INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES
[ISSN: 0975-4725; CODEN(USA): IJPS00]
Journal Homepage: https://www.ijpsjournal.com

Review Article

Extraction, Phytochemistry and Therapeutic Potential of *Asystasia gangetica*: A Systemic Review

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ARTICLE INFO

Published: 29 Oct 2025
Keywords:
Asystasia gangetica, extraction, phytochemical constituent's activity, Pharmacological actions.
DOI:
10.5281/zenodo.17474602

ABSTRACT

Medicinal plants play a vital role in the development of human culture. As a source of medicine, medicinal plants have always been at fore front in all cultures of civilization. Medicinal plants are regarded as rich resources of traditional medicines and from those plants many modern medicines are produced. For thousands of years medicinal plants are used to treat health disorders, to add flavour and conserve food and to prevent disease epidemics. Even today, plants are not only used in health care, but the best source for safe future medicines. The secondary metabolites produced from the plants are responsible for the biological characteristics used across the world. The microbial growth in diverse situations is controlled by plant derived products. This article is an overview of the plant Asystasia gangetica and its wide range of medicinal utilities. This plant belongs to the family Acanthaceae, and is used in healthcare treatment of various diseases in different countries due to its broad range of activity.

INTRODUCTION

Human beings are dependent on nature for their simple requirements like medicine, shelter, food and many other resources throughout the ages. Most of the important drugs over the past 50 years, which have revolutionized modern medicinal practice, have been isolated from plants. The plants remain to offer mankind with new medicines. Some of the beneficial properties ascribed to plants have been recognized to be flawed and medicinal plant treatment is based on the experimental findings of hundreds and thousands of years. There is a promising future of medicinal plants as there are about half million plants around the world, and most of them are not investigated yet for their medical properties and their hidden potential of medicinal activities could be determinative in the treatment of present and future studies. Medicinal plants have proved their role in dealing with many deadly diseases

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

including cancer and the diseases associated with aggressive viral attacks like Hepatitis, AIDS etc[1-2]. Asystasia gangetica is commonly known as Chinese violet, Coramandel, Creeping fox glove. This plant originated in the Indian subcontinent (including India and Sri Lanka), Africa and Arabia. It is introduced to other regions, such as Australia, North, Central and South America, and Hawaii. As an ornamental plant and is now an invasive weed in many regions including Southeast Asia, the Pacific islands and Australia. It is used in treatment of various ailments like asthma, rheumatism, and stomach ache, etc. This plant has anti-hypertensive, anti-bacterial, anti-oxidant, anti-inflammatory, anti-microbial, anti-diabetic, anti-asthmatic, and wound healing properties. The phytochemical constituents present in the plant show the activities like inhibition of platelet aggregation, anti-aging, and insecticidal effects.

APPLICATIONS

In times of scarcity, Asystasia gangetica is used locally as a leafy vegetable and potherb. It is a common vegetable in Kenya and Uganda, where it is combined with beans and sesame or groundnut paste. Additionally, it is frequently made in combination with other leafy vegetables. In Africa, an infusion of the plant is used to relieve pain during childbirth, and the sap is applied to sores, wounds, and piles, as well as in embrocations to treat children's stiff neck and enlarged spleen. Powdered roots are analgesic and used to treat stomach aches and snake bites. A leaf decoction is used to relieve pain and treat epilepsy and urethral discharge these leaves are used to treat asthma. In India, the sap is used to treat swellings, vermifuges, and rheumatism. In the Moluccas (Indonesia), the juice, along with lime and onion juice, is used to treat dry coughs, irritated throats, and chest discomfort. The leaves and flowers are used as an intestinal astringent in the Philippines. In Tanzania, water is beaten into plants to create a flea-resistant wash for young animals. Sometimes Asystasia gangetica is planted as a decorative plant[3].

