

Pharmacological Properties Of *Medinilla Speciosa* With Potential Relevance To Oral Health: A Scoping Review

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ABSTRACT

Background: Oral health is maintained through a dynamic balance between oral microorganisms, host immunity, and oral tissues. Loss of this balance leads to microbial dysbiosis and inflammation associated with many oral diseases. Multitarget agents such as herbal medicines are therefore being increasingly explored, as conventional medicine can lead to some side effects. *Medinilla speciosa* (Parijoto), an endemic Indonesian medicinal plant, has been reported to possess diverse pharmacological activities. However, its relevance to oral health has not been systematically synthesized.

Method: A scoping review was conducted using PubMed, ScienceDirect, Google Scholar, and Semantic Scholar using the search keyword: “*Medinilla speciosa*” AND (antibacterial OR antioxidant OR anti-inflammatory). The pharmacological activities of *Medinilla speciosa* reported in the included studies were recorded.

Result: A total of 253 papers were identified, of which six studies were selected after a rigorous screening process based on the PRISMA scoping review methodology. These studies demonstrated antibacterial activity against pathogenic bacteria, antioxidant properties, immunomodulatory effects, and anti-inflammatory activity. Additionally, although no studies have examined the effects of these extracts on oral tissues or models of oral diseases, their pharmacological properties are promising in terms of bacterial control, inflammation modulation, oxidative stress reduction, and tissue repair.

Conclusion: Current evidence suggests that *Medinilla speciosa* exhibits multitarget pharmacological activities with potential relevance to oral health. However, oral-specific experimental and clinical studies are required to further validate its potential application in dentistry and oral medicine.

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INTRODUCTION

Oral health is determined by a dynamic equilibrium among oral microflora, the host immune system, and the local tissue environment of the oral cavity. When this balance is disturbed, it can lead to dysbiosis, characterized by microbial overgrowth and chronic inflammation, as observed in a variety of oral diseases. These disturbances contribute to the pathogenesis of various oral diseases, such as infectious-inflammatory lesions, biofilm-induced diseases, and loss of oral tissue integrity, which can ultimately affect quality of life. Therefore, considering the mechanical forces and microbial insults to which oral tissues are constantly exposed, maintaining homeostasis in this niche represents a challenging and dynamic aspect of oral care ^{1,3}.

Oral pathological conditions are complex, as they result from multifactorial interactions among numerous biological pathways. Dysbiosis in the oral cavity may lead to chronic inflammation, which can increase oxidative stress levels and disrupt local physiological repair processes ^{4,6}. Therapeutic approaches with combined antibacterial, antioxidant and anti-inflammatory effects are therefore preferred for managing the complex mechanisms leading to poor oral health,

rather than treatments targeting a single pathological factors ⁷.

Conventional oral health therapies include antimicrobial and anti-inflammatory medicines. Although these treatments are effective in managing infection and inflammation, they may cause adverse effects such as disruption of oral microbial balance and increased antimicrobial resistance ^{7,10}. These limitations have increased interest in natural products as alternative therapies for oral health, particularly those with multiple mechanisms of action targeting pathological conditions ^{11,18}. By simultaneously controlling microorganisms, reducing inflammation and modulating immune responses, such agents may help maintain oral cavity health ¹¹.

Medinilla speciosa (Parijoto) is an endemic plant in Indonesia. *Medinilla speciosa* is known to contain phenolic and flavonoid compounds as its bioactive constituents.

Previous studies have shown that these bioactive compounds in *Medinilla speciosa* exhibit pharmacological properties such as antibacterial, antioxidant, immunomodulatory and anti-inflammatory activities ^{12,19}. These studies suggest that *Medinilla speciosa* could potentially provide benefits to oral health.

However, to date, there is limited systematically collected evidence regarding the relevance of *Medinilla speciosa* to oral health. Moreover, studies directly investigating the pharmacological effects of this plant on oral tissue or models of oral disease are scarce. This represents a gap in the current understanding. Therefore, this review aims to gather and summarize the existing evidence on the pharmacological properties of *Medinilla speciosa* and their relevance to oral health.

