TRADITIONAL REMEDIES IN MODERN DENTISTRY: EFFECTIVENESS OF AZADIRACHTA INDICA MOUTHWASH ON PLAQUE AND GINGIVITIS CONTROL

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Abstract

Background and Aim: Dental plaque–induced gingivitis is a common oral health problem. Although chlorhexidine is the gold standard for plaque control, its long-term use is associated with adverse effects, leading to interest in herbal alternatives. Azadirachta indica (neem) possesses antimicrobial and anti-inflammatory properties that may benefit oral health. This study aimed to evaluate the antiplaque and antigingivitis effects of an A.indica–based mouthrinse compared with 0.2% chlorhexidine in plaque-induced gingivitis.

Methodology: This randomized comparative clinical trial included 40 subjects (18–65 years) with plaque-induced gingivitis. Participants were equally divided into two groups after baseline scaling. Group I used neem mouthwash and Group II used chlorhexidine mouthwash twice daily. Plaque index, gingival index, and sulcus bleeding index were recorded at baseline and after 4 weeks. Paired and unpaired *t*-tests were used for intra- and intergroup comparisons, respectively.

Results: After 4 weeks, the neem mouthwash group showed significantly greater reduction in plaque, gingival inflammation, and bleeding on probing compared to the chlorhexidine group (plaque index $p = 0.002$; gingival index $p = 0.004$; bleeding on probing $p < 0.0001$)

Conclusion: A. indica based oral rinse is as effective and has fewer side effects than chlorhexidine, making it an alternative therapy for the management of plaque induced gingivitis that may be used in combination with other treatments.

Keywords: Azadirachta indica, Dental plaque, Chlorhexidine, Plaque index, Gingival Index, Bleeding on probing.

Main Text

Introduction:

Periodontal disease is characterized by inflammation and/or damage of the tooth's supporting tissue. Mechanical and chemical plaque reduction are the most effective methods of periodontal disease prevention and maintenance. Several chemical plaque management treatments, including bisbiguanides, essential oils, enzymes, and even plant extracts, have been studied for their efficacy on supragingival plaque[1]. There are several commercially available herbal extracts. **Azadirachta indica**, often known as **Neem**, has been utilised for thousands of years in India and South Asia to promote periodontal health.

Neem has traditionally been thought to offer astringent, antiseptic, antiulcer, and therapeutic effects. It is used in periodontitis and other dental diseases. The antibacterial effect of neem has been researched and known since ancient times. One possible mechanism for neem's anti- inflammatory effects is through inhibition of prostaglandin E and 5 HT, thereby reducing inflammation[2]. The antibacterial effect can be explained by "azadirachtin", which is known to destroy the bacterial cell wall and thus inevitably inhibit the growth of bacteria, and cell wall rupture thereby changes osmotic pressure and leads to cell death. However, its usefulness in treating gingivitis and periodontitis is not entirely clear.
Recent studies have highlighted the potential of neem-based mouthwashes in controlling plaque and gingivitis[3]. Azadirachta indica has been found to exhibit strong antimicrobial activity, helping to reduce the bacterial accumulation responsible for plaque formation and gingival inflammation. **Bhatnagar et al. (2016)** reported that neem mouthwash significantly reduced plaque and gingival inflammation, showing promising benefits for oral hygiene. **Jain et al. (2015)** found that neem extracts inhibit Streptococcus mutans and other plaque bacteria, and with their anti-inflammatory effects, neem mouthwash can be an effective natural option for managing gingivitis. **Khandelwal (2017)** conducted a clinical trial on neem-based mouthwash for gingivitis and reported significant reductions in plaque and gingival bleeding. Together with other studies, these findings suggest that neem mouthwash can be a safe and effective natural alternative for managing plaque and gingivitis, avoiding the side effects of conventional antimicrobial agents. Therefore, the aim of the present study was to "evaluate the antigingivitis and antiplaque properties of A. indica-based mouthrinse in plaque-induced gingivitis when compared to 0.2% chlorhexidine".

Materials and Methods:

To meet the primary objective of the study, a sample of 40 subjects with plaque induced gingivitis who reported to the Department of Periodontics, Drs.Sudha and Nageswara Rao Siddhartha Institute of Dental Sciences were selected.

The Institutional Ethical Committee at Drs. Sudha and Nageswara Rao Siddhartha Institute of Dental Sciences approved the study. The data was collected after obtaining consent from the patients and patient consent forms were submitted to the ethical committee of the institute.

