



Research Article

PHARMACOLOGICAL REVIEW ON *SESBANIA GRANDIFLORA* L. POIR

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ABSTRACT

Sesbania grandiflora (family: Fabaceae) commonly known as 'sesbania', is widely used as Indian medicine. *Sesbania grandiflora* has the common names of Agati, Corkwood Tree and West Indian Pea. The plant contains rich in tannins, flavanoids, coumarins, steroids and tri terpenes, isoflavonoids, isovestitol, medicarpin, and sativan and betulinic acid. The plant used in colic disorder, jaundice, poisoning condition, smallpox, eruptive fever, epilepsy etc., Flower extract used in various diseases like nasal catarrh, headache, laxative, aperitif, gout, ozoena, bronchitis, pain. *Sesbania grandiflora* is used alone or with other medicinal plants to treat a variety of ailments. Research studies leading to extraction, isolation and biological study of plant constituents have now formed the major field of study.

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INTRODUCTION

Sesbania grandiflora (family: fabaceae) is known as agate or the hummingbird tree (or scarlet wisteria), a small tree believed to have originated either in India or south East Asia and grows primarily in hot and humid tropical areas in the world. A native to Asian countries such as India, Malaysia, Indonesia and the Philippines where it is commonly seen growing on the dikes between rice paddies, along road sides and in backyards vegetable gardens. Most sesbania species can be described as soft, semi or slightly woody, 1-4m tall perennial nitrogen fixing trees. *sesbania grandiflora* has large red or white flowers, upto 10cm in diameters. The plant has an outstanding feature is its extremely fast growth rate, especially during the first 3 or 4 years after planting. In Australia and in India, plantations have attained heights of 8m in under 3 years. Sesbania is grown as a cover crop and green manure during the summer months. In the process of growing sesbania is the addition of organic matter to the desert soils. During the breakdown of organic matters by micro-organism. Compounds are formed that are resistant to decomposition such as gums, waxes and resins these compounds help bind together soil particles as granules or aggregates. A well aggregated soil tills easily is well aerated and has a high water infiltration rate.

The tree provides forage, firewood, pulp and paper, food, green manure and landscape decoration. It also has potential for reforesting eroded land and grassy wastelands through the tropics. The wood is low quality. The flowers of sesbania grandiflora are eaten as a vegetable in Southeast Asia, the young pods are also eaten along with the leaves.

Description

A short lived, quick growing, soft-wooded tree, 6-9m high and 0.6m high and 0.6m in girth; leaves 15-30 cm long, abruptly pinnate, leaflets 41-61, linear-oblong, deciduous, flowers 6-10cm long with showy, fleshy white, pink or red petals, pods 30cm or more long, rather flat and somewhat 4 cornered, non-tortulose, septate with swollen margins and 15-50 pale coloured seeds^{1,2}.

Habitat

It is found in tropical Asia and north Australia. In India it is found at west Bengal, Assam, Karnataka and north eastern states. It is cultivated as an ornamental plant, grows wild in hedges and shady forests³.

Taxonomy

Kingdom : plantae-plant
Subkingdom : tracheobionta-vascular plant
Super division : spermatophyte-seed plant
Division : magnoliophyte-flowering plant
Class : magnoliopsida-dicotyledons
Subclass : rosidae
Order : fabales
Family : fabaceae-pea family
Genus : sesbania scop-river hemp
Species : sesbania grandiflora (Linn)
Poir-vegetable humming bird

Vernacular names²

English : swamp pea, sesban, West Indian pea
Hindi : agast, basna, hadga, hathya, daincha, basna

Sanskrit	:	Agastya, agasti, agate, anari
Kanada	:	agasi, agaci
Malay	:	agatti, atti, argatti, akatti
Tamil	:	attikkirai, peragathi
Telugu	:	avesi, avasinara
Bangali	:	agathi, agate, agusta, bagphol, bak, bake
French	:	poisvalliere, colbrivegetal, fleur papillon
Spanish	:	Paloma, cresta de gallo, pico deflamenco

Phytochemicals

The plant *sesbania grandiflora* (Linn) contains grandifloral, arginine, cysteine, histidine, isoleucine, phenylalanine, tryptophan, valine, threonine, alanine, asparagine, aspartic acid and a saponin yields oleanolic acid, galactose, rhamnose and glucuronic acid and it also contains flavonol, glycoside, kaempferol^{1,4,5,6}.

