

A STUDY OF GYMNEMA SYLVESTRE AND ITS BIOACTIVE COMPONENTS EFFECT ON DIABETES MELLITUS

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Abstract

Gymnema sylvestre is a well-known herb used in Ayurveda for its therapeutic uses. It is widely used in Diabetes mellitus as it possesses antidiabetic activity. The Indian Ayurveda describes several herbs for the management and treatment of Diabetes mellitus among which *Gymnema sylvestre* (Asclepiadaceae) is revered as a potential anti-diabetic herbal drug. *Gymnema sylvestre* also possesses anti-obesity, anti-hyperlipidemic, anti-inflammatory, and anti-cancerous activities. The phyto-constituents responsible for sweet suppression activity includes triterpene saponins known as gymnemic acids, gymnema saponins, and a polypeptide, gurmarin. This review article mainly focused on the traditionally used medicinal herb, *Gymnema sylvestre*, its bioactive components and its pharmacological activities.

Keywords: *Gymnema sylvestre*, gymnemic acids, Diabetes mellitus, Antidiabetic.

INTRODUCTION

About 80% of people worldwide rely on herbal medicines for some aspect of their primary healthcare is estimated by WHO.[1] The medicinal plant possesses numerous phytochemical activities which shows a great potential for its therapeutic applications. Recently the utilization of medicinal herbs in the drug discovery and pharmaceutical industry is increased day to day. *Gymnema sylvestre* R. Br is one of the important medicinal plants of India widely used in indigenous medicine in the treatment of Diabetes mellitus. The active principle of the drug is a complex mixture of Gymnemic acids found in leaves. Presently there is a huge demand for the plant in the national and international markets.[2] *Gymnema sylvestre* is one of the important anti-diabetic medicinal plants. There is a growing demand for *G. sylvestre* leaves in the pharmaceutical trade. Gymnemic acid, the active ingredient of this plant, is extracted from leaves and used widely as an anti-diabetic, anti-sweetener and, anti hypercholesterolemia. It also has stomachic, diuretic, and cough suppressant properties. The plant has been reported to possess antimicrobial and ethno veterinary medicinal properties.[3] This review article mainly focused on the traditionally used medicinal herb, *Gymnema sylvestre*, its bioactive components, and its pharmacological activities.

Gymnemasylvestre R. Br. is a widely used indigenous medicinal plant of India belonging to the family Asclepiadaceae. It is commonly known as madhunashini in Sanskrit and also Gurmar, "meaning sugar (Madhu / Gur) destroying (nashini / mar)". The plant possesses anti sachrogenic property, it temporally suppresses responses to the sweet taste of sugar.[4] The taxonomical classification is given below in Table 1. *Gymnema sylvestre* is a slow-growing,

perennial, woody climber, distributed throughout India, in dry forests up to 600 m in height. It is mainly present in the tropical forests of Central and Southern India. It is also found in Banda, Konkan, Western ghats, Deccan extending to the parts of Western and Northern India.[5][20] It is also found in the tropical Africa and in Australia as well as in Asia, Malaysia, Japan, Vietnam, and Sri Lanka. The main plant parts of *Gymnema sylvestre* used for herbal preparations are its leaves and roots.[6] *G. sylvestre* leaves are opposite, usually elliptic or ovate (1.25 – 2.0 inch x 0.5-1.25 inch); flowers are small, yellow and are in axillary and lateral umbellate cymes; the follicles are terete; lanceolate and up to 3 inches in length; pedicels are long; Calyx-lobes are long, ovate, obtuse, pubescent; Corolla is pale yellow campanulate, valvate, corona single, with 5 fleshy scales. Scales adnate to throat of corolla tube between lobes; Anther connective produced into a membranous tip, pollinia 2, erect, carpels 2, unilocular; locules many ovules [7].Figure number 1 show bioactive present in *Gymnema sylvestre*.

