



# PREPARATION AND EVALUATION OF POLYHERBAL WOUND HEALING GEL CONTAINING FICUS RELEGIOSA AND ALOE VERA

## *A Synergistic Herbal Approach to Wound Healing*

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**Abstract:** Wounds, which damage the skin's structure, require prompt treatment to prevent infections and support healing. While conventional wound care products are effective, they often come with side effects or slow recovery times. Herbal remedies, valued for their biocompatibility and minimal adverse effects, are increasingly being explored as natural alternatives for wound management. This study developed a Polyherbal Wound Healing Gel using extracts of *Ficus religiosa* and *Aloe vera*, both recognized for their wound healing, anti-inflammatory, and antimicrobial properties. Carbopol 940 was used as the gelling agent to create an optimal gel base. The gel was evaluated for critical physicochemical properties, including pH, viscosity, spreadability, extrudability, homogeneity, skin irritation, and stability. The final product displayed a smooth texture, greenish color, uniform consistency, and a pH suitable for topical use. It demonstrated excellent spreadability, easy extrudability, and no signs of skin irritation in preliminary tests. Stability studies confirmed that the gel maintained its properties over time. The findings suggest that the Polyherbal Wound Healing Gel is a promising, safe, and effective herbal alternative for wound care. Further research, including in vivo studies and clinical trials, is recommended to validate its potential for broader application.

**Keywords** *Ficus religiosa*, *Aloe vera*, Wound healing gel, Polyherbal formulation, UCarbopol 940, Skin-friendly Phytoconstituents.

## 1. Introduction

Wounds are a prevalent medical condition that can result in serious morbidity and long-term consequences. Although synthetic wound-healing agents are available, they frequently cause discomfort and delay recovery (22). Consequently, the safety and effectiveness of herbal formulations have gained more attention in recent years (21).

The sacred fig, *Ficus religiosa*, has long been used for its antibacterial, anti-inflammatory, and wound-healing properties (16). Rich in tannins, flavonoids, and phenolic compounds, its leaves and bark promote tissue remodeling, collagen formation, and wound contraction (11). Studies have demonstrated its efficacy in normal and diabetic wound healing, further supporting its medicinal significance (20).

Similarly, Aloe vera is widely recognized for its soothing, hydrating, and wound-healing properties (26). Its gel stimulates collagen synthesis, enhances fibroblast and keratinocyte proliferation, and promotes re-epithelialization, thereby reducing inflammation and scarring (27). Research has demonstrated its effectiveness in accelerating wound closure, particularly in diabetic models (20,24).

When combined in a polyherbal gel formulation, Aloe vera and *Ficus religiosa* work synergistically to enhance wound healing. Aloe vera improves hydration and speeds up wound closure, while *Ficus religiosa* provides antioxidant and antibacterial properties, making the combination a promising natural treatment for efficient wound healing (1).



Figure 1: Peepal Leaves



Figure 2: Aloe Vera Gel

## 1.1 Need for Herbal Formulation in Wound Healing

Wound healing is a critical biological process that restores skin integrity after injury. While synthetic agents are commonly used, concerns over side effects and antimicrobial resistance have shifted interest toward herbal formulations, which enhance the body's natural healing mechanisms with minimal risk (1).

Medicinal plants like *Ficus religiosa* and Aloe vera are rich in bioactive compounds, including flavonoids and polyphenols, which exhibit anti-inflammatory, antimicrobial, antioxidant, and tissue-regenerative properties. Combining traditional knowledge with scientific validation ensures safety, efficacy, and better patient compliance in wound care (2).

## 1.2 Advantages of Herbal Products in Wound Healing

### 1. High Safety and Low Toxicity

Herbal formulations are well-tolerated, with minimal risk of adverse reactions, even with prolonged use (4).

### 2. Biocompatibility

Natural products maintain skin pH and promote barrier repair without irritation—suitable for all skin types (5).

### 3. Multifunctional Therapeutic Effects

Many medicinal plants provide antimicrobial, anti-inflammatory, antioxidant, and analgesic benefits in a single formulation.

Example: Aloe vera hydrates and soothes, while *Ficus religiosa* reduces inflammation and combats infection (3).

### 4. Rich in Bioactive Phytochemicals

Phytoconstituents such as tannins, flavonoids, and glycosides enhance collagen synthesis, angiogenesis, and fibroblast proliferation, accelerating healing (7).

### 5. Cost-Effective and Accessible

Herbal remedies are affordable and widely available, especially in resource-limited settings (8).

### 6. Eco-Friendly and Sustainable

Plant-derived formulations have a lower environmental impact compared to synthetic alternatives (6).