METHODS

Data Search

The data search method involved the collection of secondary data, which were not directly observed but obtained from previously published studies. A scoping review was conducted using databases such as PubMed, ScienceDirect, Google Scholar and Semantic Scholar. The search strategy was designed to retrieve articles evaluating the pharmacological effects of *Medinilla speciosa* and its relevance to oral health. The Boolean operators used were “*Medinilla speciosa*” AND (antibacterial OR antioxidant OR anti-inflammatory). The literature search was completed in December 2025. A PRISMA flow diagram was used to illustrate the study selection process.

Inclusion and Exclusion Criteria

The inclusion criteria for this review were: studies had to be original research articles published within the last five years (2021-2025), full text accessible articles, and focus of the research was *Medinilla speciosa* and its pharmacological effects. Besides, the articles had to be written in English. Studies that were article type other than original research, only contained abstracts, and did not concentrate on *Medinilla speciosa* and its pharmacological effects are excluded. The selected literature included both in vitro and in vivo studies.

RESULTS

Identified Studies

Articles were identified through searches of PubMed, ScienceDirect, Google Scholar and Semantic Scholar. The search identified one article from PubMed, one from ScienceDirect, 241 articles from Google Scholar, and 10 articles from Semantic Scholar. After duplicate removal, 33 articles were screened for eligibility. After screening, 27 articles were excluded based on the exclusion criteria. Finally, six articles were included in the qualitative synthesis. The comprehensive selection techniques are illustrated in Figure 1.

Summary of Identified Studies

Out of the 6 studies included, most studies employed in vitro assays, whereas one

study used an animal model. Most of the studies used extracts from the fruit or leaves of *Medinilla speciosa* and used alcoholic solvents for extract preparation^{13, 14, 16, 19}.

The included studies primarily investigated pharmacological activities, such as antibacterial, antioxidant, anti-inflammatory activity, which were also the primary focus of this review. To assess antibacterial activity, most studies employed in vitro agar diffusion assays^{16, 17, 19}. Antioxidant activity was evaluated based on the ability to neutralize free radicals. In addition, this also depends on how much phenolic or flavonoid substances they had¹⁴. For the anti-inflammatory effects, the studies evaluated how *Medinilla speciosa* affected immune and inflammatory responses^{13, 18}.

Although none of the included studies specifically investigated oral tissues or oral disease models, the reported pharmacological activities are mechanistically relevant to oral health. The characteristics and main findings of the included studies are summarized in Table 1.

Risk of Bias

The included studies presented several methodological aspects that may introduce potential sources of bias. Although most studies adequately

described extraction procedures and experimental protocols, variations in study design, extraction methods, and outcome measurements were observed. In addition, most studies relied on in vitro models with limited in vivo evidence and did not utilize oral disease-specific models. Moreover, standardized outcome assessments were not consistently reported. These factors were considered during data synthesis. Therefore, the findings of this review should be interpreted cautiously with regard to their translational relevance to oral health.

