

GYMNEMA SYLVESTRE (KAVALI): PHARMACOLOGICALLY IMPORTANT HERB

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ABSTRACT

Plants have played a significant role for mankind mainly as food and medicine. Medicinal plants have been used for many centuries for human diseases because they contain bioactive components of therapeutic value because of their antimicrobial properties and they contain secondary metabolites such as alkaloids, phenolic compounds. Plants for potential antibacterial activity because of the side effects and the resistance that pathogenic microorganisms build against antibiotics, recently much attention has been paid to extracts and biologically active compounds isolated from plant species used in herbal medicine. *Gymnema sylvestre* is a woody climber, is reported to cure cough, dyspnoea, ulcers, pitta, kapha and pain in the eyes. The plant is useful in inflammations, hepato splenomegaly, dyspepsia, constipation, jaundice, haemorrhoids, strangury, renal and vesical calculi, helminthiasis, cardiopathy, asthma, bronchitis, intermittent fever, amenorrhoea, conjunctivitis and leucoderma. The fresh leaves when chewed have the remarkable property of paralyzing the sense of taste for sweet and bitter substance for some time. Chemical constituents of the plant include the gymnemic acids (gymnemosides), saponins, stigmasterol, quercitol, and the amino acid derivatives betaine, choline, and trimethylamine. The present review has been made to investigate the phytochemical, pharmacological activity of different extracts of *G. sylvestre*.

KEYWORDS: *Gymnema sylvestre*, phytoconstituents, Pharmacology, Traditional use.

INTRODUCTION

Medicinal plants served as a platform for ancient Ayurvedic system of medicine. In the present scenario, herbal therapeutics is gaining momentum in pharmacological applications and as molecular targets in the drug development.

The emerging trend in rising incidence of diseases and associated complications with commercial medications poses a serious threat to mankind. It is estimated that nearly 80% of population depends on the natural remedies for health care. Plants are a valuable source of a number of bioactive compounds like alkaloids, quinine, paclitaxel, opium alkaloids, quinine, atropine, and cardiac glycosides to name a few. A major part of the total population in developing countries still uses traditional folk medicine obtained from plant resources (Abdul *et al.*, 2010).

According to WHO, medicinal plants are the best source to obtain a variety of newer herbal drugs. About 80% of individuals from developed countries use traditional medicine, which has compounds derived from medicinal plants. Therefore, such plants should be investigated to better understand their properties, safety and efficacy. India represented by rich culture, traditions and natural biodiversity, offers a unique opportunity for drug discovery researchers. In the last few decades, there has been an exponential increase in the field of herbal medicine for the treatment for chronic diseases (Satdive *et al.*, 2003).

Several natural products such as alkaloids, flavonoids, terpenoids, saponins, polysaccharides and glycosides are isolated from medicinal plants and are being reported to possess anti-diabetic activities. Herbal medicines used to treat infectious diseases were screened for their antibacterial activity against both gram positive and gram negative bacteria (Mukherjee *et al.*, 2006).

Gymnema sylvestre is referred to as “mesasrngi,” and both the dried leaf (mesasrngi leaf) and dried root (mesasrngi root) are used therapeutically. The leaves are opposite, usually elliptic or ovate. Leaves contain lupeol, β amyrin, stigmasterol, pentriacontane, hentriacontane, α and β chlorophyll, resin, tartaric acid, gymnemic acid, the mixture of triterpene saponins, anthraquinone derivatives, alkaloids, betain, choline and trimethylamine. The leaves of the plant in particular are used as antiviral, diuretic, antiallergic, hypoglycemic, hypolipidemic, for the treatment of obesity and dental caries. It is also used as Antibiotic, in stomach pains, as a blood purifier and in rheumatism.

