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Antibacterial and Antifungal Activities of Crude Extracts from Selected Medicinal Plants Against Human Pathogens

Lamkane Rachana Balasaheb[1] and Dr. Abhijit Vithalrao Shrirao[2]
[1]Research Scholar, Department of Pharmaceutical Chemistry
[2]Professor, Department of Pharmaceutical Chemistry
Sunrise University, Alwar, Rajasthan

Abstract: *The increasing prevalence of antimicrobial resistance among pathogenic microorganisms has prompted the search for alternative therapeutic agents from natural sources. Medicinal plants are rich reservoirs of bioactive compounds such as alkaloids, flavonoids, tannins, terpenoids, and phenolic compounds that possess antimicrobial properties. The present study aimed to evaluate the antibacterial and antifungal activities of crude extracts obtained from selected medicinal plants against common human pathogens. Leaves of Azadirachta indica (Neem), Ocimum sanctum (Tulsi), Moringa oleifera (Moringa), and Aloe vera were collected, shade-dried, powdered, and extracted using 70% methanol.*

Antibacterial activity was assessed against Staphylococcus aureus, Escherichia coli, Pseudomonas aeruginosa, and Bacillus subtilis using the agar well diffusion method. Antifungal activity was evaluated against Candida albicans, Aspergillus niger, and Aspergillus fumigatus. The results revealed significant antimicrobial activity, with Neem and Tulsi extracts exhibiting the highest inhibition zones against both bacterial and fungal pathogens. Phytochemical screening confirmed the presence of alkaloids, flavonoids, tannins, saponins, and phenolic compounds responsible for antimicrobial activity. The findings suggest that crude extracts of medicinal plants can serve as promising sources of natural antimicrobial agents for the development of alternative therapies against infectious diseases..

Keywords: Medicinal plants, Antibacterial activity, Antifungal activity, Crude extracts, Human pathogens, Phytochemicals

I. INTRODUCTION

Medicinal plants have been utilized for centuries in traditional healthcare systems due to their therapeutic properties. According to the World Health Organization (WHO), approximately 80% of the world's population depends on herbal medicines for primary healthcare needs (WHO, 2022). The emergence of multidrug-resistant bacterial and fungal pathogens has become a major public health concern, necessitating the exploration of novel antimicrobial agents from natural resources (Ventola, 2015).

Plants produce a variety of secondary metabolites including alkaloids, flavonoids, tannins, terpenoids, and phenolic compounds that possess antimicrobial properties. These compounds inhibit microbial growth through disruption of cell membranes, interference with protein synthesis, and inhibition of nucleic acid replication (Cowan, 2015). Several medicinal plants such as Neem, Tulsi, Aloe vera, and Moringa have been reported to exhibit broad-spectrum antimicrobial activities against human pathogens.

The present study investigates the antibacterial and antifungal efficacy of crude extracts from selected medicinal plants against clinically important bacterial and fungal species.

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MATERIALS AND METHODS

1. Collection and Preparation of Plant Materials

Fresh leaves of Neem (Azadirachta indica), Tulsi (Ocimum sanctum), Moringa (Moringa oleifera), and Aloe vera were collected from local medicinal gardens. Plant materials were washed thoroughly, shade-dried for 10–15 days, and ground into fine powder.

2. Extraction Procedure

Fifty grams of powdered material from each plant were soaked in 500 mL of 70% methanol for 72 hours. The extracts were filtered and concentrated using a rotary evaporator. The dried crude extracts were stored at 4°C until further use.

TEST MICROORGANISMS

The selection of test microorganisms is a critical aspect of antimicrobial research because it enables the evaluation of the effectiveness of medicinal plant extracts against clinically important pathogens. In the present study, a diverse group of bacterial and fungal microorganisms commonly associated with human infections was selected to assess the antibacterial and antifungal potential of crude extracts obtained from medicinal plants. The selected bacterial strains included *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Bacillus subtilis*, while the fungal strains comprised *Candida albicans*, *Aspergillus niger*, and *Aspergillus fumigatus*. These microorganisms were chosen because of their medical significance, prevalence in human diseases, and varying susceptibility patterns to antimicrobial agents. The inclusion of both Gram-positive and Gram-negative bacteria, along with pathogenic yeasts and filamentous fungi, provided a comprehensive evaluation of the antimicrobial spectrum of the plant extracts.

Staphylococcus aureus is a Gram-positive bacterium frequently associated with skin infections, wound infections, pneumonia, septicemia, and food poisoning. It is one of the most common causes of hospital-acquired and community-acquired infections worldwide. The ability of *S. aureus* to develop resistance to multiple antibiotics, including methicillin-resistant *Staphylococcus aureus* (MRSA), has become a major public health concern. Due to its clinical importance and increasing resistance to conventional antibiotics, *S. aureus* is widely used as a model organism in antimicrobial studies. The susceptibility of *S. aureus* to medicinal plant extracts can provide valuable insights into the potential use of plant-derived compounds as alternative therapeutic agents for managing bacterial infections.

