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Screening of *Phyllanthus emblica* and *Vitis vinifera* for Anti Bacterial and Anti Fungal Activity

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ABSTRACT

The rapid emergence of resistance among pathogenic microorganisms to existing antimicrobial agents has increased the demand for alternative therapies derived from natural sources. The present study was undertaken to evaluate the antibacterial and antifungal activities of *Phyllanthus emblica* (amla) and *Vitis vinifera* (grape) extracts. The plant materials were collected, authenticated, and extracted using suitable solvents such as ethanol or methanol. The antimicrobial activity of the extracts was assessed against selected bacterial and fungal strains by employing standard microbiological techniques, including the agar well diffusion method and measurement of zones of inhibition.The results indicated that both plant extracts exhibited significant inhibitory effects against the tested microorganisms. *Phyllanthus emblica* showed comparatively higher antimicrobial activity, which may be attributed to the presence of bioactive compounds such as tannins, flavonoids, and phenolic constituents. *Vitis vinifera* also demonstrated considerable antibacterial and antifungal effects due to its rich polyphenolic composition. The findings suggest that these plant extracts possess promising antimicrobial potential and may serve as effective natural sources for the development of antibacterial and antifungal agents. Further investigations are required to isolate and characterize the active components responsible for their biological activity and to evaluate their potential pharmaceutical applications.

Keywords: *Phyllanthus emblica*, *Vitis vinifera*, antibacterial activity, antifungal activity, plant extracts, antimicrobial resistance, phytochemicals, agar well diffusion method.

INTRODUCTION

Infectious diseases caused by pathogenic microorganisms remain a major global health concern. The increasing incidence of bacterial and fungal infections, along with the rapid development of resistance to conventional antimicrobial drugs, has created a serious challenge in modern healthcare. The misuse and overuse of antibiotics have contributed significantly to antimicrobial resistance, reducing the effectiveness of existing therapies. Therefore, there is a growing interest in the exploration of plant-based natural products as alternative sources of antimicrobial agents due to their safety, effectiveness, and minimal side effects.

Medicinal plants have been widely used in traditional systems of medicine for the prevention and treatment of various infectious diseases. They contain a variety of bioactive compounds such as alkaloids, flavonoids, tannins, phenolic compounds, and terpenoids, which are known to possess antimicrobial properties. These phytochemicals exert their effects by inhibiting microbial growth, disrupting cell membranes, interfering with enzyme activity, and preventing microbial replication. Screening of plant extracts for antibacterial and antifungal activity plays an important role in identifying potential therapeutic agents for the development of new drugs.

Phyllanthus emblica, commonly known as amla or Indian gooseberry, is a medicinal plant widely used in traditional medicine for its diverse therapeutic properties. It is rich in vitamin C, tannins, flavonoids, and other phenolic compounds, which contribute to its

antioxidant, anti-inflammatory, and antimicrobial activities. The presence of these bioactive constituents makes it a promising candidate for evaluating antibacterial and antifungal effects against various pathogenic microorganisms.

Similarly, *Vitis vinifera*, commonly known as grape, is another plant known for its nutritional and medicinal value. It contains significant amounts of polyphenols, flavonoids, resveratrol, and organic acids that exhibit strong biological activities, including antimicrobial, antioxidant, and anti-inflammatory effects. These phytochemicals have been reported to inhibit the growth of several bacterial and fungal species, making this plant a valuable source for antimicrobial screening.The screening of these plant extracts for antibacterial and antifungal activity is essential to evaluate their effectiveness against pathogenic microorganisms and to identify potential natural alternatives to synthetic antimicrobial agents. The present study focuses on investigating the antimicrobial potential of *Phyllanthus emblica* and *Vitis vinifera* by assessing their inhibitory effects against selected bacterial and fungal strains using standard microbiological methods. The findings of such studies may contribute to the development of novel plant-based antimicrobial agents and support the use of medicinal plants in pharmaceutical applications.

Therapeutic and Medicinal Uses:

1. Management of Bacterial Infections:

Screening studies of *Phyllanthus emblica* and *Vitis vinifera* help identify their effectiveness against disease-causing bacteria. Their extracts contain bioactive constituents such as flavonoids, tannins, and phenolic compounds that inhibit bacterial growth. These properties support their use in managing infections affecting the respiratory tract, gastrointestinal system, urinary tract, and skin. The antibacterial activity also suggests their potential as natural alternatives to conventional antimicrobial agents.

