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Original Article

Argyreia Nervosa (Burm. F.) Bojer: Rediscovering A Traditional Healer Through The Prism of Modern Science—From Ethnomedicinal Wisdom to Evidence-Based Therapeutics

Samistha Shukla*, Shailiju Gurunani

Department Of Pharmacognosy, Priyadarshini J.L. College of Pharmacy, Nagpur, Maharashtra

ABSTRACT

Argyreia nervosa (Burm. f.) Bojer, commonly known as Vidhara or Hawaiian Baby Woodrose, is an important medicinal climber extensively used in traditional systems of medicine, particularly Ayurveda, for the management of neurological disorders, inflammation, reproductive ailments, metabolic disturbances, and wound healing. Owing to its wide ethnomedicinal relevance, considerable scientific investigations have been conducted to explore its pharmacognostic characteristics, phytochemical composition, and pharmacological potential. The present review aims to provide a comprehensive and updated compilation of available information on the plant, covering its botanical taxonomy, morphology, microscopic features, physicochemical standards, traditional uses, and phytoconstituents isolated from various plant parts. The review further summarizes extraction methods, preliminary phytochemical screening, quantitative estimation of major secondary metabolites, and reported pharmacological activities validated through experimental studies. Additionally, recent efforts toward pharmaceutical utilization, including the development and evaluation of topical formulations containing plant extracts, are discussed to highlight its translational therapeutic potential. By integrating classical knowledge with contemporary scientific findings, this review attempts to identify research gaps and future prospects for standardization, clinical validation, and formulation development of *A. nervosa*. The compiled data may serve as a valuable reference for researchers working in pharmacognosy, phytochemistry, and herbal drug development.

Keywords: *Argyreia nervosa*, Ethnopharmacology, Phytochemistry, Herbal formulations Quality control of herbal drugs, Bioactive secondary metabolites, Pharmaceutical evaluation, Natural product research.

INTRODUCTION

Medicinal plants have long served as an essential resource for human health, offering a rich repertoire of bioactive compounds that predate modern pharmaceuticals. Traditional systems such as Ayurveda emphasize holistic well-being and the use of plant remedies to restore physiological balance, underscoring their enduring relevance in contemporary healthcare research [1,2]. There is growing scientific interest in validating ethnobotanical knowledge, driven by the need for multi-targeted agents with better safety profiles than many synthetic drugs [3,4].

Despite India's rich botanical heritage, many traditionally used species lack comprehensive phytochemical and pharmacological documentation. A systematic understanding of these plants is crucial for bridging the gap between traditional claims and modern therapeutic applications [5].

A. nervosa is a very valuable plant in the Ayurvedic system. In 'Rasayan' drug it has been used for the treatment of various neurological diseases. It has been also reported in indigenous medicine system that *A.nervosa* has given for chronic gonorrhea, ulcer, severe pain in urinary bladder (strangury), gleets, male sexual disorder. The plant leaves also possess the therapeutic activity against several skin diseases such as eczema, itching, ringworm and systemically in skin abscess. In addition, it also used as a rubefacient and local skin stimulant. In Rajasthan, some tribal's used leaves to prevent the conceived in

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females [6]. Its root taste is bitter and having the multiple uses like as a brain tonic, diuretic, aphrodisiac, rheumatism. In other hands for persistent cold & cough, and in resulting fever, root paste with Grewia hirsute, *Asparagus racemosus* and *Hemidesmus indicus* prescribed for immediate relief. Its seven times root powder is macerated throughout 7 days with tubers juice of *Asparagus racemosus* as nervine tonic. It promotes intellect, strengthens body and counteracts influences of age. In addition one of its preparation known as Ajmodadi Churna used for unilateral paralysis, dysentry and rheumatic ailments [7,8]. *A.nervosa* seed exhibited potential psychedelic, antihypertensive and spasmolytic activity. Seed consisted of the various neuropharmacological active constituents which are the isomer of lysergic acid diethylamide (LSD) such as lysergacidamide and lysergacidethylamide. Due to this reason, the seed has been the misuse of psychomotor agitation, an orientation of disturbances and anxiety.

GEOGRAPHICAL DISTRIBUTION

Argyreia nervosa, is widely distributed plant species in India. It is commonly known as Elephant creeper, Samundar ka pat and Vryddhadaru. It is found throughout in India up to altitude of 500 m. It is great climber with big ovate-cordate leaves found growing native in north-eastern Himalaya, Dehradun, Konkan, Rajasthan, Mysore, and Bengal [9]. A. speciosa usually appreciated for its aesthetic merit. It is grown as an ornamental and decorative plant because its leaves are heart shape, green color and flowers are look like rose purple [10].

BOTANICAL DESCRIPTION AND TAXONOMY

Argyreia nervosa (Burm. f.) Bojer is a perennial woody climber belonging to the family Convolvulaceae. The plant is characterized by large, heart-shaped leaves with dense silvery pubescence on the abaxial surface, long twining stems, and showy purple to violet funnel-shaped flowers. The seeds are globose to ovoid and covered with silky hairs. The plant thrives in tropical and subtropical climates and is widely distributed across India, Sri Lanka, and other parts of Southeast Asia [11,12].

Fig 1: *Argyreia nervosa* plant

BOTANICAL TAXONOMY (13,14)

Rank	Classification
Kingdom	Plantae
Subkingdom	Tracheobionta
Division	Magnoliophyta
Class	Magnoliopsida
Order	Solanales
Family	Convolvulaceae
Genus	Argyreia
Species	Nervosa
Botanical name	*Argyreia nervosa*

Table 1: Taxonomical classification

Language	Vernacular name
English	Elephant creeper, Baby wood-rose, Elephant-climber, Elephant-creeper
Hindi	samandar-ka-pat, Samundarsokha, Ghav-patta, Bidhara
Marathi	Samudarsoka
Sanskrit	Vridhadaraka
Bengali	Bijarka
Gujrati	Samudarsoka
Unani	Samudarsoka
Tamil	Sadarpalai, Samuddirapacchai
Telegu	Chandrapada
Nepali	Samudraphool

Table 2: Vernacular names

ETHANOPHARMACOLOGICAL USES

Whole plant: It is used for stomach issues, foot sores, small pox, syphilis, dysentery and diarrhoea, antifertility, anti-rheumatic, and antifungal, they are all covered. In vasectomies, it is also utilised during recanalization [15]

