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Efficacy of *Triphala* in treating Gingivitis diseases: A systematic review and meta-analysis

Sayali M. Jadhav
M.D., Ayurvedic Physician, Pune, Maharashtra

Ashwini A. Patil
Professor, Department of Shalakyatantra, D.Y. Patil Deemed to be University School of Ayurveda, Nerul, Navi Mumbai
Corresponding author: Ashwini A. Patil

Mrudul Y. Chitrakar
Associate Professor, Department of Swasthavritta and Yoga, D.Y. Patil Deemed to be University School of Ayurveda, Nerul, Navi Mumbai

***Abstract*---**Background and Objective: Triphala facilitates the action of anti-cavities, decreases plaque and has an antibacterial effect. Therefore, the purpose of this study was to perform a systematic review and meta-analysis of randomised controlled trials (RCTs) only to compare the overall effects of Triphala herbal mouthwashes in the treatment of gingivitis as a complement to daily oral hygiene on both plaque and chlorhexidine inflammation regulation. Methods: Electronic searches in MEDLINE/PubMed, EMBASE and CENTRAL were conducted in databases up to April 2020. Original articles, invivo studies and articles on the efficacy of Triphala on gingivitis were included in the study. 9 RCTs were included in the systematic review and 6 articles were included in meta-analysis. Results: Four included studies showed significantly greater reductions in plaque, gingivitis, and bleeding indices after the use of herbal mouthwashes (Triphala) compared with Chlorhexidine, while five studies reported that no difference was observed between herbal Triphala mouthwash and Chlorhexidine. Considering the effects of Triphala mouthwash on clinical gingival inflammatory parameters, significant heterogeneity for both gingival index (Q=102.55; pQ=0.000; I2=95.12%; T2=0.62; T=0.79) and plaque index (Q=43.83; pQ=0.000; I2=88.59%; T2=0.23; T=0.48) was observed between both Triphala mouthwash and Chlorhexidine groups. Conclusion: Triphala mouthwash seem to significantly improve the clinical gingival inflammatory parameters in plaque induced gingivitis with equal clinical efficacy as chlorhexidine

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mouthwash. TRP is a cost-effective alternative and is easily available with limited side-effects on periodontal tissues.
***Keywords*---**Triphala, mouthwash, Chlorhexidine, gingival diseases, plaque index.

Introduction

Ayurveda, a branch of Vedic Science, literally means "the science of life" and originated in India as the traditional healing system over 5,000 years ago and is often called the "Mother of All Healing". Ayurveda places great emphasis on prevention and encourages the maintenance of health through close attention to balance in one's life, right thinking, diet, lifestyle and the use of herbs [1,2].

Dental health in Ayurveda, called *dantaswasthya* in Sanskrit varies from person to person and is influenced by the *prakriti* of constitution of each person [3]. In the present era, oral health is the key indicator of overall health, well-being, and quality of life. Oral diseases are closely linked to lifestyle. The mouth is part of the mucosal immune system, and as such, it plays a role as a protective and constitutive tissue. Our lifestyle influences every aspect of our life, be it our food habits or our sleeping pattern [4]. Everything we do, has its effects, either good or bad. Poor oral hygiene has a significant impact on oral health and neglecting your oral health can give rise to various problems, such as periodontitis, tooth decay, tooth or gum pain and discomfort, and infection and loss of teeth.

Gingivitis is one of the commonly prevalent oral diseases worldwide which is caused by the bacterial biofilm adhering to the teeth surfaces. There is a total of 15 plant herbs in Ayurvedic medicine that are used effectively in dentistry [5]. Considered the most versatile and widely used of all Ayurvedic herbal formulations, Triphala is a unique blend with a very substantial value. As its name suggests, Triphala is comprised of three herbs. The prefix *tri-* in Sanskrit means three, just as it does in Latin and Greek. *Phala* refers to fruits. Triphala is made up of a distinct combination of fruits from three medicinal trees, namely Amalaki (*Embalica officinalis*), Vibhitaki (*Terminalia belerica*) and Haritaki (*Terminalia chebula*) [6,7]. Triphala is considered a general rebuilder of oral health. Triphala works well as a mouth rinse as a decoction. The healing effect of Triphala supports the connective tissue of the gums. Triphala promotes anti-cavity action, reduces plaque, and has an antibacterial effect [8]. Therefore, the aim of this study was to conduct a systematic review and a meta-analysis of randomized controlled trials (RCTs) only to compare the overall effects of herbal mouthwashes Triphalas' supplements to the daily oral hygiene on both plaque and inflammation control with chlorhexidine mouthwashes in the treatment of gingivitis.

