A Review of Phytochemical Profile of *Desmodium gangeticum* (L.) DC: A Valued Endangered Medicinal Plant

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Abstract

Phytochemical progress has been aided enormously by the development of rapid and accurate methods of screening the plants for particular chemicals. Plants have potent biochemicals and have components of phytomedicine since time immortal. India holds a goldmine of great deal of well known medicinal plants practiced traditionally for use of herbal medicine. It is generally estimated that over 6000 plants in India are in use in traditional, folk and herbal, medicine representing about 75% of the medicinal needs of the third world countries. One such medicinal herb used in Indian Ayurvedic systems of medicine is *Desmodium gangeticum* (Shalparni). A review of phytochemical profile of *Desmodium gangeticum* has been presented considering the fact that there are many species of this genus scattered

All around the world, out of which *Desmodium gangeticum* have been phytochemically explored. Hence, in the present article, an attempt has been made to overview phytochemical studies in *Desmodium gangeticum* which serves as a potential source for contribution in the modern system of herbal medicine.

Key words: Ayurvedic, goldmine, herbal, medicine, phytomedicine

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Introduction

Medicinal plants possess unlimited and untapped wealth of chemical compounds with high drug potential which are used as nutraceuticals, food supplements, folk medicines, pharmaceuticals, agrochemicals, flavors, fragrances, colours, biopesticides, food additives, and chemical entities for synthetic drugs. Recently World Health Organization (WHO) has compiled a list of 20,000

medicinal plants used in different countries. However, approximately 10,000 plants are used for phyto-therapy in Indian system of medicine. According to Biological Conservation Letter, more than 7,000 species of plants found in various ecosystems are said to be medicinal in the country [1]. The global market for medicinal plant materials and herbal medicines is estimated to be worth several billion dollars a year. India exports 32,600 tonnes annually [2]. So, India is one of the world's richest sources of medicinal and aromatic plants. The position of India is tenth among plant rich countries of the world and fourth among the Asian countries. For the past few decades compounds from the natural sources have been gaining importance due to vast chemical diversity they offer. The beneficial medicinal effects of plant materials typically result from the combinations of secondary products present in the plant. It is worth mentioning that the medicinal actions of plants are unique to particular plant species or groups and are consistent with this concept as the combination of secondary products in a particular plant is taxonomically distinct that are commonly used as home remedies against multiple ailments and also as a vast source of several pharmacologically principles.[3- 4]

Ethano pharmacological studies on such herbs/medicinally important plants are an area of interest for the investigators throughout the world. Due to depletion of habitat the genetic diversity of medicinal plants in the world is on the verge of extinction because of ruthless collection and harvesting of medicinal plants for production of medicines, with little or no regard to the future. Hence, the conservation of these valuable genotypes is imperative [5]

Although in traditional medicine genus *Desmodium* is very well known, but still *Desmodium gangeticum* invites attention of researchers worldwide for its ethnomedicinal uses, phytochemistry and pharmacological activities ranging from antidiabetic to antiviral. To the best of our knowledge, very little information is available on phytochemical profile of *Desmodium gangeticum.* Hence, the present investigation was overviewed to explore the phytochemical profile and ethnomedicinal uses of valued endangered medicinal plant – *Desmodium gangeticum* (L.) DC

Desmodium gangeticum (Linn.) DC: An endangered ethnomedicinal plant

Desmodium gangeticum Linn. DC known as Shalparni or Prishiparni in Hindi and Sanskrit is an endangered ethnomedicinal plant belonging to family Leguminoceae sub family Fabaceae [6- 7]. This plant is one among the Dashamoola (ten roots) of Ayurveda and is an important ingredient of many famous Ayurvedic drugs like Dashamoolarishta, Chyavanaprasha, Dhanwantharam Kuzhambu, Rasnadhi decoction, Agusthya Rasayanam, Sukumara gritham, Dasamula Katuthiayadi kashayam, Dasamula thailam, Danvantra thailam, Mahamasah thailam, Anu thailam, Vidaryadi gritham and Brahma Rasayan [8- 12] . It is an erect woody under shrub in tropical region with alternate leaves and compressed fruits. About 38 different species of *Desmodium* have been reported in India of which *Desmodium gangeticum* and *Desmodium adscendens* are used ethnomedicinally all over the world. Among which *Desmodium gangeticum* is used in the Indian system of medicine; particularly in the Ayurveda is an important and well explored species of genus *Desmodium.*

