“Nature’s Hidden Defense”

National Science Fair Research Paper

Level : Senior Level

Category : Life Science

Submitted by

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ABSTRACT

Fruit peels are a rich source of natural bioactive compounds such as polyphenols, flavonoids, and antioxidants. These compounds exhibit potential antimicrobial properties that can help fight bacterial infections naturally. This study aims to compare the antibacterial activity of Sapota, Jamun, and Custard apple peels against two common pathogenic bacteria—Streptococcus pneumoniae and Escherichia coli—using the disc diffusion method.

The results showed that Jamun peel extract exhibited the highest antibacterial activity, followed by Custard apple and Sapota. This study highlights the potential of fruit peel waste as an eco-friendly source of natural antimicrobial agents.

INTRODUCTION

Fruit peels are often discarded as waste, yet they contain high levels of bioactive compounds such as polyphenols, flavonoids, and antioxidants, which may possess antimicrobial activity. In India, fruits like Sapota, Jamun, and Custard apple are commonly consumed, and their peels contribute significantly to household waste. Exploring the antibacterial properties of these peels can provide an eco-friendly way to utilize fruit waste while discovering natural antimicrobial agents.

STATEMENT OF THE PROBLEM

Fruit peel waste is rich in bioactive compounds but is rarely used in antimicrobial research. There is limited data on the antibacterial properties of Sapota, Jamun, and Custard apple peels against disease-causing bacteria such as Streptococcus pneumoniae and E. coli.

This study addresses the question:
Which fruit peel (Sapota, Jamun, or Custard apple) shows the highest antibacterial activity against Streptococcus pneumoniae and E. coli?

OBJECTIVES

- To prepare extracts from Sapota, Jamun, and Custard apple peels.
- To test their antibacterial activity against Streptococcus pneumoniae and E. coli.
- To compare and identify which peel has the strongest antibacterial potential.

HYPOTHESIS

Among Sapota, Jamun, and Custard apple peels, Jamun peel will show the highest antibacterial activity against Streptococcus pneumoniae and E. coli due to its rich polyphenolic and anthocyanin content.

DESIGN OF STUDY

Independent Variable:

- Type of fruit peel (Sapota, Jamun, Custard apple).

Dependent Variable:

- Antibacterial activity (measured as inhibition zone in mm).

Controlled Variables:

- Bacterial strains (Streptococcus pneumoniae and E. coli).
- Extraction method (ethanol maceration).
- Temperature and incubation time (37°C for 24 hours).
- Type of agar medium.

MATERIALS REQUIRED

- Nutrient broth and agar medium
- Peels of Sapota, Jamun, Custard apple
- 96% Ethanol
- Streptococcus pneumoniae and E. coli cultures
- Sterile Petri dishes (120 mm)
- Sterile filter paper discs
- Mortar and pestle
- Incubator (37°C)
- Digital calipers

PROCEDURE

Preparation of Peel Extracts

- Collect Sapota, Jamun, and Custard apple peels.
- Wash thoroughly, air-dry in shade for 1 week, and grind into fine powder.
- Extract bioactive compounds by maceration in 96% ethanol.

Preparation of Bacterial Cultures

Grow Streptococcus pneumoniae and E. coli in nutrient broth and incubate for 24 hours.

Disc Diffusion Test

- Mix 0.5 ml of bacterial culture with 50 ml of molten agar medium (50°C).
- Pour into sterile Petri dishes and allow to solidify.
- Place sterile discs soaked in fruit peel extracts on the agar surface.