1. **Leaf:** The leaves are extensively used all over India for the treatment of ulcers, boils, carbuncles and tumours. The leaf is collected in the folded stage before opening and used freshly in Maharashtra; elsewhere the mature leaves are used. When leaf is applied with the ventral surface in contact with the body and bandaged, the boil, carbuncle or tumour regress and disappear. Antiphlogistic, emollient, poultices of wounds, externally for skin disease, gleet, gonorrhoea and chronic ulcers. Also used as a local stimulant and rubefacient. It is also externally used for ring worm infections and eczema. It is mixed with vinegar and the sap is rubbed to reduce obesity. The leaves contain a mixture of three phytosterolins which exhibit hypoglycemic and CNS depressant activities. The leaves are reported to be effective in diabetes Eczema, itch and other skin disease. Fresh leaves ponded into a lump and taken during empty stomach for three consecutive days from 4th day of menstruation and repeated for three successive months to avoid conception for a few years.

Fig 2: *A.nervosa* leaf

2. **Root:** The root is aphrodisiac, nervine, alterative, diuretic, tonic, antigonorrheic, intellect-promoting, thermogenic, sweet, alterative, emollient, digestive, aperient, purgative, carminative, aphrodisiac, nervine, alterative, emollient, anti-inflammatory, and antirheumatic. Anorexia, loss of appetite, dyspepsia, flatulence, colic, chronic ulcer, ascites, haemorrhoids, hemiplegia, nerve weakness, neuralgic symptoms, brain problems, synovitis, and general weakness might all benefit from it. Roots have a cardiotonic effect and are therefore helpful for heart debility. It is used to treat obesity since it has emaciation-inducing effects. Leucorrhoea, diabetes mellitus, infected wounds, syphilis, cough, bronchitis, pharyngitis, and pulmonary TB are other conditions for which it is recommended. In the Yunani medical system, the root is used to treat chronic ulcers, gleet, gonorrhoea, and

stranguria. The powdered root is used with milk for synovitis [16].

Fig 3: *A.nervosa* roots

3. **Seeds**: It has significant hypotensive and spasmolytic activity and is used to treat anorexia, diabetes, and a number of skin problems. Seed has spasmolytic and CVS (cardio-vascular system) activity. A fraction containing three alcohols, one of which being ergometrine, was the source of the hypotensive activity [17]. The seeds are used secretly as a hallucinogen. After eating seed, there have been reports of toxic psychosis including hallucinations, orientation problems, and psychomotor agitation and anxiety. The presence of alkaloids, including lysergacidamide, lysergacidethylamide, and their structurally related isomers led to the (psycho) pharmaceutical effect (LSD). It produced psychic effects that were considerably dissimilar from those of LSD but resembled those of scopolamine [18].

Fig 4: *A.nervosa* seeds

Plant Part	Traditional Uses	Mode of Application	Reported Region/System
Root	Aphrodisiac, tonic, anti-inflammatory, nervine, rejuvenator	Decoction, powder, tonic	Ayurveda, Folk medicine
Leaves	Wound healing, skin infections, inflammation	Paste/poultice (topical)	Folk medicine
Seeds	Nervine tonic, aphrodisiac, psychoactive uses	Powder/decoction	Traditional, ethnobotanical uses
Stem	Anti-inflammatory, pain relief	Decoction	Folk medicine
Whole plant	General tonic, fever management	Decoction	Folk medicine

Table 3: Compilation of Ethnopharmacological Uses (20)

MORPHOLOGY (21-26)

Convolvulaceae is the family to which *Argyreia nervosa* belongs. It is a climbing shrub with a woody tomentose stem. In English-speaking nations, it is frequently referred to as elephant creeper, while among Hindi-speaking Indians, it is called samundar-ka-pat. [21] It is widely found throughout the world's tropical regions. It is commonly grown natively in India, from Assam and Bengal to Karnataka, and has been observed up to 900 meters above sea level. [22,23] Typically, it grows as undergrowth in semidecidous forests and along riverbanks, lakeshores, and other slightly damp areas. [24] It is a twining, woody climber that can grow to a height of at least 10 meters. Simple, alternating leaves range in

length from 5 to 15 cm. Large, showy, funnel-shaped flowers with a distinct odour and slightly bitter taste are borne on stout, whitish, and tomentose peduncles. The flowers are tinted purple or pale to deep rose and are regular, with short pedicels in axillary bracteates cymes. [25] The smooth, globose, indehiscent, irregularly crumbling berries have a diameter of 1.2–1.8 cm and are yellowish brown in color. They contain one or two seeds encased in a mealy pulp. The seeds are roughly triangular in shape, with two flat or slightly concave sides and a convex third. They range in length from 0.5 to 0.75 cm and width from 5 mm. When the stem is young, it is tomentose and white. The older stem (25 mm) is so thick that many lenticels, most of which are transversely elongated, are visible along with vertical ridges. Both in size and thickness, *Argyreia nervosa* roots vary in size. The thin roots have a smooth, brownish exterior and typically have a diameter of 2-4 mm. When they are cut transversely, a thin periderm and cambium can be seen, which appears as a dark line that divides the inner central wood from the outer phloem almost halfway between the two. Due to the abundance of lenticels, the thicker roots, which have a diameter of 5 to 25 mm or more, have a rough exterior. The plant is multiplied by seeds as well as stem cuttings. [26]

Plant Part	Morphological Characteristics
Root	Thick, cylindrical, woody roots used medicinally
Stem	Twining, woody climber, pubescent when young
Leaves	Large, cordate, velvety underside
Flowers	Purple/violet, funnel-shaped
Fruit	Globose capsule
Seeds	Hard, brown or black, ovoid

Table 4: Morphological Characteristics

MICROSCOPY

Microscopic evaluation of plant tissues is an essential component of pharmacognostic standardization. It aids in authenticating the drug, detecting adulteration, and establishing key diagnostic features for quality control (World Health Organization, 1998).

