FORMULATION AND EVALUATION OF BANANA SAP GEL FOR WOUND HEALING

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Abstract:*The present study focused on the development and evaluation of a topical gel containing banana pseudo stem sap for wound-healing purposes. The sap was formulated using a Carbopol gel base and assessed for physicochemical characteristics and antimicrobial efficacy. The results demonstrated good stability and notable antibacterial activity, validating its traditional application in wound care.*

Methods*: Fresh sap was obtained from the Poovan variety of* Musa paradisiaca*, filtered, and stabilized before formulation. The stabilized sap was incorporated into a Carbopol 940 gel base using appropriate pharmaceutical excipients. The formulated gel was evaluated for physicochemical parameters including appearance, pH, viscosity, and homogeneity. Antimicrobial efficacy was determined by the agar well diffusion method against* Staphylococcus aureus *and* Escherichia coli*. Microbial quality was assessed through microbial limit testing in accordance with the Indian Pharmacopoeia.*

Conclusion*: The findings indicate that banana sap can be effectively formulated into a stable topical gel exhibiting notable antimicrobial activity. These results validate its traditional use in wound healing and suggest that the formulation holds promise as a safe, economical, and natural herbal wound-care product, meriting further pharmacological and clinical investigations.*

Keywords: Banana sap, topical gel, herbal formulation, wound healing, antimicrobial activity

INTRODUCTION

Traditional medicinal practices have long been employed for the treatment of wounds and skin disorders, particularly in developing regions where herbal remedies continue to serve as a primary source of healthcare. Wound healing is a multifaceted physiological process involving stages such as inflammation, tissue proliferation, and remodelling. The presence of microbial infection can significantly impair this process, highlighting the importance of topical therapeutic agents that possess both antimicrobial and protective properties. In recent years, herbal formulations have gained increased interest due to their perceived safety, cost-effectiveness, and widespread cultural acceptance.

Banana (Musa paradisiaca, Family: Musaceae) is a commonly cultivated plant in tropical and subtropical climates and holds a prominent place in traditional Indian medicine. Different parts of the plant—including the fruit, leaves, roots, and pseudo stem—are known to exhibit medicinal properties. The sap extracted from the banana pseudo stem has been traditionally used for wound treatment, particularly for controlling bleeding and enhancing tissue repair. Ethno medicinal evidence suggests that banana sap possesses antimicrobial, anti-inflammatory, and haemostatic activities. However, the direct use of fresh sap presents several challenges, such as rapid oxidation, limited shelf life, unpleasant odor, and a high risk of microbial contamination.

To overcome these limitations, it is necessary to incorporate traditional herbal substances into modern pharmaceutical dosage forms that improve stability, safety, and patient compliance. Topical gel formulations are especially suitable for wound management due to their non-greasy nature, ease of application, extended residence time at the site of action, and compatibility with aqueous herbal extracts. Despite the traditional importance of banana sap, scientific documentation on its formulation into a stable topical gel and systematic evaluation is scarce. Hence, the present study aimed to develop a banana sap–based topical gel and to assess its physicochemical properties, antimicrobial efficacy, and microbial quality, thereby providing scientific support for its traditional wound-healing applications.

Fig no: 01 Banana sap

Taxonomical classification:

Kingdom: Plantae

Division: Angiosperms

Class: Monocotyledonae

Order: Zingiberales

Family: Musaceae

Genus:*Musa*

Vernacular Name:

English: Banana

Tamil: Poovan Pazham

Malayalam: Poovan Pazham

Telugu: Poovan Arati

Kannada: Poovan Bale

Hindi: Kela

MATERIALS AND METHODS

Fresh banana pseudostem sap served as the active herbal ingredient in the formulation. Carbopol 940, glycerin, propylene glycol, triethanolamine (TEA), and methyl paraben were obtained from reputable suppliers and were of analytical grade. Microbiological media, including nutrient agar, Mueller–Hinton agar, and Sabouraud dextrose agar, along with sterile normal saline, were also of analytical grade. All other chemicals and reagents used in the study met analytical-grade standards.

Collection and Stabilization of Banana Sap

Fresh sap was obtained by making an incision in the banana pseudo stem and collecting the exudate in a sterile container. The sap was initially passed through muslin cloth and subsequently filtered using Whitman filter paper to eliminate fibrous and particulate matter. To improve stability, the filtered sap was subjected to mild heat treatment in a water bath maintained at 60–65 °C for 10–15 minutes. The stabilized sap was then allowed to cool to ambient temperature and was used immediately for gel preparation.

