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Debasmita Dutta Pramanick
Botanical Survey of India,
Headquarter, CGO Complex,
3rd MSO Building, Sector-1,
Salt Lake City, Kolkata-700064,
West Bengal, India.

Anatomical studies on the leaf of *Gymnema sylvestre* (Retz.) R.Br. ex Schult. (Apocynaceae): A magical herbal medicine for diabetes

Debasmita Dutta Pramanick

Abstract

Gymnema sylvestre (Retz.) R.Br. ex Schult., belongs to the family Apocynaceae, is a potent antidiabetic herb which has a reputation in Indian Proprietary medicine since the time immemorial. The plant is documented as having beneficiary effects in diabetes due to presence of gymnemic acid. In addition, the plant is also reputed in traditional system of medicine for treatment of various ailments. The present paper deals with morphological and anatomical evaluation of *Gymnema sylvestre* (Retz.) R.Br. ex Schult. along with its traditional uses.

Keywords: *Gymnema sylvestre* (Retz.) R.Br. ex Schult., Morphology, Anatomy, Traditional uses.

1. Introduction

Gymnema sylvestre (Retz.) R.Br. ex Schult., commonly known as ‘Gurmar’, belongs to the family Apocynaceae is one of the most important indigenous medicinal plants of India. The use of this plant to cure diabetes mellitus in India is well practiced since the time immemorial. The plant is widely distributed in Asia, Australia and tropical Africa. In India, the plant is found to grow in open tropical rainforests of central and southern states at an altitude of 100-1000m. It is also reported from Western Ghats area and extending upto some parts of Western and Northern India ^[1, 2]. The plant is variously named as ‘Periploca of the woods’ (Eng.); ‘Gurmar’, ‘Gurmarbooti’, ‘Merasingi’ (Hindi); ‘Kavali’, ‘Kalikardori’, ‘Vakundi’ (Marathi); ‘Meshashringi’, ‘Madhunashini’ (Sanskrit); ‘Dhuleti’, ‘Mardashingi’ (Gujarati); ‘Adigam’, ‘Cherukurinja’ (Tamil); ‘Podapatri’ (Telegu); ‘Sannagerasehambu’ (Kannada) etc ^[3-7]. The generic name ‘*Gymnema*’ is derived from two Greek words ‘*Gymnos*’ (naked) and ‘*nema*’ (thread) while the specific epithet ‘*sylvestre*’ is of Latin origin, means ‘of the forest’ ^[8]. According to the ancient literature, the name ‘Gurmar’ indicates “Destroyer of sugar” and it is believed to be good neutralizer of excess sugar present in the body of diabetics.

G. sylvestre is a potent antidiabetic plant which is used in Ayurvedic, Homeopathic, Siddha and folk medicine. The use of *Gymnema* leaf in traditional healthcare system especially for the treatment of diabetes is dated back since 2000 years ago. Sushruta described the plant as a destroyer of madhumeha (Glycosuria). The hypoglycemic property of *Gymnema* leaf was first revealed by a British officer in the mid 19th Century ^[9]. Presence of gymnemic acid in leaves suppresses the transport of glucose from the intestine into the blood stream resulting lowering of blood sugar level, cholesterol level, balancing insulin level and also promotes weight loss. The leaves are also used effectively for curing stomach ailments, constipation, liver diseases, anaemia, digestion, eye complains, jaundice, hemorrhoids, heart disease, asthma, bronchitis, leukoderma etc. The leaves act as anti-inflammatory, anthelmintic, laxative, cardiotoxic, expectorant and anti-pyretic ^[10]. The plant is reported to possess antimicrobial, hepato protective and free radical scavenging activity ^[11, 12].

