



Evaluation of Wound Healing Activity of a Polyherbal Extract of *Russelia equisetiformis* and *Quisqualis indica* (*Combretum indicum*) Flowers in Rats

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Account Information	ABSTRACT
<i>Original Research article</i> Acceptance: Aug 2026 Published: September 2026 Volume 1 • Issue 1 • 2026 Keywords: <i>Russelia equisetiformis</i>; <i>Quisqualis indica</i>; <i>Combretum indicum</i>; polyherbal extract; wound healing; excision wound; wound contraction; epithelialization; flavonoids.	Background: Cutaneous wound repair is a coordinated process involving haemostasis, inflammation, proliferation, extracellular-matrix deposition, re-epithelialization and remodelling. Plant-derived polyphenols and related secondary metabolites are being investigated as topical wound-healing agents because they can influence oxidative stress, inflammatory signaling, fibroblast activity and tissue regeneration. The present study evaluated a topical polyherbal hydroalcoholic extract prepared from <i>Russelia equisetiformis</i> and <i>Quisqualis indica</i> (<i>Combretum indicum</i>) flowers (REQI/CI) in an excision-wound model in Wistar rats. Methods: Flowers were collected near Indore, authenticated, powdered and processed to obtain a hydroalcoholic extract. Preliminary phytochemical screening was performed. Dermal irritation was assessed using an OECD Test Guideline 404-based protocol. Twenty adult Wistar rats were allocated to four groups (n=5): normal saline control, povidone-iodine standard, REQI/CI 5% w/w ointment and REQI/CI 10% w/w ointment. A full-thickness dorsal excision wound of approximately 500 mm² and 2 mm depth was produced, and treatment was applied once daily. Wound contraction was recorded on days 4, 8, 12, 16 and 20, and epithelialization time was recorded. Results: The extract yield reported in the source study was 16.35%. Screening indicated carbohydrates, flavone glycosides, phenolic compounds, flavonoids, sterols and polysaccharides, while terpenoids, saponins and alkaloids were not detected. The dermal irritation index was 0.0. On day 20, wound contraction was 84.2±2.7% in control, 99.1±0.8% with povidone-iodine, 95.3±1.2% with 5% REQI/CI and 98.4±0.9% with 10% REQI/CI. Epithelialization periods were 22.8±0.9, 16.9±0.4, 18.6±0.6 and 17.3±0.5 days, respectively. Conclusion: Topical REQI/CI accelerated wound closure and shortened epithelialization time in rats, with the 10% formulation approaching the standard treatment. The findings support further pharmacological, phytochemical and translational evaluation, while the mechanistic interpretation remains provisional because biochemical, histological and molecular endpoints were not quantitatively reported in the source dataset.

1. INTRODUCTION

Skin injury initiates a highly regulated repair response in which hemostasis is followed by inflammation, proliferation and remodeling. Successful repair requires coordinated activity of platelets, inflammatory cells, fibroblasts, keratinocytes, endothelial cells and extracellular-matrix components. Disruption of any phase may result in delayed closure, persistent inflammation, infection, excessive scarring or chronic non-healing wounds [1,2]. The pharmacological evaluation of wound-healing agents therefore commonly considers complementary endpoints such as reduction in wound area, percentage wound contraction, epithelialization time and, when available, tensile strength, collagen content and histopathology. Rodent excision models remain useful for screening topical agents because wound area can be serially quantified and treatment-related changes can be compared over a defined period. However, rodent skin heals substantially through contraction as well as re-epithelialization, so interpretation should distinguish these processes and avoid assuming that wound contraction alone is equivalent to human healing [3-5]. Standardized excisional wound protocols can nevertheless provide reproducible comparative evidence for preliminary pharmacological screening. Medicinal plants have attracted interest in wound management because their secondary metabolites may act at several stages of repair. Reviews of the literature identify flavonoids, phenolics, alkaloids, saponins and related constituents as potentially relevant to antioxidant defense, inflammatory regulation, antimicrobial activity, fibroblast proliferation, collagen synthesis and angiogenesis [6,7]. A systematic review focused specifically on flavonoids reported effects on inflammation, angiogenesis, re-epithelialization and oxidative stress, with evidence involving TGF- β 1, VEGF, Smad signaling, NF- κ B and PI3K/Akt-related pathways [8]. These observations provide a rational basis for evaluating polyherbal preparations containing phenolic and flavonoid-rich fractions. *Russelia equisetiformis* and *Quisqualis indica* (Combretum indicum) flowers were selected in the source study as a combined botanical preparation. The source material reports preliminary phytochemical constituents and a topical ointment formulation at 5% and 10% w/w. The objective of the present article is to present these experimental findings in a structured, peer-review-oriented format and to assess the magnitude and time course of wound contraction and epithelialization while clearly separating experimentally measured outcomes from mechanistic hypotheses.