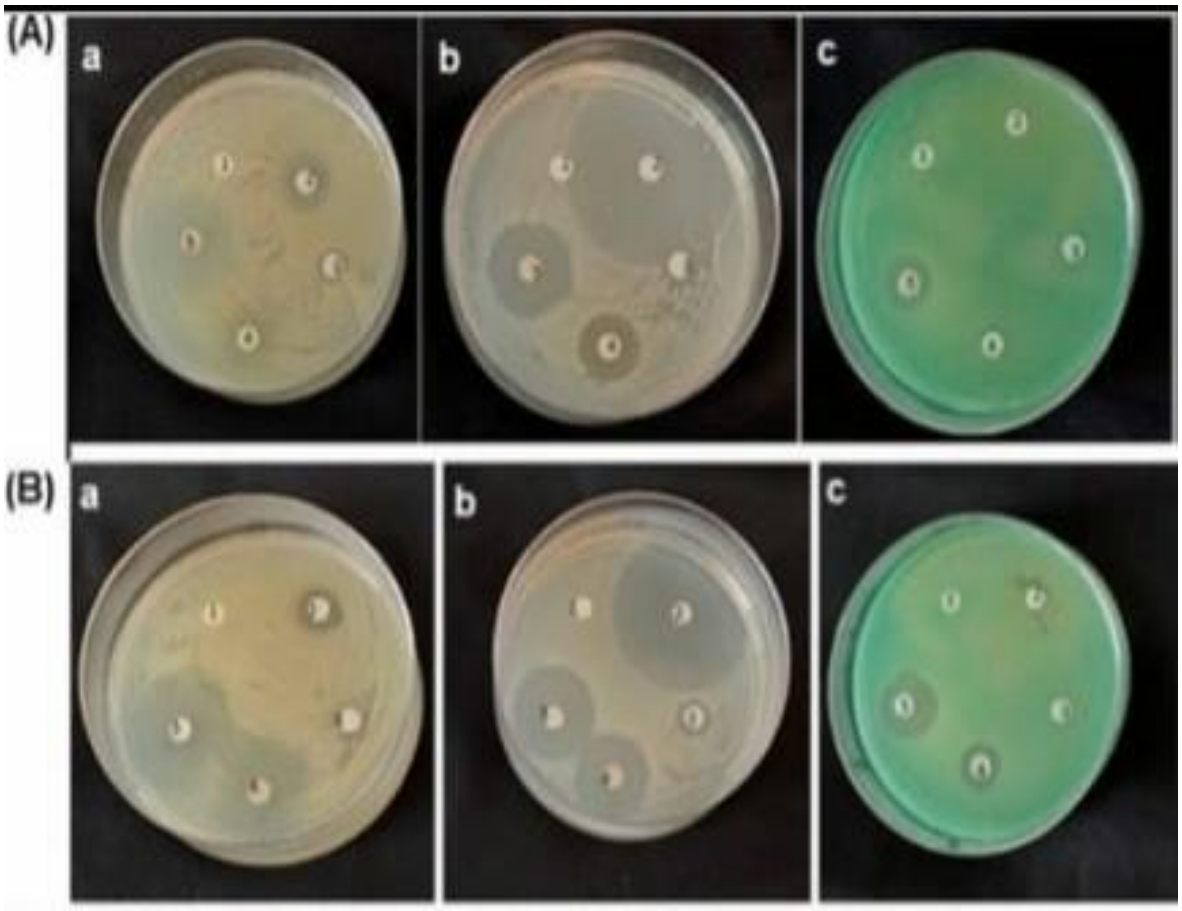
Incubation and Observation

- Incubate the plates at 37°C for 24 hours.
- Measure the inhibition zones (in mm) around the discs using digital calipers.