Inclusion Criteria:

- Patients aged 18-65 years.
- Must have atleast 10 teeth present.
- Plaque induced gingivitis.
- Those who are willing to participate, and able to provide informed consent.

Exclusion Criteria:

- Uncontrolled systemic diseases.
- Pregnant women and lactating mothers.
- Usage of antibiotics 1 month prior to the study.
- Allergic to mouthwashes.

During the baseline visit, we measured the participant's gingival index, plaque index and bleeding on probing.

Study design:

Suitable subjects for the study were selected. The nature and design of the clinical study were explained to the patients, and written consent to participate was obtained. Subjects were then randomly assigned (simple random selection, i.e., lottery method, was used to eliminate personal bias in the selection of the sample) to one of two groups of 20 subjects each.

- Group A(n=20): Scaling + Neem mouthwash
- Group B(n=20): Scaling + Chlorhexidine (CHX) mouthwash

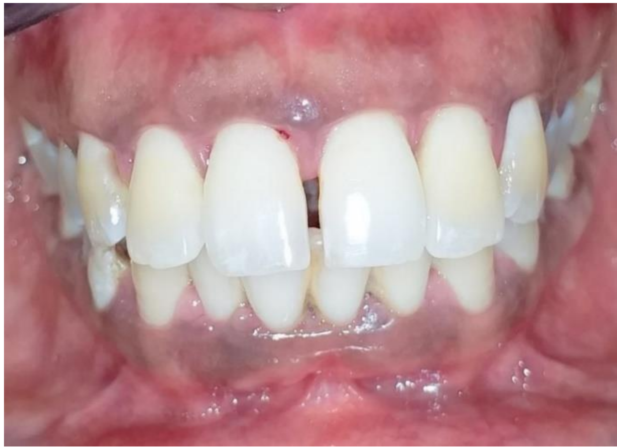
After brushing their teeth for 30 minutes, the subjects were instructed to rinse with 10 ml of mouthwash for one minute twice a day. Throughout the study period, subjects in both groups were instructed to brush their teeth regularly and refrain from using any other antiplaque medications.

<u>Clinical parameters</u>:

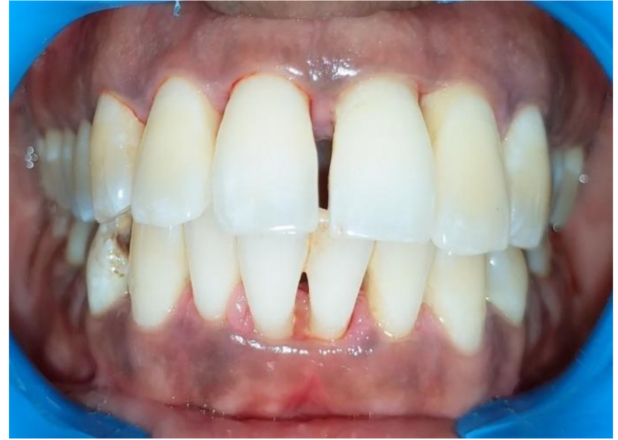
Clinical parameters like Gingival index (Loe and Silness in 1963), Plaque index (Silness P and Loe H in 1964) and Bleeding on probing were assessed at baseline and 4 weeks after SRP (scaling and root planing).