Distribution

Gymnema sylvestre plants found throughout India in a dry forest up to 600m Deccan peninsula, it mainly grows in Western Ghats, Konkan, Tamil Nadu and some parts of Bihar. The plant is cultivated in plains of India. *G. sylvestre* is slow growing herb, found ideally in tropical and subtropical humid climate and common in hills of evergreen forests. It is a climber and generally requires support for growth. The plants having different nomenclature as per San: Mesasrngi, Madhunasin; Hin: Gudmar, Merasingi; Ben: Merasingi; Mal: Chakkarakolli, Madhunasin; Tam: Sirukurumkay, Sakkarakkolli; Kan: Kadhasige; Tel: Podapatra and in Marathi: Kavali.

Botanical description



Fig. 1: *Gymnema sylvestre* plant leaves, fruits and roots.

Gymnema sylvestre R.Br. belongs to family Asclepiadaceae, a large woody, much branched, climber with pubescent young parts, Leaves are simple, opposite, elliptic or ovate, more or less pubescent on both sides, (1.25–2.0 inch × 0.5–1.25 inch), inflorescence is lateral umbel in cymes; follicles are terete and lanceolate, up to 3 inches in height. Corolla is pale yellow in colour, valvate, campanulate with single corona with 5 fleshy scales. The calyx-lobes are long, ovate, obtuse, and pubescent. Carpels-2, unilocular, ovules locules may be present, anther connective produced into a membranous tip. Flowers are small, yellow and arranged in umbellate cymes. Fruits are slender and follicles are up to 7.5cm long (Warrier *et al.*, 1995).

Traditional uses

Gymnema sylvestre in Marathi Kaval plants is mentioned in Shushruta, an ancient book on medicine as a remedy for glycosuria and urinary disorder (Nadkarni, 1986). It is a therapeutic herb having multiple potentials as mentioned in folk medicine. Traditionally, it has been used to treat diabetes, malaria and snake bites as well as to treat diseases caused by phlegm and piles in the Ayurvedic system of medicine (Singh *et al.*, 2008). In Ayurveda, the plant is prescribed for the treatment of dyspepsia, constipation, jaundice, hemorrhoids, renal and vesicle calculi, cardiopathy, asthma, bronchitis, amenorrhea, and leucoderma (Anis *et al.*, 2000). Furthermore, different parts of the plant such as the roots, stem, and leaves have been used as cardiogenic, digestive, diuretic, laxative, stimulant, stomachic, and uterine tonic in traditional medicine systems (Mathew, 2004).

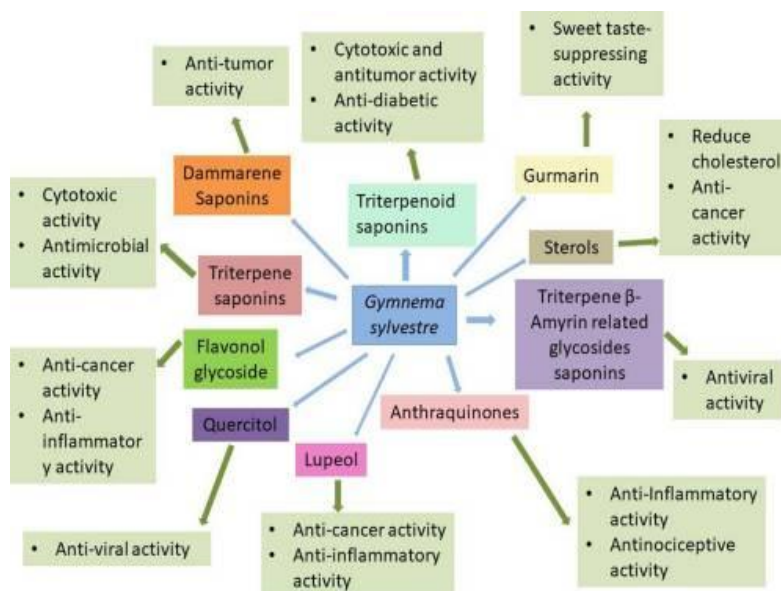


Fig. 2: Pharmacological activities of *Gymnema sylvestre* constituents.

