

Evaluation of the Antibacterial Potential of Jackfruit (*Artocarpus heterophyllus*) Leaf Extracts against Oral Pathogenic Bacteria

Reena R¹, Dr. K. Sukesh², Kiranshika K. S³

¹M.Sc. Microbiology Student, Department of Microbiology, Malankara Catholic College, Mariagiri, Affiliated to Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

²Associate Professor & Research Supervisor, Department of Microbiology, Malankara Catholic College, Mariagiri, Affiliated to Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

³Microbiology Research Scholar, Department of Microbiology, Malankara Catholic College, Mariagiri, Affiliated to Manonmaniam Sundaranar University, Tirunelveli, Tamil Nadu, India

Abstract:

Dental caries is one of the most prevalent oral diseases worldwide and is primarily associated with the colonization of *Streptococcus mutans*. The increasing occurrence of antimicrobial resistance and the adverse effects associated with synthetic antimicrobial agents have prompted the search for effective plant-based alternatives. The present study was undertaken to evaluate the phytochemical constituents and antimicrobial activity of *Artocarpus heterophyllus* (jackfruit) leaf extracts against *Streptococcus mutans* isolated from dental caries samples. Oral samples were collected, and bacterial isolates were identified using standard microbiological and biochemical methods. Leaf extracts were prepared using six different solvents, namely ethanol, methanol, acetone, chloroform, benzene, and distilled water. Phytochemical screening was carried out to detect the presence of major bioactive compounds, and the antimicrobial activity of the extracts was assessed using standard microbiological techniques. The phytochemical analysis revealed the presence of important secondary metabolites, including alkaloids, saponins, and tannins, while glycosides were absent in the tested extract. The ethanolic extract exhibited the highest antimicrobial activity against *Streptococcus mutans* when compared with the other solvent extracts, indicating that ethanol was the most effective extraction solvent for recovering antibacterial phytoconstituents from jackfruit leaves. The findings suggest that *Artocarpus heterophyllus* leaves possess promising antibacterial potential and may serve as a natural source of bioactive compounds for the development of herbal oral healthcare products. Further investigations involving purification of active compounds, toxicity evaluation, and clinical studies are recommended to validate their therapeutic applications in the prevention and management of dental caries.

Keywords: *Artocarpus heterophyllus*, Antimicrobial activity, Dental caries, Ethanolic leaf extract, Oral pathogens, Phytochemical screening, *Streptococcus mutans*.

I. INTRODUCTION

Oral health is related closely to the overall health of the body and affects the quality of life of a person. Among the various oral diseases, dental caries is one of the most common chronic diseases that affect both

children and adults throughout the world. This disease is caused due to the progressive demineralization of enamel and dentin as a result of the metabolism of acidogenic microorganisms present in dental plaque. If not treated properly, dental caries can cause pain, pulp infection, tooth loss, and other problems leading to a huge public health burden.

Streptococcus mutans is one of the major causative agents that are linked to the initiation and development of dental caries disease. Because of its special abilities to attach to the surface of teeth, to produce polysaccharides, and to form biofilms, and because the organism produces organic acids through fermentation of carbohydrates, *S. mutans* is capable of occupying the oral cavity and creating an acidified environment that contributes to the demineralization of the enamel. Therefore, reducing the level of *S. mutans* has become a widely accepted means of preventing dental caries.

Currently, the application of conventional antimicrobial agents and chemical mouthwashes is common practice in oral disease treatment; however, prolonged usage of synthetic antimicrobial products may contribute to the development of antimicrobial resistance and changes in normal oral microbiota, as well as changes in the state of the oral cavity characterized by the occurrence of certain side effects including the staining of teeth, changes in taste perception, and irritation of mucous membranes of the mouth. Thus, scientific research on alternative sources of effective, safe, and inexpensive antimicrobial agents is required.

Medicinal plants seem to be quite important contributors to the development of naturally based antimicrobial drugs. They are known for containing a wide range of secondary metabolites such as alkaloids, flavonoids, saponins, tannins, and phenolic compounds, which have pharmacological properties. Moreover, these phytochemicals are of great interest because of the comparatively low occurrence of side effects compared to traditional antimicrobial medications.

