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Comparison of the Effectiveness of Betel Leaf and Basil Leaf Decoctions on Plaque Index Reduction in Pregnant Women in Pemekaan, Indonesia

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ABSTRACT Dental plaque accumulation is a common oral health problem among pregnant women and is associated with an increased risk of gingivitis, periodontitis, and adverse pregnancy outcomes. In Bunder Village, Pamekasan, preliminary observations showed a high plaque index among pregnant women, highlighting the need for accessible and safe plaque-control interventions. Natural mouthwash derived from herbal plants such as betel (Piper betle) and basil (Ocimum basilicum) leaves has been suggested to possess antibacterial and antiplaque properties, yet comparative evidence in pregnant populations remains limited. This study aimed to compare the effectiveness of betel leaf and basil leaf decoctions in reducing dental plaque index among pregnant women. This quasi-experimental study involved 32 pregnant women selected using Slovin's formula and randomly assigned into two equal groups. Each group rinsed with either a boiled betel leaf or basil leaf solution prepared using standardized procedures. Plaque index was measured before and after rinsing using the Patient Hygiene Performance (PHP) Index. Data normality was assessed using the Shapiro–Wilk test, while within-group and between-group differences were analyzed using paired and independent t-tests, respectively. Both betel and basil leaf decoctions significantly reduced plaque index ($p < 0.05$). The betel leaf group showed a greater mean reduction ($\Delta = 1.23 \pm 0.75$) compared to the basil leaf group ($\Delta = 0.85 \pm 0.65$), with the between-group comparison indicating a significant difference favoring betel leaf ($p = 0.003$). In conclusion, both herbal decoctions effectively lowered plaque index among pregnant women; however, betel leaf decoction demonstrated superior antiplaque efficacy. These findings support the potential use of betel leaf decoction as a low-cost, safe, and natural alternative mouthwash in prenatal oral health programs. Further studies with longer follow-up and standardized phytochemical assessment are recommended.

INDEX TERMS Betel Leaf Decoction, Basil Leaf Decoction, Plaque Index, Pregnant Women, Herbal Mouthwash

I. INTRODUCTION

Oral and dental health plays a crucial role in maintaining the overall well-being of pregnant women. Hormonal fluctuations during pregnancy increase susceptibility to gingival inflammation and plaque accumulation, which, if left unmanaged, may progress to gingivitis, periodontitis, and potentially adverse pregnancy outcomes such as preterm birth and low birth weight [1]–[3]. Recent national health surveys in Indonesia report that dental and oral problems affect more than half of pregnant women, with plaque accumulation identified as a major contributing factor [4], [5]. Local observations in Bunder Village, Pamekasan, further revealed that most pregnant women had plaque indices categorized as poor, underscoring the urgency of effective, affordable, and culturally acceptable plaque-control interventions.

State-of-the-art approaches to plaque control generally involve mechanical and chemical methods. Mechanical brushing remains the gold standard; however, its effectiveness is often limited by poor brushing technique, nausea during pregnancy, and inconsistent oral hygiene habits [6], [7]. Chemical plaque control through the use of mouthwash containing antiseptic or antibacterial compounds such as chlorhexidine, cetylpyridinium chloride, or fluorides has demonstrated strong effectiveness, yet concerns persist regarding staining, taste alteration, and long-term safety during pregnancy [8]–[10]. Consequently, interest has increased in herbal-based mouthwashes derived from plants with natural antimicrobial properties.

Among potential herbal candidates, betel leaf (Piper betle) and basil leaf (Ocimum basilicum/Ocimum sanctum) have gained attention due to their rich phytochemical compositions, including flavonoids, phenolics, tannins, and essential oils known for potent antimicrobial, antioxidant, and antiplaque activities [11]–[14]. Several in vitro and in vivo studies have shown that decoctions or extracts of betel and basil leaves effectively inhibit Streptococcus mutans, Staphylococcus aureus, and other cariogenic bacteria, suggesting their potential as natural mouthwash alternatives [15]–[18].