COLLECTION OF DATA:
PHOTOGRAPHS:
PEELS OF:
SAPOTA CUSTARD APPLE JAMUN

POWDER OF:
SAPOTA CUSTARD APPLE JAMUN

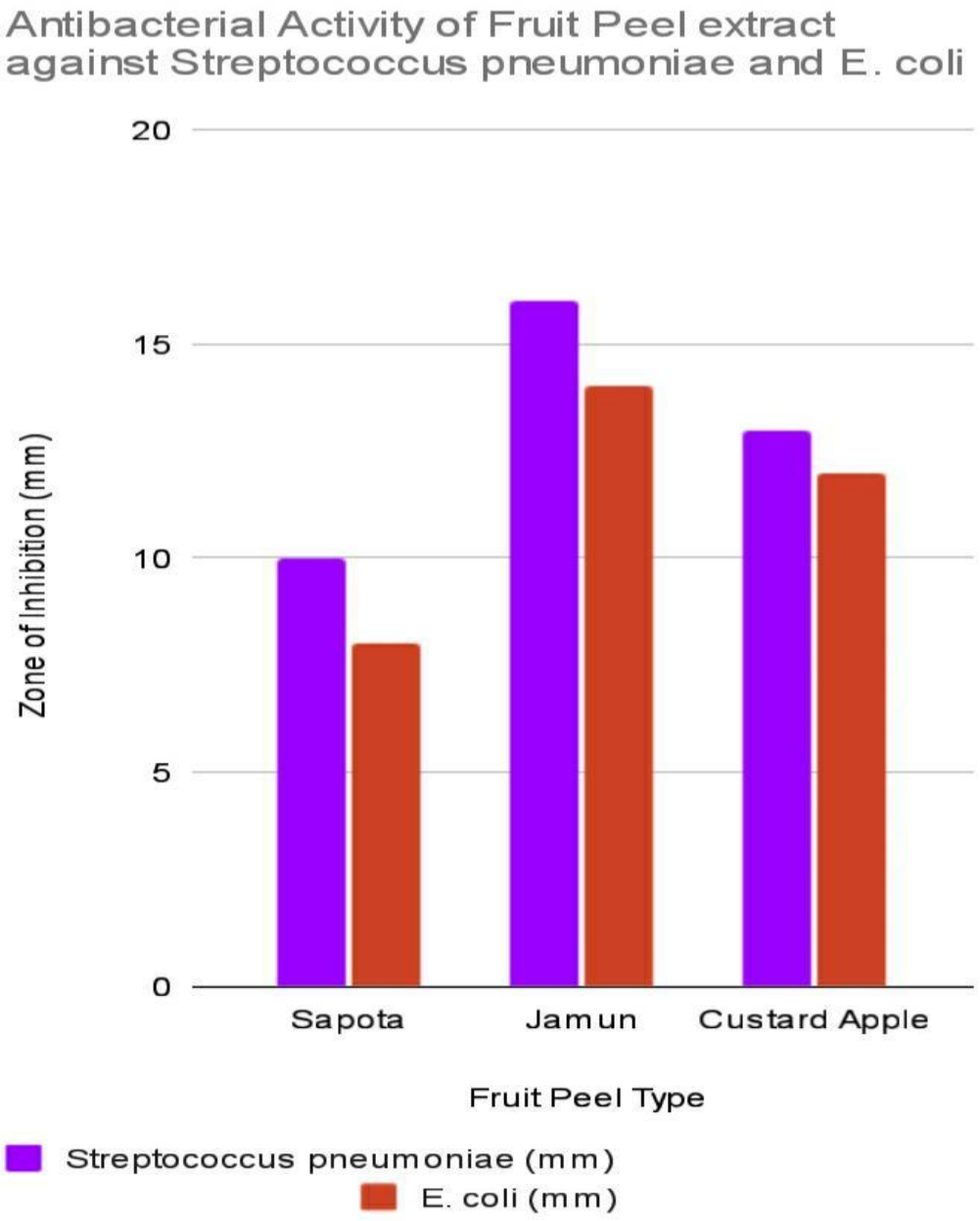
ZONE OF INHIBITION (mm)



OBSERVATION TABLE

Fruit Peel Extract	Test Organism	Zone of Inhibition (mm)
Sapota Peel	*Streptococcus pneumoniae*	10 mm
Sapota Peel	*E. coli*	8 mm
Jamun Peel	*Streptococcus pneumoniae*	16 mm
Jamun Peel	*E. coli*	14 mm
Custard Apple Peel	*Streptococcus pneumoniae*	13 mm
Custard Apple Peel	*E. coli*	12 mm

GRAPHICAL REPRESENTATION



RESULT

Jamun peel extract produced the largest inhibition zones against both Streptococcus pneumoniae (16 mm) and E. coli (14 mm).
Custard apple peel showed moderate antibacterial activity, while Sapota peel exhibited the least.
Thus, Jamun peel demonstrated the strongest antimicrobial potential, confirming the hypothesis.

CONCLUSION

The study concludes that fruit peels, especially Jamun peel, possess significant antibacterial properties. This validates their potential as natural, cost-effective alternatives to synthetic antibiotics. Utilizing fruit peel waste can also help reduce environmental pollution.

APPLICATION

- Development of natural antimicrobial formulations (ointments, soaps, or mouthwashes).
- Fruit peel-based bioproducts for eco-friendly sanitation.
- Educational demonstration of waste-to-resource biological principles.

FUTURE ENHANCEMENT

- Test against additional bacterial species (e.g., Staphylococcus aureus, Salmonella).
- Use advanced extraction methods (Soxhlet, ultrasonic).
- Quantify specific bioactive compounds through chromatography (HPLC, GC-MS).
- Develop peel-based herbal antibacterial gels or sprays.

REFERENCES

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