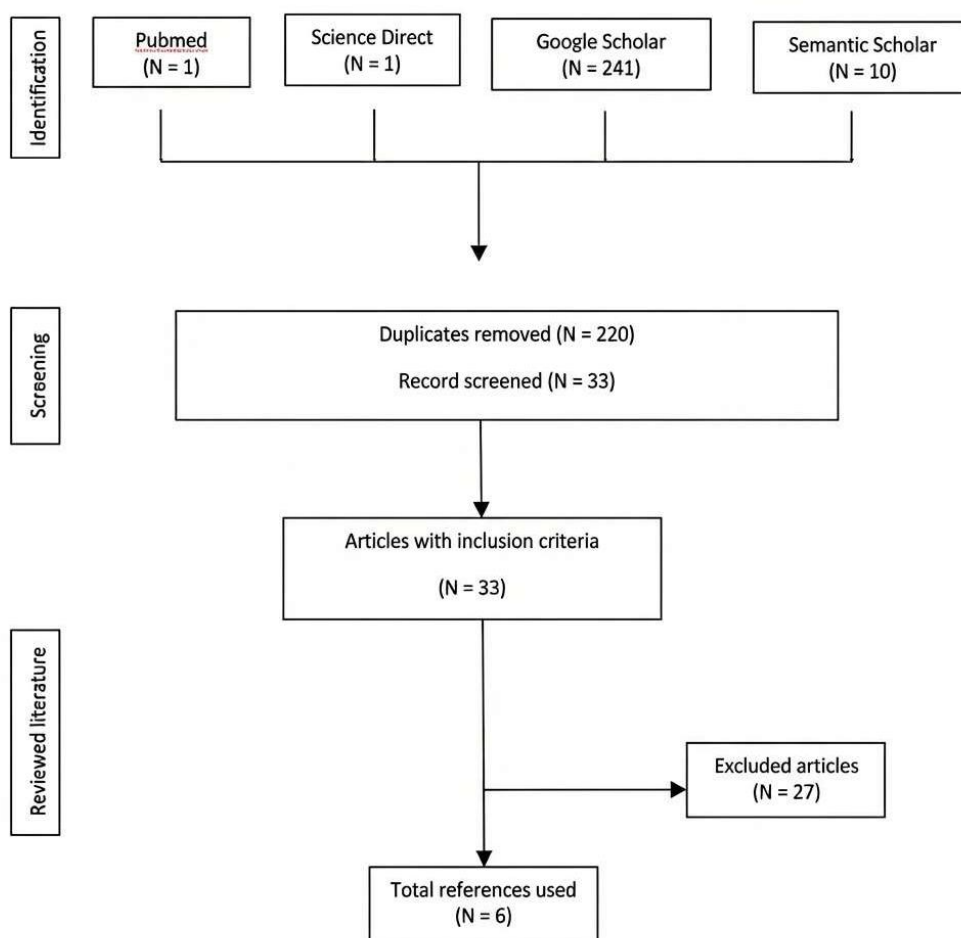


Figure 1. In the diagram, records are shown on PRISMA. Our initial search shows a total of 253 potential articles. Due to duplication, 220 articles were eliminated. Screening by titles, abstract and keyword on full text was conducted and founds 33 articles from this process based on inclusion criteria. Due to exclusion criteria, 27 articles were excluded. For the final, there were 6 articles decided for final synthesis.

Table 1. Pharmacological Properties from Reviewed Article and It's Relevance to Oral Health

Ref	Pharmacological Activity	Findings of Studies	The Relevance to Oral Health
Milanda et al. (2021) (16)	Antibacterial	<i>Medinilla speciosa</i> has antibacterial activity on <i>Streptococcus aureus</i> and <i>Streptococcus marcescens</i>	The antibacterial properties potentially control of pathogenic bacteria involved in oral infection and dysbiosis (20)
Farida et al. (2021) (17)	Antibacterial	<i>Medinilla speciosa</i> has antibacterial activity on <i>Pseudomonas aeruginosa</i>	Antibacterial broad-spectrum potentially against opportunistic gram-negative bacteria

(20)			
Damayanti et al. (2025) (14)	Antioxidant	<i>Medinilla speciosa</i> has phenolic and flavonoid as phytochemical substance which has the role as antioxidant	Antioxidant properties potentially protect oral tissue from oxidative stress associated with prolonged inflammation (5)
Winanta wt al. (2025) (18)	Immunomodulatory	Flavonoid compound on <i>Medinilla speciosa</i> exhibit a correlation with the immunomodulatory activity	Immunomodulation may support host defense and immune balance in oral tissue (3)
Sa'adah et al. (2025) (19)	Antibacterial	<i>Medinilla speciosa</i> has view phytochemical substance such as saponins, flavonoids, tannins, alkaloids, quinones, and phenols which have antibacterial activity	The antibacterial activity potentially helps prevent oral cavity from pathogenic bacteria and dysbiosis (20)
Luhurningty as et al. (2025) (13)	Anti-inflammatory	<i>Medinilla speciosa</i> reduced leukocyte as inflammatory represent cell on initial wound healing process	Anti-inflammatory activity support on oral wound healing tissue (21, 22)

DISCUSSION

Based on the results of six original studies, the research indicates that *Medinilla speciosa* has multiple pharmacological effects such as antibacterial, antioxidant, anti-inflammatory and immunomodulatory that potentially impact different processes related to the development of oral diseases. While none of the studies were conducted directly on oral tissues or models of oral disease, the effects observed are mechanistically linked to maintaining equilibrium in the oral cavity.

