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PHARMACOLOGICAL PROPERTIES AND PHYTOCHEMICAL OF GYMNEMA SYLVESTRE (GURMAR): A REVIEW

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ABSTRACT

Gymnema sylvestre (Asclepiadaceae), commonly known as gurmar or sugar destroyer is a woody climber, indigenous to India. The climber is seen in all parts of India and well known for its sugar destroying or antidiabetic properties. The plant is said to be a rich source of saponins, triterpenoids and steroids. Leaves are largely employed as antidiabetic, antiobese, antimicrobials, anti-inflammatory etc. *G. sylvestre* has good prospects in the treatment of diabetes as it shows positive effects on blood sugar homeostasis, controls sugar cravings, and promotes regeneration of pancreas. The herbal extract is used in dietary supplements since it reduces body weight, blood cholesterol, and triglyceride levels and holds great prospects in dietary as well as pharmacological applications. This review explores the transition of a traditional therapeutic to a modern contemporary medication with an overview of phytochemistry and pharmacological activities of the herb and its phytoconstituents.

KEYWORDS: Gymnema sylvestre, Gurmar, Asclepiadaceae, physicochemical, phytochemical and pharmacological. Gymnema Sylvestre, sweet destroyer.

INTRODUCTION

The naturopathic treatment for diseases has been explored extensively since ancient times and gaining momentum in the present scenario. Indian flora accounts for about 45,000 plant species out of which several thousands have pharmacological significance[1] Diabetes mellitus is a major endocrine disorder affecting nearly 10% of the population worldwide[2] and a key

issue of concern. The disease in its severe state affects major systems of the body, leading to multiorgan complications. Oral hypoglycemic agents like sulphonylureas and biguanides are the conventional drugs used for the treatment, but the adverse side effect associated with these drugs is a major limitation. The herbal medicines are becoming popular due to better results and safe use as compared to marketed drugs and more effective treatment of health problems.[3] The bioactive constituents found in many plant species are isolated for direct use as drugs, lead compounds, or pharmacological agents. These traditional

approaches might offer a natural key to unlock diabetic complications.[4] The chemical structures of a phytomolecule play a critical role in its antidiabetic activity. Several plant species being a major source of terpenoids, flavonoids, phenolics, coumarins, and other bioactive constituents have shown reduction in blood glucose levels.[5,6]

Traditional Prespective

G. sylvestre is an indigenous herb, belonging to the class dicotyledonous of the family Asclepiadaceae. The plant is a good source of a large number of bioactive substances.[7] It has deep roots in history, being one of the major botanicals used in Ayurvedic system of medicine to treat conditions ranging from diabetes, malaria, to snakebites.[8] The herb is cultivated worldwide and also known as Chigengteng or Australian Cowplant, *Waldschlinge* in German, periploca of the woods in English and gurmar in Hindi.[9]

Phytochemical in Gymnema Sylvestre

The leaves of *G. sylvestre* contain triterpene saponins belonging to oleanane and dammarane classes. The major constituents like gymnemic acids and gymnemasaponins are members of oleanane type of saponns while gymnemasides are dammarane saponins.[10,11] Other phytoconstituents include anthraquinones, flavones, hentriacontane, pentatriacontane, phytin, resins, tartaric acid, formic acid, butyric acid, lupeol, *β*-amyrin related glycosides, stigmasterol, and calcium oxalate.[12] The presence of alkaloids had been detected in plant extracts. Leaves of *G. sylvestre* have acidic glycosides and anthraquinones and their derivatives.[13] The major secondary metabolites in *Gymnema* includes a group of nine closely related acidic glycosides, the main are gymnemic acid A–D and found in all parts of the plant. The maximum content of gymnemic acid is found in shoot tips (54.29 mg-g^{-1} DW) and least in seeds (1.31 mg-g^{-1} DW). Antisaccharin property of gymnemic acid A_1 was greatly reduced on conversion into A_2, while no activity was observed in case of A_3 suggesting that

the ester group in the genin portion of gymnemic acid imparts the antisweet property to the triterpene saponins, the gymnemic acids. Gymnemic acids $A_2$and A_3 possessed both glucuronic acid and galactose in their molecular structures while glucuronic acid was found to be the only moiety in gymnemic acid A_1.[14] Further, a series of gymnemic acids (gymnemic acid I, II, III, IV, V, VI, and VII) were isolated and characterized from the hot water extract of dry leaves of *G. sylvestre*.[15,16] The Gymnemic acids comprise of several members designated as gymnemic acids I–VII, gymnemosides A–F, and gymnemasaponins . The derivatives of gymnemic acids are several acylated tigloyl, methylbutyryl group substituted members, derived from deacylgymnemic acid (DAGA) which is a 3-O-*β*-glucuronide of gymnemagenin (3*β*, 16*β*, 21*β*, 22*α*, 23, 28-hexahydroxy-olean-12-ene). Gymnemic acid A comprises of gymnemic acids A_1, A_2, A_3, and A_4 and named gymnemagenin. This constituent is a D-glucuronide of hexahydroxy-triterpene that esterifies with acids.[17] Other five gymnemic acids, namely, VIII, IX, X, XI, and XII, were isolated and characterized later.[18] Gymnemasaponins III, another antisweet compound, isolated from *G. sylvestre* was found to consist of 23 hydroxylongispinogenin as the aglycone moiety glycosylated with either one or two glucose molecules at both the 23 or 28 hydroxyl groups.[19] These compounds exhibited lesser antisweet effect than those of gymnemic acids.[20]

