A CONCISE REVIEW ON GURMAR -GYMNEMA SYLVESTRE R.Br


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ABSTRACT

Gymnema sylvestre R.Br (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., The present study aims at pharmacognosy, phytochemical and medicinal properties of Gymnema sylvestre R.Br.

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

1.0 INTRODUCTION

Gymnema sylvestre R.Br(Family: Asclepiadaceae) – gurmar or sugar destroyer is a woody plant with nativity to India. This climber has a past history of usage about 2000 years in India for the treatment of “Madhumeha or Honey urine”.[2,36 &74] The word Gymnema is derived from a Hindu word "Gurmar" meaning "destroyer of sugar" and it is believed to be chewing of the leaves neutralizes the excess of body sugar level.[25&37] The plant species is also known to be as ‘Miracle fruit’. [38] The plant had its extensive usage in various traditional literatures such as Australia, Japan and Vietnam. The plant is widely distributed in various parts of the world - India, Sri Lanka, Malaysia, Japan, Australia, Indonesia, Vietnam, Tropical Africa and Republic of China.[6, 8 &66]

2.0 REGIONAL NAMES[2,17, 28, 44, 45, 51, 53 & 54]

Bengali Mera-singi
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Gujrati Dhuleti, mardashingi
Hindi Gurmar
Kannada Sannagerasehambu, kadhasige
Malayalam Chakkarakkolli, madhunashini
Marathi Kavali, kalikardori, vakundi
Oriya Gudmari
Sanskrit Meshashringi (Meaning - ram's horn), madhunashini, vishani.
Tamil Adigam, cherukurinja
Telugu Podapatri

Synonyms: Periploca of the woods, cow plant, Australian cow plant.

Biological Synonyms: Periploca sylvestris Retz
Gymnema affine Decaisne
Gymnema formosana Warburg
Gymnema alternifolium (Lour) Merr.

3.0 TAXONOMICAL CLASSIFICATION[13, 28 &58]
Kingdom - Plantae
Subkingdom - Tracheobionta
Super division - Spermatophyta
Division - Magnoliophyta
Class - Magnolopsida
Subclass - Asteridae
Order - Gentianales
Family - Asclepiadaceae
Genus - Gymnema
Species - sylvestre

4.0 DISTRIBUTION
The woody climber is distributed throughout India in an attitude ranging from 300-700 m - Banda, Konkan, Western Ghats and Deccan extending to the part of the northern and western India, Tamil Nadu, Karnataka and Uttar Pradesh. It is also distributed in Asia, Tropical Africa, Malaysia and Srilanka. It is occasionally cultivated as a medicinal plant.[38, 55 &67]
5.0 CULTIVATION & PROPAGATION.\textsuperscript{[3 & 71]}

5.1 Soil and Climate
The plant grows in all types of soils in the tropical and sub tropical regions with an altitude of 600m.

5.2 Nursery Raising and Planting
Germination of the plant is done using mature seeds in small polybags or poly boxes in a primary field during the month of October-December. The raised plants are transplanted to the main field in February – March and are supported with proper support for the climbing purpose. Cultivation of the plant can also be achieved through cuttings and planted in rainy seasons.

5.3 Weeding
The cultivated land is periodically weeded and hoed especially after the rainy seasons.

5.4 Manure and Fertilizer
Compost or Vermi compost is suitable for the primary field and secondary field after transplantation.

5.5 Irrigation
Periodic irrigation as and when required may be done weekly/fortnightly.

5.6 Harvesting/post-harvesting
The best period of harvesting is one year after transplantation. Usually the leaves are collected during October-February and are washed and dried in shade. Whereas, the roots are collected during summer and are freed of earthy matters, washed, cut into pieces and are sun and shade dried.

