



REVIEW ARTICLE

The use of mouthwash containing essential oils (LISTERINE®) to improve oral health: A systematic review

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KEYWORDS

Listerine;
Mouthwash;
Mouthrinse;
Essential oils;
Short-term efficacy;
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Review

Abstract *Background:* Standard recommendations to maintain daily oral hygiene include tooth brushing and interdental cleaning. Evidence from literature indicates that using a mouthrinse as an adjunct provides benefit beyond mechanical methods. The objective of this article was to evaluate the short- and long-term effect of a mouthwash containing essential oils (LISTERINE®) in improving oral health.

Methods: PubMed (MEDLINE) and bibliographies from the relevant retrieved reviews were searched to identify clinical studies involving the use of LISTERINE mouthrinse. The primary outcome measure was short- and long-term efficacy of mouthrinse containing essential oil (LISTERINE®) in improving oral health.

Results: Based on our search, 26 studies supported the use of essential-oil-containing mouthrinse (LISTERINE®) as an adjunct to daily oral health regimen. Most studies were conducted in healthy subjects, 2 studies in orthodontic patients, 1 each in xerostomia patients and mentally disabled patients. Of these, 13 studies supported the short-term (< 3 months) and 13 studies supported the long-term (3–6 months) efficacy of LISTERINE mouthrinse as an adjunct to mechanical methods.

Conclusions: This review provides strong evidence of the anti-plaque and anti-gingivitis effects of essential-oil-containing mouthrinse LISTERINE® as an adjunct to daily tooth brushing and interdental cleaning.

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Contents

1. Introduction	3
2. Methods	3
3. Results and discussion	3
3.1. Short-term (< 3 months) efficacy of mouthrinse containing EO – LISTERINE®	3
3.1.1. Comparative studies	4
3.1.2. Microbiological effect	4
3.1.3. Viral contamination	4
3.1.4. Irritation potential	4
3.2. Long-term (3–6 months) effectiveness of EO-containing mouthwash – LISTERINE®	4
3.2.1. Comparative studies	4
3.2.2. Studies in orthodontic patients	5
4. Conclusions	5
Acknowledgements	5
Funding sources	6
References	6

1. Introduction

Dental plaque is the main factor for initiation and progression of oral diseases (Sbordone, 2003). Therefore, plaque removal is mandatory to prevent accumulation of plaque on the teeth and adjacent gingival surface. Standard recommendations to maintain daily oral hygiene include tooth brushing and interdental cleaning (Choo and Delac, 2001; Claydon, 2008). Tooth brushing with a dentifrice containing anti-plaque agents and interdental cleaning with toothpicks and dental floss has been proven to control plaque and gingivitis. A proximal brush is recommended in order to access open interdental spaces (Choo and Delac, 2001). Studies indicate that regular professional plaque control by a hygienist can offer maintenance of a healthy periodontium (Axelsson et al., 2004). In addition, mouthrinses can prevent plaque growth and improve oral health by inhibiting the proliferation rate of bacteria in plaque or by preventing attachment of bacteria to dental surfaces (Netuschil et al., 1995). Over the past 100 years, phenolic compounds (e.g. LISTERINE®) have been acknowledged to be germicidal and effective in reducing plaque and gingivitis.

Recently, several studies have shown the combined effectiveness of essential oil (EO) containing mouthrinse-LISTERINE® in achieving healthy gingival tissue and reducing plaque (Claffey, 1985). These studies were conducted to assess the efficacy and safety of LISTERINE® in comparison with other mouthrinses. However, it is important to highlight long-term (3–6 months) versus short-term (< 3 months) effectiveness of LISTERINE® towards achieving gingival health. Thus, the available literature was systematically assessed to address the use of mouthwash containing EO (LISTERINE®) to improve oral health.

2. Methods

We performed an electronic search of PubMed (MEDLINE) based on the following search query: (“LISTERINE”[Supplementary Concept] OR LISTERINE[tiab]) AND (essential oil[tiab] OR essential oils[tiab]). The results of PubMed/MEDLINE search were as follows:

PubMed query	Items found
Search (essential oil[tiab]) OR essential oils[tiab]	11,943
Search (LISTERINE[tiab]) OR LISTERINE [Supplementary Concept]	369
Search (((essential oil[tiab]) OR essential oils[tiab])) AND ((LISTERINE[tiab]) OR LISTERINE [Supplementary Concept])	100

Additionally, a manual search was performed by screening the bibliographies from the relevant retrieved reviews as well as included publications. All chosen clinical studies were designed to meet the commonly accepted professional and regulatory standards set by the American Dental Association (ADA) and the US Food and Drug Administration (FDA). These trial results presented detailed data including baseline characteristics, intervention protocols, and outcomes.

