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Review Article

HERBAL MOUTH RINSES AND MOUTHWASHES IN ORTHODONTIC CARE: A RAPID REVIEW

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ABSTRACT

In order to address the increasing demand for eco-friendly orthodontic care products, considering herbal-based-mouth rinses and mouthwashes are mandatory. The aim of this study is to analyze previous studies regarding herbal mouth rinses and mouthwashes that have been reported in daily orthodontic patients. The initial step was to develop a protocol with registration number PROSPERO (CRD4202230118). Databases PubMed, Cochrane, ProQuest, and Google Scholar were explored from 2010 to 2022. The studies included Randomized Controlled Trials (RCTs) that compared herbal mouth rinse and mouthwashes with chlorhexidine on their effectiveness to reduce dental plaque in orthodontic patients. Critical appraisal was performed using Joanna Briggs Institute's Checklist for RCTs. Seven studies matched the inclusion criteria. Miswak, green tea, chamomile, and aloe vera were reported as herbal natural resources effective in reducing dental plaque. Despite being less effective than chlorhexidine, aloe vera still showed significant dental plaque reduction before and after application. Given the diverse clinical methodology and high risk of bias, further high-quality RCTs and quantitative synthesis are required to provide strong support for clinical decision-makers. These herbal-based mouth rinse and mouthwash ingredients showed potential for periodontal protection in orthodontic patients. The side effects of herbal-based mouth rinses and mouthwashes as orthodontic daily care were similar to chlorhexidine, albeit minimal.

Keyword: Herbal, Mouth rinse, Mouthwash, Orthodontic

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INTRODUCTION

Maintaining good oral hygiene, including healthy periodontal, is a fundamental aspect of orthodontic treatment outcome. While brushing and flossing are essential components of a daily orthodontic care routine, the mouth rinses and mouthwashes play a vital role in enhancing oral hygiene and freshening breath of those patients. These liquid solutions serve various purposes in promoting dental health and are often used interchangeably for orthodontic patients by contributing the daily biofilm control, removal, and plaque control mechanism. The acute gingival inflammation can be treated with chlorhexidine, whereas essential oils for long-term daily use in controlling supragingival biofilm was an indication [1]. The increased dental plaque retention is concomitant with the insertion of molar bands, adhesive bonding, brackets, and other accessories due to their rough surfaces or white spot lesion in fixed orthodontic patients. Thus, patient compliance in maintaining the oral health is recommended in daily orthodontic practice [2–4] Thus, The regular brushing, flossing, and the use of antimicrobial mouthwash provide benefits in maintaining oral hygiene in order to empower you to make informed choices for your dental wellness [5].

The challenging issues are recommended to revolve around specific effectiveness, long-term outcomes, and safety mouth rinses and mouthwashes that are related to patients' factors. Nowadays, the research and development can be found in the technology integration, sustainable ingredients, personalized formulations, and multifunctional products in order to improve orthodontic care since COVID-19. The improvement of mouth rinses and mouthwashes based on natural and sustainable ingredients or Herbal based-mouth rinses and mouthwashes are conducted to address the growing demand for eco-friendly orthodontic care products [2-4].

Herbal based-mouth rinse and mouthwashes were derived from botanical sources that can inhibit bacteria, reduce inflammation, soothe irritation, and relieve pain in daily activities. These herbs can produce antioxidant and antibacterial phytochemicals according to metabolite secondary. Developments in dental herbal medicine have demonstrated that properly selecting a mouthwash as a supplement is required to deal with different oral cavity conditions. However, the potential source of herbal therapy must be described, and its use must be clarified properly. The difference between mouth rinse and mouthwash products was depending on alcohol determination, which used as an antiseptic and mouthwash for daily cleansing if mechanical cleansing were not enough. The other type of product is elixir, which contains more than 50% alcohol, so it must be diluted with water when used [6]. Application of chlorhexidine and herbal mouthwashes in the short term may effectively reduce plaque and gingival inflammation-related indexes. The gingival inflammation-related mouthwash user indexes showed significant lower in herbal mouthwash groups [7]. Herbal mouthwashes have shown promising results in terms of dental plaque control and caries prevention. The use of herbal mouthwashes increased the buffering capacity and pH of saliva while decreasing the number of bacteria in saliva [8]. Compounds derived from plant extracts can also aid in the remineralization of enamel and dentin [9]. Cai *et al.* [10] also concluded that herbal mouthwashes show potential benefits in controlling the plaque and preventing inflammation to maintain daily oral hygiene in patients with gingivitis based on randomized controlled trials (RCTs). Thus, this work aimed to assess studies related to herbal mouth rinses and mouthwashes in orthodontic care.