Comparative Analysis of Included Studies

Although all included studies reported beneficial pharmacological activities of *Medinilla speciosa*, the interpretation of these findings requires careful comparison across studies due to substantial heterogeneity in study designs, extraction approaches, and outcome assessments.

Most studies employed in vitro experimental models to evaluate antibacterial or antioxidant effects, primarily using agar diffusion assays or radical scavenging measurements, whereas only one study adopted an in vivo animal model to assess wound-healing and inflammatory responses. This fundamental difference in experimental design influences the types of biological effects that can be observed, with in vitro

studies focusing on isolated mechanisms and in vivo studies capturing more complex tissue-level responses.

Variations in extraction methods further contributed to heterogeneity among studies. While ethanolic extracts were predominantly used, differences in solvent concentration, plant parts (fruit versus leaves), and preparation protocols may have affected the composition and bioavailability of bioactive compounds. Consequently, reported pharmacological effects, such as antibacterial potency or antioxidant capacity, may reflect methodological differences rather than intrinsic variability of the plant itself. In addition, outcome measures varied considerably, ranging from bacterial growth inhibition and phytochemical quantification to immune cell activity and leukocyte modulation. These differences in measured endpoints complicate cross-study comparison and preclude quantitative synthesis of findings.

Taken together, the observed heterogeneity across experimental models, extraction strategies, and outcome parameters highlights that the current evidence base primarily supports mechanistic insights rather than direct translational conclusions. A more standardized approach to experimental design and outcome assessment would be

required in future studies to enable stronger comparative analyses and facilitate clearer interpretation of the pharmacological relevance of *Medinilla speciosa* to oral health.

These variations across study designs and outcome measures underscore the need for careful consideration of methodological limitations when interpreting the available evidence.

Methodological Limitations and Variability

Several methodological limitations should be considered when interpreting the evidence presented in this review. The majority of the included studies relied on in vitro experimental models, with only limited in vivo evidence and no oral-specific disease models. In addition, considerable variability was observed in extraction protocols, solvent concentrations, and experimental conditions, which may influence the consistency and reproducibility of the reported findings. Furthermore, outcome measures were not standardized across studies, limiting the comparability of results and constraining the generalizability of the evidence to clinical oral health contexts.

Despite these methodological limitations, the available findings provide a useful framework for discussing the

potential biological activities of *Medinilla speciosa* in relation to oral health.

Antibacterial Activity and Implications for Oral Microbial Control

Medinilla speciosa extracts have been found to be effective in fighting harmful bacteria. Milanda et al. used ethanolic fruit extracts to inhibit the growth of *Staphylococcus aureus* and *Serratia marcescens*, which showed antibacterial activity against both Gram-positive and Gram-negative organisms ¹⁶. Another study conducted by Farida et al. showed that *Medinilla speciosa* extracts demonstrated antibacterial activity against *Pseudomonas aeruginosa*. This finding indicates that *Medinilla speciosa* has antibacterial ability ¹⁷. Sa'adah et al. also prove that *Medinilla speciosa* various phytochemical compounds such as saponins, flavonoids, tannins, alkaloids, quinones, and phenols which have antibacterial activity ¹⁹.

Dysbiosis and excessive bacterial growth are central contributors to the development of oral cavity disease such as dental caries and periodontal disease ^{23, 24}. Even though the selected studies conduct the antibacterial activity not specific on oral pathogens, it shows that *Medinilla speciosa* has pharmacological properties which is potentially relevant for suppressing microbial growth in the oral

environment. Nevertheless, further studies employing oral bacterial isolates are required to confirm this applicability.

Antioxidant Activity and Protection Against Oxidative Stress

Excessive levels of oxidative stress play a role in damaging oral tissues and causing prolonged inflammation. A study held by Damayanti et al. revealed that ethanolic extract from *Medinilla speciosa* has high levels of total phenolic and flavonoid substances which aid in the effective inhibition of harmful free radicals ¹⁴.

Excessive levels of reactive oxygen species in oral tissues can lead to chronic wound healing conditions. Antioxidants may support the maintenance of reactive oxygen species balance ^{5, 20}.