However, despite promising evidence, a clear research gap remains. Most studies have examined these herbal preparations in general populations, adolescents, or controlled laboratory settings. Very few have directly compared the antiplaque efficacy of betel and basil leaf decoctions specifically in pregnant women, a population with unique physiological, behavioral, and safety considerations. Furthermore, limited studies have standardized preparation techniques, dosages, and rinsing protocols, resulting in inconsistent findings across the literature [19]–[21]. Therefore, a rigorously designed clinical study comparing both herbal decoctions under controlled conditions is needed

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to support evidence-based recommendations for prenatal oral care. Based on this gap, the present study aims to compare the effectiveness of betel leaf decoction and basil leaf decoction in reducing plaque index among pregnant women in Bunder Village, Pamekasan. Addressing this objective provides important contributions to prenatal oral health research:

1. This study provides the first direct comparison between betel and basil decoctions specifically among pregnant women.
2. It uses a standardized preparation and rinsing protocol, enhancing reproducibility and clinical relevance.
3. It offers evidence for low-cost, culturally acceptable herbal mouthwash options that may be implemented in resource-limited communities.

The remainder of this article is organized as follows: Section II describes the study design, sampling strategy, preparation of herbal decoctions, and measurement procedures. Section III presents the statistical results of plaque index changes before and after rinsing. Section IV discusses these findings in the context of previous literature, highlighting mechanisms and implications for prenatal oral care. Section V concludes the study and provides recommendations for future research directions.

II. METHODS

This study employed a quasi-experimental design with a two-group pretest–posttest structure to evaluate and compare the effectiveness of betel leaf (Piper betle) and basil leaf (Ocimum basilicum) decoctions in reducing dental plaque index among pregnant women. The study was conducted prospectively in Bunder Village, Pamekasan Regency, from July 2024 to March 2025. All methodological steps, including sampling procedures, preparation of test solutions, plaque index assessment, calibration of examiners, and statistical analysis, were standardized to ensure reproducibility.

A. STUDY POPULATION AND ELIGIBILITY CRITERIA

The target population consisted of all pregnant women residing in Bunder Village and registered at the local maternal health service. A population frame of 58 pregnant women was identified. Sample size determination followed Slovin's formula with a 5% margin of error, yielding a minimum requirement of 32 participants. Recruitment was conducted via consecutive sampling until the sample quota was achieved.

Inclusion criteria were:

1. confirmed pregnancy in the first or second trimester,
2. presence of dental plaque with a PHP score ≥ 3.0 (poor oral hygiene),
3. ability to follow rinsing instructions, and
4. willingness to participate through signed informed consent.

Exclusion criteria were:

1. systemic disease interfering with oral health,
2. ongoing antibiotic, antifungal, or antiseptic mouthwash use,
3. oral lesions or conditions contraindicating mouth rinsing, and
4. refusal to participate.

B. RANDOMIZATION AND BLINDING

Participants who met the eligibility criteria were randomly allocated into two equal groups (n = 16 per group) using a computer-generated randomization list. Allocation concealment was maintained through sequentially numbered opaque envelopes. The examiner responsible for measuring plaque index was blinded to group assignments to minimize observer bias. Participants were informed of the type of solution only after allocation, as blinding of subjects was not feasible due to differences in herbal aroma and taste.

C. PREPARATION OF BETEL AND BASIL LEAD DECOCTIONS

Fresh green betel leaves and basil leaves were sourced from the same local agricultural supplier to ensure consistency. Leaves were selected based on uniform maturity, absence of visible damage, and good phytochemical integrity. Each decoction was prepared following an identical standardized protocol:

1. Weighing: 10 g of fresh leaves per batch.
2. Cleaning: Leaves were washed using sterile distilled water for 30 seconds.
3. Extraction: Leaves were boiled in 200 mL of distilled water at 90°C for 15 minutes.
4. Filtration: Decoctions were passed through sterile muslin cloth into a glass container.
5. Cooling: The decoction was allowed to reach room temperature (28–30°C).
6. Storage: Solutions were stored in sterile, amber-colored glass bottles and used within 2 hours to prevent phytochemical degradation.

