

“A Review on the Formulation and Evaluation of Wound Healing Antimicrobial Gel Using Banana Peel Extract and Turmeric”

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ABSTRACT:

Wound healing is a dynamic and complex biological process involving a series of coordinated events such as inflammation, tissue proliferation, collagen synthesis, and remodeling of damaged skin tissue. The presence of microbial infection at the wound site often delays the healing process and may lead to complications such as chronic wounds or tissue necrosis. In recent years, there has been growing interest in the use of herbal and plant-based formulations for wound management due to their safety, biocompatibility, cost-effectiveness, and minimal side effects when compared to synthetic drugs. Natural products containing bioactive phytoconstituents such as flavonoids, tannins, phenolic compounds, and alkaloids are known to exhibit significant antimicrobial, antioxidant, and anti-inflammatory activities that promote faster tissue regeneration.

Banana peel (*Musa paradisiaca*) is an agro-waste material rich in polyphenols, flavonoids, and vitamins that contribute to antimicrobial action and enhance collagen formation at the wound site. Turmeric (*Curcuma longa*), on the other hand, contains curcumin as its major active constituent, which possesses potent antimicrobial, antioxidant, and anti-inflammatory properties that aid in reducing microbial load and accelerating epithelialization. The combination of banana peel extract and turmeric in a topical gel formulation may provide a synergistic effect by preventing infection while simultaneously promoting tissue repair and wound contraction.

The present review focuses on the formulation and evaluation of an antimicrobial herbal gel incorporating banana peel extract and turmeric for effective wound healing activity. The developed gel formulation can be evaluated on the basis of various physicochemical parameters such as pH, viscosity, spreadability, homogeneity, and stability, along with biological parameters including antimicrobial activity and wound contraction

studies. The findings from various studies suggest that such polyherbal gel formulations have the potential to serve as a promising alternative to conventional wound healing therapies by enhancing healing rate and minimizing the risk of infection.

Keywords: Wound Healing, Banana Peel Extract, Turmeric, Antimicrobial Gel, Herbal Formulation, Curcumin

I. INTRODUCTION:

Skin serves as the first line of defense of the human body against external injuries and microbial infections. Any damage to the skin due to cuts, burns, or abrasions leads to the formation of wounds, which require a proper healing process to restore normal tissue structure and function. Wound healing is a complex biological process involving inflammation, tissue formation, and remodeling. However, the presence of microorganisms at the wound site can delay healing and increase the risk of infection.

Conventional wound treatment methods mainly rely on synthetic antimicrobial agents, which may cause side effects such as skin irritation and microbial resistance after prolonged use. This has increased the demand for natural and plant-based alternatives for wound management. Medicinal plants contain bioactive compounds like flavonoids, tannins, and phenolic substances that exhibit antimicrobial, antioxidant, and anti-inflammatory properties essential for faster tissue regeneration.

Banana peel (*Musa paradisiaca*) is rich in polyphenols and flavonoids that contribute to antimicrobial activity and enhance collagen formation. Turmeric (*Curcuma longa*) contains curcumin, a potent bioactive compound known for its antimicrobial and anti-inflammatory effects that promote wound contraction and epithelialization.

Topical gels are widely used for wound treatment due to their ease of application and controlled drug release. Therefore, the formulation of an antimicrobial gel containing banana peel extract and turmeric may provide an effective and safe alternative for enhancing wound healing and preventing microbial infection.

BANANA PEEL

Biological Source: Banana peel is obtained from the fruit of *Musa paradisiaca* belonging to the family Musaceae

Description



Banana peel is generally considered an agricultural waste product; however, it is a rich source of biologically active compounds that possess significant medicinal properties. It contains various phytoconstituents such as flavonoids, tannins, glycosides, phenolic compounds, and saponins, which are known to exhibit antimicrobial and antioxidant activities.

Chemical Constituents

Banana peel contains:

- Polyphenols
- Flavonoids
- Tannins
- Vitamin C
- Dopamine
- Lutein
- Carotenoids

These compounds play an important role in protecting tissues from oxidative damage and microbial infection.