Immunomodulatory Effects and Host Response Regulation

The research conducted by Winanta et al. found that *Medinilla speciosa* enhanced macrophage phagocytic activity and promoted lymphocyte proliferation, showing that it can affect both the body's first-line and long-term immune defenses ¹⁸. Notably, this study focused on immune cell function rather than direct suppression of inflammatory mediators.

In oral health, balanced immune responses are crucial for controlling microbial challenges while preventing excessive tissue destruction. Dysregulated

immune activation or dysbiosis is a hallmark of chronic or inflammatory oral diseases ^{3, 4}.

Anti-inflammatory and Tissue Repair Potential

Oral wounds are often caused by physical injury, surgeries, and inflammation and lead to mastication or phonation dysfunction. Therefore, it is important for wounds to heal properly. A study conducted by Luhurningtyas et al. showed that applying a gel made from *Medinilla speciosa* directly to wounds helped them close faster and made the tissue repair better in a rat model where wounds were made intentionally ¹³. This wound-healing activity was associated with changes in leukocyte responses, suggesting involvement of inflammatory and reparative processes.

Even though this wound model is not designed for oral tissue, it shows that the role of *Medinilla speciosa* on anti-inflammatory capability in tissue repair remains crucial to oral wounds healing. This is due to the special healing properties of the oral mucosa, which are more susceptible to injury. These findings suggest *Medinilla speciosa* may be useful in treating oral wounds, but further studies with oral-specific models are needed ^{21, 22}.

Overall Interpretation

According to the results of this review, *Medinilla speciosa* has several pharmacological properties that potentially impact oral health (Figure 2). However, due to the limitations of this study, the results indicate that additional studies of *Medinilla speciosa* effects on the oral cavity are required. Although the reviewed studies demonstrate promising pharmacological activities, differences in study design and experimental models should be considered

when interpreting their relevance to oral health.

Therefore, the relevance of these findings to oral health should be interpreted as mechanistic and exploratory in nature. In the absence of oral-specific experimental or clinical studies, the current evidence should be regarded as hypothesis-generating rather than clinically confirmatory.



Figure 2. *Medinilla speciosa* extracts exhibit antibacterial, antioxidant, immunomodulatory, and anti-inflammatory-related activities based on experimental evidence. The antibacterial activity is associated with the inhibition of pathogenic bacteria through bioactive compounds such as flavonoids, tannins, and phenolic constituents. Antioxidant activity reflects the ability to reduce oxidative stress by neutralizing reactive oxygen species. Immunomodulatory effects involve the regulation of immune cell responses, including macrophage activity and lymphocyte proliferation. Anti-inflammatory activity is indicated by modulation of inflammatory responses and leukocyte activity, which may support tissue repair processes. Collectively, these multitarget biological activities are mechanistically relevant to oral health through microbial control, regulation of inflammation, reduction of oxidative stress, and support of oral tissue healing.

CONCLUSION

The current experimental evidence presented in this scoping review indicates

that *Medinilla speciosa* has various pharmacological effects, such as antibacterial, antioxidant,

immunomodulatory, and anti-inflammatory. The activities are mechanistically significant and relevant to several key processes in oral health maintenance, including microbial control, modulation of inflammatory and immune responses, reduction of overall oxidative stress, and facilitation of tissue repair.

USE OF AI TOOLS DECLARATION

During the process of preparing this article, the author used Quillbot for grammar checking. However, the authors reviewed and edited the content as needed after, and took full responsibility for the content of the publication. The authors also used ChatGPT to generate a non-plagiarized figure (Figure 2). After using this tool, the authors reviewed and edited the content as needed with Canva photo editor.

AUTHOR CONTRIBUTIONS

AOS contributed to the study design, supervised and responsible for all processes until the submission of this article. FPRP and AFE contribute to the data analysis, review, and design of the illustration for this article.

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CONFLICT OF INTEREST

The authors have no conflict of interest to declare.