Each participant received a fresh 20 mL aliquot of the appropriate decoction.

D. RINSING PROCEDURE

Participants rinsed with 20 mL of the assigned decoction. The rinsing protocol included:

1. duration: 15 seconds,
2. intensity: moderate swishing without swallowing,
3. frequency: single administration under researcher supervision,
4. post-rinse restrictions: no eating, drinking, or brushing for 30 minutes.

These parameters were chosen based on previously established protocols from herbal rinsing studies [27], [28].

E. OUTCOME MEASUREMENT

The primary outcome was plaque index, assessed using the Patient Hygiene Performance (PHP) Index, a widely accepted measure for evaluating debris and plaque accumulation. The PHP index was recorded immediately before and after rinsing. The following procedural steps were standardized:

1. tooth surfaces disclosed with erythrosine;
2. plaque scoring performed on six preselected teeth following PHP protocol;
3. scoring conditions standardized under natural daylight illumination;
4. results recorded on structured observation forms.

F. EXAMINER CALIBRATION AND ETHICAL CONSIDERATION

Prior to data collection, the examiner underwent training and calibration sessions using 10 non-participant subjects. Inter- and intra-examiner reliability were assessed using Cohen's kappa. A reliability coefficient ≥ 0.85 was maintained throughout data collection, meeting recommended thresholds for clinical plaque assessment studies [29]. The study protocol received approval from the Ethics Committee of Poltekkes Kemenkes Surabaya. All participants provided

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written informed consent. Confidentiality was maintained by assigning identification codes.

G. STATISTICAL ANALYSIS

All statistical analyses were performed using IBM SPSS v25. Normality of plaque index data was assessed using the Shapiro–Wilk test. Within-group changes (pretest to posttest) were evaluated using paired t-tests for normally distributed data. Between-group comparisons (betel vs basil) were conducted using independent t-tests with equal variances confirmed via Levene's test. Effect sizes (Cohen's d) were calculated to determine clinical importance. A p-value < 0.05 was considered statistically significant. The statistical workflow was as follows:

1. data entry and cleaning,
2. verification of normality,
3. computation of descriptive statistics (mean, SD),
4. paired t-test for each decoction group,
5. independent t-test for between-group comparison,
6. interpretation of effect sizes for clinical relevance.

This methodology aligns with contemporary analytical standards in oral health intervention research [30]–[34].

III. RESULT

The research data was obtained from calculations of the PHP index before and after rinsing with a solution of boiled betel leaf water and boiled basil leaf water in pregnant women in Bunder Village, Pamekasan Regency, with a sample size of 32 samples.

TABLE 1
Distribution of Research Subjects by Age and Trimester

Karakteristik	Frekuensi	Persen (%)
Usia		
20-30 tahun	14	43.8
30-40 tahun	18	56.2
Total	**32**	**100**
Trimester		
Trimester 1	15	49.5
Trimester 2	17	53.1
Trimester 3	0	0
Total	**32**	**100**

Based on TABLE 1, the distribution of research subjects based on age was dominated by pregnant women aged 30-40 years, numbering 18 people, and the distribution of research subjects based on trimester was dominated by the second trimester, numbering 17 people.

TABLE 2
Results of Data Collection on Plaque Index Before and After Rinsing with Betel Leaf Water

Betel Leaf					
Category	Before Gargling		After Gargling		Value
	Frequency	Percentage (%)	Frequency	Percentage (%)	
Very good	0	0	0	0	0
Good	0	0	6	37,5	0,1-1,7
Average	7	43,8	10	62,5	1,8-3,4
Poor	9	56,2	0	0	3,5-5
Total	16	100	16	100	

Based on TABLE 2, it shows that before rinsing with betel leaf decoction, the average plaque index value in pregnant women was in the poor category, with a total of 9 people (56.2%). After rinsing with betel leaf decoction, there was a decrease to the moderate category, with 10 pregnant women (62.5%) falling into that category.