PROPERTIES

The nutritional value of Asystasia gangetica leaves per 100 g edible portion is: water 82.6 g, energy 234 kJ (56 kcal), protein 3.7 g, fat 1.2 g, carbohydrate 10.4 g, Ca 226 mg, P 30 mg, Fe 4.7 mg, carotene 6250µg, thiamin 0.19 mg, riboflavin 0.21 mg, niacin 1.0 mg, and ascorbic acid 42 mg (Leung, W.-T.W., Butrum, R.R. & Chang, F.H., 1972). In pharmacological tests, extracts of Asystasia gangetica exhibited analgesic and anti-asthmatic activity. Substitutes and adulterations include a number of Justicia species, including Asystasia mysorensis (Roth) T. Anderson, are substituted for Asystasia gangetica.This perennial herb has a quadrangular, branched, usually ascending stem that can reach a length of 2 meters. It frequently roots at the lower nodes[4-7].

ENVIRONMENT

Asystasia gangetica is found along roadsides and riverbanks, in more or less waterlogged areas as well as well-drained cultivated areas, from sea level up to 2500 m altitude. In areas with a dry season of 4 months or more, it may not survive. It thrives on coastal alluvium, peat soils with 85% organic matter and pH 3.5–4.5, sandy loams, and clay soils. Development and growth in open spaces, the time between seedling emergence and seed dispersal can be as short as 8 weeks; however, in partially shaded areas, this time can be extended by 2 weeks. From flower development to seed dispersal, a month passes. Hot afternoons cause the fruit’s explosive opening mechanism to release the seeds up to six meters[8-12].

PROPAGATION AND PLANTING

Asystasia gangetica can be propagated from seed or stem cuttings with 1-3 nodes. Within six weeks of being buried in soil, single-node cuttings produce flowers and fruits, on the other hand, is highly palatable and digestible, making it appealing to grazing animals as plantation undergrowth.[7,9]

HARVESTING & YIELD

Asystasia gangetica's young tender leaves and shoots are harvested for use as vegetables. Cutting frequently for stall feeding causes early dieback because the stems have long internodes and growing points higher up. Low grazing pressure or long periods between grazing allow the plant to flower and set seed. It is typically consumed fresh by animals, but it can be stored as hay if properly dried.[12] Asystasia gangetica grown in heavy shade (6-16% full sunlight) produced dry matter yields of 2-5 tons per hectare[13].

HANDLING AFTER HARVEST

Asystasia gangetica leaves can be dried and ground into a powder, which can then be stored for use in the dry season. Asystasia gangetica breeding programs and germplasm collections are unknown. This is not impacted by genetic erosion. More attention to their various varieties, including their use as fodder and vegetables, their medicinal properties, their weedy characteristics, and their aesthetic value, may be beneficial. as a fodder plant, agricultural auxiliary plant, and nutrient-dense vegetable, Asystasia gangetica may be useful. It can be used to make leaf meal instead of legumes. Intervention is necessary, though, because some varieties are spreading like a serious weed[15].

Table no:1 Methods of Extraction[16-17]

Extraction Method	Principle / Process	Advantages	Disadvantages
Soxhlet Extraction	Continuous solid-liquid extraction using a Soxhlet apparatus under reflux with organic solvent (e.g., methanol, ethanol). Solvent repeatedly washes the sample until complete extraction.	Highly efficient; ensures continuous contact between solvent and sample- Automated reflux; minimal manual work-Suitable for moderately heat-stable compounds- Uses smaller solvent volumes compared to maceration- Simple setup; easy operation- Produces exhaustive extraction	Time-consuming (hours to days)- High solvent consumption- Energy intensive (requires constant heating)- Risk of thermal degradation for heat-sensitive compounds- Environmental and safety concerns from volatile solvents- Inefficient for small samples
Aqueous Extraction	Uses distilled or purified water as the solvent; plant powder is boiled, refluxed, then freeze-dried to obtain dry extract. Often follows Soxhlet setup modified for water.	Non-toxic and eco-friendly- Safe for human use- Economical and easily available solvent- Selectively extracts polar phytochemicals (flavonoids, glycosides, tannins, etc.)- Reflects traditional decoction or infusion methods	Poor solubility for non-polar compounds-High risk of microbial contamination- Lower extraction efficiency and yield-Heat-sensitive compounds may degrade- Short shelf life of extract