2. Treatment of Fungal Infections:

The antifungal screening of these plants demonstrates their ability to suppress the growth of pathogenic fungi. Plant extracts can interfere with fungal cell membrane function and metabolic processes, thereby preventing fungal proliferation. This activity is beneficial in managing conditions such as skin infections, mucosal infections, and other fungal disorders caused by opportunistic pathogens.

3. Wound Healing and Infection Prevention:

The antimicrobial properties of both plants play an important role in wound management. Their antibacterial and antifungal effects help prevent microbial contamination at the site of injury, reducing the risk of infection. In addition, their antioxidant components promote tissue regeneration, accelerate healing, and minimize inflammation.

4. Gastrointestinal Disorder Management:

The therapeutic use of these plant extracts extends to the treatment of gastrointestinal infections caused by harmful microorganisms. Their antimicrobial activity helps control pathogens responsible for diarrhea, dysentery, and gastric disturbances. They also help maintain microbial balance in the digestive tract, supporting overall digestive health.

5. Enhancement of Immune Defense:

Bioactive compounds present in *Phyllanthus emblica* and *Vitis vinifera* contribute to strengthening the immune system. Their antimicrobial and antioxidant properties help the body resist infections by improving natural defense mechanisms and protecting cells from oxidative damage.

6. Development of Herbal Therapeutic Agents:

Screening these plants for antimicrobial activity provides scientific evidence for their use in herbal drug development. Their broad-spectrum antibacterial and antifungal effects, along with relatively low toxicity, make them promising candidates for the formulation of plant-based medicines and pharmaceutical preparations.

7. Anti-inflammatory and Protective Effects

Apart from their antimicrobial action, these plant extracts exhibit anti-inflammatory properties that reduce tissue damage caused by infections. Their protective effects help in managing inflammatory conditions and support recovery from microbial diseases.

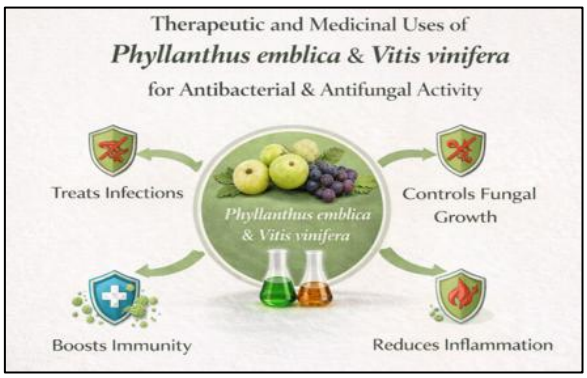

Figure:1 Therapeutic and medicinal uses

Therapeutic Applications:

1. Bacterial Infection Control – Inhibits the growth of pathogenic bacteria causing respiratory, gastrointestinal, and skin infections.

2. Fungal Infection Management – Suppresses fungal pathogens responsible for skin and mucosal infections.

3. Wound Healing Support – Prevents microbial contamination and promotes faster healing of infected wounds.

4. Gastrointestinal Protection – Controls harmful microbes in the digestive tract and maintains gut health.

5. Immune Enhancement – Strengthens immune defense against bacterial and fungal infections through antimicrobial and antioxidant action.

Materials and Methods:

Collection of Plant Materials:

Fresh fruits of *Phyllanthus emblica* (amla) and *Vitis vinifera* (grapes) are collected from a reliable source and authenticated by a qualified botanist. The plant materials are washed thoroughly with distilled water to remove dust and contaminants. They are then shade-dried at room temperature to preserve their bioactive constituents and later ground into a coarse powder using a mechanical grinder.

Preparation of Plant Extracts:

The powdered plant materials are subjected to extraction using suitable solvents such as ethanol, methanol, or aqueous solution. The extraction is commonly performed by maceration or Soxhlet extraction method. In maceration, the plant powder is soaked in the solvent for 48–72 hours with occasional stirring. The extracts are then filtered using filter paper and concentrated using a rotary evaporator or water bath to obtain crude extracts. The dried extracts are stored at low temperature until further use.

