

Review on Impact of *Gymnema Sylvestre* (*Gurmar*) on Diabetes Mellitus

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ABSTRACT: *Gymnema Sylvestre* belongs to the Asclepiadaceae family. It is woody climbing herb found in tropical forest region of central, southern and western India, Africa, Australia and Sri Lanka. It is used as folklore medicine to treat various types of diseases. It has various medicinal properties. In Hindi it is called as “*Gurmar*” meaning “sugar destroyer or sweet destroyer”. It has potential ability to treat diabetes. Gymnemic acid is major constituent present in this plant that is responsible for the taste suppression of sweet compounds. The present review article highlights various points of *Gymnema sylvestre*, such as its phytoconstituents, mechanism of action, and its hypoglycemic effect on diabetic subjects by compilation of previous studies.

Key Words: *Gymnema Sylvestre*, *gurmar*, *hypoglycemic*, *Gymnemic*, *diabetes*, *mechanism of action*.

I. INTRODUCTION:

Since ancient times, number of medicinal plants have been used for the purpose of prevention and cure of various diseases, in India and worldwide. The use of these plants varies with disease conditions like treatment in mild conditions (such as headache, diarrhea and, constipation) to more serious conditions (such as hypertension, arthritis, ulcers, diabetes, and kidney stones) [2]. These plants are getting popularity due to their less side effects [11]. On the other hand, many chemical drugs show the adverse effect on the body after ingestion for long time [28]. For example, insulin and oral hypoglycemic agents (such as biguanides and sulfonylureas) are used in diabetes but these drugs have many side effects such as GIT problems, kidney diseases, hypoglycemia, hepatotoxicity, heart risk problems, and insulinoma [6].

Around 1200 medicinal plants used as folklore medicine to treat diabetes mellitus due to their hypoglycemic properties [4]. The first indication was reported by Glazer and Halpern in 1929 that anti-diabetic medicinal plants have an insulin activity potential [9]. Diabetes mellitus is most common non-communicable disease and fourth leading cause of death in developed countries [3]. It is endocrinological, metabolic disorder [1] [17] that occurs due to irregular metabolism of protein, fats, and carbohydrates [14]. More than 100 million people are affected by it, worldwide [6].

Gymnema sylvestre is one of the important medicinal plants widely used in India to treat diabetic patients [28] due to great antidiabetic property [20]. It belongs to the Asclepiadaceae family [28] and a remedial woody climbing traditional herb (Fig.1) [29]. The tropical forest area of central, southern and western India is the native place of this plant and is also found in tropical Africa, Australia [28] [29] and Sri Lanka [19]. The pharmacological effect of the plant was identified around in the beginning of 1930 [29]. The present review focuses on pharmacological uses, antidiabetic agents, mechanism of action, and side effects of *Gymnema sylvestre* in addition to its effect on diabetic patients and laboratory animals by compiling the previous intervention studies.

II. THE NAMES OF GYMNEMA SYLVESTRE:

The word “*Gymnema*” is derived from the Hindi word “*Gurmar*” meaning “sugar destroyer or sweet destroyer” [20] [28]. In English, it is called *Periploca* of the woods, and *Meshashringi*, *madhunashini* in Sanskrit [20]. The leaves of *Gymnema* are bitter, astringent, and acid. They temporally paralyze the sensory perception of sweets and due to this amazing property, it is known as “*GUDMAR*” [28]. It is a wonderful plant to cure diabetes [19] [29]. *Gymnema Sylvestre* (Morasingi) is called *madhumeha* destroyer (glycosuria) and is also used for other urinary disorders [16].



Figure 1: *Gymnema Sylvestre* (*Gurmar*) [29]

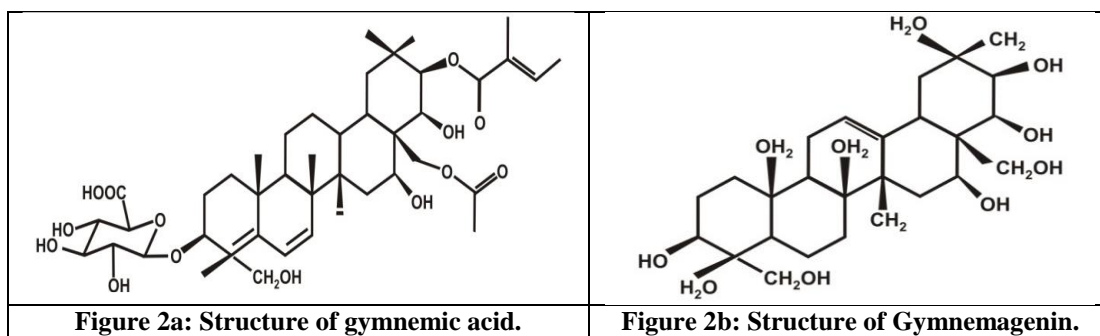
III. TRADITIONAL AND PHARMACOLOGICAL USES:

