



A comprehensive review on pharmacological properties of (Gurmar)

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Abstract

Gymnema sylvestre R. Br., commonly known as Gurmar, is an important medicinal plant traditionally used in various systems of medicine, particularly for the management of diabetes. The plant is widely distributed in tropical and subtropical regions and contains several biologically active constituents, including gymnemic acids, triterpenoid saponins, flavonoids, phenolic compounds, alkaloids and other phytochemicals. Among these, gymnemic acids are considered major contributors to its antidiabetic activity and have been investigated for their possible effects on glucose absorption, insulin secretion, pancreatic β -cell function and glucose utilisation. The plant has also attracted scientific interest because of its antioxidant, hypolipidemic, anti-obesity, antimicrobial and anti-inflammatory properties. Experimental and clinical investigations have reported promising effects of *G. sylvestre* preparations on blood glucose and certain lipid parameters, although the findings may vary according to the plant material, extraction method and preparation used.

Keywords: *Gymnema sylvestre*, gurmar diabetes management, gymnemic acids, phytochemical compounds, pharmacological properties, toxicity

Introduction

Diabetes mellitus is a long-term metabolic disorder in which the body is unable to maintain normal blood glucose levels. This may occur when the pancreas does not produce enough insulin, when the body does not respond properly to insulin, or due to a combination of both. Type 2 diabetes mellitus is the most common form and is mainly associated with changes in insulin function and glucose metabolism. Persistently elevated blood glucose can interfere with normal body functions and increase the risk of different complications. Along with conventional medicines, increasing attention has been given to medicinal plants because they contain naturally occurring compounds that may support glucose regulation and other metabolic functions. Important constituents such as saponins, flavonoids, phenolic compounds and terpenoids have been investigated for their biological effects [1].

One medicinal plant with a long association with diabetes is *Gymnema sylvestre* R. Br., commonly called Gurmar. It is a perennial woody climber found mainly in tropical and subtropical regions, including different parts of India and other Asian countries. The leaves are the main medicinal part and have traditionally been used for diabetes-related conditions and excessive urination. Gurmar is also known as the “destroyer of sugar,” a name associated with the unusual effect produced when its leaves are chewed. For a short period after chewing, the perception of sweet taste becomes reduced. This characteristic is mainly associated with gymnemic acids and the peptide gumarin. The plant is also known by names such as Meshashringi, Madhunashini and Podapatri in different traditional systems and regions [2].

The leaves contain several types of phytochemicals, with triterpenoid saponins forming one of the most important groups. These include gymnemic acids, gymneasaponins, gymneasides and gymnesosides. Other reported

constituents include gymnemagenin, gymnestrogenin, flavonoids, phenolic compounds, tannins and sterols. Gymnemic acids have received particular attention because of their association with reduced sweet-taste perception and possible glucose-regulating effects. Gymnesosides have been investigated in relation to intestinal glucose absorption, while gumarin is mainly known for its effect on sweet-taste perception. The continued study of *G. sylvestre* is mainly related to its possible role in managing abnormal blood glucose levels. Experimental research has suggested several mechanisms, including reduction of intestinal glucose absorption, influence on insulin release, support of pancreatic β cell function and improvement of glucose uptake. Some studies have also investigated its effects on insulin sensitivity and metabolic pathways [3].

Apart from its antidiabetic potential, *G. sylvestre* has been investigated for antioxidant, hypolipidemic, anti-obesity, antimicrobial and anti-inflammatory properties. However, the strength of evidence differs among these activities, with several findings still based mainly on laboratory and animal studies. Although *G. sylvestre* has been studied for many years, differences in plant material, extraction procedures, concentrations and preparation methods make comparison between studies difficult. Information regarding long-term safety and possible herb–drug interactions is also limited. Standardization and well-designed clinical studies are therefore important for establishing its therapeutic value and limitations [4].

Taxonomical Classification

- **Botanical Name:** *Gymnema sylvestre*
- **Kingdom:** Planta
- **Division:** Magnoliophyta.
- **Class:** Magnoliopsida.
- **Order:** Gentianales.

