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Review Article

Phytochemical Profiling and Multifunctional Dermatological Activities of Banana Peel

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ABSTRACT

Banana peel, generally discarded as agricultural waste, has recently attracted scientific attention due to its rich composition of bioactive compounds and potential applications in dermatology and cosmeceuticals. It contains essential primary metabolites such as carbohydrates, proteins, lipids, and dietary fibre, along with a wide range of secondary metabolites including flavonoids, phenolic compounds, tannins, alkaloids, saponins, glycosides, terpenoids, and carotenoids. Additionally, it provides vital micronutrients such as potassium, magnesium, vitamin C, and vitamin E, which contribute to skin nourishment and protection. These constituents exhibit diverse biological activities, including antioxidant, antimicrobial, anti-inflammatory, anti-acne, wound-healing, anti-ageing, and skin-brightening effects. Due to these multifunctional properties, banana peel has been increasingly explored in herbal cosmetic formulations such as scrubs, creams, gels, soaps, and face packs. Various extraction techniques, including solvent-based and advanced methods like microwave-assisted and ultrasonic extraction, are employed to isolate these active compounds. Modern analytical tools such as FTIR, HPLC, GC-MS, and LC-MS play a key role in phytochemical identification and standardisation. Despite its promising applications, challenges such as variability in composition, limited stability, and lack of clinical validation still exist. This review provides a comprehensive and critical overview of the phytochemical composition, extraction strategies, dermatological activities, and future prospects of banana peel as a sustainable and effective cosmeceutical ingredient.

INTRODUCTION

Banana is one of the most widely cultivated and consumed fruits across the globe, particularly in tropical and subtropical regions. While the edible pulp is extensively utilised for its nutritional benefits, the peel is commonly discarded, even though it constitutes approximately 30–40% of the total fruit mass. The disposal of banana peel as waste contributes to environmental pollution and

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highlights the need for effective waste management and resource utilisation strategies.

In recent years, there has been increasing interest in the valorisation of agricultural waste into value-added products. Banana peel has emerged as a promising natural material due to its rich phytochemical composition. It contains numerous biologically active compounds such as flavonoids, phenolic substances, tannins, alkaloids, and terpenoids, along with essential vitamins and minerals. These compounds are known to exhibit significant biological activities, including antioxidant, antimicrobial, anti-inflammatory, and wound-healing properties.

The growing demand for natural and plant-based skincare products has further enhanced the importance of banana peel in cosmetic and pharmaceutical research. Unlike synthetic ingredients, herbal compounds are generally associated with better safety profiles and reduced side effects. Banana peel has demonstrated potential in addressing various skin concerns such as acne, hyperpigmentation, dryness, ageing, and minor wounds. Therefore, it represents an eco-friendly, cost-effective, and sustainable raw material for the development of herbal cosmetic formulations.

Need for Work

- Banana peel is commonly thrown away as agricultural waste, even though it contains many useful phytochemical compounds.
- Unscientific disposal of banana peel can lead to environmental pollution and increase waste handling problems.
- It is a rich source of bioactive substances such as flavonoids, phenolic compounds, tannins, alkaloids, saponins, and essential vitamins that provide several benefits for skin health.
- The demand for herbal, natural, and safer skincare products is increasing because synthetic cosmetic ingredients may cause irritation and other side effects.
- Banana peel shows various dermatological benefits, including antioxidant, antimicrobial, anti-inflammatory, anti-acne, wound healing, skin brightening, and anti-ageing activities.

Botanical Description of Banana

Banana is one of the most widely grown fruit crops in the world, mainly found in tropical and subtropical climates. It belongs to the genus Musa and is known for its high nutritional value as well as its medicinal and commercial importance. Botanically, the banana plant is considered a large perennial herb and not a true tree because it does not have a woody stem. Instead, it has a pseudostem made from tightly arranged leaf sheaths and large, broad leaves. The fruit is commonly consumed by people of all age groups, while the peel is usually discarded as waste, even though it contains many useful phytochemicals and shows significant therapeutic potential.

Table No:-1

Sr. No.	Classification Level	Scientific Name
1	Kingdom	Plantae
2	Division	Magnoliophyta
3	Class	Liliopsida
4	Order	Zingiberales
5	Family	Musaceae
6	Genus	*Musa*
7	Species	*Musa paradisiaca*, *Musa acuminata*

Structure of Banana Peel

Banana peel is the protective outer layer of the fruit that helps prevent physical injury, microbial

contamination, and loss of moisture. It accounts for nearly 30–40% of the total fruit weight and is mainly divided into two layers.