1. Leaf Microscopy

Transverse Section (TS) of Leaf:

The TS of a mature *A. nervosa* leaf typically displays a dorsiventral structure with a well-defined vascular system. The lower epidermis shows a greater density of stomata than the upper surface, with paracytic stomata being commonly observed. Vascular bundles in the mesophyll are surrounded by a sheath of sclerenchyma fibers, and the presence of parenchymatous cells with chloroplasts is characteristic. Powder microscopy often reveals parenchyma cells, xylem vessels with pitted walls, and epidermal cells with anisocytic stomata (Balbir Singh, 2018; adapted from WHO recommended methods).

2. Stem Microscopy

Transverse Section of Stem:

In young stems, the epidermis consists of a single layer of thick-walled cells often covered by a cuticle. Beneath this, the cortex is composed of parenchyma cells and occasional collateral vascular bundles. The vascular tissue consists of continuous rings of xylem and phloem with interspersed fibers. Under microscopic examination, fiber cells show lignified walls, and sclerenchymatous elements are observed around the vascular bundles. Powdered stem material may show cork cells, long fibers, and stone cells, which are useful diagnostic markers in drug identification (Balbir Singh, 2018).

3. Root Microscopy

Transverse Section of Root:

Microscopic study of *A. nervosa* roots reveals distinct anatomical zones: the epidermis, cortex, and vascular tissues (xylem and phloem). The young root's epidermis consists of small, cuboidal parenchyma cells, followed by a wide cortex. The primary vascular structure is typically tetrarch or pentarch in younger roots. In mature roots, a narrow periderm of cork cells is present, beneath which secondary phloem and secondary xylem predominate. The xylem contains large vessels with bordered pits, and the presence of

rosette crystals of calcium oxalate in parenchymal cells.

4. Root Microscopy

The detailed transverse section (TS) of the seed shows a tangentially elongated, oval to rectangular, single-layered epidermis of the testa. The epidermis bears thick-walled, mostly unicellular and occasionally bicellular, pointed, simple covering trichomes. Beneath the epidermis lies a layer of unequally high, radially elongated, thick-walled, lignified hypodermal cells containing yellowish-brown contents at the top. The hypodermis, a few rows of thick-walled, column-like palisade cells with a longitudinal central lumen are present. The cells of the first row are the longest in height and show a distinct crossing linea lucida at the top. Beneath the palisade layer, there are 5–7 rows of tangentially elongated, thin-walled parenchymatous cells embedded with a few round and oval, simple starch grains. (Sukumar, S., et.al)

5. Powder Microscopy

Microscopic Features in Powdered Drug:

Powdered samples of *A. nervosa* leaf, stem, or root exhibit certain recognisable features:

- Cork cells with thick walls
- Xylem vessels with scalariform or circular pits
- Fibers and sclerenchyma cells with lignified walls
- Parenchymatous cells
- Cluster crystals of calcium oxalate
- Trichomes or cylindrical unicellular hairs (leaf/stem).

Plant Part	Diagnostic Microscopic Features
Leaf TS	Paracytic stomata; vascular bundles with sclerenchymatous sheath; parenchyma with chloroplasts
Stem TS	Thick-walled epidermal cells, lignified fibers, sclerenchyma around vascular bundles
Root TS	Cork layer, wide cortex, secondary xylem with bordered pits, calcium oxalate crystals
Powder	Cork cells, pitted xylem vessels, fibers, parenchyma, crystal aggregates