Role in Wound Healing

The presence of antioxidant compounds in banana peel helps in reducing oxidative stress at the

wound site. It also promotes collagen synthesis and enhances fibroblast activity, which are essential for tissue regeneration. The antimicrobial properties of banana peel inhibit the growth of pathogenic microorganisms and prevent infection, thereby accelerating the wound healing process

BANANA PEEL EXTRACT

Banana peel extract is prepared by drying and pulverizing the peel followed by extraction using suitable solvents such as ethanol or methanol. The extract contains concentrated phytoconstituents responsible for its therapeutic activity.

Pharmacological Activities

Banana peel extract exhibits:

- Antimicrobial activity
- Anti-inflammatory effect
- Antioxidant property
- Tissue regenerative potential

These properties contribute to faster wound contraction and epithelialization. The extract also enhances granulation tissue formation and increases the tensile strength of the healing tissue.

Importance in Gel Formulation

Incorporation of banana peel extract into a topical gel formulation allows localized delivery of active phytochemicals at the wound site. This improves the healing rate by minimizing microbial growth and stimulating collagen formation.

METHOD OF EXTRACTION

Extraction of Banana Peel: Fresh banana peels of *Musa paradisiaca* are collected and washed thoroughly with distilled water to remove dirt and impurities. The peels are then shade-dried for several days until complete removal of moisture takes place. The dried peels are ground into a coarse powder using a mechanical grinder.

The powdered material is subjected to solvent extraction using ethanol by the maceration method. In this process, the powder is soaked in ethanol for about 48–72 hours with occasional stirring to ensure proper extraction of phytoconstituents. The mixture is then filtered using filter paper, and the filtrate obtained is concentrated by evaporating the solvent at room temperature. The concentrated extract is stored in an airtight container for further use in gel formulation.

TURMERIC

Biological Source: Turmeric is obtained from the dried rhizomes of *Curcuma longa* belonging to the family Zingiberaceae.

Description: Turmeric is a widely used medicinal plant known for its therapeutic properties in traditional medicine. It contains curcumin as its principal active constituent, which is responsible for its pharmacological effects.



Chemical Constituents

Turmeric contains:

- Curcumin
- Demethoxycurcumin
- Bisdemethoxycurcumin
- Volatile oils
- Proteins
- Resins

Role in Wound Healing

Curcumin exhibits strong antimicrobial, anti-inflammatory, and antioxidant properties. It helps in reducing inflammation and prevents microbial infection at the wound site. Turmeric also enhances fibroblast proliferation, promotes collagen deposition, and supports the formation of new epithelial tissue.

Importance in Gel Formulation

Incorporation of turmeric in gel formulations provides a protective barrier against microbial invasion and supports faster wound contraction. It also improves tissue remodeling and accelerates the overall healing process.

Extraction of Turmeric:

Dried rhizomes of *Curcuma longa* are collected and cleaned to remove any foreign particles. The rhizomes are dried and finely powdered using a grinder. The powdered turmeric is extracted using ethanol as a solvent through the maceration process.

The powder is soaked in ethanol for 48 hours with intermittent shaking to facilitate the

release of active constituents such as curcumin. The extract is filtered and concentrated by allowing the solvent to evaporate. The obtained extract is preserved in a closed container for further formulation of antimicrobial gel.

MORPHOLOGY

Banana (*Musa paradisiaca*):

Banana is a perennial herbaceous plant that grows from an underground rhizome. The plant consists of a pseudostem formed by tightly packed leaf sheaths. The leaves are large, broad, and elongated with parallel venation. The fruit is elongated and fleshy, covered by a thick outer peel which is usually green when unripe and turns yellow upon ripening. The banana peel is soft, fibrous, and contains several bioactive compounds beneficial for medicinal purposes such as wound healing.

Turmeric (*Curcuma longa*):

Turmeric is a perennial rhizomatous herb characterized by underground stems known as rhizomes. The rhizomes are cylindrical, branched, and yellowish-brown in color externally with a bright orange-yellow interior. The plant bears large oblong leaves with a smooth surface and parallel venation. The rhizome possesses a characteristic aromatic odor and slightly bitter taste due to the presence of curcumin, which contributes to its medicinal properties.