2. MATERIALS AND METHODS

2.1 Plant material and extraction

Flowers of *Russelia equisetiformis* and *Quisqualis indica* (Combretum indicum) were collected from a garden near Indore, Madhya Pradesh, India, and authenticated by a botanist. The material was washed, shade-dried and powdered using an electric laboratory blender. The source protocol describes removal of fatty material using petroleum ether followed by extraction of the defatted material with a 50:50 v/v ethanol-water hydroalcoholic solvent. The extract was filtered, concentrated, dried and stored in a well-closed container until formulation. The source document reports an extract yield of 16.35% (327 g practical yield from 2000 g theoretical plant material).

2.2 Preliminary phytochemical screening

The hydroalcoholic extract was screened using conventional qualitative procedures for carbohydrates, terpenoids, flavone glycosides, phenolic compounds, flavonoids, saponins, sterols, alkaloids and polysaccharides. The interpretation was recorded as positive or negative according to the source study. Because qualitative screening establishes presence/absence rather than concentration, the results should be regarded as preliminary phytochemical characterization.

2.3 Acute dermal irritation assessment

Dermal tolerability was evaluated using an OECD Test Guideline 404-oriented procedure. OECD TG 404 evaluates acute dermal irritation/corrosion following a single dermal exposure and recommends assessment of erythema and edema after exposure, including observations over the subsequent period to assess reversibility [9]. In the source study, no erythema or edema was observed at 1, 24, 48 or 72 h; total erythema and edema scores were each zero and the reported Primary Irritation Index (PII) was 0.0.

2.4 Animals and ethical considerations

Adult Wistar albino rats of either sex, weighing 150–200 g, were housed under controlled laboratory conditions with a 12-h light/dark cycle, standard pellet diet and water ad libitum. Animals were acclimatized for seven days before experimentation. The source document reports approval from the Institutional Animal Ethics Committee (IAEC/SVCP/2022) and compliance with CCSEA requirements.

2.5 Experimental design and formulation

Group	Treatment	n
I	Normal saline, 2 mL/kg	5
II	Povidone-iodine ointment (standard)	5
III	REQI/CI ointment, 5% w/w	5
IV	REQI/CI ointment, 10% w/w	5

The polyherbal ointments were applied topically once daily from the day of wound creation until complete healing. The 5% and 10% w/w concentrations were selected after the dermal safety assessment and on the basis of the formulation concentrations described in the source study.

2.6 Excision wound model

Rats were anesthetized with ketamine hydrochloride (50 mg/kg, i.p.). Dorsal hair was shaved and the skin was disinfected with 70% ethanol. A circular full-thickness excision wound of approximately 500 mm² area and 2 mm depth was created on the dorsal thoracic region using sterile surgical instruments. Wound area was measured on days 0, 4, 8, 12, 16 and 20 by tracing the wound and determining the area using graph paper.

2.7 Outcome measures and statistical analysis

Percentage wound contraction was calculated as: % wound contraction = [(initial wound area – wound area on a specific day) / initial wound area] × 100. The epithelialization period was defined as the number of days required for complete healing with shedding of the scar tissue. The source study expressed data as mean ± SEM and reported one-way ANOVA followed by Dunnett's test, with $p < 0.05$ considered statistically significant. The present article does not reconstruct individual-animal data or recalculate inferential statistics because only group-level summary values were available.

