

Research Report

The effect of gargling with 10% concentration of green betel leaf (*Piper betle* L.) decoction on gingivitis in pregnant women

Yanuar Firmansyah, Sri Hidayati, Siti Fitria Ulfah

Department of Dental Health, Surabaya Ministry of Health Polytechnic, Surabaya, Indonesia

ABSTRACT

Background: In pregnant women, gingivitis can result from hormonal fluctuations, local oral conditions, and behavioral factors. Bacteria and inflammatory mediators may enter the circulation and reach the uterus, which can increase the risk of low birth weight and preterm delivery. The decoction of green betel leaves exhibits antibacterial properties that may help prevent gingivitis. **Purpose:** This study addresses the high prevalence of gingivitis among pregnant women at *Unit Pelayanan Terpadu (UPT) Pusat Kesehatan Masyarakat (Puskesmas)* / Health Centre Kamal. It aims to evaluate the effects of gargling a 10% green betel leaf decoction on gingivitis in pregnant women at UPT Puskesmas Kamal, Bangkalan District. **Methods:** This study employed a quasi-experimental design, involving 83 pregnant women as respondents. The gingival index, as proposed by Loe and Silness, was measured both before and after gargling to assess the impact of the intervention. Additionally, an observation sheet was utilized to evaluate participants' adherence to the gargling regimen at home. Data were analyzed using the Wilcoxon test. **Results:** The results indicated an improvement in the average initial gingival index from 2.1013, classified as severe, to 1.2787, classified as moderate. The Wilcoxon test yielded a significance value of $p < 0.05$, demonstrating a statistically significant effect of gargling a 10% green betel leaf (*Piper betle* L.) decoction on gingivitis in pregnant women at UPT Puskesmas Kamal, Bangkalan District. **Conclusion:** Betel leaf (*Piper betle* L.) can reduce the prevalence of gingivitis in pregnant women.

Keywords: Gingivitis; Green betel leaf; Medicine; *Piper betle* L.; Pregnant women

Correspondence: Yanuar Firmansyah, Department of Dental Health, Surabaya Ministry of Health Polytechnic, Jl. Pucang Jajar Tengah No. 56, Surabaya 60282, Indonesia. Email: yanuarfirmansyah76@gmail.com.

INTRODUCTION

The World Health Organization (2022) reports a significant global health challenge, with approximately 3.5 billion people nearly half of the world's population—affected by oral diseases.¹ Among the most vulnerable demographics are pregnant women, whose susceptibility to oral cavity problems is heightened during gestation. Frequent nausea and vomiting contribute to a more acidic oral environment, a key factor in the increased incidence of dental caries and gingivitis in this population.²

The situation in Indonesia is particularly acute, with a reported gingivitis frequency of 96.58%, ranking it as the nation's second most prevalent oral disease.³ Further evidence from the 2023 Indonesian Health Survey highlights that 18.8% of the population experienced gum and soft tissue disorders within the last year, including 14.1% who presented with swollen gums (abscesses) and gingival bleeding. These findings establish gingivitis as the third most common health disorder in Indonesia. At the provincial level, 10.1% of the population in East Java reported experiencing swollen and bleeding gums.⁴

Pregnancy renders women more susceptible to oral infections. Pregnancy *Gingivitis*, a condition aggravated by the hormonal fluctuations inherent to gestation, is considered the most common oral manifestation of pregnancy and is reported to affect up to 100% of expectant mothers.⁵ Critically, untreated *gingivitis* can progress to infections linked to adverse pregnancy outcomes, such as prematurity and low birth weight (LBW).⁶ A variety of risk factors influence the severity of *gingivitis*, including dental plaque, calculus, caries, age, gender, education level, income, and place of residence. Furthermore, poor oral hygiene, micronutrient deficiencies, psychological factors such as stress, and metabolic or hematopoietic diseases like leukemia and anemia also contribute.⁷ The inflammatory response to dental plaque is heightened during pregnancy.⁸

The practice of using mouthwash can inhibit the formation and proliferation of dental plaque.⁹ A decoction of *Piper betle* (L.) leaves also serves as a viable gargling solution due to its potent antiseptic properties capable of killing bacteria within the oral cavity.¹⁰ Phytochemical analysis of green betel leaf reveals the presence of bioactive

compounds, such as alkaloids, flavonoids, phenols, saponins, tannins, and essential oils. The bactericidal capacity of green betel leaf is attributed to its flavonoid and chavicol content, which confers its antiseptic capabilities.¹¹