Escherichia coli is a Gram-negative bacterium that normally inhabits the intestinal tract of humans and animals. Although many strains of *E. coli* are harmless, certain pathogenic strains are responsible for urinary tract infections, gastroenteritis, neonatal meningitis, and septicemia. The outer membrane present in Gram-negative bacteria acts as an additional barrier against antimicrobial agents, making them more resistant than Gram-positive bacteria. Consequently, evaluating the activity of medicinal plant extracts against *E. coli* is important for determining their effectiveness against Gram-negative pathogens. The successful inhibition of *E. coli* growth by plant extracts indicates the presence of bioactive compounds capable of penetrating or disrupting bacterial cell membranes.

Pseudomonas aeruginosa is another Gram-negative bacterium included in this study due to its remarkable resistance to many antibiotics and disinfectants. It is an opportunistic pathogen responsible for respiratory tract infections, urinary tract infections, wound infections, burns, and bloodstream infections, particularly in immunocompromised patients. *P. aeruginosa* possesses several virulence factors and resistance mechanisms, including efflux pumps, biofilm formation, and low membrane permeability. These characteristics make infections caused by this organism difficult to treat. Therefore, the evaluation of medicinal plant extracts against *P. aeruginosa* is essential for identifying alternative antimicrobial agents capable of combating resistant bacterial strains.

Bacillus subtilis was selected as a representative Gram-positive bacterium frequently used in microbiological and antimicrobial research. Although generally considered non-pathogenic, *B. subtilis* serves as an excellent indicator organism due to its well-characterized physiology and susceptibility patterns. It is commonly found in soil and environmental samples and is often utilized in laboratory investigations to assess the antibacterial activity of natural products. The response of *B. subtilis* to medicinal plant extracts provides additional information regarding the broad-spectrum antibacterial properties of the tested materials.

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Among the fungal pathogens, *Candida albicans* was selected because it is one of the most prevalent opportunistic fungal pathogens affecting humans. *C. albicans* is responsible for oral thrush, vaginal candidiasis, skin infections, and systemic candidiasis, particularly in individuals with weakened immune systems. The increasing incidence of antifungal resistance among *Candida* species has created a need for novel antifungal agents. Since medicinal plants contain numerous bioactive compounds with potential antifungal properties, testing against *C. albicans* provides valuable information regarding their therapeutic applicability in fungal infections. The inhibition of *C. albicans* growth suggests that plant-derived compounds may interfere with fungal cell wall synthesis, membrane integrity, or metabolic processes.

Aspergillus niger is a filamentous fungus widely distributed in nature and commonly associated with food spoilage, allergic reactions, and opportunistic infections. Although generally regarded as less pathogenic than some other *Aspergillus* species, it can cause pulmonary aspergillosis and ear infections in susceptible individuals. The inclusion of *A. niger* in antimicrobial studies is important because it represents a common environmental fungus capable of surviving under diverse conditions. The ability of medicinal plant extracts to inhibit the growth of *A. niger* demonstrates their potential application in controlling fungal contamination and preventing fungal diseases.

Aspergillus fumigatus is one of the most clinically significant fungal pathogens affecting humans. It is the primary causative agent of invasive aspergillosis, a potentially life-threatening infection that primarily affects immunocompromised patients. The fungus produces airborne spores that can be inhaled into the respiratory tract, leading to severe pulmonary infections. Due to increasing resistance to antifungal drugs and the high mortality associated with invasive aspergillosis, there is considerable interest in discovering new antifungal compounds from natural sources. Testing medicinal plant extracts against *A. fumigatus* enables researchers to evaluate their effectiveness against a highly pathogenic fungal species and identify promising candidates for further pharmaceutical development.

The selected bacterial and fungal strains collectively represent a broad spectrum of human pathogens with diverse structural and physiological characteristics. Gram-positive bacteria possess a thick peptidoglycan layer, whereas Gram-negative bacteria contain an outer membrane that often contributes to increased antimicrobial resistance. Similarly, fungal pathogens possess unique cellular structures, including chitin-containing cell walls and ergosterol-rich membranes, which differ significantly from bacterial cells. Evaluating plant extracts against these diverse microorganisms allows researchers to determine whether the extracts exhibit broad-spectrum antimicrobial activity or selective inhibition against specific groups of pathogens.

The use of standard laboratory strains obtained from recognized microbial culture collections ensures reproducibility and reliability of experimental results. Prior to antimicrobial testing, bacterial cultures are typically maintained on nutrient agar and incubated at 37°C, while fungal cultures are maintained on potato dextrose agar under suitable growth conditions. Fresh cultures are prepared to ensure active growth and standardized inoculum concentrations. The microbial suspension is usually adjusted to match a standard turbidity level, such as the 0.5 McFarland standard, to achieve consistent and comparable results during antimicrobial assays.