- **Family:** Apocynaceae (formerly Asclepiadaceae).
- **Genus:** *Gymnema*.
- **Common Names:** Gurmar, Gudmar, Madhunashini, Australian cowplant,

Botanical Description And Distribution

Gymnema sylvestre R. Br, commonly known as Gurmar (Hindi), Meshashringi (Sanskrit), and periploca of the

woods (English), is a slow-growing, perennial woody climber belonging to the family Apocynaceae (formerly classified under Asclepiadaceae). The plant is indigenous to the tropical and subtropical regions of India, Sri Lanka, parts of Africa, and Australia. It typically grows in forested areas, especially in central and southern India, where it has been widely used in traditional medicine systems like Ayurveda and Siddha [5].



Fig 1: Gurmar plant

Ethnomedicinal And Traditional Uses of Gurmar

Gymnema sylvestre, traditionally known as "Gurmar" (meaning "sugar destroyer" in Hindi), has a well-documented history of use in Ayurveda, Siddha, Unani and various folk-medicine systems of India. Revered primarily for its anti-diabetic potential, *G. Sylvester* is also used for multiple treatment including digestive issues, respiratory diseases, urinary tract disorders, and even as a snakebite antidote in tribal, practice [6].

1. Ayurveda and classical texts

In Ayurvedic pharmacology, *G. sylvestre* is categorised under:

1. Rasayana (rejuvenative herbs)

2. Medohara (anti-obesity)
3. Kaphahara and Vatahara (reducing Kapha, Vata and doshas) [7].

Traditional uses listed in Charaka Samhita and Sushruta Samhita highlight its role in

1. Regulating sugar metabolism
2. Enhancing digestion (Deepana)
3. Treating cough (Kasa), asthma (Shwasa), and urinary issues (Mutrakrichhra) [8].

2. Folk and tribal medicine

Various indigenous communities across India (including Gond, Bhil, and Santhal tribes) use different parts of the plant: [8].

Table 1: Phytochemical Constituents of Gurmar

Part Used Ethnomedicinal Use	Part Used Ethnomedicinal Use
Leaves	Leaves Chewed to suppress sweet taste and control sugar cravings; paste applied on wounds and snakebites
Roots	Decoction given for stomach ache, constipation, and dyspepsia.
Stem/Whole plant	Used in decoctions for respiratory ailments like bronchitis, and in uterine complaints

Table: 2

Phytochemical group	Important constituents
Triterpenoid saponins	Gymnemic acids, gymnemasaponins, gymnemasides, gymnemosides, gymnemasins
Triterpenes / sapogenins	gymnestrogenin, gymnemanol, lupeol, β -amyrin
Flavonoids	Epicatechin, apigenin, luteolin, kaempferol
Alkaloid-related compounds	Gymnamine, conduritol
Sterols	Stigmasterol
Long-chain hydrocarbons	Hentriacontane, pentatriacontane, nonacosane
Organic acids	Tartaric acid, formic acid, butyric acid, cinnamic acid
Antioxidant compounds	Flavonoids, tannins, phenols, cinnamic acid, folic acid, ascorbic acid
Other constituents	Gurmarin, resins, chlorophyll, carbohydrates, phytin, calcium oxalate, lignin, cellulose

Gymnemasaponins

Gymnemasaponins are another important group of oleanane-type triterpenoid saponins present in *G. sylvestre*. They occur mainly in the leaves and are chemically related to gymnemic acids. Gymnemasaponins contain a triterpenoid aglycone linked with sugar components, and several individual members have been characterised [11]

Gymnemic Acids

Gymnemic acids are considered the major and most characteristic phytochemical constituents. They are mainly oleanane-type triterpenoid saponins and occur as a group of structurally related compounds. Several members, including gymnemic acids I–VII and later VIII–XII have been isolated from the leaves. Gymnemic acids are particularly important because they are associated with the characteristic antisweet or sweetness-suppressing activity of Gurmar and are also extensively investigated for their role in glucose metabolism [12].

Gymnemagenin

Gymnemagenin is an important pentahydroxy/hexahydroxy oleanane-type triterpenoid aglycone associated with the gymnemic acid group. De-acylgymnemic acid has been described as a 3-O- β -glucuronide of gymnemagenin [13].

Gymnemosides

Gymnemosides are a group of dammarane-type saponins isolated mainly from the leaves of *G. sylvestre*. The important members including gymnemosides A, B, C, D, E and F. These compounds differ structurally in their sugar moieties and aglycone substitutions [14].

