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Review Article

Wound-Healing Potential of *Tradescantia pallida* and *Tecoma stans*: A Comparative Review of Phytochemistry, Pharmacological Evidence and Therapeutic Prospects

Vandana Yadav*, Shilpi Mishra, Dr. Anurag Kumar

Shree Krishna College of Pharmacy, India

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ABSTRACT

Wound healing is a complex biological process involving coordinated phases of haemostasis, inflammation, proliferation, tissue formation and remodelling. Delayed wound healing is associated with microbial infection, excessive inflammation, oxidative stress, impaired collagen deposition and inadequate tissue regeneration. Medicinal plants have attracted considerable interest as potential sources of affordable and multifunctional wound-healing agents because their secondary metabolites may simultaneously exhibit antioxidant, antimicrobial, anti-inflammatory and tissue-regenerative effects. *Tradescantia pallida* (Rose) D.R. Hunt, commonly known as Purple Heart or Purple Queen, belongs to the family Commelinaceae, whereas *Tecoma stans* (L.) Juss. ex Kunth, commonly known as yellow trumpet or yellow bells, belongs to the family Bignoniaceae. Both plants contain diverse bioactive constituents, particularly phenolics, flavonoids and other secondary metabolites that may be relevant to skin repair. Published literature indicates that *T. stans* has comparatively stronger direct evidence for wound healing, including excision, incision and burn wound models, while recent research has also explored *T. stans*-loaded hydrogels for in-vitro wound repair. In contrast, available literature on *T. pallida* is predominantly focused on pharmacognostic standardization, antioxidant, antimicrobial, anti-inflammatory and other pharmacological properties, and direct experimental wound-healing studies remain comparatively scarce. This review critically summarizes the botanical characteristics, phytochemical composition, proposed mechanisms, pharmacological evidence and formulation prospects of both plants, with particular emphasis on their possible application in topical wound-management systems. The review identifies *T. stans* as a relatively better-supported wound-healing candidate and *T. pallida* as a promising but under-investigated candidate requiring direct in-vitro, in-vivo and clinical validation.

*Corresponding Author: Vandana Yadav

Address: Shree Krishna College of Pharmacy

Email ✉: shilpimishra53@gmail.com

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INTRODUCTION

Wound healing is a highly regulated physiological process through which damaged tissue is restored following injury. Normal cutaneous healing consists of overlapping phases of haemostasis, inflammation, proliferation and remodelling. Successful repair requires coordinated activity of platelets, inflammatory cells, fibroblasts, keratinocytes, endothelial cells and extracellular-matrix components. Disturbance of any of these processes may result in delayed healing, chronic wounds, excessive scarring or infection.

Oxidative stress and microbial contamination are important factors that can interfere with wound repair. Consequently, compounds possessing antioxidant, antimicrobial and anti-inflammatory properties may be particularly useful in wound-management formulations. Reviews of medicinal plants indicate that flavonoids, phenolic compounds, tannins, saponins and alkaloids can contribute to wound healing through mechanisms involving reduction of inflammation and oxidative stress, antimicrobial activity, fibroblast proliferation, collagen synthesis and angiogenesis.

The search for plant-derived wound-healing agents has therefore increased considerably. Plant extracts may provide multiple biological activities because they contain complex mixtures of secondary metabolites rather than a single active constituent.

Among medicinally interesting plants, *Tradescantia pallida* and *Tecoma stans* have attracted attention because of their diverse phytochemical profiles and pharmacological properties. *T. pallida* is an ornamental plant of the Commelinaceae family. Published reviews describe phenolics, flavonoids, anthocyanins and other compounds associated with antioxidant, antimicrobial and anti-inflammatory activities.

Tecoma stans, belonging to the Bignoniaceae family, has a longer history of ethnomedicinal use and has been investigated for antimicrobial, antioxidant, anti-inflammatory and wound-healing activities. A comprehensive review identified more than 120 compounds from the plant, including monoterpene alkaloids, phenolic acids, flavonoids, carotenoids, terpenoids, glycosides, phytosterols and fatty acids.

The objective of the present review is to critically compare the available evidence for the wound-healing potential of *T. pallida* and *T. stans*, with emphasis on phytochemistry, biological activities, mechanisms relevant to wound repair and future pharmaceutical applications.