The study identified *Streptococcus sanguinis* as a primary colonizer that promotes the penetration of periodontopathogen bacteria, such as *Porphyromonas gingivalis*, into gingival cells within the biofilm. These microorganisms are typical constituents of the oral microbiota involved in the development of gingivitis. Findings from the research demonstrated that mouthwash formulations containing *Syzygium polyantha* L. and *Piper betle* L. exhibit preventive effects against gingivitis, with effectiveness closely comparable to that of 2% chlorhexidine gluconate.¹² Further research investigated the antiseptic efficacy of a mouthwash derived from green betel leaf (*Piper betle* (L.)) extract against oral bacteria. Utilizing the phenol coefficient method at concentrations of 10% and 20% with 0.2% chlorhexidine gluconate as a comparator, the results demonstrated a significant suppression of bacterial growth, positioning it as a promising and safe natural antiseptic alternative.¹¹

Bangkalan Regency has 22 public health centers/Unit Pelayanan Terpadu (UPT) Pusat Kesehatan Masyarakat (Puskesmas), with Kamal Subdistrict served by a single center, namely UPT Puskesmas Kamal, which oversees 10 villages. According to secondary data from July 2024, there were 64 pregnant women recorded, among whom 10 (16%) had mild gingivitis, 18 (28%) had moderate gingivitis, and 36 (56%) had severe gingivitis. These extant issues have motivated the present study to investigate the effect of a 10% concentration of green betel leaf (*Piper betle* (L.)) decoction, prepared via infusion, as a mouthwash for managing gingivitis in pregnant women within the operational area of the Kamal Community Health Centre (UPT Puskesmas Kamal), Bangkalan District.

MATERIALS AND METHODS

This study employed a quasi-experimental, one-group pre-test and post-test design. This study was conducted following ethical guidelines and approved by the Ethics Committee of the Politeknik Kesehatan Kementerian Kesehatan (Poltekkes Kemenkes) Surabaya, with the ethical clearance number No. EA/3681/KEPK-Poltekkes_Sby/V/2025.

The study population comprised all pregnant women who attended the UPT Puskesmas Kamal between December 2024 and January 2025, totaling 104 individuals (53 in December and 51 in January). A purposive sampling method was utilized to select participants based on predefined inclusion and exclusion criteria. Inclusion criteria refer to specific characteristics that participants must possess to be eligible for inclusion in a study. The inclusion criteria applied in this study are as follows: (1) pregnant women residing within the working area of UPT Puskesmas Kamal, Bangkalan Regency; (2) pregnant women who do not have

a history of smoking; (3) pregnant women who do not wear dentures or prosthetic devices and are not undergoing orthodontic treatment; (4) pregnant women who are in good physical and mental health; and (5) pregnant women who have expressed willingness to participate by signing an informed consent form.

Exclusion criteria refer to specific characteristics that disqualify individuals from participating in a study, even if they meet the inclusion criteria. Participants who meet any of these conditions must be excluded to maintain the integrity and homogeneity of the sample and to minimize potential confounding variables. The exclusion criteria employed in this study are as follows: (1) pregnant women who decline to participate in the research; (2) pregnant women with a history of degenerative diseases; (3) pregnant women who are unable to be present for data collection during either the pre-test or post-test phase; (4) pregnant women who do not consistently perform mouth rinsing for a period of seven days; and (5) pregnant women without access to a refrigerator. From the population, a final sample of 83 subjects who met the eligibility criteria was identified and included in the study.

Data were collected by measuring the Gingival Index according to Loe and Silness. According to Loe and Silness, a Gingival Index (GI) score of 0 indicates healthy gingiva. Scores ranging from 0.1 to 1.0 are classified as mild gingivitis, 1.1 to 2.0 as moderate gingivitis, and 2.1 to 3.0 as severe gingivitis. The use of 6 (six) specific teeth known as Ramfjord Teeth can be utilized to make Gingival Index assessment easier. Ramfjord teeth consist of the first molar of the upper right jaw (element 16), the first incisor of the upper left jaw (element 21), the first premolar of the upper left jaw (element 24), the first molar of the lower left jaw (element 36), the first incisor of the lower right jaw (element 41), and the first premolar of the lower right jaw (element 44). Gingivitis was assessed both before and after rinsing with a decoction of green betel leaf extract (*Piper betle* L.). The evaluation was conducted on the eighth day through direct clinical examination using a mouth mirror and dental probe, with findings recorded on a standardized examination sheet.

