e-ISSN: 2637-0611

Available online at
https://journal.uitm.edu.my/ojs/index.php/COS

Compendium of Oral Science 12 (2) 2025, 154 - 163

Compendium of Oral Science

Anti-Bacterial and Anti-Biofilm Activities of *Hopea ferrea* Stembark Extract against Cariogenic Bacterium

Nurul 'Izzah Mohd Sarmin[1,3*], Fatin Azfareena Mohd Haris[2,3], Nur Raihan Aqilah Mohammad Azmin[2,3], Juliana Yusoff[2,3] & Isna Athirah Othman[2,3]

[1]*Centre of Preclinical Science Studies, Faculty of Dentistry, Universiti Teknologi MARA (UiTM) Sungai Buloh Campus, Jalan Hospital 47000 Sungai Buloh, Selangor, Malaysia*
[2]*Faculty of Applied Sciences, Universiti Teknologi MARA (UiTM), 40450 Shah Alam, Selangor, Malaysia*
[3]*Atta-ur-Rahman Institute for Natural Product Discovery (AuRIns), Universiti Teknologi MARA (UiTM) Selangor Branch, Puncak Alam Campus, 42300 Bandar Puncak Alam, Selangor, Malaysia*

ARTICLE INFO

Article history:
Received 06 June 2024
Revised 04 November 2025
Accepted 03 March 2025
Online First
Published 01 September 2025

Keywords:
Hopea ferrea
anti-bacterial
anti-biofilm
cariogenic bacterium

DOI:
10.24191/cos.v12i2.8838

ABSTRACT

Dental caries, caused by enamel-adherent cariogenic bacteria breaking down sugars into acid, gradually demineralizes tooth structure. Cariogenic biofilms contribute significantly to antibiotic resistance, treatment failure, increased morbidity, and rising healthcare costs. Hence, research is exploring strategies to interrupt biofilm formation and bacterial communication, aiming to modify the microbial pathogenic cycle. This interest is supported by studies on *Hopea ferrea's* therapeutic potential due to its secondary compounds like flavonoids, phenols, and tannins.

Objectives: The main objective of the present study is to determine the minimum inhibitory concentration (MIC), minimum bactericidal concentration (MBC), and anti-biofilm activity of *H. ferrea* extract against cariogenic bacteria namely *Streptococcus mutans.*

Method: This study used a Brain Heart Infusion (BHI) medium for growing bacterium *S. mutans*. Antimicrobial activity was tested by growing bacteria on agar plates and in broth cultures. Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC) were determined following standard procedures. Biofilms were grown in 24-well plates, and their biomass was assessed using a crystal violet stain. Finally, data was analyzed using GraphPad Prism.

Results: The results showed that the MIC and MBC results of the *H. ferrea* extract against *S. mutans* were at of 2.5 mg/mL. Anti-biofilm activity of the extract using crystal violet assay showed significant reduction of the biomass at 2.5 and 1.25 mg/mL ($p<0.01$). However, biofilm reduction on the biomass was not significant on formed biofilm.

[1,3*] Corresponding author. *E-mail address*: izzahsarmin@uitm.edu.my

Conclusion: The anti-biofilm activity of *H. ferrea* extract against *S. mutans* suggests its potential as a promising candidate for further development as a natural anti-biofilm agent in dentistry.

1. INTRODUCTION

Dental caries, commonly known as tooth decay, is a major global health issue affecting individuals of all ages, with an estimated 2 billion cases worldwide (WHO, 2018). Dental caries, commonly known as tooth decay, arises primarily from dental biofilm, a complex microbial community adhering to tooth surfaces (Moore et al., 2020). It is primarily caused by biofilms, complex microbial communities that adhere to tooth surfaces and produce acids leading to enamel demineralization. Among the bacteria responsible for dental caries, *Streptococcus mutans* plays a crucial role in initiating biofilm formation and generating an acidic microenvironment that promotes demineralization (Balhaddad et al., 2019). Management of dental biofilm is vital for preventing tooth decay, involving polymicrobial colonies from the oral microbiota (Balhaddad et al., 2019).

