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Review Article

Phytochemical Screening and Pharmacological Effect of Argyreia Speciosa: A Comprehensive Review

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ABSTRACT

Argyreia speciosa (Linn. f.) Sweet, popularly known as Vidhara or Elephant Creeper, is a climbing perennial of the family Convolvulaceae and a celebrated rasayana in classical Ayurveda. Although roots and leaves of the plant have received considerable scientific scrutiny, the stem historically called Vidhara Lakdi in the indigenous pharmacopoeia remains comparatively under-investigated despite well documented folk use in chronic wounds, ulcers and inflammatory conditions. This review consolidates findings from forty-five primary and secondary sources to provide an integrated account of phytochemical screening procedures applied to A.speciosa stem and of the wound healing pharmacology associated with its extracts. Reported screenings indicate that aqueous, hydroethanolic, methanolic, ethanolic, chloroform and petroleum ether stem preparations contain alkaloids, flavonoids, tannins, phlobatannins, saponins, triterpenes, sterols, phenolic acids, coumarins, anthraquinones and carbohydrates. Preclinical evidence from excision, incision and dead-space wound models demonstrates accelerated wound contraction, shortened epithelialisation time, increased hydroxyproline content and enhanced tensile strength (Singhal et al., 2011; Yadav et al., 2014). Pharmacological actions consistent with these outcomes namely antioxidant, anti-inflammatory, antimicrobial, angiogenic and immunomodulatory effects are reviewed mechanistically. The paper concludes with a critical appraisal of methodological limitations, safety considerations and translational gaps that warrant future investigation.

INTRODUCTION

The treatment of wounds is one of the oldest concerns of organised medicine, and plant-derived remedies have remained at its centre across millennia (Pereira and Bártolo, 2016). Even with the proliferation of synthetic antiseptics, growth factor preparations and bioengineered dressings, a substantial proportion of acute and chronic wounds particularly in low- and middle-

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income settings continue to be managed with botanical interventions because of their accessibility, broad pharmacological footprint and favourable safety profile (Carvalho et al., 2021). The rising prevalence of diabetes mellitus, peripheral vascular disease and antimicrobial resistance has additionally rekindled scientific interest in herbal candidates capable of multi-target action on inflammation, oxidative stress, microbial colonisation and extracellular matrix deposition (Maver et al., 2015).

Among the medicinal plants extolled in classical Indian texts, Argyreia speciosa (Linn. f.) Sweet botanically synonymised with Argyreia nervosa (Burm. f.) Bojer has been afforded a special place. The plant is referred to as Vidhara or Vriddhadaru in Sanskrit, Samudrasokh in Hindi and Elephant Creeper in English, in recognition of the velvety silver underside of its leaves and the elephantine girth of its woody climbing stem (Galani et al., 2010). Traditional materia medica describes it as bitter, pungent, alterative and rejuvenative, recommending its use for chronic ulcers, rheumatism, nervous debility, gonorrhoea and skin diseases (Sharma et al., 2010). The stem in particular has been deployed in indigenous practice as a poultice on indolent wounds and as a decoction for inflammatory swellings, although the corresponding pharmacological literature has historically focused on roots and seeds.

The present review brings together evidence from forty-five sources to construct an evidence-based portrait of A. speciosa stem extracts. Three guiding questions shape the synthesis: (i) Which secondary metabolite classes have been reliably detected in stem extracts and through which methodologies? (ii) What is the experimental evidence for wound healing activity of stem and closely allied preparations of the plant? (iii) Which biochemical and molecular mechanisms plausibly link the phytochemistry to the observed pharmacology? Throughout, attention is given to methodological heterogeneity, since extraction solvent, dose,animal model and end-point selection profoundly shape comparability across studies.

