

## A REVIEW ON *GYMNEMA SYLVESTRE* A MAJOR ANTIDIABETIC ASCLEPIADACEAE HERB

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### ABSTRACT

*Gymnema sylvestre* (Family- Asclepiadaceae), popularly known as gurmar or Madhunashini. It is one of the most important medicinal plant in India. It is a slow growing, perennial, medicinal woody climber grows in Deccan Peninsula and widely distributed in Asia, tropical Africa, Malaysia and Srilanka. It is well known for the treatment of diabetes for over 2000 years in Indian Ayurvedic system of medicine. The major chemical component of *Gymnema sylvestre* is gymnemic acids which has antidiabetic, anti sweetener and anti-inflammatory activities. Traditionally *Gymnema* is used for treatment of glycosuria and urinary disorders. The leaves are also used as diuretic. *Gymnema* is propagated through seeds and stem Cuttings for commercial cultivation in India. In *Gymnema*, many genetic variation studies were done. It is also used in the treatment of asthma, eye

complaints, inflammations, family planning and snakebite. In addition to this it possesses antimicrobial, antihypercholesterolemic, hepatoprotective and sweet suppressing activities. It also acts as feeding deterrents to caterpillar, *Prodenia eridania*, prevent dental caries caused by *Streptococcus mutans* and used in skin cosmetics. Recent reports suggest that Gymnemic acid formulations have been found useful against obesity. It also has anti cancer activity which was tested using biofunctionalized Silver and gold nanoparticles derived from aqueous leaf extracts of *G. sylvestre*.

**KEY WORDS:** *Gymnema sylvestre*, antidiabetic, leaves, antimicrobial, silver and gold nano particles.

## INTRODUCTION

*Gymnema sylvestre* (*G. sylvestre*) R. Br. is native to central and western India, tropical Africa and Australia. Vernacular names to *G. sylvestre* are Meshashringi, madhunashini (Sanskrit), Gur mar (Hindi), merasingi (Marathi), Kavali, kalikardori, vakundi, (Gujrathi), Dhuleti, mardashingi, Podapatri (Telugu), Adigam, cherukurinja (Tamil) Sannagerasehambu(Kannada:). *Keshava murthy and Yoga narasimhan* (1992) reported that the word “Gymnema” is derived from a Hindu word “Gurmar” meaning “destroyer of sugar” and it is believed that it may neutralize the excess of sugar present in the body in Diabetes mellitus. *G. sylvestre* (Asclepiadaceae), is a slow growing, perennial, medicinal woody climber found in central and peninsular India.

### Taxonomical Classification



<b>Kingdom</b>	<b>Plantae</b>
Sub-kingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Gentianales
Family	Asclepiadaceae
Genus	<i>Gymnema</i> R. Br.
Species	<i>Sylvestre</i>

**Fig 1: *Gymnema sylvestre***

**Table 1: Taxonomy of *Gymnema sylvestre***

It is a potent antidiabetic plant and used in folk, ayurvedic and homeopathic systems of medicine. *G. sylvestre* is a large, more or less pubescent, woody climber. It is occasionally cultivated as medicinal plant. The Leaves are opposite, usually elliptic or ovate (1.25– 2.0 inch×0.5–1.25 inch). The plant description of *G.Sylvestre* is that its flowers are small, yellow, located in axillary and lateral umbel in cymes and its follicles are terete and lanceolate upto 3 inches in length. The Calyx-lobes are long, ovate, obtuse and pubescent. Its Corolla is pale yellow campanulate, valvate, corona single, with 5 fleshy scales. Scales of *G.sylvestre* are adnate to throat of corolla tube between lobes and Anther connective produced into a memberanous tip, pollinia 2, erect, carpels 2,unilocular; locules many ovuled (Gurav *et al.*, 2007 and Potawale *et al.*, 2008).

**Geography:** *Gymnema sylvestre* R. Br. commonly known as gurmar belongs to the family Asclepiadaceae. It is a woody, climbing herb grown in India, China, Indonesia, Japan, Malaysia, Srilanka, Vietnam and South Africa (Hill, 1952).

**Uses:** It is used in the treatment of asthma, eye complaints, inflammations, family planning and snakebite. In addition to this it possesses antimicrobial, antihypercholesterolemic, hepatoprotective and sweet suppressing activities. It also acts as feeding deterrents to caterpillar, *Prodenia eridania* and prevents dental caries caused by *Streptococcus mutans* and used in skin cosmetics *Komalavelli and Rao* 2000.