It has various traditional as well as pharmacological uses like this plant traditionally used to treat type 1 and 2 diabetes, snakebite [28]. In addition, to manage cardiac diseases (blood cholesterol, and triglyceride levels), antipyretic, expectorant, uterine tonic,

leukoderma, and anthelmintics. It is also medicinally important in urinary complaints, stomach problems, piles, chronic cough, breathing troubles, bronchitis, asthma, eye complaints, water retention, and liver diseases, constipation, jaundice, and cataract. It also has another pharmacological activities like anti-obesity, anti-inflammatory, anti-microbial, hypolipidemic, anti-arthritis activity, smooth muscle relaxant and used as an anticancer-cytotoxic agent [19] [28] [29] [30]. That is why this plant is also named the 'Miracle Fruit' [28]. In India, gurmar is the majorly used medicinal herb in Ayurvedic anti-diabetic formulations [26].

IV. PHYTOCONSTITUENTS AND ANTI-DIABETIC AGENTS PRESENT IN GYMNEMA SYLVESTRE:

Gymnema Sylvestre contains a number of phytoconstituents as well as anti-diabetic agents, as reported by various scientists (Table-1). These components are present in leaves of this plant [10]. These phytoconstituents such as polypeptide (gurmarin) and triterpene saponins (gymnemic acids and gymnemasaponins), [10] belong to oleanane and dammarane classes [20] [30]. Gymnemic acid (acidic glycosides) is major component present in this plant, [30] that are responsible for the taste suppression of sweet compounds, without affecting other taste elements [31]. Turner et.al. 2020, [31] investigated the effect of consuming 4 mg of gymnemic acids containing mint dissolving tablet on the desire to consume high-sugar sweet foods (chocolate) on 56 healthy young men and women. In this study, participants ingested their favourite chocolate between 14–18 g with energy varied between 292–370 kJ, then consumed the *Gymnema sylvestre* (GS) contained mint tablet and majored their perceived pleasantness and desire for more chocolate. The results found that the number of chocolate bars eaten decreased by 21.3% within 15-min period of consumption of the GS mint tablet, the desire to eat and pleasantness of the high-sugar sweet food also reduced after the ingestion of GS mint tablet. The daily-recommended dose of gymnemic acid content varies from 38 to 251 mg [8]. Gymnemic acid 219.9 mg/300 ml of fennel RTS beverage can fulfil the daily requirement for diabetic persons [24]. Structures of triterpene saponins showed in fig. (2a, and 2b).



Source: Thakur et al., (2012) [29]

Table-1: Phytoconstituents and Anti-Diabetic Agents of *Gymnema Sylvestre*

Anti-diabetic agents and phytoconstituents present in <i>Gymnema Sylvestre</i>	References
Oleanane saponins category: Gymnemic acids and gymnemasaponins	[20] [29] [30]
Dammarene saponins category: gymnemasides	
Gymnemic acids, phytin, d-quercitol, pentriacontane, Gurmarin peptide. Leaves contain about 2.4% of Gymnemic acid (W/W).	[10]
Alkaloids, flavonoids, saponins, Dihydroxy gymnemic triacetate	[33]
Hentriacontane, Pentriacontane Phytin, Alpha and Beta chlorophylls, Butyric acid, Lupeol, Beta amyryl, Stigmasterol, Gymnemic acid	[19]
Tri-terpenes saponins (Gymnemic acids, Gymnemagenin and Gurmarin)	[28]
Anthraquinones, flavones, hentriacontane, pentatriacontane, phytin, resins, tartaric acid, formic acid, butyric acid, lupeol, β -amyryl related glycosides, stigmasterol, calcium oxalate, alkaloids.	[30]
Gurmarin (35 amino-acid polypeptide), flavones, anthraquinones, hentriacontane, pentatriacontane, α and β -chlorophylls, phytin, resins, d-quercitol, tartaric acid, formic acid, butyric acid, lupeol, β -amyryl related glycosides and stigmasterol, alkaloids.	[29]
Glycosides, hexokinase and glycogen synthase (Insulin-dependent enzymes)	[15]

V. MECHANISM OF ACTION:

There are some possible mechanisms that create the hypoglycemic effect by this plant when ingested, are observed by different scientists [10] [20] [28] [29] [30]:

- It stimulates the pancreas that is the cause of an increase in insulin release.
- Slowdown of glucose absorption from intestine due to the presence of alpha-glucosidase.
- Regeneration of pancreatic Islets cells, increased glucose utilization due to increase in the activities of Phosphorylase enzymes and decrease in Sorbitol dehydrogenase and Gluconeogenic enzymes activity.

VI. SUGAR LEVELS AFTER INGESTION OF GYMNEMA SYLVESTRE:

Administration of *Gymnema sylvestre* showed significant reduction in blood glucose, glycosylated hemoglobin (HbA1C) and glycosylated plasma proteins by regeneration of the pancreatic beta cells in type II diabetic patients [9]. Due to the presence of phytoconstituents, the leaf extract of *Gymnema Sylvestre* creates the hypoglycemic effect as found in various clinical interventions and experimental studies on different subjects as shown in Table- 2.

