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Waste to Wound Care: Transforming Banana Peels into Burn Cream by the Minasari Farming Community in Jemur Wonosari, Surabaya

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Abstrak

Pemanfaatan kulit pisang sebagai bahan alami penyembuh luka bakar ringan dan agen antimikroba menjadi topik yang semakin relevan, terutama di tengah meningkatnya kesadaran terhadap pengobatan tradisional berbasis tanaman. Penelitian ini mengeksplorasi kandungan bioaktif dalam kulit pisang seperti *flavonoid*, tanin, dan *polifenol* yang berperan dalam mempercepat penyembuhan luka dan mencegah infeksi mikroba. Melalui pendekatan pengabdian masyarakat di Kelurahan Jemur Wonosari, Surabaya, kegiatan ini dirancang agar dapat direplikasi secara mandiri oleh masyarakat dengan menggunakan bahan dan alat rumah tangga. Prosedur pembuatan krim luka dari kulit pisang melibatkan tahap pembersihan, pemanasan bersama minyak kelapa murni atau sejenisnya, dan penambahan madu alami sebagai agen antibakteri tambahan. Hasilnya menunjukkan bahwa kulit pisang berpotensi secara signfikan sebagai krim luka alami dengan aktivitas antimikroba dan antioksidan, sekaligus mendukung prinsip ekonomi sirkular melalui pemanfaatan limbah pertanian. Penelitian lebih lanjut diperlukan untuk standarisasi formulasi dan validasi klinis penggunaan salep kulit pisang ini dalam skala luas.

Abstract

The utilization of banana peels as a natural remedy for minor burn wound healing and antimicrobial activity has garnered increasing attention amidst the growing interest in plant-based traditional medicine. This study investigated the bioactive components present in banana peels, including flavonoids, tannins, and polyphenols, which contribute to wound healing and the prevention of infections. Conducted as a community engagement initiative in Jemur Wonosari Sub-district, Surabaya, the activity was designed to be replicable at the household level using simple tools and locally available materials. The preparation process involved cleaning the peels, heating them with virgin coconut oil, and optionally adding natural honey to enhance antibacterial properties. Findings highlight the potential of banana peels as an effective natural burn ointment with antimicrobial and antioxidant properties, while also supporting circular economy principles through the utilization of agricultural waste. Further research is needed to standardize formulations and clinically validate the widespread use of ointments based on banana peels.

INTRODUCTION

The growing interest in natural remedies and alternative treatments for various ailments has led to an investigation into materials that are traditionally regarded as waste. In Indonesia, the banana plant (Musa spp.) is prevalent across agricultural landscapes, yielding a significant amount of waste, particularly banana peels. Typically discarded, banana peels contain