Preparation of green betel leaf decoction (*Piper betle* L.) with the infusion procedure, with several steps: A 10% concentration mouthwash is prepared using the infusion method by combining 10 grams of green betel leaves with 100 ml of water. The mixture was heated in a covered pot for fifteen minutes, timed from the moment the internal temperature reached 90°C. To prevent the evaporation of essential oils, the solution was stirred occasionally while the pot remained covered. After cooling, the decoction was filtered through a flannel cloth to separate the residue from the liquid extract. The final solution was then transferred into sterile glass bottles for use as a mouthwash. Using glass bottles is considered one of the most effective methods of packaging, as glass is chemically inert and does not react with the contents. Moreover, it prevents contamination and effectively minimizes evaporation, making it a highly reliable packaging material.¹³

A 10% concentration of decoction green betel leaf extract, stored in a glass bottle, was administered to pregnant women. The following instructions were provided for its use: (1) Respondents were instructed to gargle with 20 ml of the decoction for 30 seconds twice daily (once in the morning after breakfast and once at night before bed) for seven consecutive days, (2) Participant compliance was monitored through a daily checklist or via reports sent to the researcher through WhatsApp, (3) The prepared mouthwash was stored in a refrigerator at a temperature between 0°C and 8°C for a maximum period of 14 days. (14) The bottle was to be shaken before each use. On the eighth day, a post-intervention Gingival Index score was recorded for each participant through an objective examination. The pre-test and post-test data were analyzed using the Wilcoxon signed-rank test, performed with the aid of the SPSS statistical software.

RESULTS

The characteristics of the respondents, as shown in Table 1, are representative of a general population of pregnant women. The majority of participants fall within the productive childbearing age range (25–35 years, 69.9%) and possess an educational background sufficient for understanding health information (senior high school graduates, 49.4%). A key finding from this data is the high concentration of

Table 1. Frequency Distribution of Pregnant Women's Characteristics at UPT Puskesmas Kamal (December 2024 – January 2025)

Characteristic	Frequency	Percentage (%)
Age (years old): Mean $\pm$ SD = 28.95 $\pm$ 5.099		
< 25	16	19.3
25 – 35	58	69.9
> 35	9	10.8
Total	83	100
Education		
Elementary School	10	12
Junior High School	11	13.3
Senior High School	41	49.4
Vocational High School	3	3.6
Diploma-III	1	1.2
Diploma-IV	1	1.2
Bachelor's (S-1)	15	18.1
Master's (S-2)	1	1.2
Total	83	100
Gestational age (trimester): Mean $\pm$ SD = 1.81 $\pm$ 0.653		
1	27	32.5
2	45	54.2
3	11	13.3
Total	83	100

Table 2. Frequency Distribution of Gingival Index before gargling with 10% Green Betel Leaf (*Piper betle L.*) Decoction

Gingival Index	Frequency	Percentage (%)
Healthy	0	0
Mild	5	6
Moderate	16	19.3
Severe	62	74.7
Total	83	100

respondents in their second trimester of pregnancy (54.2%). This period is highly significant, as it marks the peak of hormonal changes specifically in progesterone and estrogen that directly intensify the inflammatory response in the gums, acting as a primary trigger for pregnancy gingivitis. Therefore, this demographic data reinforces the relevance of the study's findings on gingivitis, as the largest portion of the sample was drawn from the highest-risk gestational period.

According to the pre-intervention data in Table 2, all participants suffered from some form of gingivitis. The problem was particularly acute, as a vast majority (74.7%) presented with the severe form of the condition. This initial data provides a crucial benchmark and demonstrates a clear clinical need for an effective intervention in this group.

Table 3 demonstrates the strong efficacy of the 10% green betel leaf decoction intervention. The most dramatic outcome is the complete eradication of severe gingivitis cases (from 74.7% to 0%). A significant shift occurred, with the majority of participants (73.5%) now classified under the 'Moderate' category, indicating a substantial reduction in severity. Furthermore, the emergence of a 'Healthy' category (4.8%), which was absent at baseline, suggests that the treatment can lead to a full recovery for some individuals. Overall, this data provides strong evidence that the intervention is effective in significantly improving gingival health in this population.