2. BOTANY, TAXONOMY AND ETHNOMEDICINAL CONTEXT

Characterstics of *Argyreia speciosa* will be studied in the given table:

Taxonomical rank	Taxon
Kingdom	Plants
Subkingdom	Tracheobionta - Vascular plants
Superdivision	Spermatophyta - Seed plants
Division	Magnoliophyta - Flowering plants
Class	Magnoliopsida - Dicotyledons
Subclass	Asteridae
Order	Solanales
Family	Convolvulaceae
Genus	Argyreia Lour. - Argyreia
Species	Argyreia nervosa (Burm. f.) Bojer

2.1 Taxonomic placement and morphology

Argyreia speciosa is placed within the kingdom Plantae, division Magnoliophyta, class Magnoliopsida, order Solanales, family Convolvulaceae and genus Argyreia Lour. (Galani et al., 2010). It is a perennial woody climber with a thick stem, lanate young branches, cordate-ovate leaves with a densely silvery-pubescent abaxial surface, axillary cymes of large rose-purple campanulate flowers and globose berries enclosed within accrescent calyces (Modi et al., 2010). The stem is hairy when young, becoming glabrous, woody and longitudinally fissured at maturity, and may attain a diameter exceeding ten centimetres in older specimens (Nagare et al., 2018).

2.2 Distribution and ecological occurrence

The species is indigenous to the Indian subcontinent and is widely distributed in tropical and subtropical zones of Asia, with naturalisation reported in Hawaii, the Caribbean, parts of Africa and Australia (Galani et al., 2010). In India, the plant flourishes across the deciduous forests of the Western Ghats, the Eastern Himalayan foothills and the Gangetic plains, often clambering along hedges and forest margins (Bachhav et al., 2009).

2.3 Vernacular names and Ayurvedic identity

Sanskrit synonyms Vidhara, Vriddhadaru, Samudra-soshk and Antakopika denote properties such as enhancement of strength, anti-aging vitality and absorption of fluids (Singh and Mukul, 2018). The Ayurvedic Pharmacopoeia of India lists the dried mature stem (Vidhara Lakdi) as the official drug for inclusion in classical formulations such as Vidaryadi Ghrita, Vidaryadi Kashaya and certain Chyawanprash variants (Sharma et al., 2010). Folk traditions across Maharashtra, Madhya Pradesh and Odisha additionally employ stem decoctions in chronic wounds, eczema and rheumatic swellings (Galani et al., 2010).

2.4 Comparison with congeneric species

Disambiguation from morphologically similar congenerics is important. Argyreia nervosa is now widely regarded as the accepted name for the taxon historically described as A. speciosa Sweet, while genuinely distinct species such as A. cuneata, A. pierreana and A. acuta possess overlapping but non-identical chemical profiles (Modi et al., 2010; Ambika and Nair, 2019).

Misdentification continues to compromise reproducibility, underscoring the need for voucher specimen deposition in any future study of stem-based interventions (Galani et al., 2010).

3. MECHANISTIC LINKAGES BETWEEN PHYTOCHEMISTRY AND WOUND HEALING

3.1 Flavonoids

Flavonoids are pre-eminent among plant constituents associated with wound repair. They scavenge free radicals, chelate transition metals, inhibit lipoxygenase and cyclo-oxygenase pathways, stabilise mast cells, modulate transcription factors such as nuclear factor-κB and stimulate collagen biosynthesis (Carvalho et al., 2021). Quercetin and kaempferol both reported in A. speciosa leaves and probably present in stem also up-regulate vascular endothelial growth factor and fibroblast growth factor signalling, accelerating angiogenesis (Tabandeh et al., 2023). Their capacity to strengthen collagen cross-links contributes to the enhanced tensile strength observed in extract-treated incision wounds (Pereira and Bártolo, 2016).

3.2 Tannins

Tannins exert astringent action by precipitating surface proteins on the wound bed, forming an antiseptic protective layer that limits microbial colonisation and reduces transudate loss (Hupkens et al., 1995). Their

antioxidant capacity, derived from polyphenolic hydroxyl groups, neutralises reactive oxygen species and supports fibroblast proliferation, while their interaction with extracellular matrix proteins promotes wound contraction (Orhan et al., 2007).

3.3 Saponins

Saponins are amphipathic glycosides that lower surface tension, enabling improved permeation of co-administered phytochemicals across the epidermal barrier (Sparg et al., 2004). They additionally stimulate fibroblast and keratinocyte migration and have been shown to induce expression of transforming growth factor-β1 in dermal explants (Kim et al., 2008).

3.4 Triterpenes and sterols

β-sitosterol, friedelanol, epifriedelinol and related triterpenes have been associated with anti-inflammatory effects, membrane stabilisation and stimulation of macrophage activity necessary for orderly transition between inflammatory and proliferative phases (Moghadamtousi et al., 2015). Lupeol and ursolic acid, characteristic Convolvulaceae triterpenes, additionally modulate matrix metalloproteinase activity and elevate epidermal growth factor (Agra et al., 2015).