Two essential strategies are employed to manage dental biofilm and prevent dental caries and periodontal disorders. Mechanical control reduces periodontopathogens, altering the pocket microbiota composition, and influencing the long-term success of periodontal therapy (Moore et al., 2020). Proper oral hygiene practices, including mechanical biofilm control, are crucial, emphasizing the significance of preventive education initiatives. Due to the increasing prevalence of antimicrobial resistance and the limitations of synthetic antimicrobial agents such as chlorhexidine, research has shifted toward exploring plant-derived compounds as alternative antibacterial and anti-biofilm agents (Tungmunnithum et al., 2018).

In addition to mechanical approaches, chemical biofilm control methods, like chlorhexidine (CHX), disrupt bacterial cell membranes, impeding biofilm formation (Naumova et al., 2019). Despite comparable efficacy observed between commonly used CHX mouthwash concentrations, concerns persist regarding microbial resistance and adverse effects, necessitating judicious antibiotic therapy use in dental practice (Fernandes et al., 2018; Koukos et al., 2016).

Hopea ferrea, a member of the Dipterocarpaceae family, has been traditionally used in Southeast Asia for its medicinal properties, including its antimicrobial and anti-inflammatory effects. The presence of bioactive secondary metabolites such as flavonoids, tannins, alkaloids, and phenolics makes this plant a promising candidate for developing novel antibacterial treatments (Ranganathaiah et al., 2016). These phytochemicals have been shown to interfere with bacterial quorum sensing, inhibit biofilm formation, and disrupt bacterial cell membranes, making them potential alternatives for managing dental caries (Naumova et al., 2019).

Moreover, natural sources like *Hopea ferrea* are gaining interests for managing dental biofilm and preventing dental caries and periodontal disorders due to their rich composition of secondary compounds with medicinal properties (Tungmunnithum et al., 2018). These compounds exhibit antimicrobial and anti-biofilm activities, potentially mitigating the risk of dental caries and periodontal disorders, offering promising applications in oral healthcare products (Balhaddad et al., 2019). This plant, also known as ironwood or Malaysian ironwood, holds promise for biofilm modulation and dental care, aligning with ongoing efforts to combat dental caries and periodontal diseases (Nparks, 2023).

The main objective of this study is to investigate the antibacterial and anti-biofilm activities of *H. ferrea* extract against *S. mutans*, determine its minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC), and evaluate its potential mechanism of action. By understanding the

https://doi.org/10.24191/cos.v12i2.8838

effects of this extract on cariogenic bacteria, this research aims to provide insight into the development of natural, plant-based oral healthcare products with reduced side effects and antimicrobial resistance risks.

2. MATERIALS AND METHOD

2.1 Extraction method

The stembark of *Hopea ferrea* was collected from a reserve forest in Pulau Tuba, Langkawi, Malaysia, and authenticated at the herbarium with voucher number PT9. The stembark of *H. ferrea* was air-dried, and finely powdered. Approximately 100 g of powdered bark was extracted in 500 mL of methanol for 72 hours with occasional stirring. The extract was filtered and concentrated using a rotary evaporator (Buchi, Switzerland) at 40°C under reduced pressure to remove the solvent. The final crude extract was stored at 4°C until further use. The extraction yield was calculated and recorded for consistency in subsequent assays.

2.2 Materials

In this experiment, the Brain Heart Infusion (BHI) medium from Oxoid, United Kingdom, and Melford, UK, was utilized for both agar and broth cultures. This choice was made due to its suitability for supporting the growth of various microorganisms. Additionally, cultures were stored as glycerol stocks at -80°C to ensure long-term preservation. The microbial species employed in the study was *Streptococcus mutans* (NCTC 10449), obtained from the Atta-ur-Rahman Institute for Natural Product Discovery (AuRIns).

2.3 Antimicrobial activity

S. mutans was stored in glycerol at -80°C. Agar plates were streaked with culture were incubated at 37°C for 72 hours. *S. mutans* was cultured on Columbia blood agar. Finally, the bacterial species were cultured statically in their respective broth, which was BHI at 37°C (25-30 mL) for 72 hours.