Table 5: Microscopic Diagnostic Features

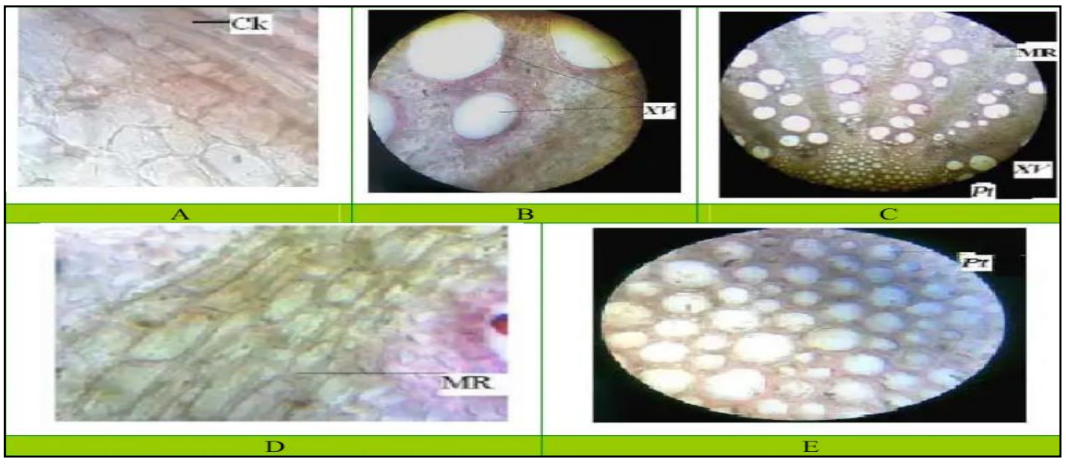


Fig 5: Microscopy of roots (Ahlawat, S., et al. (2009**)**

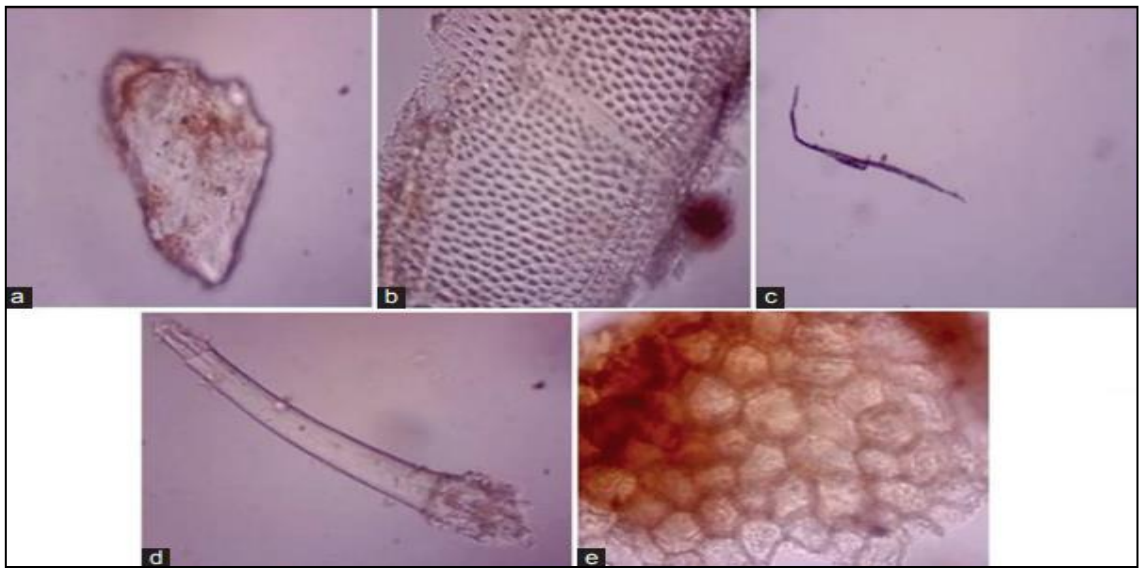


Fig 6: Powder microscopy of *A.nervosa* (Balbir Singh. (2018**)**

Parameter	Observation / Value	Type	Significance	Reference
Stomatal Type	Anomocytic	Qualitative	Diagnostic feature of Convolvulaceae	Metcalfe & Chalk (1950)
Stomatal Index (Upper Epidermis)	4.5/mm²	Quantitative	Indicates low stomatal density on upper surface	*Secondary compiled data*
Stomatal Index (Lower Epidermis)	16/mm²	Quantitative	Confirms hypostomatic nature of leaf	*Secondary compiled data*
Stomatal Distribution	Lower > Upper epidermis	Qualitative	Typical dorsiventral leaf	Evans (2009)
Vein Islet Number	10.2/mm²	Quantitative	Important for leaf authentication	*Secondary compiled data*
Vein Termination Number	12.6/mm²	Quantitative	Species-specific diagnostic parameter	*Secondary compiled data*
Palisade Cells	Single-layered, elongated	Qualitative	Indicates dorsiventral anatomy	Nadkarni (2009)
Palisade Index	Not reported	Quantitative	Gap in pharmacognostic standardization	—
Trichomes	Multicellular, uniseriate covering hairs	Qualitative	Gives velvety texture; diagnostic	Warrier et al. (1993)
Epidermal Cells	Irregular, wavy walls	Qualitative	Typical dicot feature	Metcalfe & Chalk (1950)

Spongy Parenchyma	Loosely arranged	Qualitative	Facilitates gas exchange	Evans (2009)
Calcium Oxalate Crystals	Present	Qualitative	Microscopic diagnostic marker	Kokate et al. (2010)
Vascular Bundle	Collateral, closed	Qualitative	Typical dicot structure	Esau (1977)
Cuticle	Thick (upper epidermis)	Qualitative	Protective adaptation	Evans (2009)
Powder Microscopy	Fibers, trichomes, starch grains	Qualitative	Useful for crude drug identification	Kokate et al. (2010)

Table 6: Quantitative and Qualitative Microscopic parameters

Quantitative leaf constants such as stomatal index, vein islet number, and vein termination number are compiled from available secondary data sources and require further experimental validation for standardization in *Argyreia nervosa*

PHYSICOCHEMICAL ESTIMATION

Several pharmacognostic studies on *Argyreia nervosa* have employed physicochemical parameters to establish quality standards of plant materials, particularly roots and leaves, which are widely used in traditional medicine (Kokate et al., 2010; Mukherjee, 2019).

➢ Ash Values

Ash values measure the total inorganic residue remaining after incineration and help identify contamination or adulteration. The parameters commonly assessed include:

- Total ash, representing total mineral content,
- Acid-insoluble ash, indicating siliceous impurities such as sand,
- Water-soluble ash, representing soluble inorganic salts.

➢ Extractive Values

Extractive values estimate the amount of active constituents extracted by solvents of varying polarity. Alcohol-soluble and water-soluble extractive values are commonly measured and provide insight into the presence of polar phytoconstituents such as phenolics, flavonoids, glycosides, and alkaloids (Evans, 2009).

➢ Moisture Content (Loss on Drying)

Loss on drying reflects moisture content present in plant material (WHO, 2011).

➢ pH Determination

pH evaluation is particularly relevant for formulation development, especially topical applications.

➢ Foreign Matter Determination

Foreign matter analysis ensures removal of extraneous materials such as soil, insects, or other plant contaminants before pharmaceutical processing. Proper cleaning and authentication reduce risk of adulteration (Evans, 2009).

S. No.	Ash type	Percentage of Ash
1	Total ash	4.3% w/w
2	Acid insoluble ash	1.6% w/w

3	Water soluble ash	3.94% w/w

Table 7: Ash value

S. No.	Solvent	Percentage of extractive
1	Petroleum ether	3.16% w/w
2	Chloroform	0.8% w/w
3	Ethyl acetate	1.4% w/w
4	Ethanol	0.2% w/w
5	Water	7.6% w/w

Table 8: Extractive value

Parameter	Typical Reported Range
Total ash	4–10 % w/w
Acid-insoluble ash	1–3 % w/w
Water-soluble ash	2–6 % w/w
Alcohol extractive value	7–16 % w/w
Water extractive value	10–22 % w/w
Loss on drying	5–11 % w/w
pH (1% solution)	5.5–7.5

Table 9: Summary of Physicochemical Parameter

PHYTOCHEMICAL SCREENING

Preliminary phytochemical screening provides qualitative information regarding the presence of major classes of bioactive compounds responsible for therapeutic effects. In *Argyreia nervosa*, different plant parts including roots, leaves, seeds, and stems have been subjected to phytochemical investigation, revealing the presence of diverse secondary metabolites contributing to its pharmacological activities. (Harborne, 1998).