Chlorhexidine mouthwash **A. indica (Neem) mouthwash**

Test group

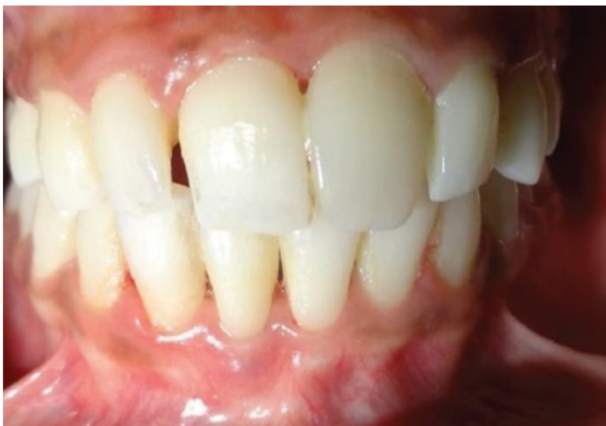


Baseline

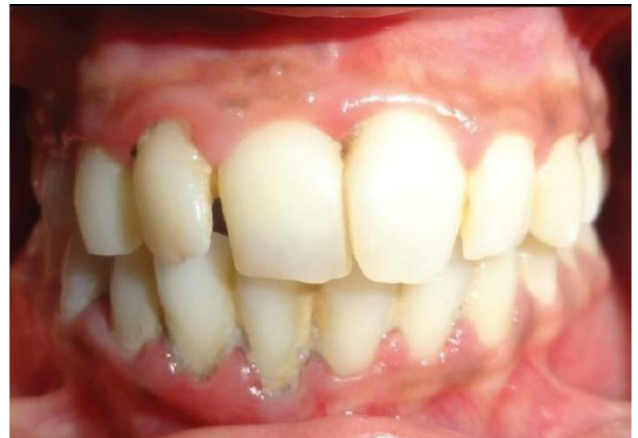


4 weeks

Control group



Baseline



4 weeks

Statistical analysis:

After calculating the gingival index, plaque index and bleeding on probing of the test and control sides using the above indices. The data is collected and entered in Microsoft excel and is subjected to statistical analysis using SPSS version 21.0. The data is checked for normality using the Shapiro–Wilk test ($p<0.312$) and it showed the data is normally distributed. Descriptive statistics and inferential statistics such as independent t test are performed for intergroup comparisons and Paired t test are performed for intragroup comparisons at baseline and 4 weeks after SRP.

Results:

Demographic and baseline clinical parameters were analogous across both the study groups. The average age of the test group was 35 ± 6.2 years and of the control group was 33 ± 5.8 years. The test group and control group are statistically comparable at baseline for age, GI, PI, and BOP. These results support the assumption that the groups were randomly assigned and had no significant differences before the intervention, allowing for a valid comparison of changes in GI, PI, and BOP at 4 weeks [Table 1].

Gingival Index (GI):

Test Group: At baseline, the mean GI is 2.2 with SD = 0.3, and at 4 weeks, the mean GI is 1.6 with SD = 0.4. The mean difference between baseline and 4 weeks is 0.6. Test group showed statistically significant difference in GI at 4 weeks when compared to baseline ($p<0.0001$) [Table 2]

Control Group: At baseline, the mean GI is 2.0 with SD = 0.2, and at 4 weeks, the mean GI is 1.9 with SD = 0.3. The mean difference is 0.1. Control group showed no statistically significant difference in GI at 4weeks when compared to baseline values ($p=0.16$)
[Table 2]

Inter-group Comparison: The p-value for the difference between the test and control groups at 4 weeks is 0.004, indicating that the test group shows a significantly greater improvement compared to the control group [Table 3]

Plaque Index (PI):

Test Group: At baseline, the mean PI is 2.4 with SD = 0.5, and at 4 weeks, the mean PI is 1.9 with SD = 0.4. The mean difference between baseline and 4 weeks is 0.5. Test group showed statistically significant difference in PI at 4 weeks when compared to baseline ($p<0.0001$) [Table 2]

Control Group: At baseline, the mean PI is 2.3 with SD = 0.4, and at 4 weeks, the mean PI is 2.1 with SD = 0.3. The mean difference is 0.2. Control group showed statistically significant difference in PI at 4weeks when compared to baseline values ($p=0.008$)
[Table 2]

Inter-group Comparison: The p-value for the difference between the test and control groups at 4 weeks is 0.002, indicating a significant difference in improvement between the two groups [Table 3]

Bleeding on Probing (BOP):

Test Group: At baseline, the mean BOP is 78% with SD = 10%, and at 4 weeks, the mean BOP is 52% with SD = 12%. [Table 2]

Control Group: At baseline, the mean BOP is 75% with SD = 9%, and at 4 weeks, the mean BOP is 70% with SD = 8%. [Table 2]

Inter-group Comparison: The p-value for the difference between the test and control groups at 4 weeks is <0.0001, indicating a highly significant difference, with the test group showing a greater improvement [Table 3]

TABLES

Table 1: Intergroup comparison for demographic and clinical outcomes using independent t-test.