Material and Methods

Electronic searches in MEDLINE/PubMed, EMBASE and CENTRAL were conducted in databases up to Sept 2020. Original articles, invivo studies and articles on the efficacy of Triphala on gingivitis were included in the study. While

review articles, studies done on other than gingival diseases and studies done in a combination of Triphala with other herbs were excluded from the study.
Published literatures on recent advancements in assessing the efficacy of Triphala on gingival-related diseases which includes original articles and research papers in databases such as PubMed Central, and Science Direct etc. were taken into the study for review. A literature search to collect relevant data was performed using the MeSH terms Triphala, gingivitis, and dentistry. A total of 250 abstracts appeared with this combination. Of these, 30 articles were research related. For each retraction, a total of 9 articles were retrieved for systematic review and 6 were included for meta-analysis. The detailed literature selection is depicted in figure 1.

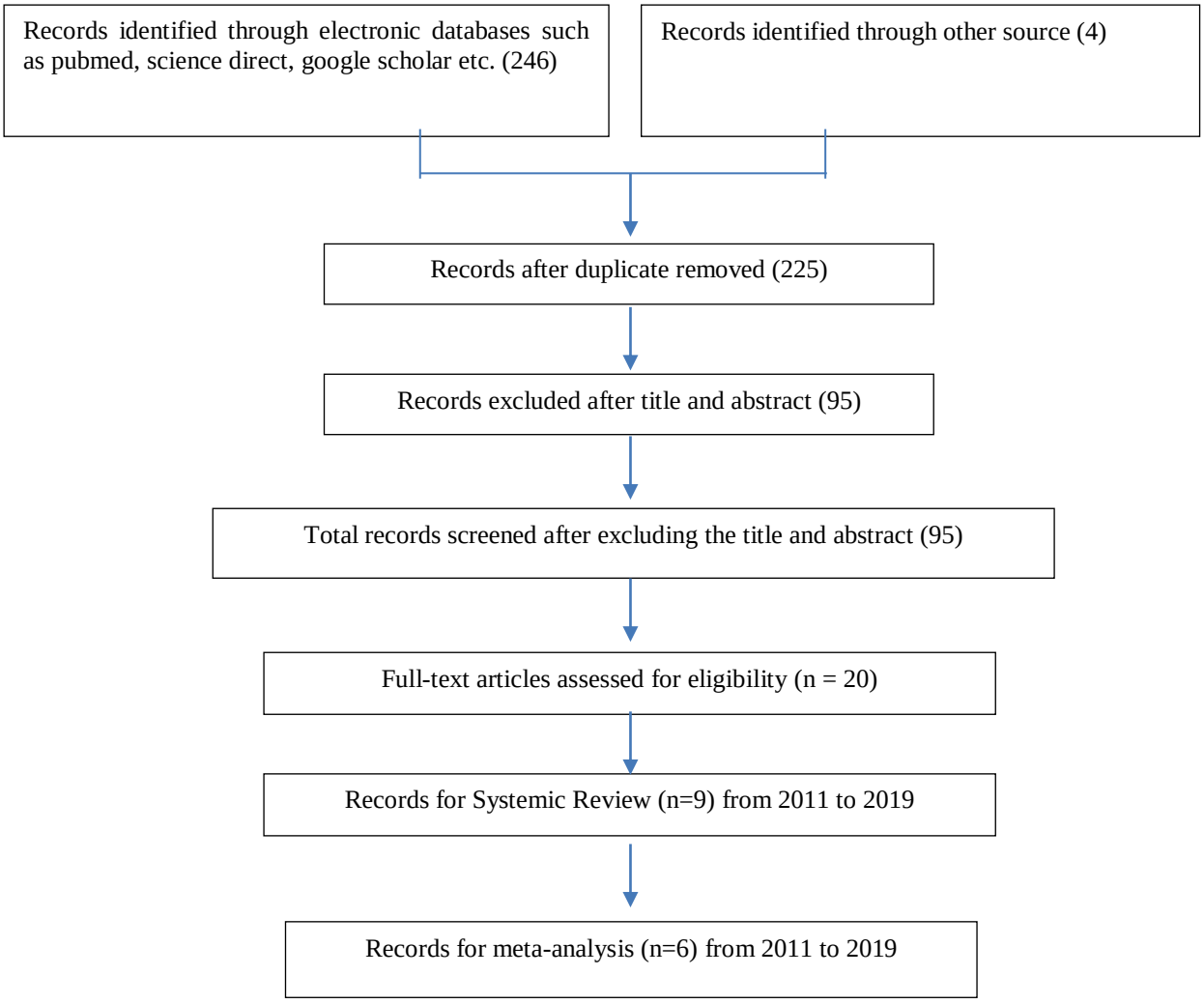

Figure 1: Flow diagram of literature selection procedure of study

Results

Search selection

A total of 250 study titles and abstracts were initially identified from the multi-database search. After exclusion of duplicate publications (n=225), initial screening of titles and abstracts was performed. Of these, 250 articles were excluded as irrelevant to the PICO question. Twenty papers were selected for full text reading after excluding articles that did not meet the inclusion criteria. Finally, 9 RCTs were included in the systematic review and 6 articles were included in meta-analysis. All studies were performed at health care-centres and university hospitals. The characteristics features of intervention in study group (RCTs) is given in table 1.

Table 1: Characteristics features of intervention in study group (RCTs)

Investigators	Sample size	Patient Characteristics	Disease	Duration of treatment	Dose	Groups	Results	Conclusion