Artocarpus heterophyllus Lam (jackfruit) of the Moraceae family is widespread over the whole tropical area and cultivated in India. Some parts of this plant, including its leaves, root, bark, and fruits, have been used in folk medicine for a long time to treat various diseases. Previous researches have confirmed that jackfruit leaves possess many bioactive components that have antimicrobial properties. The present research studied the antimicrobial effectiveness of extracts from jackfruit leaves against *Streptococcus mutans*. The technology used for the extraction was the same as the one used for extracting conventional antibiotics. Both physical and chemical identification methods were used in the study followed by the energetic advantage study of methodologies employed in the process of extracting. The outcome of the study may lead to the creation of new plant-based medicines and the new herbal oral hygiene products used in the fight against dental caries.

Need for the Study

Tooth decay continues to be one of the most common dental conditions that people suffer from globally. It is a major concern for dental specialists and the public as persons from any age group are affected equally. Tooth decay is mainly associated with infection caused due to colonization of *Streptococcus mutans*, which is responsible for the development of caries. Although synthetic antibacterial agents and commercial oral hygiene products are available, the issue of development of resistance among microorganisms, recurring diseases, and side effects like tooth discoloration, alteration of taste, and irritation of oral mucosal tissues has emphasized the need for safer and effective alternatives to current therapies.

Research on medicinal plants has attracted the attention of various researchers for their bioactive compounds with a good range of therapeutic effects including antimicrobial, antioxidant, anti-

inflammatory and other properties. Among several plants, *Artocarpus heterophyllus* (jackfruit) is considered a traditional medicine to treat a variety of health issues. Preliminary studies have shown that different parts of jackfruit have phytochemicals like alkaloids, flavonoids, tannins, saponins, and phenolic compounds, and some of these compounds possess good antibacterial properties against a number of pathogens. However, the information related to antimicrobial activity of jackfruit leaves against oral pathogens including *Streptococcus mutans* is not available in the literature.

Peeking into the phytochemicals and antimicrobial properties of *Artocarpus heterophyllus* leaves is, therefore, important to evaluate and identify possible natural compounds with applications in oral hygiene. The study may help in creating mouthwash and toothpaste formulations that are made from plants, effectively binding the benefits of the agents mentioned above.

Therefore, the objective of the current study is the isolation and identification of *Streptococcus mutans* from dental caries samples, identification of the presence of phytochemical constituents and the antibacterial activity of the leaf extracts. The obtained outcomes of this study could be used in future studies investigating the use of jackfruit leaves for the prevention and treatment of dental caries in patients.

II. RESEARCH METHODOLOGY

This study aims to assess the presence of phytochemicals and the antimicrobial efficacy of jackfruit leaf extracts against *Streptococcus mutans*, obtained from dental caries. The research methods included isolation of pathogenic bacteria, preparation of extracts, phytochemical analysis, assessment of antimicrobial activity, and result interpretation. The methodology is elaborated below.

2.1 Study Design

An experimental laboratory study was carried out to carry out the research in the Department of Microbiology of Malankara Catholic College in Mariagiri. The goal of the study was to establish the antibacterial properties of the extracts of *Artocarpus heterophyllus* leaves with respect to the *Streptococcus mutans* from the sample denature.

2.2 Collection of Plant Material

Fresh, healthy leaves of *Artocarpus heterophyllus* were collected from locally available jackfruit trees. The collected leaves were washed thoroughly with distilled water to remove dust and debris, shade-dried at room temperature, and powdered using a sterile mechanical grinder. The powdered plant material was stored in airtight containers until further use.

2.3 Preparation of Leaf Extracts

The powdered leaf material was extracted using six different solvents, namely ethanol, methanol, acetone, chloroform, benzene, and distilled water. The extracts were prepared following standard solvent extraction procedures and filtered to obtain clear extracts. The concentrated extracts were stored under refrigerated conditions until used for phytochemical and antimicrobial analyses.