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various bioactive compounds, including polyphenols, flavonoids, tannins, and alkaloids, which are recognized for their potential medicinal applications, particularly in wound healing and antimicrobial activities (Cartika *et al.*, 2023; Kurniawan *et al.*, 2021; Sari, 2024). Therefore, this paper explored the utilization of banana peels as a natural remedy for wound healing, specifically in burn treatments, alongside their antimicrobial properties. The healing process of burn wounds is intricate and can be hampered by infection. Thus, it is crucial to utilize materials that can promote healing while also protecting against microbial invasions. Several studies highlight the effectiveness of banana peel extracts in enhancing wound healing by not only accelerating the repair of damaged tissues but also serving as an antimicrobial agent (Ferreira *et al.*, 2022; Maulidya *et al.*, 2020). The rich composition of banana peels contributes to both antioxidant activity and antibacterial properties, making them a valuable resource for treating wounds (Amanah *et al.*, 2024; Kurniawan *et al.*, 2023). Research conducted by (Maulidya *et al.*, 2020 demonstrated that ethanol extracts from Muli banana peels effectively promoted wound healing in mice, indicating a significant reduction in healing time compared to control treatment. The ability of banana peels to support healing processes can be attributed to their antioxidant properties, which mitigate oxidative stress that often exacerbates inflammation and slows recovery (Abdel-Rahman *et al.*, 2017; Amanah *et al.*, 2024). Additionally, the high tannin content within banana peels contributes to their astringent properties, which help in coagulation and reducing bacterial loads in wounds (Kurniawan and Zahra 2021; Brown *et al.*, 2023). (Moreover, Aly *et al.*, 2017 exhibited the comparative effectiveness of various fruits' peels, including bananas, highlighting their role as natural antioxidants, which are crucial for protecting skin integrity during wound healing. Furthermore, (Franco *et al.*, 2017) showed the schematic of gels derived from banana peel could potentially serve as effective wound dressings due to their sustained release of antimicrobial compounds. Their findings align with traditional uses of banana peels observed in various cultures, including Indonesian folklore, wherein banana peels were utilized for burns and cuts, validating the contemporary exploration of such traditional applications (Cardoso *et al.*, 2017). The multifaceted usage of banana peels not only addresses health concerns but also contributes to environmental sustainability by reducing agricultural waste. This utilization aligns with circular economy principles by transforming waste into valuable health-promoting products (Rasmuin, 2021). With this backdrop, Indonesia's rich crop of banana varieties presents an unique opportunity to develop bioactive, cost-effective treatments for wound management, enhancing healthcare practices in rural and urban settings alike. The ongoing research into the antimicrobial properties of banana peels is also paramount, as infections remain a significant cause of morbidity in burn wounds. The natural compounds found in banana peels have shown efficacy against common bacterial strains involved in wound infections, including Staphylococcus aureus and Escherichia coli (Abdel-Rahman *et al.*, 2017; D *et al.*, 2024). This represents a dual benefit of utilizing banana peels not only for their healing capabilities but also in combating the microbial factors that threaten wound recovery. Furthermore, as the emphasis on natural and holistic health solutions continues to grow, the public's acceptance of and preference for plant-based treatments lend further credence to the exploration of banana peel applications. Consumer trends are shifting towards sustainable, non-pharmaceutical products, reinforcing the necessity to validate the efficacy and safety of such traditional remedies through rigorous scientific research (Armi *et al.*, 2023; Kimelvina *et al.*, 2020; Samban *et al.*, 2022). Studies have shown successful formulations in using banana peel extract in the form of creams that are not only effective but also convenient to use and have minimal side effects compared to conventional medicines. The utilization of banana peels in the context of wound burn healing and antimicrobial applications presents an intriguing avenue for further exploration. Future research is required to investigate the specific mechanisms by which banana peel extracts promote healing and inhibit microbial growth, as well as explore the practical implications of incorporating these natural remedies into everyday medical practices.

METHOD

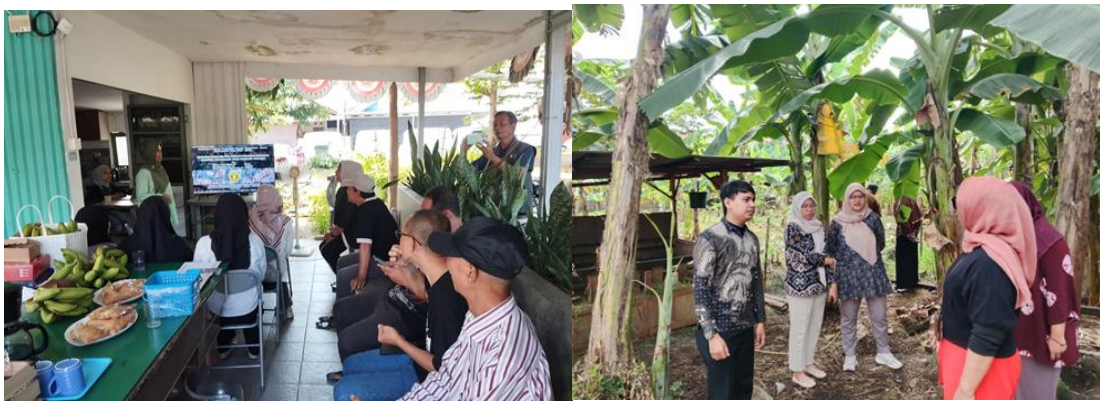
This community engagement activity was designed to be easily replicated by local residents of Jemur Wonosari Sub-district, particularly members of the Minasari Farmers Group, Sutabaya City, East Java, by utilizing banana peel waste as a natural remedy for minor burn wounds. The ingredients used in this household-scale preparation include fresh banana peels

