Original Research Paper

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Comparative Evaluation of Curcumin Chewing Gum and Chlorhexidine Mouthwash in Patients with Chronic Gingivitis: A Randomized Clinical Trial.

Abstract:

Introduction: Gingivitis is a plaque induced disease that causes inflammation of the gums. Chlorhexidine is the gold standard antiplaque agent used but has some side effects like staining. Curcumin hasanti-inflammatory, antibacterial and antiplaque properties with minimal side effects and cost effectiveness. Chewing gums stimulate saliva flow and increases plaque pH, which prevents tooth decay.

Aim: To evaluate and compare the effectiveness of 0.5g curcumin infused chewing gum with 0.12% Chlorhexidine mouthwash as antiplaque agents in patients with chronic gingivitis over a one-month period.

Materials And Method: A randomizedclinical trial was conducted among 40 participants diagnosed with moderate gingivitis. After SRP, they were divided into two groups: Group1 used 0.12% chlorhexidine mouthwash twice a day. Group2 used 0.5g indigenously prepared curcumin chewing gum for 15 min twice a day. Clinical parameters (PI, GI & SBI) were recorded at baseline,14th day and 1month. Statistical analysis was performed using paired t-test and independent t-test.

Result: Both groups demonstrated statistically significant improvement in clinical parameters over the study period ($p \leq 0.05$). However, Intergroup comparisons showed significant differences in gingival inflammation and bleeding scores in chlorhexidine, although both interventions demonstrated clinical improvement.

Conclusion: Curcumin chewing gum demonstrated comparable clinical efficacy to chlorhexidine mouthwash in reducing plaque accumulation and gingival inflammation, suggesting it may serve as a safe and effective herbal alternative for managing chronic gingivitis.

Keywords: Gingivitis; Curcumin; Chlorhexidine; Chewing gum; Plaque control; Herbal therapy.

Introduction:

Gingivitis is an inflammatory condition of gingival tissues, primarily caused by the accumulation of dental plaque along the gingival margin. It represents the earliest stage of periodontal disease and, if not treated properly, it may progress to periodontitis ,with irreversible destruction of the supporting structures of the teeth.[1] The gingivitis includes redness, inflammation, and bleeding on probing, without any loss of connective tissue attachment or alveolar bone involvement.[2]

Dental plaque is a biofilm composed of microorganisms, salivary glycoproteins, food particles, and extracellular matrix components, is the primary etiological agent responsible for initiating and sustaining gingival inflammation.[3]While tooth brushing and flossing are the first line of defense in mechanical plaque control, its effectiveness often falls short due to inconsistent oral hygiene practices, physical limitations, or difficulty accessing certain areas of the mouth, such as interproximal or posterior regions.[4] Consequently, adjunctive chemotherapeutic agents have been recommended

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to enhance plaque control and improve gingival health and oral hygiene protocols.

Chlorhexidine gluconate (CHX) has long been considered the gold standard due to its broad-spectrum antimicrobial action and high substantivity, allowing prolonged retention.[5] Studies have demonstrated its effectiveness in reducing supragingival plaque and gingival inflammation when combined with mechanical plaque control. However, prolonged CHX use is limited by undesirable side effects, including tooth staining, altered taste perception, mucosal irritation, and rare allergic reactions.[6]

Curcumin, a polyphenolic compound derived from the rhizome of *Curcuma longa* (turmeric), has emerged as a promising candidate for oral health due to its pharmacological properties. It exhibits a wide range of pharmacological actions, including anti-inflammatory, antimicrobial, antioxidant, and tissue-reparative effects.[7] Curcumin exerts its anti-inflammatory effects through the modulation of several molecular pathways, including inhibition of nuclear factor-κB (NF-κB) activation and suppression of pro-inflammatory cytokines such as interleukin-1β and tumor necrosis factor-α[8]With a long-standing history of use in traditional medicine systems like Ayurveda, curcumin is considered safe for long-Recent studies have demonstrated that curcumin-based formulations can effectively reduce plaque accumulation and gingival inflammation, comparable to CHX, without adverse effects.[9] In recent years, the development of medicated chewing gum has opened new avenues for delivering therapeutic agents in the oral cavity. This drug delivery system provides extended contact between the active ingredient and oral tissues, enhances drug absorption through the buccal mucosa, bypasses hepatic first-pass metabolism, and promotes patient compliance due to its ease of use and acceptability.[11]The incorporation of curcumin into a chewing gum combines its therapeutic potential with the mechanical cleansing action of chewing, potentially enhancing oral hygiene and gingival health in a user-friendly format.[12]