Outcome Measure	Test Group (Mean ± SD)	Control Group (Mean ± SD)	P-Value (Intergroup comparison)
Age	35 ± 6.2	33 ± 5.8	0.30
GI (Baseline)	2.2 ± 0.3	2.0 ± 0.2	0.23
PI (Baseline)	2.4 ± 0.5	2.3 ± 0.4	0.49
BOP (%) (Baseline)	78% ± 10%	75% ± 9%	0.32

Table 2: Intragroup Comparison of GI, PI, and BOP at Baseline and 4 weeks

Outcome Measure	Group	Baseline (Mean ± SD)	4 Weeks (Mean ± SD)	Mean Difference (4W-Baseline)	SE	p-value
GI	Test Group	2.2 ± 0.3	1.6 ± 0.4	0.6	0.0894	<0.0001
	Control Group	2.0 ± 0.2	1.9 ± 0.3	0.1	0.067	0.16
PI	Test Group	2.4 ± 0.5	1.9 ± 0.4	0.5	0.0894	<0.0001
	Control Group	2.3 ± 0.4	2.1 ± 0.3	0.2	0.067	0.008
BOP	Test Group	78% ± 10%	52 ± 12%	26%	2.683	<0.0001
	Control Group	75% ± 9%	70% ± 8%	5%	1.788	0.01

Table 3: Intergroup Comparison of GI, PI, and BOP at Baseline and 4 weeks

Outcome Measure	Group	Baseline (Mean ± SD)	4 Weeks (Mean ± SD)	Mean Difference (4W-Baseline)	Standard Error (SE)	p-value (Intergroup comparison)
Gingival Index (GI)	Test Group	2.2 ± 0.3	1.6 ± 0.4	0.6	0.0894	0.004
	Control Group	2.0 ± 0.2	1.9 ± 0.3	0.1	0.067	
Plague Index (PI)	Test Group	2.4 ± 0.5	1.9 ± 0.4	0.5	0.0894	0.002
	Control Group	2.3 ± 0.4	2.1 ± 0.3	0.2	0.067	
BOP (%)	Test Group	78% ± 10%	52 ± 12%	26%	2.683	<0.0001
	Control Group	75% ± 9%	70% ± 8%	5%	1.788	

BAR DIAGRAMS

Chart depicting the mean values of Gingival Index in both test group and control group at Baseline and 4 weeks.

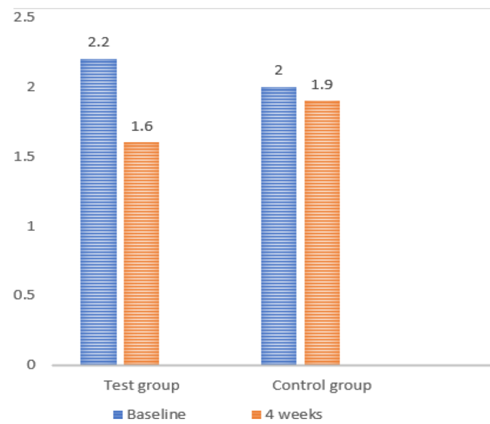


Chart depicting the mean values of Plaque Index in both test group and control group at Baseline and 4 weeks.

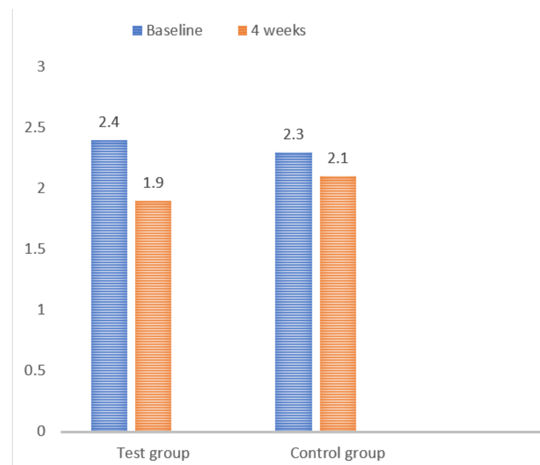
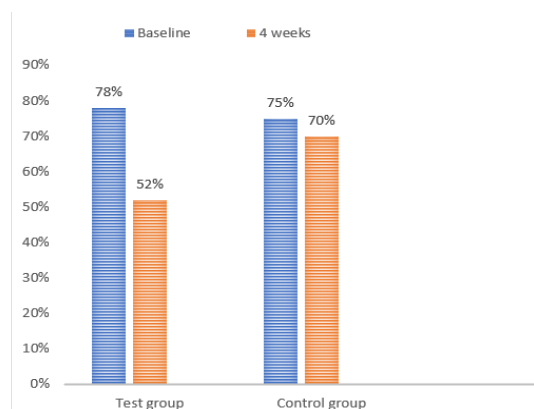


Chart depicting the values of Bleeding on probing in both test group and control group at Baseline and 4 weeks.