Traditional uses

The root-bark of the red-flowered variety is useful in vitiated condition of *vata* and arthralgia.

The bark is astringent, cooling, bitter, tonic, anthelmintic and febrifuge. The pounded bark is externally applied to cure scabies. The juice of the bark is good for dyspepsia, diarrhoea and gastralgia².

The leaves are acrid, bitter, sweet, cooling, aperient, tonic and diuretic and contain a non-poisonous sap like substance. The leaf juice was used as nasal catarrh, nyctalopia and Cephalalgia. Leaves are chewed to disinfect mouth and throat and are useful in stomatalgia⁷.

The flowers have cooling, bitter, astringent, acrid and antipyretic. The juice of the flowers is applied to the eyes for nyctalopia and is used for intermittent fevers. The fruits are sweet, bitter and they are effective as astringent, cooling, bitter, tonic, laxative, febrifuge, cure scabies, dyspepsia, diarrhoea and gastralgia, nyctalopia, anaemia, emaciation and vitiated conditions of *tridosas*. The ethanolic extract of leaves and flowers shows anticancer activity⁸, antioxidant and cardioprotective effect^{9,10}, leaf juice shows antiurolithiatic activity¹¹, hepatoprotective activity^{12,13}, leaves were evaluated for anxiolytic and anticonvulsive activity¹⁴, leaf extract had wound healing activity¹⁵, bark had antiulcer activity¹⁶, the leaves, stems and granules, pods of fruit and roots of the plant had antibacterial activity¹⁷, seed oils and flowers had anthelmintic activity^{18,19}, bark had anti-inflammatory and anti-arthritis activity²⁰, leaves shown hypolipidemic activity²¹, flowers possessed immunomodulatory activity²², roots had tuberculous activity²³, leaf extract had analgesic and CNS depressant activity²⁴, seeds act as tablet binder²⁵, flowers are used to treat ophthalmic infection²⁶, leaves had antiproliferative and apoptotic effects²⁷, flowers showed analgesic activity²⁸.

Pharmacological activities

Anticancer activity

Ethanol extract of *sesbania grandiflora* of both leaves and flowers showed anticancer activity in Swiss albino mice against Ehrlich Ascites Carcinoma cell line at the doses of 100 and 200mg/kg body weight intraperitoneally. The extracts

significantly ($p < 0.05$) decreased the levels of lipid peroxidation and significantly ($p < 0.05$) increased the levels of GSH, SOD and CAT. The results showed that the ethanol extract of *sesbania grandiflora* was effective in inhibiting the tumour growth in ascetic models and that is comparable to 5-fluorouracil⁸.

Antioxidant and cardioprotective effect

Sesbania grandiflora was evaluated for the cardio protective effects against cigarette smoke-induced oxidative damage in rats. Adult male Wistar-Kyoto rats were exposed to cigarette smoke for a period of 90 days and consequently treated with *s. grandiflora* aqueous suspension (SGAS, 1000mg/kg body weight per day orally) for a period of 3 weeks. The results suggested that chronic cigarette smoke exposure increases the oxidative stress, thereby disquieting the cardiac defence system and *s. grandiflora* protects the heart from the oxidative damage through its antioxidant potential^{9,10}.

Antiuro lithiatic activity

The leaf juice of *s. grandiflora* was evaluated for median lethal dose, gross behavioural changes, antiuro lithiatic and antioxidant activities. The antiuro lithiatic activity was evaluated by a calculi-producing diet model, using gentamicin (subcutaneously) and 5% ammonium oxalate in rat feed to induce calcium oxalate-type stones. The leaf juice of *s. grandiflora* was safe orally and exhibited no gross behavioural changes except for an increase in urination. The leaf juice of *s. grandiflora* showed significant antiuro lithiatic activity against calcium oxalate-type stones and also exhibited antioxidant properties¹¹.

Hepatoprotective activity

Oral administration of an ethanolic extract of *s. grandiflora* leaves (200mg/kg/day) for 15 days produced significant hepatoprotection against erythromycin estolate (800mg/kg/day) induced hepatotoxicity in rats. The increased level of serum enzymes (aspartate transaminase, alanine transaminase, alkaline phosphatase), bilirubin, cholesterol, triglycerides, phospholipids, free fatty acids, plasma thiobarbituric acid reactive substances and hydroperoxides in rats treated concomitantly with *sesbania* extract and erythromycin estolate¹².

