CHAPTER-II

REVIEW OF LITERATURE
2.1 Desmodium gangeticum (L.) DC.

2.1.1 Botany


*Desmodium gangeticum* (L.) DC. is commonly known as 'Shalaparni' in Ayurveda. It is an erect woody under shrub, 2-4 feet high. Stem is irregularly angled and pubescent. Leaves are 1 foliolate; petioles 1-2 cm. long; stipules scarious, 6-8 cm. long, linear- subulate, striate at the base. Leaflets are membranous, ovate or oblong-ovate, entire, obtuse or acute. Flowers are in copious ascending, terminal and axillary racemes, arranged in few flowered fascicles along a slender pubescent some what angular rachis; pedicel long,
filiform, pubescent; bracts subulate; bracteoles minute; calyx hairy with triangular teeth; corolla violet in colour; standard broad, cuneate at the base.

Pods are sessile, pubescent, curved, falcate, 6-8 jointed, sparingly clothed with hooked hairs. Seeds are compressed, reniform without strophiole.

Flowering and fruiting occur throughout the year (Saxton and Sedgwick, 1918; Kirtikar and Basu, 1935; Anonymous, 1953; Collett, 1971; Hooker, 1973; Cook, 1967; Talbot, 1976).

2.1.2 Distribution

It is found almost throughout India ascending to 1500 m. in the Himalayas and throughout India. It is also found in Ceylon, Burma, Malay peninsula and Islands, China, Philippines and Tropical Africa (Kirtikar and Basu, 1935; Anonymous, 1953; Collett, 1971; Watt, 1972; Hooker, 1973; Satapau and Henrry, 1973; Cook, 1967; Agharkar, 1991). In India it is common in wastelands and open forests of Rajasthan (Sharma and Tiagi, 1979; Shetty and Singh, 1987), Gujrat (Saxton and Sedgwick, 1918), Bihar, Orissa (Hains, 1961) and Sutlej valley of Simla (Collett, 1971). It is also found in most of the districts of Tamilnadu (Gamble, 1967; Nair, et al., 1983), Karnataka (Sharma et al., 1984), Goa, Nagar haveli, Daman (Rao, 1985), Andhra Pradesh, Assam, Himachal Pradesh, Jammu and Kashmir, Kerala, Uttar Pradesh (Kurup et al., 1979) and Bengal (Prain, 1963). It is frequently found in Maharashtra (Watt, 1972; Cook, 1967; Lakshminarsimhan and Sharma, 1991; Kothari and Moorthly, 1993; Naik et al., 1998) and common in Madhya Pradesh (Anonymous, 1990).
2.1.3 Chemical constituents

Ghosal and Banerjee (1969) investigated the alkaloidal constituents in aerial part and reported occurrence of indol-3-alkamine bases viz., N, N-dimethyltryptamine, 5-methoxy-N, N-dimethyltryptamine, and their Nb-oxides and Nb-methyltetrahydroarman, 6-methoxy-2-methyl-β-carbolinium derivative. Yadav and Tripathi (1998) isolated flavone glucoside, 4’-5,7-trihydroxy-8-prenylflavone-4’-0-alpha-L-rhamnopyranosyl-(1 to 6)-beta-D-glucopyranoside from the stem of D. gangeticum (L.) DC. Ingham and Dewick (1984) have reported isoflavonoid phytoalexin- desmocarpin together with genistein, 2’- hydroxygenistein, dalbergioiden, diphysolone and kievitone in the leaflets of D. gangeticum (L.) DC. Ghosal and Banerjee (1969) isolated seven alkaloids from the root of D. gangeticum (L.) DC. and identified them as N, N- dimethyltryptamine, its Nb-oxides, hypaphorine, hordenine, caudicine, N- methyl tyramine, β- phenylethylamine. In addition to alkaloids, major and minor pterocarpanoids viz., gangetin, gangetinin, desmodin and gangetial have been reported in roots of D. gangeticum (L.) DC. by Purushotaman et al. (1971), Purushotaman et al. (1975) and Balakrishna et al. (2000), respectively. Seeds contain 5 phospholipids (Jain and Defilips, 1991; Husain et al., 1992; Asolkar et al., 1992).

2.1.4 Action and uses

Whole plant, mainly roots are used in medicine (Anonymous, 1953; Nadkarni, 1976; Agharkar, 1991). The plant is a bitter tonic, indigestible, antidysenteric, alterative, aphrodisiac, anthelmintic, fattening, astringent to bowels, antipyretic, anticatarrhal, diuretic, febrifuge (Kirtikar and Basu, 1935; Anonymous, 1953; Chopra et al., 1958; Ahuja, 1965; Nadkarni, 1976; Kurup
et al., 1977, 1979; Sharma and Tiagi, 1979), antiseptic (Chopra et al., 1956),
acrid, sweet, cooling, expectorant, galactogogue (Anonymous, 1994) and
carminative (Husain et al., 1992).

