International Journal of Pharmacy and Pharmaceutical Research (IJPPR)
Volume 32, Issue 5, May 2026 **ijppr.humanjournals.com** ISSN: 2349-7203

Formulation and Evaluation of *Tridax procumbens* Gel for Wound Healing Activity and Antimicrobial Activity

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Received: 22 March 2026 Revised: 15 April 2026 Accepted: 23 April 2026

ABSTRACT:

Tridax procumbens is a medicinal plant widely known for its antimicrobial and wound-healing properties due to the presence of bioactive compounds such as flavonoids, alkaloids, and tannins. Even though more and more people are turning to herbal medicines, there are still important concerns about their quality, safety, and how well they actually work—both in developed and developing countries. This study focused on developing a simple topical gel containing Tridax procumbens powder to evaluate its effectiveness in treating wounds and infections. The gel was prepared using a suitable gelling agent. It was then evaluated for important properties such as appearance, pH, spreadability, and stability to ensure it is suitable for skin application. Antimicrobial studies showed that the gel was effective against common bacteria like E. coli, producing a noticeable zone of inhibition, which confirmed its ability to fight infections. In addition, in vitro wound-healing studies demonstrated that the gel promoted cell growth and wound closure, although its performance was slightly lower compared to standard commercial drugs. Overall, the results suggest that a simple Tridax procumbens gel can be an effective, natural, and affordable option for topical wound healing and antimicrobial treatment, with good potential for further development.

Keyword : T*ridax procumbens* ,Herbal gel formulation ,Wound healing activity, Antimicrobial activity ,Topical drug delivery,Agar well diffusion method , Skin irritation test ,Natural medicinal plants.

INTRODUCTION:

In recent years, more people have started turning toward herbal remedies because they are generally considered safer and gentler on the body. Unlike many allopathic medicines, which can sometimes cause unwanted side effects, herbal treatments are often better tolerated, leading to higher patient acceptance and comfort in long-term use. Building on this growing trust in natural therapies, the present research focuses on developing and evaluating an herbal gel made from the extracts of *Tridax procumbens*. This plant have a long history of use in traditional medicine. While *Tridax procumbens* is commonly used in rural areas—especially among farming communities—for its healing properties.[1]

Since ancient times, medicinal plants have played a vital role in treating human diseases, and even today, nearly one-fourth of the global population depends on traditional medicine for their healthcare needs. In regions like rural Maharashtra, plants like *Tridax procumbens* are easily available and widely used in everyday life, particularly by farmers and labourers. Its easy accessibility has contributed to its increasing acceptance; however, proper usage, dosage, and method of application still remain challenges. To address these concerns, transforming these herbal extracts into a gel form offers a practical and user-friendly solution.[2] Gels are soft, semi-solid preparations that are easy to apply on the skin, non-irritating, and simple to remove. They provide a soothing effect and allow better absorption of active ingredients, making them an ideal choice for topical herbal formulations. Using antimicrobial treatments directly on the skin is one of the most important and effective ways to care for wounds, as it helps prevent infection and supports faster healing. In simple terms, gels are systems where small amounts of solid substances are evenly dispersed within a larger liquid phase, giving them a jelly-like texture. This structure is created using gelling agents, which can be synthetic, such as carbopol or cellulose derivatives, or natural, like tragacanth. This unique composition gives gels their smooth consistency and makes them both effective and convenient for therapeutic use. Overall , this research aims to combine the traditional healing benefits of *Tridax procumbens* with modern formulation techniques, creating a herbal gel that is not only effective but also safe, easy to use, and widely acceptable for everyday healthcare needs.[3]

Advantage:

- Non-oily in nature during application
- Convenient to incorporate with active pharmaceutical ingredients
- Provides good adhesion at the site of application
- Safe, non-toxic, and easy to wash off
- Maintains stability for an extended period
- Delivers medication directly to the affected area for quick action and relief
- Minimizes side effects by avoiding the gastrointestinal route
- Spreads smoothly on the skin surface
- Ensures prolonged retention on the skin
- Produces a soothing and cooling sensation upon application

Disadvantage:

- In many cases, strong interactions occur between the drug and the polymer, which can decrease the hydrophilicity of nanogels, potentially disrupting their structure and trapping the drug within.
- Certain drugs show limited absorption through the skin barrier.
- There is a risk of hypersensitivity or allergic responses.
- Gel formulations tend to have a delayed onset of action, although their effects are sustained for a longer duration.
- Some excipients present in the gel may cause skin irritation.
- The application area should be carefully observed for any adverse reactions.
- External conditions such as temperature, humidity, and environmental factors can influence the overall effectiveness of the formulation.[2]