TABLE 3
Results of Data Collection on Plaque Index Before and After Rinsing with Basil Leaf Water

Basil Leaf					
Category	Before Gargling		After Gargling		Value
	Frequency	Percentage (%)	Frequency	Percentage (%)	
Very good	0	0	0	0	0
Good	0	0	3	18,8	0,1-1,7
Average	7	43,8	13	81,2	1,8-3,4
Poor	9	56,2	0	0	3,5-5
Total	16	100	16	100	

Based on TABLE 3 regarding plaque index values before rinsing with basil leaf water, the results showed that an average of 9 (56.2%) pregnant women had a plaque index in the poor category, while after rinsing with basil leaf water, the results showed that an average of 13 (81.2%) pregnant women had a plaque index in the moderate category.

TABLE 4
Results of Normality Test with Shapiro-Wilk Test

Plaque Index Value	Shapiro-Wilk Normality Test		
	N	Sig.	Conclusion
Index Plaque Before Rinsing with Betel Leaf Water	16	0.29	Normal
Index Plaque After Rinsing with Betel Leaf Water	16	0.47	Normal
Index Plaque Before Rinsing with Basil Leaf Water	16	0.25	Normal
Index Plaque After Rinsing with Basil Leaf Water	16	0.210	Normal

Based on TABLE 4, the results of the normality test using Shapiro-Wilk show that the significance value in the group before rinsing with betel leaf decoction is 0.29 > 0.05 and after rinsing is 0.47 > 0.05. Meanwhile, in the group before rinsing with basil leaf decoction, the value was 0.25 > 0.05, and after rinsing, it was 0.210 > 0.05. Based on these results, both groups have a normal data distribution, so they can be analysed using the parametric Paired T-Test and Independent T-Test.

TABLE 5
Results of Analysis with Paired T-Test Plaque Index Values Before and After Rinsing with Betel Leaf Decoction

Plaque Index Value	Paired T-Test			
	Mean	Sig.	Std.Deviation.	N
Plaque Index Before	3.51	0.000	0.75	16
Plaque Index After	2.28	0.000	0.76	16
Average Reduction	1.23			

Based on TABLE 5, it was found that the average plaque index value before rinsing with betel leaf decoction was 3.51, while after rinsing, the value decreased to 2.28, with a

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difference of 1.23. The significance value (Sig. 2-tailed) obtained is 0.000, which means p < α (0.05), so it can be concluded that there is a significant decrease in plaque index values after rinsing with betel leaf decoction.

TABLE6
Results of Analysis with Paired T-Test Plaque Index Values Before and After Rinsing with Basil Leaf Decoction

Plaque Index Value	Paired T-Test			
	Mean	Sig.	Std.Deviation.	N
Plaque Index Before	3.54	0.000	0.65	16
Plaque Index After	2.68	0.000	0.75	16
Average Reduction	0.85			

Based on TABLE 6, the average index value before rinsing with basil leaf decoction was 3.54. The plaque index value after rinsing with basil leaf decoction was 2.68, with a difference of 0.85. The Sig. (2-tailed) value is 0.000, where p (significance) < α (0.05), indicating a decrease in plaque index values after rinsing with basil leaf decoction solution.