This study aims to compare the clinical effectiveness of curcumin-infused chewing gum with that of 0.12% chlorhexidine mouthwash in individuals diagnosed with chronic gingivitis.

Materials and Methods:

Ethical Considerations

The present randomized clinical trial was conducted in accordance with the ethical principles outlined in the the Declaration of Helsinki (1975), revised in 2000. Ethical approval for the study was obtained from the Institutional Ethics Committee of Pacific Dental College and Hospital, Debari, Udaipur, Rajasthan, India prior to the commencement of the study (Reference No. PDCH/26/EC-63). All participants were informed about the nature and purpose of the study, and written informed consent was obtained before enrollment.

Study Design:

This study was designed as a randomized, parallel-group clinical trial conducted over a period of one month in the Department of Periodontics at Pacific Dental College and Hospital, Udaipur, India.

Selection and Description of Participants:

Study Population

A total of 40 systemically healthy individuals diagnosed with mild-to-moderate chronic gingivitis were recruited from patients reporting to the outpatient department of Periodontics.

Inclusion Criteria:

Participants fulfilling the following criteria were included in the study:

- Systemically healthy individuals
- Age group between 20 and 45 years
- Presence of at least 20 natural teeth
- Clinical diagnosis of mild-to-moderate gingivitis characterized by gingival inflammation and bleeding on probing

Exclusion Criteria:

- Participants were excluded if they met any of the following criteria:
- Use of antibiotics or anti-inflammatory drugs within the past three months
- History of scaling and root planing within the previous six months
- Presence of orthodontic appliances or extensive prosthetic restorations
- Known allergy to curcumin or chlorhexidine
- Pregnant or lactating women
- Smokers, alcoholics, or drug abusers
- Current use of any antimicrobial mouthrinse

Randomization and Allocation:

Participants were randomly allocated into two equal groups (n = 20 each) using a simple randomization method. Allocation concealment was achieved using sealed opaque envelopes prepared prior to the study.

Group 1 (Test Group):

Participants received 0.5 g curcumin-infused chewing gum.They were instructed to chew one gum twice daily for 15 minutes after tooth brushing.(Fig 1)

Group 2 (Control Group):

Participants were instructed to rinse with 10 ml of 0.12% chlorhexidine gluconate mouthwash (Hexidine-EP®, ICPA Health Products Ltd., India) twice daily for 30 seconds.(Fig 2)

Clinical Procedure

All participants underwent full-mouth scaling and root planing (SRP) followed by polishing prior to the initiation of the study to standardize baseline plaque levels.Consequently, the Plaque Index score at baseline was recorded as zero for all subjects. Participants were given oral hygiene instructions and were advised to maintain their regular tooth brushing practices during the study period.

Clinical parameters were recorded at:

Baseline (Day 0)

Day 14 One month

The following clinical indices were evaluated:

Plaque Index (PI) (Löe and Silness)

Gingival Index (GI) (Löe and Silness)

Modified Sulcular Bleeding Index (MSBI)

All measurements were recorded using a William's periodontal probe (Hu-Friedy, Chicago, USA) by a single calibrated examiner to minimize inter-examiner variability.