(preferably from plantains due to their high antioxidant and tannin content), boiled water, virgin coconut oil (VCO) or alternatively olive oil such bee wax, and natural honey, which is optional but recommended for its antibacterial properties and its ability to accelerate tissue regeneration. In addition, 70% alcohol is used for sterilizing tools, while sterile gauze is used as a wound dressing. For storing the ointment, sealed glass jars are used, covered with plastic wrap or aluminum foil to maintain product cleanliness. The tools used include a stove or hotplate, a small saucepan or frying pan, a blender or mortar and pestle, and clean cloth strainers such as a tea towel or gauze. The activity also required a stainless-steel mixing bowl, a spatula or wooden spoon for stirring, a spray bottle filled with alcohol, and basic measuring tools such as a kitchen scale and measuring cup. Disposable plastic gloves were also utulized to maintain hygiene throughout the process. Documentation was carried out manually using writing materials and a mobile phone camera. First, the preparation of banana peel ointment was designed as a simple, household-scale process that can be easily replicated by the local community. The first stage involved material preparation, starting with the selection of banana peels from ripe bananas, preferably Musa acuminata (cavendish banana), known for their high antioxidant and tannin content. The entire banana peel was used, including both the yellow outer layer and the inner lining (white, soft portion attached to the pulp). This was done because both parts contain bioactive compounds: the outer peel provides tannins, flavonoids, and anthocyanins with anti-inflammatory and antioxidant effects, while the inner part is rich in polysaccharides and contributes for the moisturization and tissue repair. Any dirty, rotten, or moldy parts were discarded. Additionally, in this community engagement activity, banana peels from various cultivars (such as plantain, kepok, and Cavendish) and at different stages of ripeness are generally suitable for ointment preparation, as they all contain bioactive compounds beneficial for wound healing. Nevertheless, this program specifically employed ripe Cavendish peels. The decision was based on two considerations: first, Cavendish is the dominant banana variety cultivated and consumed in the local area, resulting in abundant peel waste that is often underutilized; second, ripe peels are more readily available from household consumption, making the practice easier for community replication. By focusing on Cavendish peels, the program is not only addressed the biomedical potential of banana peel extracts but also emphasized sustainability by transforming a common agricultural by-product into a value-added material. Second stage was cleaning and formulation. The peels were first washed under running water and soaked in boiled water for 10–15 minutes. After soaking, the peels were cut into small pieces and blended into a smooth paste. This paste was transferred to a saucepan and mixed with virgin coconut oil in a 1:2 ratio (one part peel paste to two parts oil). The mixture was heated over low heat for approximately 15–20 minutes with continuous stirring to avoid overheating and degradation of active compounds. Once cooled to below 40°C, one tablespoon of natural honey was added (optional) to enhance antibacterial and healing properties. The final mixture was filtered using a clean cloth or gauze to remove solids and stored in a sterilized glass jar. Thrid stage was packaging and storage. The filtered oil was poured into a sterilized glass jar that has been disinfected with 70% alcohol. The jar was sealed tightly and stored in a cool, dry place away from direct sunlight. Without preservatives, the ointment can be used for up to one week at room temperature, or for a longer period if refrigerated. Before application, it is recommended to perform a patch test on a small area of skin to check for possible allergic reactions. Last stage was the application of the banana peel ointment for minor burn wounds which was carried out by cleansing the affected skin area with boiled water or a mild antiseptic. After that, a thin layer of the ointment was then applied to the wound, which was covered with sterile gauze and gently wrapped. The dressing should be replaced every 8–12 hours or as needed, depending on the condition of the wound.

RESULT AND DISCUSSION

The community service activity began with the delivery of educational material on the utilization of agricultural waste, particularly banana peels, as a traditional remedy for minor burns. The session aimed to increase awareness among members of the Minasari Farming Group in Jemur Wonosari, Surabaya, about the potential of banana peel as a natural, accessible, and eco-friendly wound treatment. Participants were first introduced to the basic concepts of wound healing which is the role of natural antioxidants such as tannins and flavonoids, and the medicinal properties found in banana peels.