2.4 Isolation and Identification of Bacterial Isolates

Dental caries samples were collected under aseptic conditions and inoculated onto Mitis Salivarius Base Agar for the selective isolation of *Streptococcus mutans*. The inoculated plates were incubated at 37°C for 24–48 hours. Isolated colonies were identified based on colony morphology, Gram staining characteristics, and standard biochemical tests, including Indole, Methyl Red, Voges–Proskauer, Citrate Utilization, Catalase, Oxidase, Urease, and Carbohydrate Fermentation tests.

2.5 Phytochemical Screening

Qualitative phytochemical analysis of the prepared leaf extracts was carried out to detect the presence of

major secondary metabolites. The extracts were screened for alkaloids, flavonoids, saponins, tannins, glycosides, and other phytochemical constituents using standard phytochemical procedures. The presence or absence of each phytochemical group was recorded based on characteristic colour reactions and precipitate formation.

2.6 Antimicrobial Activity Assay

The antimicrobial activity of the various leaf extracts against *Streptococcus mutans* was evaluated using the agar diffusion method under aseptic laboratory conditions. Standardized bacterial inocula were prepared and uniformly spread on the culture medium. Wells or discs containing the different solvent extracts were placed on the inoculated plates, followed by incubation at 37°C for 24 hours. The antimicrobial activity was assessed by measuring the diameter of the zone of inhibition around each extract. The solvent extract producing the largest inhibition zone was considered the most effective against the test organism.

2.7 Data Analysis

The experimental observations obtained from phytochemical screening, biochemical identification, and antimicrobial activity assays were compiled and analysed using descriptive methods. The findings were presented in tables and figures, and the antibacterial efficacy of the different solvent extracts was compared to identify the most active extract against *Streptococcus mutans*. The results were interpreted to evaluate the potential of *Artocarpus heterophyllus* leaves as a natural antimicrobial agent for oral healthcare applications.

IV. RESULTS AND DISCUSSION

4.1 Phytochemical Screening of *Artocarpus heterophyllus* Leaf Extract

Qualitative phytochemical analysis of the leaf extract of *Artocarpus heterophyllus* was conducted with the aim of identifying the major bioactive components present in the extract. The results indicated the presence of a number of secondary metabolites with a well-established antimicrobial activity. While the leaf extract contained alkaloids, saponins, and tannins, no flavonoids or glycosides were found in the extract, preferably under the experimental conditions used. The presence of these phytochemicals suggests the presence of antimicrobial components in the leaves of jackfruit and thus supports its traditional use in medicine.

Table 4.1. Phytochemical constituents detected in *Artocarpus heterophyllus* leaf extract

Phytochemical constituent	Observation
Alkaloids	Present (+)
Flavonoids	Absent (–)
Saponins	Present (+)
Tannins	Present (+)
Glycosides	Absent (–)

The presence of alkaloids, saponins, and tannins may contribute to the antibacterial activity of the plant extract. These compounds are reported to interfere with bacterial cell wall integrity, membrane permeability, enzyme activity, and microbial metabolism, thereby inhibiting bacterial growth.

4.2 Isolation and Identification of *Streptococcus mutans*

The isolation of *Streptococcus mutans* was achieved in oral samples obtained from patients with dental

caries using the Mitis Salivarius base agar method. The colonies were then characterized based on their unique morphological features. The confirmation of the identity of the bacterial culture as *Streptococcus mutans* was carried out through microscopic observation and biochemical tests.

Table 4.2. Biochemical characteristics of the bacterial isolate

Biochemical test	Result
Gram staining	Negative
Indole	Negative
Methyl Red	Negative
Voges–Proskauer	Negative
Citrate utilization	Negative
Catalase	Negative
Oxidase	Negative
Carbohydrate fermentation	Positive
Urease	Negative

The Gram-stain result is reported exactly as recorded in the thesis.

4.3 Antimicrobial Activity of Jackfruit Leaf Extract

The different solvent extracts of the leaves of *Artocarpus heterophyllus* were tested for their antimicrobial effect against *Streptococcus mutans* isolated from humans. The ethanolic extracts proved to give the best antibacterial results as compared to other solvent extracts. The ethanolic extracts were indeed the most efficient products of the extraction process for isolating antimicrobial phytochemicals from jackfruit leaves. It is suggested that the antibacterial property may be due to the presence of alkaloids, saponins, and tannins present.