3.5 Phenolic acids

Caffeic acid, ferulic acid and their conjugates demonstrate antioxidant, antimicrobial and matrix-stabilising effects. They have been reported to enhance keratinocyte migration and modulate inflammatory cytokine release in scratch-wound assays (Mota et al., 2009).

3.6 Alkaloids and coumarins

Alkaloids contribute analgesic and antimicrobial properties, while coumarins such as scopoletin display anti-inflammatory, antioxidant and vasodilatory actions which collectively augment microvascular perfusion at the wound margin (Galani et al., 2010).

4. PHYTOCHEMICAL SCREENING OF ARGYREIA SPECIOSA

4.1 Collection, authentication and preparation

Robust phytochemical work begins with sound botanical practice. Most stem-focused studies have collected material from regions in Gujarat, Maharashtra and Tamil Nadu, authenticating specimens through regional botanical surveys and depositing vouchers in herbaria (Goti and Dasgupta, 2024; Modi et al., 2010). The stems are typically washed, chopped, shade-dried for one to three weeks, mechanically pulverised and passed through a forty-mesh sieve before extraction (Nagare et al., 2018).

4.2 Extraction techniques

Three classical techniques dominate the literature: cold maceration, Soxhlet extraction and decoction. Goti and Dasgupta (2024) compared all three using eight solvents water, chloroform, ethanol, methanol, hexane, acetone, petroleum ether and hydroethanol applied to ten grams of dried stem powder in two hundred

millilitres of solvent. Maceration retains thermolabile constituents but is slow; Soxhlet provides higher yields through continuous solvent percolation but may degrade heat-sensitive compounds; decoction, although closest to traditional preparation, restricts the recovery of lipophilic metabolites (Sasidharan et al., 2011). The variation among methods explains, at least in part, the heterogeneity in reported constituent profiles.

4.3 Qualitative phytochemical tests

Qualitative analysis follows standardised reagent-based protocols. Alkaloids are detected by Mayer's, Wagner's, Dragendorff's and Hager's tests; flavonoids by Shinoda's, alkaline reagent and ferric chloride tests; tannins by ferric chloride and lead acetate reactions; saponins by foam and haemolysis assays; triterpenes and sterols by Liebermann–Burchard and Salkowski tests; phenolic compounds by ferric chloride; coumarins by alkaline hydrolysis; cardiac glycosides by Keller–Killiani and Baljet tests; anthraquinones by Borntrager's test; and carbohydrates by Molisch's, Fehling's and Benedict's reactions (Goti and Dasgupta, 2024; Harborne, 1998).

4.4 Reported constituents in the stem

A 2024 systematic screening confirmed the presence of flavonoids, phlobatannins, tannins, anthraquinones, proteins, phenols, coumarins, saponins and starch across the eight solvent extracts of stem, with the highest qualitative density observed in methanolic and hydroethanolic preparations (Goti and Dasgupta, 2024). An earlier investigation reported antifungal stem extracts containing flavonoids, alkaloids, anthocyanins, phlobatannins, tannins and proteins (Investigating the Phytochemical Screening and Antifungal Activity of Argyreia speciosa, 2023). The methanolic stem extract has additionally yielded antihyperglycaemic fractions that contain triterpenoid glycosides and phenolic acids (Modi et al., 2010). Comparative evidence from other plant parts further informs the stem profile: leaves contain quercetin, kaempferol, kaempferol-3-O-α-L-rhamnopyranoside, epifriedelinol, β-sitosterol, 1-triacontanol and friedelanol (Jaiswal et al., 2011); roots furnish scopoletin, stigmasteryl p-hydroxycinnamate, hexadecanyl p-hydroxycinnamate and coumarin glycosides (Galani et al., 2010); and seeds contain ergoline alkaloids such as ergometrine alongside fatty acid glycerides (Bachhav et al., 2009).

4.5 Quantitative estimation

Total phenolic content (TPC) is most often determined by the Folin–Ciocalteu method and expressed as gallic acid equivalents, while total flavonoid content (TFC) is estimated through the aluminium chloride colorimetric assay and reported as quercetin or rutin equivalents (Nagare et al., 2018). A 2022 study of A. speciosa from Darrang district, Assam, recorded a TPC of approximately 78 mg GAE per gram and a TFC of approximately 32 mg QE per gram in methanolic extracts, with significant correlation between phenolic richness and free radical scavenging capacity (Phytochemical profiling, antioxidant activity and antimicrobial activity, 2022).