2. BIOLOGICAL BASIS OF WOUND HEALING

Wound healing can broadly be divided into four overlapping phases.

2.1 Haemostasis

Haemostasis begins immediately after injury. Vasoconstriction and platelet activation occur, followed by formation of a fibrin clot. The clot provides temporary protection and serves as a matrix for subsequent cellular migration.

2.2 Inflammatory Phase

Neutrophils and macrophages migrate into the wound and remove microorganisms, cellular debris and damaged tissue. Cytokines and growth factors released during this phase regulate subsequent tissue repair.

Excessive or prolonged inflammation, however, can delay healing and increase tissue damage.



2.3 Proliferative Phase

This phase involves:

- fibroblast proliferation,
- collagen synthesis,
- angiogenesis,
- granulation-tissue formation,
- re-epithelialization, and
- wound contraction.

Fibroblasts are particularly important because they produce collagen and other extracellular-matrix components.

2.4 Remodelling Phase

Newly deposited collagen undergoes maturation and reorganization. Collagen III is progressively replaced by stronger collagen I, resulting in increased tensile strength of the repaired tissue.

Because several biological processes occur simultaneously, an ideal wound-healing agent would ideally possess multiple activities, including antioxidant, antimicrobial, anti-inflammatory and tissue-regenerative effects.

3. TRADESCANTIA PALLIDA

3.1 Botanical profile

Tradescantia pallida (Rose) D.R. Hunt belongs to:

Taxonomic rank	Classification
Kingdom	Plantae
Family	Commelinaceae
Genus	<i>Tradescantia</i>
Species	<i>Tradescantia pallida</i>
Common names	Purple Heart, Purple Queen

The plant is a perennial ornamental herb characterized by elongated purple leaves and purple stems. Pharmacognostic investigation of its leaves has documented macroscopic and microscopic characteristics, physicochemical parameters and preliminary phytochemical profiles that can be useful for authentication and standardization.

3.2 Phytochemical profile

Literature on *Tradescantia* species indicates the presence of several classes of secondary metabolites, including:

- phenolic compounds,
- flavonoids,
- anthocyanins,
- tannins,
- saponins,
- alkaloids,
- terpenoids,
- steroids, and
- coumarin-related constituents.

A recent review specifically addressing *T. pallida* reported significant interest in phenolics, flavonoids and anthocyanins, together with antioxidant, antimicrobial and anti-inflammatory properties.

Anthocyanins are particularly relevant because the characteristic purple colour of the plant is associated with anthocyanin pigments. These compounds may contribute to antioxidant activity by scavenging reactive oxygen species.



3.3 Pharmacological relevance

Available literature suggests that *T. pallida* possess several biological activities:

1. antioxidant activity,
2. antimicrobial activity,
3. antifungal activity,
4. anti-inflammatory potential,
5. antidiabetic activity,
6. cytotoxic activity in selected experimental models, and
7. environmental/phytoremediation applications.

The broader *Tradescantia* genus has also been reviewed for antioxidant, antimicrobial, anti-inflammatory and other biological properties.

3.4 Possible relevance to wound healing

The wound-healing relevance of *T. pallida* can currently be considered mainly potential rather than conclusively established.

Its antioxidant constituents may theoretically reduce oxidative damage at the wound site. Phenolics and flavonoids may also contribute to antimicrobial and anti-inflammatory effects, both of which are important for successful repair.

A generalized proposed mechanism is:

Phenolics/ flavonoids/ anthocyanins → antioxidant activity → reduction of oxidative stress → protection of cells

and

Antimicrobial constituents → reduction of microbial burden → reduced infection-related inflammation → improved healing environment.

However, direct evidence from standardized wound models specifically using *T. pallida* extract remains limited. Therefore, further experimental investigation is required before definitive wound-healing claims can be made.

4. TECOMA STANS

4.1 Botanical profile

Tecoma stans (L.) Juss. ex Kunth belongs to:

Taxonomic rank	Classification
Kingdom	Plantae
Family	Bignoniaceae
Genus	<i>Tecoma</i>
Species	<i>Tecoma stans</i>
Common names	Yellow bells, Yellow elder, Yellow trumpet

The plant is native to the Americas and is now widely distributed in tropical and subtropical regions. It has considerable ethnomedicinal importance and has traditionally been used for several conditions, including skin disorders and infections.