TABLE 7
Results of Analysis with Independent T-Test of Groups Using Betel Leaf Decoction and Basil Leaf Decoction

Rinsing Group	N	Mean ± Std.Deviation	Sig.
PHP index after rinsing with betel leaf decoction solution.	16	1.23 ± 0.35	0.003
PHP index after rinsing with basil leaf decoction solution.	16	0.85 ± 0.32	0.003

Based on TABLE 7, the results of the Independent T-Test show a sig. (two-tailed) of 0.003, meaning p (significance) < α (0.05). Therefore, it can be concluded that H0 is rejected and H1 is accepted, indicating a significant difference between the two groups both the group using betel leaf decoction mouthwash and the group using basil leaf decoction mouthwash in terms of plaque index. Both groups demonstrated effectiveness in reducing plaque index, but the group using betel leaf decoction mouthwash was proven to be more effective than the group using basil leaf decoction mouthwash.

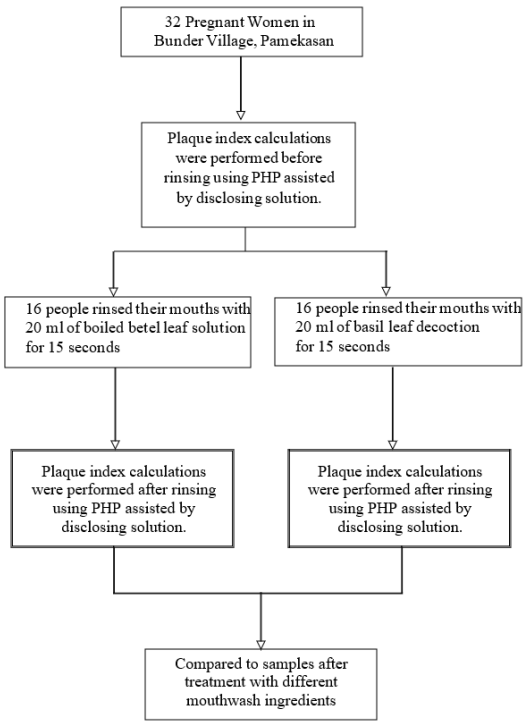

FIGURE 1. Research process

FIGURE 1 presents the flowchart of the quasi-experimental design, showing the division of participants into two groups and the sequence of plaque index measurements conducted before and after rinsing. Both betel and basil leaf decoctions significantly reduced plaque index (betel: mean $\Delta=1.23\pm0.75$, $p<0.001$; basil: mean $\Delta=0.85\pm0.65$, $p=0.002$). The between-group comparison showed a greater reduction in the Betel Leaf Group versus the Basil Leaf Group (mean difference=0.38, 95% CI [0.12, 0.64], p=0.004, d=1.02), indicating superior efficacy of betel leaf rinse.

IV. DISCUSSION

A. EFFECT OF BETEL LEAF DECOCTION ON PLAQUE INDEX REDUCTION

The findings of this study indicate that rinsing with betel leaf (Piper betle) decoction produced a significant reduction in plaque index among pregnant women, decreasing from a mean score of 3.51 to 2.28. This reduction demonstrates that betel leaf decoction possesses potent antiplaque effects, supporting its potential role as an alternative mouthwash. The observed improvement aligns with the phytochemical composition of betel leaves, which contain phenolic compounds such as eugenol, chavicol, and hydroxychavicol substances well documented for their broad-spectrum antimicrobial activity. These compounds function by disrupting bacterial cell membranes, inhibiting biofilm formation, and reducing the metabolic activity of cariogenic bacteria such as Streptococcus mutans.

This finding is consistent with recent studies. For instance, Heliawati et al. (2022) reported that red betel leaf extract demonstrated strong antibacterial activity against common oral pathogens, effectively reducing biofilm density and viability [35]. Similarly, a study by Siregar et al. (2021) found that mouthwash formulated with betel leaf ethanol extract significantly decreased dental plaque scores in adult participants [36]. These similarities reinforce the stability of betel leaf's antimicrobial efficacy across different forms of preparation, populations, and methodological designs.