4.6 Instrumental fingerprinting

Beyond qualitative reagents, modern phytochemical characterisation employs thin layer chromatography,

high performance liquid chromatography, ultraviolet–visible spectrophotometry, gas chromatography–mass

spectrometry and Fourier transform infrared spectroscopy. Yadav et al. (2014) used HPLC fingerprinting of water extracts to demonstrate reproducible peak patterns, although exact identification was limited by unavailability of reference standards. Jaiswal et al. (2011) quantified quercetin and kaempferol in leaf extracts at 0.56% and 0.23% respectively, providing a benchmark for future stem-focused HPLC investigations.

4.7 Variability and standardisation

The qualitative consensus on stem chemistry conceal considerable variability across geographic, seasonal and processing dimensions. Soil composition, altitude, time of harvest and post-harvest handling can alter the proportions of flavonoids, alkaloids and phenolics by several-fold, which in turn complicates dose translation (Khanam et al., 2015). The future of stem-based pharmaceutical development depends critically on harmonised standardisation through chemical markers, fingerprinting and bioactivity-guided fractionation.

5. PHARMACOLOGICAL ACTIVITIES

5.1 Antioxidant activity

Reactive oxygen species are generated in vast quantities at wound sites; while low levels are necessary for signalling and antimicrobial defence, persistent oxidative stress damages membranes, proteins and DNA, prolonging inflammation and impeding repair (Schäfer and Werner, 2008). Methanolic and ethyl acetate extracts of A. speciosa have demonstrated robust scavenging activity in 2,2-diphenyl-1-picrylhydrazyl (DPPH), nitric oxide and superoxide assays, with reductions in malondialdehyde and elevations in endogenous antioxidant enzymes such as superoxide dismutase, catalase and glutathione peroxidase observed in vivo (Habbu et al., 2010). Flavonoid quercetin and phenolic acids such as caffeic acid are likely contributors to this antioxidant phenotype (Tiwari et al., 2011).

5.2 Anti-inflammatory effects

Bachhav et al. (2009) reported that a methanolic extract of A. speciosa root significantly inhibited carrageenan-induced rat paw oedema and acetic acid-induced writhing, comparable to indomethacin and aspirin respectively. The proposed mechanism includes suppression of prostaglandin synthesis through cyclooxygenase inhibition, reduced release of pro-inflammatory cytokines and stabilisation of lysosomal membranes (Lalan et al., 2015). Stem methanolic extract has likewise demonstrated inhibition of granuloma formation in cotton pellet assays, indicative of activity against the proliferative component of chronic inflammation (Modi et al., 2010).

5.3 Antimicrobial action

Wound infection is a principal obstacle to healing. Aqueous, ethanolic, chloroform and petroleum ether stem extracts have exhibited antifungal activity against Candida albicans, with the ethanolic extract performing best in zone of inhibition assays (Investigating the Phytochemical Screening and Antifungal Activity of Argyreia speciosa, 2023). Methanolic stem fractions have also displayed inhibitory effects on Gram-positive bacteria including Staphylococcus aureus and Bacillus subtilis (Phytochemical profiling, antioxidant activity and antimicrobial activity, 2022). The presence of tannins, flavonoids and saponins is mechanistically consistent with these effects, as such compounds disrupt microbial cell walls, complex with bacterial proteins and inhibit microbial enzymes (Cushnie and Lamb, 2011).

5.4 Immunomodulatory effects

Habbu et al. (2010) demonstrated that ethanolic root extracts of A. speciosa increase phagocytic indices, primary and secondary antibody titres and delayed-type hypersensitivity responses in rodent models. Because effective wound healing depends on coordinated immune trafficking, these immunomodulatory properties are arguably as important to repair as antimicrobial and antioxidant effects (Tiwari et al., 2011).

5.5 Other relevant activities

Additional pharmacology of the plant including hepatoprotective effects (Singh et al., 2010), gastroprotective action (Jaiswal et al., 2011), antineuropathic effects (Singh et al., 2020), antihyperglycaemic activity of methanolic stem extract (Modi et al., 2010), and protective effects against cerebral ischaemia (Habbu et

al., 2010) collectively support the systemic regenerative reputation enjoyed by Vidhara in Ayurveda.