MATERIALS AND METHODS

Protocol and registration

This systematic review was reported following the Preferred Reporting Items for Systematic Reviews and Meta-analyzes (PRISMA) guidelines. A detailed protocol was developed a priori and registered in the International Prospective Register of Systematic Reviews (registration number: CRD42022301183).

Selection criteria

The inclusion criteria conformed to Participants, Intervention, Comparisons, Outcomes and Study design. The articles must focus on the evaluation of the effectiveness of herbal mouthwash on patients undergoing orthodontic treatment. Randomized Controlled Trials (RCTs) without any restriction to time of publication and meeting the following inclusion criteria were

included:

1. Population: orthodontic patients of any age and sex
2. Intervention: mouthwash containing plant extracts
3. Comparisons: chlorhexidine
4. Outcomes: reduction of dental plaque
5. Study design: RCTs

Exclusion criteria

Other study design than RCTs and non-English language

Information sources and search strategy

Table 1 shows the reference lists of all eligible studies from Google Scholar, Proquest, PubMed, and Cochrane databases identified through advanced search (NA).

Table 1: Search strategy

Database	Search	Items found
Google Scholar	("orthodontic patient" or "orthodontic appliance") ("herbal mouthwash" or "herbal mouth rinse") or extract plaque	837
Proquest	(orthodontic or "orthodontic patients" OR "orthodontic appliances") and (herbal or extract) and (mouthwash OR mouth rinse) and plaque	237
PubMed	(orthodontic or "orthodontic patient*" or "orthodontic appliance*") and (herbal or extract* or plant*) and (mouthwash* or mouth rinse*) and plaque	37
Cochrane	(orthodontic or (orthodontic appliance) or (orthodontic patient)) and (herbal or extract) and (mouthwash or mouth rinse) and plaque	25

Risk of bias of individual studies

Table 2 showed the methodological quality of all included studies was independently assessed by three reviewers (ES, DS, and PW). For RCTs, the Joanna Briggs Institute (JBI) Checklist was conducted (AAA). Following data collection analysis, PRISMA flow charts were adopted to distinguish relevant articles (fig. 1).

Table 2: Risk of bias summary for reviewing authors' judgments about each risk of bias item for each included study

Items	Farhadian, 2015	Goes, 2016	Raju, 2017	Yeturu, 2015	Niazi, 2018	Shalini, 2018	Sobouti, 2018
Considering the true randomization used for assignment of participants to treatment groups.	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Considering allocation to groups concealed.	(+)	(+)	(-)	(+)	(-)	(+)	(+)
Considering the treatment groups similar at the baseline.	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Considering the participants blind to treatment assignment.	(-)	(+)	(-)	U/C	(+)	(+)	(+)
Cosidering the delivering treatment blind to treatment assignment.	(-)	U/C	(-)	U/C	U/C	(-)	(-)
Considering the outcomes assessors blind to treatment assignment.	(+)	(-)	(-)	(-)	(+)	(+)	(+)
Considering the treatment groups treated identically other than the intervention of interest.	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Considering the follow-up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed.	U/C	U/C	(+)	U/C	U/C	(+)	(+)
Considering the participants analyzed in the groups to which they were randomized.	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Considering the outcomes measured in the same way for treatment groups.	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Considering the outcomes measured in a reliable way.	U/C	U/C	U/C	U/C	U/C	(+)	(+)
Considering the appropriate statistical analysis that was used.	(+)	(+)	(+)	(+)	(+)	(+)	(+)
Considering the trial design appropriate for the topic, and any deviations from the standard RCT design accounted for in the conduct and analysis	(+)	(+)	U/C	(+)	(-)	(+)	(+)