5.7 Flowering and fruit period: April – June.\textsuperscript{[5]}

5.8 Commercial varieties: Jhalawar, Lotiajhir, RUBL 18050 (NKS 1343).\textsuperscript{[5]}

6.0 PLANT DESCRIPTION
\textit{Gymnema sylvestre} is a perennial climber with woody nature, largely seen in most parts of India. The plant is seen with rooting at nodes. Leaves - elliptic, acuminate and the base - acute to acuminate, glabrous sparingly above or densely tomentose beneath. Flowers are small, occurs in axillary and lateral umbel like cymes, pedicels - long; Calyx - lobes are long, ovate, obtuse, pubescent; Corolla - pale yellow, campanulate, valvate, corona single, with 5 fleshy scales. Scales - adnate to throat of corolla tube between lobes. Anther is connective produced into a membranous tip, pollinia 2, erect, carpels 2, unilocular; locules many ovuled. Follicle – long and fusiform.\textsuperscript{[16, 18, 25, 31 & 77]}
6.1 Macroscopy and Microscopical characters

6.1.1 Leaves
Colour  Green
Size  2-6cm length, 1-4cm width.
Margin  Entire
Apex  acute
Venation  Reticulate.
Odour  Characteristic
Taste  Slightly bitter and astringent\textsuperscript{[1 &31]}

6.1.2 Lamina
Epidermal cells are square shaped with outer convex wall and thin cuticle. The epidermal cells are interrupted with uniseriate, multicellular trichomes of 2-5 celled seen on both upper and lower epidermis. Palisade cells are compactly arranged, Vascular bundles – amphicribral type.\textsuperscript{[1,17,31 & 70]}

6.1.3 Stem
6.1.4 Petiole
Made up of Horse shoe shaped cells. Epidermis – single layered, thick walled cells. Uniseriate, multicellular, covering trichomes are seen intercepting the epidermal layer. Cortex – collenchymatous cell, vascular bundles - amphicibriral type, phloem – sieve tubes, companion cells and phloem parenchyma. Xylem - vessels, tracheids and trachedial fibres. Starch grains – simple or compound, polygonal.[1,31, 60 & 70]

6.1.5 Powder
The powdered crude drug was found to be slightly yellowish green colour, taste – bitter, odour – pleasant aromatic. Powder microscopy of gurmar shows thick walled, uniseriate multicellular trichomes, anomocytic stomata, occurrence of idioblast with calcium oxalate crystals rosette, starch grains, remnants of collenchymatous and parenchymatous cells, vessels, tracheids, trachedial fibres, bast fibres and sieve plates.[1 , 31, 60 & 70]

7.0 TRADITIONAL USES
The Jungle Irulas, inhabitants of Nagari hills of the Chittoor District, Bombay and Gujarat from India, Bourgeois of Bombay and Gujarat have the habit of chewing a few green leaves of G. sylvestre in the morning in order to keep the urine clear and to reduce glycosuria. In Bombay and Madras, ‘Vaids’ are known to recommend the leaves in the treatment of furunculosis and Madhumeha. The Juice obtained from root is used to treat vomiting and in dysentery and the plant paste is applied with milk to treat mouth ulcer.[1, 14, 28 & 67]

G. Sylvestre is used in folk medicine and Ayurvedic system of medicine to treat type 1 and 2 diabetes. It is also helpful for the treatment of urinary complaints, chronic cough, piles,
stomach problems, breathing troubles, asthma, eye complaints, cardiopathy, jaundice, constipation and bronchitis. It is also used by trials to treat to neutralize the toxin of snake bite.\cite{11, 38, 40, 63 & 72}

8.0 PHYSICOCHEMICAL EVALUATION

Powdered crude drug when treated with 1N aqueous sodium hydroxide and 50 % potassium hydroxide shows green fluorescence under UV at 254 nm and orange yellow colour with 50 % nitric acid in day light.\cite{17 & 71}

Loss on Drying(Moisture content) of the powdered crude drug was found to be not more than 6.0%, Total ash- Not more than 12.0%, Acid insoluble ash- Not more than 2.0%, Ethanol soluble extractive- Not less than 20.0%, Water soluble extractive-Not less than 29.0%, Heavy metal content in leaves or leaf extract NMT 40ppm and final dosage form Not more than 10ppm.\cite{1, 17, & 56}

Flouresence analysis of the powdered crude drug exhibits the following results.

