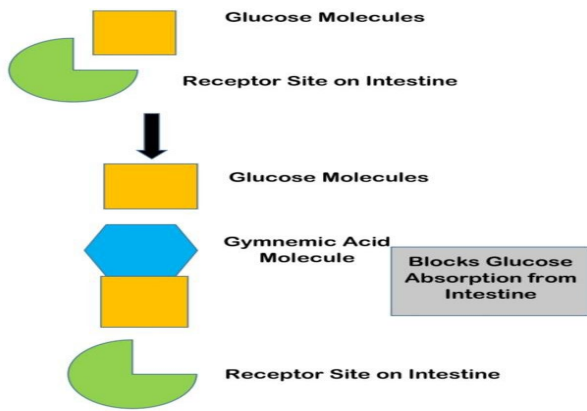


Figure 3) Competitive inhibition of receptors on the intestine by Gymnemic acid

Pharmacological properties

Scientific investigations have elucidated the pharmacological basis of *Gymnema sylvestre* therapeutic actions. The plant contains bioactive compounds such as gymnemic acids, flavonoids, and triterpenoids, which contribute to its pharmacological activities [19,20]. The plants possess various activities like hypolipidemic, antidiabetic, antioxidant, anti-inflammatory, antimicrobial, and hepatoprotective effects [21-23]. *Gymnema sylvestre* emerges as a multifaceted botanical with promising pharmacological properties. *Gymnema sylvestre* stands as a valuable natural resource with the potential to complement conventional therapies and improve healthcare outcomes. Below figure 4 shows the antidiabetic mechanism of the plant and table 3 shows the key pharmacological actions of *Gymnema sylvestre*. and its mode of action.

TABLE 3
Pharmacological activity of *Gymnema sylvestre*

Pharmacological Effects	Mode of Action
Antidiabetic effects	Stimulating insulin secretion, enhancing glucose uptake, and regenerating pancreatic beta cells.
Hypolipidemic effects	Regulating lipid metabolism and reducing body weight.
Antioxidant effects	Scavenging free radicals and protecting against oxidative stress.
Anti-inflammatory effects	Modulating inflammatory pathways and reducing inflammatory markers.
Antimicrobial effects	Inhibiting the growth of bacteria, fungi, and viruses.
Hepatoprotective effects:	Protecting the liver from damage and promoting liver function.

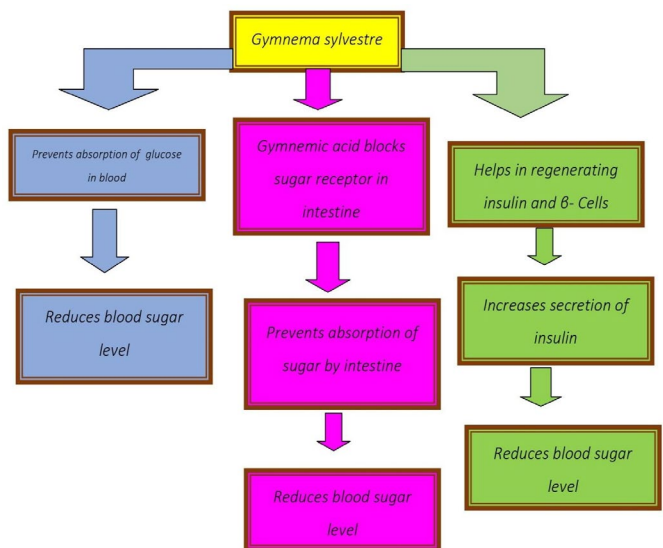


Figure 4) Mechanism of Anti-diabetic activity (Glucose lowering activity) by *Gymnema sylvestre*

Therapeutic applications

Herbal medicines are one type of dietary supplement that are given in the form of various dosages such as tablets, capsules, powders, dried plants etc. These herbal medicines are used to maintain and improve their health [24,25]. Therapeutic application of *Gymnema sylvestre* is given in table 4.

TABLE 4
Therapeutic Activity of *Gymnema sylvestre*

Disease and Disorder	Effect On Body	Management & Control
Diabetes Mellitus	Reduce blood glucose levels and improve insulin sensitivity	Stimulating insulin secretion, enhancing glucose uptake and regenerating pancreatic beta cells Regulate lipid metabolism, reduce body weight and improve metabolic parameters
Obesity and Metabolic Syndrome	Potential adjunctive therapy	Supporting cardiovascular health through regulation of blood pressure and lipid metabolism
Cardiovascular Diseases	Lowering blood pressure, reducing lipid oxidation & improving endothelial function	
Gastrointestinal Disorders	constipation, and gastric ulcers	Health Oral hygiene by preventing dental caries and periodontal diseases
Dental Health	Exhibits antimicrobial properties against oral pathogens	

Molecular marker

Directed Amplification of Mini-satellite region DNA (DAMD) and Inter Simple Sequence Repeat (ISSR) are the most frequently used molecular markers to analyse the genetic diversity and population's genetic structure in plant. These methods are used because quick, inexpensive, robust, highly polymorphic, and widely applicable to any genome [26].