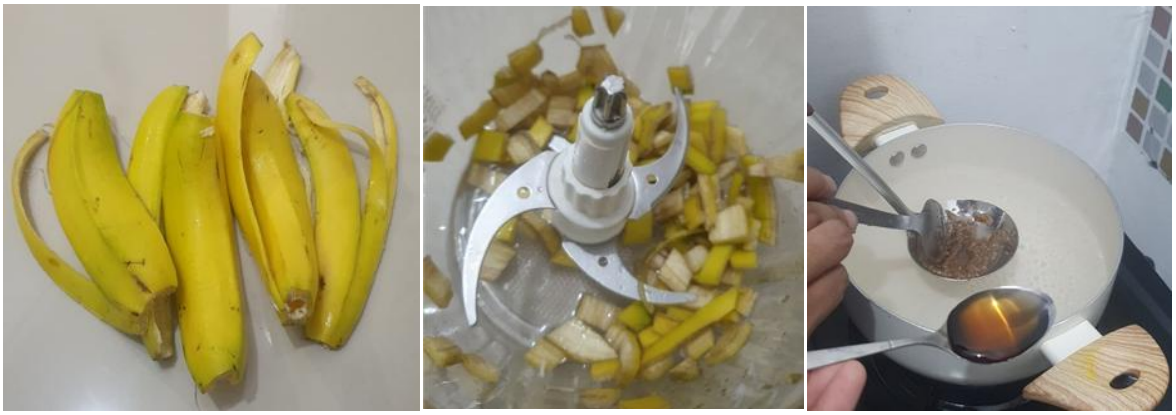
The presentation was interactive, encouraging discussion and question-and-answer sessions to clarify the scientific basis of the formulation. Historically, banana peels have been integrated into various medicinal practices worldwide. For instance, in Brazilian folk medicine, banana peel is reputed for its ability to facilitate wound healing when applied topically, reflecting a rich cultural knowledge surrounding its bioactive properties (Cardoso *et al.*, 2017). The therapeutic potential of banana peel is largely attributed to its unique chemical composition, including phenolic compounds and flavonoids, known for their antioxidant and anti-inflammatory properties (Udayani *et al.*, 2023). Banana peels are recognized as a rich source of essential nutrients and bioactive compounds, which contain for approximately 40% of the mass of the fruit and are abundant in proteins, carbohydrates, vitamins, and minerals (Hariningsih *et al.*, 2022). Studies have indicated that the phenolic compounds found in banana peels, such as flavonoids and tannins, contribute significantly to their therapeutic efficacy in wound healing (D *et al.*, 2024; Zou *et al.*, 2022). The antibacterial mechanism of tannins is attributed to their inhibition of peptidoglycan formation in bacterial cell walls, which compromises structural integrity and suppresses infection (Kurniawan *et al.*, 2023; Kurniawan *et al.*, 2021). Furthermore, the antimicrobial properties of banana peel extracts have been demonstrated, suggesting their utility in preventing wound infections (Dwi *et al.*, 2023; Hamidah *et al.*, 2022). Research highlighted the presence of secondary metabolites in banana peels that are responsible for various therapeutic properties, with phenolic compounds especially noted for their antioxidant potential (Lopes *et al.*, 2017). Secondary metabolites can modulate biochemical pathways associated with wound healing, encompassing processes such as inflammation reduction and cell proliferation enhancement (Maulidya *et al.*, 2020). Before beginning the hands-on practice, participants were invited to observe the local banana plantation managed by the Minasari group. This activity helped participants identify the types of bananas being cultivated, the condition of the plantation, and the volume of banana peel waste typically generated. It also reinforced the relevance of the material by directly connecting the theory to their real farming environment. Previous research has demonstrated that extracts obtained from both unripe and ripe banana peels have promising effects in enhancing wound healing. Nevertheless, the unripe peel extract displayed considerably greater effectiveness. This stronger activity is believed to stem from the elevated levels of bioactive compounds particularly condensed tannins (proanthocyanidins) present in unripe peels (Kumar *et al.*, 2012). These molecules are well known for their strong astringent and antimicrobial actions, which support wound contraction, minimize exudate, and provide a protective layer against microbial invasion, thus creating favorable conditions for the early inflammatory and proliferative stages of tissue repair (Kurniawan *et al.*, 2021). In addition, unripe banana peels contain higher concentrations of total phenolics and flavonoids, which enhance antioxidant defenses at the wound site. This reduces oxidative stress, limits cellular damage, and encourages fibroblast migration as well as collagen synthesis (Perira *et al.*, 2015). During ripening, however, many of these polyphenolic compounds are enzymatically converted into simpler sugars, leading to a decline in astringent and antimicrobial capacity (Someya *et al.*, 2002). As a result, although ripe peel extracts retain some therapeutic value, the evidence consistently supports that unripe peels provide a more potent pharmacological source for developing innovative wound healing agents.