II. MATERIALS AND METHODOLOGY

Materials Required

- Fresh banana peel (*Musa paradisiaca*)
- Turmeric powder (*Curcuma longa*)
- Carbopol 940 (gelling agent)
- Propylene glycol (humectant)
- Methyl paraben (preservative)
- Triethanolamine (pH adjuster)
- Distilled water
- Ethanol (solvent)

All the chemicals used in the formulation were of analytical grade.

Methodology

Preparation of Banana Peel Extract

Fresh banana peels were collected and washed thoroughly with distilled water to remove dirt and impurities. The peels were shade-dried for several days and then ground into a coarse powder using a mechanical grinder. The powdered material was subjected to maceration with ethanol for 48–72 hours with occasional stirring. The mixture was

filtered, and the filtrate was concentrated by evaporation of the solvent at room temperature. The obtained extract was stored in an airtight container for further use.

Preparation of Turmeric Extract

Dried turmeric rhizomes were cleaned, dried, and powdered. The powdered material was soaked in ethanol for 48 hours with intermittent shaking. The mixture was filtered, and the solvent was allowed to evaporate to obtain the concentrated extract. The extract was preserved in a closed container until further use.

Preparation of Herbal Gel

Carbopol 940 was dispersed in distilled water and allowed to hydrate for a few hours. The required quantity of banana peel extract and turmeric extract was added to the hydrated gel base with continuous stirring. Propylene glycol and methyl paraben were added to the mixture and mixed uniformly. Finally, triethanolamine was added dropwise to adjust the pH and obtain the desired consistency of the gel. The prepared gel was transferred into suitable containers for further evaluation.

1. Fayaz et al. (2019),Journal:Processes Journal (MDPI)

Topic: Antimicrobial and Antifungal Activity of Musa paradisiaca Peel Extract

Short Abstract:

The study evaluated the antimicrobial potential of methanolic banana peel extract against various bacterial and fungal strains. The extract showed significant inhibitory effects against both Gram-positive and Gram-negative bacteria such as *E. coli* and *Staphylococcus aureus*. The presence of phenolic and flavonoid compounds was identified as the main reason for its antimicrobial activity.

2. K. Alisi et al. (2021),Journal:Bulletin of the National Research Centre **Topic:** Antibacterial Activity of Banana Peel Extract Against Periodontal Pathogens

Short Abstract:

This research focused on assessing the antibacterial effectiveness of alcoholic banana peel extract against oral pathogens. The results indicated inhibition of *Porphyromonas gingivalis* and *Aggregatibacter actinomycetemcomitans*. The findings support the potential use of banana peel

extract as a natural antimicrobial agent in oral healthcare products.

3. Bankar et al. (2016),Journal:Contemporary Clinical Dentistry

Topic: In-Vitro Antimicrobial Activity of Banana Peel Extract on Oral Pathogens

Abstract:

The study investigated the antimicrobial action of banana peel extract against oral disease-causing microorganisms. Significant microbial growth inhibition was observed in treated samples. The activity was mainly attributed to bioactive phytochemicals present in the peel extract.

4. S. M. Kiran et al. (2020),Journal:International Journal of Life Sciences **Topic:** Antibacterial Activity of Musa acuminata Peel Against Gram-Positive Bacteria

Abstract:

This study examined the antibacterial activity of banana peel extract against Gram-positive bacterial strains. The extract demonstrated effective inhibition against organisms like *Bacillus cereus* and *Streptococcus pyogenes*. The antimicrobial activity was associated with tannins and flavonoids found in the peel.

5. G. N. Akinyemi et al. (2022),Journal:Research Journal of Pharmaceutical Technology **Topic:** Evaluation of Antibacterial Activity of Banana Peel Methanolic Extract

Abstract:

The antibacterial activity of methanolic banana peel extract was tested against *Escherichia coli* and *Staphylococcus aureus*. A measurable zone of inhibition was observed, indicating its effectiveness in preventing bacterial growth. The study highlighted its possible application in pharmaceutical formulations.