Taxonomical classification of *Desmodium gangeticum:*
Scientific Classification [13]

Kingdom	Plantae
Subkingdom	Tracheobionta
Super division	Spermatophyta
Division	Magnoliophyta
Class	Magnoliopsida
Subclass	Rosidae
Order	Fabales
Family	Fabaceae
Genus	*Desmodium*
Species	*gangeticum* (L.) DC.

Vernacular names [10]

Regions/ Language	Names
Sanskrit	Prishiparni
Hindi	Sarivan, Salpan
Marathi	Kon, Salvan and Radbhal
Gujrati	Selman
Kannada	Shaliparni
Tamil	Pullaadi
Telgu	Gitanaram
Bengali	Salpani
Urdu	Shalwan

Synonyms [14 and 15]

Desmodium latifolium, *Hedysarun gangeticum* and *Hedysarum collinum*, Chitraparnyahi, Parnyapi Krestuvinna, Simhapucchi, Kalasi, Dhavaniguha

Parts used: Whole plant, root and bark.
Family: Leguminoceae
The Leguminosae is one of the largest families of flowering plants with 18,000 species classified into around 650 genera [16]**. Out of which about 163 genera and 1, 252 species that are used as sources of medicinal plants.** Amongst the sources of oriental herbal medicines,

Leguminoceae is fourth largest family in terms of number of medicinal genera and species that are used following Graminaeae, Compositae and Orchidaceae. [17-19]

Genus: *Desmodium*

It includes 350-450 spp contributing from tropical and subtropical areas. The name of the genus is derived from the Greek, "*desmos*": "bond" or "chain" and "*hode*": "like"; in reference to the resemblance of the jointed seed pods to links of a chain [20]

Geographical Distribution [21]

Desmodium gangeticum is common n and grows wild on the lower hills and plains throughout India; on the Himalayan regions it ascends to 5,000 feet. It is spread east to Pegu and Ceylon, the Malay Peninsula and Archipelago, and is distributed to China, the Philippine Islands and tropical Africa.

Botanical description of *Desmodium gangeticum*

Desmodium gangeticum is a slender, sub erect diffusely branched under shrub growing about 2 – 3 feet high following a terrestrial life cycle [22 -23]. The stem is woody with slender branches which are irregularly angled and clothed with upwardly directed short soft grey hairs [10]. Leaves alternate, unifoliate, petioles 1-2cm long; stipules 6-8 mm long, striate at the base. Margins waved, glabrous and green above with dense soft appressed hairs. [24]. Inflorescence many flowered, which are produced terminally or axillary and variable in colour, probably vary from one region to the other, white to red or purple or a combination such as pink and purple or mauve and white flowers which are pea shaped. Fruits are compressed and are almost stalkless, up to 7-8-jointed. Seeds compressed reniform without strophiole. [25]. The root is tap root which is poorly developed, light yellow and smooth. The root bark is yellowish white in colour and has a leathery texture.