Preparation of Curcumin Extract:

Curcumin was extracted from the rhizomes of *Curcuma longa* using a solid–liquid extraction technique (maceration). Ethanol was used as the extraction solvent due to its favorable polarity and safety profile. The extraction process was performed at 30°C for one hour using a sample-to-solvent ratio of 1:8 (w/v) to obtain an optimal yield of curcumin.[13]

Preparation of Curcumin Medicated Chewing Gum:

The chewing gum formulation was prepared using a standard pharmaceutical gum base technique. The gum base (500 g) was softened by heating to approximately 70°C in a water bath. A plasticizer and antioxidant were added to the softened gum base, followed by incorporation of curcumin extract (125 g) with continuous mixing to ensure uniform distribution.(Fig1)

Sweetening agents and fillers were blended into the mixture to improve texture and palatability. Once the temperature decreased to approximately 40°C, flavoring agents were added. The final mixture was allowed to cool to room temperature and was subsequently cut into uniform chewing gum pieces suitable for intraoral use.[14]

The Concentration of Each Ingredient Used Was:

Ingredients	Weight (gm)
Curcumin	125
Gum Base	500
Softening Agent	160
Filler	100
Antioxidant	1
Flavouring Agent	20
Emulsifier	10

Statistical Analysis

Statistical analysis was performed using SPSS version 23.0 (IBM Corp., Chicago, USA). Continuous variables were expressed as mean ± standard deviation (SD).

Intragroup comparisons between baseline, Day 14, and one month were performed using the paired t-test.

Intergroup comparisons between the control group (chlorhexidine mouthwash) and the test group (curcumin chewing gum) at each time interval were analyzed using the independent samples t-test.

A P value < 0.05 was considered statistically significant.

Results:

Participant Characteristics:

A total of 40 systemically healthy participants diagnosed with chronic gingivitis were included in the present randomized clinical trial. The participants were randomly allocated into two equal groups with 20 subjects in each group.

- Control Group: 0.12% Chlorhexidine mouthwash
- Test Group: Curcumin-infused chewing gum

All participants completed the study period of one month, and no dropouts were reported.

Plaque Index (PI)

Since all participants underwent full-mouth scaling and root planing prior to baseline recording, plaque deposits were removed and the Plaque Index score at baseline was recorded as zero for all participants. Therefore, subsequent measurements represent plaque re-accumulation during the follow-up period.

At Day 14, the mean plaque index score was 0.97 ± 0.10 in the control group and 0.71 ± 0.42 in the test group.

At one month, the mean plaque index was 1.06 ± 0.14 in the control group and 0.96 ± 0.05 in the test group.

Intergroup comparison demonstrated a statistically significant difference between the groups at both Day 14 (P = 0.01) and one month (P = 0.005).

These findings indicate that plaque re-accumulation occurred in both groups following scaling and root planing; however, the test group showed slightly lower plaque scores compared with the control group during the follow-up period.

Gingival Index (GI)

At baseline, the mean gingival index scores were 1.43 ± 0.16 in the control group and 1.52 ± 0.24 in the test group, indicating no statistically significant difference between the groups (P = 0.19).

After 14 days, the mean gingival index reduced to 0.71 ± 0.16 in the control group and 0.93 ± 0.11 in the test group.

At one month, further reduction was observed with scores of 0.19 ± 0.13 in the control group and 0.62 ± 0.35 in the test group.

Intragroup comparison demonstrated a statistically significant reduction in gingival inflammation from baseline to one month in both groups (P < 0.001).

Intergroup comparison at one month showed that the control group exhibited significantly lower gingival index scores compared to the test group (P < 0.001).

These findings indicate that although both interventions were effective in reducing gingival inflammation, chlorhexidine mouthwash demonstrated greater clinical improvement.

Modified Sulcular Bleeding Index (MSBI):

The mean baseline MSBI scores were 1.55 ± 0.17 in the control group and 1.56 ± 0.22 in the test group, showing no statistically significant difference between the groups (P = 0.81).

At Day 14, the mean MSBI values decreased to 0.87 ± 0.14 in the control group and 0.86 ± 0.12 in the test group.

At one month, the mean MSBI further reduced to 0.18 ± 0.21 in the control group and 0.48 ± 0.32 in the test group.

Both groups demonstrated statistically significant intragroup reductions in bleeding scores from baseline to one month (P < 0.001).

However, intergroup comparison revealed that the control group showed significantly lower bleeding scores compared to the test group at one month (P < 0.001).

Summary of Clinical Findings:

Both treatment modalities demonstrated significant improvements in gingival health over the study period.