Outer Peel (Exocarp):

The outer peel is the firm and coloured external layer of the banana. During the ripening process, its colour changes from green to yellow due to natural pigment changes. It contains fibre, pigments, and several protective phytochemicals.

Inner Peel (Mesocarp):

The inner peel is the soft, white, and fibrous layer found beneath the outer surface. It contains higher amounts of starch, moisture, dietary fibre, and phenolic substances. Because of its soft texture and beneficial compounds, it is commonly used in herbal skin care products.

Phytochemical Profiling of Banana Peel

Table No -2

Section	Component	Information
Primary Metabolites	Carbohydrates	Provide energy and support structural composition of the peel
Primary Metabolites	Proteins	Help in tissue repair and support biological activities
Primary Metabolites	Lipids	Maintain skin moisture and support barrier function
Primary Metabolites	Fibers	Useful in exfoliating formulations like scrubs
Secondary Metabolites	Flavonoids	Show antioxidant and anti-inflammatory effects
Secondary Metabolites	Phenolic Compounds	Help prevent oxidative stress and skin damage
Secondary Metabolites	Tannins	Possess antimicrobial and astringent properties
Secondary Metabolites	Alkaloids	Contribute to antimicrobial and healing actions
Secondary Metabolites	Saponins	Help in cleansing and provide antimicrobial benefits
Secondary Metabolites	Glycosides	Support therapeutic and protective skin functions
Secondary Metabolites	Terpenoids	Show anti-inflammatory and healing properties
Secondary Metabolites	Carotenoids	Help in skin protection and improve skin appearance
Minerals and Vitamins	Potassium	Maintains skin hydration and softness
Minerals and Vitamins	Magnesium	Supports skin repair and reduces inflammation
Minerals and Vitamins	Vitamin C	Promotes collagen formation and skin brightening

Methods of Banana Peel Extraction

Drying and Powder Preparation

Fresh banana peels are thoroughly cleaned to remove dust and unwanted materials. They are then sliced into smaller pieces and dried by shade drying, sunlight exposure, or using a hot air oven. Once fully dried, the peels are crushed into a fine powder and preserved in airtight containers for future extraction procedures.

1. **Solvent Extraction**

Various solvents are used to separate active phytochemicals from banana peel powder.

2. **Aqueous Extraction:**

In this method, water is used to obtain water-soluble compounds such as sugars, proteins, and certain phenolic substances.

3. **Ethanol Extraction:**

Ethanol is widely preferred for extracting flavonoids, phenolics, and antioxidant compounds due to its effectiveness and safer nature.

4. **Methanol Extraction:**

Methanol is useful for extracting a broad range of phytochemicals, especially phenolic compounds and antioxidants, with high extraction efficiency.

5. **Hydroalcoholic Extraction:**

This method uses a combination of water and alcohol to improve the recovery of both polar and non-polar constituents, resulting in higher phytochemical yield.

6. **Advanced Extraction Techniques**

Modern extraction techniques help improve yield and reduce processing time.

7. **Soxhlet Extraction:**

It is a continuous hot extraction process in which the solvent repeatedly flows through the sample to maximise compound extraction.

8. **Microwave-Assisted Extraction:**

Microwave energy helps break plant cells rapidly, allowing faster release of active compounds and improving extraction efficiency.

9. **Ultrasonic Extraction:**

Ultrasound waves assist in releasing phytochemicals from plant tissues, leading to better extraction with lower solvent consumption.

Dermatological Activities of Banana Peel

Improve the skin barrier and keep the skin soft, smooth, and healthy.

1. **Antioxidant Activity**

Banana peel shows strong antioxidant activity due to the presence of flavonoids and phenolic compounds. These compounds help in scavenging free radicals and protecting the skin from oxidative stress. This action helps prevent premature skin ageing, wrinkles, and dullness.

2. **Antimicrobial Activity**

The peel possesses antimicrobial properties that help inhibit the growth of harmful microorganisms. It is effective against acne-causing bacteria and also shows antifungal effects, making it useful in treating skin infections and maintaining skin hygiene.

3. **Anti-inflammatory Activity**

Banana peel helps reduce skin inflammation and irritation due to its anti-inflammatory compounds. It provides a soothing effect on inflamed skin and helps in reducing redness, swelling, and discomfort.