2.4 Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC)

The modified method was carried out as instruction of the Clinical and Laboratory Standards Institute (CLSI) using a 96-well microtiter plate technique in order to determine the MIC value or minimal concentration of an antimicrobial agent required to inhibit in-vitro visible growth of microorganisms. This test was repeated 3 times in duplicate to ensure reproducibility of the results.

First, a 96-well microtiter plate was removed from its sterile packaging and labeled accordingly. 50 µl of sterile Brain Heart Infusion (BHI) was loaded to each well from column 2-11, 100 µl in the sterility controls wells (column 12). Next, each 100 µl of extract was pipette into their respective wells (column 1). The two serial dilution were made, 50 µl of sample was transfer from the first well to the next in such a way that each well had 50 µl of test samples with serially descending concentration each row. 50 µl of the mixed solution was pipette out from the last well of each row out (column 10). The same serial dilution for positive and negative control wells was applied to each plate.

The overnight grown microorganisms was adjusted to a standardized final OD620nm of approximately 0.08 - 0.10 to meet the 0.5 McFarland standard of 5×10^8 CFU/mL and was mix using a vortex. Then, the adjusted suspension was diluted to 1:100 by adding 200 µl of bacterial suspension to 19.9 mL sterile BHI to prepare a 20 mL of bacterial inoculum, mixed well. This gave a final inoculum concentration of 5×10^5 CFU/mL in each well.

https://doi.org/10.24191/cos.v12i2.8838

Next, 50 µl of adjusted bacterial inoculum was dispensed into each well except the sterility control well (column 12). The final volume in each well was 100 µl. The microtiter plate was covered and incubated at 35 °C for 18 to 24 hours (bacterial strains). Controls that have been incorpartaed in these study were positive control (C): Chlorhexidine; vehicle control (VC): 0.5% Dimethyl Sulfoxide (DMSO); sterility control (SC): sterile BHI and growth control (GC): bacteria and BHI.

Subsequently, bacterial growth observation was performed by adding 10 µL of resazurin solution (5mg/mL) to each well and further incubating for the next 4 hours. MIC was defined as the lowest concentration of the extract that completely inhibited growth in comparison with the non-treated control. The minimum bactericidal concentration (MBC) was determined by pipetting 10 µl of each well suspension onto the BHI and incubate at 35 °C for 18 - 24 hours. This step had done on the same day.

2.5 Development of bacterial biofilms

The development of bacterial biofilms aimed to mimic the oral environment within patients' mouths. Two 24-well plates were designated for the biofilm assay, with one plate labeled for preformed cariogenic biofilm and the other for formed cariogenic biofilm, both consisting of *S. mutans*. Broth cultures were standardized and inoculated into the wells, followed by biofilm growth using a 600 µL inoculation volume in clear flat-bottomed plates. On day 1, *S. mutans* was inoculated into the biofilm. To introduce treatments, 6 µL of each well was replaced accordingly. The plates were then incubated at 37°C. For the formed biofilm plate, the supernatant was replaced with fresh BHI broth after 24 hours, followed by the addition of treatments. Each step was performed meticulously to minimize disruption of the biofilm structure.

2.6 Biofilm assessment: Crystal Violet (CV) Assay and data presentation

For the assessment of biofilms, the biomass was quantified using a crystal violet (CV) stain. Initially, the supernatant was removed, and the biofilm was washed twice with phosphate-buffered saline (PBS). Subsequently, it was fixed with 200 µl of methanol for 15 minutes, air-dried for 45 minutes with the plate lid partially covered, and stained with 200 µl of CV for 20 minutes at room temperature. After washing twice with running water, acetic acid was added for color development. A 100 µl sample was collected in duplicate from each well and placed in a 96-well plate for spectroscopy analysis at 620 nm. The data collected were corrected with a blank value of acetic acid, and the average value of each sample was determined. Graphs were generated using GraphPad Prism to present the data, which was utilized to investigate the biofilm response to treatments. This methodological approach contributes to the support objectives of the study, focusing on the development of bacterial biofilms and their assessment using the crystal violet assay as part of the biochemical method to evaluate antibacterial activity against Streptococcus mutans, a cariogenic microorganism.