*Notes: (-)=NO; (+)=YES; U/C=Unclear; N/A=Not applicable

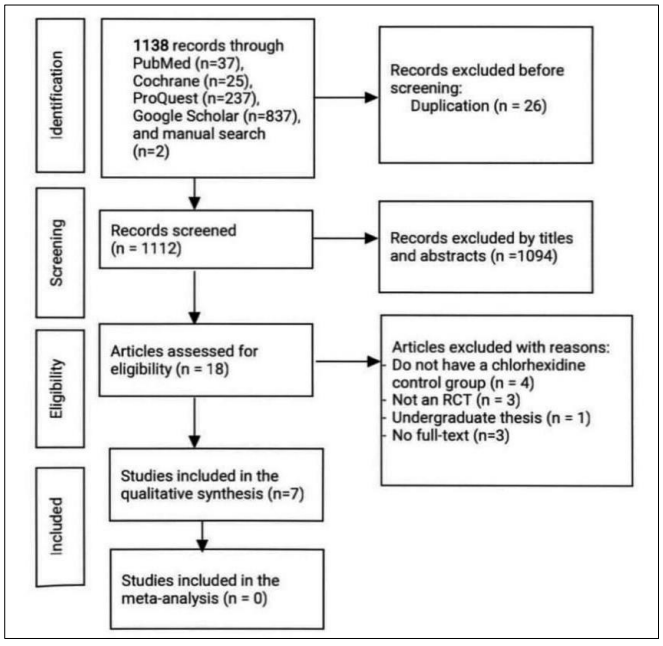

Fig. 1: PRISMA flow diagram

Table 3: Characteristics of the studies included in the qualitative synthesis

Researcher	Number of samples	Age	Intervention	Control	*Follow-up*	Clinical measurement	Results
Farhadian *et al.*, 2015 [11]	72	18.6±4.8	Gargle with Persica, 15 drops in 15 ml of water for 20 seconds, twice a day	Chlorhexidine 0.2%	2 w	- Bleeding on probing index (BOP) - Gingival index (GI) - O'Leary's plaque index (PI) Hyperplastic index (HI)	- Significant difference in BOP (p = 0.00), PI (p = 0.04) and GI (p = 0.02) between the manual toothbrush group and the electric toothbrush group. - Significant difference in BOP (p = 0.01) between the manual toothbrush and manual toothbrush groups with Persica. - No significant difference in BOP (p = 0.95), PI (p = 0.83), and GI (p = 0.74) between the manual toothbrush group with *Persica* and the manual toothbrush group with chlorhexidine. Significant difference in the number of hyperplastic gingival areas before and after treatment (p = 0.03) in the manual toothbrush group with Persica.
Goes *et al.*, 2016 [12]	30	10–40 (28.8±3.28)	Gargle with 1% *Matricaria chamomile* (MTC) extract, 15 ml, for 1 minute.	Chlorhexidine 0.12%; placebo	15 d	- Visible plaque index (VPI) Gingival bleeding index (GBI)	Change in VPI: - Placebo = 10.16±14.60 - Chlorhexidine = −39.93±31.19 - MTC = −25.59±17.73 Change in GBI: - Placebo = 23.15±35.67 - Chlorhexidine = −32.05±29.35 - MTC = −29.90±44.64 Significant differences between the chlorhexidine and MTC groups when compared to the placebo group, but no significant differences between the chlorhexidine and MTC groups.
Raju *et al.*, 2017 [13]	30	15–30	Gargle with green tea (group 1) and Listerine (group 2), 10 ml, twice daily	Chlorhexidine 0.12%	15 d; The 31st day groups 1 and 2 were crossed-over. Follow-up on day 45.	- Sulcus bleeding index (gingival score) Turesky-Gilmore modification of Quigley hein index (plaque score)	Gingival score: - Green tea = 1.2±0.164 to 0.69±0.133 - Listerine = 1.01±0.294 to 0.73±0.165 - Chlorhexidine = 1.16±0.079 to 0.95±0.082 Plaque score: - Green tea = 2.17±0.610 to 1.48±0.474 - Listerine = 1.74±0.482 to 1.48±0.474 - Chlorhexidine = 1.05±0.063 to 0.85±0.072 **After crossing over:** Gingival score: - Listerine = 1.26±0.332 to 1.03±0.375 - Green tea = 1.16±0.348 to 0.71±0.320 - Chlorhexidine = 1.05±0.063 to 0.85±0.072 Plaque score: - Listerine = 2.07±0.436 to 1.79±0.385 - Green tea = 1.97±0.351 to 1.48±0.344 Chlorhexidine = 2.15±0.311 to 1.95±0.306
Yeturu *et al.*, 2015 [14]	90	Aloe vera: 21.53±3.41; Chlorhexidine: 21.72±4.67 *Chlorine dioxide*: 21.70±3.01	Aloe vera, chlorine dioxide, 10 ml for 1 minute, twice daily.	Chlorhexidine	15 d	- Modified Silness and Loe plaque index Gingival index	Plaque score: - Aloe vera = 1.27±0.38 to 0.98±0.30 - Chlorhexidine = 1.27±0.37 to 0.86±0.30 - Chlorine dioxide = 1.30±0.60 to 0.84±0.27 Gingival score: - Aloe vera = 1.53±0.37 to 1.36±0.27 - Chlorhexidine = 1.63±0.36 to 1.35±0.30 - Chlorine dioxide = 1.43±0.36 to 1.23±0.19 No significant difference between the chlorhexidine and chlorine dioxide groups.
Niazi *et al.*, 2018 [15]	100	13–37	*Salvadora persica* 10% (miswak); *Azadirachta indica* 10% (neem); 10 ml, 1 minute, twice daily	Chlorhexidine 0.2%; Cetylpyridinium 0.05%	3 w	Bonded bracket plaque index	Significant reduction in plaque score occurred between the chlorhexidine and miswak groups (p = 0.016).
Shalini *et al.*, 2018 [16]	32	12–30	Herbal mouthwash (HiOra); green tea extract; 10 ml, twice a day for 1 minute.	Chlorhexidine 0.2%	3, 7 and 14 d	Plaque index	The herbal mouthwash and green tea extract groups were significantly different (p = 0.008) on the third day. On day-7, the chlorhexidine with herbal mouthwash (p = 0.053), chlorhexidine with green tea (p = 0.000), and herbal mouthwash with green tea extract (p = 0.000) were significantly different. On day 14, the chlorhexidine group with herbal mouthwash (p = 0.000), chlorhexidine with green tea (p = 0.000), and the herbal mouthwash group with green tea extract (p = 0.000) were significantly different.
Sobouti *et al.*, 2018 [17]	54	12–21 (14.8)	Persica, 10 drops in 2 spoons of water, 3 times a day.	Chlorhexidine (Orthokine); placebo	Cohort phase: 4 mo. RCT phase: 1 mo	- O'Leary plaque index (PI) - Loe and Silness gingival index (GI) - Carter and Barnes gingival bleeding index (GBI) Pocket probing depth (PPD)	Significant decrease in all 4 indices during the RCT phase. Significant difference in PI between the Persica group and placebo (p = 0.0127). Significant difference in GBI between the Persica group and placebo (p = 0.0009) and the chlorhexidine group and placebo (p = 0.0187)