Phytochemical Constituents	Test	Hexane Extract	Chloroform Extract	Methanol Extract	Aqueous Extract
Carbohydrates	Molisch's test	–	–	–	+
	Fehling's test	–	–	–	+
	Benedict's test	–	–	–	+
	Phloroglucinol test	–	–	–	–

Proteins	Biuret test	−	−	−	+
	Millon's test	−	−	−	+
	Ninhydrin test	−	−	−	−
	Xanthoprotein test	−	−	−	+
Steroids & Triterpenes	Liebermann–Burchard test	+	−	−	−
	Salkowski test	−	−	+	−
	Antimony trichloride test	−	−	−	−
	Trichloroacetic acid test	−	−	−	−
Saponins	Foam test	−	−	+	−
	Hemolysis test	−	−	+	−
Alkaloids	Dragendorff's test	−	+	+	−
	Mayer's test	−	+	+	−
	Wagner's test	−	+	+	−
	Hager's test	−	+	+	−
	Tannic acid test	−	+	+	−
Anthraquinone glycosides	Borntrager's test	−	−	+	−
	Modified Borntrager's test	−	−	−	−
Cardiac glycosides	Keller–Killiani test	−	−	−	−
	Legal test	−	−	−	−
Flavonoids	Lead acetate test	−	−	+	−
	Ammonia test	−	−	+	−
	Shinoda test	−	−	+	−
	Vanillin HCl test	−	−	−	−
Lipids	Solubility test	+	−	−	−
	Sudan IV test	+	−	−	−

	Grease spot test	+	–	–	–
	Emulsification test	+	–	–	–

Table 10: Preliminary Phytochemical screening (Kaur, et.al)

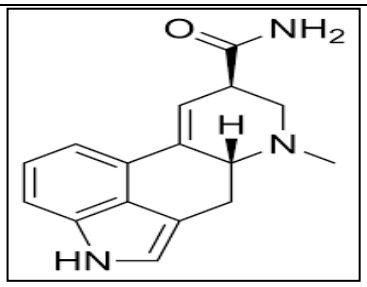
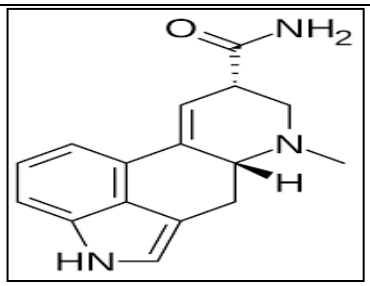
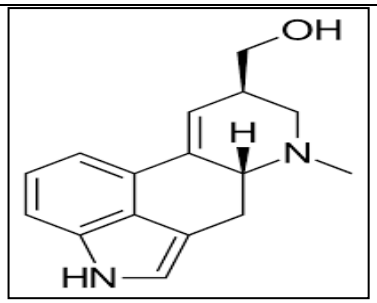
Phytochemical Constituents Reported in *Argyreia nervosa*:-

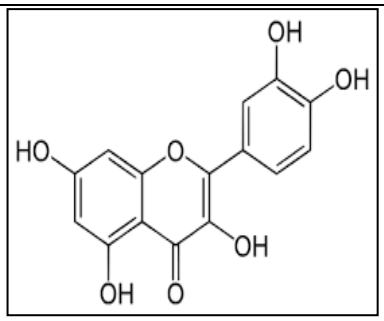
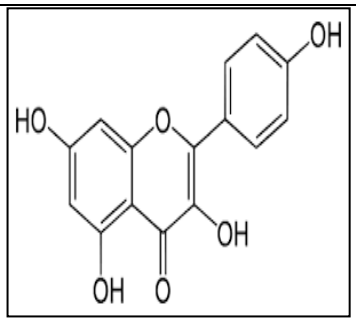
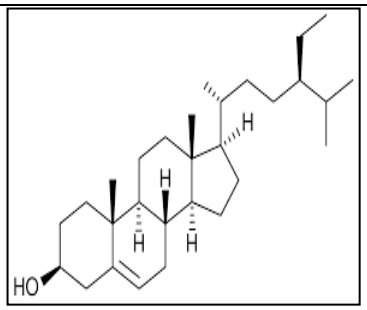
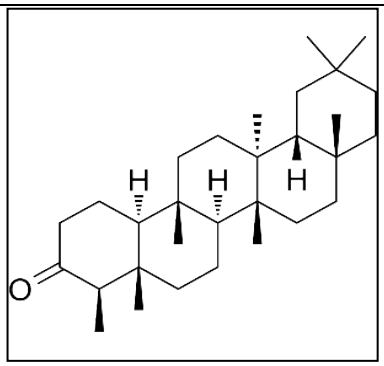
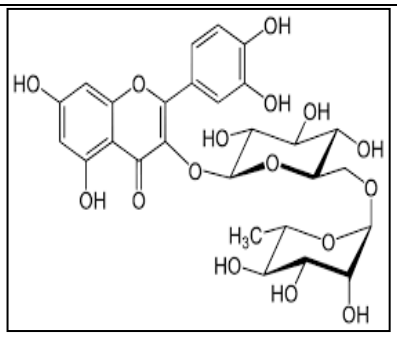
A. nervosa is phytochemically rich and comprises a diverse array of secondary metabolites, including alkaloids, flavonoids, phenolic compounds, glycosides, saponins, and terpenoids. Among these, **ergoline alkaloids** are the most extensively studied and pharmacologically significant constituents, particularly concentrated in the seeds (Ghosal et al., 1971; Chao & Der Marderosian, 1973).

Phytochemical investigations across different plant parts such as seeds, leaves, and roots indicate variation in chemical composition, suggesting a **part-specific distribution of bioactive compounds**, which contributes to the plant's broad spectrum of pharmacological activities (Jaiswal et al., 2010).

Various studies report that hydroalcoholic and ethanolic extracts of *A. nervosa* show strong presence of phenolic compounds and flavonoids, along with alkaloids and tannins, which correlate with antioxidant, anti-inflammatory, antimicrobial, and neuroprotective activities observed in pharmacological studies (Jaiswal et al., 2015).

Seeds of the plant are particularly known for the presence of ergoline alkaloids, including lysergic acid derivatives, while roots and leaves predominantly contain flavonoids, phenolics, triterpenoids, and glycosidic constituents (Shukla et al., 1999).