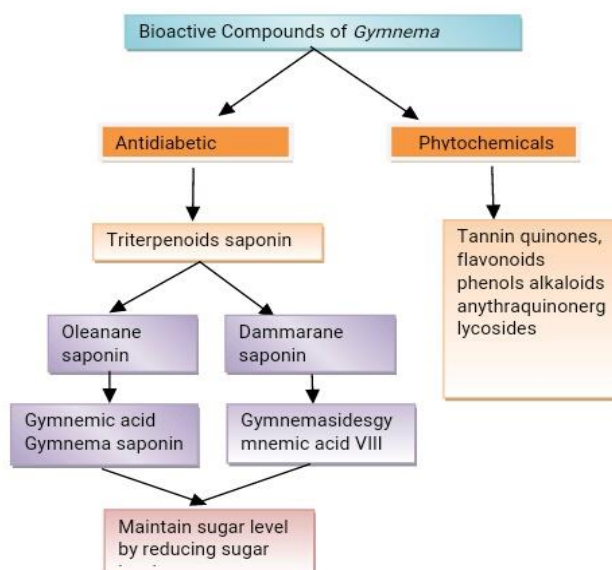


Figure1 Bioactive compounds of *Gymnema sylvestre*

Table 1 Taxonomical classification of *Gymnema sylvestre*

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Asteridae
Order	Gentianales
Family	Asclepiadaceae
Genus	<i>Gymnema</i>
Species	<i>Sylvestre</i>

Table 2 Morphological features of *Gymnema sylvestre*

Form	Slow-growing, perennial, woody climber,
Distribution	Southern India, Banda, Konkan, Western ghats, Deccan extending to the parts of Western and Northern India, tropical Africa, and in Australia, Asia, Malaysia, Japan, Vietnam, and Sri Lanka.
Leaves	Opposite, usually elliptic or ovate (1.25 – 2.0 inch x 0.5-1.25 inch)

Flowers	Small, yellow, and are in axillary and lateral umbellate cymes; the follicles are terete; lanceolate and up to 3 inches in length; pedicels are long; Calyx-lobes are long, ovate, obtuse, pubescent; Corolla is pale yellow campanulate, valvate, corona single, with 5 fleshy scales. Scales adnate to throat of corolla tube between lobes; Anther connective produced into a membranous tip, pollinia 2, erect, carpels 2, unilocular; locules many ovules.
Growth period	The seeds are sown in the months of November-December and harvested from September to February. The propagation through seed germination is difficult due to the low viability of the seeds; therefore, the alternative has been root cuttings which are generally planted in June and July Terminal cuttings with three of four nodes have also been used for vegetative propagation and usually planted in the month of February-March.

GYNMEMIC ACID

Gymnemic acids and Gymnema saponins are major chemical constituents of this plant and are classified as oleanane saponins. Oleanane and dammarane types of saponins are found in the leaves of *Gymnema sylvestre*. The leaves of this plant also have saponins, anthraquinones, cardiac glycosides etc. [8] Moreover, this plant was also observed to have tannin, quinones, flavonoids, and phenols.[9] Gymnemic acids, a group of triterpenoid saponins belonging to oleanane and dammarene classes. Oleanane saponins are gymnemic acids and Gymnema saponins, while dammarene saponins are gymnemasides. Gymnemic acids I-VI were isolated and characterized through aqueous leaf extracts and gymnemic acids XV-XVIII from the saponin fraction of the leaves. Gymnemic acids VIII-XII have been elucidated as glucosideuronic acid derivatives of gymnemagenin.[10] Gymnemic acids are thought to be responsible for the antidiabetic activity of *G. sylvestre*; gymnemic acid VIII was the major component of an extract shown to stimulate insulin release from the pancreas. In earlier studies, it was observed that the maximum contents of gymnemic acid were accumulated in the shoot tips and fresh leaves, which are renewable sources. The leaves and stalks of *Gymnema sylvestre* will play an important role in the increase of the availability of raw material for pharmaceutical purposes.[11] Various methods were used in earlier studies.HPLC methods have already been reported for the estimation of gymnemic acid in *Gymnema sylvestre*[12]In previous studies it found that the gymnemic acid thus obtained was further identified, purified, and characterized using various TLC, preparative TLC, and circular TLC techniques. The glycosidic nature of gymnemic acid were confirmed on acid hydrolysis by two different methods. The stigmasterol,

β-amyrin, *β*-amyrin acetate, and lupeol were also identified as the other leave constituents of *Gymnemasylvestre* [13].