4.2 Phytochemical constituents

Phytochemical investigations have identified numerous compounds from *T. stans*. Major reported groups include:

- monoterpene alkaloids,
- phenolic acids,
- flavonoids,
- carotenoids,
- terpenoids,



- glycosides,
- phytosterols,
- fatty acids,
- tannins,
- saponins, and
- other phenolic constituents.

Important reported compounds include tecomine, tecomanine and chlorogenic-acid-related constituents.

The presence of these chemically diverse constituents may explain the broad pharmacological profile of the plant.

5. EVIDENCE FOR WOUND-HEALING ACTIVITY OF *TECOMA STANS*

Among the two plants considered in this review, *T. stans* has substantially stronger direct evidence for wound healing.

5.1 Bark extract study

A study evaluating petroleum ether, chloroform and methanolic bark extracts of *T. stans* investigated wound healing in albino rats using incision and excision models.

The methanolic extract produced significantly improved wound contraction and scar formation in the excision model and increased breaking strength in the incision model compared with the control. The authors associated the activity with phytosterols, triterpenes, glycosides, phenols, flavonoids, saponins and tannins.

These findings suggest that the wound-healing activity may result from a combination of phytoconstituents rather than a single compound.

5.2 Flower extract study

Another experimental investigation evaluated a 10% ethanolic extract ointment of *T. stans* flowers in excision, incision and burn wound models in rats.

The study reported significant improvements in wound contraction, epithelialization, hydroxyproline content and tensile strength compared with the control. Histopathological observations also supported improved healing. Silver sulfadiazine was used as the standard treatment.

The increase in hydroxyproline is particularly relevant because hydroxyproline is widely used as an indirect marker of collagen deposition.

5.3 Recent hydrogel research

More recent research has moved beyond crude extracts toward pharmaceutical wound-dressing systems.

A 2026 study investigated *T. stans* leaf-extract-loaded PVA/gelatin hydrogels. The extracts were incorporated into dual-crosslinked hydrogel systems, and characterization included FTIR, FESEM, XRD and viscosity studies. The formulation demonstrated antimicrobial activity against *Escherichia coli* and *Staphylococcus aureus*. In-vitro cytocompatibility and fibroblast scratch assays showed enhanced cell viability, migration and proliferation, suggesting potential for chronic wound-healing applications.

This represents an important transition from traditional crude extract research toward modern phytopharmaceutical wound-dressing systems.



6. MECHANISMS POTENTIALLY RESPONSIBLE FOR WOUND HEALING

The possible wound-healing mechanisms of *T. pallida* and *T. stans* are summarized below.

Mechanism	<i>T. pallida</i>	<i>T. stans</i>
Antioxidant activity	Promising	Well documented
Antimicrobial activity	Reported	Reported
Anti-inflammatory activity	Potential	Reported
Collagen synthesis	Requires direct validation	Supported by animal studies
Fibroblast proliferation	Requires direct validation	Supported by recent in-vitro work
Wound contraction	Direct evidence limited	Demonstrated
Increased tensile strength	Direct evidence limited	Demonstrated
Improved epithelialization	Requires validation	Demonstrated
Hydroxyproline enhancement	Requires validation	Reported
Modern topical formulation	Limited	Increasing evidence

Natural wound-healing agents can act through multiple pathways. Reviews of medicinal plants indicate that phenolics, flavonoids, alkaloids and saponins may contribute through antioxidant, antimicrobial, anti-inflammatory, collagen-

stimulating, proliferative and angiogenic mechanisms.

7. COMPARATIVE PHYTOCHEMICAL AND PHARMACOLOGICAL ASSESSMENT

Table 1. Comparative profile of *Tradescantia pallida* and *Tecoma stans*

Parameter	<i>Tradescantia pallida</i>	<i>Tecoma stans</i>
Family	Commelinaceae	Bignoniaceae
Major reported constituents	Phenolics, flavonoids, anthocyanins, tannins, saponins	Alkaloids, phenolics, flavonoids, terpenoids, glycosides, phytosterols, fatty acids
Antioxidant potential	Reported	Reported
Antimicrobial potential	Reported	Reported
Anti-inflammatory potential	Reported/potential	Reported
Wound-healing evidence	Limited direct evidence	Direct animal evidence available
Excision model	Needs further study	Positive results reported
Incision model	Needs further study	Positive results reported
Burn model	Needs further study	Positive results reported
Hydroxyproline	Needs validation	Increased in experimental study
Tensile strength	Needs validation	Increased in experimental study
Formulation research	Limited	Ointment and hydrogel research available
Research status	Under-investigated for wound healing	Relatively well investigated