Gymnemasins

Gymnemasins A, B, C and D are triterpenoid saponins isolated from *G. sylvestre* leaves. Their structures contain the triterpenoid nucleus gymnemanol together with different sugar and acyl groups [15].

Gymnemanol

Gymnemanol is a polyhydroxylated oleanane-type triterpenoid and acts as an aglycone component of some *Gymnema* saponins. It has been identified during investigations of the triterpenoid constituents of *G. sylvestre*. Gymnemanol is structurally characterized by several hydroxyl groups on the oleanane skeleton and forms part of the chemical framework of gymnemasins and related compounds [16].

Gymnestrogenin

Gymnestrogenin is a pentahydroxytriterpene isolated from the leaves of *G. sylvestre*. It represents another important triterpenoid constituent of Gurmar and was identified through classical phytochemical investigations [17].

Gurmarin

Gurmarin is a distinctive 35-amino-acid polypeptide/peptide isolated from *G. sylvestre* leaves, with a reported molecular weight of approximately 4209. Unlike gymnemic acids, which are saponins, gurmarin is a peptide constituent. It is particularly notable for its ability to suppress the responses to sweet taste and also called as a “sugar destroyer” [18].

Stigmasterol

Stigmasterol is a phytosterol reported among the chemical constituents. It has been identified particularly in investigations of the stem and other plant materials. Stigmasterol belongs to the sterol class of plant-derived compounds and is one of the non-saponin constituents contributing to the chemical diversity of the plant [19].

Lupeol

Lupeol is a pentacyclic triterpenoid. It belongs to the triterpenoid class but differs structurally from the gymnemic acid saponins because it is not itself a glycosylated saponin.

β -Amyrin-Related Glycosides

β -Amyrin-related compounds are triterpenoid constituents reported from *G. sylvestre*. They occur as part of the non-glycosidic and glycosidic triterpenoid fraction of the plant [20].

Quercitol

Quercitol, particularly D-quercitol, has been reported as one of the non-saponin phytochemical constituents. It is a cyclitol-type compound and differs chemically from the major triterpenoid saponins [21].

Flavonoids and Flavone Derivatives

Flavonoids and flavone-type compounds have also been reported. These compounds represent a different phytochemical class from the dominant triterpenoid saponins. Flavonoid constituents are of interest because this class of plant metabolites is commonly associated with antioxidant and other biological activities [22].

Kaempferol Glycoside

kaempferol glycoside has been isolated from the aerial parts of *G. sylvestre*. Kaempferol is a flavonol-type compound, and glycosylation increases the structural diversity of the flavonoid fraction. The isolation of kaempferol glycosides provides evidence that flavonoid constituents occur alongside the major triterpenoid saponins in Gurmar [23].

Anthraquinones and Anthraquinone Derivatives

Anthraquinones and their derivatives have been reported among the phytochemicals. These compounds belong to the quinone-related group of secondary metabolites and have been detected during phytochemical investigations of different plant extracts. Their presence demonstrates that the plant contains several secondary-metabolite classes in addition to triterpenoid saponins [24].

Hentriacontane

Hentriacontane is a long-chain hydrocarbon reported among the phytoconstituents of *G. sylvestre*. It is chemically different from the major triterpenoid and flavonoid constituents and represents part of the less-polar chemical fraction of the plant [25].

Pentatriacontane

Pentatriacontane is another long-chain hydrocarbon reported from *G. sylvestre*. Like hentriacontane, it represents non-polar constituent rather than a major pharmacologically characterized saponins [26].

Phytin

Phytin has been reported among the chemical constituents. It is associated with the seed plant mineral-storage fraction and is chemically distinct from the triterpenoid saponins

Tartaric Acid

Tartaric acid is one of the organic acids reported from *G. sylvestre*. It is chemically distinct from the major triterpenoid constituents and belongs to the group of smaller organic compounds present in the plants [27].

Formic Acid

Formic acid has been reported as one of the organic acid constituents of *G. sylvestre*. It represents a small organic component of the plant rather than a major triterpenoid or peptide constituent. Its presence has been documented in phytochemical reviews of Gurmar.

Butyric Acid

Butyric acid is another organic acid reported in the phytochemical profile. It is a low-molecular weight fatty acid and is chemically different from the large triterpenoid saponins characteristic of the plant [28].

