



## Comparison of curcumin topical nanogel and chlorhexidine mouthwash for the treatment of chronic gingivitis: A randomized clinical trial

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### Original Article

#### Abstract

**BACKGROUND AND AIM:** Gingivitis is an inflammation of oral soft tissue without attachment loss as a result of bacterial aggregation. The aim of this study was to compare the effect of topical curcumin nanodrug gel and chlorhexidine (CHX) mouthwash on the treatment of gingivitis.

**METHODS:** In this study, 40 patients who had generalized chronic gingivitis and symptoms of redness and inflammation of the gums, as well as bleeding on probing (BOP) without attachment loss were enrolled and divided into two groups of 20 members. In one group, scaling and root planing (SRP) with the use of CHX 0.2% (twice a day for a week) was prescribed, and in the other group, SRP was done with the use of topical curcumin 1% nanogel (once a day), which was injected in gingival sulcus. Then, plaque index (PI), gingival index (GI), and BOP were measured and compared at three times (before treatment, 2 weeks and one month after treatment). 5 patients did not attend in the follow-up sessions; therefore, the results were presented with 35 patients.

**RESULTS:** BOP, GI, and PI significantly reduced in the first, second, and third times in both CHX and curcumin groups ( $P \leq 0.04$ ). The average of PI in CHX group was higher than that in curcumin group in the second and third times, but the difference was statistically significant only in the third time ( $P = 0.014$ ).

**CONCLUSION:** Based on the results of this study, curcumin as an herbal compound in gel form significantly improves gum status and clinical parameters (BOP, GI, and PI); therefore, it can be used in addition to mechanical treatments.

**KEYWORDS:** Curcumin; Chlorhexidine; Gingivitis; Dental Plaque

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Periodontal diseases are among the most common diseases of mankind and the main reason of tooth loss in adults. Microbial plaque plays a substantial role in these infectious diseases. The disease is initiated when bacteria aggregate in dental biofilm.<sup>1</sup>

Gingivitis is a kind of periodontal disease which is the inflammation of oral soft tissue without the migration of junctional epithelium as a result of bacterial aggregation and their products. Gingivitis has a number of symptoms such as redness, edema, and

bleeding on probing (BOP). Over 82% of teenagers in various societies show gingival bleeding and gingivitis. It is estimated that half of adult population worldwide, suffer from gingivitis.<sup>2</sup>

Mechanical removal of supragingival calculus is the most effective method of prevention from gingivitis, but unfortunately, the majority of people do not have a suitable control on their dental plaque; therefore, gingivitis is common. Scaling and root planing (SRP) is the conventional treatment of gingivitis. In addition, chemical treatments like

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using the mouthwash or the gel of some antimicrobials such as chlorhexidine (CHX), when used beside mechanical treatments, considerably increase the success of treatment.<sup>3</sup>

CHX has been studied more than any other antimicrobial mouthwash and researches have shown that it is always more effective than others.<sup>4</sup>

The antimicrobial spectrum of CHX is vast and it has no interaction with microbial enzymes and receptors. Thus, there would be no microbial resistance. CHX has unwanted side effects such as unpleasant taste, tooth staining, and mouth irritation.<sup>5</sup>

Hence, there is a need for a new antimicrobial compound which can be used daily and does not have the side effects of chemical antimicrobials, e.g., CHX. Herbal mouthwashes are effective in reducing gingival plaques. They can help us to have a better treatment with less side effects.<sup>6</sup>

Using herbal gels and mouthwashes in subgingival areas considerably reduces gingival index (GI) and bleeding index (BI). Herbal mouthwashes such as *Persica*,<sup>7</sup> *aloe vera*,<sup>8</sup> and green tea<sup>9</sup> have a good effect on controlling periodontal parameters. Especially, when they are used beside SRP.<sup>10</sup>

Curcumin mouthwash is one of the best mouthwashes. Curcumin is a useful compound in turmeric. It has anti-inflammatory, anti-tumor, anti-microbial, and wound-repairing effects and is useful in gingivitis treatment. Curcumin has a high absorption when it is used as a topical nanodrug and causes better results in less time. Studies have shown that CHX and topical herbal drugs such as curcumin gel have beneficial effects on treatment of gingival diseases, but CHX is still the first choice.<sup>11</sup>

Hence, this study aimed to compare the effect of topical curcumin nanogel and CHX mouthwash on improving chronic gingivitis.