Preparation of Banana Sap Gel

Carbopol 940 (1.25 g) was gradually dispersed in 40–45 mL of distilled water with continuous gentle stirring and allowed to swell for 1–2 hours to ensure complete hydration. Glycerin (7.5 mL) and propylene glycol (5 mL) were then incorporated and mixed thoroughly to obtain a uniform base. Stabilized banana sap (10 mL) was added slowly with constant stirring. Methyl paraben (0.1 g), previously dissolved in warmed propylene glycol, was incorporated as a preservative. Neutralization was carried out by the drop wise addition of triethanolamine until a transparent gel with a skin-friendly pH range of 5.5–6.8 was achieved. Finally, the volume was made up to 100 mL using distilled water.

Fig no: 02 Banana Sap Gel

EVALUATION OF BANANA SAP GEL

Physical Evaluation

The formulated banana sap gel was examined visually for colour, clarity, homogeneity, and consistency. The formulation was found to be smooth, homogeneous, free from grittiness, and non-greasy in nature, indicating uniform dispersion of the active constituents.

PH Determination

The pH of the formulated gel was determined using a calibrated digital pH meter at room temperature. About 1 g of gel was dispersed in distilled water and the pH was recorded. The pH of the gel was found to be within the skin-compatible range, indicating suitability for topical application.

Viscosity Measurement

The viscosity of the banana sap gel was measured using a suitable viscometer at room temperature. The gel exhibited appropriate viscosity, ensuring easy application and adequate retention at the site of application.

Spread ability

Spread ability of the gel was determined by placing a fixed quantity of gel between two glass slides and applying a known weight. The time taken for the slides to separate was noted. The formulation showed good spread ability, which is essential for uniform application over the skin surface.

Homogeneity

The gel was tested for homogeneity by visual inspection after filling into containers. No lumps or aggregates were observed, indicating uniform distribution of ingredients.

Stability Observation

The formulated gel was observed for physical stability at room temperature for a short period. No significant changes in colour, consistency, or phase separation were observed, indicating acceptable stability of the formulation.

ANTIMICROBIAL ACTIVITY OF BANANA SAP GEL

Test Microorganisms

Two bacterial strains were selected for the antimicrobial evaluation. Standard cultures of *Staphylococcus aurous* and *Escherichia coli* were procured from the Microbial Type Culture Collection (MTCC), Institute of Microbial Technology, and Chandigarh, India. These organisms were used throughout the study to assess antibacterial efficacy.

Antibacterial Assay

i. Preparation of Inoculum

Stock cultures of the test organisms were preserved on nutrient agar slants at 4 °C. For experimental use, a loopful of each culture was transferred aseptically into test tubes containing Mueller–Hinton broth (MHB) and incubated at 37 °C for 24 hours without shaking. The resulting cultures were diluted with fresh MHB to obtain a standardized bacterial suspension with an approximate concentration of 2.0×10^6 colony-forming units (CFU/mL), as described in standard protocols.

ii. Preparation of Sterile Swabs

Cotton swabs mounted on wooden or plastic applicators were prepared and sterilized prior to use. Sterilization was achieved either by autoclaving or, in the case of wooden swabs, by dry heat. The swabs were packed in culture tubes, paper wraps, or metal containers to maintain sterility until use.

iii. Sterilization of Forceps

Forceps used during the assay were sterilized by immersing them in alcohol followed by flaming to burn off the alcohol before each use.

Antibacterial Activity by Agar Well Diffusion Method

The agar well diffusion technique was employed to evaluate the in vitro antibacterial activity of the banana sap gel. Mueller–Hinton agar (MHA) obtained from Hi media (Mumbai, India) was used as the culture medium. Approximately 15 mL of molten MHA was poured into sterile Petri plates and allowed to solidify. The surface of the agar was uniformly inoculated with 0.1 mL of the standardized bacterial suspension using sterile swabs and allowed to dry for 5 minutes. Wells were then aseptically bored into the agar, and 20 µL of different concentrations of the test formulation were introduced into the wells. The plates were incubated at 37 °C for 24 hours. Antibacterial activity was determined by measuring the diameter of the zone of inhibition around each well, following NCCLS guidelines (1993). Chloramphenicol discs were used as a positive control.