3. RESULTS

3.1 Determination of Minimum Inhibitory Concentration (MIC) and Minimum Bactericidal Concentration (MBC)

The antimicrobial activity of *H. ferrea* extract against selected bacterial strains was assessed to determine the MIC and MBC values. MIC assay of the extract on *S. mutans* (NCTC 10449) was conducted using the 96-well microplate technique, with comparison to negative and positive controls. Resazurin test was employed to observe bacterial growth, with colour change indicating viability. The MIC value for *S. mutans* treated with the extract was determined to be 2.5 mg/ml, while the MBC value was the same. The MIC and MBC values of 2.5 mg/mL suggest a strong antimicrobial potential. When compared to other

https://doi.org/10.24191/cos.v12i2.8838

plant-based antimicrobial agents, these values are within an effective range, indicating that *H. ferrea* could be a promising candidate for further drug development

3.2 Detection of biofilm biomass assay

The inhibitory potential of *H. ferrea* against *S. mutans* biofilm was assessed using a method outlined previously. This method detects microbial attachment to a surface and measures the optical density (OD) to quantify biofilm formation at 24 and 48-hour time points. Figure 1 illustrates the 24-hour biofilm created by *S. mutans*, evident by the violet film along the microplate walls and bottoms. *S. mutans* was selected for its role as the main bacterial colonizer of human dental biofilm. Solutions were loaded onto a 96-well microplate as depicted in Figure 2 while Figure 3 shows the view of 24-hours biofilm plate after fixation with acetic acid. after fixation with acetic acid. Tests were conducted in triplicate and results are presented in Table 1. The average values were calculated (Table 2) and graphed using GraphPad Prism (Figure 4). This graph supports visual analysis, where extended incubation periods resulted in increased biofilm production, with *S. mutans* biofilm activity was tested after 48 hours. At 2.5 mg/mL and 1.25 mg/mL, there was no significant degradation of biofilm biomass. However, raising the concentration may lead to degradation in the 48-hour biofilm. Chlorhexidine, the positive control, showed significant biomass reduction compared to the control at $p<0.05$.

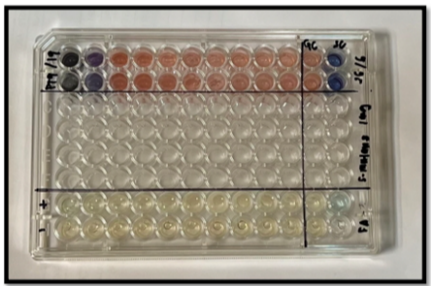

Fig. 1. Minimum Inhibitory Concentration (MIC) assay of *H. ferrea* extract on *S.mutans* (NCTC 10449). The MIC value was determined using the 96-well microplate technique, the MIC value is 2.5 mg/mL.

Notes: 1 (5 mg/mL), 2 (2.5 mg/mL), 3 (1.25 mg/mL), 4 (0.625 mg/mL), 5 (0.313 mg/mL), 6 (0.156 mg/mL), 7 (0.078 mg/mL), 8 (0.039 mg/mL), 9 (0.0195 mg/mL), 10 (0.0097 mg/mL).

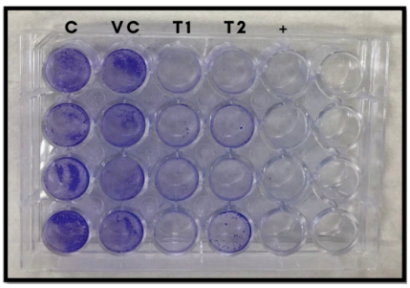

Fig. 2. Formation of experimental *S. mutans* biofilms in microwell plates using crystal violet assay in 24-hours biofilm.

https://doi.org/10.24191/cos.v12i2.8838

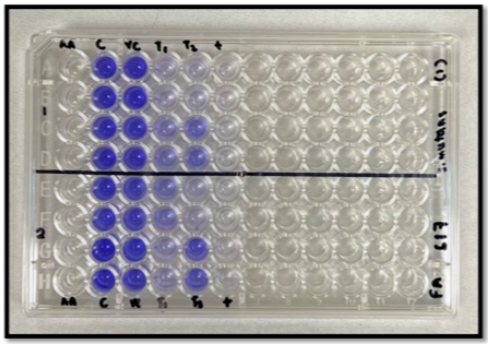

Fig. 3. View of 24-hours biofilm plate after fixation with acetic acid.