## Methods

This study was a clinical trial that was conducted on 40 participants with chronic gingivitis and necessary inclusion criteria

who had come to School of Dentistry, Mashhad University of Medical Sciences, Mashhad, Iran.

Inclusion criteria were having a good general health, no consumption of antibiotics, anti-inflammatory, anti-histamine, analgesic drugs, and antidepressants in the last 6 weeks, no attachment loss, and not being pregnant. In addition, people with a history of medical and herbal allergy especially turmeric allergy were not entered the study.

According to similar studies<sup>3</sup> and sample size formula  $[n = 1 + 2C(\frac{z}{d})^2]$ , 40 patients (20 patients in each group) were enrolled in the study. Data were collected and entered into SPSS software (version 21, IBM Corporation, Armonk, NY) and clinical parameters between groups were compared by Fisher's exact test, Friedman test, and one-way analysis of variance (ANOVA).

Before starting the study, the method and probable benefits and cautions were completely explained to the participants and informed consent was obtained from all of them. This study was approved by the Ethics Committee of Mashhad University of Medical Sciences (Ethical code: IR.MUMS.SD.REC.1394.162).

This study was designed as a double-blind, randomized trial; to eliminate bias, diagnosis, scaling, and the findings were recorded by a single examiner. The person who measured clinical items and the researcher who analyzed the obtained data were blinded. Forty participants who met the inclusion criteria were randomly allocated to one of the following two groups (20 people in each group).

Using a random number table, a random list was created with the patient number (as many as 40 required patients specified in the sample size section) and a block (the number and volume of blocks were selected according to the sample size). This list was given to a person who was unaware of the treatments and other than the research team (examiner, patient, and analyst) and he allocated them to treatment groups A and B, according to the list of patients.

Debridement was performed in

supragingival and subgingival areas using ultrasonic devices (Woodpecker, UDS-K LED, China), and SRP was done for both groups. Then, for the test group, the patients were asked to use curcumin 1% nanodrug gel via application in gingival sulcus. This is a hydrophobic gel and is formulated in the Nanotechnology Research Center (NTRC) of Mashhad. The gel is prepared in 15g tubes and each tube is used for one patient. It contains curcumin 1% and the formulation is confidential. The license for the use of gel on humans was obtained.

The participants were advised to follow their regular brushing protocol. The control group was asked to use CHX 0.2% mouthwash (Iran Najo Pharmaceutical Co., Tehran, Iran) twice a day for a week, according to the protocol. The patients were assessed before treatment and two weeks and one month after treatment in terms of plaque index (PI),<sup>12</sup> GI,<sup>12</sup> and BOP.<sup>13</sup>

In order to evaluate PI, a number was allocated to every surface of the tooth, according to the amount of plaque in that surface. For GI, a number was allocated to every surface of the tooth, according to gingival status. For BOP, a probe was entered in the gingival sulcus and moved longitudinally through the internal wall of the sulcus. If there was any bleeding in each surface, a positive sign (+) was put for that surface and if there was no bleeding, a negative sign (-) was put for that surface. The recording was blind and no side effects were reported.

## Results

This study was conducted on 40 participants including 20 members in curcumin test group and 20 members in CHX control group.

Unfortunately, 5 people left the study during the follow-up period. Therefore, the results are presented with 35 members including 22 female subjects (62.9%) and 13 male subjects (37.1%) with the mean age of  $30 \pm 9$  years and the age range of 16 to 50 years.

At first, demographic information was collected as follows:

According to table 1, the number of male subjects in CHX and curcumin groups was 4 (22.2%) and 9 (52.9%), respectively. The number of female subjects in two groups was 14 (77.8%) and 8 (47.1%), respectively. In general, sex distribution was not significantly different in the studied groups ( $P = 0.060$ ). Sex cannot be a confounding variable in this study.

As shown in this table, the minimum and maximum age of the participants was 16 and 50 years in both groups, respectively. It means that the age range was exactly the same in both groups. The mean age of the participants in curcumin group was higher than that in CHX group, but the difference was not significant ( $P = 0.800$ ).