Polyphenol Extraction	Multi-step process: defatting plant powder with petroleum ether followed by ethanol extraction (often using Soxhlet). Extract is condensed and stored at low temperature.	High yield of polyphenol-rich bioactive compounds- Therapeutic benefits (antioxidant, anti-inflammatory, etc.)-Natural and environmentally friendly antioxidants- Flexible solvent choices (acetone, ethanol, methanol, water)-Advanced techniques preserve compound stability	Low yield with some methods- Possibility of compound degradation by heat or light-Solvent residues or toxicity issues-Time-consuming extraction- Expensive equipment for advanced techniques (e.g.. ultrasound, supercritical fluids)
Maceration	Plant material soaked at room temperature in solvent (ethanol, water, etc.) for days. Mixture occasionally stirred or shaken, then filtered and evaporated	Simple and low-cost method- Does not require heat, safe for thermolabile compounds- Suitable for small-scale extractions- Adaptable to different solvents	Requires long extraction time- Low extraction efficiency- Risk of microbial growth during soaking- Uses large solvent volume- Incomplete penetration of solvent into plant tissues

Table no 2: Phytochemical constituents' determination[18-28]

Phytochemical	Preparation of Sample	Test Performed	Observation (Positive Result)	Inference
Alkaloids	0.5 g of powdered leaves dissolved in 30 mL of dilute HCl and filtered after methanolic extraction.	(a) Mayer's Test: 4 drops of Mayer's reagent added to 1 mL filtrate. (b) Wagner's Test: 4 drops of Wagner's reagent added to 1 mL filtrate.	(a) Creamy-yellow precipitate. (b) Reddish-brown precipitate.	Presence of alkaloids.
Flavonoids	0.5 g of powdered leaves boiled in 30 mL distilled water for 5 minutes, then filtered.	Lead Acetate Test: 4 drops of lead acetate added to 1 mL filtrate.	Formation of yellow precipitate.	Presence of flavonoids.
Saponins	0.5 g of powdered leaves boiled in 30 mL distilled water for 5 minutes, then filtered.	Froth Test: Equal volume of filtrate and distilled water shaken for 3 minutes.	Persistent froth formation.	Presence of saponins.
Tannins	0.5 g of powdered leaves boiled in 30 mL distilled water for 20 minutes, then filtered.	Ferric Chloride Test: 1 mL filtrate mixed with 4 drops of ferric chloride	Formation of dark green precipitate.	Presence of tannins.
Steroids	0.5 g of powdered leaves extracted with 30 mL methanol by heating for 30 minutes, then filtered while hot.	Acetic Anhydride Test: 4 drops of acetic anhydride added to 1 mL filtrate.	Violet to blue coloration.	Presence of steroids.
Terpenoids	10 mg of powdered leaves mixed with 2 mL chloroform and layered with 3 mL concentrated sulfuric acid.	Salkowski Test: Observation of interface between two layers.	Reddish-brown coloration at the interface.	Presence of terpenoids.

Glycosides	5 mg of powdered leaves boiled in 20 mL of 10% HCl for 5 minutes, filtered, and cooled.	Borntrager's Test: Filtrate mixed with chloroform; 4 drops of 10% ammonia added and heated.	Formation of pink coloration.	Presence of glycosides.

Table no:3 Pharmacological activity of *Asystasia gangetica*[29]