Table 4 presents the results of the Wilcoxon Signed-Rank Test, which statistically confirms the effectiveness of the intervention. The decrease in mean ranks from 2.1013 (before) to 1.2787 (after) indicates a clear positive improvement in the gingivitis scores following the treatment. Crucially, the p-value of 0.000 is less than the standard significance level of 0.05. This means the observed improvement is statistically significant and not due to random chance. Therefore, it can be confidently conclude that gargling with the 10% green betel leaf decoction has a significant effect on reducing gingivitis in the pregnant women studied.

Table 3. Frequency Distribution of Gingival Index After Gargling with 10% Green Betel Leaf (*Piper betle L.*) Decoction for 7 Days (Recorded on Day 8)

Gingival Index	Frequency	Percentage (%)
Healthy	4	4.8
Mild	18	21.7
Moderate	61	73.5
Severe	0	0
Total	83	100

Table 4. Effect of Gargling with 10% Green Betel Leaf (*Piper betle L.*) Decoction on *Gingivitis* using the Wilcoxon Test

Category	Mean	SD	p-Value
Before Gargling	2.1013	0.55580	0.000
After Gargling	1.2787	0.51452	

DISCUSSION

This study found that most pregnant women at UPT Puskesmas Kamal experienced severe gingivitis, particularly on the labial surface of the anterior mandibular teeth. This finding is consistent with previous studies, which stated that this region is most susceptible to plaque accumulation due to anatomical factors and difficulties in cleaning.¹⁵ Some women reported irregular tooth brushing due to nausea and vomiting, leading to plaque accumulation. The inflammatory response to plaque is known to increase during pregnancy.⁸

Dental plaque is widely acknowledged as the primary etiological factor in gingivitis.¹⁶ Its microbial composition includes facultative gram-positive bacteria such as *Actinomyces viscosus* and *Streptococcus sanguinis*, followed by secondary colonizers like *Prevotella intermedia*, *Capnocytophaga*, and *Porphyromonas gingivalis*. In a comparative study evaluating the efficacy of green betel (*Piper betle* L.) and guava (*Psidium guajava*) leaf decoctions, the green betel leaf infusion was found to be significantly more effective in reducing plaque index scores.¹⁷

One notable limitation encountered in this study was the inadequacy of dental equipment particularly the non-functional ultrasonic scaler at the health center which hindered calculus removal procedures. Field examinations revealed that dental calculus was prevalent in most participants, predominantly on the lingual surfaces of the mandibular anterior teeth and buccal aspects of posterior molars. Furthermore, the oral hygiene index (OHI-S) scores of these subjects fell within the "poor" category, corroborated by secondary data from July 2024. Healthcare providers can raise awareness through counseling and education. Individual counseling can increase a pregnant woman's understanding of *gingivitis* and its complications, such as low birth weight, by up to 45%.³ While antenatal care (ANC) at the facility was regular, the dental polyclinic's involvement was limited to examination and odontogram charting. Health education was confined to basic therapeutic communication, and oral prophylaxis procedures like scaling and plaque control were not performed. Dental treatments are often postponed during the first and late third trimesters, with the second trimester (weeks 14-20) being the recommended period, as it is the safest and most stable for oral care.¹⁸

Sociodemographic factors also significantly influenced gingivitis severity. Pregnant women with lower educational attainment and those in their second trimester of gestation exhibited more severe gingival inflammation. These findings are consistent with studies by previous studies which identified age and education as key risk factors.^{7,19} Educational level affects not only access to health information but also an individual's capacity to implement proper oral hygiene practices.

Education also influences preferences in utilizing healthcare services. Research in Klungkung also found a correlation between education and higher rates of *gingivitis*

in pregnant women.²⁰ A study in North Jakarta similarly showed that pregnant women with lower educational attainment had a greater predisposition to *gingivitis*, often due to a lack of understanding about proper oral hygiene practices, including the interval of brushing their teeth, as this activity, according to previous study is rather crucial in determining oral health.²¹

A pregnant woman's comprehension of oral health is a critical factor in achieving optimal oral care. In practice, however, it was observed that pregnant women at the UPT Puskesmas Kamal in Bangkalan District had not yet received health education from dentists or dental therapists. The prevention of *gingivitis* can be achieved through adequate knowledge and appropriate care.¹⁸ Individualized education and counseling have been proven effective in optimizing pregnant women's understanding of gum disease. For instance, in Gampong Kyee Leu, Aceh Besar, pregnant women demonstrated significant improvement in their comprehension of oral hygiene maintenance and appropriate toothbrushing methods following an educational intervention.³

The second trimester was identified as the period with the highest incidence of *gingivitis*, wherein a majority of the cases were classified as severe. This finding is consistent with research previous study which demonstrated that while the gingival health status of pregnant women generally shows no significant pathological changes during the first trimester, it tends to decline upon entering the second.⁷ Subsequently, an improvement in the condition of the gingival tissue is observed in the third trimester, although it does not fully return to the state of the first trimester.