It is used to cure typhoid and other fevers, asthma, bronchitis, vomiting,
dysentery, alexipharmic, biliousness, chorela, chronic affection of chest, brain
and lungs (Ramarao, 1914; Kirtikar and Basu, 1935; Anonymous, 1953;
Chopra et al., 1958; Ahuja, 1965; Sharma and Tiyagi, 1979; Agharkar, 1991;
The roots are used in scorpion sting and snake bite (Chopra et al., 1956;
Nadkarni, 1976). The plant is useful in vitiated conditions of pitta, wounds.
abscess, sore, pruritus, erysipelas, flatulence and burning sensation. It is also
used in general anasaraca, consumption, piles, worms (Kurup et al., 1977),
leucorrhoea and lochiorrhoea (Said, 1970). Adivasis used seed smoke to
remove insect from the body of cattle (Laxminarsimhan and Sharma, 1991).

2.1.5 Pharmacological activity

The plant showed different pharmacological activities such as purified
alkaloidal fraction caused marked positive inotropic effect on isolated heart
preparation in dose from 0.001-0.1 mg suggesting cardiac stimulating activity. It
also inhibited contractile response of acetocholine on rabbit ileum and air
perfused isolated rat lung and relaxation of bronchial muscle. The drug
possessed antipyretic activity against T.A.B. vaccine induced pyrexia. Total
alkaloids from seeds showed spasmolytic property against acetylcholine,
BaCl₂ on guinea pig ileum and on rat uterus against 5-HT, acetylcholine and
oxytocin. Alkaloid from root produced spasmogenic effect antagonised by
pentolium and produced anticholinesterase, smooth muscle stimulant, CNS
stimulant and depressor response, nicotine like effect on dogs' intestine in situ and carotid blood pressure (Ghosal and Bhattacharyya, 1972). It also shows antibacterial activity (Bhatt and Mukul, 1984). The drug showed inhibitory effect on isolated frogs' heart. It had a relaxtant effect on smooth muscles of intestines of rabbit and dog and on the isolated rat uterus. The drug had mild diuretic effect and it inhibited respiration in moderate doses. It was found to be nontoxic in acute toxicity studies (Prema, 1968). The total alkaloid fraction of stem and leaves of *D. gangeticum* (L.) DC. exhibited curariform activity on frogs' rectus muscle (Bhattacharya and Sanyal, 1969). Quartenary aromatic β-carbolines isolated from *Desmodium* sps. were found to be about one-sixth, as potent as physostigmine as cholinesterase inhibitors. The inhibitory potencies were nearly the same against acetylcholinesterase and pseudocholinesterase. The tertiary β-carbolines showed only weak activity (Ghosal *et al.*, 1972). Gangetin -a pterocarpons, isolated from roots of *Desmodium gangeticum* (L.) DC. shows anti-inflammatory activity in exudative phase of inflammation in 50 and 100 mg/kg and antiarthritic activity against formaldehyde induced arthritis in rats. It shows analgesic activity in acetic acid induced writhing as well as on hot plate method (Anonymous, 1996). Gangetin showed significant antiinflammatory activity in the exudative and proliferative phases of inflammation in the dose of 50 and 100 mg/kg orally. The compound showed significant analgesic activity, but no antifertility and antipyretic activity in albino rats (Ghosh and Anandkumar, 1983). Gangetin showed moderate anti implantation activity in female albino rats at level of 40, 60.6, 50 and 62.5 % at dose levels 20, 40, 80 and 160 mg/kg. It did not show any antieostrogene activity (Pillali *et al.*, 1981). Biochemical
studies in uterus of female albino rats after the administration of gangetin showed that it did not change pH, sodium or potassium but decreased glycogen, acid phosphatase and alkaline phosphatase (Alam et al., 1982). Gangetin showed 87.5 % antiimplantation activity at 100 mg/kg body weight and 50 % at 50 mg/kg body weight in female rats. In male rats the sterility studies of seminal vesicle and testes showed no change in pH, alkaline and acid phosphate, reducing sugar, protein, sodium, potassium and calcium (Pillali et al., 1981). Daily administration of gangetin 0.5, 1.0, 1.5 and 2.0 mg/kg body weight for 30 days caused an impairment of fertility and it was dose dependent. The treatment also caused reduction in vaginal sperm count and an enhancement of pre-implantation losses. Complete recovery of fertility was evident 30 days after the withdrawal of gangetin treatment. The weights of testes epididymis, vas deferens and prostate were also significantly decreased. (Latha et al., 1997). Anti inflammatory and antipyretic activity was shown by the plant extract in careogenin induced oedema, cotton pellete induced granuloma, writhing response and pyrexia in rats (Chatterjee, 1997). Seed extract was tested for agglutination of 11 different types of Pseudomonas aeruginosa. The results indicate the possibility of differentiating P. aeruginosa by plant seed extract (Chatterjee et al., 1980).