8. ROLE OF ANTIOXIDANT ACTIVITY IN WOUND REPAIR

Reactive oxygen species are naturally produced during wound healing. At physiological concentrations, they participate in cell signalling

and host defence. Excessive ROS generation, however, can damage proteins, lipids and cellular membranes and may delay tissue repair.

Phenolic compounds, flavonoids and anthocyanins can act as free-radical scavengers. Therefore, the



antioxidant activity of *T. pallida* may provide a biological rationale for further investigation as a wound-healing agent. The antioxidant potential of *T. stans* is also well documented and may contribute to its experimentally observed healing activity.

9. ANTIMICROBIAL ROLE

Microbial contamination can prolong inflammation and delay epithelialization. Therefore, antimicrobial activity is an important characteristic of a potential wound-healing formulation.

Both plants have reported antimicrobial properties. *T. stans* has demonstrated antimicrobial activity in multiple studies, and its antimicrobial effects have been proposed as one contributor to its wound-healing activity.

For *T. pallida*, antimicrobial activity has been reported in the broader pharmacological literature, but its direct contribution to wound healing requires experimental validation.

10. ANTI-INFLAMMATORY ACTIVITY

Inflammation is essential during the initial phase of wound repair but becomes harmful when excessive or prolonged.

Flavonoids and phenolic compounds can influence inflammatory signalling pathways and reduce excessive inflammatory responses. *T. stans* has demonstrated anti-inflammatory activity in experimental studies, strengthening the mechanistic basis for its wound-healing application.

The anti-inflammatory potential reported for *T. pallida* likewise provides a rationale for investigation in wound models, although direct wound-specific evidence is currently inadequate.

11. COLLAGEN FORMATION AND TISSUE REGENERATION

Collagen is an essential structural component of repaired tissue. Increased collagen deposition is associated with improved tensile strength and tissue integrity.

In the *T. stans* flower extract study, increased hydroxyproline content and tensile strength were reported after treatment, indicating enhanced collagen-associated repair.

The recent *T. stans*-loaded hydrogel study additionally demonstrated fibroblast migration and proliferation in an in-vitro scratch assay, suggesting that formulations containing *T. stans* may support cellular processes involved in tissue regeneration.

For *T. pallida*, this aspect remains an important research gap.

12. POTENTIAL PHARMACEUTICAL FORMULATIONS

The therapeutic application of plant extracts requires suitable dosage forms that provide reproducible concentration, stability and controlled delivery.

Potential topical formulations include:

- ointments,
- creams,
- gels,
- hydrogels,
- nanoemulgels,
- emulgels,



- nanofibrous dressings,
- liposomes,
- niosomes, and
- polymeric wound dressings.

For *T. stans*, the progression from crude extracts and ointments to extract-loaded polymeric hydrogels demonstrates the potential for developing modern wound-dressing systems.

For *T. pallida*, formulation development remains an attractive area because its phenolic and anthocyanin-rich profile could potentially be incorporated into antioxidant and antimicrobial topical systems. However, extract standardization, stability and safety must first be established.

13. SAFETY CONSIDERATIONS

Natural origin does not automatically guarantee safety. Extract concentration, solvent, plant part, route of administration and duration of exposure can substantially affect toxicity.

Phytochemical and safety investigations of *T. stans* have highlighted the need for systematic toxicity evaluation and standardized characterization.

For *T. pallida*, caution is particularly important because the sap of the plant has been reported to cause skin irritation in humans and animals. Therefore, topical wound application should not be assumed to be safe solely on the basis of antioxidant or traditional-use evidence.

Future investigations should include:

- acute dermal toxicity,
- repeated-dose dermal toxicity,

- skin-irritation studies,
- sensitization studies,
- cytotoxicity assays,
- microbial quality assessment,
- extract standardization, and
- stability studies.

14. RESEARCH GAPS

Several important research gaps remain.