Furthermore, research conducted by Rachmadani concluded that there is a significant correlation between the trimester of pregnancy and the severity of *gingivitis* in pregnant women.²² Their study identified a correlation between elevated levels of estrogen and progesterone and the onset of *gingivitis*. This hormonal increase stimulates the production of inflammatory mediators, such as prostaglandins, within the gingival tissue. Hormonal changes during pregnancy are also known to play a role in suppressing the immune response, characterized by a decrease in *T-lymphocyte* activity and a concurrent increase in the population of *Prevotella intermedia* bacteria. Consequently, this renders the gingival tissue more susceptible to inflammation, ultimately triggering the development of *gingivitis* during gestation.²²

Familial support plays a crucial role in the prevention and management of *gingivitis* in pregnant women. This support, particularly from a spouse, can motivate expectant mothers to maintain their oral health. As an example, a study conducted at the Salak Community Health Center in Pakpak Bharat District showed that providing education and supportive guidance to pregnant women can increase their awareness of the importance of maintaining dental health throughout their pregnancy, thereby reducing the risk of developing *gingivitis*.²³

Post-intervention analysis showed a significant decrease in the Gingival Index score after using a 10% boiled green

betel leaf. Most participants experienced a reduction in gingivitis severity from severe to moderate. These results are supported by animal study which demonstrated that betel leaf has antimicrobial and anti-inflammatory activities comparable to chlorhexidine.¹²

Green betel leaf has been demonstrated to possess broad-spectrum antimicrobial properties against a variety of pathogenic microorganisms. The active substances in green betel leaf (*Piper betle L.*), including phenolates, alkaloids, terpenoids, and flavonoids, contribute to its diverse antimicrobial effects. Its mechanism of action is attributed to the disruption of the microbial cell membrane, inhibition of microbial growth, and inhibition of biofilm formation. Additionally, green betel leaf is reported to have antiviral and antiparasitic properties.²⁴

Betel leaf also contains various other active compounds, such as vitamins C and A, riboflavin, chlorophyll, and high concentrations of phenolic compounds. These constituents possess anti-inflammatory and antimicrobial properties that play a vital role in reducing inflammation and accelerating the healing process of gingival swelling.²⁵ Active compounds, including *allypyrocatechol* and *hydroxychavicol*, exhibit antimicrobial properties.

Allypyrocatechol is a phenolic compound effective against the obligate anaerobic bacteria responsible for halitosis. Meanwhile, it is a primary phenolic compound possessing anticarcinogenic, anti-nitrosation, and antimutagenic activities, which help to protect tissues from damage.²⁶ Previous research has revealed that phenolic compounds can disrupt bacterial cell membranes, inhibit enzymatic activity, and prevent protein denaturation. This damage occurs due to a reduction in the flexibility of the cytoplasmic membrane, which consequently interferes with the transport of essential organic ions into the bacterial cell. In some cases, this process inhibits cellular development and can even lead to cell death.²⁷

In addition to its effectiveness, the storage aspect is also crucial for the practical use of betel leaf decoction as a natural mouthwash. Storage is an effort to maintain product quality over a certain period of time. During storage, quality degradation may occur due to the deterioration of active compounds or microbial contamination. Two types of storage commonly used are natural and controlled storage. Controlled storage, such as refrigeration (0–8 °C), has been shown to extend the shelf life of herbal products including boiled green betel leaf and miswak solutions up to 14 days while maintaining their antimicrobial effect.¹⁴

Packaging also plays a key role in maintaining the quality of herbal products. Appropriate packaging protects the contents from environmental contamination and slows down quality degradation. Packaging materials with low permeability to gases and moisture are more effective in preserving product stability.¹³ Glass bottles are considered ideal due to their inert nature, which means they do not react with chemical compounds, and they are effective in preventing evaporation and microbial contamination. Sterilization of glass bottles is necessary before use, typically done by autoclaving at 121 °C for 15 minutes. This

method has been proven effective in killing bacteria, spores, and fungi.²⁸ Herbal beverages stored in autoclaved glass bottles could last up to four weeks at room temperature, whereas those sterilized using a regular boiling method lasted only five days.²⁸