The hepatoprotective activity of ethanolic and aqueous extract of *sesbania grandiflora* (Linn) flower in CCl_4 induced hepatotoxicity models in rats was investigated. The ethanolic and aqueous extract of *sesbania grandiflora* (Linn) flower was screened for hepatoprotective activity in CCl_4 induced rats for its dose 200mg/kg bw. The ethanolic and aqueous extract of *s. grandiflora* (Linn) flower significantly ($p < 0.001$) decreased the biochemical parameters (SGOT, SGPT, ALP, TP, and TB). Silymarin (25mg/kg), a known hepatoprotective drug used for comparison exhibited significant activity ($p < 0.001$). The extract did not show any mortality up to a dose of 2000mg/kg body weight. These findings suggested that the ethanolic and aqueous extract of *sesbania grandiflora* (Linn) flower 500mg/kg was effective in bringing out functional improvement of hepatocytes. The healing effect of this extract was also confirmed by histological observations. The ethanolic extract at doses of 250 and 500mg/kg, p.o and aqueous extract at doses 500mg/kg, p.o of *sesbania grandiflora* (Linn) flower had significant effect on the liver of CCl_4 induced hepatotoxicity animal model¹³.

Anxiolytic and anticonvulsant activity

The anticonvulsive activity of *s.grandiflora* leaves was evaluated using a variety of animals models of convulsions like pentylenetetrazol (PTZ) and strychnine (STR) induced seizures in mice. The benzene;ethylacetate fraction(BE) contained a triterpene as a major component. Mice treated with BE preferred to remain in the open arm of the elevated plus maze indicating anxiolytic activity. The BE raised the brain contents of gamma-aminobutyric acid and serotonin. Thus the triterpene containing fraction of *s.grandiflora* exhibits a wide spectrum of anticonvulsant profile and anxiolytic activity¹⁴.

Wound healing activity

Wound healing activity of methanol extract of bark of *sesbania grandiflora*(L) had been evaluated by using excision wound model in Wistar albino rats. Methanol extract showed significant wound healing activity at 10% w/w dose when compared to standard 1% framycetin Sulphate. The results confirmed that methanol extract of bark of *sesbania grandiflora* (L) showed significant wound healing activity¹⁵.

Antiulcer activity

The ethanolic extract of the bark of *s.grandiflora* prevented acute gastric injury in rats. Stress and non-steroidal anti-inflammatory drugs induced lesions were significantly prevented by the extract. At the doses of 36.75 mg/kg(p.o) the extract did not modify the volume, p^h and hydrochloric acid contents of gastric secretion. At the doses used, the animals had no depressive, excitatory or sleepness symptoms, suggesting that probably centrally acting components involved in anti ulcer action are not found in the extract. The results were suggested that *s.grandiflora* had antiulcer potential¹⁶.

Antibacterial activity

The antibacterial activity of *sesbania grandiflora* used in traditional pharmacopoeias in Burkina faso was evaluated. Aqueous, methanol and hydro-acetone extractions were carried out on the leaves, stems, granules, pods of fruit and roots of the plant. The phytochemical groups were identified by the tests of characterization and then quantified by the tests of proportioning of total phenols, flavonoids and tannins. Extracts expressed a good antibacterial activity¹⁷.

Anthelmintic activity

Seed oils of *sesbania grandiflora* were investigated for their anthelmintic property against *Pheritima pasthuma*. Three concentrations (10,50,100 mg/ml) of each oil were studied in the bioassay, which involved the determination of time paralysis and time of death of the worm. *Sesbania grandiflora* showed the highly significant anthelmintic activity in both the parameters (paralysis and death)¹⁸.

Anthelmintic activity of ethanol, methanol and ethyl acetate crude extract of flower of *musa paradisiaca* and *sesbania grandiflora* leaves on indian adult earthworms (*pheretimapasthuma*) was evaluated. All the extracts exhibited concentration dependent activity at tested concentrations of 10-100 mg/ml higher activities were observed at the higher concentrations. Ethanolic extract of *musa paradisiaca* and *sesbania grandiflora* was more active than methanol and ethyl acetate extracts. At concentrations 80mg/ml the aqueous

extracts of both plants showed better activity with paralysis time(9.5,13.4 min) and death times(12.4,23.1 min) respectively when compared to the standard piperazine citrate at 10mg/ml¹⁹.