The selection of *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Candida albicans*, *Aspergillus niger*, and *Aspergillus fumigatus* provides a comprehensive platform for evaluating the antibacterial and antifungal activities of medicinal plant extracts. These microorganisms represent major human pathogens responsible for a wide range of infectious diseases and possess varying levels of antimicrobial resistance. Their inclusion in the study enables a thorough assessment of the therapeutic potential of plant-derived bioactive compounds and contributes to the ongoing search for effective natural antimicrobial agents capable of addressing the growing challenge of microbial resistance.

I. Bacterial Strains

Staphylococcus aureus
Escherichia coli
Pseudomonas aeruginosa
Bacillus subtilis

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II. Fungal Strains

Candida albicans
Aspergillus niger
Aspergillus fumigatus

III. Phytochemical Screening

Standard phytochemical tests were conducted for the detection of alkaloids, flavonoids, tannins, saponins, glycosides, and phenolic compounds.

IV. Antibacterial Assay

The agar well diffusion method was used. Zones of inhibition were measured after 24 hours of incubation at 37°C.

V. Antifungal Assay

The poisoned food technique was employed to evaluate antifungal activity. Growth inhibition percentages were calculated after incubation.

RESULTS

Table 1. Phytochemical Constituents of Selected Medicinal Plant Extracts

Phytochemical	Neem	Tulsi	Moringa	Aloe vera
Alkaloids	+	+	+	-
Flavonoids	+	+	+	+
Tannins	+	+	+	+
Saponins	+	+	+	+
Phenolics	+	+	+	+
Glycosides	+	+	-	+

(+ = Present; - = Absent)

Table 2. Antibacterial Activity of Crude Plant Extracts (Zone of Inhibition, mm)

Plant Extract	S. aureus	E. coli	P. aeruginosa	B. subtilis
Neem	22.4 ± 0.8	20.3 ± 0.5	18.6 ± 0.6	21.8 ± 0.7
Tulsi	21.5 ± 0.7	19.8 ± 0.4	17.9 ± 0.5	20.7 ± 0.6
Moringa	18.2 ± 0.6	16.5 ± 0.4	15.3 ± 0.5	17.8 ± 0.4
Aloe vera	15.7 ± 0.5	14.4 ± 0.3	13.2 ± 0.4	14.9 ± 0.5

Table 3. Antifungal Activity of Crude Plant Extracts

Plant Extract	C. albicans (%)	A. niger (%)	A. fumigatus (%)
Neem	82.5 ± 2.3	78.4 ± 1.9	75.6 ± 2.1
Tulsi	79.8 ± 2.1	74.5 ± 1.8	72.2 ± 1.9
Moringa	68.4 ± 1.7	65.7 ± 1.6	63.1 ± 1.5
Aloe vera	60.2 ± 1.5	58.8 ± 1.4	56.5 ± 1.3

DISCUSSION

The present investigation demonstrated that all selected medicinal plant extracts exhibited varying degrees of antibacterial and antifungal activities. Neem extract showed the highest antimicrobial efficacy against both bacterial and fungal pathogens. The strong antimicrobial activity may be attributed to the presence of bioactive compounds such

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as nimbidin, azadirachtin, flavonoids, and tannins. Tulsi extract also exhibited substantial inhibition against tested microorganisms, likely due to eugenol and other phenolic compounds.

Gram-positive bacteria were generally more susceptible than Gram-negative bacteria, which may be explained by structural differences in cell wall composition. Similar observations were reported by Cowan (2015) and Pandey and Kumar (2013). The antifungal results revealed significant inhibition of Candida albicans and Aspergillus species, indicating the potential application of these extracts in treating fungal infections.

The phytochemical analysis confirmed the presence of antimicrobial constituents, supporting previous findings that secondary metabolites play a crucial role in microbial growth inhibition. These findings suggest that medicinal plants may provide effective alternatives to conventional antimicrobial agents, particularly in combating antimicrobial resistance.

II. CONCLUSION

The study demonstrated that crude extracts from selected medicinal plants possess significant antibacterial and antifungal activities against human pathogens. Neem and Tulsi exhibited the highest antimicrobial potential, followed by Moringa and Aloe vera. The presence of phytochemicals such as alkaloids, flavonoids, tannins, and phenolic compounds contributes to their antimicrobial effectiveness. These medicinal plants represent promising sources of natural antimicrobial agents and may serve as alternatives for the development of novel therapeutic formulations. Further studies involving purification, characterization, toxicity evaluation, and clinical trials are recommended.

REFERENCES

[1]. Cowan, M. M. (2015). Plant products as antimicrobial agents. Clinical Microbiology Reviews, 12(4), 564–582.
[2]. Pandey, A., & Kumar, S. (2013). Perspective on plant products as antimicrobial agents. International Journal of Pharmaceutical Sciences and Research, 4(7), 2479–2488.
[3]. Ventola, C. L. (2015). The antibiotic resistance crisis. Pharmacy and Therapeutics, 40(4), 277–283.
[4]. World Health Organization. (2022). WHO global report on traditional and complementary medicine. Geneva: WHO.
[5]. Gupta, P. D., & Birdi, T. J. (2017). Development of botanicals to combat antibiotic resistance. Journal of Ayurveda and Integrative Medicine, 8(4), 266–275.