Padiyar et al 2018 [9]	60	9 to 12 years located in residential ashram	Salivary Streptococcus mutans	15 days	10 mL to be used once a day at night for 15 days.	Group I (n = 15) was given 6% *Triphala* mouthwash, Group II (n = 15) was given 0.2% chlorhexidine mouthwash, Group III (n = 15) was given 2.5% garlic extracts mouthwash, Group IV (n = 15): Control group—mouth rinsing with distilled water	Triphala and garlic mouthwashes show similar efficacy against S. mutans, even though Triphala showed slightly better results.	Triphala, chlorhexidine gluconate, and garlic mouthwash were comparably efficient in reducing the salivary S. mutans count as well as in limiting plaque score
Penmetsa et al 2019 [10]	60	29 males and 31 females, aged 18–40 years; mean age: 29 years	Gingivitis.	30 days	15 mL mouthwash twice daily, 30–45 min after brushing,	Group A: n = 20 was given Triphala mouthwash Group B: n = 20 was given A. vera mouthwash Group C: n = 20 was given Chlorhexidine mouthwash.	Triphala group effectively in reduction in GI and BI index scores compared to A. vera group and the effect is equivocal to the reduction seen with Chlorhexidine.	Triphala to be superior in the reduction of plaque, gingival inflammation, and bleeding compared to that of A. vera and chlorhexidine.
Baratakke et al 2017 [11]	60	18-24 years.	Plaque accumulation and gingival inflammation	21 days	Rinse 10 ml twice daily for 30 seconds	Participants were randomly allotted to three groups with 20 participants in each group of 0.6% Triphala, 0.12% chlorhexidine and control group	Triphala and Chlorhexidine showed significant reduction in plaque and gingival scores as compared to Control group	Triphala extract mouth rinse was effective in reducing plaque accumulation and gingival inflammation with reported no side effects.
Saxena et al 2017 [12]	40	15-40 years of age	Salivary Streptococcus Mutans	7 days	15 ml of the freshly prepared 10% rinse	Group 1- T. chebula, Group 2- T. bellirica, Group 3- E. officinalis, Group 4- Triphala	Triphala mouth rinse is very effective in reducing the S. mutans CFUs at 5 and 60 minutes after rinse.	All four rinses were effective in reducing S. mutans CFUs, but 10% Triphala has greater efficacy than its other constituents.
Chainani et al 2014 [13]	120	aged 13-16 years	Antiplaque and antigingivitis	30 days	20 ml once daily	three groups: 10% Triphala, 0.2% chlorhexidine and negative control	Triphala and chlorhexidine yielded a significant reduction in plaque and gingival index	The antiplaque and antigingivitis activity of Triphala closely parallels that of chlorhexidine.