*Comparison of BOP, GI, and PI between the study groups and between the first, second, and third measurements:* According to table 2, there was a significant difference in the percentage of BOP, GI, and PI from the first to the third time in both groups ( $P < 0.001$ ) and PI in CHX group ( $P = 0.044$ ).

Two groups were compared with each other and it was found that in both CHX and curcumin groups, the percentage of BOP and GI in the second and third times was significantly lower than that in the first time ( $P < 0.001$ ). It was found that in curcumin group, the decrease in PI was significant between the first and third time points, as well as between the second and third times ( $P < 0.001$ ).

**Table 1.** Sex and age distribution in the study groups

Variable	Group		P
	Curcumin (n = 17)	CHX (n = 18)	
Gender [n (%)]			0.060*
Women	14 (77.8)	8 (47.1)	
Men	4 (22.2)	9 (52.9)	
Age (year) (mean $\pm$ SD)	30.1 $\pm$ 10.2	30.9 $\pm$ 8.9	0.800**

\*Chi-square test, \*\*Two independent samples t-test  
CHX: Chlorhexidine; SD: Standard deviation

**Table 2.** Mean and variance of general changes of periodontal parameters

Variable	Group	Mean ± SD	Mann-Whitney test result
Overall changes of BOP	Curcumin	0.58 ± 0.20	Z = 0.32, P = 0.764
	CHX	0.61 ± 0.22	
Overall changes of GI	Curcumin	0.83 ± 0.43	Z = 0.35, P = 0.726
	CHX	0.81 ± 0.41	
Overall changes of PI	Curcumin	0.43 ± 0.42	Z = 1.93, P = 0.053
	CHX	0.20 ± 0.35	

BOP: Bleeding on probing; GI: Gingival index; PI: Plaque index; CHX: Chlorhexidine; SD: Standard deviation

*Comparison of periodontal parameters between the first and third times in CHX and curcumin groups:* According to table 3, BOP change between the first and third times in curcumin group was less than that in CHX group, but the difference was not significant (P = 0.764). GI and PI changed more in curcumin group than CHX group, but the difference was not significant (for GI, P = 0.726; for PI, P = 0.053).

In addition, curcumin had some benefits such as better taste and not having the side effects like tooth staining, increasing supragingival calculus, taste disorder, and parotid gland inflammation.<sup>14</sup>

## Discussion

Gingivitis is the inflammation of oral soft tissue without apical migration of junctional epithelium. The main signs of gingivitis are redness, edema, and BOP. Inappropriate hygiene causes bacterial plaque to aggregate around the teeth. Biofilm, bacteria, and their products initiate gingival diseases.<sup>15</sup>

Mechanical control of dental plaque is the most efficient treatment of gingivitis. In order to improve current treatments of gingivitis, researchers have suggested to use

a chemical compound beside mechanical treatments. Chemical factors have a lot of side effects; thus, scientists have focused on herbal compounds with high efficiency and less side effects.<sup>16</sup>

Curcumin as an herbal compound is being used for the treatment of many diseases. Researchers have shown abundant therapeutic effects for curcumin such as anti-inflammatory, antioxidant, antibacterial, antiviral, antifungal, antitumor, anti-spasm, and wound repair.<sup>17</sup>

To the best of our knowledge, there is no study evaluating the effect of curcumin as a topical compound on periodontal diseases and comparing it with CHX. Therefore, this study aimed to compare the effects of topical curcumin gel and CHX mouthwash on chronic gingivitis.

The present study shows that both curcumin 1% nanogel and CHX 0.2% mouthwash significantly reduce BOP, GI, and PI. But statistical analysis revealed that CHX reduced GI more than curcumin at the beginning of the study. It was also revealed that curcumin reduced dental plaque more than CHX at the end of the study.