## 7. Safe for Long-Term Use

Unlike corticosteroids or synthetic agents, herbal formulations do not cause skin thinning or pigmentation issues with extended use (11).

### 1.3 Limitations of Synthetic Products in Wound Healing

#### 1. Toxicity and Side Effects

Prolonged use of corticosteroids and antiseptics may lead to irritation, hypersensitivity, and systemic toxicity (17).

#### 2. Antimicrobial Resistance

Overuse of synthetic antibiotics contributes to the rise of resistant bacterial strains, reducing treatment efficacy (16).

#### 3. Impaired Healing and Scarring

Some synthetic products interfere with natural wound repair, increasing the risk of delayed healing and excessive scarring (19).

#### 4. High Cost and Limited Availability

The complex production processes make synthetic wound treatments expensive and less accessible in rural areas (22).

#### 5. Risk of Chemical Additives

Preservatives and artificial components in synthetic formulations may cause allergies or skin reactions (23).

#### 6. Environmental Concerns

The manufacturing and disposal of synthetic products contribute to pollution due to non-biodegradable waste (24)

### 1.4 Justification for Selecting Aloe vera and Ficus religiosa

Both *Ficus religiosa* (peepal tree) and *Aloe vera* have traditional and scientifically validated wound-healing properties. *Ficus religiosa* exhibits antibacterial, astringent, and anti-inflammatory effects. Its bark, leaves, and latex promote tissue regeneration and infection control (26).

*Aloe vera* is known for its moisturizing, anti-inflammatory, and collagen-stimulating properties, which accelerate wound closure and prevent infections (27).

Their complementary mechanisms make them ideal for a synergistic herbal formulation—*Ficus religiosa* for antimicrobial and tissue regeneration and *Aloe vera* for hydration and anti-inflammatory support (28). This combination provides enhanced healing with minimal side effects.

**Aim**—The goal is to formulate and evaluate a polyherbal wound healing gel containing *Ficus religiosa* and *Aloe vera*.

#### Objective of the Study-

The study aimed to develop and evaluate a polyherbal wound healing gel using *Ficus religiosa* and *Aloe vera* to enhance wound healing through their synergistic effects. Specific objectives included:

1. To create a stable gel combining *Ficus religiosa* and *Aloe vera*, recognized for their anti-inflammatory, antimicrobial, and wound healing properties (1,2,5).
2. To assess the gel's appearance, color, texture, pH, viscosity, spreadability, and stability for topical suitability (3,4).
3. To confirm the gel's safety and non-irritant nature through skin irritation tests (2,5).
4. To investigate the combined wound healing potential of *Ficus religiosa* and *Aloe vera*, supported by traditional knowledge and scientific evidence (1,3,4).

## 2. EXPERIMENTAL

### I. Materials

Table 1: List of instruments used

Sr.No	Name	Company/Model
1	Weighing Balance	Vaman
2	Homogenizer	RQ-127AF
3	Brookfields Viscometer	AMETEK 2000
4	Rotary Vacuum Evaporator	

Table 2: Ingredients used (formula)

Ingredient	Quantity (gm)	Function
Ficus religiosa Extract	1.5	Anti-inflammatory, wound healing, antioxidant
Aloe vera Gel	10	Soothing, moisturizer, penetration enhancer
Carbopol 940	0.5	Gelling agent
Propylene Glycol	2.5	Penetration enhancer
Glycerin	1.5	Humectant, hydrates skin
Methylparaben & Propylparaben	0.1	Preservatives
Triethanolamine (TEA)	q.s (to pH 6-7)	pH Adjuster
Distilled Water	q.s upto 50gm	Solvent

## II. Methodology

### 2.1 Extraction of Active Ingredients

The extraction of active ingredients from Ficus religiosa (Peepal) leaves and Aloe vera gel was carried out using appropriate techniques to ensure maximum potency and bioactivity. The process involved ultrasound-assisted extraction (UAE) for Ficus religiosa and mechanical separation for Aloe vera gel.

#### Extraction of peepal Leaves

Fresh leaves of Ficus religiosa were collected and thoroughly washed with distilled water to remove dust and debris. The leaves were then shade-dried at room temperature for 7 to 10 days. Once completely dried, they were ground into a fine powder using a mechanical grinder. For the extraction process, 100 g of the powdered leaves were mixed with 500 mL of 95% ethanol in a conical flask. The mixture was subjected to ultrasonic

extraction using a probe-type sonicator operating at a frequency of 20–40 kHz and a power of 150 W at room temperature for 30 minutes (Chemat et al., 2017). To prevent overheating and degradation of phytoconstituents, the flask was placed in an ice bath during sonication (Gallo et al., 2018). After completion of the sonication process, the extract was filtered through Whatman No. 1 filter paper. The filtrate was then concentrated under reduced pressure using a rotary evaporator at 40°C until a semisolid extract was obtained. The dried crude extract was stored in an airtight container at 4°C until further use.