- Chlorhexidine mouthwash showed greater reduction in gingival inflammation and bleeding scores.
- Curcumin-infused chewing gum also produced significant clinical improvement, suggesting that it may serve as a potential adjunctive herbal alternative for the management of gingivitis.

However, the magnitude of improvement observed with chlorhexidine was superior at the end of the one-month follow-up period.

Table 1 : Comparison of Plaque Index (PI) Scores Between Control and Test Groups

Time Interval	Control Group (Mean ± SD)	Test Group (Mean ± SD)	Intergroup P value
Baseline	0.00 ± 0.00	0.00 ± 0.00	—
Day 14	0.97 ± 0.10	0.71 ± 0.42	0.01
1 Month	1.06 ± 0.14	0.96 ± 0.05	0.005

*PI: Plaque Index †SD: Standard deviation

‡Baseline plaque scores were recorded after full-mouth scaling and root planing.

Table 2: Comparison of Gingival Index (GI) Scores Between Control and Test Groups

Time Interval	Control Group (Mean ± SD)	Test Group (Mean ± SD)	Intergroup P value
Baseline	1.43 ± 0.16	1.52 ± 0.24	0.19
Day 14	0.71 ± 0.16	0.93 ± 0.11	<0.001
1 Month	0.19 ± 0.13	0.62 ± 0.35	<0.001

*GI: Gingival Index †SD: Standard deviation

‡Both groups demonstrated significant intragroup reduction in gingival inflammation from baseline to one month ($P < 0.001$).

Table 3: Comparison of Modified Sulcular Bleeding Index (MSBI) Scores

Time Interval	Control Group (Mean ± SD)	Test Group (Mean ± SD)	Intergroup P value
Baseline	1.55 ± 0.17	1.56 ± 0.22	0.81
Day 14	0.87 ± 0.14	0.86 ± 0.12	0.75
1 Month	0.18 ± 0.21	0.48 ± 0.32	<0.001

*MSBI: Modified Sulcular Bleeding Index †SD: Standard deviation

Intragroup comparison: Both groups demonstrated statistically significant reduction in bleeding scores over the study period ($P < 0.001$)

Table 4: Intragroup Comparison of Clinical Parameters Over Time

Parameter	Group	Baseline Mean ± SD	Day 14 Mean ± SD	1 Month Mean ± SD	P value
Plaque Index	Control	0.00 ± 0.00	0.97 ± 0.10	1.06 ± 0.14	<0.001
	Test	0.00 ± 0.00	0.71 ± 0.42	0.96 ± 0.05	<0.001
Gingival Index	Control	1.43 ± 0.16	0.71 ± 0.16	0.19 ± 0.13	<0.001
	Test	1.52 ± 0.24	0.93 ± 0.11	0.62 ± 0.35	<0.001
MSBI	Control	1.55 ± 0.17	0.87 ± 0.14	0.18 ± 0.21	<0.001
	Test	1.56 ± 0.22	0.86 ± 0.12	0.48 ± 0.32	<0.001

*MSBI: Modified Sulcular Bleeding Index

†SD: Standard deviation

Figure 1:Group 1Test group 0.5 g curcumin infused chewing

Figure 2: Group 2: Control group Hexidine-EP®, ICPA Health Products Ltd., India

Discussion:

The present randomised clinical study aimed to evaluate and compare the clinical efficacy of curcumin-based medicated chewing gum and 0.12% chlorhexidine (CHX) mouthwash in managing chronic gingivitis. The findings demonstrated that both interventions resulted in statistically significant improvements in clinical parameters, including Plaque Index (PI), Gingival Index (GI), and Modified Sulcular Bleeding Index (MSBI), over the one-month study period.

Intergroup comparison demonstrated statistically significant differences between the treatment groups in several clinical parameters. Chlorhexidine mouthwash showed greater reductions in Gingival Index and Modified Sulcular Bleeding Index scores at one month when compared with curcumin chewing gum. Although plaque scores were slightly lower in the test group during follow-up, the overall reduction in gingival inflammation and bleeding was more pronounced in the chlorhexidine group. These findings indicate that while curcumin chewing gum provides clinical benefits in gingivitis management, chlorhexidine mouthwash remains more

effective in reducing inflammatory parameters over the short-term evaluation period.