Tradescantia pallida

1. Limited direct wound-healing studies.
2. Lack of standardized wound models.
3. Limited information on dose-response relationships.
4. Insufficient identification of wound-active constituents.
5. Limited fibroblast migration/proliferation studies.
6. Lack of collagen and hydroxyproline studies.
7. Limited topical formulation research.
8. Insufficient dermal safety evaluation.

Tecoma stans

Although evidence is stronger, several limitations remain:

1. Extract standardization is inconsistent between studies.
2. Different plant parts and solvents are used.



3. Dose optimization requires further investigation.
4. Mechanistic molecular studies remain limited.
5. More chronic-wound models are required.
6. Long-term dermal toxicity needs additional evaluation.
7. Clinical studies are required before therapeutic claims can be generalized.

The major review literature has also noted incomplete reporting of some *T. stans* in-vivo studies, particularly regarding dose, control groups, intervention duration and toxicity.

15. FUTURE PERSPECTIVES

Future research should move from preliminary screening toward standardized pharmacological and pharmaceutical evaluation.

For *T. pallida*, a logical research pathway would be:

Plant authentication → extraction → phytochemical screening → total phenolic/ flavonoid estimation → antioxidant studies → antimicrobial studies → cytotoxicity → fibroblast scratch assay → collagen-related studies → excision wound model → histopathology → topical formulation → stability and safety evaluation.

For *T. stans*, future work should focus on:

bioactive-marker identification → standardized extract → mechanism-based studies → chronic wound models → advanced hydrogel/ nanoformulation → dermal toxicity → pharmacokinetic/biopharmaceutical assessment → clinical investigation.

Combination approaches involving both plants may also be scientifically interesting because their phytochemical profiles may provide complementary antioxidant, antimicrobial and anti-inflammatory effects. However, synergy should be experimentally demonstrated rather than assumed.

16. CONCLUSION

Tradescantia pallida and *Tecoma stans* represent two interesting medicinal plants with phytochemical characteristics relevant to wound management. *T. pallida* contains phenolics, flavonoids and anthocyanins and demonstrates antioxidant, antimicrobial and other pharmacological activities that provide a plausible biological basis for wound-healing investigation. However, direct evidence specifically demonstrating wound closure, collagen deposition, tensile strength improvement or histological repair following *T. pallida* treatment remains limited.

In comparison, *Tecoma stans* has stronger experimental support. Methanolic bark extract has demonstrated improved wound contraction and tensile strength in animal models, while ethanolic flower extract ointment has shown beneficial effects in excision, incision and burn wound models, including increased hydroxyproline and tensile strength. Recent work using *T. stans* leaf extracts in PVA/gelatin hydrogels has further demonstrated antimicrobial activity and enhanced fibroblast migration and proliferation in vitro, indicating potential for advanced wound-dressing applications.

Overall, *T. stans* can currently be considered a more experimentally validated wound-healing candidate, whereas *T. pallida* should be regarded as a promising but insufficiently investigated candidate. Rigorous comparative studies using



standardized extracts, validated wound models, molecular mechanisms, histopathology, collagen estimation, dermal safety studies and modern topical formulations are required to establish the true therapeutic potential of both plants.

17. PROPOSED COMPARATIVE EXPERIMENTAL FRAMEWORK

A future experimental study comparing both plants could use the following design:

Study stage	<i>T. pallida</i>	<i>T. stans</i>
Plant part	Leaves	Leaves/bark/flowers
Extraction	Hydroalcoholic/ethanolic	Hydroalcoholic/ethanolic
Phytochemical screening	Yes	Yes
Total phenolic content	Yes	Yes
Total flavonoid content	Yes	Yes
DPPH/ABTS antioxidant assay	Yes	Yes
Antibacterial assay	Yes	Yes
Cell viability	Yes	Yes
Fibroblast scratch assay	Yes	Yes
Excision wound model	Yes	Yes
Wound contraction	Yes	Yes
Epithelialization period	Yes	Yes
Hydroxyproline	Yes	Yes
Tensile strength	Yes	Yes
Histopathology	Yes	Yes
Formulation	Gel/ointment/hydrogel	Gel/ointment/hydrogel
Stability	Yes	Yes

This approach would provide a stronger scientific comparison than relying only on phytochemical screening.

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