According to the ethnobotanical surveys, the plant is widely used by different tribal communities of Deccan Peninsula. It has been reported that Irulas of Nagari hills of the N. Arcot Dist. chew a few green leaves in the morning for clear urine and to reduce glycosuria. Bourgeois class of Bombay and Gujarat has also been reported to practice the same for the similar effects. The root extract is prescribed by ‘Vaid’ of some regions of Bombay, Goa and Madras to cure vomiting and dysentery ^[13]. In traditional system of medicine, the leaves are used as diuretic and as effective antidote of snakebite ^[14]. Being a very important medicinal plant, used in various antidiabetic and antiobesity formulations, overexploitation is resulted. Many fold uses of plant based medicine, increase in commercial market demand in national

Correspondence:

Debasmita Dutta Pramanick
Botanical Survey of India,
Headquarter, CGO Complex,
3rd MSO Building, Sector-1,
Salt Lake City, Kolkata-700064,
West Bengal, India.

and international basis and extensive uprootation has made the plant rare in several states of India [15, 16].

2. Materials and Methods

The dried leaf sample of *Gymnema sylvestre* were procured from local drug market of Kolkata. The fresh leaves were collected from TBGRI Campus, Pachapalode, Kerala and identified with the help of authentic literature and herbarium specimens. After authentication, the leaves have been examined macroscopically and microscopically following standard method [17]. The shed dried and half dust grinded leaves were subjected to powder analysis.

3. Results and Discussions

3.1. Morphological evaluation

Gymnema sylvestre is a perennial, woody climber, wildly running over the tops of the trees. Stems cylindrical, hard, twining, branched; internodes terete; rooting at nodes. Leaves opposite, elliptic or ovate, 1.0-9.5 x 0.5-5.5cm, acute at apex, base rounded, ciliate along margins, smooth above, densely velvety pubescent beneath, especially on the nerves; petioles 0.5-1cm long, pubescent. Flowers small, yellow, in axillary and lateral umbellate cymes. Calyx 5-lobed, ovate, obtuse, ciliated; corolla campanulate, yellow, 5-lobed; lobes ovate-deltoid, spreading and glabrous, united at base; corona with 5-fleshy scales adnate to the throat of corolla tube between lobes; stamens 5; anther connective is modified into a membranous tip; gynostegium erect. Carpel-2; ovary unilocular; ovule many; style apex thick, sub-hemispherical. Follicles terete, lanceolate, arise in pairs, 5.0-7.5 cm long. Seed 10-12, dark-brown. (Plate 1).



Plate 1: *Gymnema sylvestre* (Retz.) R.Br. ex Schult.: A. Habit; B. Flower; C. Fruit (Follicle).

3.2. Anatomical evaluation

3.2.1. Petiole

Transverse section of petiole is horse shoe shaped. The epidermis is composed of single layered, thick walled, barrel shaped cells, covered by uniseriate, multicellular non-glandular trichomes. The cortex is collenchymatous. Vascular bundles are amphicribal and three in number; xylem consists of vessels, tracheids and tracheidal fibres; phloem consists of well-developed sieve tubes, companion cells and phloem parenchyma. The starch grains are simple or compound, polygonal. The rosette crystals of Ca-oxalate are abundant towards the centre. (Fig. 1. A).

3.2.2. Lamina

In transverse section, lamina shows a typical dorsiventral structure. The epidermis of both the surfaces consists of single layered, rectangular to barrel shaped cells with outer convex wall and thin cuticle. Both the epidermis are externally covered by uniseriate, multicellular, 2-5 celled trichomes. Mesophyll tissue is differentiated into two layers, viz. palisade and spongy parenchyma. The vascular bundle is surrounded by a parenchymatous bundle sheath. Laticiferous tubes are present in the midrib. The xylem is characterized by the presence of small vessels, tracheids and fibres. Xylem lies towards upper epidermis and phloem lies below the xylem towards lower epidermis. (Fig. 1.).

