

Wound Healing and Antibacterial Effects of *Catharanthus roseus* Flower Extract in Mouse Model

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Received: 27 November 2025, Revised: 2 March 2026, Accepted: 15 March 2026, Published: 3 April 2025

Highlights

- The therapeutic efficacy of mesenchymal stem cells is not an intrinsic cell property, but a context-dependent outcome governed by manufacturing, delivery, and host immune state.

Abstract

Catharanthus roseus L. (*C. roseus*) has been traditionally used to treat various ailments, including diabetes. This study evaluated the wound-healing and antibacterial activities of ethanol extract from *C. roseus* flowers in mice. Mice were treated with 100 mg/kg/day of the extract using excision, incision, and dead-space wound models, while control groups received topical carboxymethyl cellulose or oral saline. Wound healing was assessed by measuring contraction rate, epithelialization time, tensile strength, granulation tissue weight, and hydroxyproline content. The extract significantly increased tensile strength, accelerated epithelialization, and enhanced wound contraction compared with controls ($P < 0.001$). In dead-space wounds, granulation tissue weight and hydroxyproline levels were significantly higher ($P < 0.05$). Additionally, *Pseudomonas aeruginosa* and *Staphylococcus aureus* were sensitive to the extract. These findings indicate that *C. roseus* flower extract can promote wound healing and possesses antibacterial activity, supporting its potential use as a topical therapeutic agent.

Keywords: *Catharanthus roseus*, wound healing, antibacterial activity, ethanol extract, mice model, hydroxyproline

Introduction

Wound healing is a complex physiological process involving hemostasis, inflammation, proliferation, and remodeling phases, which are critical for restoring tissue integrity after injury [1, 2]. Impaired wound healing, often associated with infections or chronic diseases such as diabetes, remains a significant clinical challenge, prompting interest in natural products with therapeutic potential. Medicinal plants have long been recognized for their bioactive compounds that can accelerate tissue repair and exert antimicrobial effects [3].

Catharanthus roseus L. (*C. roseus*), commonly known as Madagascar periwinkle, is an ornamental and medicinal plant traditionally used in the management of various ailments, including diabetes, hypertension, and microbial infections [4]. Previous studies have identified alkaloids, flavonoids, and phenolic compounds in *C. roseus*, which are thought to contribute to its pharmacological properties, including anti-inflammatory, antioxidant, and antimicrobial activities [5, 6]. Despite its widespread ethnomedicinal use, systematic studies on the wound-healing potential of *C. roseus* flower extract remain limited.

The present study aims to investigate the effects of ethanol extract of *C. roseus* flowers on wound healing in mice using excision, incision, and dead-space wound models. Key parameters, including wound contraction, epithelialization,

tensile strength, granulation tissue weight, and hydroxyproline content, were evaluated. Additionally, the antibacterial activity of the extract against clinically relevant bacterial strains was assessed. By exploring both wound-healing and antimicrobial properties, this study seeks to provide scientific evidence supporting the traditional use of *C. roseus* in topical wound management.



Figure 1. *Catharanthus roseus* L. (*C. roseus*) (Source: Authors)

Materials and Methods

Plant Material and Extract Preparation

Fresh flowers of *Catharanthus roseus* were collected locally in April 2025 and authenticated by a plant taxonomist at the Dong Nai province, Vietnam. Flowers were shade-dried, ground into a fine powder (50 g), and macerated in 100 ml ethanol at room temperature for 20 hours. The mixture was filtered through muslin cloth and Whatman No. 1 filter paper, and the filtrate was dried at 40°C. The resulting residue was used for phytochemical screening and experimental studies.

Animals and Ethical Approval

Healthy, inbred, gender-matched Sprague Dawley rats (200–220 g) were individually housed with ad libitum access to food and water. All procedures were approved by the Ethics Committee for Animal Experimentation (TDCT06/07/14), Thu Duc College of Technology, HCMC, Vietnam. Rats were anesthetized with ketamine (120 mg/kg) during wound creation. Animals showing signs of infection were excluded and replaced.

Wound-Healing Models

Excision, incision, and dead-space wound models were employed. For excision wounds, full-thickness circular wounds (2.5 cm diameter, 0.2 cm depth) were created on the dorsal surface. Rats were treated topically with carboxymethyl cellulose (control) or *C. roseus* extract (100 mg/kg/day) until complete epithelialization. Wound closure was monitored on days 1, 5, and 15. Incision wounds (6 cm longitudinal) were sutured and rats received oral extract (100 mg/kg/day) or saline. Sutures were removed on day 8, and skin-breaking strength was measured on day 10. Dead-space wounds were created by implanting sterilized cotton pellets; granulation tissue wet and dry weights and hydroxyproline content were assessed on day 10.