Table 1. Reading of 48-hours biofilm values of *H. ferrea* extract againts *S. mutans*.

Biofilm	Technical replicates duplicates	Crystal violet assay					
		Blank	Control	CHX	Vehicle control	2.5 mg/mL	1.25 mg/mL
24-hours biofilm	A1	0.096	0.601	0.51	0.619	0.613	0.567
	A1	0.096	0.721	0.519	0.772	0.737	0.686
	B1	0.092	0.763	0.48	0.739	0.704	0.621
	B1	0.09	0.792	0.518	0.791	0.737	0.7
	A2	0.091	0.764	0.441	0.777	0.553	0.484
	A2	0.096	0.745	0.492	0.803	0.573	0.514
	B2	0.093	0.774	0.444	0.815	0.596	0.605
	B2	0.094	0.64	0.497	0.694	0.515	0.539
	A3	0.09	0.612	0.452	0.682	0.56	0.595
	A3	0.088	0.655	0.467	0.716	0.588	0.615
	B3	0.089	0.595	0.428	0.502	0.583	0.589
	B3	0.088	0.607	0.483	0.54	0.569	0.634

Table 2. An average value of 24-hours biofilm for graph production using GraphPad Prism.

Biofilm	Technical replicates duplicates	Crystal violet assay					
		Blank	Control	CHX	Vehicle control	2.5 mg/mL	1.25 mg/mL
24-hours biofilm	1	0.087	0.448	0.108	0.421	0.164	0.185
	2	0.088	0.474	0.109	0.387	0.234	0.221
	3	o.089	0.554	0.121	0.495	0.180	0.197

https://doi.org/10.24191/cos.v12i2.8838

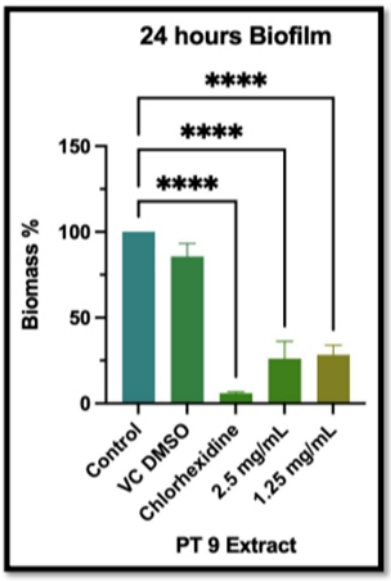

Fig. 4. The histogram of the classification of biofilm formation based on OD in 24- hours. The comparison of 24-hours was calculated by GraphPad Prism.

4. DISCUSSION

The study demonstrates that *H. ferrea* extract effectively inhibits the growth and kills *S. mutans*, a major contributor to dental caries, with both MIC and MBC values established at 2.5 mg/mL. This finding indicates that the extract has strong antibacterial properties against *S. mutans*. The use of resazurin in the MIC assay provided a clear and reliable indicator of bacterial viability, while the MBC assay confirmed the bactericidal capability of the extract. These results suggest that *H. ferrea* could be a potent natural antimicrobial agent for controlling *S. mutans*-related infections.

One of the key strengths of this study is the use of a well-established biofilm assay to evaluate the extract's efficacy. Regarding biofilm inhibition, the extract showed a significant reduction in biofilm biomass at concentrations of 2.5 mg/mL and 1.25 mg/mL after 24 hours. However, its limited effectiveness against mature biofilms highlights a potential limitation, indicating that it may be more effective in early-stage prevention rather than established infections.