Table : 01 Fluorescence analysis of the powdered aerial part of G. sylvestre R. BR\cite{23}

<table>
<thead>
<tr>
<th>S.No</th>
<th>Experiment</th>
<th>Visible/Day light</th>
<th>UV light 254nm</th>
<th>UV light 365nm</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Powdered drug</td>
<td>Green</td>
<td>Green</td>
<td>Light Green</td>
</tr>
<tr>
<td>02</td>
<td>Powder + 1N Sodium hydroxide(aqueous)</td>
<td>Brown yellow</td>
<td>Light green</td>
<td>Dark green</td>
</tr>
<tr>
<td>03</td>
<td>Powder + 1N Sodium hydroxide (alcohol)</td>
<td>Light yellow</td>
<td>Fluorescent green</td>
<td>Orange</td>
</tr>
<tr>
<td>04</td>
<td>Powder + 1N Hydrochloric acid</td>
<td>Brown</td>
<td>Light brown</td>
<td>Brown</td>
</tr>
<tr>
<td>05</td>
<td>Powder + 50% Sulphuric acid</td>
<td>Brown</td>
<td>Light blue</td>
<td>Light green</td>
</tr>
<tr>
<td>06</td>
<td>Drug powder + Nitric acid</td>
<td>Reddish brown</td>
<td>Light green</td>
<td>Light green</td>
</tr>
<tr>
<td>07</td>
<td>Drug Powder + Picric acid</td>
<td>Green</td>
<td>Fluorescent green</td>
<td>Green</td>
</tr>
<tr>
<td>08</td>
<td>Drug Powder + Acetic acid</td>
<td>Yellow</td>
<td>Fluorescent green</td>
<td>Fluorescent green</td>
</tr>
<tr>
<td>09</td>
<td>Drug Powder + Ferric chloride</td>
<td>Light brown</td>
<td>Light green</td>
<td>Green</td>
</tr>
<tr>
<td>10</td>
<td>Drug Powder + Nitric acid+ Ammonia</td>
<td>Light brown</td>
<td>Light green</td>
<td>Pale green</td>
</tr>
</tbody>
</table>

9.0 PHYTOCHEMICAL STUDIES

Preliminary phytochemical studies of the aerial parts of Gymnema sylvestre R.Br shows the presence of Alkaloids, terpenoids, steroids, coumarin, tannins, saponins, flavanoids, quinines, anthroquinones, phenolics, xanthoproteins, carbohydrates, glycosides and fixed oils.\cite{23}
9.1 Leaves

The leaves are said to contain triterpene saponins – oleanane and dammarene classes. Oleanane saponins are Gymnemic acids, gymnema saponins. Dammarene saponins are gymnemosides.\[12,26 & 76\]

The individual gymnemic acids (saponins) include gymnemic acids 1-VII, gymnemosides A-F.\[67\] Triterpenoid saponins - Gymnenmasins A,B,C and D.\[59 & 69\] Other constituents - resins, albumin, chlorophyll, carbohydrates, tartaric acid, formic acid, butyric acid, anthraquinone derivatives, inositol alkaloids, organic acid (5.5%), parabin, calcium oxalate (7.3%), lignin (4.8%), cellulose (22%), \[21\] acidic glycosides and anthraquinones and their derivatives.\[37\] Gymnestrogenin, a new pentahydroxy triterpne from the leaves has been recently reported.\[62\]

Gurmarin, a polypeptide isolated from the leaves of the Gymnema sylvestre found to suppress the sweet taste of sucrose, glucose, glycine and saccharin.\[4, 43 & 50\] Gymnamine and conduritol were also reported from the leaves of gurmar.\[15, 50 & 64\]

9.2 Aerial Parts

kaempferol -3 -0 -beta – D – glucopyranosyl -(1 -- > 4) - alpha- l- rhamnopyranosyl-(1 -- > 6) -beta- D- glucuronopyranoside.\[19, 29, 30 & 35\]
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Conduritol

Gymnemagerin
Gymnemic acid I
Gymnemic acid II
Gymnemic acid III
Gymnemic acid IV
Gymnemic acid V
Gymnemic acid VI
Gymnemic acid VII
Gymnemic acid VIII
Gymnemic acid IX
Gymnemic acid X
Gymnemic acid XI
Gymnemic acid XII
Gymnemic acid XIII
Gymnemic acid XIV