Anti-inflammatory and anti-arthritis activity

It had been examined the effects of prophylactic administration of extracts of bark of *sesbania grandiflora* (300mg/kg bw p.o) on the development of carrageenan induced paw edema and adjuvant induced arthritis to assess influence of high NO level in the form of exogenous herbal extracts of bark of *sesbania grandiflora* in the progress of inflammation. Inflammation was assessed by measuring paw swelling and arthritis was assessed by measuring primary and secondary paw swelling and changes in thymus, spleen and body weight. It was also claimed that exposure to extracts of *sesbania grandiflora* during inflammation process may be modulate the inflammation process due to presence of the isolated triterpenoidal compounds²⁰.

Hypolipidemic activity

Hyperlipidemia was the greatest risk factor of coronary heart disease. Currently available hypolipidemic drugs have been associated with number of side effects. Herbal treatment for hyperlipidemia had no side effects and was relatively cheap and locally available. A literature claims that flavonoids can able to reduce the hyperlipidemia. SG administered a dose of 200µg/kg (p.o) to the triton induced hyperlipidemic rats. SG showed a significant decrease in the levels of serum levels of serum cholesterol, phospholipid, triglyceride, LDL, VLDL and significant increase level of serum HDL at the dose of 200µg/kg(p.o) against triton induced hyperlipidemic in rats. Aqueous extract of leaves of SG was investigated hypolipidemic activity on triton induced hyperlipidemic profile. The aqueous extract decreased the serum level of total cholesterol and increased serum HDL level²¹.

Immunomodulatory activity

The immunomodulatory activity of *sesbania grandiflora* on cellular and humoral immunity was evaluated and oral administration of the methanolic extract of *s.grandiflora* flowers in mice, dose-dependently significantly enhanced the production of circulating antibody titre in mice in response to SRBC. It significantly potentiated the delayed type hypersensitivity reaction induced by sheep red blood cells (SRBC). Good response was also found towards phagocytosis in carbon clearance assay and prevented myelosuppression in cyclophosphamide drug. Aqueous extract at low dose level failed to show immunomodulatory activity but at specified dose (500mg/kg) potentiated the activity however less significantly compared with both dose of methanolic extract²².

Anti tuberculous activity

The three isoflavanoids, isovestitol, medicarpin, and sativan, along with another known compound betulinic acid, was isolated from the root of *sesbania grandiflora*, their structures were characterised by means of spectroscopic techniques. All the tested compounds exhibited antituberculous activity against *M.tuberculosis* with MIC values of 50µg/ml and 100µg/ml for those compounds whereas methanolic extract exhibited antituberculous activity of 625µg/ml²³.

Analgesic and CNS depressant activity

Sesbania grandiflora, a plant of Fabaceae is full of various pharmacologically important components like, alkaloids, flavanoids, tannins, triterpenes, gums, mucilage, and anthraquinone glycosides. The investigations had brought out the significant effects of extract. Hence, CNS depressant and analgesic drug can be produced from the leaf of *Sesbania grandiflora* through a suitable formulation. After collecting, the plant has been dried out by using an oven (L-C Oven) at 40°C for 7 days. Then the plant part was grinded by Blender machine (Nowake, Japan). After grinding, fine powder was obtained whose amount was about 1000gm/1kg. From this powder 100gm soaked in 300ml of 80% of methanol in a glass container for 7 days. The extract was separated from the leaf debris by filtration by filter paper (9 Whitman Filter Paper). The extract was concentrated by evaporation and dried to solid in an oven. Methanol and acetic acid, Tween 80 and Diclofenac Sodium are the reagents used Swiss albino mice (wt. 18-20gm) are used as experimental models. They conducted Analgesic activity test -Acetic acid induced writhing test, Tail Flick Method Neurological activity tests - Open Field Test, Hole Cross Test . The results definitely prove that the leaf extract of this plant has a good analgesic and CNS depressant activity²⁴.