REFERENCES

1. Block C, Konig HH, Hajek A. Oral health and quality of life: findings from the Survey of Health, Ageing and Retirement in Europe. *BMC Oral Health*. 2022;22(1):606. <https://pmc.ncbi.nlm.nih.gov/articles/PMC9753255/>
2. Caselli E, Fabbri C, D'Accolti M, Soffritti I, Bassi C, Mazzacane S, et al. Defining the oral microbiome by whole-genome sequencing and resistome analysis: the complexity of the healthy picture. *BMC Microbiol*. 2020;20(1):120. <https://pubmed.ncbi.nlm.nih.gov/32423437/>
3. Gaffen SL, Moutsopoulos NM. Regulation of host-microbe interactions at oral mucosal barriers by type 17 immunity. *Sci Immunol*. 2020;5(43). <https://pubmed.ncbi.nlm.nih.gov/31901072/>
4. Kanzaki H, Wada S, Narimiya T, Yamaguchi Y, Katsumata Y, Itohiya K, et al. Pathways that Regulate ROS Scavenging Enzymes, and Their Role in Defense Against Tissue Destruction in Periodontitis. *Front Physiol*. 2017;8:351. <https://pubmed.ncbi.nlm.nih.gov/28611683/>
5. Liu W, Guo D. Oxidative stress in periodontitis and the application of antioxidants in treatment: a narrative review. *Front Physiol*. 2025;16:1485367. <https://pubmed.ncbi.nlm.nih.gov/40488141/>
6. Hunt M, Torres M, Bachar-Wikstrom E, Wikstrom JD. Cellular and molecular roles of reactive oxygen species in wound healing. *Commun Biol*. 2024;7(1):1534. <https://pubmed.ncbi.nlm.nih.gov/39562800/>
7. Monika P, Chandraprabha MN, Rangarajan A, Waiker PV, Chidambara Murthy KN. Challenges in Healing Wound: Role of Complementary and

- Alternative Medicine. *Front Nutr.* 2021;8:791899.
<https://pubmed.ncbi.nlm.nih.gov/35127787/>
8. Oliveira A, Simões S, Ascenso A, Reis CP. Therapeutic advances in wound healing. *J Dermatolog Treat.* 2022;33(1):2-22.
<https://pubmed.ncbi.nlm.nih.gov/32056472/>
 9. Kolimi P, Narala S, Nyavanandi D, Youssef AAA, Dudhipala N. Innovative Treatment Strategies to Accelerate Wound Healing: Trajectory and Recent Advancements. *Cells.* 2022;11(15).
<https://www.mdpi.com/2073-4409/11/15/2439>
 10. Hayashi M, Morimoto Y, Iida T, Tanaka Y, Sugiyama S. Risk of Delayed Healing of Tooth Extraction Wounds and Osteonecrosis of the Jaw among Patients Treated with Potential Immunosuppressive Drugs: A Retrospective Cohort Study. *Tohoku J Exp Med.* 2018;246(4):257-64.
<https://pubmed.ncbi.nlm.nih.gov/30568073/>
 11. Anwar MA, Sayed GA, Hal DM, Hafeez MSAE, Shatat A-AS, Salman A, et al. Herbal remedies for oral and dental health: a comprehensive review of their multifaceted mechanisms including antimicrobial, anti-inflammatory, and antioxidant pathways. *Inflammopharmacology.* 2025;33(3):1085-160.
<https://pubmed.ncbi.nlm.nih.gov/39907951/>
 12. Vifta RL, Sunnah I, Chanifah N, Advistasari Y. PURIFIKASI BUAH PARIJOTO (*Medinilla speciosa* Blume) DAN UJI BIOAKTIVITASNYA SEBAGAI ALTERNATIF PENGOBATAN DIABETES MELLITUS. *Media Informasi Penelitian Kabupaten Semarang.* 2019;2:185-99.
<https://sinov.semarangkab.go.id/index.php/sinov/article/view/92>
 13. Luhurningtyas F, Vifta RL, Musyarofah M. The Effect of Administration of Parijoto Fruit Extract Gel (*Medinilla speciosa*) on Incision Wound Healing and Total Leukocyte Count in Male Wistar White Rats. *Research Journal of Pharmacy and Technology.* 2025;2010-6.
<https://rjptonline.org/AbstractView.aspx?PID=2025-18-5-10>
 14. Damayanti PN, Luhurningtyas FP, Indrayati LL. Penetapan Kadar Fenolik dan Flavonoid Total Ekstrak Etanol Buah Parijoto (*Medinilla speciosa* Blume) dengan Metode Spektrofotometri UV-Vis. *Jurnal Farmasi (Journal of Pharmacy).* 2023.
https://www.researchgate.net/publication/373912526_Penetapan_Kadar_Fenolik_dan_Flavonoid_Total_Ekstrak_Etanol_Buah_Parijoto_Medinilla_speciosa_Blume_dengan_Metode_Spektrofotometri_UV-Vis
 15. Toni S R, Apriana M, Huda M, Kamal M, Allahuddin, Septiani R, et al. ARTIKEL REVIEW: STUDI FITOKIMIA DAN FARMAKOLOGI PARIJOTO (*Medinilla magnifica*). *Jurnal Buana Farma.* 2022;2:36-46.
<https://pdfs.semanticscholar.org/d490/777f480aa10920f4c63670883e88ac6f5a92.pdf>
 16. Milanda T, Lestari K, Tarina N. Antibacterial Activity of Parijoto (*Medinilla speciosa* Blume) Fruit Against *Serratia marcescens* and *Staphylococcus aureus*. *Indonesian Journal of Pharmaceutical Science and Technology.* 2021;8:76.
<https://jurnal.unpad.ac.id/ijpst/article/view/32166>
 17. Farida R, Vifta R, Erwiyani A. Uji Aktivitas Antibakteri Ekstrak Buah Parijoto (*Medinilla Speciosa* B.) Dengan Perbandingan Pelarut Etanol 70% Dan Etanol 96% Terhadap Bakteri *Pseudomonas Aeruginosa*. *Indonesian Journal of Pharmacy and Natural Product.* 2021;4.
<https://share.google/GuG0EOX8ynQ7ssD7V>
 18. Winanta A, Bagir H, Febriansah R, Nugraha AT. The immunomodulatory activity of parijoto fruit (*Medinilla speciosa*) fraction against phagocytosis macrophages and lymphocyte proliferation. *J Adv Pharm Technol Res.* 2025;16(1):6-11.
<https://pubmed.ncbi.nlm.nih.gov/40177515/>