Gymnema sylvestre is widely used as a naturopathic treatment for diabetes; it also demonstrates promising effects in the treatment of obesity, arthritis, hyperlipidemia, Parkinsonism, and hypercholesterolemia. Furthermore, the bioactive compounds of plant have antimicrobial, anti-inflammatory, and anticancer properties. The leaves of the plant are used for the treatment of obesity, dental caries, antibiotic, in stomachache, blood purifier, and in rheumatism. Some of the significant pharmacological properties of the herb had been discussed in detail.

1. Antidiabetic

The *Gymnema sylvestre* herb accounts for its sweet inactivation property to the presence of triterpene saponins known as gymnemic acids, Gymnema saponins, and gurmarin. There was a slight increase in body weight and protein and a

significant decrease in fasting blood glucose in diabetic rats treated with *G. sylvestre*, *C. auriculata*, *E. jambolanum*, and *S. reticulata* and the effects were quite similar to insulin and glibenclamide treated mice.

Gymnema leaf ethanolic extract have a role of antioxidants in diabetic rats. Further LC/MS analysis revealed the presence of antihyperglycemic compounds like gymnemagenin and gymnemic acids in *G. sylvestre* extract and the level of lipid peroxidation reduced by 31.7% in serum, 9.9% in liver, and 9.1% in kidney in diabetic rats fed with the ethanolic extract. Anti hyperglycemic effect of crude saponin fraction and five triterpene glycosides (gymnemic acids I–IV and gymnema saponin V), isolated from the methanolic extract of the leaves, was reported (Sugihara, *et al*, 2000). It was found that gymnemic acid IV (3.4/13.4mg/kg) decreased blood glucose levels by 14.0–60.0% within 6 hours of administration as compared to glibenclamide.

2. Antiarthritic

The leaf extract of *G. sylvestre* was assumed that the most potent antiarthritic activity of the leaves may be due to the nature of triterpenoids, steroids, and saponin glycosides (Malik, *et al*, 2010). The petroleum ether extract treated group showed significant reduction in paw swelling possibly due to inhibiting the response of inflammatory cells or blocking the release of mediators like cytokines (IL-1b and TNF-a), GM-CSF, interferons, and PGDF which are responsible for pain and disabilities arising due to destruction of bone and cartilage (Eric and Lawrence, 1996). The other possible mechanism of action suggested protection of the release of joint cartilage and bone destruction in chronic arthritic model. The multiple studies employing use of polar solvents in extract preparations by investigators demonstrated the anti arthritic potential of the leaf extract (Malik *et al*, 2010).

3. Dental Caries.

Dental caries can be defined as infection of tooth, occurring due to various kinds of grampositive cariogenic bacteria, like *S. aureus*, *S. mitis*, and *S. mutans*, and fungus-like *Candida albicans* which attaches to the tooth surface through release of extracellular polysaccharides from sucrose and metabolize sugar to organic acid mainly lactic acid resulting in demineralization of the tooth enamel (Akhtar and Bhakuni, 2004). The chloroform, petroleum ether, and methanolic leaf extracts of *G. sylvestre* at various concentrations of 25, 50, and 100mg/mL were tested against microbial dental infections and found to be significantly effective against these cariogenic bacteria particularly the methanolic extract which showed highest activity at minimum concentration. The good potential of the hydroalcoholic extract of the plant leads to the development and manufacture of gurmar tooth powdered marketed as “Gurmar Herbal tooth paste” and “Gurmar Herbal Tooth powder.” These herbal formulations offer new prospects in the treatment of dental caries once clinically approved by the scientific community (Parimala Devi and Ramasubramaniraja, 2010).