6. WOUND HEALING: A PHYSIOLOGICAL OVERVIEW

6.1 The four-phase model

Cutaneous wound healing is conventionally partitioned into four overlapping phases: haemostasis, inflammation, proliferation and remodelling (Velnar et al., 2009). Haemostasis is established within minutes through vasoconstriction, platelet aggregation and fibrin polymerisation, providing a provisional matrix for cellular ingress. The inflammatory phase, dominated initially by neutrophils and subsequently by monocyte-derived macrophages, is characterised by phagocytosis, debridement and release of cytokines including interleukin-1β, tumour necrosis factor-α and transforming growth factor-β (Eming et al., 2014). The proliferative phase encompasses re-epithelialisation, fibroblast migration, collagen deposition, angiogenesis and contraction. Remodelling, which may extend for months, involves replacement of type III collagen with type I collagen, cross-linking and gradual recovery of tensile strength (Reinke and Sorg, 2012).

6.2 Biochemical markers and growth factors

Several biochemical indices are routinely employed to evaluate experimental wound healing. Hydroxyproline content correlates with collagen deposition, since this imino acid is virtually exclusive to collagen and its measurement allows quantitative inference of matrix synthesis (Srivastava and Sharma, 2016). Tensile strength of incision wounds reflects the cross-linking maturity of newly deposited collagen, while period of epithelialisation reports the duration required to cover the wound bed with continuous keratinocyte sheets (Kumar et al., 2013). Key growth factors include vascular endothelial growth factor for angiogenesis, fibroblast growth factor for stromal regeneration, platelet-derived growth factor for fibroblast chemotaxis, and epidermal growth factor for keratinocyte migration (Bao et al., 2009).

6.3 Reasons for failed healing

A wound is described as chronic when normal repair does not progress in an orderly fashion within four to twelve weeks. Excessive proteolysis, prolonged inflammation, persistent infection, oxidative stress, ischaemia and metabolic disturbances most notably hyperglycaemia all conspire to derail healing (Frykberg and Banks, 2015). It is precisely against this multifactorial backdrop that polyvalent plant extracts, capable of simultaneously addressing several offending mechanisms, become therapeutically attractive (Pereira and Bártolo, 2016).

In view of the critical role of bioactive phytoconstituents in modulating the different phases of wound healing, characterization of the chemical profile of *Argyreia speciosa* stem is indispensable. Various qualitative, quantitative and instrumental studies have identified several classes of secondary metabolites with potential wound-healing properties. A summary of the reported phytochemical screening of *Argyreia speciosa* stem is presented in Table 1.

Table 1. Phytochemical screening of *Argyreia speciosa* stem: Summary of collection, extraction, phytochemical analysis, reported constituents and standardization

Aspect	Details	References
Collection and authentication	Stem samples collected from different regions of India (Gujarat, Maharashtra and Tamil Nadu). Plant material authenticated by regional botanical surveys and voucher specimens deposited in herbaria.	Goti and Dasgupta (2024); Modi et al. (2010)
Sample preparation	Fresh stems washed thoroughly, chopped into small pieces, shade-dried for 1–3 weeks, pulverized mechanically and passed through a 40-mesh sieve before extraction.	Nagare et al. (2018)
Extraction methods	Cold maceration, Soxhlet extraction and decoction are the most commonly employed methods. Eight solvents including water, methanol, ethanol, hydroethanol, acetone, chloroform, hexane and petroleum ether have been used. Soxhlet generally provides higher extraction yield, maceration preserves thermolabile constituents, whereas decoction resembles traditional preparation but extracts fewer lipophilic compounds.	Goti and Dasgupta (2024); Sasidharan et al. (2011)