DIABETES MELLITUS

Diabetes mellitus is a complex metabolic disorder characterized by chronic hyperglycemia and associated with long-term damage and dysfunction of various organs. Nowadays Type 2 Diabetes mellitus is increasing alarmingly day by day. Starting from aged persons to young ones even children are also suffering from this epidemic disorder. Type 2 diabetes is a metabolic disorder which is characterized by hyperglycemia resulting from defective insulin secretion, resistance to insulin action or both. Oxidative stress is also related to long-term complications (development of vascular complications) of Type 2 diabetes. [14]Oxidative stress is used to describe the high level of oxidative damage in a cell, tissue, or organ, caused by the ROS (Reactive Oxygen Species) and imbalance between the Reactive species (RS) and antioxidants result in the development of Type 2 diabetes.

MECHANISM OF ACTION OF *G. SYLVESTER* (GYMNEMIC ACID)

G. sylvestre leaves are cause of hypoglycemia in laboratory animals and show use in herbal medicine to treat Diabetes mellitus in adults. When leaf extract of the plant, administered to a diabetic patient, there is stimulation of pancreas by the virtue of which there is an increase in insulin release. These compounds have also been found to increase the fecal excretion of cholesterol. There are some possible mechanisms by which leaf extract of *Gymnema sylvestre* or (Gymnemic acid) possess its hypoglycemic acid effects are: 1) It promotes regeneration of islet cells, 2) It increases secretion of insulin, 3) It causes inhibition of glucose absorption from the intestine, 4) It increases utilization of glucose as it increase the activities of enzymes and are responsible for glucose utilization by insulin-dependent pathways, an increase in phosphorylase activity, decrease in gluconeogenic enzymes and sorbitol dehydrogenase [15].

ANTIDIABETIC ACTIVITY

G. sylvestre was useful in certain cases of non-insulin dependent diabetes as it reduces serum glucose concentration and improves glucose tolerance. Administration of leaf extract of *G. sylvestre* (120 mg/kg/ day p.o.) for 7 days in STZ induced rats reduced amylase activity in serum, increased β -cell function, regenerated β -cells in pancreatic islets and showed higher levels of serum C-peptide. The beneficial effect was observed in oral treatment to cure Non-Insulin Dependent Diabetes mellitus (NIDDM) to use the 400 mg/kg of leaf extract, there is a significant reduction of blood glucose, glycosylated hemoglobin and plasma protein which increase in serum insulin levels. In another study on patients with type 2 diabetes, *G. sylvestre* leaf extract was given at a dose of 400 mg/day was administered for 18-20 months as a supplement to the conventional oral drugs, regenerated β -cells, and raised insulin level in serum of the patients [16].

CONCLUSION

Herbal medicines are widely used by the world population due to their lesser side effects and utilization of various medicinal plants. Due to the high demand for herbal drugs in market, the marker compound of drug should be standardized with appropriate methods. Type 2 Diabetes mellitus is increasing alarmingly day by day. Starting from aged persons to young ones even children are also suffering from this epidemic disorder. *Gymnema sylvestre* a well-known herb used in Ayurveda for its therapeutic uses. It is widely used in Diabetes mellitus as it possesses antidiabetic activity. Gymnemic acids are thought to be responsible for the antidiabetic activity of *G. sylvestre*; gymnemic acid VIII was the major component of an extract shown to stimulate insulin release from the pancreas. It is concluded that *Gymnema sylvestre* is the most benefited herbal drug for Diabetes and other diseases related to diabetes.

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Competing interests

The authors report no conflicts of interest. The authors alone are responsible for the given data of this article.

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