3. RESULTS

3.1 Extract yield and physical characteristics

Parameter	Reported observation
Extract yield	16.35%
Colour	Reddish brown
Consistency	Sticky, semi-solid

The source document reports a practical yield of 327 g from 2000 g plant material, corresponding to 16.35% yield. A reddish-brown, sticky semi-solid extract was obtained and subsequently used for topical formulation.

3.2 Phytochemical profile

Phytoconstituent	Result
Carbohydrates	Positive
Terpenoids	Negative
Flavone glycosides	Positive
Phenolic compounds	Positive
Flavonoids	Positive
Saponins	Negative
Sterols	Positive
Alkaloids	Negative
Polysaccharides	Positive

The preliminary profile indicates the presence of several classes of constituents with plausible relevance to wound repair, particularly flavonoids and phenolic compounds. However, qualitative screening alone cannot establish which constituent(s) are responsible for the observed activity or their concentrations.

3.3 Dermal irritation

Observation time	Erythema score	Edema score	Interpretation
1 h	0	0	No reaction
24 h	0	0	Normal skin
48 h	0	0	No visible irritation
72 h	0	0	Intact skin; no inflammation

No mortality or systemic toxicity was reported. The total erythema score and edema score were both zero, yielding a reported PII of 0.0, consistent with negligible irritation under the study conditions.

3.4 Wound contraction

Day	Control	Standard	REQI/CI 5%	REQI/CI 10%
4	17.8 ± 1.6	31.4 ± 1.9*	25.3 ± 1.8*	29.1 ± 2.0*
8	36.5 ± 2.1	58.6 ± 2.3*	49.8 ± 2.2*	55.4 ± 2.1*
12	55.7 ± 2.4	80.2 ± 2.0*	71.5 ± 2.3*	77.6 ± 1.9*
16	73.1 ± 2.2	94.5 ± 1.5*	87.4 ± 1.8*	92.6 ± 1.6*
20	84.2 ± 2.7	99.1 ± 0.8*	95.3 ± 1.2*	98.4 ± 0.9*

Table 1. Percentage wound contraction (mean ± SEM). *p<0.05 vs control as reported in the source study.