RESULTS AND DISCUSSION

Study selection

A total of 1138 studies were obtained in the databases and manual search. After excluding ineligible studies, a total of 7 studies were included for qualitative synthesis (fig. 1).

Study characteristics

The studies (above of 2015) included in qualitative synthesis are described in table 3.

Risk of bias

Critical assessment in table 3 revealed that two studies did not conceal the allocation to groups, leading to a risk that those allocating participants would deliberately intervene in the allocation, thus distorting the study results. The participants' baseline characteristics were similar in all studies, implying that the effect can be attributed to the study's cause [18].

In four articles, the participants and outcome assessors were blinded, but those administering treatment were not. Overall, the studies treated the control group in a similar way, so the effect could be attributed to the investigated cause. Among the seven studies, three conducted a complete follow-up, and the others did not provide clear information.

All studies measured the treatment group outcomes in a similar way, reducing the risk of bias in the study's validity. Only two studies performed a reliable outcome measurement. The statistical analysis used in the seven studies was appropriate because strength and statistical analyses are critical in interpreting the causal relationships of the studies. Appropriate RCT designs were adopted by five studies. Overall, the risk of bias across the studies was considered moderate to high.

Persica/Miswak (Salvadora persica)

Farhadian *et al.* revealed that there was no significant difference in efficiency between Persica mouthwashes and chlorhexidine mouth rinse in reducing plaque and gingival inflammation in patients with fixed orthodontic appliances [11]. Similarly, Sobouti *et al.* [17] discovered that Persica showed similar effect as well as chlorhexidine in reducing plaque and gingival bleeding [17]. A long treatment time may be beneficial, but long-term use of chlorhexidine mouthwash is not advised due to its undesirable effects, such as tooth discoloration documented as early as 3 w of use, thus limiting its appeal to users. Thus, Persica mouthwash may be safe and helpful as the first step in treating gingival overgrowth in orthodontic patients [11].