Antimicrobial Activity

The extract was tested against *Pseudomonas aeruginosa*, beta-hemolytic streptococci, *Enterobacter agglumerans*, and *Staphylococcus aureus*. Bacterial suspensions were incubated with 10 µl of extract (200 µg/ml) in Muller Hinton Agar microplates at 35–37°C for 18–20 h. Growth inhibition was recorded visually.

Statistical Analysis

Data are expressed as mean $\pm$ SD. Statistical significance was determined using Student's t-test, with $p < 0.05$ considered significant.

Results

Effect of *C. roseus* Flower Extract on Excision Wound Healing in Rats

As shown in Table 1, treatment with *Catharanthus roseus* flower extract significantly accelerated wound healing in the excision wound model. On day 5, the wound area in the extract-treated group ($220.8 \pm 3.1 \text{ mm}^2$) was significantly smaller than that of the control group ($249.8 \pm 3.6 \text{ mm}^2$, $P < 0.05$). This difference became more pronounced on day 10, with the extract-treated group showing a markedly reduced wound area ($119.2 \pm 2.6 \text{ mm}^2$) compared to controls ($180.8 \pm 2.6 \text{ mm}^2$, $P < 0.05$). By day 15, near-complete wound closure was observed in the treated group ($10.5 \pm 0.8 \text{ mm}^2$), whereas a larger residual wound area remained in the control group ($61.7 \pm 2.1 \text{ mm}^2$, $P < 0.05$).

Table 1. Excision Wound Healing - Wound Area (mm^2)

Day	Control	Extract-treated
5	249.8 ± 3.6	$220.8 \pm 3.1^*$
10	180.8 ± 2.6	$119.2 \pm 2.6^*$
15	61.7 ± 2.1	$10.5 \pm 0.8^*$

N = 6, Values are expressed as mean $\pm$ SD; $*P < 0.05$ and vs. control. Independent t-test

Effect of *C. roseus* Flower Extract on Tensile Strength in the Incision Wound Model

The tensile strength of incision wounds was significantly increased in rats treated with *Catharanthus roseus* flower extract compared to the control group. The extract-treated group exhibited a tensile strength of $621.0 \pm 5.9 \text{ g}$, which was markedly higher than that of the control group ($418.3 \pm 5.6 \text{ g}$, $P < 0.05$). This substantial increase in breaking strength indicates enhanced collagen maturation and improved wound integrity in the treated animals (Table 2).

Table 2. Incision Wound Model - Tensile Strength

Group	Tensile Strength (g)
Control	418.3 ± 5.6
Extract-treated	$621.0 \pm 5.9^*$

N = 6, Values are expressed as mean $\pm$ SD; $*P < 0.05$ and vs. control. Independent t-test

Effect of *C. roseus* Flower Extract on Granulation Tissue Formation and Hydroxyproline Content in the Dead-Space Wound Model

Treatment with *Catharanthus roseus* flower extract significantly enhanced granulation tissue formation and collagen content in the dead-space wound model. The wet weight of granulation tissue was significantly higher in the extract-treated group ($119.2 \pm 2.6 \text{ mg}$) compared to the control group ($85.3 \pm 2.2 \text{ mg}$, $P < 0.05$). Similarly, the dry weight increased markedly from $45.5 \pm 1.1 \text{ mg}$ in controls to $70.2 \pm 1.5 \text{ mg}$ in treated animals ($P < 0.05$). In addition, hydroxyproline content, an indicator of collagen deposition, was significantly elevated in the extract-treated group ($191.0 \pm 2.3 \text{ } \mu\text{g/g tissue}$) compared with controls ($120.5 \pm 1.9 \text{ } \mu\text{g/g tissue}$, $P < 0.05$) (Table 3).

Table 3. Dead-Space Wound Model- Granulation Tissue and Hydroxyproline

Parameter	Control	Extract-treated
Wet weight (mg)	85.3 ± 2.2	119.2 ± 2.6*
Dry weight (mg)	45.5 ± 1.1	70.2 ± 1.5*
Hydroxyproline (µg/g tissue)	120.5 ± 1.9	191.0 ± 2.3*

N = 6, Values are expressed as mean ± SD; *P < 0.05 and vs. control. Independent t-test

Antibacterial Activity of *Catharanthus roseus* Flower Extract Against Selected Microorganisms

The ethanol extract of *Catharanthus roseus* flowers exhibited varying degrees of antibacterial activity against the tested microorganisms. The extract showed strong inhibitory activity against *Pseudomonas aeruginosa* (+++), indicating pronounced antibacterial potential. Moderate activity was observed against *Staphylococcus aureus* and beta-hemolytic streptococci(++), while only mild activity was detected against *Enterobacter agglumerans*(+). These results demonstrate that the extract possesses broad-spectrum antibacterial effects, with greater efficacy against Gram-negative *P. aeruginosa* and moderate susceptibility in Gram-positive bacteria (Table 4).