Toxic effects

Gymnema sylvestre is generally considered safe when taken in appropriate doses. However, excessive consumption may lead to

hypoglycemia (low blood sugar) in some individuals. Pregnant and breastfeeding women should avoid using it due to a lack of sufficient safety data in these populations. As with any herbal supplement, it's essential to consult with a healthcare professional before use, especially for individuals with pre-existing medical conditions or those taking medication [27].

Marketed formulations

Gymnema sylvestre is available in various forms, including capsules, tablets, teas, and liquid extracts. It is often marketed as a dietary

TABLE 5
Marketed Formulations of *Gymnema sylvestre*

Type	Brand Name	Company Name	Dose	Price (INR)
Tablet	Sugar Destroy	Nutralife Inc.	500 mg	41.45
Capsule	Sugar-Guard Plus	Herbal Wellness Co.	750 mg	62.17
Extract	Gymnemax	Nature Cure Labs	1000 mg	82.9
Capsules	Gurmar Capsules	Himalaya Wellness	500 mg	150
Powder	Gurmar Powder	Baidyanath	1000 mg	250

Home remedies

The home remedies of *Gymnema sylvestre* which contributes in health benefits are given below.

Gurmar tea: Crush a few dried *Gymnema sylvestre* leaves. Steep the crushed leaves in hot water for 5 m-10 m. Strain and drink the tea. This tea is believed to help regulate blood sugar levels.

Gurmar leaf paste: Grind fresh *Gymnema sylvestre* leaves to make a fine paste. Apply this paste topically on minor wounds, cuts, or bruises. It may help in faster healing and reducing inflammation.

Gurmar vinegar tonic: Combine *Gymnema sylvestre* leaves with apple cider vinegar. Let the mixture sit for a few days in a cool, dark place. Strain the mixture and use the infused vinegar as a tonic by diluting it with water. Consuming a small amount of this tonic before meals may aid digestion.

Gurmar infused oil: Infuse dried *Gymnema sylvestre* leaves in carrier oil such as coconut oil or olive oil. Heat the mixture gently for a few hours on low heat. Strain the oil and store it in a clean container. Massage this oil onto the skin to alleviate minor skin irritations or dryness.

Gymnema herbal curd: During fermentation, *Gymnema sylvestre* leaf is extracted for the preparation of herbal curd. This curd showed the activity against Liver cancer.

Challenges and future perspectives

Despite the promising therapeutic prospective of *Gymnema Sylvestre* several challenges hinder its widespread adoption and utilization. These challenges include:

Standardization: Ensuring consistent quality and potency of *Gymnema sylvestre* extracts is essential for reliable therapeutic outcomes. However, standardizing herbal preparations can be challenging due to variations in growing conditions, plant genetics, and extraction methods.

Dosage optimization: Determining the appropriate dosage regimen

supplement for diabetes management and weight loss. These preparations often tout *Gymnema sylvestre* potential benefits for managing diabetes, reducing sugar cravings, promoting weight loss, and supporting overall metabolic health. They may also be marketed as a complementary therapy for individuals looking to maintain healthy blood sugar levels alongside other lifestyle changes such as diet and exercise. These supplements can be a valuable addition to a comprehensive approach to managing blood sugar levels and promoting overall health and well-being The various marketed formulations are given below in table 5.

for *Gymnema sylvestre* poses a challenge, particularly in the absence of well-established guidelines. Optimizing dosage requires careful consideration of factors such as patient characteristics, disease severity, and potential drug interactions.

Mechanistic understanding: Despite extensive research, the precise mechanisms underlying *Gymnema sylvestre* therapeutic effects remain incompletely understood. Further elucidating its pharmacological actions is crucial for maximizing efficacy and developing targeted therapies.

Clinical validation: While preclinical studies have demonstrated promising results, rigorous clinical trials are needed to validate the safety and efficacy of *Gymnema sylvestre* in human populations. Large-scale randomized controlled trials are essential for establishing evidence-based recommendations.

Regulatory considerations: Herbal products, including *Gymnema sylvestre* supplements, are subject to varying regulatory frameworks worldwide. Ensuring compliance with regulatory requirements, including quality control standards and safety assessments, is essential for consumer protection.