Test Microorganisms:

The antimicrobial activity of the plant extracts is evaluated against selected bacterial and fungal strains. Common bacterial strains include Gram-positive and Gram-negative organisms, while fungal strains include pathogenic fungi responsible for infections. Pure cultures of microorganisms are obtained from microbiological laboratories and maintained on suitable culture media.

Preparation of Culture Media:

Nutrient agar or Mueller–Hinton agar is used for bacterial cultures, while Sabouraud dextrose agar is used for fungal cultures. The media are prepared according to standard procedures, sterilized in an autoclave, and poured into sterile Petri plates under aseptic conditions. The prepared plates are allowed to solidify before inoculation.

Preparation of Inoculum:

Microbial inoculum is prepared by transferring a loopful of microbial culture into sterile nutrient broth and incubating it at an appropriate temperature to achieve a standardized microbial suspension. The turbidity of the suspension is adjusted to ensure uniform microbial growth during screening.

Antibacterial Screening Method:

The antibacterial activity of *Phyllanthus emblica* and *Vitis vinifera* extracts is commonly evaluated using the agar well diffusion or disc diffusion method. Sterile agar plates are inoculated with bacterial cultures using a sterile swab. Wells are made in the agar using a sterile cork borer, and measured concentrations of plant extracts are introduced into the wells. The plates are incubated at 37°C for 24 hours, after which the zone of inhibition around the wells is measured to determine antibacterial activity.

Antifungal Screening Method:

For antifungal activity, a similar agar diffusion method is used. Fungal cultures are inoculated on Sabouraud dextrose agar plates, and plant extracts are introduced into wells or discs placed on the agar surface. The plates are incubated at suitable conditions for fungal growth, typically for 48–72 hours. The antifungal activity is evaluated by measuring the inhibition zones around the extract.

Determination of Minimum Inhibitory Concentration (MIC):

The minimum inhibitory concentration of the plant extracts is determined using broth dilution methods. Different concentrations of plant extracts are prepared and added to microbial cultures in broth media. After incubation, the lowest concentration of extract that prevents visible microbial growth is recorded as the MIC.

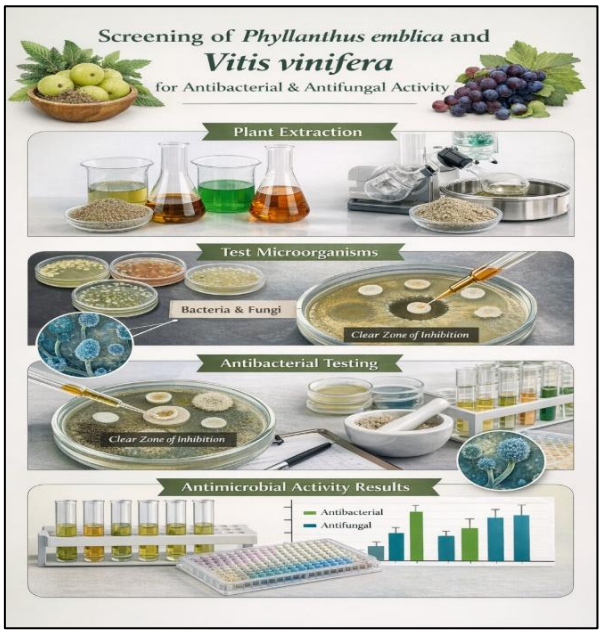

Figure:2

Microbial Assay for Antibacterial and Antifungal Activity

1. Preparation of Plant Extracts

Fresh fruits or plant materials of *Phyllanthus emblica* and *Vitis vinifera* are washed thoroughly with distilled water, shade-dried, and ground into fine powder. The powdered material is extracted using suitable solvents such as ethanol, methanol, or aqueous medium through Soxhlet extraction or maceration. The extract is filtered and concentrated using a rotary evaporator and stored at 4°C until use.

2. Test Microorganisms

The antimicrobial activity is evaluated against selected pathogenic microorganisms.