6. Gupta et al. (2020),Journal:Journal of Applied Pharmaceutical Science

Topic: Antibacterial and Antibiofilm Activity of Curcuma longa Extract

Abstract:

This research evaluated the antibacterial and antibiofilm properties of turmeric extract against pathogenic bacteria. The extract effectively inhibited microbial growth and prevented biofilm formation. Curcumin was identified as the major compound responsible for antimicrobial action.

7. Prasad &Tyagi (2015),Journal:International Journal of Pharma Sciences

Topic: Antimicrobial Activity of Curcumin Against Oral Pathogens

Abstract:

Curcumin extracted from turmeric was tested against oral pathogens using the agar diffusion method. The results showed significant inhibition of bacterial growth including *Streptococcus mutans*. This suggests its usefulness in natural antimicrobial formulations.

8. Khan et al. (2023),Journal:Materials Today Proceedings

Topic: Green Synthesized Nanoparticles Using Turmeric Extract and Antibacterial Study

Abstract:

The study examined nanoparticles synthesized using turmeric extract for antibacterial activity. The synthesized particles showed effective inhibition against bacteria such as *Klebsiellapneumoniae* and *Staphylococcus aureus*. Enhanced antimicrobial activity was observed due to improved interaction with microbial cells.

9. Mahady et al. (2002),Journal:Antimicrobial Agents and Chemotherapy

Topic: Antimicrobial Effect of Turmeric Extract on *Helicobacter pylori*

Abstract:

This study evaluated turmeric extract against gastric pathogen *Helicobacter pylori*. A dose-dependent inhibition of bacterial growth was observed. The findings suggested turmeric extract could be used along with conventional antibiotics.

10. Rai et al. (2008),Journal:Indian Journal of Pharmaceutical Sciences

Topic: Antibacterial Activity of Turmeric Extract Against Pathogenic Bacteria

Abstract:

Turmeric extract was assessed for antibacterial activity against different pathogenic microorganisms.. The study supports the use of turmeric in herbal medicinal formulations.

III. DISCUSSION:

This review highlights the potential use of plant-based extracts such as banana peel obtained from *Musa paradisiaca* and turmeric derived from

Curcuma longa in the formulation of an antimicrobial wound healing gel.

Banana peel extract contains bioactive compounds like flavonoids, tannins, phenols, and alkaloids that contribute to antimicrobial and anti-inflammatory activities by inhibiting the growth of pathogenic microorganisms. It has shown effectiveness against bacteria such as *Staphylococcus aureus* and *Escherichia coli*, which are commonly associated with wound infections.

Turmeric extract, due to the presence of curcumin, exhibits strong antimicrobial, antioxidant, and anti-inflammatory properties. It promotes collagen synthesis, reduces oxidative stress, and enhances tissue regeneration, thereby accelerating the wound healing process.

The combined use of banana peel and turmeric extracts in gel formulation may provide a synergistic antimicrobial effect. The gel form offers advantages such as ease of application, localized drug delivery, and improved patient compliance. Therefore, herbal gel formulations prepared using these natural extracts may serve as a safe and cost-effective alternative to synthetic antimicrobial agents.

IV. CONCLUSION:

In conclusion, the formulation of an antimicrobial wound healing gel using banana peel extract obtained from *Musa paradisiaca* and turmeric derived from *Curcuma longa* demonstrates significant potential in the development of effective herbal wound care products. These natural extracts contain various bioactive compounds that exhibit antimicrobial, antioxidant, and anti-inflammatory properties, which help in preventing microbial infection, reducing inflammation, and promoting tissue regeneration at the wound site. The incorporation of these plant-based ingredients into a topical gel formulation enhances ease of application, localized drug delivery, and patient compliance. Therefore, herbal gel formulations prepared from banana peel and turmeric extracts may serve as a safe, economical, and efficient alternative to synthetic antimicrobial agents used in wound management. However, further in-vitro and in-vivo studies are required to validate the safety and therapeutic efficacy of the formulation for clinical use.

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