4. Antibiotic and Antimicrobial

The antibiotic and antimicrobial activity of different extracts of *G. sylvestre* was determined against a number of pathogens, namely, *S. aureus*, *E. coli*, and *B. subtilis*, while no activity was observed against gram-negative bacteria. *G. sylvestre* leaf extracts showed good prospects as an antibiotic herbal remedy was effective as herbal formulation for the treatment of microbe's related infections (Saumendu *et al*, 2010). The antibacterial activity of *G. sylvestre* and gymnemic acid was also studied against *E. coli* and *B. cereus* and the antimicrobial effect was significant against the microbes (Yogisha and Raveesha, 2009). The antimicrobial effect of ethanolic extract of *G. sylvestre* against *Bacillus pumilus*, *B. subtilis*, *P. aeruginosa*, and *S. aureus* showed promising antimicrobial effect (Satdive *et al*, 2003). It can be

inferred from the studies that the methanolic and ethanolic leaf extract of *Gymnema sylvestre* possesses considerable antibiotic and antimicrobial activity.

5. Anti-Inflammatory

The leaf of *G. sylvestre* has been widely used and is considered as bitter, acrid, thermogenic, digestive, liver tonic, anodyne, and anti-inflammatory in Ayurvedic system of medicine (Kokate, 1999). The bioactive constituents in *G. sylvestre* known as tannins and saponins are responsible for the anti-inflammatory activity of the plant (Diwan, 1995). It was found that the *Gymnema* aqueous extract at a concentration of 300mg/kg significantly decreased the paw edema volume by 48.5% within 4 hours of administration, while the drug phenyl but azone decreased the paw edema volume by 57.6%. Also, the aqueous extract at a concentration of 200 and 300mg/kg exhibited reduction in granuloma when compared with the control group (Malik, *et al*, 2007).

6. Anticancer and Cytotoxic

Many plant derived saponins, namely, ginsenosides, soyasaponins, and saikosaponins have been found to exhibit significant anticancer activity. Anticancer potential of gymnemagenol on *HeLa* cancer cell lines in *invitro* conditions was determined (Jain *et al*, 2007). The cytotoxic activity of the saponins was tested by MTT cell proliferation assay. The bioactive constituent, gymnemagenol, was found to show a high degree of inhibition to the proliferation of *HeLa* cancer cell line. Further, these saponins were not toxic to the growth of normal cells under *in vitro* conditions, with the rising percentage of cancer in people, the herbal formulation is a prospective medication in cancer therapy (Khanna and Kannabiran, 2009).

7. Antihyperlipidemic

The prevalence of coronary artery disease is the cause of higher incidence of mortality than other causes combined. The major factor contributing to atherosclerosis and related disorders like coronary artery diseases is hyperlipidemia. Reduction in serum cholesterol levels may significantly reduce the chances of coronary heart disease (Hardman *et al*, 2001). Due to the limitations of synthetic drugs in having adverse effects, plant-based formulations offer a good prospect for the treatment of heart disease. *Gymnemic* acids preparations have been found to be effective against obesity. The group administered with hydro alcoholic extract of *Gymnema* leaves at a dose of 200mg/kg showed significant reduction in the levels of all lipids with increase in HDL-C as compared to high cholesterol diet control (Rachh *et al*, 2010).

The hexane extract improved the cholesterol, triglyceride, LDL, and HDL levels. The hexane extract of the leaves of *G. sylvestre* have the potential to treat obesity comparable with that of standard drug, atorvastatin (Shivaprasad *et al*, 2006).

8. Immunostimulatory

The term Immunomodulation is referred to as the regulation or control of the immunity which involves the enhancement or reduction in the immune responses. The body response to a particular condition might be regulated by agent that enhances or suppresses its action (Trease and Evans, 1983). *G. sylvestre* is reported to be an Immunostimulatory plant and the leaves possess immunostimulatory effect. The aqueous leaf extract was tested for immunostimulatory activities by detecting the movement of neutrophils, chemotaxis tests, phagocytosis of killed *C.*

albicans, and nitroblue tetrazolium assays. Aqueous leaf extract of *G. sylvestre* showed remarkable immunostimulatory activity at 10, 25, 50, 100, and 1000 $\mu\text{g/mL}$ on human neutrophils under *in vitro* conditions (Malik *et al.*, 2009).