4. **Anti-acne Activity**

Its antibacterial and anti-inflammatory properties make banana peel useful in acne management. It helps control excess sebum production and reduces bacterial growth on the skin, thereby minimising pimples and acne breakouts.

5. **Skin Brightening and Detanning**

Banana peel helps improve skin tone by reducing pigmentation and tanning. It supports the removal of dead skin cells and promotes a brighter and healthier skin appearance.

6. **Wound Healing Activity**

The presence of healing compounds in banana peel supports tissue repair and regeneration. It helps in faster healing of minor wounds, cuts, and skin damage by promoting skin recovery.

7. **Anti-aging Effects**

Banana peel contributes to anti-ageing benefits by reducing wrinkles and fine lines. It supports collagen production and helps maintain skin elasticity and firmness.

8. Moisturising and Skin Nourishment

Banana peel provides hydration and nourishment to the skin due to its moisture content, vitamins, and minerals.

Banana Peel in Herbal Cosmetic Formulations

Banana peel is commonly included in herbal cosmetic products because of its antioxidant, antimicrobial, anti-inflammatory, and skin-enhancing properties. Its phytochemical richness makes it an effective natural ingredient for different types of skincare preparations.

Sr. No.	Formulation Type	Purpose
1	Face Scrub	Exfoliation and brightening
2	Face Pack	Moisturizing and detanning
3	Soap	Cleansing and antimicrobial
4	Body Scrub	Skin polishing and rejuvenation
5	Cream	Hydration and anti-aging
6	Gel	Acne control and soothing
7	Herbal Cubes	Easy-to-use solid skincare product

Comparative Review of Previous Studies

Sr. No.	Author and Year	Title of Study	Objective	Methodology	Key Findings
1	Dhana Lakshmi B et al., 2022	Formulation and Evaluation of Herbal Soap Using Natural Ingredients	To prepare and evaluate herbal soap using natural ingredients including banana peel	Preparation of herbal soap followed by evaluation of pH, foam retention, stability, and skin irritation	Herbal soap showed good cleansing action, acceptable pH, and skin-friendly properties
2	Muralidhar A et al., 2020	Preparation of Soap Using Banana Peel and Olive Tree Ashes	To develop soap using banana peel as a natural ingredient	Soap preparation using banana peel extract and evaluation of physical properties	Banana peel-based soap showed good antimicrobial and cleansing properties
3	Pratyusha N.S. et al., 2019	Formulation and Evaluation of Polyherbal Face Scrubber for Oily Skin in Gel Form	To formulate a polyherbal face scrub for oily skin treatment	Preparation of gel scrub and evaluation of spreadability, pH, and anti-acne activity	Effective oil control and improved skin cleansing were observed

Advantages of Banana Peel in Dermatology

1. Natural and Safe:

Banana peel is a plant-based ingredient and is generally considered safer for skin use, with fewer side effects than many synthetic cosmetic substances.

2. Eco-friendly:

Using banana peel in skincare products helps reduce organic waste and supports environmentally responsible product development.

3. Low Cost:

As a by-product of banana consumption and processing, banana peel is affordable and does not require high production costs.

4. Easily Available:

Because bananas are commonly consumed across the world, banana peel is easily accessible in large amounts throughout the year.

5. Sustainable Cosmetic Ingredient:

The use of banana peel in cosmetic formulations supports waste utilisation and encourages the development of sustainable and herbal skincare products.

Limitations

1. Standardisation Issues:

The phytochemical content of banana peel can differ based on the banana variety, stage of ripening, and method of extraction, which makes it difficult to maintain uniform quality.

2. Stability Concerns:

Active compounds present in banana peel extract may degrade over time because of exposure to air, heat, light, and moisture, which can reduce product effectiveness.

3. Short Shelf Life:

Herbal formulations prepared with banana peel generally have a limited storage period due to the absence of strong chemical preservatives.

4. Need for Toxicity Studies:

Even though banana peel is a natural material, detailed toxicity and safety studies are important to ensure its safe use for long-term skin applications.

5. Lack of Large Clinical Trials:

Most available research is based on laboratory studies, while large human clinical trials are still limited, making it difficult to confirm complete safety and therapeutic effectiveness.

Future Perspectives

1. Nanotechnology-based Formulations:

Upcoming research may explore nano-sized formulations of banana peel extract to enhance product stability, improve absorption through the skin, and increase therapeutic efficiency.