(a) (b)

Figure 1. Education before action (a) presentation material about utilization of banana peel for wound healing; (b) observase the local babana platation by Minasari farming group (Private Documents).

Following the material session, a hands-on workshop was conducted. The facilitator demonstrated the preparation of a traditional burn ointment using fresh banana peels, virgin coconut oil (VCO) or others such as bee wax, and optionally, natural honey. All equipment was sterilized using 70% alcohol, and clean procedures were emphasized to ensure product hygiene. Participants were actively involved in each step, including peeling, blending, heating, straining, and packaging the final product. The session revealed strong enthusiasm among participants, as they recognized the economic and health benefits of utilizing waste material from their own plantations. Moreover, they expressed interest in replicating the process at home and potentially developing it as a small-scale herbal product for community use. Post-activity discussions showed the imporovment of understanding and confidence in processing banana peels into burn cream. Participants also appreciated the added value of waste, turning what was previously discarded into a product with both therapeutic and commercial potential. This program demonstrated the effectiveness of combining scientific education with local empowerment to promote sustainable health practices.

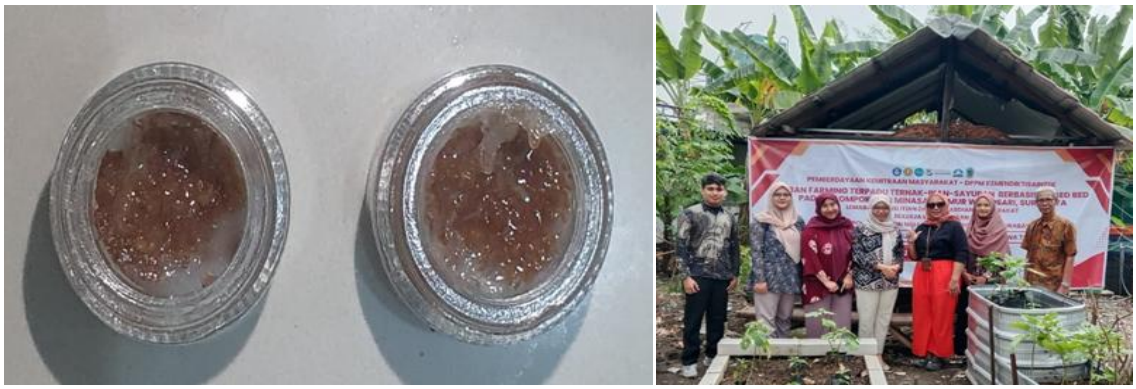


(a) (b) (c)

Figure 2. Banana peel processing sequence (a). example of banana peel to be utilized,; (b) processing and grinding of banana peel; (c) the result of grinded banana peels and added natural honey (Private Documentations).