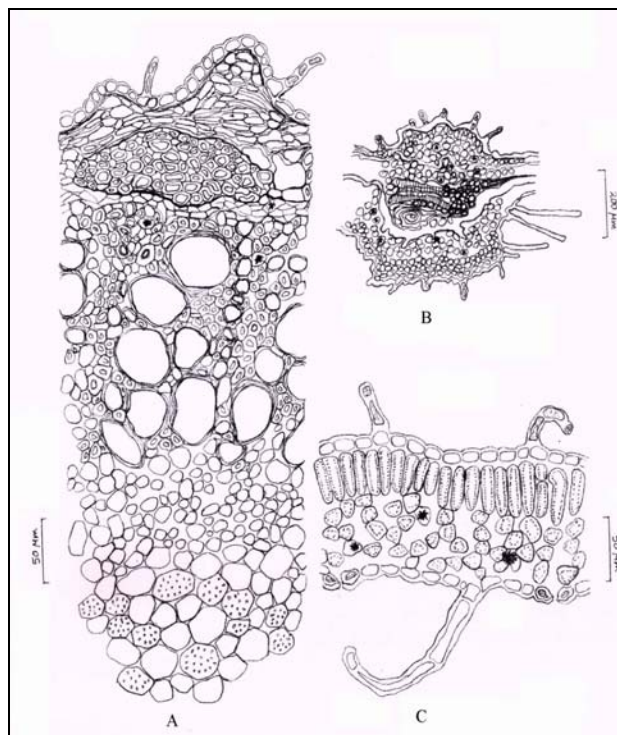


Fig 1: Leaf anatomy of *Gymnema sylvestre* (Retz.) R.Br. ex Schult.: A.T.S. of petiole; B.T.S. of midrib; C.T.S. of lamina

3.3. Powder microscopy

The powdered material is yellowish green to brown in colour, bitter in taste with pleasant aromatic odour. On microscopic study, it shows uniseriate multicellular trichomes, rosette cluster of Ca-oxalate crystals, group of xylem vessels, epidermal cells and paracytic stomata. (Fig. 2).

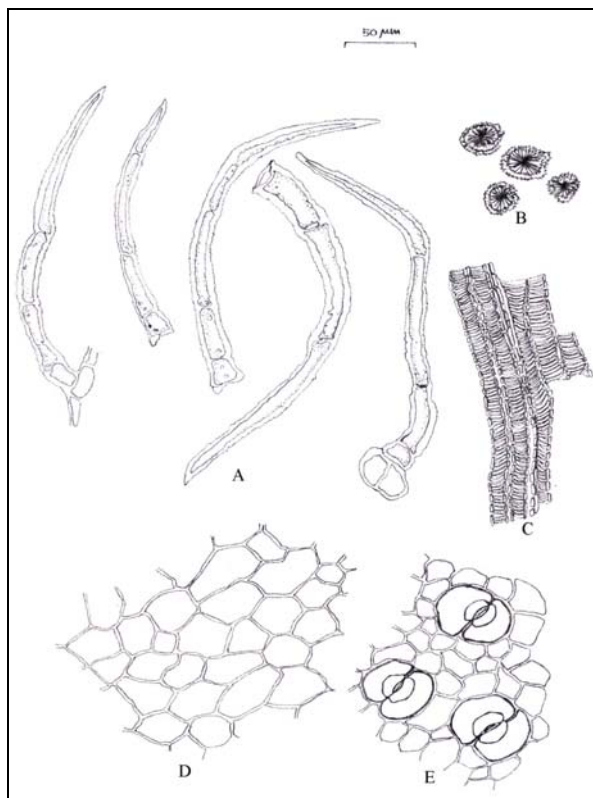


Fig 2: Powder drug analysis of leaf powder of *Gymnema sylvestre* (Retz.) R.Br. ex Schult.: A. Uniseriate multicellular trichomes; B. Rosette crystals of Ca-oxalate; C. Group of xylem; vessels; D. Group of epidermal cells; E. Paracytic stomata

4. Conclusion

In recent years, natural compounds of plant based origin have received much attention as they are well tested for their efficacy and believed to be much safer than synthetic drugs. Therefore critical studies on modern approaches, viz. physiochemical characterization, biological evaluation, toxicity studies, molecular mechanism of action, is needed for management of various diseases. Anatomical characterization provides additional support towards authentication and elimination of adulteration of market sample of potent medicinal plants as *Gymnema sylvestre*.

In connection with the increased practice of herbal medicine in treatment of diabetes mellitus throughout the world and short market supply, trend of adulteration and substitution of the concerned plant are resulted. As conventional propagation is hampered due to the low rate of germination, poor seed viability and rooting ability^[18], critical studies are required for standardization of micropropagation protocols towards an urgent need for conservation, large scale multiplication and cultivation of *G. sylvestre* to meet the commercial market demand.

5. References

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