2. Clinical Dermatological Studies:

Additional studies involving human participants are necessary to verify the safety, effectiveness, and long-term dermatological benefits of banana peel-based products.

3. Commercial Cosmetic Applications:

Due to its beneficial skin properties, banana peel can be further developed for large-scale cosmetic products such as soaps, creams, scrubs, gels, and face masks.

4. Patent Opportunities:

New and unique formulations prepared using banana peel extract may provide scope for patent registration in the fields of herbal cosmetics and pharmaceutical sciences.

5. Sustainable Cosmeceutical Development:

Using banana peel as a cosmetic ingredient encourages sustainable product development by transforming agricultural waste into useful and eco-friendly skincare formulations.

CONCLUSION

Banana peel is an important natural source of many beneficial phytochemicals, including flavonoids, phenols, tannins, alkaloids, saponins,

glycosides, terpenoids, carotenoids, essential vitamins, and minerals. These active compounds are responsible for several skin-related benefits, such as antioxidant, antimicrobial, anti-inflammatory, anti-acne, wound healing, skin brightening, anti-ageing, and moisturising activities. Due to these multiple dermatological properties, banana peel has become useful in the preparation of herbal cosmetic products like face scrubs, face packs, soaps, creams, gels, body scrubs, and solid skincare formulations. Its natural availability, affordability, and environmentally friendly nature make it a suitable ingredient for sustainable cosmetic development. Even though banana peel has shown promising results in skincare and pharmaceutical applications, more detailed research is still required for proper standardisation, improved stability, safety assessment, and large-scale clinical evaluation. With continuous advancements in herbal formulation techniques, banana peel has strong future potential as a valuable ingredient in cosmeceutical and pharmaceutical industries.

REFERENCES

1. Wani KM, Dhanya M. Unlocking the potential of banana peel bioactives: extraction methods, benefits and industrial applications. Discov Food. 2025;5:8.
2. Vu HT, Scarlett CJ, Vuong QV. Phenolic compounds within banana peel and their potential uses: a review. J Funct Foods. 2018;40:238-248.
3. Bhavania M, Morya S, Saxena D, Awuchi CG. Bioactive, antioxidant, industrial and nutraceutical applications of banana peel. Int J Food Prop. 2023;26(1):1-20.
4. Savitri D, Djawad K, Hatta M, Wahyuni S, Bukhari A. Active compounds in kepok banana peel as anti-inflammatory in acne vulgaris: review article. Ann Med Surg (Lond). 2022;84:104868.
5. Siddique S, Nawaz S, Muhammad F, Akhtar B, Aslam B. Phytochemical screening and in-vitro evaluation of pharmacological activities of peels of Musa sapientum and Carica papaya fruit. Nat Prod Res. 2018;32(11):1333-1336.
6. Hanafy SM, Abd El-Shafea YM, Saleh WD, Fathy HM. Chemical profiling, in vitro antimicrobial and antioxidant activities of pomegranate, orange and banana peel extracts against pathogenic microorganisms. J Genet Eng Biotechnol. 2021;19(1):80.
7. Rawat N, Das S, Wani AW, Javeed K, Qureshi SN, Zarina. Antioxidant potential and bioactive compounds in banana peel: a review. Int J Res Agron. 2024;7(7):7-16.
8. Manzoor A, Ahmad S. Banana peel: characteristics and consideration of its extract for use in meat products preservation: a review. ACS Food Sci Technol. 2021;1(9):1492-1506.
9. Ee LY, Ng BH, Ng BY, Laserna AKC, et al. Phytochemical fingerprint revealing antibacterial and antioxidant activities of endemic banana cultivars in Southeast Asia. Heliyon. 2024;10(15):e35139.
10. Transforming waste into medicine: wound healing potential of banana peel phytoconstituents. J Drug Deliv Sci Technol. 2026;108052.
11. Mohapatra D, Mishra S, Sutar N. Banana and its by-product utilisation: an overview. J Sci Ind Res. 2010;69:323-329.
12. Emaga TH, Andrianaivo RH, Wathelet B, Tchango JT, Paquot M. Effects of the stage of maturation and varieties on the chemical composition of banana and plantain peels. Food Chem. 2007;103(2):590-600.
13. Someya S, Yoshiki Y, Okubo K. Antioxidant compounds from bananas. Food Chem. 2002;79(3):351-354.