Rationale of the Study

The increasing demand for safer and naturally derived therapeutic products has led to growing interest in herbal antimicrobial formulations. Conventional synthetic antimicrobial agents, although effective, are often associated with adverse effects, toxicity, and the development of resistance. In contrast, herbal-based systems offer a biocompatible and eco-friendly alternative. Herbal antimicrobial gels, in particular, provide targeted delivery, ease of application, and improved patient compliance. These formulations combine the antimicrobial properties of plant-derived constituents with the advantages of topical gel systems, making them a promising approach in modern pharmaceutical and cosmetic applications.[4]

Need of the Work

- To develop an herbal antimicrobial gel using natural ingredients with proven activity against microorganisms.
- To provide an alternative to synthetic antimicrobial agents that may cause harmful side effects.
- To formulate a product capable of inhibiting or killing bacteria, viruses, and fungi effectively.

- To enhance safety and reduce toxicity associated with conventional antimicrobial therapies.
- To meet the increasing preference of consumers toward herbal and natural products.
- To improve topical drug delivery with better patient compliance and ease of application.
- To promote overall health and hygiene using plant-based formulations.[5]

PLAN OF WORK: -

- Selection of pure crude drug -tridax procumbens
- Preparation of carbopol gel base
- Processsing of tridax powder dispersion
- To prepare preservative solution
- Mixing of ingredients
- To prepare and evaluate herbal antimicrobial gel
- Comparative study
- Result &discussion
- Conclusion
- Reference

Plant Profile:

Taxonomical Classification of *Tridax procumbens*

- **Botanical Name:** *Tridax procumbens*
- **Kingdom:** Plantae
- **Order:** Asterales
- **Family:** Asteraceae
- **Genus:** *Tridax*
- **Species:** *Tridax procumbens*
- **Synonyme:** Dagadipala , Kabarmodi, Coat buttons

Fig.1: *Tridax procumbens* plant

Morphological Description

- A creeping, perennial herb commonly found in tropical and subtropical regions
- Stems are hairy, branched, and spread along the ground
- Leaves are opposite, simple, and coarsely toothed with a rough surface
- Flowers are small, daisy-like, with white ray florets and yellow disc florets
- Fruits are achenes with feathery pappus, aiding in wind dispersal

Phytochemical Constituents

- Flavonoids
- Alkaloids
- Tannins
- Saponins
- Carotenoids
- Essential oils

Medicinal Uses

- Exhibits antimicrobial activity against various pathogens
- Promotes wound healing and tissue regeneration
- Possesses anti-inflammatory properties
- Traditionally used for treating skin infections and cuts
- Shows antioxidant activity, helping to reduce oxidative stress[6]

Table 1: Formulation Table

Sr.No.	Ingredients	Quantity	Role
1	Tridax powder	5gm	Antimicrobial and Wound Healing
2	Carbopol	3gm	Gelling Agent
3	Propylene Glycol	5ml	Penetration enhancer
4	Glycerin	2ml	Humactant
5	Sodium Benzoate	0.1gm	Preservative
6	triethanolamine	q.s.	pH adjuster
7	Water	Upto 10ml	Vehicle

Drugs and chemicals: Tridax Powder, carbopol, Propylene Glycol, distilled water, Triethanolamine, Sodium Benzoate, Glycerin.

Glassware's and instruments: Beaker, volumetric flask, measuring cylinder, weighing balance, stirrer, spatula, petri dish

Materials and Methods:

1. ***Tridax procumbens*** **(Tridax Powder)**

Tridax powder is prepared from the dried leaves of *Tridax procumbens*, a medicinal herb commonly found in tropical regions. It contains natural compounds like flavonoids and tannins that contribute to its antimicrobial and wound-healing effects. The powder is often used in herbal formulations to prevent infection and promote faster healing of minor cuts and skin problems.[7]

Fig 2*: Tridax procumbens* powder

2. Carbopol

Carbopol is a high molecular weight polymer used as a thickening and gelling agent. It helps in forming transparent gels with smooth texture. In formulations, it provides proper consistency, enhances stability, and improves the application properties of the product. It requires neutralization (usually with triethanolamine) to form a gel.[8]