Despite these limitations, this study provides preliminary indications that green betel leaf decoction may serve as a low-cost and accessible complementary intervention for managing gingivitis during pregnancy, particularly in resource-limited settings. However, to validate these findings and address the existing weaknesses, further research is warranted. Future studies are recommended to include (1) a Randomized Controlled Trial (RCT) design with a placebo group or active control group (e.g., chlorhexidine) to isolate the true effect of the intervention; (2) implementation of examiner calibration protocols and reporting of Kappa coefficients to ensure data reliability; (3) use of standardized betel leaf extract to ensure consistent dosing and active compound concentration; (4) long-term studies to evaluate the sustainability of effects and safety of use; and (5) microbiological analysis of plaque samples before and after intervention to confirm changes in oral microbiota composition.

In conclusion, this study provides preliminary evidence of the potential of 10% green betel leaf decoction in reducing gingivitis severity among pregnant women. However, due to significant methodological limitations particularly the absence of a control group and examiner standardization these findings should be interpreted as a foundation for more rigorous future research. Well-designed RCTs are essential to establish the definitive efficacy of this intervention as an evidence-based therapy in maternal oral health care.

ACKNOWLEDGEMENT

The authors would like to express our sincere gratitude to the head and staff of Puskesmas Kamal and all the participants, who made this study possible. To everyone who willingly shared their information and viewpoints to make this research possible, we would like to thank you. Their combined efforts were essential to the completion of this investigation.

REFERENCES

1. World Health Organization. Global oral health status report. World Health Organization, editor. Vol. 57, Who., Geneva: World Health Organization; 2022. 120 p.
2. Aulyah DR, Usman F, Jauharuddin A, Sundu S. Hubungan Pengetahuan Ibu Hamil Dengan Gingivitis Selama Kehamilan Di Puskesmas Bahodopi Kabupaten Morowali. Media Kesehat Gigi. 2024;23(1).
3. Nuraskin CA, Reca. Peningkatan Pengetahuan Ibu Hamil Tentang Gingivitis Melalui Penyuluhan Individual Sebagai Upaya Pencegahan Bayi Berat Lahir Rendah (Bblr) Di Gampong K Ayee Leu Aceh Besar. J PADE Pengabmas dan Edukasi. 2024;2024(6):111–4.