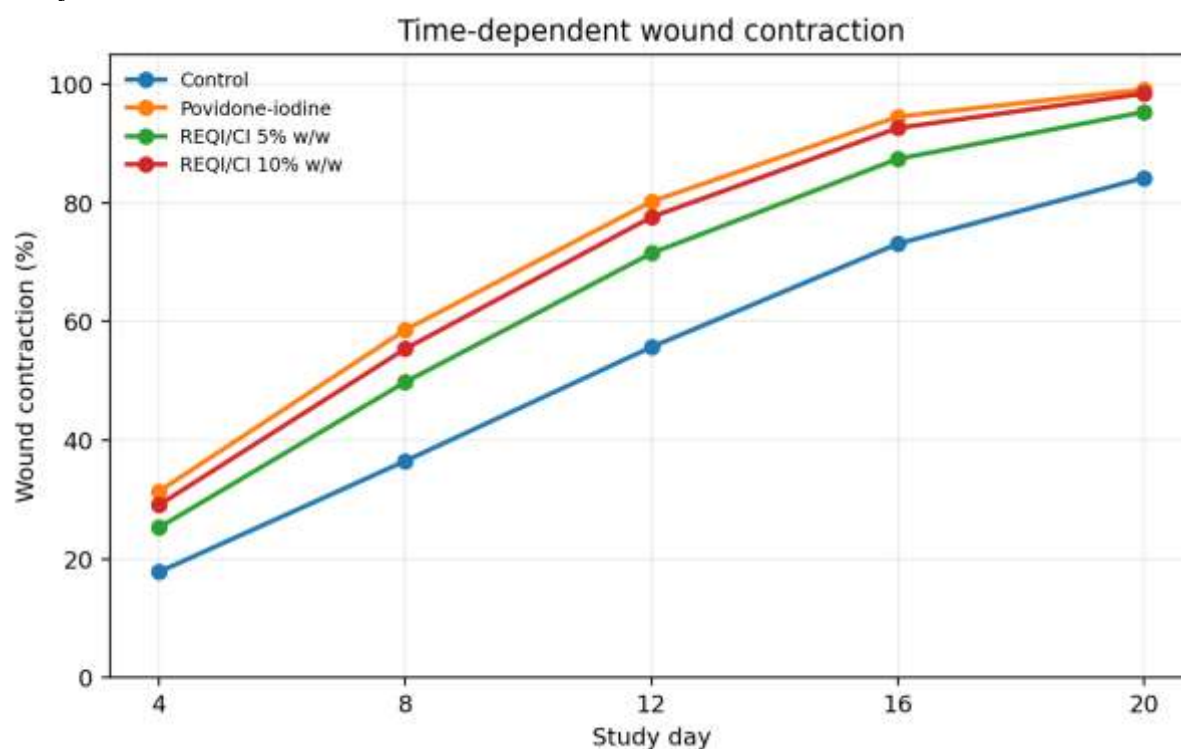


Figure 1. Time-dependent percentage wound contraction in control, standard and REQI/CI-treated groups.

3.5 Epithelialization period

Table 2. Epithelialization period. *p<0.05 vs control as reported in the source study.	
Group	Epithelialization period (days)
Control	22.8 ± 0.9
Standard	16.9 ± 0.4*

REQI/CI 5%	18.6 ± 0.6*
REQI/CI 10%	17.3 ± 0.5*

The high-dose formulation reduced the epithelialization period to 17.3±0.5 days, approaching the standard group (16.9±0.4 days). The low-dose formulation also shortened epithelialization relative to control. Collectively, the contraction and epithelialization findings demonstrate a concentration-related improvement in the measured wound-healing endpoints.

4. DISCUSSION

The present investigation provides *in vivo* evidence that topical REQI/CI ointment can accelerate closure of full-thickness excision wounds in Wistar rats. The most prominent finding was the progressive increase in wound contraction across all treatment groups, with both extract concentrations consistently exceeding control values from day 4 onward. By day 20, the 10% formulation produced 98.4% closure compared with 84.2% in the control group and 99.1% in the povidone-iodine group. The 5% formulation produced 95.3% closure. Thus, the higher concentration approached the performance of the reference topical treatment in this model. The reduction in epithelialization time strengthens the interpretation that the extract did not merely alter wound-area measurements but was associated with faster completion of the repair process. The 10% formulation required 17.3 days for epithelialization compared with 22.8 days in control, a reduction of approximately 24%. The 5% formulation required 18.6 days. Similar endpoints are widely used in experimental wound-healing research because contraction and epithelialization provide complementary information about closure kinetics [3,4]. The phytochemical profile provides a plausible pharmacological context. Flavonoids and phenolic compounds were detected in the extract, while sterols, carbohydrates, flavone glycosides and polysaccharides were also reported. Contemporary literature indicates that flavonoids may modulate inflammatory signaling, oxidative stress, angiogenesis and re-epithelialization through interactions involving TGF- β , VEGF, Smad, NF- κ B and PI3K/Akt-related pathways [8,10]. More broadly, medicinal-plant preparations containing phenolics and flavonoids may influence several phases of tissue repair through antioxidant, anti-inflammatory and cell-regulatory effects [6,7]. These mechanisms are consistent with the direction of the present findings, but they should be considered hypotheses rather than demonstrated mechanisms because the present dataset did not include cytokine assays, oxidative-stress biomarkers, collagen quantification, angiogenesis markers or pathway-level experiments.