Sustainability: Overharvesting and destruction of habitat pose significant threats to wild populations of *Gymnema sylvestre*. Sustainable cultivation practices and conservation efforts are necessary to safeguard this valuable medicinal plant for future generations.

Cultural acceptance: Integrating *Gymnema sylvestre* into mainstream healthcare systems may require overcoming cultural barriers and scepticism regarding traditional medicine practices. Education and awareness campaigns can help promote acceptance and understanding among healthcare providers and consumers.

The future perspectives of *Gymnema sylvestre* as a medicinal plant are promising, offering a myriad of opportunities for research, development, and application in various healthcare settings. Future research should focus on exploring novel formulations, pharmacokinetic studies, and potential synergistic effects with

conventional therapies. Here are some key future perspectives:

Clinical validation and standardization: Continued research is essential to validate the efficacy and safety of *Gymnema sylvestre* in clinical settings. Rigorous clinical trials will provide robust evidence of its therapeutic benefits, guiding healthcare practitioners in its proper use. Additionally, standardization of herbal extracts and formulations is crucial to ensure consistency in quality and dosage, enhancing its reliability as a medicinal agent.

Exploration of novel formulations: Future research should explore innovative formulations of *Gymnema sylvestre*, such as nano formulations, microencapsulation, and targeted delivery systems. These advancements can improve bioavailability, enhance therapeutic efficacy, and optimize dosage regimens, ultimately maximizing its clinical utility.

Pharmacokinetic studies: Comprehensive pharmacokinetic studies are needed to elucidate the Absorption, Distribution, Metabolism, and Excretion (ADME) profiles of *Gymnema sylvestre* bioactive compounds. Understanding its pharmacokinetics will provide insights into optimal dosing strategies, drug interactions, and potential adverse effects, facilitating safe and effective clinical use.

Synergistic interactions with conventional therapies: Investigating the synergistic interactions between *Gymnema sylvestre* and conventional therapies, such as oral hypoglycaemic agents and lipid-lowering drugs, holds promise for improving treatment outcomes. Combination therapy approaches may offer enhanced efficacy, reduced side effects, and improved patient compliance, particularly in complex health conditions like diabetes and metabolic syndrome.

Personalized medicine approaches: Advancements in personalized medicine and pharmacogenomics present opportunities to tailor *Gymnema sylvestre*-based interventions to individual patient profiles. By considering genetic variations, metabolic phenotypes, and lifestyle factors, healthcare practitioners can optimize treatment strategies for better patient outcomes and long-term management of chronic diseases.

Exploration of novel therapeutic targets: Beyond its well-established antidiabetic and antioxidant effects, further research should explore novel therapeutic targets of *Gymnema sylvestre*. This includes investigating its potential neuroprotective, anti-cancer, and anti-inflammatory properties, opening new avenues for the treatment of diverse health conditions.

Sustainability and conservation: As the demand for *Gymnema sylvestre* increases, ensuring sustainable cultivation practices and conservation efforts is paramount. Adopting environmentally friendly cultivation methods, promoting biodiversity conservation, and supporting local communities will safeguard the long-term availability and accessibility of this valuable medicinal plant.

CONCLUSION

Gymnema sylvestre stands out as a promising medicinal plant with versatile therapeutic applications, particularly in the management of diabetes, obesity, and various other health conditions. With its rich phytochemical profile, including gymnemic acids, flavonoids, and triterpenoids, exhibits potent pharmacological properties such as antidiabetic, antioxidant, anti-inflammatory, and hepatoprotective

effects. Throughout history, *Gymnema sylvestre* has been revered in traditional medicine systems like Ayurveda for its ability to regulate blood sugar levels, stimulate insulin secretion, and support weight management. Scientific investigations have further validated its efficacy, paving the way for its integration into modern healthcare practices. Its role in managing diabetes, obesity, cardiovascular diseases, gastrointestinal disorders, and dental health underscores its importance in modern healthcare. However, challenges such as standardization of herbal extracts, optimization of dosage regimens, and rigorous clinical validation persist. Addressing these challenges requires concerted efforts from researchers, healthcare professionals, and regulatory bodies to ensure the safety, efficacy, and quality of *Gymnema sylvestre*-based interventions. Looking ahead, future research should focus on exploring novel formulations, conducting pharmacokinetic studies, and elucidating synergistic effects with conventional therapies. By doing so, we can unlock the full therapeutic potential of *Gymnema sylvestre* and harness its benefits for improving global health outcomes.

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