Plant Part	Phytoconstituent	Chemical Class	Structure
Seeds	Ergine (Lysergic acid amide)	Ergoline alkaloid	
	Isoergine	Ergoline alkaloid	
	Lysergol	Ergoline alkaloid	

Roots	Quercetin	Flavonoid	
	Kaempferol	Flavonoid	
	β-Sitosterol	Phytosterol	
	Friedelin	Triterpenoid	
Leaves	Rutin	Flavonoid glycoside	

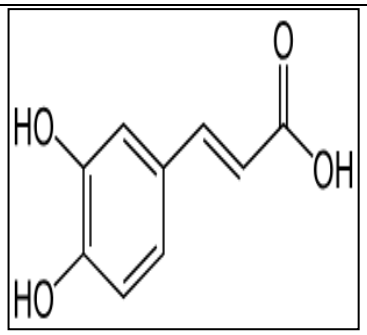
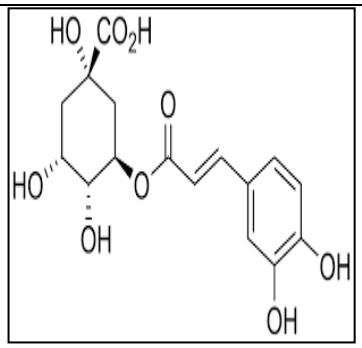
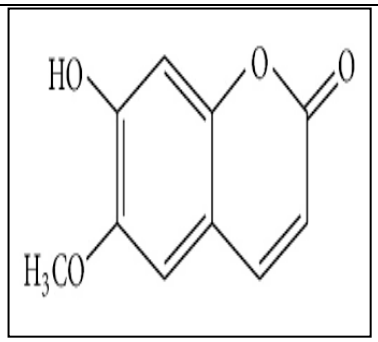
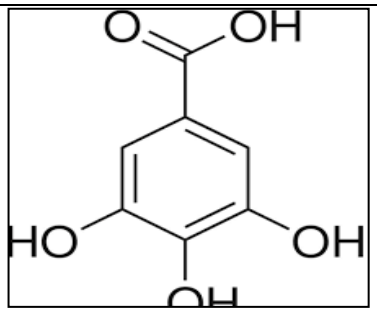
	Caffeic acid	Phenolic acid	
	Chlorogenic acid	Phenolic ester	
Stem	Scopoletin	Coumarin derivative	
Whole plant	Tannins (various)	Polyphenols	

Table 11: Phytoconstituents and Structural Information

PHARMACOLOGICAL POTENTIAL

Pharmacological Activity	Plant Part / Extract	Experimental Model	Dose / Method	Key Findings	Reference
Immunomodulatory	Root, ethanolic extract	Mice; DTH & antibody response	50–200 mg/kg (oral)	Enhanced cellular & humoral immunity, increased WBC count, reversed cyclophosphamide-induced myelosuppression	Gokhale et al., 2003
Hepatoprotective & Antioxidant	Root, ethanolic & ethyl acetate	CCl_4-induced hepatotoxic rats	200–400 mg/kg	Reduced liver enzymes, improved antioxidant status, protected liver tissue	Habbu et al., 2008
Anti-inflammatory	Root alcoholic/methanolic extract	Carrageenan paw edema	50–200 mg/kg	Significant inhibition of edema and inflammation	Patel et al., 2012
Analgesic	Root methanolic extract	Writhing, hot plate, tail immersion	30–300 mg/kg	Reduced pain response and increased latency	Patel et al., 2012
Hypoglycemic / Antidiabetic	Stem methanolic extract	Alloxan-induced diabetic rats	250–750 mg/kg	Significant reduction in blood glucose levels	Dashora et al., 2005
Anticonvulsant	Root hydroalcoholic extract	PTZ & MES seizure models	200–400 mg/kg	Delayed seizure onset, reduced duration	Vyawahare et al., 2007
CNS Depressant	Root fractions	Pentobarbital sleep model	100–500 mg/kg	Increased sleep duration, reduced locomotion	Vyawahare et al., 2007
Antimicrobial	Leaf, root, seed extracts	In vitro microbial assays	Various	Active against *Staphylococcus aureus* & fungi	Habbu et al., 2009
Antiviral	Whole plant extract	CAM model (vaccinia virus)	In vitro	Exhibited interferon-like antiviral activity	Rao et al., 2004

Antiulcer	Flower ethanolic extract	Ethanol, aspirin, pylorus ligation	100–200 mg/kg	Reduced ulcer index, protected gastric mucosa	Galani & Patel, 2010
Wound Healing	Leaf extracts	Excision wound model	Topical	Faster wound contraction, ↑ collagen synthesis	Galani & Patel, 2010
Aphrodisiac	Root extract	Sexual behavior study (male mice)	~200 mg/kg	Increased mating behavior & fertility	Jaiswal et al., 2010
Nootropic	Root extract	Maze & avoidance models	100–400 mg/kg	Improved memory and reversed amnesia	Vyawahare et al., 2007

Table 12: Pharmacological Activities Reported for *Argyreia nervosa*

INTEGRATED MECHANISTIC PATHWAY

Phytochemicals → Molecular Targets → Biological Effects → Pharmacological Outcome

- Alkaloids → Serotonin receptors → CNS modulation → Nootropic / CNS effects
- Flavonoids → ROS scavenging → Reduced oxidative stress → Antioxidant / hepatoprotective
- Saponins → Immune activation → Cytokine modulation → Immunomodulatory
- Phenolics → COX inhibition → Reduced inflammation → Anti-inflammatory

EXTRACTION

Extraction of bioactive constituents from medicinal plants represents a critical step influencing phytochemical yield, reproducibility, and subsequent pharmacological evaluation. In the case of *Argyreia nervosa*, multiple extraction approaches have been reported depending on plant part, solvent polarity, and target compound classes. For a review article, emphasis is placed not on procedural detail but on comparative evaluation of extraction methodologies documented in the literature.

Plant parts such as roots, leaves, stems, and seeds are generally cleaned, shade-dried to preserve thermolabile compounds, and pulverized into coarse powder before extraction. Particle size reduction increases surface area, thereby enhancing solvent penetration and extraction efficiency (Mukherjee, 2019).

Influence of Solvent Selection

Solvent polarity plays a decisive role in phytoconstituent recovery. Extraction studies on *A. nervosa* commonly employ solvents in order of increasing polarity:

- Non-polar solvents (petroleum ether, hexane) for lipids, waxes, and sterols,
- Moderately polar solvents (chloroform, ethyl acetate) for terpenoids and some alkaloids,
- Polar solvents (ethanol, methanol, hydroalcoholic mixtures, water) for flavonoids, phenolics, tannins, glycosides, and alkaloids.