4.4 Discussion

The current study proved that *Artocarpus heterophyllus* leaf extract has promising antibacterial effects against *Streptococcus mutans*, which is one of the microorganisms responsible for dental caries. The evaluation of phytochemicals in jackfruit leaves established that certain compounds could exhibit antimicrobial activity. Moreover, these compounds could be effective because they may disrupt cell membranes, interfere with the metabolic pathways, or inhibit enzymatic activity.

The results of the antibacterial tests revealed that the ethanolic extract has had the highest antibacterial effect on *Streptococcus mutans*. This means that ethanol has efficiently extracted active compounds from leaves and validated the claims stated in the thesis that explain the antibacterial nature of jackfruit leaves. Based on this study, it can be assumed that *Artocarpus heterophyllus* leaves can serve as natural sources of antimicrobial agents and can be applied to herbal oral care products; however, it is recommended to conduct further studies about the isolation of phytochemicals, determination of minimum inhibition concentrations, assessment of toxicity, and clinical studies.

ACKNOWLEDGMENT

The authors sincerely appreciate the management and the principal of Malankara Catholic College, Mariagiri, Tamil Nadu, India for giving the necessary facilities and creating a good research atmosphere

for conducting the study. The authors also thank the all contributors who did it voluntarily for providing samples for the study. Their help was important for the smooth completion of the research. The authors thank their family members and close friends for helping them throughout the research work.

REFERENCES

1. Landim, R. R., Alencar, G., Tahim, M. O., Gomes, M. A. M., & Costa Filho, R. N. (2012). Studies on the biological properties of *Artocarpus heterophyllus*. *Journal of Medicinal Plant Research*.
2. Abadi, H., Diana, V. E., Tarigan, J., Khairani, T. N., & Sundari, T. (2021). Phytochemical and biological evaluation of *Artocarpus heterophyllus*. *Jurnal Ilmiah Manuntung*, 7(1), 66–72.
3. Fonseca, C. M. B. Desidratação da jaca (*Artocarpus heterophyllus* Lam.). (Publication details as available in the original source.)
4. Nuria, M. C., & Faizatun, A. (2009). Antibacterial activity of ethanol extract of *Jatropha curcas* leaves against *Staphylococcus aureus*, *Escherichia coli*, and *Salmonella typhi*. *Mediagro: Jurnal Ilmu-Ilmu Pertanian*, 5(2).
5. Prakash, O., Kumar, R., Mishra, A., & Gupta, R. (2009). Pharmacognostic and phytochemical studies on medicinal plants. Faculty of Pharmacy, Babu Banarasi Das National Institute of Technology and Management, Lucknow, India.
6. Alan, G., Mathew, C., Cissell, R., & Liamthong. (2007). Antibiotic resistance in bacteria associated with food animals.
7. Madaleno, I. M. (2011). Traditional uses of organic medicinal plant species. *Acta Horticulturae*, 925, 321–326.
8. Loizzo, M. R., Tundis, R., Chandrika, U. G., Abeysekera, A. M., Menichini, F., & Frega, N. G. (2010). Antioxidant and antibacterial activities of *Artocarpus heterophyllus* leaf extracts against foodborne pathogens.
9. Mubarak, Z., Chismirina, S., & Qamari, C. A. (2016). Antibacterial activity of cinnamon (*Cinnamomum burmannii*) extract against *Enterococcus faecalis*. *Cakradonya Dental Journal*, 8(1).
10. Karthy, E. S., Ranjitha, P., & Mohankumar, A. (2009). Antimicrobial potential of plant seed extracts against multidrug-resistant methicillin-resistant *Staphylococcus aureus* (MDR-MRSA).
11. Majid, N. S., Yamlean, P. V., & Citraningtyas, G. Formulation and antibacterial effectiveness of cream containing *Artocarpus heterophyllus* leaf extract.
12. Raaman, N., Sivaraj, C., & Tenzing. (2014). Antioxidant activities and phytochemical analysis of methanol extract of *Artocarpus heterophyllus* leaves. *International Journal of Pharmacy and Pharmaceutical Sciences*, 6, 289–293.