19. Sa'adah A, Sari F, Sukoharjanti B, Darmawati S. The Effectiveness of Antibiofilm Synergy of Parijoto Leaf Extract (*Medinilla speciosa*) and Gentamicin on Methicillin-Resistant *Staphylococcus aureus* (MRSA) from Diabetic Ulcers. *Media Kesehatan Politeknik Kesehatan Makassar*. 2025;20:330-8.
<https://ojs3.poltekkes-mks.ac.id/index.php/medkes/article/view/1715>
20. Mira A, Simon-Soro A, Curtis MA. Role of microbial communities in the pathogenesis of periodontal diseases and caries. *J Clin Periodontol*. 2017;44 Suppl 18:S23-s38.
<https://pubmed.ncbi.nlm.nih.gov/28266108/>
21. Waasdorp M, Krom BP, Bikker FJ, van Zuijlen PPM, Niessen FB, Gibbs S. The Bigger Picture: Why Oral Mucosa Heals Better Than Skin. *Biomolecules*. 2021;11(8).
<https://pubmed.ncbi.nlm.nih.gov/34439831/>
22. Toma AI, Fuller JM, Willett NJ, Goudy SL. Oral wound healing models and emerging regenerative therapies. *Transl Res*. 2021;236:17-34.
<https://pubmed.ncbi.nlm.nih.gov/34161876/>
23. Kilian M, Chapple IL, Hannig M, Marsh PD, Meuric V, Pedersen AM, et al. The oral microbiome - an update for oral healthcare professionals. *Br Dent J*. 2016;221(10):657-66.
<https://pubmed.ncbi.nlm.nih.gov/27857087/>
24. Jakubovics NS, Goodman SD, Mashburn-Warren L, Stafford GP, Cieplik F. The dental plaque biofilm matrix. *Periodontol*. 2000. 2021;86(1):32-56.
<https://pubmed.ncbi.nlm.nih.gov/33690911/>