R₁ R₂ R₃ R₄
H H H H
β-glα tga tga tga
β-glα mba mba mba
β-glα mba mba mba
β-glα tga tga tga
β-glα tga tga tga
β-glα tga tga tga
β-glα tga tga tga
β-glα tga tga tga
β-glα tga tga tga
β-glα H H H
β-glα tga tga tga
β-glα H H H
β-glα H H H

Gymnastrogenin
<table>
<thead>
<tr>
<th>Sr no</th>
<th>Chemical constituents</th>
<th>Structures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Gymnemoside A</td>
<td><img src="image1.png" alt="Structure 1" /></td>
</tr>
<tr>
<td>2.</td>
<td>Gymnemoside B</td>
<td><img src="image2.png" alt="Structure 2" /></td>
</tr>
<tr>
<td>3.</td>
<td>Gymnemoside C</td>
<td><img src="image3.png" alt="Structure 3" /></td>
</tr>
<tr>
<td>4.</td>
<td>Gymnemoside D</td>
<td><img src="image4.png" alt="Structure 4" /></td>
</tr>
<tr>
<td>5.</td>
<td>Gymnemoside E</td>
<td><img src="image5.png" alt="Structure 5" /></td>
</tr>
<tr>
<td>6.</td>
<td>Gymnemoside F</td>
<td><img src="image6.png" alt="Structure 6" /></td>
</tr>
</tbody>
</table>
Structures of Gymnemosides.\cite{51}

10. PHARMACOLOGICAL STUDIES

10.1 Antiobesity studies

Studies shows 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.\cite{41,48,60} *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.\cite{52,60} *Gymnema sylvestre* leaf aqueous extract was evaluated for its antiobesity studies at 100mg/kg body weight on high fat diet induced Wistar rats. Orlistat was the standard drug used and the study was carried for a period of 8 weeks. Parameters such as changes in body weight, organ weight and other related plasma biochemical profile was monitored. The aqueous extract is found to be a potent antiobese agent by suppressing the body weight gain, organ weights and other plasma lipid levels.\cite{57} 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.\cite{39} Hexane fractions of *Gymnema sylvestre* was evaluated for antiobesity properties in sprague dawley rats. A significant reduction in increased body weight, temperature due to obesity was observed after 45 days of treatment. The fraction also improved the triglycerides, LDL, HDL, cholesterol levels.\cite{24} Use of *G. sylvestre* in combination with fenugreek, chitosan and vit. C was investigated on obese adults (body mass index 30 kg/m 2 or more) and found significant loss in body weight.\cite{75}

10.2 Antidiabetic Activity

The first scientific evidence of *G. sylvestre* effect on human diabetes dates back to century.\cite{9} Gurmar leaf powder had shown significant effect on blood glucose levels on experimental animals.\cite{44} Antihyperglycemic effect of crude saponins and five triterpene glycosides from methanolic extract of *G. sylvestre* was studied.\cite{68} Mary sujin et al reported the antidiabetic effect of *G.Sylvestre* powder in the stomach of rates.\cite{34} Dihydroxy gymnemic triacetate was isolated from acetone extract of *G. sylvestre* and was tried for its antidiabetic and hypolipidemic properties at 20mg/kg body weight. The isolated compound was found to be a potent normoglycemic and hypolipidemic agent by increasing plasma insulin, muscle
and liver glycogen content. It also decreased blood glucose and glycated haemoglobin levels and maintains the hepatic enzymes and serum lipid at normal levels.\textsuperscript{[49]}

### 10.3 Hypolipidaemic Activity
On administration of leaf extract of \textit{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.\textsuperscript{[7 &54]}