Fig – 1 *Desmodium gangeticum* in natural habitat

Fig – 2 Flowering twig of *Desmodium gangeticum*

Fig – 3 Seeds of *Desmodium gangeticum*

Fig – 4 Roots of *Desmodium gangeticum*

Ethnomedicinal Uses

D. gangeticum is of great therapeutic value in treating diseases such as typhoid, piles, asthma, and bronchitis [26].The plant has high medicinal value and is used as bitter tonic, febrifuge, digestive, anti-catarrhal, anti-emetic, in inflammatory conditions of the chest and in various other inflammatory conditions, which are due to vata-disorders [12 and 27]. The plant contains calcium, phosphorus, magnesium, vitamins A and C. *Dasamula* is known to pacify pain, arthritis, fever, cough, bronchitis, general weakness, neuropathy, and boosts immune power. The whole plant decoction is given to treat digestive disorders, edema, diarrhea, intermittent fevers, malaria, and urinary tract infections [28]. In folklore medicine, decoction from *D. gangeticum* leaves used for stones of the gall bladder and kidneys. The aqueous extract of *D. gangeticum* plant has strong antiwrithing and moderate CNS depressant activities [29]. The flavonoids and terpenes in the aqueous extract of this plant is highly potent in wound healing, and its effect is equal to standard drug povidone iodine ointment in terms of wound closure time, wound contracting ability, tensile strength, and regeneration at wound site [30 - 31]. This plant has potential prophylactic and therapeutic efficacy against *Leishmania donovani* infection which may be due to the presence of amino glycosyl glycerolipids and glycosphingolipid [32]. The flavone and isoflavonoid glycosides present in this plant form the ingredient of many Ayurvedic formulations for diabetics. [33].The root is nervine tonic, diuretic, cardiotonic, and expectorant [8]. The root decoction is used for the treatment of heart diseases, especially in angina pectoris and myocardial infarction. It strengthens heart muscles and reduces cholesterol [34 and 35]. Roots are chewed daily for the cure of typhoid and pneumonia. Boiled root extracts of several plants including *D. gangeticum* is orally administered to overcome weakness. Paste prepared form root mixed with water and sugar when taken orally in empty stomach in the morning daily prevents spermatorrhoea [36]. The plant parts form a part of compositions of popular Ayurvedic medicine such as Dasamula Kwatha (M/s Zandu Pharmaceuticals), Dasamularishta (Dabur, Himalayan Drugs) [17]. Owing to the high medicinal value of this plant, the National Medicinal

Plant Board of India (NMPB) has identified this plant as "high trade sourced medicinal plant species from tropical forests" and also included in the list of vulnerable group of species that needs immediate management attention [37]. Department of Indian Systems of Medicine and Homeopathy, Ministry of Health and Family Welfare, Government of India, has formulated a Central Scheme for Cultivation and Development of Medicinal Plants. [38]

Phytochemistry *of Desmodium gangeticum*

Preliminary phytochemical screening of *Desmodium gangeticum* revealed the presence of tryptamines, phenethylamines like alkaloids and their *N*-oxides, pterocarpnoid, desmocarpin, isoflavanoid glycoside, cardiac glycoside, steroids, saponins, salicylic acid, rutin, chlorogenic acid and caffeic acid, phospholipids, glycosphingolipids, uridine triacetate, trans – 5 – hexadecanoic acid, 1 – Tritriacontanol, 1- heptadecanol, β – amyrone and flavanoid glycosides like 4,5,7- trihydroxy-8-prenylflavone-4'Ox-L-rhamnopyranosyl-(1-6)-D-glucopyranoside and 8-C-prenyl-5,7,5-trimethoxy-3,4- methylenedioxy flavones. [39 - 47]. Ghosal and Bhattacharya (1972) reported the isolation of sterols, N, N-dimethyltryptamine, 5-methoxy-N, N-dimethyl tryptamine, and their oxides from aerial parts of *D. gangeticum* and reported that the alkaloids indole -3-alkylamines and β carbolines has biological activities like anticholinesterase, smooth muscle stimulant and CNS stimulant response. They also studied the chemical composition of the roots and reported three pterocarpeniods, gangetin, gangetinin and desmodin respectively. [48]. The phenolic composition of the roots and aerial parts of *D. gangeticum* by HPLC and MS/MS analysis was substantiated by Niranjan and Tewari (Table – 1.) While, in other study, Hemlal and Subban identified about eighteen compounds from the roots of *D. gangeticum* by HPTLC and GC – MS analysis (Table – 2) [25, 44]. A new aminoglucosyl glycerolipid group has been reported by PK Mishra *et al* [29]. Meena *et al* (2010) reported kaempferol 7-O-β-D-glucopyranoside, rutin, quercetin 7-O-β -D glucopyranoside from the aerial parts of *D. gangeticum* which showed *in vitro* antileishmanial activity [49].