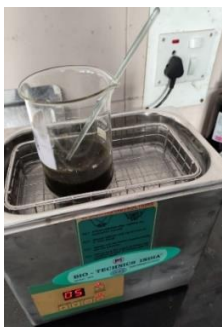


Fig. ficus Relegiosa extraction using ethanol



Fig. filtration



Fig. 3: Concentration via rotary evaporator.



Fig. Ficus extract



## Extraction of Aloe Vera

Fresh Aloe vera leaves were harvested and thoroughly washed with distilled water to remove any surface impurities. The outer green rind was carefully peeled away to collect the inner mucilaginous gel. The collected gel was then homogenized using a blender to achieve a uniform consistency. The homogenized gel was filtered through a muslin cloth to remove coarse particles. To ensure microbial stability, the filtered gel was pasteurized at 70°C for 15 minutes (24,26,27). The processed gel was then stored in an airtight container at 4°C until further use.

## 2.2. Formulation of wound healing Gel

A polyherbal wound healing gel was formulated using *Ficus religiosa* leaf extract and Aloe vera gel as the primary active ingredients. Carbopol 940 (1% w/w) was used as the gelling agent, glycerin (5% w/w) was incorporated as a humectant, and methylparaben (0.2% w/w) served as the preservative. Triethanolamine was used as a pH adjuster, while distilled water was used as the solvent to make up the volume to 100%.

For the preparation of the gel, Carbopol 940 was first dispersed in distilled water and allowed to swell overnight for complete hydration. Glycerin and methylparaben were then added to the hydrated Carbopol solution under continuous stirring. The ethanolic extract of *Ficus religiosa* leaves (obtained through ultrasound-assisted extraction) and Aloe vera gel were slowly incorporated into the gel base with continuous stirring to ensure uniform mixing. During the incorporation of Aloe vera gel, Vitamin E was also added as an antioxidant to help stabilize the formulation by preventing oxidative degradation of the gel components. Finally, triethanolamine was added dropwise to adjust the pH of the formulation to a range of 6.0 to 7.0, resulting in the formation of a smooth and transparent gel. The formulated polyherbal gel was then transferred into sterilized containers and stored at an appropriate temperature for further evaluation (1,2).



Fig. Final polyherbal wound healing gel formulation

## 3. Evaluation of polyherbal wound healing gel

### 3.1 Homogeneity Test

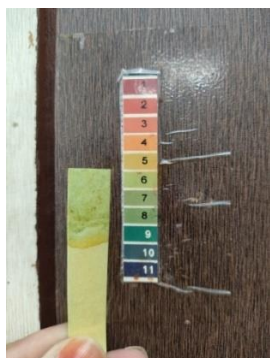
The homogeneity of the gel was examined to ensure uniform distribution and consistency throughout the formulation. A small portion of the gel was taken and rubbed gently between the fingers to check for any gritty particles or lumps. In addition, the gel was visually inspected for any signs of phase separation or irregular texture. The formulation was found to be smooth, uniform, and free from any visible separation.

### 3.2 Color and Odor Test

The physical appearance and sensory characteristics of the gel were evaluated through color and odor testing. The color of the gel was observed in natural daylight to confirm its uniformity and visual appeal. The odor was assessed by smelling a small amount of the gel to ensure it had a pleasant and distinctive aroma without any signs of spoilage or off-odors.

### 3.3 pH Determination

The pH of the gel was measured to verify its compatibility with skin and to ensure formulation stability. A small sample of the gel was tested using a calibrated digital pH meter. The pH was found to be within the acceptable range of 5.5 to 6.5, which is considered ideal for topical applications as it corresponds closely to the skin's natural pH.



pH test

### 3.4 Viscosity Measurement

The viscosity of the gel was measured using a Brookfield Viscometer (Model: CAP 2000+). Spindle number 01 was used at a speed of 50 rpm with a shear rate of 667, and measurements were recorded for 1 minute at a controlled temperature of 26-27°C. The viscosity values indicated a moderately viscous gel suitable for easy application without being too runny.