Calcium Oxalate

Calcium oxalate has been reported among the inorganic/mineral-associated constituents. It is chemically different from the plant's bioactive secondary metabolites but is included in descriptions of the overall phytochemical composition of the leaves.

Resins

Resins are reported among the non-polar constituents of *G. sylvestre* leaves. They represent complex mixtures of lipophilic plant substances rather than a single chemically defined molecule. Resins occur together with triterpenoids, sterols and other non-polar compounds and contribute to the overall chemical composition of the plant [29].

Chlorophyll

Chlorophyll pigments are naturally present in the green leaves of *G. sylvestre*. Chlorophylls are photosynthetic pigments and therefore represent primary plant constituents rather than the principal antidiabetic saponins.

Carbohydrates

Carbohydrates are also reported among the constituents of *G. sylvestre*. They represent a broad group of primary metabolites and occur together with secondary metabolites such as triterpenoid saponins, flavonoids and anthraquinones.

Alkaloids

Alkaloids have been detected in extracts of *G. sylvestre*. They constitute a chemically diverse class of nitrogen-containing secondary metabolites. Although the triterpenoid saponins are more characteristic of Gurmar, the detection of alkaloids indicates that the plant contains additional classes of secondary metabolites [30].

Phenolic Compounds

Phenolic compounds have also been reported in phytochemical investigation. Phenolics constitute a broad group of plant secondary metabolites and are of interest

because many phenolic compounds can participate in antioxidant activity.

Tannins

Tannins have been reported during preliminary phytochemical investigations. They are polyphenolic plant constituents and are chemically distinct from the major triterpenoid saponins.

Fatty Acids

Phytochemical and GC-MS investigations of its extracts have reported the presence of saturated and unsaturated fatty acids. These compounds occur particularly in solvent extracts containing non-polar constituents [31].

Pharmacological Properties Of Gurmar

Gymnema sylvestre R. Br., commonly known as Gurmar, has attracted considerable scientific interest because of its wide range of pharmacological activities. Among these, its antidiabetic and glucose-regulating effects have been investigated most extensively. The leaves contain several biologically active constituents, particularly gymnemic acids, gymnemasaponins, gymnemosides and other triterpenoid compounds. Research on these constituents suggests that the pharmacological effects of the plant may involve several complementary mechanisms rather than the action of a single compound. The reported action include antidiabetic, antihyperglycemic, antioxidant, antihyperlipidemic, anti-inflammatory, antimicrobial, anti-obesity and antisweet effects. However, the strength of evidence is not the same for all of these activities, and many findings remain based on laboratory or animal studies [32].

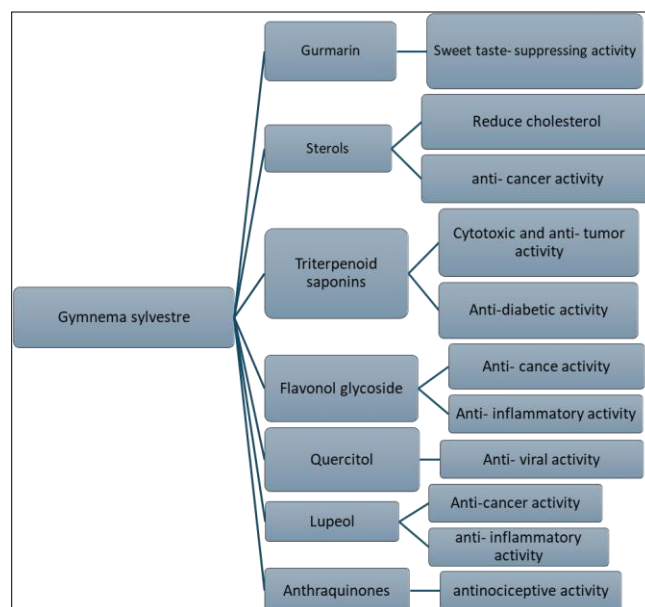


Fig 2: Pharmacological properties of Gurmar

Antidiabetic activity

The antidiabetic activity is one of the most extensively studied properties of *Gymnema sylvestre*. Gymnemic acids may help reduce intestinal glucose absorption and suppress sweet taste perception. Some studies also suggest that *Gymnema* extracts may influence insulin secretion and glucose utilization. However, the magnitude of these effects and their clinical significance require further investigation.