4. Kemenkes RI. Survei Kesehatan Indonesia (SKI). Badan Kebijakan Pembangunan Kesehatan, editor. Jakarta. 2023. 1–926 p.
5. Pratiwi AR, Wardani SC. Manajemen Klinis Perawatan Gigi pada Ibu Hamil dan Menyusu. UB Press; 2021. 134 pages.
6. Budiarti I, Dara M, Suja D, Studi P, Gigi T, Tanjungkarang PK, et al. Pregnancy Gingivitis Terhadap Berat Badan Lahir Rendah (BBLR): Studi Literatur. 2023;4:5374–81.
7. Safitri DN. Tingkat Keparahan Gingivitis pada Ibu Hamil. Higeia J Public Heal Res Dev. 2020;4(3):470–9.
8. Reddy S. Periodontologi: Gambaran Klinis & Terapi. fourth. olivia sandra, Juwono L, editors. Jakarta: penerbit buku kedokteran EGC; 2020. 382–384 p.
9. Ahmad AH, Pratidina NB, Gartika M, Yulina V. Efek berkumur menggunakan chlorine dioxide terhadap penurunan akumulasi plak: studi eksperimental. Padjadjaran J Dent Res Students. 2024;8(2):231–6.
10. Machfoedz I. Menjaga Kesehatan Gigi dan Mulut Anak - Anak dan Ibu Hamil. 6th ed. Yogyakarta: Fitramaya; 2018. 1–116 p.
11. Febrianti E, Harun N. Uji Efektivitas Antiseptik Obat Kumur Ekstrak Daun Sirih Hijau (Piper betle L.) Terhadap Bakteri Isolat Mulut Effectiveness. J Sains dan Kesehat. 2022;4(3):259–64.
12. Putri MH, Nurjanah N, Laela DS, Sukmasari S. Protective effects of mouthwash formulations of Syzygium polyantha(L.) and Piper betel(L.) on oral microbiota-induced gingivitis. Healthc Low-resource Settings 2024; 1211768. 2024;12:333–43.
13. Rosmawati, Syam H, Sukainah A. Pengaruh Jenis Kemasan dan Lama Penyimpanan Terhadap Kualitas Minuman Khas Sinjai (Ires). Pharmacogn Mag. 2021;7(1):79–92.
14. Khoiriyah YN, Wahyuni DS. Aplikasi kombinasi air rebusan daun sirih dan kayu siwak pada penurunan indeks plak gigi. J Vokasi Kesehat. 2019;115–20.
15. Çelik H, Güngörmek HS. Severity, extent, distribution and predisposing factors of gingival recession in Turkish patients: a cross-sectional study. Med Oral Patol Oral Cir Bucal. 2025;30(3):e401–10.
16. Restuning S, Widyastuti T, Utami U. Epidemiologi Dental. 1st ed. NEM; 2023. 90 p.
17. Fione VR, Adam J dÁrc Z, Lestari NMAS. The Effectiveness Of Gargling Decoction Of Green Betel Leaf (Piper betle L) And Guava Leaf (Psidium guajava) Against Plaque Index. Eduvest – J Univers Stud. 2024;4(7):6271–8.
18. Ramadhani NA, Astuti IG. K, Larasati R. Pengetahuan Tentang Gingivitis Pada. Indones J Heal Med. 2023;3(4).
19. Simamora DLPD, Edi IS, Hadi S. Hubungan Pengetahuan Ibu Hamil tentang Pemeliharaan Kesehatan Gigi dan Mulut Dengan Kejadian Gingivitis (di Puskesmas Putat Jaya Kota Surabaya). Indones J Heal Med. 2022;2(3):276–84.
20. Pradnyanaputri KE, Kusumadewi S, Susanti DNA. Prevalensi gingivitis pada ibu hamil berdasarkan usia kehamilan, Pekerjaan, dan pendidikan di rsud klungkung tahun 2017. ODONTO Dent J. 2018;5(2):1–2.
21. Ummiyati H, Amanah SP, Maulani C. Hubungan gingivitis dengan faktor-faktor risiko pada ibu hamil. Padjadjaran J Dent Res Student. 2020;4(1):36–42.
22. Rachmadani N, Wati HIFH, Sari M. Hubungan Trimester Kehamilan Dengan Tingkat Keparahan Gingivitis Pada Ibu Hamil Di Puskesmas Polokarto. Researchgate. 2023;(February):0–4.
23. Pintaui S, Aritonang EY, Nasution RO. Edukasi Dan Pendampingan Ibu Hamil Dalam Memelihara Kesehatan Gigi Mulut Untuk Mencegah Radang Gusi Selama Kehamilan (Pregnancy Gingivitis) Dan Stunting Di Puskesmas Salak Kabupaten Pakpak Bharat. 2024;4:230–7.
24. Afroj A S, Dd S, Mp S, Sj A. A Systematic Review on Antimicrobial Activity of Piper betle Linn Leaves. Curr Trends Pharma Clin Trial. 2023;6(2).
25. Agung, I Gusti Ayu Ari Hervina H, Sandi NWA. Nutrisi dan Zat Bioaktif Daun Sirih (Piper betle L.), Kesehatan Gigi dan Mulut, Serta Covid-19. I Gusti Agung Ayu Hartini, editor. Universitas Mahasaraswati Press. Denpasar: Universitas Mahasaraswati Press; 2021. 1–50 p.
26. Afriliani R, Maulana IT, Kodir RA. Penelusuran Pustaka Senyawa Aktif dan Mekanisme Aksi Aktivitas Antimikroba Ekstrak Daun Sirih (Piper betle L.) terhadap Mikroorganisme Penyebab Gangguan Kesehatan Gigi dan Mulut. Bandung Conf Ser Pharm. 2022;2(2):321–31.
27. Harun N, Febrianti S E. Uji Efektivitas Antiseptik Obat Kumur Ekstrak Daun Sirih Hijau (Piper betle L.) Terhadap Bakteri Isolat Mulut. J Sains dan Kesehat. 2022;4(3):268–74.
28. Ningsih EMN, Nugroho YA. Panci Sterilisasi Untuk Peningkatan Mutu Minuman Herba Di Industri Rumah Tangga Kel. Bumiayu Kota Malang. J Apl dan Inov Ipteks SOLIDITAS. 2021;4(2):86–92.