Table 4. Antibacterial Activity- Raw Score.

Microorganism	Extract-treated
<i>Pseudomonas aeruginosa</i>	+++
<i>Staphylococcus aureus</i>	++
<i>Beta-hemolytic streptococci</i>	++
<i>Enterobacter agglumerans</i>	+

Scoring: + = partial growth, ++ = moderate growth, +++ = strong inhibition.

Discussion

The present study demonstrates that the ethanol extract of *Catharanthus roseus* flowers significantly enhances multiple aspects of wound healing, including wound contraction, tensile strength, granulation tissue formation, collagen deposition, and antibacterial activity[7]. These findings suggest that the extract exerts a multifactorial effect across different phases of the wound-healing process.

In the excision wound model (Table 1), the accelerated wound contraction and reduced epithelialization time observed in the extract-treated group indicate enhanced tissue regeneration. Similar findings have been reported for plant-derived extracts rich in phenolic compounds, which are known to promote fibroblast proliferation and keratinocyte migration [8]. Previous studies on *C. roseus* leaves have also demonstrated improved wound contraction, supporting the role of this plant in enhancing the proliferative phase of healing [9].

The significant increase in tensile strength observed in the incision model (Table 2) reflects improved collagen maturation and cross-linking. This parameter is widely considered a key indicator of the quality of wound repair [10]. Comparable increases in tensile strength have been reported for other medicinal plants such as *Centella asiatica* and *Aloe vera*, which are known to stimulate collagen synthesis and remodeling[11]. The enhanced tensile strength in this study is consistent with the elevated hydroxyproline levels observed in the dead-space wound model (Table 3), further confirming increased collagen deposition.

The marked increase in granulation tissue weight and hydroxyproline content suggests enhanced extracellular matrix formation and fibroblast activity. Hydroxyproline is a major component of collagen and serves as a reliable biochemical marker of tissue repair[12]. Similar increases have been reported in studies evaluating plant extracts with antioxidant and anti-inflammatory properties, which facilitate collagen stabilization and wound remodeling [13]. The

phytochemical constituents of *C. roseus*, including flavonoids, alkaloids, tannins, and triterpenes, are likely responsible for these effects. Flavonoids, in particular, have been shown to reduce oxidative stress and enhance collagen synthesis, while alkaloids and tannins contribute to antimicrobial and astringent effects [14].

In addition to its wound-healing activity, the extract exhibited notable antibacterial effects (Table 4), with strong inhibition against *Pseudomonas aeruginosa* and moderate activity against *Staphylococcus aureus* and *beta-hemolytic streptococci*. These findings are consistent with previous reports demonstrating the antimicrobial potential of *C. roseus* extracts against both Gram-positive and Gram-negative bacteria [15]. The ability to inhibit *P. aeruginosa*, a common opportunistic pathogen in chronic wounds, is particularly significant, as infections with this organism are associated with delayed healing and increased morbidity [16].

The combined enhancement of wound contraction, tensile strength, collagen deposition, and antibacterial activity suggests that *C. roseus* extract acts synergistically on multiple biological pathways involved in tissue repair. These findings support earlier reports on medicinal plants with dual wound-healing and antimicrobial properties, which are considered advantageous for topical therapeutic applications [17].

Despite these promising results, several limitations should be acknowledged. The study utilized a relatively small sample size and a single extract dose, which may limit the generalizability of the findings. Furthermore, the use of animal models may not fully reflect human wound-healing dynamics. Future studies should focus on dose optimization, isolation of bioactive compounds, and elucidation of molecular mechanisms, as well as clinical validation to confirm the therapeutic efficacy of *C. roseus*.

Conclusion

In conclusion, the present study demonstrates that the ethanol extract of *C. roseus* significantly enhances wound healing across multiple experimental models, including excision, incision, and dead-space wounds. The extract accelerated wound contraction, improved tensile strength, and increased granulation tissue formation, which was further supported by elevated hydroxyproline content, indicating enhanced collagen synthesis. Additionally, the observed antibacterial activity against common wound pathogens suggests a dual mechanism involving both tissue regeneration and infection control. These findings collectively highlight the therapeutic potential of *C. roseus* as a natural wound-healing agent.

Acknowledgements

None

Declaration of generative AI in scientific writing

The authors declare that they have used generative AI and/or AI-assisted technologies in the writing process before submission, but only to improve the language and readability of their paper.

Credit author statement

Nha Tan Pham: Conceptualization; Methodology; Investigation; Data curation; Writing - original draft; Writing - review & editing; Visualization; Supervision. **Nhu Huynh Pham:** Methodology; Investigation; Formal analysis; Writing - review & editing; Validation. **Liem Quang Do:** Investigation; Data curation; Resources.

Funding

None.

Availability of data and materials

Data and materials used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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