Table no: 01 ZONE OF INHIBITION (MM)

S. NO	MICRO ORGANISMS	ZONE OF INHIBITION (MM)				
		25µl	50µl	75µl	100 µl	STD
Gram positive bacteria						
1	*Staphylococcus aurous*	7	9	14	17	23
Gram negative bacteria						
2	*Escherichia coli*	5	11	16	19	25

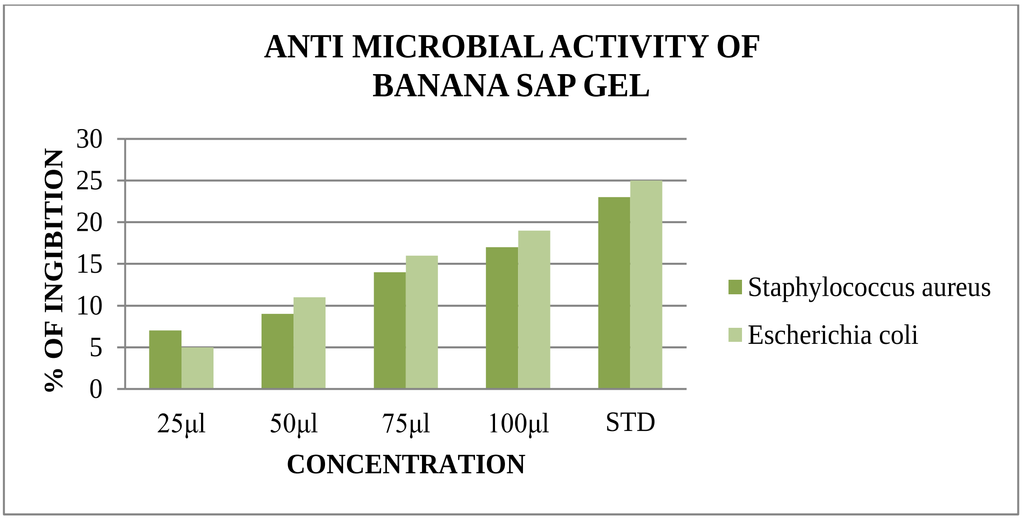
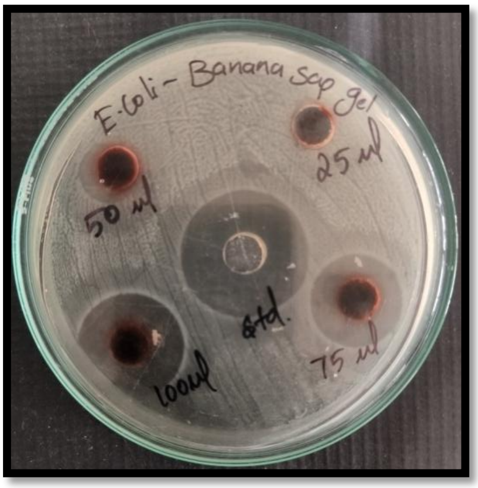


Fig no 03: ANTI MICROBIAL ACTIVITY OF BANANA SAP GEL



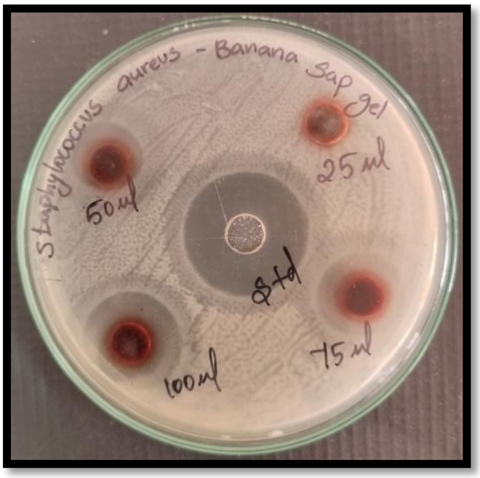


Fig no :04 Escherichia coli *Fig no: 05 Staphylococcus aureus*

Conclusion

The banana sap–based gel showed notable antibacterial activity against key wound-related microorganisms, demonstrating its ability to suppress bacterial proliferation. The results substantiate the traditional medicinal use of banana sap in wound treatment and suggest that the formulation may serve as a safe, economical, and naturally derived topical antimicrobial agent.

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