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Broad-Spectrum Antimicrobial Potential of *Garcinia mangostana* Pericarp Extract: A Natural Therapeutic Agent

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Abstract

Garcinia mangostana, commonly known as mangosteen, has been traditionally used in Asian cultures for its medicinal properties. This study aimed to evaluate the antimicrobial activity of mangosteen pericarp extract against various bacterial and fungal pathogens. The pericarp was dried, powdered, and extracted in distilled water at concentrations of 1%, 5%, and 10%. Antimicrobial activity was assessed using the agar well diffusion method against *Staphylococcus aureus*, *Enterococcus faecalis*, *Bacillus spp.*, and *Candida albicans*. The extract exhibited significant antimicrobial activity, with zones of inhibition increasing in a concentration-dependent manner. The 10% extract demonstrated the most potent inhibitory effects. These findings support the traditional use of mangosteen pericarp and suggest potential development as a natural antimicrobial agent. Future research should focus on isolating active compounds and evaluating their efficacy in vivo.

Keywords: Garcinia mangostana, mangosteen pericarp, antimicrobial activity, natural therapeutic agent

Introduction

The search for natural remedies has been an integral aspect of pharmaceutical research, driven by the growing demand for effective, safe, and sustainable therapeutic agents. In recent years, there has been an increasing interest in plant-based compounds, which are often rich in bioactive substances with potential therapeutic applications. Among these, *Garcinia mangostana* (commonly known as mangosteen) has emerged as a promising source of medicinal compounds due to its diverse pharmacological properties [1,2].

Mangosteen is a tropical fruit native to Southeast Asia and has been traditionally used in various Asian cultures for treating ailments ranging from skin infections to wounds and gastrointestinal disorders [3,4]. The therapeutic potential of mangosteen, particularly its pericarp (the fruit's outer rind), has been attributed to its rich content of bioactive compounds such as xanthones, tannins, and flavonoids [5]. These compounds have been shown to exhibit a wide range of biological activities, including antimicrobial, antioxidant, anti-inflammatory, and anticancer effects [6,7].

Recent scientific studies have validated many of the traditional uses of mangosteen. For instance, xanthones isolated from the pericarp have demonstrated potent antimicrobial activity against both Gram-positive and Gram-negative bacteria, as well as various fungal pathogens [8]. This antimicrobial potential is particularly significant given the rising global concern over antimicrobial resistance (AMR), which poses a serious threat to public health by rendering standard treatments ineffective against common infections [9,10]. The World Health Organization

(WHO) has emphasized the urgent need to develop new antimicrobial agents, particularly those derived from natural sources, to combat this growing issue [11].

Given this background, the present study aims to scientifically evaluate the antimicrobial activity of *Garcinia mangostana* pericarp extract against a range of bacterial and fungal pathogens. By doing so, we seek to validate its traditional use and explore its potential as a natural therapeutic agent that could contribute to addressing the AMR crisis.

Materials and Methods

Plant Material and Extract Preparation

The pericarp of *Garcinia mangostana* was collected, authenticated, and dried at room temperature, avoiding direct sunlight. The dried pericarp was ground into a fine powder and extracted in distilled water to prepare concentrations of 1%, 5%, and 10%.

Antimicrobial property of mangosteen pericarp extract

Antibacterial activity of mangosteen pericarp extract against the strain Staphylococcus aureus, Streptococcus mutans, Enterococcus faecalis, and Candida albicans. Mueller Hinton Agar (MHA) and Rose Bengal Agar (RBA) bases were utilized for this activity to determine the zone of inhibition.

Antibacterial activity:

Antibacterial activity of mangosteen pericarp extract against the strain *Staphylococcus aureus, Bacillus, and E.coli.* Mueller Hinton Agar was utilized for this activity to determine the zone of inhibition. Mueller hinton agar was prepared and sterilised for 15 minutes at 121ºC. Media was poured into the sterilised plates and left it stable for solidification. The wells were cut using a 9mm sterile polystyrene tip and the test organisms were swabbed. The extract with different concentrations (1%,5% and 10 %) were loaded and in the fourth well standard antibiotic amoxyrite was loaded. The plates were incubated for 24 hours at 37 °C. After the incubation time, the zones of inhibition were measured [Figure 1,2,3].