Table 2: Intervention Study of *Gymnema Sylvestre*

Subject	Dose/ extract type/part used with durations/days	Antidiabetic effect of <i>Gymnema sylvestre</i>	Reference
Clinical trial	Intake of <i>Gymnema sylvestre</i> supplementation. Recommended dose at 500 mg/day for three months, in some clinical trials	Decreased the level of 2-hr post-prandial plasma glucose concentration by 13% (from 207 to 180 mg/dl) and HbA1C level by 0.6% (from 8.8% to 8.2%).	[10]
In streptozotocin induced rats.	Leaf extract (3.4/13.4 mg/kg)	Reduction of blood Sugar level	[33]
Diabetic patients	200 or 400 mg extract containing 25% gymnemic acids)	Hypoglycemic effects	[25]
20 non-insulin dependent diabetic human subjects	Gurmar leaf powder (1 gm/day) for 90 days	Reduction in fasting, post-prandial blood glucose level, as per dose administered to different groups according to study.	[29]
Type-2 diabetes patients	500 mg/day (three months)	Lowered polyphagia and suppressed excessive hunger Reduction in fasting, post-prandial blood glucose and HbA1C	[12]
Adults	25 to 75 ml per week (liquid extract form) 8 to 12 g per day (tablet form)	Good results but the best results get after 6 to 12 months of continuous use.	[20]
20 non-insulin dependent diabetic patients	6 gm/day, leaf powder	Positive and encouraging effects on fasting as well as postprandial blood glucose levels	[18]
Rats	5, 10, 15, 20 gm concentrations for 25 days, in powdered form	Anti-diabetic effect. Reduces the level of protein, triglycerides, cholesterol and glucose. Up to 10 gm concentration/kg body weight showed safe to use to the diabetics. 15 and 20 gm/kg body weight showed the histopathological change	[27]
Streptozotocin induced diabetic rats	Alcoholic extract of leaf Dose of 250 mg/ kg body weight, at 2 and 4 h after the glucose load in glucose tolerance test	Reduction in blood glucose levels (Hypoglycaemic effect)	[32]
Diabetes mellitus patients	3/4 tsp of Gurmar in one glass boiling water as tea	Reduction in blood glucose levels	[15]
Non-insulin-dependent type-2 diabetes mellitus, 22 patients	Leaf extract, 400mg/day oral drug dose for 18-20 months	Reduction in blood glucose, glycosylated haemoglobin, and glycosylated plasma proteins. (GS4 supplementation may help to repair the beta cells by raising the	[5]

		insulin level in type 2 diabetic patients)	
Insulin-dependent diabetes mellitus, 27 patients (insulin therapy)	Water-soluble leaf extract, 400mg/day	Reduction in requirement for insulin, along with fasting blood glucose and glycosylated hemoglobin (HbA1C) and glycosylated plasma protein levels. Serum lipids returned to near-normal levels. (GS4 therapy helps to increase the endogenous insulin by regeneration of the residual beta cells in insulin-dependent diabetes mellitus).	[21]
Type-1 diabetes mellitus (animals)	Isolate from gymnema sylvestre leaf extract	Hypoglycaemic effect Increased in serum insulin levels, the blood glucose homeostasis created. (The islets of langerhans appear to be regulated). Glycoprotein, nephropathy, retinopathy, and micro and macroangiopathy under controlled.	[22]
Diabetes mellitus patients	2 g of dry leaf powder per day for 10 days	Significant blood glucose Lowering effect	[23]

VII. SIDE EFFECTS OF GYMNEMA SYLVESTRE:

The chronic use of this herb creates hepatotoxicity and can lower blood pressure, and the ability of the tongue to detect the sweet taste is suppressed due to Gymnemic acid and Gurmarmine [19]. The reduction in taste sensation (sweetness and bitterness) is one of the major side effects [7]. The certain gymnema extracts may intensify the glucose-lowering effects of some antidiabetic drugs [13] whereas, Syeda and Nama, (2014) [28] reported that gudmar powder has no harmful effect and is effective in reduction of fasting as well as postprandial blood glucose levels.

CONCLUSION:

Gymnema sylvestre is woody climbing medicinal herb widely used in India not only for treating diabetes but also useful in managing various diseases such as cardiac diseases, antipyretic, expectorant, leukoderma, stomach problems, piles, chronic cough, breathing troubles, bronchitis, liver diseases, constipation, jaundice, etc. This medicinal herb contains a number of phytoconstituents and antidiabetic agents that are majorly present in their leaves. The leaves of Gymnema are bitter, astringent, and acrid, temporally paralyze the sensory perception of sweets. That is why it is also known as “GUDMAR”. The gymnemic acid (W/W) is majorly presents in leaves contained about 2.4%. This article concludes by giving overview of the consumption as an alternative traditional medicine. This article can help to visualize future research prospects in this area.

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