Table – 1: Phenolic composition of aerial parts of *D. gangeticum* [26]

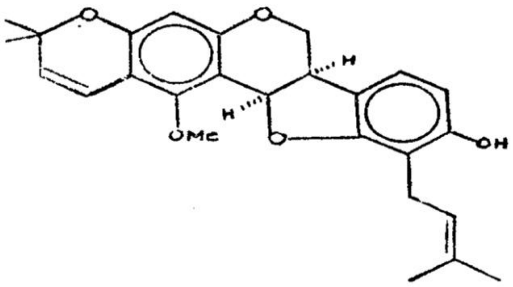
Sr. No	Name of the compounds
1.	Gallic acid
2.	Protocatechuic acid
3.	Salicylic acid
4.	Cholorogenic acid
5.	Caffeic acid
6.	Rutin
7.	Quercetin
8.	Kaempferol

Table – 2: Compounds from the root extracts of *D. gangeticum* [45]

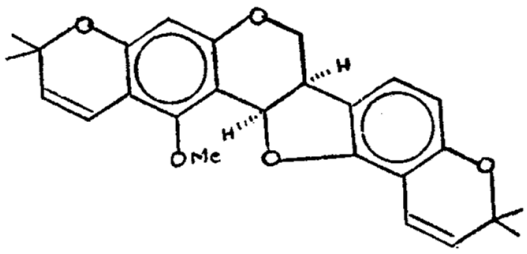
Sr. No	Name of the compounds
1.	Benzaldehyde, 4 - methoxy
2.	1,2, 3 – Benzenetriol
3.	2-Propenal, 3-(4-hydroxy-3-methoxyphenyl)-
4.	4-(1E)-3-Hydroxy-1-propenyl)-2-methoxyphenol
5.	N,N-Dimethyltryptamine
6.	Hexadecanoic acid, methyl ester
7.	7-Hexadecanoic acid
8.	n-Hexadecanoic acid
9.	3,5-Dimethoxy-4-hydroxycinnamaldehyde
10.	9,12-Octadecadien-1-ol,methyl ester
11.	11-Octadecenoic acid, methyl ester
12.	Heptadecanoic acid, 16-methyl-, methyl ester
13.	9.12-Octadecadienoic acid
14.	Octadecanoic acid
15.	12-Ethylsophoramine
16.	E,Z-1,3,12-Nonadecatriene
17.	Stigmasterol
18.	Gamma Sitosterol

Shrivastava *et al* (2011) isolated simple indole base namely, N, N-Dimethyltryptamine from the methanolic extract of leaves of *D. gangeticum* by HPTLC.[42] Recently, Yadav *et al* isolated a new aliphatic enone, (17Z, 20Z)-hexacosa-17,20-dien-9-one (3), and one new bisindole alkaloid, gangenoid (6), from roots and aerial parts of *D. gangeticum* [50]

Some important phytochemicals isolated from *Desmodium gangeticum*



Gangetin



Gangetinin

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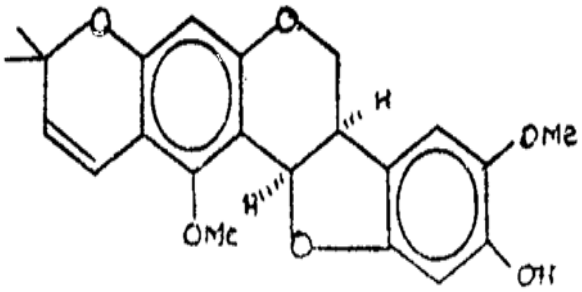
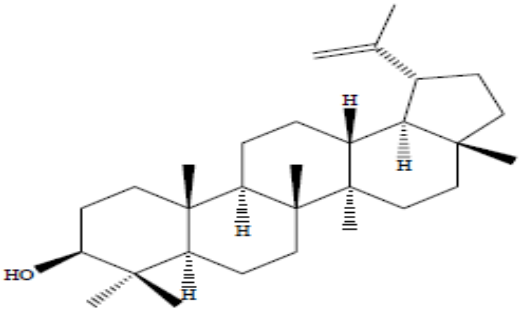