Mechanism of action

- **Suppression of sweet taste:** Gymnemic acids interact with sweet taste receptors on the tongue, temporarily reducing the perception of sweetness. This may help reduce the preference for sweet foods.
- **Reduction of intestinal glucose absorption:** Gymnemic acids may interfere with glucose absorption in the intestine, potentially reducing the amount of glucose entering the bloodstream after meals.
- **Stimulation of insulin secretion:** Experimental studies suggest that certain *Gymnema* extracts may support insulin secretion from pancreatic beta cells. However, the precise mechanism and clinical significance are not fully established.
- **Support of pancreatic beta-cell function:** Some experimental findings suggest that *Gymnema* preparations may help preserve or support pancreatic beta-cell function. Evidence for regeneration of beta cells in humans remains insufficient.
- **Improvement in glucose utilization:** *Gymnema* extracts have been investigated for their potential to improve peripheral glucose utilization, which may contribute to glucose regulation.
- **Inhibition of carbohydrate-digesting enzymes:** Some extracts have demonstrated inhibitory activity against enzymes such as alpha-amylase in experimental studies. This may slow carbohydrate digestion and reduce post-meal glucose elevation [33].

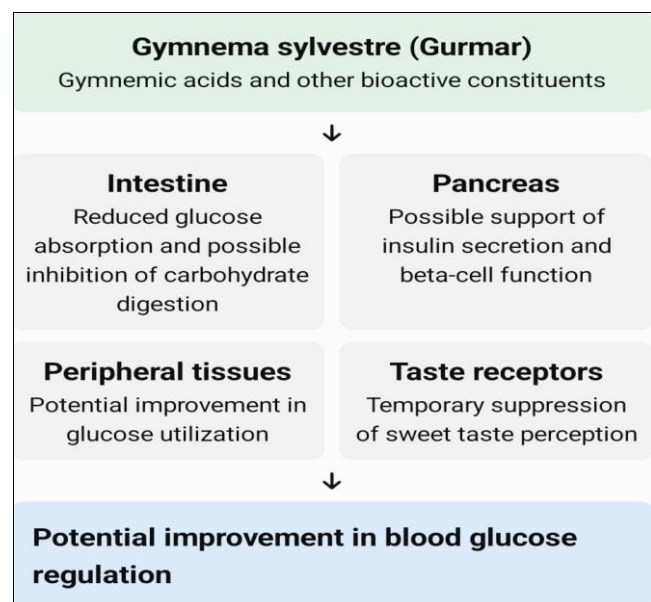


Fig 3: MOA of antidiabetic of gurmar

Antioxidant activity

Gymnema sylvestre contains flavonoids and other phenolic compounds that may contribute to antioxidant activity. These compounds can help neutralize free radicals and reduce oxidative stress under experimental conditions. This activity may be relevant because oxidative stress is associated with the development of several metabolic disorders.

Anti-inflammatory activity

Certain extracts and bioactive constituents of *Gymnema sylvestre* have demonstrated potential anti-inflammatory effects in experimental studies. These effects may involve the modulation of inflammatory processes. However, further research is required to establish their effectiveness and safety in humans [34].

Hypolipidemic activity

Some experimental and clinical studies suggest that *Gymnema sylvestre* may help improve lipid metabolism by influencing blood cholesterol and triglyceride levels. These effects may be associated with changes in lipid absorption and metabolism. Nevertheless, the evidence is not sufficient to consider it a replacement for established lipid-lowering treatments.

Antimicrobial activity

Extracts of *Gymnema sylvestre* have been investigated for activity against certain microorganisms. The observed effects may depend on the plant material, extraction solvent, concentration, and microorganism tested. More studies are needed to determine whether these findings have practical clinical applications [35].

Anti-obesity potential

Gymnema sylvestre has been studied for its potential role in weight management. Its ability to suppress sweet taste perception may influence the preference for sugary foods. Some studies also suggest possible effects on glucose and lipid metabolism. However, evidence supporting a direct weight-loss effect remains limited.

Hepatoprotective potential

The antioxidant properties of certain *Gymnema* extracts have led researchers to investigate their potential protective effects against liver injury. Some experimental findings suggest possible benefits, but the evidence is not sufficient to establish hepatoprotective efficacy in humans.