**Table 2.** Mean and variance of general changes of periodontal parameters

Group/time	BOP1 (%)	BOP2 (%)	BOP3 (%)	Friedman test result
Curcumin	69.00 ± 22.00	27.00 ± 18.00	11.00 ± 13.00	P < 0.001
CHX	69.00 ± 23.00	23.00 ± 17.00	8.00 ± 13.00	
Mann-Whitney test result	Z = 0.34, P = 0.853	Z = 0.62, P = 0.617	Z = 0.19, P = 0.341	
	GI1	GI2	GI3	
Curcumin	1.73 ± 0.38	1.17 ± 0.36	0.90 ± 0.38	P < 0.001
CHX	1.69 ± 0.27	1.12 ± 0.25	0.88 ± 0.31	
Mann-Whitney test result	Z = 0.22, P = 0.827	Z = 0.87, P = 0.380	Z = 0.68, P = 0.490	
	PI1	PI2	PI3	
Curcumin	1.00 ± 0.29	0.83 ± 0.22	0.57 ± 0.26	P < 0.001
CHX	1.00 ± 0.00	0.95 ± 0.15	0.80 ± 0.35	
Mann-Whitney test result	Z = 0.40, P = 0.688	Z = 1.63, P = 0.104	Z = 2.46, P = 0.014	P = 0.044

Data are presented as mean ± standard deviation (SD)

BOP: Bleeding on probing; GI: Gingival index; PI: Plaque index; CHX: Chlorhexidine

In the present study, curcumin 1% and CHX 0.2% mouthwash were not significantly different in terms of BOP and GI during the periodic examinations, but PI was significantly different. In other words, it can be concluded that CHX mouthwash and curcumin gel have no difference in terms of reducing BOP and GI. However, PI was reduced more in curcumin group than CHX group in the third periodic examination (after one month).

In the study of Mali et al., PI reduction on days 0-14 was 43.76% for CHX group and 43.77% for curcumin group. Besides, PI reduction on days 0-21 was 69.07% for CHX group and 64.20% for curcumin group. GI reduction on days 0-14 was 51.88% for CHX group and 52.18% for curcumin group. In addition, GI reduction on days 0-21 was 61.15% for CHX group and 62.54% for curcumin group. These differences were not statistically significant and show that both products have the same effect on the PI and GI reduction.<sup>18</sup> The results of this study are consistent with the results of the present study except that in the present study, curcumin gel was more effective in reducing dental plaque than CHX mouthwash due to the difference in the clinical examination times. Stoyell et al. reported that the follow-up periods were short in previous studies.<sup>19</sup>

In a study by Kandwal et al., PI reduction on days 0-14 was 44.20% and 48.69% in CHX and curcumin groups, respectively. Moreover, PI reduction on days 0-21 was 60.81% and 60.21% in CHX and curcumin groups, respectively. According to these results, although both curcumin and CHX had considerably reduced PI, CHX was more effective than curcumin in long time, which is inconsistent with the results of the 30-day follow-up in the present study. GI reduction on days 0-14 was 43.07% and 44.37% in CHX and curcumin groups, respectively. Furthermore, GI reduction on days 0-21 was 71.79% and 71.20% in CHX and curcumin groups, respectively. Thus, there was a statistically significant difference between

both groups. Although the difference was not significant between two groups,<sup>14</sup> these results are consistent with the results of the present study.

According to the results obtained from comparing previous studies, it was revealed that curcumin considerably reduced dental plaque and gingivitis. The studies reporting that curcumin is not comparable with CHX in terms of preventing from gingivitis might have used diluted CHX. It can be also due to different function of CHX in dental plaque development. Other studies concluded that curcumin and CHX had the same effect on plaque control and gingivitis prevention and treatment.<sup>20</sup>

The main limitations of the present study are assessing a small number of participants, short follow-up period and periodic examinations (30 days), and lack of cooperation of some patients in using the mouthwash according to the protocol. Further research with larger sample sizes and longer follow-up periods is needed to reach a better conclusion.

## Conclusion

According to the results of the present study, curcumin can be used as an antiplaque agent and its effectiveness in reducing gingival inflammation and gingival bleeding was found to be comparable to that of CHX. Curcumin's effectiveness in plaque control was found to be better than that of CHX's. However, further studies with larger sample sizes and longer follow-up periods are needed to obtain a better conclusion and a more exact comparison.

## Conflict of Interests

Authors have no conflict of interests.