3. Results and discussion

In the retrieved literature, it is well documented that brushing and flossing are the ‘gold standard’ procedures for controlling bacterial plaque. However, based on results derived from several clinical trials, the ADA has recommended a mouthrinse containing EO (LISTERINE®) as an adjunct to routine mechanical oral hygiene measures. We grouped the studies into short-term and long-term efficacy.

3.1. Short-term (< 3 months) efficacy of mouthrinse containing EO – LISTERINE®

Several clinical studies have demonstrated that EO-containing mouthrinse – LISTERINE® can combat harmful bacteria and improve oral health (Vlachojannis et al., 2015). A study to quantify the additional benefit provided by an EO-containing mouthrinse in reducing plaque and gingivitis in patients who brush and floss regularly confirmed that adjunctive use of an EO-containing mouthrinse provides a clinically significant

and meaningful additional benefit in reducing plaque and gingivitis (Sharma et al., 2004).

3.1.1. Comparative studies

3.1.1.1. Chlorhexidine (CHX). In a short, randomized, crossover clinical trial, alcohol-based EO mouthrinse and alcohol-free EO mouthrinse was compared with a positive control (0.2% CHX) and a negative control (saline), using an *in vivo* plaque regrowth model for 3 days. At the end of the trial, alcohol-free and alcohol-based EO mouthrinses showed better inhibitory effect on plaque regrowth versus controls (Marchetti et al., 2017). A post hoc analysis of 5 clinical trials that evaluated the ability to achieve gingival health with daily rinsing with Cool Mint® LISTERINE® Antiseptic EO compared with only brushing/flossing plaque control. Results showed that healthier gingival sites and plaque-free tooth surfaces were achieved as early as 4 weeks with use of an EO-containing antimicrobial mouthrinse (Charles et al., 2014).

3.1.1.2. Cetylpyridinium chloride (CPC). A study that compared the safety, and anti-plaque and anti-gingivitis efficacy of a high bioavailable, alcohol-free 0.07% CPC rinse with a positive control rinse containing EO and 21.6% ethyl alcohol suggested that twice daily rinsing with 0.07% CPC rinse may provide anti-plaque and anti-gingivitis efficacy similar to that with the alcohol-based EO mouthrinse (Witt et al., 2005). However, another two-week comparative clinical trial showed that EO-containing mouthrinse provided superior anti-gingivitis as well as anti-plaque efficacy compared to a 0.075% CPC mouthrinse (Parikh-Das et al., 2013). In addition, another study that compared mouthrinse containing EO and 0.075% CPC showed that the EO-containing mouthrinse has superior anti-plaque/anti-gingivitis effectiveness compared to the 0.075% CPC-containing mouthrinse without mechanical oral hygiene influence (Charles et al., 2011).

3.1.1.3. Amine fluoride/stannous fluoride (ASF). A study compared the plaque-inhibiting effects of two commercially available mouthrinses containing EO and ASF on supragingival plaque regrowth. Results showed that ASF and EO rinses may represent effective alternatives to CHX rinse as adjuncts to oral hygiene (Pizzo and La Cara, 2008).

3.1.1.4. Azithromycin. A study to investigate the effects of irrigation with an EO-containing antiseptic and oral azithromycin (AZM) on bacteremia caused by scaling and root planing showed significant reduction of subgingival bacterial counts in both the EO and AZM groups ($P < .01$) (Morozumi et al., 2010).

3.1.2. Microbiological effect

The antimicrobial effectiveness of mouthrinses against predominant oral bacteria *in vitro*, is determined by the minimum inhibitory concentration (MIC). The inhibitory effects of the three test agents was assessed against 40 oral bacteria at concentrations of 1, 2, 4, 8, 16, 32, 64, 128, 256 and 512 µg/ml. The data suggest that the herbal mouthrinse containing EO may provide oral health benefits by inhibiting the growth of periodontal and cariogenic pathogens (Haffajee et al., 2008).