The mechanisms by which banana peel promotes wound healing involve multiple pathways. For instance, extracts of unripe banana peel have been shown to stimulate cellular proliferation and enhance the incorporation of thymidine into DNA, ultimately aiding in epithelial regeneration (Munir *et al.*, 2023). The anti-inflammatory effects mediated by bioactive compounds in the peel help to minimize tissue damage and accelerate healing processes (Maulidya *et al.*, 2020; Silva *et al.*, 2021). In vivo studies have demonstrated significant wound healing effects when banana peel extracts are administered in animal models. For example, an investigation indicated that Ambon banana peel extract significantly accelerated the healing of cuts and burns in mice, reinforcing the potential for its application in clinical settings (D *et al.*, 2024). This evidence underscores the relevance of traditional knowledge in guiding scientific inquiry into the healing properties of plant-based remedies. The antioxidant capacity of banana peel extracts has been extensively appreciated, contributing to their capability in mitigating oxidative stress at wound sites (Arista *et al.*, 2023; Putra *et al.*, 2022). Zou *et al.*, (2022) also exhibiting the bioactivity of banana by-products, which noting their potential to reduce inflammation through the scavenging of free radicals. Effective management of oxidative stress plays a pivotal role in wound healing, as it prevents damage to cellular components and supports the integrity of the healing process. Moreover, the antimicrobial properties of banana peel have been characterized against various strains of bacteria, including Staphylococcus aureus and Escherichia coli, which are common culprits in wound infections. The inhibition of these pathogens by banana peel extracts highlights its potential as a natural alternative for preventing secondary infections in wounds (Chen *et al.*, 2024) and adds a layer of efficacy to its use in traditional wound care practices. In order to optimize the healing efficacy of banana peel, various extraction methods have been studied. Ethanol extraction has demonstrated a greater yield of bioactive compounds compared to water extraction, enhancing the antimicrobial and antioxidant properties of the final product (Maulidya *et al.*, 2020). Combining banana peel with other natural substances, such as chitosan, has been explored in novel formulations aimed at wound healing,

demonstrating enhanced therapeutic effects due to synergistic interactions (Ferreira *et al.*, 2022). Recent innovations in formulation include the development of nanoemulsions incorporating banana peel extracts, which can enhance the bioavailability of therapeutic compounds when applied topically (D *et al.*, 2024). These advancements signify a fusion of traditional knowledge and modern scientific techniques aimed at improving therapeutic outcomes. While much research emphasizes the benefits of banana peel for wound healing, comparative studies with other traditional and synthetic materials remain limited. Future investigations should seek to elucidate the mechanisms underlying these effects and establish standardized formulations for clinical applications. Furthermore, scaling up the extraction processes while maintaining the integrity of bioactive compounds will be crucial for translating these findings into practical treatments. Banana peel, often regarded as mere agricultural waste, holds untapped potential as a natural remedy for minor burn wounds. Rich in antioxidants, tannins, flavonoids, and essential vitamins, banana peel offers antimicrobial and anti-inflammatory properties that can accelerate skin healing and tissue regeneration. This makes it a promising raw material for producing a traditional, home-scale burn healing cream. For the farming community of Kelompok Tani Minasari in Kelurahan Jemur Wonosari, Surabaya, which cultivates banana plantations as one of its main commodities, utilizing banana peel represents not only an innovative health solution but also an opportunity to reduce organic waste and create added value from agricultural by-products. By transforming this waste into a healing cream that can be produced independently using simple kitchen tools and easily accessible ingredients, the community gains both economic and health benefits.



(a) (b)

Figure 3. Healing cream from banana peel (a). final product: banana peel-based burn healing cream; (b) Presenting an appreciation to the leader of minasari farming community (Private Documentations).

This initiative is designed to be replicable and sustainable, empowering local residents-particularly women and youth-to adopt traditional herbal knowledge and apply it practically. It also opens new avenues for local product development, small-scale entrepreneurship, and improved health awareness through the use of safe, affordable, and effective natural remedies sourced directly from their own land.

CONCLUSION

This community engagement initiative successfully demonstrated the practical and scientific value of utilizing banana peel waste as a traditional burn wound healing ointment among members of the Minasari Farmers Group in Jemur Wonosari, Surabaya. Through educational sessions, field observation, and hands-on workshops, participants gained knowledge and skills in transforming agricultural waste into a simple, natural, and functional health product. The banana peel-based ointment formulated using accessible materials such as virgin coconut oil and optionally honey proved to be both cost effective and culturally acceptable. The activity was not only enhanced public understanding of the medicinal potential of banana peels, particularly their antioxidant and antimicrobial properties, but also promoted sustainable practices by reducing organic waste through value-added reuse. This program highlights the potential for empowering local communities through science-based traditional medicine, aligning with environmental and health promotion goals. Further

support and development could foster small-scale production initiatives that contribute to both household healthcare resilience and local economic opportunities.

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