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Qualitative phytochemical tests	Alkaloids (Mayer's, Wagner's, Dragendorff's, Hager's); flavonoids (Shinoda, alkaline reagent); tannins and phenolics (Ferric chloride); saponins (Foam test); steroids/triterpenes (Liebermann–Burchard, Salkowski); coumarins (Alkaline hydrolysis); cardiac glycosides (Keller–Killiani, Baljet); anthraquinones (Borntrager's); carbohydrates (Molisch's, Benedict's and Fehling's tests).	Goti and Dasgupta (2024); Harborne (1998)
Major phytochemicals identified in stem	Flavonoids, phlobatannins, tannins, anthraquinones, proteins, phenols, coumarins, saponins, starch, alkaloids, anthocyanins, triterpenoid glycosides and phenolic acids. Methanolic and hydroethanolic extracts showed the richest phytochemical profile.	Goti and Dasgupta (2024); Investigating the Phytochemical Screening and Antifungal Activity of *Argyreia speciosa* (2023);
		Modi et al. (2010)
Comparative phytochemicals from other plant parts	Leaves contain quercetin, kaempferol, kaempferol-3-*O*-α-L-rhamnopyranoside, β-sitosterol, epifriedelinol, friedelanol and 1-triacontanol; roots contain scopoletin, coumarin glycosides and hydroxycinnamate derivatives; seeds contain ergoline alkaloids (ergometrine) and fatty acid glycerides.	Jaiswal et al. (2011); Galani et al. (2010); Bachhav et al. (2009)
Quantitative estimation	Total phenolic content (TPC) determined using the Folin–Ciocalteu assay and expressed as gallic acid equivalents (GAE), whereas total flavonoid content (TFC) is estimated using the aluminium chloride colorimetric assay and expressed as quercetin equivalents (QE). Methanolic extract reported approximately **78 mg GAE/g** TPC and **32 mg QE/g** TFC, which correlated positively with antioxidant activity.	Nagare et al. (2018); *Phytochemical Profiling, Antioxidant Activity and Antimicrobial Activity* (2022)
Instrumental characterization	Thin-layer chromatography (TLC), UV–Visible spectrophotometry, HPLC, GC–MS and FTIR are commonly employed for phytochemical fingerprinting. HPLC fingerprinting demonstrated reproducible chromatographic profiles, while leaf extracts contained quercetin (0.56%) and kaempferol (0.23%), providing reference markers for future stem studies.	Yadav et al. (2014); Jaiswal et al. (2011)
Variability and standardization	Phytochemical composition varies with geographical location, soil type, altitude, harvesting season and post-harvest processing. Future standardization should include authenticated plant material, optimized extraction methods, HPLC/GC–MS fingerprinting, validated chemical markers and bioactivity-guided fractionation to ensure batch-to-batch consistency.	Khanam et al. (2015); Yadav et al. (2014); Nagare et al. (2018)

		Modi et al. (2010)

WOUND HEALING EVIDENCE FROM ARGYREIA SPECIOSA EXTRACTS

Topical activity in healthy animals

The most cited investigation in this domain is that of Singhal et al. (2011), in which an ethanolic extract of A. nervosa leaves was applied topically and orally in albino rats subjected to 300 mmZ full-thickness excision wounds. Topical application at 2% w/w produced a wound closure of 92.96% by day sixteen, significantly exceeding the untreated control ($P < 0.05$), whereas oral administration at 100 mg/kg did not differ meaningfully from control. This methodological insight is critical: cutaneous regeneration depends on adequate local concentration of active phytochemicals, which is reliably achieved only through topical delivery.

Yadav et al. (2014) extended these findings using leaf extracts of A. speciosa in Swiss albino mice with circular excision (177 mmZ) and linear incision (3 cm × 2 mm) wounds. Three ointment bases at ten percent w/w were prepared ethanol, ethanol-water and water extracts and compared against a marketed positive control containing one percent Centella asiatica extract. The water extract achieved 96.30% wound closure by day fourteen, significantly higher than placebo (83.41%) and approaching the positive control (98.83%). Hydroxyproline content was significantly elevated ($P < 0.05$) and breaking strength reached 376.56 grams in the water extract group versus 310.75 grams in the positive control, indicating superior collagen maturation.

7.2 Activity in diabetic models

Diabetic wounds heal poorly because of microangiopathy, glycation of matrix proteins, neuropathy and persistent inflammation (Falanga, 2005). Singhal et al. (2011) included alloxan-induced diabetic rats, demonstrating significant healing in both topical (76.20% closure) and oral (74.36% closure) groups by day sixteen, with topical application again outperforming oral. The dual antihyperglycaemic effect of methanolic stem extract reported by Modi et al. (2010) suggests systemic and local mechanisms could be combined to advantage in diabetic ulcer pharmacotherapy.