The antibacterial and anti-biofilm activities of H. ferrea extract can be attributed to its high flavonoid and tannin content. Flavonoids interfere with bacterial enzyme systems and disrupt cell membrane integrity, leading to bacterial cell death (Ranganathaiah et al., 2016). Tannins bind to bacterial adhesins, inhibiting biofilm formation by preventing surface attachment (Naumova et al., 2019). This mechanism aligns with previous reports on plant-based antimicrobial agents. The choice of *S. mutans* is justified due to its significant role in dental caries and biofilm formation, making it a suitable model for assessing potential oral health applications.

Another important aspect is the potential for bacterial resistance development. Although plant-based antimicrobials are often regarded as safer alternatives to synthetic antibiotics, long-term exposure studies should be conducted to evaluate bacterial adaptation and resistance mechanisms. Comparative studies with

https://doi.org/10.24191/cos.v12i2.8838

conventional agents, such as chlorhexidine, may provide further insights into the extract's relative effectiveness and suitability for clinical use.

Given its bioactive compounds, *H. ferrea* extract could serve as a natural adjunct to conventional oral hygiene products. Integrating plant-based antimicrobial agents into mouthwashes, toothpaste, or dental coatings could help combat biofilm formation and dental caries progression. However, further clinical trials are essential to validate its efficacy and safety in real-world applications.

Despite its promising antibacterial properties, the long-term stability, formulation feasibility, and potential resistance mechanisms associated with *H. ferrea* extract require further investigation. Future studies should focus on synergistic combinations with existing antimicrobials, exploring potential drug delivery systems for enhanced bioavailability.

While *H. ferrea* extract shows promising antibacterial and anti-biofilm properties, its long-term effects on oral microbiota remain unknown. Some tannin-rich extracts are known to cause tooth staining and mild cytotoxic effects on human gingival fibroblasts (Moore et al., 2020). Therefore, further in vivo studies are essential to evaluate its safety profile before clinical applications.

5. CONCLUSION

This study highlights *H. ferrea* extract's effectiveness against *S. mutans*, a bacterium linked to tooth decay. By determining MIC and MBC values, it was proven that the extract inhibits bacterial growth (MIC = 2.5 mg/ml) and kills the bacteria (MBC = 2.5 mg/ml), aligning with previous research on plant-based compounds' antimicrobial effects. Moreover, the extract significantly reduces *S. mutans* biofilm at concentrations of 2.5 mg/mL and 1.25 mg/mL, suggesting its potential for preventing biofilm-related dental problems. However, more research is needed to determine the best dosage and exposure time. The extract shows promise for developing new treatments for tooth decay, though its effects on the mouth's natural bacteria and potential side effects must be considered. Future studies should explore how it works, its safety, and its effectiveness in real-life settings. Additionally, combining it with existing treatments could improve results.

ACKNOWLEDGMENTS

The authors are thankful to the Ministry of Higher Education for awarding the Fundamental Research Grant Scheme FRGS/1/2021/SKK0/UITM/02/33 for supporting to this study. Gratitude also expressed to the Atta-ur-Rahman Institute for Natural Product Discovery (AuRIns) for their provision of research facilities, invaluable advice, and guidance throughout the research process. We also extend our appreciation to the Faculty of Applied Sciences at UiTM Shah Alam and the Faculty of Dentistry at UiTM Sungai Buloh for their support.

CONFLICT OF INTEREST STATEMENT

The authors agree that this research was conducted in the absence of any self-benefits, commercial, or financial conflicts and declare the absence of conflicting interests with the funders.

AUTHORS' CONTRIBUTIONS

Nurul 'Izzah Mohd Sarmin, Fatin Azfareena Mohd Haris, Nur Raihan Aqilah Mohammad Azmin were contributed to data collection and manuscript writing. **Juliana Yusoff** was contributed to preparing the crude extract from *Hopea ferrea*. **Isna Athirah Othman** was responsible for editing the content, figures and tables. **Nurul 'Izzah Mohd Sarmin** designed the study, revised the manuscript, and approved it for submission.

REFERENCES

Balhaddad, A. A., Kansara, A. A., Hidan, D., Weir, M. D., Xu, H. H. K., & Melo, M. A. S. (2019). Toward dental caries: Exploring non-particle-based platforms and calcium phosphate compounds for dental restorative materials. *Bioactive Materials, 4*, 43-55. https://doi.org/10.1016/j.bioactmat.2018.12.002.