Effects on sweet taste perception

One distinctive property of *Gymnema sylvestre* is its ability to temporarily reduce the perception of sweetness. Gymnemic acids are thought to interact with sweet taste receptors on the tongue, reducing the sensation produced by sweet substances. This property has contributed to the traditional use of the plant and has attracted interest in dietary research [36].

Toxicological and safety profile of Gurmar

Gymnema sylvestre has been traditionally used as an herbal medicine, particularly for diabetes. Although several experimental studies suggest that *G. sylvestre* preparations are generally well tolerated at investigated doses, toxicological information is not as extensive as the pharmacological literature. Therefore, safety depends on the dose, extract type, duration of administration and individual patient factors.

General Safety

Experimental studies have generally reported a relatively favorable safety profile when used at investigated doses. Acute and subacute toxicity studies of extracts have not consistently demonstrated severe toxic effects at the tested

doses. However, the absence of toxicity in experimental studies does not establish complete safety in humans, particularly with prolonged or high-dose use [37].

Acute Toxicity

Acute toxicity studies are performed to determine the potential harmful effects following administration of a single or short-term high dose. Studies of *G. sylvestre* extracts have generally indicated low acute toxicity within the tested experimental dose ranges. No major signs of acute toxicity were consistently observed in several animal investigations [38].

Subacute and Repeated-Dose Toxicity

Repeated administration of its extracts has been evaluated in experimental animals to investigate possible effects on body weight, behavior, hematological parameters and biochemical markers. Available studies generally suggest that the plant extract is reasonably tolerated during the experimental periods studied, although results can vary according to extract preparation and dose [39].

Gastrointestinal Adverse Effects

Gastrointestinal symptoms may occur following administration of herbal preparations. Reported or theoretically possible effects include nausea, abdominal discomfort, vomiting or changes in bowel habits. Such effects may depend on the dose and formulation. Because clinical safety data are limited compared with conventional antidiabetic medicines, gastrointestinal tolerance should be considered when using concentrated preparations [40].

Hypoglycemia

One of the most important potential safety concerns is excessive lowering of blood glucose. Since it possesses anti-hyperglycemic activity, combining it with antidiabetic medicines such as insulin or other glucose-lowering drugs could potentially produce additive glucose-lowering effects. Therefore, blood glucose monitoring is particularly important [41].

Effects on Liver

Available experimental evidence does not establish significant hepatotoxicity as a consistent characteristic of *G. sylvestre*. Nevertheless, because concentrated herbal extracts may contain different amounts of active constituents, liver safety should be considered during prolonged use, particularly when the preparation is not standardized [42].

Effects on Kidney

Similarly, available experimental studies have not established Gurmar as a consistently nephrotoxic plant. However, data regarding long-term renal safety in humans are limited. Individuals with pre-existing renal problems should therefore use concentrated preparations only under appropriate medical supervision [43].

Reproductive and Pregnancy-Related Safety

There is insufficient evidence to establish the safety during pregnancy and breastfeeding. Because adequate reproductive and developmental toxicity studies in humans are lacking, medicinal use during pregnancy should be

avoided unless specifically recommended by a qualified healthcare professional [44].

Drug Interactions

The glucose-lowering effect may interact pharmacodynamically with conventional antidiabetic medicines. Concomitant use could potentially increase the risk of hypoglycemia. Therefore, patients taking the drugs should not independently add concentrated *Gymnema* supplements without discussing their use with a healthcare professional.

Importance of Dose

As with many medicinal plants, the safety is closely related to the dose and duration of exposure. A dose used in traditional preparations may not be equivalent to a highly concentrated standardized extract or purified phytochemical. Increasing the dose does not necessarily increase therapeutic benefit and may increase the possibility of adverse effects [45].

Health Benefits of Gurmar

Reduction of Sugar Cravings

Gymnema sylvestre is traditionally known as “Gurmar” or the “sugar destroyer” because chewing its leaves can temporarily reduce the ability to perceive sweet taste. This effect is mainly associated with bioactive constituents such as gymnemic acids and the polypeptide gurmarin. Gymnemic acids and other antisweet constituents present in *Gymnema sylvestre* can interfere with the perception of sweetness, thereby reducing the attractiveness of sweet foods. The review identifies gymnemic acid homologues as sweetness-inhibiting substances and gymnemic acid A1 and its derivatives as having antisweet activity. Gurmarin, a polypeptide obtained from *Gymnema sylvestre*, has been reported to block sweet-taste responses and may consequently reduce the desire for sweet foods [46].