Phytoconstituents in Gymnema Sylvestre: Gurmarin, an important 35 amino-acid peptide having a molecular weight of 4209, was isolated from *G. sylvestre*.[21] The sugar suppression activity of this compound was determined electrophysiologically on the taste responses of rat.[22] The antisweet effect of this polypeptide is very specific to sweet taste on tongue, affected by the pH change. It has been reported that the polypeptide exhibited maximum antisweetner property near its isoelectric point.[23] The hydrophobic, rather than the ionic, interaction plays a significant role in proper binding of gurmarin to the target molecules.[24,25] The other important constituents isolated from leaves are gymnemasins A, B, C, and D and alkaloids.[26] A number of saponins such as gymnemic acid, deacyl gymnemic acid, gymnemagenin[27], 23-hydroxylnogispinogenin, and gymnestrogenin have been purified[28,29] from *G. sylvestre*. The phytochemicals in leaf extract were also analyzed through gas chromatography coupled to mass spectrometry and identified for the presence of terpenoids, glycosides, saturated and unsaturated fatty acids, and alkaloids in three different leaves extract, namely, petroleum ether, chloroform, and methanol as solvents used for extraction.[30] The bioactive constituents present in the plant were found to be mixture of diverse

phytomolecules such as gymnemic acids, gymnemosides, gymnemasaponins, gurmarin, gymnemanol, stigmasterol, d-quercitol, *β*-amyrin related glycosides, anthraquinones, lupeol, hydroxycinnamic acids, and coumarols group.

Pharmacological Studies

1 Antiobesity studies

A studies show that gurmarin-a peptide from Gymnema sylvestre, block the ability to sweet taste or bitter flavors and thus reduces sweet carvings. This may leads to the weight loss.[31] Gymnema sylvestre extract in combination with niacin-bound chromium and hydroxycitric acid was evaluated for antiobesity properties through body weight , BMI, appetite, lipid profiles, serum leptin and excretion of urinary fat metabolites. The study revealed that the combination was found to be effective.[32] The effects of some medicinal plants that are claimed to be useful in the treatment of obesity are reviewed. Gymnema sylvestre had indication in obesity, lipid and glucose metabolism alterations, due to presence of Gymnemic acid and daily dosage was mentioned as 15mg.[33]

2 Antidiabetic Activity

The first scientific evidence of G. sylvestre effect on human diabetes dates back to century.[34] Gurmar leaf powder had shown significant effect on blood glucose levels on experimental animals.[35] Antihyperglycemic effect of crude saponins and five triterpene glycosides from methanolic extract of G. sylvestre was studied.[36]

3 Hypolipidaemic Activity

On administration of leaf extract of Gymnema sylvestre to hyperlipidemic rats for about 2 weeks found to be effective by reducing the elevated serum triglyceride (TG), total cholesterol (TC), very low density lipoprotein (VLDL) and low density lipoprotein (LDL) – cholesterol in dose dependent manner. The results were comparable to that of the standard drug clifibrate.[37]

4 Antiviral activity

Gymnemic acids A to D isolated from the aqueous extract of leaves of Gymnema sylvestre were tested againsy in vitro influenza virus. Viral growth cycle was studied in control and treated cultures. The yield of viral hem agglutinin and infectivity was measured. Gymnemic acid-A and B showed demonstrable inhibition of growth of viral infected cells while Gymnemic acid C and D was none investigated for their anti-viral activity.[38]

5 Anticancer activity

Successive extracts of Gymnema sylvestre with chloroform, Ethyl acetate and 95% alcohol were evaluated against MCF 7 (epithelial cells of human breast cancer) and A 549 (epithelial cells of human lung cancer) by MTT assay. All the three extracts exhibited IC 50 value concentration dependently and at 50 and 100µg/ml exhibit IC 50 value similar to that of standard drug etoposide.[39]

6 Antiarthritic activity

Aqueous and petroleum ether extracts of Gymnema sylvestre was evaluated for its antiarthritic activity in Freund‟s adjuvant induced arthritic rat and was found to be effective. The antiarthritic activity of the plant was believed to be due to rich source of saponins, triterpenoids and steroids.[40]

CONCLUSIONS

Gymnema sylvestre (Family: Asclepiadaceae) – commonly known as gurmar or sugar destroyer, is seen in various parts of India. The woody climber is used for various diseases and disorders in traditional medicines such as glycosuria, urinary complaints, chronic cough, piles, stomach problems, breathing troubles, asthma, eye complaints, cardiopathy, jaundice, constipation and bronchitis. e current updated review on the plant highlights its botanical, pharmacognostical, phytochemical and pharmacological aspects of the climber. This updated review on the plant will be much more helpful for all those researchers who are all carrying out their investigations and research on this climber.

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