2.1.6 Therapeutic evaluation

A classical herbal preparation, Shalpamyadi churna, consisting of Desmodium gangeticum (L.) DC., Zingiber officinale Rosc., Aegle marmelos (L.) Correa ex. Roxb., Coriandrum sativum Linn. and Sida cordifolia Linn. was subjected to clinical trial on 15 patients of irritable bowel syndrome in doses of
3 gm T-D-S for 30 days. It is reported that the results showed positive response in all 15 patients (Sharma and Mishra, 1993).

2.1.7 Formulations

The roots of *D. gangeticum* (L.) DC. are used as one of the ingredients of two very important Ayurvedic preparations, 'Dashmoola Kwatha' and 'Dashamoolarishta' (Anonymous, 1952). It is also used in other Ayurvedic preparations viz., *Shalaparnyadi kvatha*, *Chyavanaprasha*, *Chitrakaharitaki*, *Mahanarayana taila*, *Brahachchhagaladya ghrita*, *Dashamoola taila*, *Mooshikadya taila*, *Vayuchchhaya surendra taila* and *Vyahri taila* (Anonymous, 2001). In the unani system of medicine it is used in *Arq Dasmol* (Said, 1970).

2.1.8 Adulterants

In Kerala *Pseudarthria viscida* (Linn.) Wright and Arn. is used as substitute for *Desmodium gangeticum* (L.) DC. Some other taxa viz., *Desmodium polycarpum* DC., *Urania lagopoides* DC., *U. hamosa* Wall., *Flemingia paniculata* Wall. and *F. stricta* Roxb. are used as *Shalparni* in different parts of the country (Ahuja, 1965; Garg, 1992).

2.1.9 Propagation and cultivation

It is propagated by seeds and prefers light soil (Sharma, *et al.*, 2001), but rate of seed germination of *Desmodium gangeticum* (L.) DC. was found to be very poor due to hard seed coat. Earlier efforts were made by Chaghatai *et al.* (1978), to increase the germination percentage of *Desmodium gangeticum* (L.) DC., where they could increase germination upto 22 percent after causing mechanical injury.
It is identified as promising plant, which is in great demand and of high commercial potential. Estimated domestic demand for *D. gangeticum* (L.) DC. is about 678.4 tonnes/ year (Anonymous, 2001). The drug, *Desmodium gangeticum* (L.) DC. is mostly collected from wild sources to meet the requirement of pharmaceutical industries, as such no efforts have yet been made towards its cultivation except Dhan prakash et al (2000). They conducted experimental cultivation to study the variation of total chemical contents in roots due to seasons, different cultural conditions, soil texture, pH and stress conditions like open/shade, wild/cultivated etc. Department of Indian Systems of Medicine and Homeopathy of the Ministry of Health and Family Welfare, Government of India has formulated a Central Scheme for Cultivation and Development of Medicinal Plants. They have included *Desmodium gangeticum* (L.) DC. in the list of plants identified for promoting their cultivation in order to reduce pressure on their natural habitat and to meet the shortage against the demand of the industry (Rawat and Sharma, 1998). There is no report on tissue culture studies of *D. gangeticum* (L.) DC., though such studies on other species of *Desmodium* have been reported such as *D. Heterocarpon* (L.) DC. and *D. ovalifolium* Wall. (Wofford et al., 1992). Therefore, in order to domesticate the plant and to evolve the techniques for cultivation and propagation, trials were also made. Apart from routine propagation techniques, trials were also made to propagate the plant through tissue culture.
2.2 *Viola serpens* Wall.

2.2.1 Botany

*Viola* is a genus of mostly perennial herbs, distributed in the temperate zones and restricted to mountains in the tropics, a few species extending to the Arctic zone. Over 30 species are found wild in India and a number of exotic have been introduced in the Indian gardens. Some of the species like *V. odorata* L., *V. biflora* L., *V. cinerea* Boiss., *V. serpens* Wall., *V. sylvestris* Lam., *V. patrinii* DC., *V. tricolor* L. yield perfume and medicaments, while others are grown in gardens for ornaments (Kirtikar and Basu, 1935; Anonymous, 1976).

*Viola serpens* Wall. belongs to family Violaceae and commonly known as 'Banafsha'. It is a small glabrous, perennial herb. Stolon is usually long, leafy and flowering stem short, but distinct, covered with withered scales, often producing runners. Leaves are broadly ovate, cordate, obtuse, crenate or sharply toothed; stipules lilac blue or some times white; sepals acute; stigma 3-lobed, produced laterally in hooked beak; capsule globose, only a few seeded. Flowering and fruiting occur during March-September (Hooker, 1875; Bal, 1932; Collet, 1971; Singh, 1974; Anonymous, 1976; Chauhan, 1999).