7.3 Dead space and granuloma models

Although direct dead-space studies on A. speciosa stem are limited, the methodology wherein cylindrical polypropylene grass piths or cotton pellets are implanted subcutaneously and granulation tissue is harvested seven to ten days later has been validated for A.nervosa allied formulations and is recommended for future stem-specific work (Kumar et al., 2013).

7.4 Clinical translation

Patil et al. (2025) reported a split-mouth randomised clinical study comparing an A. speciosa gel formulation with non-eugenol periodontal dressing following periodontal flap surgery. The Argyreia gel achieved superior wound healing as measured by the Early Healing Score and the Healing Index, and significantly reduced pain perception at one week. This is the first clinical-grade evidence that an A. speciosa preparation can outperform a conventional surgical dressing, lending real-world weight to the preclinical findings.

7.5 Synthesis across wound models

Across excision, incision, diabetic, and clinical periodontal contexts, A. speciosa preparations consistently demonstrate three signatures: accelerated wound contraction, increased hydroxyproline and collagen content, and improved tensile strength. These outcomes are observed across ethanolic, hydroethanolic and aqueous extracts, suggesting that multiple chemical classes within the plant contribute to a polyvalent regenerative profile rather than a single magic-bullet metabolite (Ambika and Nair, 2019).

8. SAFETY, TOXICOLOGY AND ADVERSE EFFECTS

Limited acute toxicity data exist for stem-specific preparations. Studies on root and leaf extracts performed under OECD Test Guideline 425 indicate an oral LD50 greater than 2000 mg/kg in rodents, supporting a

wide therapeutic margin (Jaiswal et al., 2011). However, the seeds of A. speciosa contain ergoline alkaloids capable of producing psychoactive and vasoconstrictive effects, and seed material must therefore be carefully excluded from stem-based preparations to prevent cross-contamination (Galani et al., 2010). Topical

preparations of leaf and gel formulations have shown no irritant or sensitising potential in animal studies (Patil et al., 2025). Future research should pursue sub-chronic and chronic toxicity, reproductive safety, and dermal sensitisation profiles specifically for stem extracts before clinical translation.

9. CRITICAL APPRAISAL AND METHODOLOGICAL GAPS

Several limitations restrain confident clinical translation. First, the bulk of literature has investigated leaves or roots, with stem-specific pharmacological data largely confined to phytochemical screening and anti-hyperglycaemic models (Modi et al., 2010; Goti and Dasgupta, 2024). Second, even within the broader corpus, sample sizes are often modest, blinding is inconsistently applied and molecular endpoints such as immunohistochemistry of growth factors are rarely reported (Ambika and Nair, 2019). Third, standardisation through bioactivity-guided fractionation remains incomplete; identification of the specific compounds responsible for the observed wound healing is therefore still tentative. Fourth, the only available clinical trial is small and focused on periodontal application, leaving general dermal wound translation untested (Patil et al., 2025). Fifth, formulation science encompassing penetration enhancement, controlled release, microbial preservation and stability has scarcely been addressed for stem extracts.

10. FUTURE DIRECTIONS

Future investigation should pursue four parallel lines. The first concerns rigorous phytochemical characterisation of stem extracts through ultra-high-performance liquid chromatography coupled to high-resolution mass spectrometry, supplemented by nuclear magnetic resonance for structure elucidation. The second is mechanistic profiling, including expression of vascular endothelial growth factor, transforming growth factor-β, matrix metalloproteinases-2 and -9, and tissue inhibitors of metalloproteinases in standardised wound models. The third is formulation development, exploring nanoemulsions, hydrogel composites and electrospun scaffolds loaded with characterised stem extract. The fourth is multicentre randomised clinical trials, beginning with chronic venous and diabetic foot ulcers where current standards of care leave substantial unmet need.

CONCLUSION

The available evidence converges on the conclusion that Argyreia speciosa is a pharmacologically rich Convolvulaceae climber whose stem represents a viable but under-investigated source of phytochemicals with credible wound healing potential. Phytochemical screening consistently identifies flavonoids, tannins, phlobatannins, saponins, alkaloids, triterpenes, sterols, phenolic acids and coumarins in stem extracts across multiple solvent systems. Preclinical wound healing studies although predominantly conducted on leaves and roots of the species uniformly demonstrate accelerated wound contraction, enhanced collagen deposition and improved tensile strength, with one recent clinical study extending these benefits to post-surgical

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