Bacterial strains (antibacterial screening):

Escherichia coli (Gram-negative)

Staphylococcus aureus (Gram-positive)

Pseudomonas aeruginosa

Bacillus subtilis

Fungal strains (antifungal screening):

Candida albicans

Aspergillus niger

Aspergillus flavus

The microbial cultures are obtained from recognized culture collections and maintained on nutrient agar (bacteria) and potato dextrose agar (fungi).

3. Preparation of Inoculum

Fresh microbial cultures are prepared by transferring colonies into sterile broth media.

Bacterial inoculum: Adjusted to approximately 0.5 McFarland turbidity standard (≈10^8 CFU/mL).

Fungal inoculum: Spore suspension prepared in sterile saline or distilled water.

Standardization of inoculum ensures reproducibility of results according to Clinical and Laboratory Standards Institute guidelines.

Antibacterial Activity Assay

4. Agar Well Diffusion Method

This method determines the inhibitory effect of plant extracts against bacteria.

Procedure:

1.Sterile molten nutrient agar is poured into Petri plates and allowed to solidify.

2.The standardized bacterial inoculum is uniformly spread on the agar surface using a sterile swab.

3.Wells of about 6 mm diameter are made using a sterile cork borer.

4.Different concentrations of plant extracts are introduced into the wells.

5.A standard antibiotic (e.g., streptomycin or ampicillin) is used as positive control, while solvent serves as negative control.

6.Plates are incubated at 37°C for 18–24 hours.

7.The zone of inhibition around each well is measured in millimeters.

Interpretation:
Larger zones indicate stronger antibacterial activity of the extract.

5. Minimum Inhibitory Concentration (MIC)

MIC determines the lowest concentration of extract that inhibits visible microbial growth.

Procedure:

1.Serial dilutions of plant extracts are prepared in nutrient broth.

2.Standard bacterial inoculum is added to each tube.

3.Tubes are incubated at 37°C for 24 hours.

4.The lowest concentration showing no turbidity is recorded as MIC.

Antifungal Activity Assay

6. Poisoned Food Technique

This method evaluates inhibition of fungal growth by plant extracts.

Procedure:

1.Plant extract is mixed with molten potato dextrose agar at required concentrations.

2.The medium is poured into sterile Petri plates and allowed to solidify.

3.A fungal disc (5–7 mm diameter) from an actively growing culture is placed at the center.

4.Plates are incubated at 25–28°C for 3–5 days.

5.Radial growth of fungal colonies is measured and compared with control.

7. Disc Diffusion Method (Alternative Antifungal Assay)

1.Sterile discs impregnated with plant extract are placed on fungal culture plates.

2.Plates are incubated at suitable temperature.

3.Zones of inhibition are measured to assess antifungal activity.

8. Statistical Analysis

All experiments are conducted in triplicate, and results are expressed as mean ± standard deviation. Statistical comparison may be performed using appropriate tests such as ANOVA.

RESULTS

The antimicrobial activity of *Phyllanthus emblica* and *Vitis vinifera* extracts was evaluated against selected bacterial and fungal strains using agar well diffusion, minimum inhibitory concentration (MIC), and poisoned food techniques. The extracts exhibited varying degrees of inhibitory activity depending on concentration and microorganism tested.

CONCLUSION:

The present study demonstrated that extracts of *Phyllanthus emblica* and *Vitis vinifera* possess significant antibacterial and antifungal activities against selected pathogenic microorganisms. The observed antimicrobial effects may be attributed to the presence of bioactive phytochemicals such as tannins, flavonoids, phenolic compounds, and polyphenols, which inhibit microbial growth through various mechanisms including disruption of cell membranes and interference with metabolic processes. Among the tested extracts, *Phyllanthus emblica* showed comparatively higher antimicrobial activity, indicating its strong therapeutic potential. The findings support the traditional use of these medicinal plants in the treatment of infectious diseases and highlight their importance as natural alternatives to synthetic antimicrobial agents. Furthermore, these plant extracts may serve as promising candidates for the development of plant-based pharmaceutical formulations with minimal side effects. However, further research is required to isolate, identify, and characterize the active constituents responsible for antimicrobial activity and to evaluate their safety, efficacy, and clinical applications.

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Conflict of Interest Statement: All authors have nothing else to disclose.