### 10.4 Antimicrobial Activity
The leaf ethanolic extract of \textit{G. sylvestre} leaves was found to be effective against \textit{Bacillus pumilis}, \textit{B. subtilis}, \textit{Pseudomonas aeruginosa} and \textit{Staphylococcus aureus} and ineffective against \textit{Proteus vulgaris} and \textit{Escherichia coli}.\textsuperscript{[62]} Aqueous and methanolic extract of leaves of \textit{G. sylvestre} was found to be moderately effective against \textit{Salmonella} species (\textit{Salmonella typhi}, \textit{S. typhimurium} and \textit{S. paratyphi}).\textsuperscript{[46]} Ethanolic, Chloroform and Ethyl acetate extracts of the aerial parts of \textit{G. sylvestre} was found to be antibacterial against \textit{P. vulgaris}, \textit{E. coli}, \textit{P. aeroginosa}, \textit{Klebsella pneumoniae} and \textit{S.aureus}.\textsuperscript{[47]} Petroleum ether, chloroform and ethanol extracts of leaves of \textit{Gymnema sylvestre} were evaluated against a broad spectrum of gram positive and gram negative bacteria’s using agar well diffusion method. All the extracts were found to be potent antibacterial in dose dependent manner with poor or nil activity at 10 and 20mg/ml.\textsuperscript{[61]}

### 10.5 Antiviral activity
Gymnemic acids A to D isolated from the aqueous extract of leaves of \textit{Gymnema sylvestre} were tested againsy \textit{in vitro} influenza virus. Viral growth cycle was studied in control and treated cultures. The yield of viral hemagglutinin 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.\textsuperscript{[22]}

### 10.6 Anti-Inflammatory Activity
Anti-inflammatory activity of aqueous extract of \textit{G. sylvestre} was carried out using carrageenin-induced paw oedema and cotton pellet models in rats at 200, 300 and 500mg/kg. The activity was compared with the standard drug phenyl butazone. Aqueous extract decrease the paw oedema by 48.5% at 300mg/kg b.wt, whereas the standard drug by 57.6% within 4
hrs. The aqueous extract at 200mg/kg and 300mg/kg produced significant reduction in granuloma weight also and the results were comparable to that of the standard drug phenylbutazone.[32]

10.7 Free Radical Scavenging Activity
Aqueous extract of *G. sylvestre* was screened for its free radical scavenging properties by DPPH and LDL oxidation method. It is found to be 32.1μl of aqueous extract is required to produce 50% of scavenging of the DPPH radicals.[42]

10.8 Immunomodulatory activity
*Gymnema sylvestre* aqueous leaf extract was tried for its immunomodulatory activity by determining neutrophil locomotion, chemotaxis test, phagocytosis of killed *Candida albicans* and nitroblue tetrazolium tests. The aqueous extract of leaves significantly increased the phagocytic function and chemo tactic movement at 25μg/ml. Also intracellular reduction of nitroblue tetrazolium dye to formazan was increased indicating killing property of neutrophils at 50μg/ml concentration. All these results showed Immunomodulatory activity of *Gymnema sylvestre*. [20]

10.9 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.[65]

10.10 Snake venom neutralizing effect
*Gymnema sylvestre* was tested for antidote property against snake venom and found to be effective. The activity of the plant was believed to be due to gymnemgenin.[73]

10.11 Wound healing activity
Carbopol gels was prepared using hydroalcoholic extracts of *Gymnema sylvestre* and *Tagetes erecta Linn*. The prepared gel was evaluated for wound healing activity by excision wound model and burn wound models in albino mice. The study was compared with the standard metrogyl. Significant increase in percentage wound contraction was observed in groups treated with both extracts and were comparable to that of the standard.[27]
10.12 Radioprotective Activity
Gymnemic acid isolated from *Gymnema sylvestre* was tried out for its radioprotective effect on swiss albino mice. Hepatic biochemical alterations were monitored. Gymnemic acid lowered lipid peroxidation, protected the endogenous GSH depletion, increased protein concentration and showed a significant hepato-protective effect against irradiation as compared to normal and control groups.\(^6\)

10.13 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.\(^10\)

11.0 CONCLUSIONS
*Gymnema sylvestre* R.Br(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. The 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.

12.0 REFERENCES


56. Rajpal V. Testing and extraction methods of medicinal plants, 2006; 1: 140-150.