							scores as compared to negative control	
Srinagesh and Pushpanjali 2011 [14]	57		Streptococcus Mutans	15 days	15 ml twice daily	three study groups: 1) 15 ml of 6% Triphala mouthwash; 2) 15 ml of 0.2% chlorhexidine (active control); 3) no mouthwash (passive control).	After using mouthwash for 15 days, an 83% and 80% reduction and at 45 days a 67% and 65% reduction in salivary MS colony count was observed in the Triphala and chlorhexidine groups, respectively	The antimicrobial action of Triphala against mutans streptococci closely parallels that of chlorhexidine
Naiktari et al 2014 [15]	120	20-65 years,	Periodontal diseases	15 days	Twice daily for two weeks	group A with 10 mL of distilled water, group B with 0.2% chlorhexidine, and group C with Triphala mouthwash	Change in GI and PI after 15 days in the Triphala and the CHX groups	The Triphala mouthwash (herbal) is an effective antiplaque agent like 0.2% chlorhexidine.
Bajaj and Tondon 2011 [16]	1431	8 to 12 years	Dental plaque, gingival inflammation, and microbial growth.	9 months	10 ml daily	Group I (n = 457): using Triphala mouthwash (0.6%) Group II (n=440): using Chlorhexidine mouthwash (0.1%) Group III (n = 412): using distilled water.	There was inhibitory effect on microbial counts except Lactobacillus where Triphala had shown better results than Chlorhexidine.	There was no significant difference between the Triphala and the Chlorhexidine mouthwash.
Mamgain et al 2016 [17]	60	Age >18 years	Plaque-Induced Gingivitis and Halitosis	21 days	Twice daily	Group A was given Triphala and Ela decoction for 21 days and group B was given chlorehexidine mouthwash	Both treatment groups reported significant reduction in plaque index & gingival index from baseline.	Triphala and Ela decoction has similar efficacy as that of chlorhexidine in reducing dental biofilm build-up, gingivitis, and halitosis

Results of individual studies and synthesis of results

The focus of this study was mainly to compare the overall clinical effects between Triphala and Chlorhexidine mouthwashes on plaque and inflammation control. Four included studies showed significantly greater reductions in plaque, gingivitis, and bleeding indices after the use of herbal mouthwashes (Triphala) compared with Chlorhexidine, while five studies reported that no difference was observed between herbal Triphala mouthwash and Chlorhexidine.

Main outcome of the included studies

All studies showed that Triphala administration was significantly effective as compared to Chlorhexidine in the treatment of plaque-induced gingivitis. Considering the effects of Triphala mouthwash on clinical gingival inflammatory parameters, significant heterogeneity for both gingival index (Q=102.55; pQ=0.000; I2=95.12%; T2=0.62; T=0.79) and plaque index (Q=43.83; pQ=0.000; I2=88.59%; T2=0.23; T=0.48) was observed between both Triphala mouthwash and Chlorhexidine groups. Summary of results of meta-analysis for gingival and plaque index are described in Table 2.

Table 2
Summary of meta-analysis for plaque index

Study	Triphala	SD	Chlorhexidine	SD	Mean Difference	Sample population	Sample population	95% CI	CI Lower limit	CI Upper limit
Mamgain et al 2016 [17]	0.94	0.14	0.91	0.13	-0.03	30	30	0.19	-0.73	0.29
Bajaj and Tondon 2011 [16]	0.49	0.16	0.61	0.25	0.12	457	440	0.76	0.44	0.71
Naiktari et al 2014 [15]	1.13	0.44	1.23	0.43	0.1	120	120	0.64	-0.02	0.48
Chainani et al 2014 [13]	0.43	0.13	1.44	0.83	1.01	40	40	6.42	1.19	2.21
Baratakke et al 2017 [11]	0.9	0.32	0.94	0.37	0.04	20	20	0.25	-0.51	0.74
Penmetsa et al 2019 [10]	0.49	0.19	0.41	0.22	-0.08	20	20	0.51	-1.02	0.24