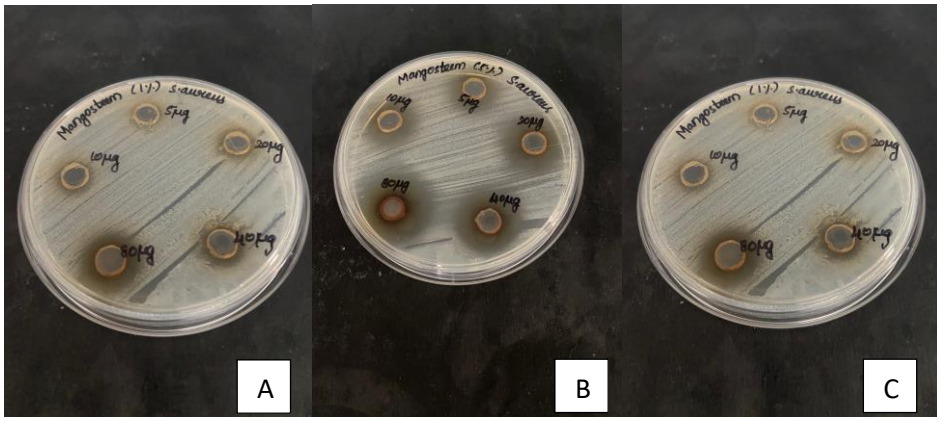


Figure 1: Antimicrobial activity of 1%, 5% and 10 % concentration of mangosteen pericarp extract against S.Aureus

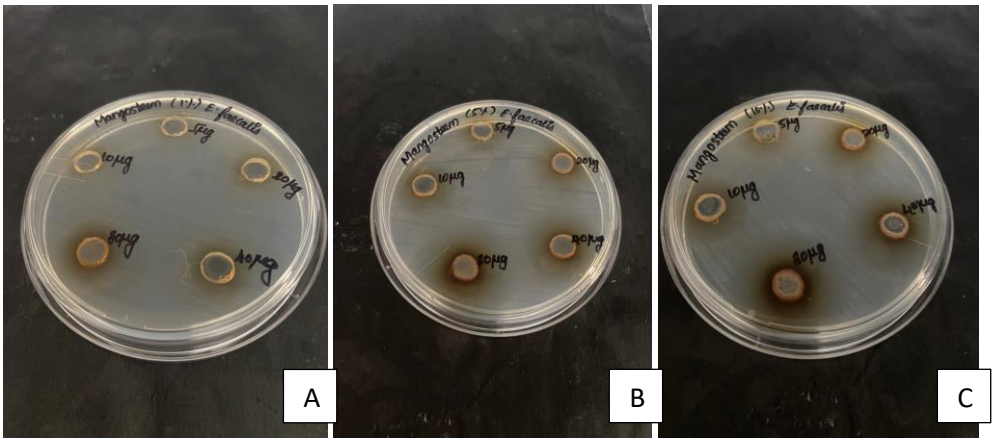


Figure 2: Antimicrobial activity of 1%, 5% and 10 % concentration of mangosteen pericarp extract against E. Faecalis

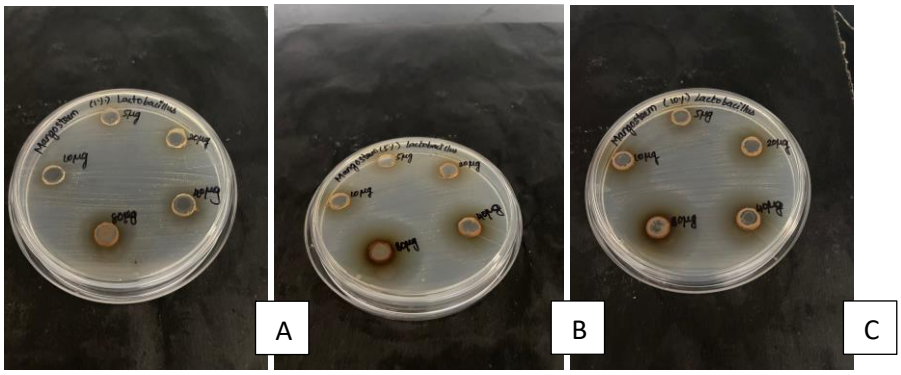


Figure 3: Antimicrobial activity of 1%, 5% and 10 % concentration of mangosteen pericarp extract against Lactobacillus species