Tablet binder

The hydrophilic mucilage from the seeds of *Sesbania Grandiflora* (Leguminosae) was isolated and studied the potential of mucilage in tablet formulation as a binder. The DSC thermogram of the drug, drug-mucilage mixture indicates no chemical interactions. The tablet formulations of SG I, SG II, SG III, SG IV and SG V was prepared by using 2, 4, 6, 8, and 10% of mucilage, using lactose as diluents, Diclofenac sodium as a model drug and 2% of talc and magnesium stearate used as a glidant and lubricant, respectively. The granules was prepared by wet granulation technique and evaluated the granules properties like flow rate, Carr index, Hausner ratio and angle of repose was studied and compared with starch which was used as standard binder at 10% concentration. The tablets was compressed and evaluated the various parameters of weight variations, hardness, friability, disintegration and *in vitro* dissolution. The result shows that the granules having the excellent flow property and tablet prepared using 8 and 10 % of mucilage shows drug release over a period of 5 h and it exhibits more hardness than other formulations²⁵.

Ophthalmic infection

Sesbania grandiflora used in traditional knowledge of ayurveda for various diseases and infections. The acetone (70%) extraction was carried out on the flowers of the plant. The phytochemical groups were identified by the tests of characterization, and then quantified by the tests of proportioning of total phenolics and flavonoides. The total flavonoids and phenolic contents were also quantified in acetone extract of flower part. This activity is related to phenolic compounds contained in the extracts. The total polyphenolic content in the flower extract found to be 49.1±0.96 mcg/mg and flavonoid content was 12.86±0.72 mcg/mg. Extracts also expressed a good antibacterial activity. The flowers extract FE 200 showed highest inhibition against *P. Aeruginosa* (25.00 ± 0.60 mm), *S. Aureus* (21.00 ± 0.50

mm) and *E. Coli* (19.00 ± 0.60), which are especially responsible for ophthalmic infection, conjunctivitis²⁶.

Antiproliferative and Apoptotic Effects

Natural phytochemicals and their derivatives are good drug candidates for anticancer therapeutic approaches against multiple targets. They reported here the initial findings from our studies on the anticancer properties of the leaves of the medicinal plant *Sesbania grandiflora*. They found five different solvent fractions from the leaves of *S. Grandiflora* were tested on cancer cell lines such as MCF-7, Hep-2, HCT-15, and A549. The methanolic fraction of *S. Grandiflora* was found to exert potent anti-proliferative effects especially in the human lung cancer cell line, A549. Caspase 3 was activated in the methanolic fraction treated A549 cells thereby leading to cell death by apoptosis. DAPI staining, DNA laddering, and decrease in mitochondrial membrane potential further confirmed the apoptotic mode of cell death. The high levels of ROS intermediates as evidenced by DCF-DA staining could have played a role in the apoptotic induction. Decrease in levels of cyclin D1 and decrease in the activation of nfkb were observed in A549 cells on treatment with methanolic fraction, giving a hint on the possible mechanism of action. These results proved that the medicinal plant *S. Grandiflora* can be explored further for promising candidate molecules to combat cancer, especially lung cancer²⁷.

Analgesic activity

The antipyretic activity of *sesbania grandiflora* flowers was evaluated by the three different extract using petroleum ether, ethyl acetate and ethanol as solvent were subjected for screening on albino rats for analgesic activity using Tail Flick methods. The ethyl acetate extract showed better analgesic and antipyretic activities compared with petroleum ether and ethanol extract²⁸.

CONCLUSION

In recent years, ethno medicinal studies received much attention as this brings to light the numerous little known and unknown medicinal virtues especially of plant origin. Pharmacological screenings of *Sesbania grandiflora* revealed its medicinal potential and represents as a valuable medicinal plant with several medicinal properties. As the pharmacologists are looking forward to develop new drugs from natural sources, development of modern drugs from *Sesbania grandiflora* can be emphasized for the control of various diseases. In combination it shows anthelmintic activity, the ethanol, methanol and ethyl acetate crude extract of flower of *Musa paradisiaca* and *Sesbania grandiflora* leaves on Indian adult earthworms (*Pheretimaposthuma*) was evaluated. A systemic research and development work should be undertaken for the conservation of *Sesbania grandiflora* and development of products for their better economic and therapeutic utilization.

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