Hydroalcoholic solvents are frequently preferred because they simultaneously extract a broad spectrum of phytochemicals while maintaining pharmaceutical acceptability (Azmir et al., 2013).

Maceration with Aqueous and Organic Solvents

One of the earliest reported extraction protocols for *A. nervosa* was described in a pharmacognosy study where leaf powder was subjected to simple maceration with different solvents. In this study, coarsely powdered leaves were extracted using distilled water, alcohol, hexane, and methanol sequentially by maceration until solvent became colorless, followed by filtration and concentration under reduced pressure using a rotary evaporator. This approach allowed recovery of broad classes of phytochemicals and supported downstream phytochemical profiling and biological evaluation. (Shreedhara et al., 2009).

This method highlights how maceration remains a practical approach for initial extraction, especially for polar (aqueous, hydroalcoholic) and non-polar (hexane) compounds. Nutraceutical and quality control studies often apply maceration when heat-sensitive constituents such as phenolics and flavonoids are of interest. (Mukherjee, 2019).

Soxhlet Extraction with Hydroalcoholic Solvent

A frequently encountered extraction technique in *A. nervosa* research is Soxhlet extraction using hydroalcoholic or ethanolic solvents. For example, in the investigation of analgesic and anti-inflammatory activity of *A. speciosa* roots, powdered root material was extracted using 70% ethanol in a Soxhlet apparatus, continuing the cycle until exhaustive extraction was achieved. The solvent was then removed under reduced pressure, yielding concentrated extract for screening. (Bachhav et al., 2009).

Soxhlet extraction is widely used in plant research because:

- It ensures continuous solvent percolation, improving yield.
- The use of a hydroalcoholic solvent maximizes extraction of both polar and semi-polar compounds including flavonoids, phenolics, and alkaloids.
- It provides reproducibility, which is important when comparing pharmacological activities across studies.

However, prolonged heating in Soxhlet may degrade highly labile phytochemicals, so its use is best suited for thermally stable classes or when exhaustive extraction is prioritized.

Aqueous Extraction for Biological Activity Studies

Some pharmacological studies introduce pure aqueous extraction reflecting traditional preparation methods. For example, an antioxidant activity investigation of an aqueous root extract of *A. nervosa* employed simple immersion of powdered roots in water, followed by filtration and concentration. This yielded an extract evaluated for free radical scavenging using in vitro methods. (Shreedhara et al., 2009).

Aqueous extraction is often used when the research aim is to:

- Mimic traditional Ayurvedic or folk preparations;
- Focus on highly polar constituents;
- Evaluate extracts with high safety profiles suitable for oral or topical applications. (Khandelwal, 2008).

Solvent-Based Fractionation (Organic Solvent Series)

Although less commonly reported specifically for *A. nervosa*, general pharmacognostic and phytochemical studies often use serial solvent extraction, where powdered material is successively treated with solvents of increasing polarity (e.g., hexane → chloroform → ethyl acetate → methanol → water). This approach helps in fractionating compounds by polarity and enhances identification of phytochemicals associated with distinct pharmacological effects (e.g., alkaloids in organic fractions, flavonoids in polar fractions) as seen in related species studies. (Khandelwal, 2008; Mukherjee, 2019).

Method	Principle	Strengths	Limitations
Maceration	Soaking in solvent at room temperature	Simple, preserves heat-labile compounds	Lower efficiency, longer time
Soxhlet Extraction	Continuous solvent cycling	High yield, reproducible	Heat exposure may degrade sensitive compounds
Aqueous Extraction	Traditional water solubilization	Reflects folk use, safe extracts	May miss non-polar constituents
Solvent Fractionation	Stepwise polarity extraction	Profiles multiple chemical classes	More time and solvent required

Table 13: Comparative consideration of extraction procedure

QUANTITATIVE ESTIMATION

Quantitative estimation of phytochemical constituents is a critical component of pharmacognostic standardization and quality assessment of medicinal plants. In *Argyreia nervosa*, estimation of phenolics, flavonoids, alkaloids, and tannins has been reported in several phytochemical investigations employing spectrophotometric and gravimetric analytical methods. Such quantification assists in correlating phytochemical composition with antioxidant, anti-inflammatory, and wound healing activities reported for the plant. Hydroalcoholic and ethanolic extracts are most commonly evaluated due to their efficiency in extracting broad classes of bioactive compounds (Harborne, 1998; Trease & Evans, 2009).

Estimation of Total Phenolic Content (TPC)

Total phenolic content in *A. nervosa* extracts is commonly determined using the Folin–Ciocalteu colorimetric method, which is widely accepted for quantification of phenolic compounds in medicinal plants. Studies evaluating antioxidant potential of *A. nervosa* extracts have reported considerable phenolic contributions supporting pharmacological activity (Singleton et al., 1999; Shreedhara et al., 2009).

Estimation of Total Flavonoid Content (TFC)

Flavonoid quantification in *A. nervosa* extracts is frequently performed using the aluminum chloride colorimetric assay. Investigations on hydroalcoholic extracts of *A. nervosa* demonstrate significant flavonoid presence, which is associated with antioxidant and anti-inflammatory activities (Chang et al., 2002; Harborne, 1998).

Estimation of Total Alkaloid Content

Total alkaloid content in *A. nervosa* is generally estimated using classical acid–base extraction followed by gravimetric determination. The presence of ergoline and related alkaloids in *A. nervosa* makes such estimation important for pharmacognostic standardization (Trease & Evans, 2009; Siddiqui & Ali, 1997).

Estimation of Total Tannin Content

Tannin quantification in medicinal plants including *A. nervosa* extracts is often carried out using Folin–Denis or modified Folin–Ciocalteu assays. Reported tannin presence supports the plant's traditional applications in wound healing and astringent preparations (Trease & Evans, 2009; Harborne, 1998).