2.2.3 Distribution

It is found through out India in moist woods and hilly districts. It is also found in China, Java, Ceylon, Philippines and Thailand upto an altitude of 2000 m. In India it is distributed in Himalayan region, hills of Meghalaya, Nagaland, Manipur, (Hooker, 1875; Bal, 1932; Anonymous, 1976; Dhar and Kachroo, 1983; Santapau and Henrry, 1973), It is also found in Gunjam hills of Orissa (Gamble, 1967; Collett, 1971), Himachal Pradesh, Tehri Garhwal in
Uttar Pradesh (Chauhan, 1999, Chaudhary and Wadhwa, 1984), Karnataka (Sharma et al., 1984) and Tamilnadu (Nair et al., 1983).

2.2.3 Chemical constituents

Roots, leaves and blossoms contain saponin, methyl salicylate in the form of glucoside, an alkaloid violine and viola quercitrin, which is probably identical with rutin (Dey, 1980; Dymock, 1889; Chauhan, 1999).

2.2.4 Action and uses

The whole plant is medicinally useful. It is aperient, antiseptic, antipyretic, cooling, demulcent, diaphoretic, diuretic, emetic, emollient, expectorant, febrifuge and purgative in action. It is useful in asthma, bleeding piles, cancer of throat, constipation, cough, fever, headache and skin diseases (Anonymous, 1986; Kurup et al., 1979; Chauhan, 1999; Shastri, 2001). This species also yields 'Banafsha' of the bazaars and is considered to have medicinal properties similar to those of *Viola odorata* L. A decoction of flowers is administered for improving the complexion. It is also used in bilious and pulmonary affections (Uniyal and Issar, 1967).

2.2.5 Formulations

In Unani system of medicine, this plant is the main ingredient of 'Joshanda' consisting mixture of drugs, used mainly for cough and cold in the form of decoction. A medicinal oil called 'Raughan -e- banafsha', 'Banafshadi-kwath', 'Gulkand banafsha' and 'Banafsha syrups' are prepared from it (Kirtikar and Basu, 1935; Uniyal and Issar, 1967; Singh, 1974; Anonymous, 1976; Anonymous, 1986; Nadkarni, 1976; Chauhan, 1999).
2.2.6 Propagation and cultivation

The plant is propagated by divisions, cuttings or seeds. It grows well in a cool and moist climate, but exposure to heavy or frequent rains is fatal for its blooming. Flowers are collected during March-April, air dried, packed, stored and marketed at the rate of Rs. 325-400/- per Kg. Whereas leaves + flowers are marketed at the rate of Rs. 140-160/- per Kg. (Chauhan, 1999).

The soil and climatic conditions of Tehri-Garhwal (Uttar Pradesh), Shimla, Kullu, Kinnaur, Sirmour and Chamba (Himachal Pradesh) are conducive for large scale cultivation of this plant. But commercial cultivation of this species has not been taken up so far. The localities traditionally known as rich are exploited heavily and this has adversely affected the natural regeneration, the result being that the plant is facing much depletion in nature. Further regular collection of the drug in an area without periodical resting time and lack of maintenance have increased their cost of collection. The quantity of Viola serpens Wall. exported from Himachal Pradesh has declined from 1991-1992 (Gupta, 1971; Anonymous, 1976; Chauhan, 1999). Therefore it is necessary to provide protection to these areas and to permit natural regeneration and simultaneously to bring out the plant under cultivation. Department of Indian Systems of Medicine and Homeopathy of the Ministry of Health and Family Welfare, Government of India has formulated a scheme for cultivation and development of medicinal plants wherein they have identified some species, Viola serpens Wall. being one of them, for promoting their cultivation in order to reduce pressure on their natural habitat and to meet the demand of the industry involved in producing the Indian Systems of Medicine (Rawat and Sharma, 1998).
There is no report on tissue culture studies of *Viola serpens* Wall., though such studies on other species of *Viola* have been reported, such as *Viola odorata* L. (Sakai Shingo *et al.*, 1991; Van Canegem, 1997), *Viola tricolor* L. (Sharma and Babbar, 1991) and *Viola patrinii* DC. (Tadahiko Sato *et al.*, 1995). Therefore efforts were made to develop methodology for *in vitro* propagation of *Viola serpens* Wall., the data obtained, are presented in this thesis.
Plate-1
Plate showing habit of *Desmodium gangeticum* (L.) DC. and *Viola serpens* Wall.

Fig. 1 Plant of *Desmodium gangeticum* (L.) DC. growing in the field.
Fig. 2 Potted plants of *Viola serpens* Wall.