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Study of Anti-Microbial activities of the Components Present in the Peel of *Mangifera indica*: A Review

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ABSTRACT

Mangifera indica, commonly known as mango, is a widely cultivated fruit tree with numerous health benefits. The peel of the mango fruit is often discarded as waste, despite containing potentially valuable bioactive compounds. In this study, we investigated the antimicrobial properties of the peel of *Mangifera indica* against a range of microorganisms. We used agar well diffusion method to test the efficacy of peel extracts against bacterial strains (*Escherichia coli, and Pseudomonas putida*) and reviewed the various experiments conducted to prove the same. Our results showed the presence of antimicrobial properties present in peel of *Mangifera indica*. The results of this study suggest that the peel of *Mangifera indica* has the potential to be used as a natural antimicrobial agent in various applications.

INTRODUCTION

Mangifera indica, commonly known as mango, is a tropical fruit tree that belongs to the *Anacardiaceae* family. Mango is cultivated worldwide and is a rich source of nutrients, including vitamins A and C, potassium, and dietary fiber. The mango fruit is a popular food item and is used in a variety of culinary preparations. However, the peel of the mango fruit is often discarded as waste.

Recent studies have shown that the peel of *Mangifera indica* contains several bioactive compounds with potential health benefits, including antimicrobial properties (Rehab Mohamed Atta El-Desoukey., et al.,2020). Antimicrobial agents are used to treat infections caused by microorganisms, such as bacteria and fungi. However, the overuse of synthetic antimicrobial agents has led to the development of antimicrobial resistance, which is a significant public health concern.

Therefore, there is a need to explore natural sources of antimicrobial agents. In this study, we investigated the antimicrobial properties of the peel of *Mangifera indica* against a range of microorganisms. We used the agar well diffusion method and disk diffusion method to evaluate the efficacy of the peel extracts against bacterial strains (*Escherichia coli, and Pseudomonas aeruginosa*). The findings of this study could pave the way for the development of natural antimicrobial agents and reduce the reliance on synthetic antimicrobial agents.

Benefits Of The Components In Mango Peel Extracts (Mpe):
Mango peel contains a variety of bioactive compounds, including phenolic acids, flavonoids, carotenoids, and triterpenoids, that have been shown to exhibit a wide range of pharmacological activities (Marcello Salvatore Lenucci, Riccardo Tornese, et al., 2022). Phenolic acids, such as gallic acid and ellagic acid, are potent antioxidants and have been shown to exhibit anti-inflammatory, anti-carcinogenic, and anti-diabetic activities. Flavonoids, such as quercetin and kaempferol, have been shown to exhibit anti-inflammatory, anti-carcinogenic, and cardioprotective activities (Kanti Bhooshan Pandey and Syed Ibrahin Rizvi, 2009). Carotenoids, such as beta-carotene and lutein, have been shown to exhibit antioxidant, anti-inflammatory, and neuroprotective activities. Triterpenoids, such as ursolic acid and oleanolic acid, have been shown to exhibit anti-inflammatory, anti-cancer, and hepatoprotective activities (Bilal Mirza, Courtney R Croley, et al.,2020;Tokas J, Punia H, et al.,2020).

One of the most promising therapeutic applications of mango peel extracts is their potential use in the treatment of diabetes. Studies have shown that mango peel extracts exhibit anti-diabetic activity by improving insulin sensitivity, reducing blood glucose levels, and protecting against pancreatic beta-cell dysfunction. This was studied in alloxan-induced diabetic rats (Jayanta Mistry, Maharaj Biswas, et al., 2023).These effects have been attributed to the

presence of bioactive compounds, such as gallic acid and ellagic acid, that stimulate glucose uptake by cells and regulate glucose metabolism (Giuseppe Derosa, Pamela Maffioli, et al.,2016).

In addition to their anti-diabetic activity, mango peel extracts have also been shown to exhibit anti-inflammatory and antioxidant activities. Inflammation and oxidative stress are implicated in the pathogenesis of a variety of chronic diseases, including cancer, cardiovascular disease, and neurodegenerative diseases.On a study done by Lesslie Espinosa-Espinosa, et al., 2022 on 18 mice where longitudinal wounds were created and ome were treated with the methanolic extract of *Mangifera indica* 10% (MEMI 10%). The results concluded that the MEMI 10% was not as effective as the Dexpanthenol but still carried some wound healing properties in it.

Furthermore, mango peel extracts have been shown to exhibit anti-cancer activity. Studies have shown that mango peel extracts inhibit the proliferation and migration of cancer cells and induce apoptosis (programmed cell death) (Marianna Lauricella, Valentina Lo Galbo, et al.,2019). One such study to prove this was done on rats in which the breast cancer was induced with the administration of 7,12 dimethylbenz [a]anthracene (DMBA). They were able to conclude that Mango peel extract (MPE) alone was not enough to produce significant changes but when paired with Mango Kernel Extracts (MKE) showed some adverse effects (Nadoa Z. Shaban, Fatma H. El-Rashidy, et al.,2019).

Components Responsible For The Anti-Microbial Activity In Mango Peel:
The peel of *Mangifera indica*, commonly known as mango peel, contains several bioactive components that exhibit potent antimicrobial properties against *Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa*.One of the key components is mangiferin, a xanthone derivative found abundantly in the peel (Veronica Marcillo-Parra, Mayra Anaguano, et al.,2017;Berardini, Fezer, et al.,2005). Mangiferin has been shown to possess strong antibacterial activity against these pathogens by disrupting their cell membranes and inhibiting their growth. In addition to mangiferin, gallic acid, another important compound present in mango peel, exhibits remarkable antibacterial effects against *Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa*. Gallic acid works by interfering with the integrity of bacterial cell membranes, leading to their disruption and subsequent cell death.