14. Sulaiman SF, Yusoff NAM, Eldeen IM, et al. Correlation between total phenolic and mineral contents with antioxidant activity of banana cultivars. J Agric Food Chem. 2011;59(10):5509-5514.
15. Pereira A, Maraschin M. Banana (Musa spp.) from peel to pulp: ethnopharmacology, source of bioactive compounds and its relevance for human health. J Ethnopharmacol. 2015;160:149-163.
16. Fatemeh SR, Saifullah R, Abbas FM, Azhar ME. Total phenolics, flavonoids and antioxidant activity of banana pulp and peel flours. J Food Meas Charact. 2012;6:1-10.
17. Rebello LPG, Ramos AM, Pertuzatti PB, et al. Flour of banana peel as a source of antioxidant compounds. Food Res Int. 2014;55:397-403.
18. Gondokesumo ME, Kusuma HSW, Widowati W. α-Glucosidase inhibitory activity of banana peel extract. Maj Obat Tradis. 2017;22(2):118-123.
19. Aboul-Enein AM, Salama ZA, Gaafar AA, et al. Identification of phenolic compounds from banana peel. Aust J Basic Appl Sci. 2016;10(12):117-123.
20. Mokbel MS, Hashinaga F. Antibacterial and antioxidant activities of banana peel extracts. J Food Agric Environ. 2005;3(1):56-61.
21. Hossain MF, Akhtar S, Anwar M. Nutritional value and medicinal benefits of banana. Int J Nutr Food Sci. 2015;4(1):1-6.
22. Bankar A, Joshi B, Kumar AR, Zinjarde S. Banana peel extract mediated synthesis of gold nanoparticles. Colloids Surf B Biointerfaces. 2010;80(1):45-50.
23. Sundaram S, Anjum S, Dwivedi P, Rai GK. Antioxidant activity and protective effect of banana peel. Indian J Exp Biol. 2011;49:453-457.
24. Pathak PD, Mandavgane SA, Kulkarni BD. Fruit peel waste: characterization and its potential uses. Curr Sci. 2017;113(3):444-454.
25. Kotecha PM, Kadam SS. Preparation of banana peel powder and its utilization. Beverage Food World. 2003;30(9):58-60.
26. Agama-Acevedo E, Islas-Hernández JJ, Pacheco-Vargas G, et al. Starch digestibility and antioxidant activity of banana peel. Starch. 2015;67(9-10):784-790.
27. Nagarajaiah SB, Prakash J. Chemical composition and antioxidant potential of peels from banana varieties. J Food Sci Technol. 2015;52(7):4331-4338.
28. Kumar KP, Bhowmik D, Duraivel S, Umadevi M. Traditional and medicinal uses of banana. J Pharmacogn Phytochem. 2012;1(3):51-63.
29. Krishnan A, Sinija VR. Moisture sorption characteristics of banana peel powder. J Food Process Preserv. 2016;40(3):420-428.
30. Pelissari FM, Andrade-Mahecha MM, Sobral PJA, Menegalli FC. Isolation and characterization of banana starch and peel components. Food Hydrocoll. 2013;30(2):681-690.
31. Baskar R, Shrisakthi S, Sathyapriya B, et al. Antioxidant potential of peel extracts of banana varieties. Food Nutr Sci. 2011;2:1128-1133.
32. Kanazawa K, Sakakibara H. High content of dopamine in banana peel. J Agric Food Chem. 2000;48(3):844-848.
33. Singh B, Singh JP, Kaur A, Singh N. Bioactive compounds in banana and their health benefits. Food Chem. 2016;206:1-11.
34. Kaur M, Arora DS. Antibacterial and antioxidant activity of banana peel extracts. Indian J Microbiol. 2013;53(4):467-474.
35. Nirmala M, Girija K, Lakshman K, Divya T. Hepatoprotective activity of Musa paradisiaca peel extract. Asian J Pharm Clin Res. 2012;5(2):164-166.

36. Elanthamilan M, Rajamani K, Valarmathi R. Cosmetic applications of herbal extracts in skin care products. Int J Pharm Sci Rev Res. 2014;29(2):87-93.
37. Sharma N, Gupta PC, Rao CV. Nutrient content and antioxidant potential of banana peel. Asian J Chem. 2013;25(9):4939-4942.
38. Vijayakumar S, Presannakumar G, Vijayalakshmi NR. Antioxidant activity of banana peel extracts. Food Nutr Sci. 2008;2:31

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