Heterogeneity Q=43.83; pQ=0.000; I2=88.59%; T2=0.23; T=0.48

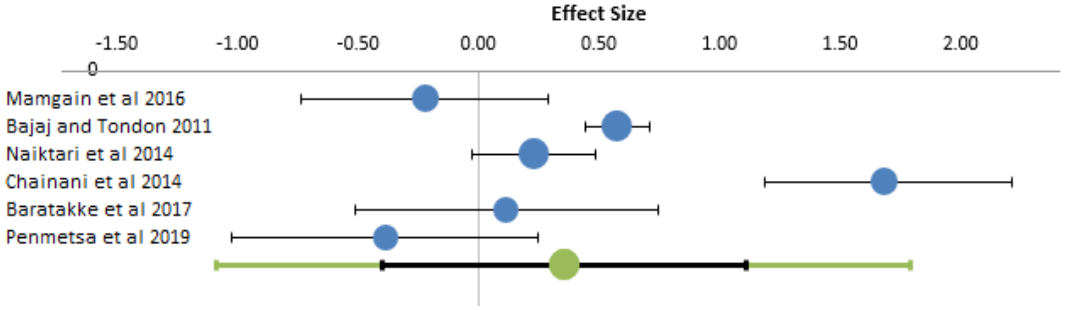

Figure 2: Forest plot of Plaque index of studies

Table 3
Summary of meta-analysis for Gingival Index

Study	Triphala	SD	Chlorhexidine	SD	Mean Difference	Sample population	Sample population	95% CI	CI Lower limit	CI Upper limit
Mamgain et al 2016 [17]	0.53	0.12	0.59	0.16	0.06	30	30	0.42	-0.09	0.94
Bajaj and Tondon 2011 [16]	0.4	0.16	0.46	0.2	0.06	457	440	0.33	0.20	0.46
Naiktari et al 2014 [15]	0.93	0.39	1.08	0.42	0.15	120	120	0.37	0.11	0.63
Chainani et al 2014 [13]	0.43	0.16	1.92	0.41	1.49	40	40	4.74	3.92	5.65
Baratakke et al 2017 [11]	0.9	0.24	0.92	0.26	0.02	20	20	0.08	-0.55	0.71
Penmetsa et al 2019 [10]	0.19	0.07	0.2	0.12	0.01	20	20	0.1	-0.53	0.73

Heterogeneity Q=102.55; pQ=0.000; I2=95.12%; T2=0.62; T=0.79

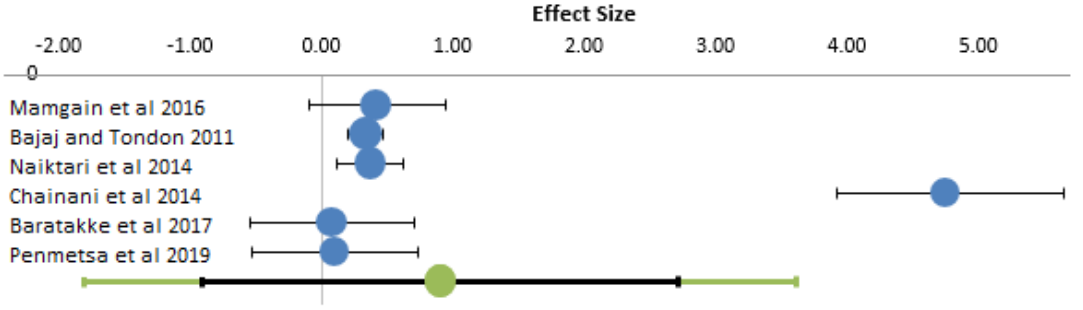

Figure 3: Forest plot of Gingival index of studies

Risk of bias

The results of the risk of bias are presented in Table 4. A total of 4 studies were considered as having moderate risk of overall bias, whereas 2 studies had an overall high risk of bias. The high risk of bias in the included studies was mainly due to lack of reporting sequence generation and selective reporting. All studies reported the completion of the trial and clear explanation of withdrawals.