Fig 3: Carbopol

3. Propylene Glycol

Propylene glycol is a synthetic liquid widely used as a solvent and moisture-retaining agent. It helps dissolve active ingredients and improves their absorption through the skin. It also prevents the formulation from drying out, maintaining softness and usability over time.[9]

4. Glycerin

Glycerin is a clear, viscous liquid derived from natural sources. It acts as a humectant, meaning it draws moisture from the environment into the skin. It helps keep the skin hydrated, soft, and smooth, and also improves the feel and spreadability of topical preparations.[10]

5. Sodium Benzoate

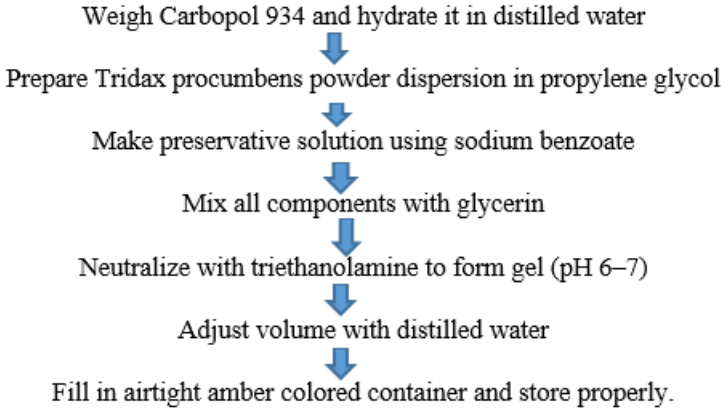
Sodium benzoate is a commonly used preservative that protects formulations from microbial contamination. It is effective against bacteria, yeast, and fungi, especially in slightly acidic conditions. Its presence ensures longer shelf life and safety of the product during storage.[11]

Fig 4: Sodium Benzoate

6. Triethanolamine

Triethanolamine is an organic compound used to adjust the pH of formulations. It plays a key role in gel preparation by neutralizing carbopol, which leads to the formation of a stable gel structure. It also improves the texture and consistency of the final product.[1]

Procedure:



International Journal of Pharmacy and Pharmaceutical Research (IJPPR)
Volume 32, Issue 5, May 2026 ijppr.humanjournals.com ISSN: 2349-7203

Fig 5: Prepared Tridax powder dispersion and carbopol gel base

Formulations of Tridax Procumbens Gel shown in below table:

Table 2: Formulation table of two different batches

Sr	Ingredients	F1	F2	Role
1	Tridax powder	3gm	5gm	Antimicrobial and Wound Healing
2	Carbopol	1.5gm	3gm	Gelling Agent
3	Propylene Glycol	2.5ml	5ml	Penetration enhancer
4	Glycerin	2ml	2ml	Humectant
5	Sodium Benzoate	0.1gm	0.1gm	Preservative
6	triethanolamine	Q.S.	Q.S.	pH adjuster
7	Water	Up to 10ml	Up to 10ml	Vehicle

Evaluation Test:

1. Physical Appearance

The prepared herbal gel formulations were examined visually for their colour, clarity, and overall uniformity. Any change in appearance or presence of lumps was carefully noted.

Table 3: Physical Appearance

Sr No.	Physical Appearance	F1 Batch	F2 Batch
1.	Colour	Dark Green	Green
2.	Appearance	Partially gel like appearance	Gel
3.	Odour	Mild	Rose Like
4.	Grittiness	No	No
5.	Texture	Easily applied	Easily applied

2. pH Determination

The pH of each gel formulation was measured using a calibrated pH meter. For analysis, a 1% aqueous solution of the gel was prepared, and the pH was recorded to ensure suitability for skin application.[14]

Table 4: pH Determination

Batch	F1	F2
pH	5.8	6.3

3. Homogeneity

Homogeneity was assessed through visual inspection of the gel samples. The formulations were checked for uniform texture and even distribution of ingredients. Any presence of coarse particles, phase separation, or color inconsistency was recorded.