Fig. Gel viscosity test on Brookfield viscometer

P	RPM	%	D (cm)	Visc	°C	MMS.T
13.162	50	35.1	8774.58	666.66	24.9	01:00.6
14.287	50	38.1	9574.57	666.66	24.9	01:00.5
13.350	50	35.6	8899.91	666.66	25.0	01:00.4
14.475	50	38.0	9649.90	666.66	25.0	01:00.3
12.712	50	33.9	8474.58	666.66	25.0	01:00.5
13.700	50	31.2	7799.92	666.66	25.0	01:00.6

Result of Viscosity

### 3.5 Spreadability Test

The spreadability test was conducted to evaluate the ease of spreading the gel on the skin. A pre-marked glass slide was placed on a flat surface, and 1 gram of the gel was placed at the center. Another glass slide was placed on top, and a weight of 500 g was applied for 1 minute. The upper slide was displaced, and the spreadability was calculated using the formula:

$$S = M \times L / T$$

Where S is the spreadability, M is the applied weight (g), L is the length moved by the glass slide (cm), and T is the time (sec). The gel showed good spreadability, ensuring ease of application without excessive dripping.



Fig. Spreadability Apparatus

### 3.6 Skin Irritation (Patch Test)

The skin irritation (patch test) was performed to assess the dermal safety of the polyherbal wound healing gel. A small amount of gel was applied to a 1 cm × 1 cm area on the forearm of a healthy volunteer. The area was covered with sterile gauze and observed for 24 hours for any signs of redness, itching, swelling, or irritation. No adverse reactions were observed, indicating that the formulation is safe for topical use.



Skin Irritation Test

### 3.7 Extrudability test:

Extrudability was determined by filling the gel in an aluminum collapsible tube. The tube was pressed at the crimped end and the amount of gel extruded was noted. The formulation exhibited easy extrudability with uniform flow, indicating user-friendly packaging.

### 3.8 Stability Test :

The gel was subjected to stability studies by storing it at different temperatures (4°C, room temperature, and 40°C) for one month. Parameters such as physical appearance, pH, and spreadability were checked periodically. The formulation remained stable with no significant changes.

## 4. RESULT:

The prepared polyherbal wound healing gel was evaluated for various physicochemical parameters and was found to meet the required standards. The formulation exhibited desirable properties such as a smooth texture, uniform spreadability, ease of application, and an acceptable pH suitable for topical use. The gel maintained stability throughout the study period, showing no signs of phase separation, color change, or microbial growth. It was also found to be safe in preliminary skin irritation testing, with no evidence of redness, itching, or inflammation.

Table 3: Physicochemical evaluation of formulated gel.

SR NO	EVALUATION PARAMETERS	RESULTS
1	Physical appearance	Smooth, Greenish & Homogenous
2	pH	6.7
3	Viscosity	14.037
4	Spreadability	Uniform
5	Excrudability	Easily Squeezed out of tube
6	Homogeneity	Excellent
7	Skin Irritation Test	No Reaction
8	Stability	Stable

#### 4.CONCLUSION

The polyherbal wound healing gel was successfully formulated as a topical preparation combining *Ficus religiosa* and *Aloe vera*. Designed to leverage the wound healing, anti-inflammatory, and soothing properties of these herbal extracts, the gel demonstrated favorable physicochemical characteristics, including a skin-friendly pH, suitable viscosity, and excellent spreadability, ensuring ease of application and improved patient adherence. Preliminary skin irritation tests revealed no adverse reactions, confirming its safety for topical use.

While these initial findings indicate that the formulation is stable and appropriate for skin application, further research is needed to assess its therapeutic efficacy and long-term stability. Overall, the polyherbal wound healing gel holds promise as a natural topical treatment and serves as a foundation for future advancements in herbal wound care.

#### DISCUSSION

The findings of the study indicate that the polyherbal wound healing gel, developed using *Ficus religiosa* and *Aloe vera*, possesses favorable physicochemical properties suitable for topical application. With a pH of 6.7, closely matching the skin's natural pH, the gel ensures compatibility and reduces the likelihood of irritation. Its viscosity and spreadability were found to enable smooth and effortless application, while skin irritation tests showed no adverse effects, further validating its safety for topical use.

The combination of *Ficus religiosa* and *Aloe vera* is supported by prior research, emphasizing their combined wound healing, anti-inflammatory, and antimicrobial effects. *Ficus religiosa* aids in wound contraction and tissue regeneration, while *Aloe vera* promotes epithelialization and offers moisturizing and anti-inflammatory benefits. These complementary properties significantly enhance the gel's wound healing capabilities.

The results suggest that the polyherbal gel is a promising, safe, and effective formulation for wound healing. It exhibits excellent physicochemical attributes, such as a skin-compatible pH, ideal viscosity, and superior spreadability, alongside a strong safety profile in initial skin irritation tests. Its therapeutic potential and ease of use establish a robust foundation for further clinical research and development.

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