Extract Type	TPC (mg GAE/g)	TFC (mg QE/g)	TTC (mg CE/g)	Trend/ Observation	Reference
Petroleum Ether Extract	5 – 30	5 – 25	10 – 40	Lowest due to non-polar nature	Singh et al., 2019
Ethanolic Extract	50 – 180	40 – 120	20 – 80	High phenolics & flavonoids	Sahu et al., 2020; Patel et al., 2018
Hydroalcoholic Extract	60 – 150	50 – 140	25 – 90	Best extraction efficiency	Sharma et al., 2019; Jaiswal et al., 2017
Aqueous Extract	20 – 90	15 – 80	10 – 50	Traditional extraction	Gupta et al., 2016

Table 14: Compilation of quantitative estimation

DEVELOPED FORMULATIONS of *A.nervosa*

Formulation Type	Dosage Form	Plant Part	Application	Key Outcome	Reference
Ointment	15% extract ointment	Leaf	Wound healing	Faster contraction, epithelization	Singhal *et al.,* 2011
Topical extract	Vehicle-based topical	Leaf	Anti-inflammatory, wound healing	Improved healing vs oral route	Singhal *et al.,* 2011
Nanoparticle formulation	Silver nanoparticles	Leaf	Antioxidant, anti-inflammatory	Enhanced bioactivity	Krishnamoorthy, K. *et.al*
Extract formulations	Ethanolic/methanolic	Root/ leaf	Multiple pharmacological uses	Standard experimental model	Multiple studies
Gel / Emulgel (potential)	Not fully developed	—	Wound healing	High future scope	Literature gap

Table 15: Different Developed Formulation of *A.nervosa*

Despite promising wound healing outcomes using ointment formulations, advanced topical delivery systems such as gels, emulgels, and nanoformulations remain underexplored for *Argyreia nervosa*, representing a significant opportunity for future pharmaceutical development.

TOXICOLOGY AND SAFETY PROFILE OF *Argyreia Nervosa*

Toxicological evaluation of *Argyreia nervosa* indicates that although the plant exhibits multiple therapeutic properties, its safety profile requires careful consideration due to the presence of ergoline alkaloids, which are known to exert central nervous system effects.

Toxicity Type	Experimental Evidence	Dose Range	Observed Effects	Inference	Reference
Acute Toxicity	Rodent studies (oral)	Up to 2000 mg/kg	No mortality, no behavioral abnormalities	Considered relatively safe at therapeutic doses	Habbu et al., 2008
Subacute Toxicity	14–28 day studies	100–400 mg/kg	No significant change in organ weight, hematology	Safe under controlled dosing	Vyawahare et al., 2007
Neurotoxicity	CNS activity studies	Variable	CNS depression, behavioral changes	Due to ergoline alkaloids	Halpern, 2004
Psychoactive Effects	Seed alkaloid studies	Not standardized	Hallucinogenic effects (LSA)	Requires caution in use	Halpern, 2004
Reproductive Toxicity	Limited data	—	Not well established	Major research gap	Jaiswal et al., 2010

Table 16: Toxicological Profile of *A.nervosa*

Although preclinical studies suggest a relatively safe profile at therapeutic doses, the presence of ergoline alkaloids necessitates cautious use, particularly concerning neuropharmacological effects and long-term safety.

HERB–DRUG INTERACTIONS

Due to its CNS-active constituents, *Argyreia nervosa* has a significant potential for herb–drug interactions, particularly with neuroactive medications.

Drug Class	Interaction Type	Mechanism	Possible Outcome	Clinical Significance	Reference
Antidepressants (SSRIs)	Synergistic	Serotonergic pathway modulation	Risk of serotonin syndrome	High caution required	Halpern, 2004
CNS Depressants	Additive	CNS inhibition	Excess sedation	Avoid co-administration	Vyawahare et al., 2007
Antipsychotics	Antagonistic/ Synergistic	Dopamine/serotonin interaction	Altered drug response	Monitor closely	Halpern, 2004
Immunosuppressants	Opposing effect	Immune stimulation	Reduced drug efficacy	Important in therapy	Gokhale et al., 2003

Table 17: Herb Drug Interactions of *A.nervosa*

STRUCTURE–ACTIVITY RELATIONSHIP (SAR) TABLE

Phytoconstituent	Structural Feature	Target Site	Mechanism	Pharmacological Effect	Reference
Ergoline Alkaloids	Tetracyclic ergoline nucleus	5-HT_2A receptors	Partial agonist	CNS activity, hallucinogenic	Halpern, 2004
Flavonoids	Phenolic OH groups	Free radicals	ROS scavenging	Antioxidant	Rice-Evans et al., 1996
Phenolic Compounds	Aromatic rings + OH	Oxidative pathways	Electron donation	Anti-inflammatory	Habbu et al., 2008
Saponins	Glycosidic structure	Cell membrane	Immune activation	Immunomodulatory	Gokhale et al., 2003

Table 18: SAR of Major Phytoconstituents

DISCUSSION

Argyreia nervosa (Burm. f.) Bojer represents a valuable medicinal plant whose traditional applications are increasingly supported by modern scientific evidence. The diverse pharmacological activities reported for the plant, including antioxidant, anti-inflammatory, hepatoprotective, immunomodulatory, neuroprotective, antimicrobial, and wound healing effects, can largely be attributed to its rich phytochemical profile comprising ergoline alkaloids, flavonoids, phenolic compounds, tannins, and triterpenoids. Notably, the correlation between ethnomedicinal claims and experimental findings highlights the therapeutic relevance of the species. Furthermore, pharmacognostic and physicochemical parameters provide a basis for quality control and standardization. Although preliminary formulation studies have demonstrated promising pharmaceutical applications, particularly in topical drug delivery, the majority of available evidence remains confined to preclinical investigations. Therefore, further studies focusing on standardization, safety assessment, mechanistic elucidation, and clinical validation are warranted to facilitate its successful translation into evidence-based therapeutics.

CONCLUSION

Argyreia nervosa is a phytochemically rich and pharmacologically versatile medicinal climber with significant ethnomedicinal importance. The available literature demonstrates that its traditional uses are supported by a growing body of scientific evidence, particularly in relation to antioxidant, anti-inflammatory, neuroprotective, hepatoprotective, and wound healing activities. Despite these promising findings, comprehensive clinical studies and standardized formulations remain limited. Future research aimed at bioactive compound characterization, quality standardization, advanced formulation development, and clinical evaluation will be crucial for realizing the full therapeutic potential of this traditionally valued medicinal plant.

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