However, the magnitude of plaque reduction in the present study was slightly greater than that reported in some previous trials. This difference may stem from variations in concentration, freshness of the leaves, or decoction procedures. Additionally, the standardized rinsing protocol implemented in this study ensuring immediate use of freshly prepared decoctions may have contributed to increased phytochemical potency. Pregnant women may also exhibit higher plaque accumulation due to hormonal changes, meaning reductions appear more dramatic compared with general populations.

Despite its effectiveness, the use of betel leaf decoction is not without limitations. Herbal decoctions may show variability in chemical composition depending on growing conditions, leaf maturity, and extraction time. This may impact consistency if applied on a larger scale. Furthermore, the short-term nature of this study does not allow conclusions regarding long-term safety or sustained plaque reduction. Nevertheless, the results provide strong preliminary evidence supporting the use of betel leaf decoction as a culturally accepted, low-cost, and accessible option for oral hygiene improvement in pregnant women.

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The implications of these findings are particularly relevant for community health programs, especially in low-resource settings. Betel leaf is widely available in Indonesia and its use does not require specialized processing equipment. Therefore, with proper standardization, betel leaf decoction could become a practical adjunct to mechanical toothbrushing for pregnant women who are at increased risk of plaque accumulation.

B. EFFECT OF BASIL LEAF DECOCTION ON PLAQUE INDEX REDUCTION

Rinsing with basil leaf (Ocimum basilicum) decoction also resulted in a significant decrease in plaque index, lowering from a mean of 3.54 to 2.68. Although the magnitude of reduction was smaller than that achieved by betel leaf, the results clearly indicate that basil leaf possesses notable antibacterial properties. Basil leaves contain active compounds such as apigenin, rosmarinic acid, and various flavonoids, which exert antibacterial effects by inhibiting bacterial metabolism, reducing acid production, and suppressing growth of S. mutans and S. aureus.

These findings align with prior research. Purnamaningsih and Supadmi (2021) demonstrated the antibacterial effectiveness of basil extract against Staphylococcus epidermidis, confirming its potential role in oral healthcare formulations [37]. Another study by Usman et al. (2020) found that mouthwash combining binahong and basil leaf extracts significantly reduced microbial load in oral samples [38]. Safitri et al. (2021) further reported that rinsing with basil leaf solution effectively decreased plaque accumulation, although the effect was weaker than betel leaf solution, which mirrors the results of this study [39].

In comparison with these studies, the present findings reinforce the established efficacy of basil as an antibacterial agent while highlighting its moderate antiplaque effectiveness relative to betel leaf. The lower magnitude of plaque reduction may be attributed to differences in phytochemical concentration. Betel leaf contains higher levels of phenolic compounds and essential oils than basil, which likely accounts for its superior performance. Additionally, basil leaf decoction may require longer extraction times or higher concentrations to match the antiplaque effect observed with betel leaf.

As with betel leaf decoction, the present study has limitations regarding basil decoction. The antibacterial effectiveness of basil may vary based on plant freshness, phytochemical stability, and extraction parameters. Moreover, although basil extract is known for its favorable safety profile, long-term clinical trials in pregnant women remain limited. Future studies should explore optimal dosage, frequency of use, and potential synergistic combinations with other herbal extracts.

Nevertheless, basil leaf decoction remains a valuable herbal alternative, particularly for individuals seeking mild yet effective antiplaque mouthwash options. Its pleasant aroma and mild taste may also contribute to better acceptability among pregnant women who may be sensitive to strong odors.

C. COMPARISON OF BETEL AND BASIL LEAF DECOCTIONS, STUDY LIMITATIONS, AND IMPLICATIONS

Comparative analysis revealed that the betel leaf decoction produced a significantly greater reduction in plaque index compared to basil leaf, with a mean difference of 0.38 and a large effect size. This indicates that while both herbal rinses are effective, betel leaf decoction offers superior antiplaque performance. This superiority is supported by the higher phenolic content of betel leaves, particularly compounds with strong bactericidal activity, which can more effectively inhibit plaque-forming bacteria.