### **Phytochemicals in *Gymnema Sylvestre***

The medicinal value of *Gymnema sylvestre* lies in its bioactive phytochemical constituents that produce definite physiological actions on human body as described by Akinmoladun *et al.*, 2007. The leaves of *G. sylvestre* contain triterpene, saponins belong to oleanane and dammarane classes. The major constituents belong to oleanane type of saponins are gymnemic acids and gymnemasaponins, while gymnemasides are dammarane saponins. Other phytochemicals in *Gymnema* include anthraquinones, flavones, hentriacontane, pentatriacontane, phytin, resins, tartaric acid, formic acid, butyric acid, lupeol,  $\beta$ -amyryn related glycosides, stigmasterol, and calcium oxalate. The presence of alkaloids, acidic glycosides, anthraquinones and their derivatives had been detected in the leaves of *G. sylvestre*. The major secondary metabolites in *Gymnema* are gymnemic acid A–D and are found in all parts of the plant. A group of nine closely related acidic glycosides also constitutes plant's secondary metabolites (*Tiwari et al.*, 2014). *Bhuvaneswari et al.*, 2012 studied antimicrobial activities of phytochemicals present in extracts of *Gymnema sylvestre*. They analyzed *Gymnema sylvestre* aerial and root extracts in chloroform and revealed the presence of 11 compounds (aerial) and 24 compounds (root). Among the compounds they identified, eicosane, Oleic acid and Stigmasterol are important. Leaves contain lupeol,  $\beta$ -amyryn, stigmasterol, pentriacontane, hentricontane,  $\alpha$  and  $\beta$  chlorophyll, resin, tartaric acid, gymnemic acid (anti sweet compounds) the mixture of triterpene saponins, anthraquinone derivatives, alkaloids, betaine choline and trimethylamine (*Karadeniz et al.*, 2005). Antisweet constituent of the leaves has been found to be a mixture of triterpene saponins. The sugar residues are glucuronic acid and galacturonic acid while ferulic and angelic acids have been attached as the carboxylic acid. Chewing of leaves reduces sensitivity to sweet substances (*Kokate et al.*, 2006). The active principles which have

been identified as glycosides (7 gymnemic acids) suggest that the topical and selective anaesthetic effect of the plant might result from the competition of the receptor sites between glycosides and the sweet substances (Kumaran and Karunakaran, 2007) Gopinath *et al.*, 2012 conducted studies on *Gymnema sylvestre* and identified that its extracts are rich in alkaloids, flavonoids and Saponins. Tiwari *et al.*, 2011, reported that ethanolic leaf extract of *Gymnema sylvestre* shows the highest scavenging activity than methanol. Methanol and ethanol has been proven as effective solvent to extract phenolic compounds. Ethanol has showed the best effectiveness in extracting phenolic components. Ethanol is preferred for the extraction of antioxidant compounds mainly because of its lowers toxicity. Kalyani Singh *et al.*, 2014 concluded that *G.sylvestre* extracts are rich in alkaloids, tannins, saponins, phenols, glycosides, flavonoids etc and can be used as antioxidant. They also evaluated in vitro antioxidant activity and preliminary phytochemical analysis of *Gymnema sylvestre* R.Br and reported that the ethanolic extract of *Gymnema sylvestre* R.Br. showed antioxidant activity by inhibiting DPPH. Significant antioxidant activity of ethanolic leaf extract of *Gymnema Sylvestre* R.Br. might be due to the presence of tannins, saponins, phenols, flavonoids and alkaloids found in the preliminary phytochemical analysis.

### **Antimicrobial activity**

Sanker narayan sinha *et al.*, 2010 described the ethno medicinal claim of *Gymnema sylvestre* leaf possessing antibacterial activity that could be a better alternative for synthetic antibacterial agents, the antibacterial property of *Gymnema sylvestre* leaf was tested against three Gram positive (*Bacillus subtilis*, *Staphylococcus aureus* and *Micrococcus luteus*) and five Gram negative (*Escherichia coli*, *Vibrio cholerae*, *Pseudomonas aeruginosa*, *Shigella dysenteriae* and *Shigella flexneri*) bacteria by using different solvents namely petroleum ether, chloroform and ethanol. The susceptibility of Gram-positive bacteria towards various plant extracts than those of Gram-negative bacteria was also reported earlier by Sinha and Biswas 2010. Bhuvanewari *et al.*, 2011 tested the anti-microbial activities of the phytochemicals from *G.sylvestre* and identified that the extracts effectively inhibited the growth of all the gram-negative bacteria including *P. aeruginosa* (Bhuvanewari *et al.*, 2011). Similar studies were done by Murugan *et al.*, 2012 and detected antibacterial activity of Petroleum ether extract of *G. sylvestre* leaf against *S. aureus*, *B. subtilis*, *P.aeruginosa* and *S. typhi*. Aqueous and methanolic leaf extracts were studied against *Escherichia coli*, *Serratia marcescens*, *Staphylococcus aureus* and *Candida*

*albicans* for their antimicrobial efficacy by Minal Wani *et al.*, and they confirmed anti-microbial and anti-fungal activities of *G.sylvestre* (Minal Wani *et al.*, 2012).