9. Hepatoprotective

The hepatoprotective effect of hydro-alcoholic extract of *G. sylvestre* was evaluated by Srividya *et al.* (2010). The rat hepatocytes (freshly prepared) were subject to treatment with different concentration of hydroalcoholic extract prepared by the hot maceration process. The extract at concentrations of 200, 400, and 600 $\mu\text{g/mL}$ showed significant anti hepatotoxicity against the D-galactosamine-induced hepatotoxicity, and the concentration of 800 $\mu\text{g/mL}$ was found to be cytotoxic.

10. Wound Healing

The *G. sylvestre* alcoholic extract of leaves of was found to exhibit significant wound healing activity in rats. The hydroalcoholic extract of *G. sylvestre* has good wound healing property as compared with control group. TLC analysis, wound contraction, and qualitative tests supported the synergistic wound healing effect of the plant. The increased wound healing activity of hydroalcoholic extracts may be attributed to the free radical scavenging action and the presence of phytoconstituent (flavonoids) which may act individually or have additive effect (Kiranmai *et al.*, 2011).

11. Ethnobotanical Uses.

The leaves of *G. sylvestre* were traditionally used for the treatment of diabetes and other disorders, while the flowers and bark are given in diseases related to phlegm (Kirtikar and Basu, 1975). The ancient literature on Indian medicine, *Sushruta*, describes gurmar as a destroyer of Madhumeha (glycosuria) and other urinary disorders. The plant extract is reported to be a bitter acrid, anti-inflammatory, anodyne, digestive, liver tonic, emetic, diuretic, thermogenic, stomachic, stimulant, anthelmintics, laxative, cardiogenic, expectorant, antipyretic, and uterine tonic.

The *G. sylvestre* plant also exhibits medicinal importance in the treatment of human diseases like jaundice, constipation, cardiopathy, asthma, bronchitis, amenorrhoea, conjunctivitis, renal and vesical calculi, dyspepsia, leucoderma, and Parkinsonism (Anis *et al.*, 2000). As per ancient literature this kawali plant has multiple medicinal applications namely, antihelminthic, antipyretic, astringent, an alexipharmic, anodyne, cardiogenic, digestive, diuretic, cough dyspepsia, hemorrhoids, hepatosplenomegaly, laxative, stimulant, stomachic, uterine tonic, intermittent fever, jaundice, and leucoderma. The root bark of *G. sylvestre* is useful as an emetic, expectorant, and analgesic for bodyache and root juice in the treatment of snakebite (Sastry, 1994).

Conclusion and Future Prospects

G. sylvestre plant is of good prospects of herbal medicines. Due to lack of availability of standards for herbal formulations is a major limitation. Although, a vast repertoire of plant resources is available but very few have experimentally validated and scientifically approved as medications for the treatment of diseases. The many medicinal plants of commercial importance face threat of extinction due to increase in demand and destruction of their habitats due to urbanization and industrialization. The prime initiative should focus on the cultivation and conservation of medicinal plants with pharmacological importance.

G. sylvestre, being a valuable medicinal plant and source of bioactive substances, needs to be propagated and conserved. *In vitro* propagation of plants with high bioactive content and cell culture technologies for large-scale

production of such secondary metabolites with medicinal significance will be highly prospective and will provide new dimensions to this area of research. Studies have been made in the past few years to understand the complex and incompletely understood nature of plant cells *in vitro* cultures. *G. sylvestre* holds a unique position among the sweetness modifying materials of natural origin. *G. sylvestre* dried leaf powder is orally consumed by Paliyan tribes of Sirumalai hills for treatment of diabetes. Among the medicinal plants, *G. sylvestre* is herb less exploited for its innumerable advantages.

The main aim of this review of *G. sylvestre* plant is to highlight the prospects of this rare herb as a potential medication for treatment of diseases from diabetes, obesity to cardiovascular disorders as well as a very good dietary and health supplements in food industry as an health tablets, beverages, tea bags, energy supplements, and in food items which regulates body weight. The development of genetic transformation systems will provide an edge in the propagation and maintenance of such pharmacologically important plant having applications in drug discovery and development.

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