Conceptual mechanistic framework for the observed wound-healing effect

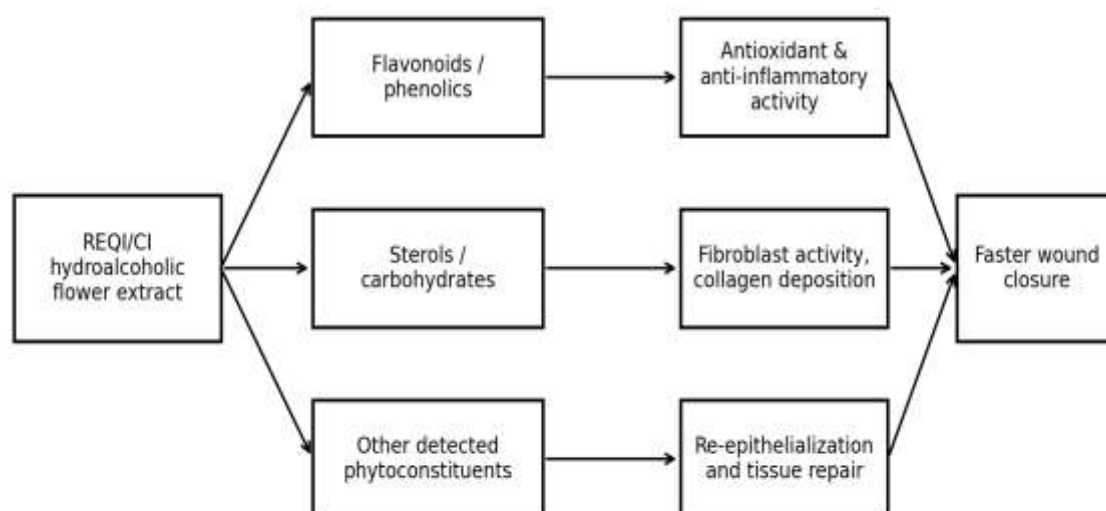


Figure 2. Conceptual mechanism linking the detected phytochemical classes with plausible wound-repair pathways. The diagram is hypothesis-generating and does not represent directly measured molecular endpoints.

Angiogenesis is another important component of granulation tissue formation because new capillaries supply oxygen and nutrients to the regenerating wound bed [11]. Fibroblast proliferation and extracellular-matrix deposition are likewise central to the formation and maturation of new tissue. The present study did not directly quantify these processes. Therefore, statements that the extract increased collagen synthesis, fibroblast proliferation or angiogenesis should be framed as biologically plausible explanations rather than experimentally proven outcomes. The dermal irritation findings are relevant to the development of a topical formulation. OECD TG 404 is designed to characterize acute dermal irritation/corrosion using erythema and edema scoring and assessment of reversibility [9]. The reported PII of 0.0 and absence of visible irritation at the observation points support good acute local tolerability under the reported conditions. Nevertheless, an acute irritation result does not establish long-term dermatological safety, sensitization status, systemic exposure or clinical tolerability. The findings also have translational limitations. Rodent excisional wounds heal partly through contraction, and this differs from the relative contribution of re-epithelialization in humans [5]. Consequently, future work should incorporate histopathology, hydroxyproline/collagen estimation, inflammatory cytokines, oxidative-stress markers, angiogenic markers and, ideally, a splinted wound model that reduces contraction. Chemical standardization by HPLC/LC-MS and isolation of active constituents would further strengthen reproducibility and mechanistic attribution.

5. CONCLUSION

Strengths of the study include the use of an established excision model, inclusion of a reference topical treatment, evaluation of two extract concentrations, serial wound-area measurement and a dermal irritation assessment. The major limitations are the small sample size ($n=5/\text{group}$), reliance on qualitative phytochemical screening, absence of individual-animal data, and lack of quantitative histological, biochemical and molecular endpoints. In addition, the source document contains differing descriptions of extraction procedures in different sections and mentions an incision model without providing numerical tensile-strength results. Accordingly, this article confines the quantitative interpretation to the extract yield, dermal irritation, wound contraction and epithelialization data that are explicitly reported. Topical polyherbal REQI/CI ointment prepared from *Russelia equisetiformis* and *Quisqualis indica* (*Combretum indicum*) flowers demonstrated accelerated wound contraction and shortened epithelialization time in a rat excision-wound model. The 10% w/w formulation produced 98.4% wound contraction by day 20 and an epithelialization period of 17.3 ± 0.5 days, approaching the povidone-iodine standard. The preparation was reported to produce no acute dermal irritation under the study conditions. The results support further development of REQI/CI as a candidate botanical wound-healing formulation, but confirmation requires standardized phytochemical characterization, mechanistic biomarker studies, histopathology, larger controlled experiments and eventual clinical evaluation.

6. REFERENCES

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Declarations

Ethics approval: The source study reports IAEC approval No. IAEC/SVCP/2022 and compliance with CCSEA requirements.

Conflict of interest: Not reported in the source document. **Funding:** Not reported in the source document. **Data availability:** The article is based on the experimental data contained in the supplied source document; individual-level raw data were not provided.