### **Anti-diabetic activity**

*Gymnema sylvestre* is one of the most important medicinal plants used in India for the treatment of diabetes. Gymnemic acid is an active compound extracted from this plant which has anti-diabetic property. Lot of research has been done on this anti-diabetic property of this plant all over the world. Shanmugasundaram *et al.*, (1983) studied anti-diabetic activity of *Gymnema* on alloxan diabetic rabbits. They showed that the dried leaf powder of *Gymnema* regulated blood sugar level and maintained its homeostasis. It also regulated the levels of phosphorylase, gluconeogenic enzymes and sorbitol dehydrogenase. Similar studies were done by Baskaran *et al.*, (1990) on non-insulin dependent diabetes mellitus patients. Their experimental data suggested that the beta cells of pancreas may be regenerated or repaired in Type 2 diabetic patients on supplementation of *Gymnema* leaf extracts. Raised insulin levels were observed in the serum of patients after supplementation (Baskaran *et al.*, 1990). Many such studies confirmed the role of *Gymnema* leaf extracts in the treatment of Diabetes (Okabayashi *et al.*, 1990; Grover *et al.*, 2002; Prabhakar *et al.*, 2011).

**Anti obesity:** Vinay kumar *et al.*, (2012) conducted experiments on obese mice fed with high fat diet (HFD) and concluded that *G. sylvestre* extract has anti-obesity properties and act via suppression of levels of leptin, insulin, dyslipidemia, apolipoproteins, lipids, visceral fat pad weights, and oxidative stress. It also prevents myocardial apoptosis and can be used as potential antiobesity drug in near future. Manish *et al.*, (2011) evaluated the anti-obesity activity of hexane extract of leaves of *G.sylvestre* in Sprague dawley rats and concluded lipid lowering activities of flavonoids and saponins present in extracts of *G.sylvestre*.

**Anti inflammatory:** Gupta *et al.*, (2010) evaluated the anti-inflammatory activity of *G.sylvestre* plant extract. They concluded that the presence of Tannins in the leaves of *G.sylvestre* possess anti-inflammatory and immunomodulatory properties.

### **Micropropagation**

Various In vitro studies like micropropagation and callus induction have been done for enhanced production of phytochemicals in *G.sylvestre*. Manonmani and Francisca (2012) described that the Growth and proliferation of multiple shoots in *Gymnema sylvestre* R.Br. can be stimulated easily by using in vitro techniques. Multiple shoot formation by rapid

clonal propagation has done to overcome problems in conventional methods of propagation. They also reported that nodal explants of *Gymnema sylvestre* were used for in vitro multiplication on a medium containing various concentrations of growth regulators such as BA and NAA. Among the combinations used, MS medium fortified with BA at 1.0 mg/l was found to be suitable for induction of multiple shoots. The shoots were observed within 1 week of inoculation. The regenerated shoots were transferred to rooting media supplemented with different concentrations of NAA. The highest percentage of rooting was observed with NAA at 1.0 mg/l.

### Green synthesis of Nanoparticles

In recent years metal nanoparticles have been shown to have potential applications in the field of Medicine and Pharmacy. Various researchers studied the use of plant extracts in the synthesis of these metal nanoparticles, as plant extracts are eco-friendly, stable and have faster rate of synthesis (Siavash Iravani 2011). Arunachalam *et al.*, (2014) biofunctionalized the gold nanoparticles from *G.Sylvestre* to increase the medicinal properties of bioactive compounds and suggested that it can be used as anti-cancer drug. In addition these gold nanoparticles from extracts of *Gymnema* are stable, non-toxic and economic.

### Future Prospects

The increased demand is causing a great strain on the natural populations of *G.Sylvestre*. *G.Sylvestre* has proved its ability to cure diabetes so it is called Madhunashini and also fight against different types of diseases. Collectors of medicinal plants are resorting to unsustainable exploitation causing serious threat to the survival of the species. Cultivation in a substantially high scale is yet to be started. Therefore, there is a need to conserve the species for the benefit of mankind. More importantly, critical elements of effective conservation strategies need to be discussed.

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