Pharmacological Activity	Extract / Compound Used	Experimental Model / Method	Key Findings / Observations
Anti-inflammatory	80% ethanolic extract and isolated glycoside (luteolin-7-o-neohesperidoside)	Hypotonicity-induced haemolysis and carrageenan-induced rat paw oedema	Produced dose-dependent inhibition of haemolysis and significant anti-inflammatory effect comparable to phenylbutazone.
Anti-asthmatic	Ethyl acetate, hexane, and methanol leaf extracts	Histamine-pre-contracted tracheal strips in guinea pigs; egg albumin-induced acute inflammation in rats	Ethyl acetate extract showed strong relaxation effect on tracheal strips; methanol extract exhibited anti-inflammatory response.
Anti-hypertensive	Methanolic leaf extract	In vitro ACE inhibition assay and in vivo rat BP monitoring	Showed 51% ACE inhibition; significantly reduced systolic, diastolic, and mean arterial pressure ($p<0.01$); reduced heart rate ($p<0.05$); inhibited hypertensive effect of angiotensin I & II.
Anti-diabetic & Hypolipidemic	Ethanolic, aqueous, and anthocyanin extracts of leaves and flowers	Alloxan-induced diabetic rats; α-amylase and α-glucosidase inhibition assays	Reduced blood glucose and lipid levels; anthocyanins showed strong α-amylase (71.46%) and α-glucosidase (76.85%) inhibition; improved body weight and lipid profile.
Anti-oxidant	70% ethanolic and alcoholic extracts; isolated iridoid glycosides	Alloxan-induced diabetic rats; DPPH and ORAC assays	Increased antioxidant enzymes (CAT, SOD, GPX, GSH, etc.); reduced lipid peroxidation; isolated iridoid glycosides exhibited potent free radical sca+D6venging (SC_{50} = 3 mM).
Anti-microbial	Hexane, ethyl acetate, and methanol extracts	Agar diffusion pour plate method	Dose-dependent inhibition of 12 pathogenic microorganisms (6 bacteria and 6 fungi), including E. coli, S. aureus, Candida albicans, and A. niger.
Anti-snake venom	Methanolic extract and polyphenolic fractions (flavonoids, tannins, saponins)	Naja melanoleuca venom challenge in mice	Methanolic extract (1 g/kg) gave 60% protection; flavonoids and saponins (1 g/kg) gave 80% and 60% protection respectively ($p<0.05$).
Anthelmintic	Methanolic leaf extract (12.5–200 mg/mL)	Nsukkadrilus spp. and Pheretima posthuma	Dose-dependent reduction in paralysis and death time of worms; 200 mg/mL showed potent effect comparable to albendazole.

Anti-arthritic	Methanolic extract	Protein denaturation inhibition assay (10–1000 µg/mL)	Inhibited protein denaturation in a dose-dependent manner (max 78.94%) comparable to diclofenac sodium (84.47%).
Anti-platelet	Methanolic extract	In vitro platelet aggregation assay (100–500 µg/mL)	Showed dose-dependent inhibition of platelet aggregation; maximum inhibition at 500 µg/mL comparable to aspirin.
Effect on Blood Viscosity	Methanolic extract and flavonoid fraction	In vitro blood viscosity measurement	Displayed dose-dependent (100–500 µg/mL) reduction in blood viscosity; flavonoid fraction showed higher effect than methanol extract.

SUMMARY:

Medicinal plants have played a key role in human culture and healthcare since ancient times. They are valuable sources of traditional and modern medicines, used for treating diseases, adding flavor, preserving food, and preventing epidemics. Even today, plants remain a primary and safe source for developing new medicines, largely due to their secondary metabolites, which possess various biological activities. Plant-derived compounds are also effective in controlling microbial growth in diverse environments. The plant Asystasia gangetica, belonging to the family Acanthaceae, is one such medicinal plant known for its wide range of therapeutic uses. It is utilized in different countries for the treatment of various diseases because of its broad biological activity.

CONCLUSION:

Medicinal plants like Asystasia gangetica continue to be vital in modern healthcare due to their natural bioactive compounds. Their long-standing use in traditional medicine and potential for new drug discovery make them an essential and sustainable resource for future medical advancements.

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HOW TO CITE: Dr. E. Usha Rani, K. J. S. Varshini, K. MahaLakshmi, K. Nityanjali, K. Jyothi, K. S. S. D. Pavani, K. Nayana Harshitha, Extraction, Phytochemistry and Therapeutic Potential of Asystasia gangetica: A Systemic Review, Int. J. of Pharm. Sci., 2025, Vol 3, Issue 10, 3109-3116. https://doi.org/10.5281/zenodo.17474602