Fernandes, T., Bhavsar, C., Sawarkar, S., & D'souza, A. (2018). Current and novel approaches for control of dental biofilm. *International Journal of Pharmaceutics, 536*(1), 199-210. https://doi.org/10.1016/j.ijpharm.2017.11.019.

Koukos, G., Konstantinidis, A., Tsalikis, L., Arsenakis, M., Slini, T., & Sakellari, D. (2016). Prevalence of β-lactam (bla(TEM)) and metronidazole (nim) resistance genes in the oral cavity of Greek subjects. *Open Dentistry Journal, 10*, 89-98. https://doi.org/10.2174/1874210601610010089.

Moore, C., McLister, C., Cardwell, C., O'Neill, C., Donnelly, M., & McKenna, G. (2020). Dental caries following radiotherapy for head and neck cancer: A systematic review. *Oral Oncology, 100*, 104484. https://doi.org/10.1016/j.oraloncology.2019.104484.

Naumova, E. A., Weber, L., Pankratz, V., Czenskowski, V., & Arnold, W. H. (2019). Bacterial viability in oral biofilm after tooth brushing with amine fluoride or sodium fluoride. *Archives of Oral Biology, 97*, 91-96. https://doi.org/10.1016/j.archoralbio.2018.10.013.

Nparks. (2023). *Hopea ferrea*. Retrieved June 6, 2023, from https://www.nparks.gov.sg/florafaunaweb/flora/5/4/5420.

Ranganathaiah, P., Hanumanthappa, M., & Venkatarangaiah, K. (2016). Evaluation of in vitro anti-inflammatory activity of stem bark extracts of Mesua ferrea Linn. *International Journal of Pharmacy and Pharmaceutical Sciences, 8*(2), 173-177.

Tungmunnithum, D., Thongboonyou, A., Pholboon, A., & Yangsabai, A. (2018). Flavonoids and other phenolic compounds from medicinal plants for pharmaceutical and other medical aspects: An overview. *Medicines (Basel), 5*(3), 93. https://doi.org/10.3390/medicines5030093.

World Health Organization (WHO) (2018). Global Burden of Disease Study. https://www.who.int/health-topics/oral-health

6. APPENDIX

A. About the authors

Nurul 'Izzah Mohd Sarmin is a Senior Lecturer at Universiti Teknologi MARA (UiTM). Her research interest in the anti-biofilm activity of endophytic actinomycetes and medicinal plants against multi-species oral biofilms focuses on the role of quorum-sensing systems in regulating microbial resistance mechanisms, to reduce antimicrobial resistance cases. She is working on isolating anti-biofilm compounds from Dipterocarpaceous plants and peptides from endophytic bacteria.

Fatin Azfareena Mohd Haris graduated with Bachelor of Science (Hons.) in Applied Microbiology at UiTM. Her worked on antibacterial and antibiofilm activity of Hopea ferrea extract against cariogenic bacterium has open up to the discovery of bioactive compounds from the plant.

Nur Raihan Aqilah Mohammad Azmin recently graduated with a Master of Science in Applied Biology at UiTM and is preparing to pursue her PhD studies. Her research interest in microbiology leads to the development of innovative therapeutic products in reducing oral biofilm formation. She is currently exploring in-situ gel systems formulated with bioactive peptides isolated from endophytic bacteria. Her work focuses on harnessing natural compounds to target oral pathogens and contribute to alternative strategies for managing biofilm-related dental diseases.

Juliana Yusoff is a Senior Research Assistant Officer at Atta-ur-Rahman Institute for Natural Product Discovery (AuRIns). Her research focuses on chromatographic techniques. She is working on extraction, isolation and purification of compounds from plants.

Isna Athirah Othman is a researcher at AuRIns. Her work focuses on the isolation, purification, and structural elucidation of bioactive compounds from medicinal plants. Her previous work explored the antidiabetic potential of plant-derived metabolites through glucose uptake studies in muscle cells. She is currently working on isolating compounds from endophytic bacteria with potential antibiofilm activity.

https://doi.org/10.24191/cos.v12i2.8838