Table 4
Assessment of risk of bias in studies

Investigators	Sequence generation	Allocation concealment	Blinding of study participants and personnel	All patients accounted for at the end of study	Clear explanation of withdrawals	Selective reporting	Over risk of bias
Mamgain et al 2016 [17]	Yes	Unclear	Unclear	Yes	Yes	Yes	Moderate
Bajaj and Tondon 2011 [16]	No	Unclear	No	Yes	Yes	No	High
Naiktari et al 2014 [15]	Yes	Unclear	Yes	Yes	Yes	Yes	Moderate
Chainani et al 2014 [13]	Yes	Unclear	Yes	Yes	Yes	Yes	Moderate
Baratakke et al 2017 [11]	No	Unclear	Yes	Yes	Yes	No	High
Penmetsa et al 2019 [10]	Yes	Unclear	Yes	Yes	Yes	Yes	Moderate

Discussion

Triphala has been used in dentistry in recent times, especially to improve gingival health. Our quest yielded five studies in support of the efficacy of Triphala that was found to be equal to the gold standard mouth rinse of chlorhexidine; however, two of the studies showed no major efficacy variations. The antimicrobial and antioxidant effect of Triphala has been proved in vitro to inhibit Streptococcus mutans at concentrations as low as 50 µg / ml. The tannic acid present in Triphala plays an anti-plaque role, which is adsorbed on the bacterial cell surfaces and results in protein denaturation and eventually cell death [18].

In plaque management in various patient groups, chlorhexidine has been shown to be more effective than placebo mouthwash [19-21]. In the current analysis, chlorhexidine was used as the gold standard antiplaque agent as a positive control [22]. However, some drawbacks, including the unpleasant taste and discoloration of the teeth, limit their long-term use and require the use of herbal agents that may be equally effective with limited drawbacks [23,24].

In both the Triphala and chlorhexidine groups, Bajaj and Tandon [16] recorded a substantial progressive decrease in plaque scores from baseline to the end of 9

months, while plaque scores increased in the negative control group. Bhattacharjee et al. [11] recorded that the gingival and plaque scores in both the chlorhexidine and Triphala groups decreased significantly at follow-up than at baseline with a $P < 0.001$. However, in the chlorhexidine group, the percentage difference in the mean plaque index was substantially higher relative to the Triphala group with a $P<0.048$. Herbal medicines are currently widely used for the treatment of a number of diseases. Chemicals for the treatment of various diseases, including periodontal diseases, are quickly replaced by ayurvedic drugs due to equivalent potential and lower side effects [18]. For the treatment of gingival bleeding and inflammation [25,26], oral rinses made from herbal agents are currently being used. Gingivitis herbs include: 1) chamomile; 2) echinacea; 3) green tea; 4) peppermint; 5) sage; 6) clove; and 7) myrrh. For the treatment of gingivitis, a mixture of mouthwash including sage oil, peppermint oil, mint oil, menthol, chamomile tincture, expressed Echinacea purpurea juice, myrrh tincture, clove oil, and caraway oil has been successfully used. Kamillosan liquid contains chamomile (Matricariarecutita) and is commonly used to treat periodontal disease [27]. The effectiveness of TRP is based on the finding that TRP has a significant inhibitory effect on the metalloproteinase matrix polymorphonuclear leukocyte, which plays an important role in the degradation of periodontal tissue, implying efficacy in the treatment of periodontal diseases. Bajaj et al [16] recorded a 5 % and 10% decrease in TRP concentrations in Streptococcus mutans. In an in vivo study by Srinageshet al. [14], TRP mouthwash was found to be effective in decreasing oral streptococci index score and colony-forming unit counts in decayed, missing, and filled teeth.

It is therefore critical that Triphala is equally effective in improving oral health compared to chlorhexidine. The numerous beneficial effects of Triphala as an antimicrobial agent on dental plaque reduction are both an effective and an economical alternative. Of similar efficiency, Triphala may be used as a short-term regimen. There is no definitive proof that the most effective regimen for gingivitis treatment is Triphala.

High-quality experiments need to be performed in order to use potential advice from these agents. The drawbacks of this analysis include; out of a total of 250 publications screened, but only nine of the papers were based on clinical trials taken for this analysis; all differed by population age, sample size, and length of the procedure.

Conclusion

The clinical gingival inflammatory parameters in plaque-induced gingivitis with the same clinical efficacy as chlorhexidine mouthwash tend to be substantially enhanced by Triphala mouthwash. Triphala is a cost-effective option and, with fewer side effects on periodontal tissues, is readily available. Before advising gingivitis patients on whether they should use herbal mouthwashes to replace chlorhexidine mouthwashes or not, more high-quality RCTs are required for more firm support.

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