Discussion:

The management of plaque and gingivitis is crucial in maintaining oral health, and mouthwashes are widely used as adjuncts to mechanical cleaning. While CHX is considered the gold standard for oral antiseptics, recent studies have explored alternative treatments like neem mouthwash due to its natural antimicrobial properties. This discussion compares the effectiveness of neem mouthwash with CHX in controlling plaque and gingivitis.

Chlorhexidine gluconate, typically used in a 0.12% to 0.2% concentration, is a widely recognized antimicrobial agent with proven efficacy in controlling plaque formation and gingivitis. It works by disrupting bacterial cell walls and inhibiting bacterial growth. Numerous studies have shown that CHX significantly reduces plaque accumulation and inflammation in the gingiva. **Nassani (2020)** concluded that chlorhexidine (CHX) effectively reduces plaque and gingival inflammation in both short- and long-term use, decreasing plaque by up to 50%. However, its use may cause side effects such as tooth staining, altered taste, and mucosal irritation. Similarly, **Sato et al. (2018)** reported that CHX, as an adjunct to mechanical oral hygiene, effectively controls plaque biofilm and reduces gingival inflammation.

While Chlorhexidine remains the superior option for immediate and powerful plaque control, its side effects may influence patient compliance and long-term use. Neem (Azadirachta indica), a tree native to the Indian subcontinent, has been utilized for its medicinal properties for centuries. Recent studies have suggested that neem mouthwash can also effectively control plaque and gingivitis, offering a natural alternative to chemical agents like CHX. Neem contains compounds such as azadirachtin, nimbolide, and other bioactive substances that exhibit antimicrobial, anti-inflammatory, and antioxidant properties.

Neem compounds, particularly azadirachtin, have been shown to interfere with the bacterial cell membrane, leading to leakage of cellular contents and disruption of cell integrity. Neem inhibits the production of pro-inflammatory cytokines, such as interleukin-1 (IL-1), interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF-α), which are involved in the inflammatory process in gingivitis. By downregulating these cytokines, neem reduces the inflammation of the gingiva, thereby alleviating redness, swelling, and bleeding. Neem has been found to inhibit the activity of Matrix Metalloproteinases (MMPs), enzymes that break down the extracellular matrix of gingival tissues. By preventing excessive tissue breakdown, neem helps preserve the integrity of the gingival tissues and slows the progression of gingivitis. Neem has been shown to promote tissue repair and regeneration by enhancing collagen synthesis and accelerating the healing of inflamed tissues. This not only reduces inflammation but also strengthens the gingival tissues, making them less prone to bleeding. Neem has proven to be a promising adjunct in the management of gingivitis, providing both therapeutic benefits and patient satisfaction.

Tiwari et al. (2023) found that neem mouthwash significantly reduced plaque and gingival bleeding, with results similar to chlorhexidine (CHX) but fewer side effects.

Neem works by inhibiting oral bacteria like Streptococcus mutans and reducing inflammation (**Patil et al., 2020**).

Patil et al. (2022) showed that CHX is highly effective, but herbal mouthwashes offer good results with fewer side effects and higher patient satisfaction. This suggests neem may be a safe and natural alternative for managing gingivitis, though long-term studies are needed.

The results of this study suggest that both chlorhexidine and neem mouthwash are valuable tools in the management of gingivitis, though they offer different benefits and drawbacks. Chlorhexidine is more potent and provides quicker relief in reducing plaque, gingival inflammation, and bleeding, making it a preferred option in acute or more severe cases. However, its side effects, such as staining and potential alterations to taste, may limit its use for long-term maintenance.

On the other hand, neem mouthwash is a gentler, natural alternative with antimicrobial and anti-inflammatory properties. It may be particularly beneficial for patients who prefer a holistic approach or who experience side effects with chlorhexidine. Therefore, it remains an effective and well-tolerated option for managing gingivitis, especially in the long term.

Conclusion:

This study demonstrates that neem mouthwash is a promising, effective natural alternative to chlorhexidine for the control of plaque and gingivitis. The results are in line with previous research that supports the efficacy of neem in reducing oral plaque and inflammation, with comparable outcomes to chlorhexidine. Moreover, the absence of significant side-effects associated with neem, such as staining or taste alteration, makes it a particularly attractive option for long-term use. Future studies with larger sample sizes and longer follow-up periods are needed to substantiate these findings further and explore the long-term benefits and safety of neem in oral health care.

Acknowledgements:

Nil References:

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