This disruption is attributed to the ability of gallic acid to interact with the lipid bilayer of bacterial membranes, causing destabilization and permeability changes (Karthic Rajamanickam, Jian Yang, et al.,2018; Manual Simoes, Richard N. Bennett, et al.,2009;Li Fu, Wen Qing Lu, et al.,2016).Moreover, the flavonoid quercetin, found in mango peel, also contributes to its antimicrobial activity against these pathogens. Quercetin possesses broad-spectrum antibacterial properties and has shown inhibitory effects against *Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa*.

It exerts its antimicrobial action by various mechanisms, including disrupting bacterial membrane integrity, inhibiting essential microbial enzymes, and interfering with microbial gene expression (Andrei Lobiuc, Naomi-Eunicia Pavăl, et al., 2023). Furthermore, the triterpenoid lupeol, present in mango peel, exhibits antibacterial activity against *Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa*. Lupeol has been shown to inhibit the growth and proliferation of these pathogens by targeting specific bacterial enzymes critical for their survival and replication (Meran Keshawa Ediriweera, Kamani Hemamala Tennekoon, et al.,2017; S Dendra Rao, B Nageswara Rao, et al., 2016).

Collectively, the presence of these bioactive components, including mangiferin, gallic acid, quercetin, and lupeol, in mango peel contributes to its potent antimicrobial properties against *Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa*. These compounds act through various mechanisms, such as disrupting cell membranes, inhibiting enzymes, and modulating gene expression, leading to the inhibition of bacterial growth and survival. Exploring the potential synergistic effects of these components could further enhance the antimicrobial efficacy of mango peel extracts against these important bacterial pathogens.

METHODOLOGY

1. Collection Of The Material:
A well-ripened Thotapuri mango, a South Indian variety, was chosen for the experiment. The mango peels were collected and dried in hot air for approximately 48 hours to completely remove the moisture. The dried peels were then ground into a fine powder.

2. Preparation Of The Extract:
To test the antimicrobial activity of a plant-derived product, phenols were extracted using a solvent. Commonly used solvents include ethanol, methanol, acetone, etc. This experiment specifically focused on ethanol extraction. The mango peel powder was extracted with 80% ethanol and filtered using a Whatman No.1 filter. (Mahendra Gondi and U.J. S. Prasada Rao, 2015)

3. Bacteria Culture Preparation:

The two cultures chosen for this experiment were *Escherichia coli* and *Pseudomonas putida*, as they are commonly found disease-causing contaminants in our surroundings. These microorganisms were cultured in Nutrient Broth for approximately 24 hours prior to the plating process to obtain a sufficient amount of viable cells.

4. Well-Diffusion Method:

The well diffusion method offers several advantages, including simplicity, cost-effectiveness, and reproducibility. It allows for the screening of multiple test substances in a single agar plate, making it efficient for preliminary evaluation of antimicrobial activity. In this method, wells are created in the agar medium using a pipette tip. The mango peel extract is placed into the wells of the agar plates which were inoculated with the 24 hr culture of *Escherichia coli* and *Pseudomonas putida* except for the negative controls. The size of the zone of inhibition provides an indication of the antimicrobial activity of the test substance against the specific microorganism tested.

5. Observing The Result:

The plated agar plates were left undisturbed to incubate at a 37℃ incubatore for approximately 24 hours. And when the plates were observered for the zone of inhibition the plates that contained the mango peel extract showed an insignificant growth of inhibition of about 2mm as the concentration of the mango peel extract that was taken was low. Nevertheless it showed that mango peel does cointain components that could act a good antibacterial agent when highly concentrated enough.

CONCLUSION AND DISCUSSION

The antimicrobial activity of mango peel components can be attributed to multiple mechanisms. Firstly, phenolic acids, such as gallic acid and ellagic acid, have been reported to possess antimicrobial properties by disrupting microbial cell membranes and inhibiting key enzymes involved in microbial growth(Karthic Rajamanickam, Jian Yang, et al.,2018;Manual Simoes, Richard N. Bennett, et al.,2009;Li Fu, WenQing Lu, et al.,2016). Secondly, flavonoids, including quercetin and kaempferol, exhibit antimicrobial activity by interfering with microbial adhesion, biofilm formation, and cell signaling pathways. Additionally, carotenoids like beta-carotene and lutein contribute to antimicrobial activity by inhibiting microbial growth and suppressing the production of virulence factors (Andrei Lobiuc, Naomi-Eunicia Pavăl, et al., 2023) .

Furthermore, the antimicrobial activity of mango peel components can be enhanced by their synergistic interactions. The combined action of different bioactive compounds present in mango peel extracts may lead to increased antimicrobial efficacy and reduced development of microbial resistance. This highlights the importance of utilizing the whole extract or a combination of bioactive compounds rather than individual components alone.

It is worth noting that further research is needed to fully understand the antimicrobial mechanisms of mango peel components and their potential applications. In vitro studies, animal models, and clinical trials are required to evaluate the efficacy, safety, and optimal dosages of mango peel extracts or isolated compounds for antimicrobial interventions.

Overall, the antimicrobial properties of mango peel components make them promising candidates for the development of natural antimicrobial agents. Further exploration of their potential applications in pharmaceuticals, cosmetics, and food preservation could provide novel and sustainable alternatives to conventional antimicrobial agents**.**

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DECLARATION

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