Niazi *et al.* [15] reported that miswak mouthwash reduced plaque more effectively than chlorhexidine. Miswak contains fluoride and gallotannins, a phenolic compound that is reportedly bactericidal against cariogenic microorganisms. Its benefit in inhibiting the *Streptococcus mutans* bacterial strain colonization on orthodontic rings [15]. Persica-based mouth rinse and mouthwashes may provide antibacterial and anti-inflammatory for those orthodontic patients who are potent with gingivitis.

Green tea *(Camellia sinensis)*

Raju *et al.* [13] reported that green tea mouthwash produced the best results when compared with Listerine and chlorhexidine mouthrinse. According to Shalini *et al.*, chlorhexidine was the most effective at reducing plaque and gingival inflammation, followed by HiOra herbal mouthwash, that produced nearly the same results as chlorhexidine, and green tea was the least effective. However, a significant reduction in plaque was observed after using green tea mouthwash. HiOra mouthwash contains a variety of herbal plants, including miswak [16]. This result supported the findings of Farhadian *et al.*, Niazi *et al.*, and Sobouti *et al.* on the effectiveness of miswak mouthwash. HiOra herbal mouthwash and green tea also have an advantage over chlorhexidine, that is, they have no side effects [11,15,16,17]. Polyphenols catechin, epicatechin, epicatechin gallate, epigallocatechin, and epigallocatechin-3-gallate are the most abundant in green tea and have antioxidant and lesser anti-plaque efficacy. Green tea catechin inhibits the production of toxic metabolites by *porphyromonas gingivalis* and the formation of osteoclast cells, potentially preventing alveolar bone resorption [16,19].

Chamomile (Matricaria chamomilla/MTC)

According to Goes *et al.*, [12] 1% MTC mouthwash has the same effectiveness as chlorhexidine in reducing plaque and gingival bleeding. Pourabbas *et al.* [20] also reported a better reduction in plaque and gingival inflammation after using MTC mouthwash compared with the use of chlorhexidine. Compounds in the MTC extract, such as flavonoid epigenin and terpene derivatives, have anti-inflammatory and antioxidant properties that can reduce gingival inflammation and control peri-implantitis. Research on oral cavity biofilms found that MTC extract was effective in reducing Staphylococcus aureus and Candida [21]. MTC does not exhibit the side effects of chlorhexidine [12].

Aloe vera

Aloe vera mouthwas significantly reduced plaque and gingival scores. However, aloe vera's effectiveness in reducing plaque and gingival inflammation is still weaker than that of chlorhexidine and chlorine dioxide. Chandrahas *et al.*[22] discovered the same result, stating that aloe vera significantly reduced plaque and gingivitis but was less effective than chlorhexidine. Aloe vera contains a number of active substances, such as aloesin, aloin, aloeride, flavonoids, saponins, and sterols, which have antibacterial, anti-inflammatory, and antioxidant properties that help lower plaque and gingival scores [23-25].

Only a few studies have focused on mouthwash specifically for patients with fixed orthodontics. Owing to its antimicrobial, anti-inflammatory, and antioxidant properties, mouthwash has been widely recommended as an adjunct to daily oral hygiene in patients with fixed orthodontic appliances [5].

LIMITATION

This study is limited to the English language. Thus, variations in product composition, treatment duration, frequency of use, follow-up, and outcome measurements across studies may contribute to high heterogeneity. Finally, the risk of bias in the included studies was considered moderate to high; hence, their validity might be compromised.

Further high-quality RCTs and quantitative synthesis will be required to provide strong support for clinical decision-making. Despite the abundant findings about various types of mouthwash, those specially formulated for patients with fixed orthodontic appliances are still limited and require longitudinal studies. Indonesia as a tropical country has thousands of plant species that can be used as medicinal plants; an example is mangrove leaves. *In silico* and *in vivo* studies reported the anti-periodonto-pathogenic potential of secondary metabolites found in Indonesian natural marine resources at high concentrations [26]. Clinical trials for herbal mouthwashes require a long period of research to determine their true long-term effects. Therefore, the ideal mouth rinse and mouthwash for orthodontic patients could focus on discovering and developing herbal-based products with antimicrobial, anti-inflammatory, and antioxidant properties.

CONCLUSION

These herbal-based mouth rinse and mouthwash ingredients showed potential for periodontal protection in orthodontic patients. The side effects associated with chlorhexidine were minimal in herbal mouthwashes.

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AUTHORS CONTRIBUTIONS

All of the authors have contributed equally.

CONFLICT OF INTERESTS

Declare that there is no conflict of interest regarding the publications of this paper.

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