The superior reduction in gingival inflammation and bleeding observed in the chlorhexidine group in the present study it can be attributed to its sustained antimicrobial activity and substantivity, which facilitate prolonged interaction with oral tissues and effective suppression of plaque biofilm [15]. This sustained release action is likely contributed to the greater improvement in gingival parameters observed at the end of the study period. However, the clinical use of chlorhexidine, particularly for long-term use, remains limited due to its adverse effects, including extrinsic tooth staining, taste alteration, and mucosal irritation, which may alters patient compliance [6].

In contrast, the clinical improvements observed in the curcumin chewing gum group appear to be primarily mediated through modulation of the host inflammatory response rather than direct antimicrobial substantivity. Curcumin has been shown to downregulate key inflammatory pathways, including inhibition of nuclear factor-κB (NF-κB) and suppression of pro-inflammatory cytokines, thereby contributing to a reduction in gingival inflammation and bleeding [7,8]. The findings of the present study are in agreement with previous clinical investigations that have demonstrated significant anti-gingivitis effects of curcumin-based formulations. Studies by Muglikar et al. and Mali et al. have reported comparable reductions in gingival inflammation with curcumin and chlorhexidine formulations, supporting its role as an effective adjunct in periodontal therapy [18,19]. Similarly, Waghmare et al. observed notable antiplaque and anti-inflammatory effects with turmeric-based preparations, further substantiating the therapeutic potential of curcumin in gingival disease management [20].

Furthermore, Zaidi et al.[15] specifically investigated the use of curcumin in a medicated chewing gum formulation and reported a marked reduction in gingival inflammation and plaque scores within a short evaluation period. Their findings closely mirror the outcomes observed in the present study, reinforcing that curcumin, when delivered via chewing gum, can serve as an effective alternative to conventional chemical agents in the management of gingivitis.

An added strength of this study was the novel delivery method of curcumin in the form of medicated chewing gum. This mode of delivery offers several benefits, including prolonged mucosal contact, stimulation of salivary flow, ease of administration, and potential improvement in patient compliance, particularly among populations with difficulties using mouth rinses[24,11] In this study, the curcumin chewing gum was well accepted by participants, with no reported side effects—further supporting its clinical viability.

Although significant reductions were observed in both GI and MSBI across both groups, the MSBI values were initially higher in the CHX group at baseline. This discrepancy, however, was neutralized by Day 30, indicating that both treatments effectively reduced gingival bleeding regardless of baseline differences. The PI scores showed a gradual increase from Day 14 to Day 30 in both groups, which may suggest a decline in patient compliance over time, a factor commonly encountered in clinical studies without reinforcement of oral hygiene practices.

The absence of significant intergroup differences in any of the three clinical parameters implies that curcumin chewing gum can be considered as clinically equivalent to CHX in short-term gingivitis management. Furthermore, the nonexistence of adverse effects in the curcumin group adds to its potential as a safer, natural alternative for patients who are sensitive to or prefer to avoid synthetic agents.

Nevertheless, this study is not without limitations. The sample size was modest, and the observation period was limited to 30 days. Future studies with larger populations, extended follow-up durations, and inclusion of microbiological and immunological parameters would provide a more comprehensive understanding of the long-term efficacy and mechanism of curcumin-based therapies.

Future Research Directions:

Future studies should focus on larger randomized clinical trials with longer follow-up periods to evaluate the sustained effects of curcumin chewing gum in periodontal therapy. Investigations incorporating microbiological analysis, inflammatory biomarkers, and dose-optimization studies would also help clarify the mechanisms underlying the therapeutic effects of curcumin and facilitate the development of improved formulations for periodontal disease management.

Conclusion:

Both curcumin chewing gum and chlorhexidine mouthwash produced significant improvements in gingival health following scaling and root planing. However, chlorhexidine demonstrated greater reductions in gingival inflammation and bleeding scores over the one-month follow-up period. Although curcumin chewing gum showed beneficial effects and good patient acceptance, chlorhexidine mouthwash

remains more effective in short-term management of chronic gingivitis.

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