Desmodin



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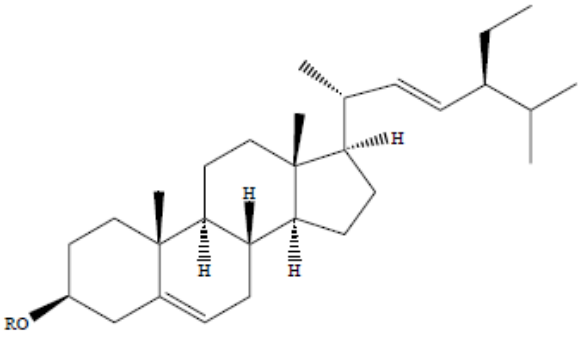
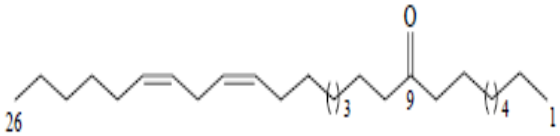


2 **R = OH**

4 **R = Glucose**



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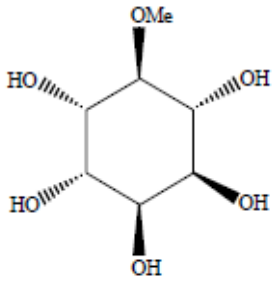

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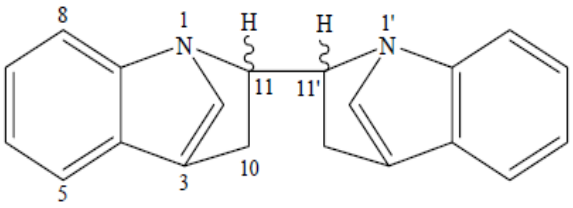
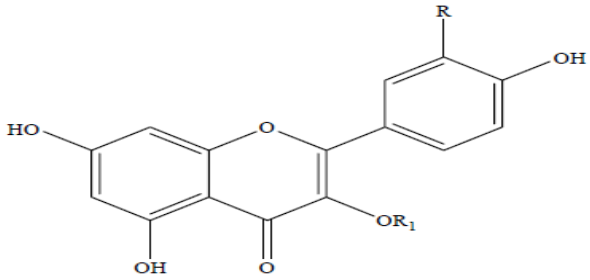


6



7	R = OH	R1 = rha-(1⟶6)-glu
8	R = H	R1 = rha-(1⟶6)-gal
9	R = H	R1 = rha-(1⟶6)-glu

Conclusion

Plants are considered as significant part of the drug industry due to their potential therapeutic activities In the present review, we have made an attempt to flock taxonomical information, ethnomedicinal uses geographical distribution and phytochemistry of *Desmodium gangeticum*, a species of medicinal herb used in the Indian system of medicine. Extensive biochemical analyses have resulted in the detection and isolation of a wide variety of the phytochemical constituents from different parts of the plant. Application of advanced spectroscopy tools such as NMR, EMR, and FTIR along with X- ray crystallography studies would bring to light more such biologically active phytochemicals in different parts of the plant. Use of *in silico* tools to evaluate the efficacy of these phytochemical moieties as drugs would endow an added value to such a study. Presence of wide range of chemical compounds indicates that the active constituents isolated from the species could serve as a "lead" for the development of novel agents having good efficacy in various pathological disorders. Establishment of pharmacognostic profile will assist in standardization of quality, purity and sample identification. Thus, there is a vital need for further research in regards to evaluate more phytochemicals from the *invitro*

cultured cells, tissues of the medicinal plants. Thus, the information provided in the present review will act as an important segment for development of effective medicines.

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