Antifungal activity:

Candida albicans is used as a test pathogen by agar well diffusion assay. Rose Bengal Agar is used to prepare the fungal medium. The prepared and sterilised medium was swabbed with test organisms and mangosteen extract with different concentrations (1%,5% and 10 %) were added to the wells, and in the fourth well standard antibiotic fluconazole was loaded. The plates were incubated at 37°C for 48-72 hours. After the incubation time, the zone of inhibition was measured [Figure 4].

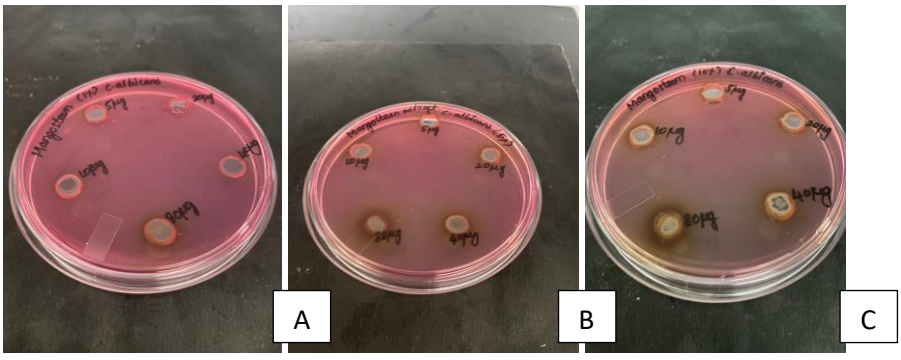
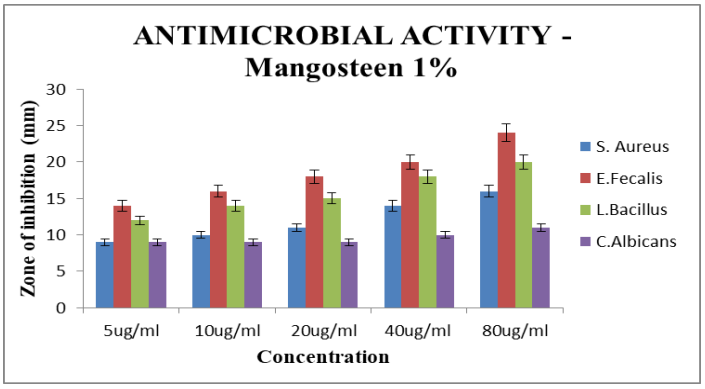


Figure 4: Antifungal activity of 1%, 5% and 10 % concentration of mangosteen pericarp extract against C. Albicans species

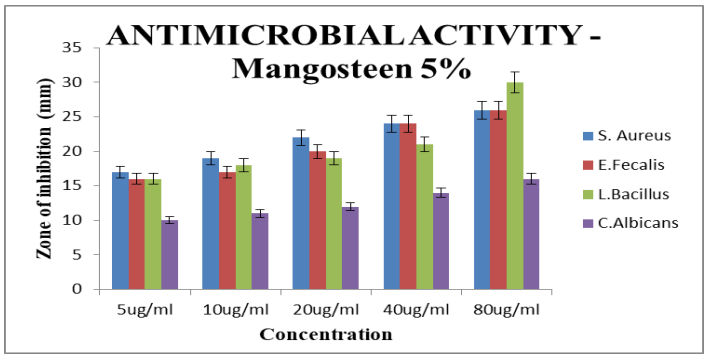
Results:

ANTIMICROBIAL PROPERTY OF MANGOSTEEN PERICARP EXTRACT

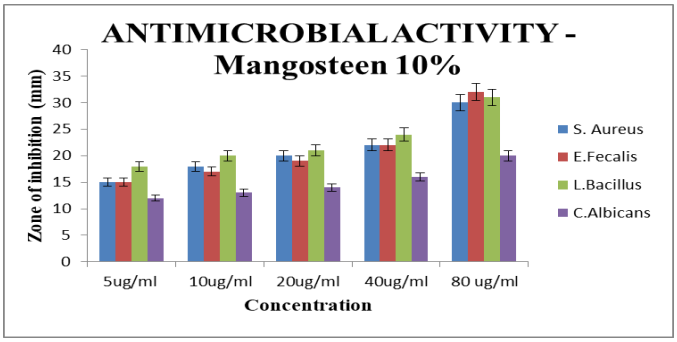
Mangosteen extract exhibited a significant inhibitory effect against S. aureus, with the zone of inhibition expanding from 15 mm to 30 mm for the 10% extract concentration as the dosage increased, indicating a strong antimicrobial potential against this strain. Against E. faecalis, the extract's antimicrobial activity was also notable, with the zone of inhibition ranging from 16 mm to 26 mm for the 10% extract concentration, underscoring its effectiveness against this particular bacterial strain. The extract showed a potent inhibitory effect on L. bacillus, with the zone of inhibition increasing from 16 mm to 31 mm for the 10% concentration, highlighting its capacity to combat this bacterium effectively. Although C. albicans is a fungal strain, the extract demonstrated antimicrobial activity against it as well, with the zone of inhibition ranging from 10 mm to 16 mm for the 10% extract concentration, suggesting its broad-spectrum antimicrobial properties.



Graph 1: Antimicrobial activity of 1 % mangosteen pericarp extract at different concentrations



Graph 2: Antimicrobial activity of 5 % mangosteen pericarp extract at different concentrations



Graph 3: Antimicrobial activity of 10% mangosteen pericarp extract at different concentrations

These results indicate that Mangosteen extract possesses significant antimicrobial activity against a range of bacterial strains, including S. aureus, E. faecalis, L. bacillus, and C. albicans, with the effect intensifying as the concentration of the extract increases (Graph 1,2 and 3). This underscores the potential of Mangosteen extract as a natural antimicrobial agent, which could be further explored for its applications in treating infections caused by these strains.

Discussion

The findings of this study confirm the significant antimicrobial activity of *Garcinia mangostana* pericarp extract, supporting its traditional use in treating infections. The extract exhibited a concentration-dependent inhibitory effect against all tested strains, including *Staphylococcus aureus*, *Enterococcus faecalis*, *Bacillus spp.*, and *Candida albicans*. These results are consistent with previous studies that have reported the antimicrobial properties of mangosteen, particularly its effectiveness against both bacterial and fungal pathogens [12,13].

The observed antimicrobial activity is likely due to the presence of xanthones, tannins, and flavonoids in the mangosteen pericarp. Xanthones, in particular, have been extensively studied for their broad-spectrum antimicrobial properties. They are known to disrupt microbial cell membranes, inhibit enzymatic activity, and interfere with microbial communication pathways such as quorum sensing, which is crucial for biofilm formation and virulence in many pathogenic bacteria [14,15]. Additionally, tannins and flavonoids have been shown to exert antimicrobial effects by precipitating microbial proteins and inhibiting the growth of microorganisms [16].

The significance of these findings extends beyond the validation of traditional medicine. In the context of the global AMR crisis, the development of new antimicrobial agents derived from natural products such as mangosteen could provide a valuable alternative to synthetic antibiotics, which are increasingly losing their effectiveness due to the emergence of resistant strains [17]. The WHO has highlighted the critical need for new antimicrobials, especially those that can be developed from natural sources and used in combination with existing therapies to enhance their efficacy and reduce the risk of resistance development [18].

Moreover, the broad-spectrum activity of the mangosteen pericarp extract suggests its potential use in treating various infections, particularly those caused by multi-drug resistant organisms. The ability to inhibit both bacterial and fungal pathogens also indicates its versatility as a natural therapeutic agent. However, while the in vitro results are promising, further research is needed to isolate and characterize the specific bioactive compounds responsible for the antimicrobial effects and to evaluate their efficacy in vivo [19].

Future studies should also explore the potential synergistic effects of combining mangosteen pericarp extract with conventional antibiotics. Such combinations could enhance the overall antimicrobial activity and potentially reduce the required dosage of synthetic antibiotics, thereby minimizing their side effects and the likelihood of resistance development. Additionally, investigating the safety and pharmacokinetics of the extract in animal models and human clinical trials will be crucial steps in the development of mangosteen-based antimicrobial therapies [20].

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