Reduction of Blood Glucose Levels

Gymnema sylvestre possesses considerable antidiabetic potential because it contains several bioactive compounds, including gymnemic acids, gymnemasaponins, gymnemasides, triterpenoid saponins and other phytoconstituents. These compounds have been associated with hypoglycemic or antihyperglycemic activity. Gymnemic acid may reduce blood glucose by interfering with intestinal glucose absorption. It also describes gymnemic acid as interacting with intestinal receptor sites and preventing glucose from binding, thereby reducing excess glucose absorption. Gymnemasides have also been reported to inhibit increases in serum glucose, while gymnemasaponins containing gymnemagenin and gymnestrogenin have demonstrated hypoglycemic activity.

3. Support for Insulin Secretion and Pancreatic β -Cell Function

The hypoglycemic action of *Gymnema sylvestre* has been associated with possible enhancement of insulin secretion and regeneration of pancreatic islet cells. Gymnemic acid has been proposed to increase insulin secretion and promote regeneration of insulin-producing islet cells. It also described as having hypoglycemic activity and a potential role in β -cell regeneration. Gymnemagenin has additionally been reported to inhibit glucose absorption.

Improvement of Glucose Utilization

Gymnemic acids may contribute to blood-glucose regulation not only by reducing intestinal glucose absorption but also by increasing glucose utilization. The review reports that gymnemic acids may increase the activities of enzymes involved in insulin-dependent glucose-utilization pathways. The combined effects of reduced intestinal glucose absorption, increased glucose utilization and possible enhancement of insulin secretion provide a proposed explanation for the hypoglycemic activity of *Gymnema sylvestre* [47].

Possible Role in Weight Management

The reduction of sweet-taste perception is a potential mechanism through which *Gymnema sylvestre* may influence dietary intake, particularly the consumption of sweet foods. Gurmarin and gymnemic acids are associated with suppression of sweet taste, which may make sugary foods less attractive. Therefore, the plant may have potential applications in dietary control and weight management.

Potential pancreatic effects

Experimental studies have been investigated whether *Gymnema sylvestre* may help protect pancreatic cells and support insulin-producing beta-cell function. Although these findings are promising, the extent of pancreatic protection in human has been conclusively established.

Traditional digestive and general health uses

In traditional medicines, *Gymnema sylvestre* has been used for several health-related purposes, including digestive complaints and general wellness. However, many of these traditional uses lack sufficient clinical evidenced to confirm their safety and effectiveness [48].

Conclusion

Gymnema sylvestre is a valuable medicinal plant that has attracted considerable attention because of its traditional use and its potential role in managing diabetes and other metabolic problems. The available literature shows that the leaves contain several important phytoconstituents, particularly gymnemic acids, gymnemagenin, gymnemaglycosides, gymnemosides, and other bioactive compounds. These constituents are believed to contribute to many of the biological activities reported for the plant.

Research carried out so far has shown that *G. sylvestre* may influence blood glucose levels through more than one mechanism. Its constituents have been investigated for their ability to reduce sweet taste perception, influence intestinal glucose absorption, affect glucose uptake, and inhibit carbohydrate-digesting enzymes such as α -amylase. In addition to its antidiabetic potential, studies have reported antioxidant, antihyperlipidemic, and antibacterial activities, making the plant an interesting subject for further pharmacological research.

The findings from laboratory and animal studies provide encouraging evidence, but they should not be considered equivalent to established clinical treatment. Differences in plant material, extraction methods, preparation, dosage, and concentration of active constituents can also affect the results obtained from different studies. Therefore, proper standardization of *G. sylvestre* preparations is important for obtaining consistent and reliable results.

Overall, *Gymnema sylvestre* has considerable potential as a source of biologically active compounds, particularly in the area of diabetes-related research. Further well-designed studies are needed to better understand its mechanisms of action, establish standardized doses, evaluate long term safety, and confirm its effectiveness through properly conducted clinical trials.

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