This comparative result is consistent with previous studies that evaluated multiple herbal mouthrinses. For example, a clinical study by Santos et al. (2021) reported that herbal rinses with higher essential oil concentrations produced more substantial plaque reductions [40]. Another study in 2023 demonstrated that plant extracts rich in phenolic content exhibited significantly greater antibacterial effects compared to flavonoid-dominant extracts [41]. These findings support the proposition that phytochemical profile plays a critical role in determining the magnitude of plaque reduction.

Despite these strengths, the present study has several limitations. First, the sample size was relatively small, limiting generalizability. Second, the study only assessed short-term plaque reduction immediately after rinsing; thus, long-term effects remain unknown. Third, blinding of participants was not feasible due to differences in aroma and taste. Finally, the study did not evaluate the potential impact of dietary patterns, brushing habits, or hormonal variations among participants, which may influence plaque formation.

The implications of this study are significant for public health practice. The findings support the use of herbal decoctions particularly betel leaf as accessible and culturally relevant alternatives to commercial mouthwashes. This is particularly important in low-resource communities where affordability and availability of oral hygiene products may be limited. Additionally, incorporating herbal rinses into maternal health programs may enhance oral hygiene compliance among pregnant women.

For policymakers and healthcare providers, the results suggest the need for developing standardized guidelines for preparing and safely using herbal mouthwash. Future research should also consider long-term randomized controlled trials, phytochemical quantification, toxicity assessments, and evaluation of user acceptance.

V. CONCLUSION

This study aimed to compare the effectiveness of betel leaf (Piper betle) and basil leaf (Ocimum basilicum) decoctions in reducing dental plaque index among pregnant women. The findings demonstrated that both herbal preparations produced significant decreases in plaque accumulation; however, the magnitude of reduction differed between groups. The betel leaf decoction group exhibited a mean plaque index reduction from 3.51 to 2.28 ($\Delta = 1.23 \pm 0.75$), whereas the basil leaf group showed a decrease from 3.54 to 2.68 ($\Delta = 0.85 \pm 0.65$). Statistical comparison confirmed that the betel leaf decoction provided significantly greater antiplaque efficacy ($p = 0.003$), indicating its superior antibacterial potential. These results suggest that betel leaf decoction may serve as a more optimal herbal alternative for improving oral hygiene among pregnant women, especially in resource-limited communities where commercial mouthwashes may not be readily accessible. The effectiveness of both decoctions is likely attributable to their phytochemical profiles, with betel leaf containing higher concentrations of phenolic compounds capable of inhibiting oral biofilm formation. Despite these promising outcomes, the study is limited by its relatively small sample size, short-term assessment period, and lack of long-term follow-up on sustained plaque reduction or

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potential side effects. Therefore, future research should involve larger randomized controlled trials, extended observation periods, phytochemical quantification of both herbal preparations, and evaluation of user acceptability. Additional studies should also explore optimal formulation techniques, dosage standardization, and potential synergistic effects when combined with other herbal extracts. Overall, this research provides important preliminary evidence supporting the integration of herbal decoctions, particularly betel leaf, into community-based maternal oral health programs.

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DATA AVAILABILITY

Data supporting this study's findings are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTION

All authors contributed equally to the development of this study. Author A conceptualized the research design, supervised data collection, and performed data analysis. Author B conducted the literature review, prepared the herbal decoctions, and coordinated field implementation. Author C drafted the manuscript, organized the results, and revised the paper for academic quality and journal standards. All authors reviewed and approved the final manuscript.

DECLARATIONS

ETHICAL APPROVAL

The study was approved by the Ethics Committee of Poltekkes Kemenkes Surabaya.

CONSENT FOR PUBLICATION PARTICIPANTS.

All participants provided written informed consent before enrollment.

COMPETING INTERESTS

The authors declare that there are no conflicts of interest regarding the publication of this work.

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