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## References

1. Lovegrove JM. Dental plaque revisited: Bacteria associated with periodontal disease. *J N Z Soc Periodontol* 2004; (87): 7-21.
2. Sharva V, Reddy V, Bhambal A, Agrawal R. Prevalence of gingivitis among children of urban and rural areas of Bhopal District, India. *J Clin Diagn Res* 2014; 8(11): ZC52-ZC54.
3. Zarandi A, Salahaddin S, Faramarzi M. Efficacy of different concentrations of chlorhexidine mouthwash on plaque accumulation and periodontal parameters. *J Periodontol Implant Dent* 2016; 8(1): 8-11.
4. Lang NP, Tan WC, Krahenmann MA, Zwahlen M. A systematic review of the effects of full-mouth debridement with and without antiseptics in patients with chronic periodontitis. *J Clin Periodontol* 2008; 35(8 Suppl): 8-21.
5. Flotra L, Gjermo P, Rolla G, Waerhaug J. Side effects of chlorhexidine mouth washes. *Scand J Dent Res* 1971; 79(2): 119-25.
6. Samuels N, Grbic JT, Saffer AJ, Wexler ID, Williams RC. Effect of an herbal mouth rinse in preventing periodontal inflammation in an experimental gingivitis model: A pilot study. *Compend Contin Educ Dent* 2012; 33(3): 204-11.
7. Biglari H, Saeidi M, Sohrabi Y, Khaksefidi R, Rahdar S, Narooie MR, et al. Persica a miracle in the protect and promote oral and dental health. *International Journal of Pharmacy and Technology* 2016; 8(3): 17957-67.
8. Gupta RK, Gupta D, Bhaskar DJ, Yadav A, Obaid K, Mishra S. Preliminary antiplaque efficacy of aloe vera mouthwash on 4 day plaque re-growth model: Randomized control trial. *Ethiop J Health Sci* 2014; 24(2): 139-44.
9. Moghbel A, Farajzadeh A, Aghel N, Agheli H, Raisi N. Formulation and evaluation of green tea mouthwash: A new, safe and nontoxic product for children and pregnant women. *Toxicol Lett* 2009; 189(Suppl): S257.
10. Gottumukkala SN, Koneru S, Mannem S, Mandalapu N. Effectiveness of sub gingival irrigation of an indigenous 1% curcumin solution on clinical and microbiological parameters in chronic periodontitis patients: A pilot randomized clinical trial. *Contemp Clin Dent* 2013; 4(2): 186-91.
11. Van der Weijden FA, Van der Sluijs E, Ciancio SG, Slot DE. Can chemical mouthwash agents achieve plaque/gingivitis control? *Dent Clin North Am* 2015; 59(4): 799-829.
12. Loe H. The gingival index, the plaque index and the retention index Systems. *J Periodontol* 1967; 38(6): Suppl-6.
13. Ainamo J, Bay I. Problems and proposals for recording gingivitis and plaque. *Int Dent J* 1975; 25(4): 229-35.
14. Kandwal A, Mangain RK, Mangain P. Comparative evaluation of turmeric gel with 2% chlorhexidine gluconate gel for treatment of plaque induced gingivitis: A randomized controlled clinical trial. *Ayu* 2015; 36(2): 145-50.
15. Prasad M, Patthi B, Singla A, Gupta R, Jankiram C, Kumar JK, et al. The clinical effectiveness of post-brushing rinsing in reducing plaque and gingivitis: A systematic review. *J Clin Diagn Res* 2016; 10(5): ZE01-ZE07.
16. van der Ouderaa FJ. Anti-plaque agents. Rationale and prospects for prevention of gingivitis and periodontal disease. *J Clin Periodontol* 1991; 18(6): 447-54.
17. Nagpal M, Sood S. Role of curcumin in systemic and oral health: An overview. *J Nat Sci Biol Med* 2013; 4(1): 3-7.
18. Mali AM, Behal R, Gilda SS. Comparative evaluation of 0.1% turmeric mouthwash with 0.2% chlorhexidine gluconate in prevention of plaque and gingivitis: A clinical and microbiological study. *J Indian Soc Periodontol* 2012; 16(3): 386-91.
19. Stoyell KA, Mappus JL, Gandhi MA. Clinical efficacy of turmeric use in gingivitis: A comprehensive review. *Complement Ther Clin Pract* 2016; 25: 13-7.
20. Singh V, Pathak AK, Pal M, Sareen S, Goel K. Comparative evaluation of topical application of turmeric gel and 0.2% chlorhexidine gluconate gel in prevention of gingivitis. *Natl J Maxillofac Surg* 2015; 6(1): 67-71.