4. Spreadability

Spreadability was determined by placing one gram of gel between two glass plates and applying a standard weight. The ease with which the gel spread after 24 hours was measured to evaluate its application properties on the skin.[15]

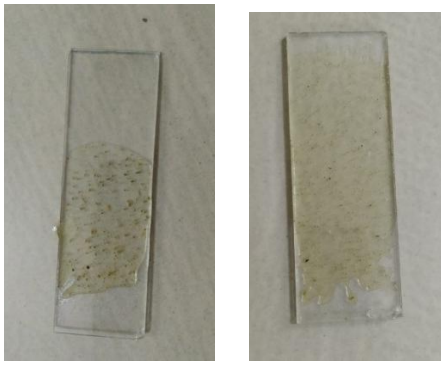


Fig 6 : F1 and F2 Batch Spreadability Test

5. Viscosity

The viscosity of the gel formulations was measured using a Brookfield viscometer at 10 rpm with spindle number 4. This test helped in determining the flow behavior and consistency of the prepared gels.[16]

6. Skin Irritation Test

A patch test was performed to assess the safety of the formulation. A small quantity of gel was applied to a limited area of skin, typically on the forearm or back, and observed for signs of irritation such as redness, itching, or swelling.

7. Antimicrobial Test

Agar Well Diffusion Method

In this method, a sterile agar plate is prepared and uniformly inoculated with the test microorganism. Wells are then created in the agar, and the test substance is introduced into these wells. The plates are incubated at 37°C for 18–24 hours to allow microbial growth and diffusion of the substance. After incubation, the presence of a clear zone around the well indicates antimicrobial activity, and the size of this zone reflects the effectiveness of the test compound.[17]

Fig.7 Agar Well Diffusion

Results and Discussion

Two formulations of Tridax procumbens gel (F1 and F2) were successfully prepared and evaluated for their physicochemical properties. The evaluation revealed noticeable differences between the two batches based on composition.The F1 formulation showed a dark green color with a partially gel-like appearance, indicating incomplete gel formation. In contrast, the F2 formulation exhibited a uniform green color and proper gel consistency, suggesting better polymer hydration and gel structure. Both formulations were free from grittiness and demonstrated satisfactory texture, allowing easy application on the skin. The odor of F1 was mild, whereas F2 showed a more acceptable rose-like odor, which may improve patient compliance. The improved characteristics of F2 can be attributed to the higher concentration of Carbopol, which enhances viscosity and gel formation, as well as the increased amount of Tridax procumbens powder, which contributes to therapeutic activity.

Although exact values for pH, viscosity, and spreadability were not specified, both formulations are expected to fall within acceptable limits for topical preparations. However, due to better consistency and composition, F2 is likely to exhibit improved spreadability, stability, and overall performance.

Conclusion

Based on the formulation and evaluation of the two batches (F1 and F2) of Tridax procumbens gel, a comparative assessment can be drawn from the observed parameters: Both formulations were successfully prepared using Carbopol as a gelling agent and showed acceptable physical characteristics. F1 batch exhibited a partially gel-like appearance, dark green color, and mild odor, indicating comparatively lower consistency and aesthetic appeal. F2 batch showed a proper gel consistency, green color, and a more pleasant odor, making it more acceptable for topical application. Both batches were free from grittiness and showed good texture and ease of application. The higher concentration of Tridax powder and Carbopol in F2 contributed to improved gel structure, better homogeneity, and likely enhanced antimicrobial and wound healing potential. Although specific values for pH, viscosity, and spreadability are not provided, the composition of F2 suggests better stability, viscosity, and spreadability compared to F1. F2 formulation was found to be superior to F1 in terms of appearance, consistency, and overall performance. The increased concentration of active ingredient (Tridax procumbens) in F2 likely enhances its antimicrobial activity and wound healing effectiveness. Therefore, F2 can be considered the optimized formulation for further studies and potential therapeutic use.

The study concludes that Tridax procumbens gel is a promising herbal formulation, and among the two batches, F2 demonstrated better pharmaceutical and functional properties, making it more suitable for topical wound healing and antimicrobial applications.

Acknowledgement

I would like to express my sincere gratitude to my project guide for their continuous guidance, valuable suggestions, and encouragement throughout the course of this research work on the formulation and evaluation of *Tridax procumbens* gel. Their support played a crucial role in the successful completion of this study. I am also thankful to the faculty members of the Department of Pharmacy for their constant assistance, technical support, and insightful feedback during the research process. Their expertise greatly contributed to improving the quality of this work. I extend my heartfelt thanks to the laboratory staff for providing the necessary facilities, materials, and cooperation required to carry out the experimental work smoothly. I would also like to acknowledge my institution for providing the infrastructure and resources essential for completing this research. Finally, I am deeply grateful to my family and friends for their encouragement, understanding, and moral support throughout the study.

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How to cite this article:
Shruti Alasandkar et al. Ijppr.Human, 2026; Vol. 32 (5): 122-131.
Conflict of Interest Statement: All authors have nothing else to disclose.

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