A study evaluated the clinical and microbiological effects of an EO-containing mouthrinse in 20 chronic periodontitis subjects. The EO group revealed significant reduction in the occurrence of *P. gingivalis* in saliva compared to the baseline, and 45 days; this difference was stable at 180 days. The EO-containing mouthrinse also demonstrated beneficial effects on clinical parameters. However, microbiological findings were less consistent (Cortelli et al., 2009).

3.1.3. Viral contamination

A clinical study was undertaken to evaluate the effect of an EO-containing oral antiseptic (LISTERINE®) on the reduction of viral titer in saliva during active viral infection. LISTERINE® showed reduction of viral contamination in oral fluids for at least 30 min after the oral rinse (Meiller et al., 2005).

3.1.4. Irritation potential

A study was conducted to assess the irritation potential of an EO-containing mouthrinse (LISTERINE® Antiseptic) in a population with objectively documented xerostomia (hyposalivation) using an exaggerated-exposure clinical model. The oral irritation potential of the EO mouthrinse was minimal, and oral mucosal abnormalities attributable to the test rinses were seen in only two subjects, both at the 7-day examination. These subjects were both using the EO mouthrinse. The abnormalities consisted of an asymptomatic “whitish slough” which was readily wiped off leaving a normal appearing, non-erythematous mucosa. In both subjects, the oral mucosa appeared normal at the 14-day examination (Fischman et al., 2004).

3.2. Long-term (3–6 months) effectiveness of EO-containing mouthwash – LISTERINE®

Several clinical studies have demonstrated the long-term efficacy of EO-containing mouthrinse – LISTERINE®.

3.2.1. Comparative studies

A meta-analysis of studies from PubMed-MEDLINE, Cochrane-CENTRAL and EMBASE databases on the effects of an EO mouthwash versus alcohol vehicle solution on plaque, gingival inflammation parameters and extrinsic tooth staining showed that EO mouthwash appears to provide a significant oral health benefit during the 6 months of use (Van Leeuwen et al., 2014). In a clinical trial to determine the oral health benefits of recommending twice-daily brushing and rinsing with an EO-containing mouthrinse in 766 healthy subjects with mild to moderate levels of gingivitis, 85% of subjects judged the EO mouthrinse as efficacious. The oral health benefits of brushing and rinsing twice daily with an EO mouthrinse were well-perceived by patients and professionals alike and measurable by dentists at a 3-month recall visit (Pilloni et al., 2010).

3.2.1.1. Cetylpyridinium chloride (CPC). A 6-month clinical study compared the potential of EO versus a 0.07% CPC-containing mouthrinse in 354 healthy patients. Results showed a significant reduction in gingivitis and plaque for both EO and CPC mouthrinses (Cortelli et al., 2014). In another trial,

subjects received control, 0.05% CPC, or a fixed combination of EO. The EO group showed lower mean scores for modified gingival index and plaque index than CPC (32.4% and 56.2% reductions, respectively) in reducing plaque and gingivitis (Sharma et al., 2010). A third study compared the effects of an experimental mouthrinse containing 0.07% CPC (Crest Pro-Health®) with a mouthrinse containing EO (LISTERINE®) on dental plaque accumulation and prevention of gingivitis in 151 subjects for 6 months. Results indicated that there was no statistically significant difference ($p = .05$) in the anti-plaque and anti-gingivitis benefits between the two groups over a 6-month period (Albert-Kiszely et al., 2007).

3.2.1.2. Dental floss. A study compared the use of dental floss with that of an EO-containing mouthrinse in 326 subjects. Results showed that in conjunction with professional care (prophylaxis) and tooth brushing over 6 months, rinsing twice daily with an EO-containing mouthrinse was at least as good as flossing daily in reducing interproximal plaque and gingivitis (Bauroth et al., 2003). Another study compared the effectiveness of rinsing with an EO-containing antimicrobial mouthrinse with that of dental floss in reducing interproximal gingivitis and plaque in 301 subjects. Results showed that EO-containing mouthrinse was “at least as good as” dental floss for the control of interproximal gingivitis (Sharma et al., 2002).

3.2.1.3. Stannous fluoride dentifrice. A study compared the efficacy of a stabilized stannous fluoride dentifrice (Crest Plus Gum Care), baking soda and peroxide (NaF) dentifrice (Mentadent), and EO mouthrinse (LISTERINE®) to a conventional NaF dentifrice (Crest) for the control of plaque, gingivitis and gingival bleeding over 6 months. The results showed the stabilized stannous fluoride dentifrice produced statistically significant 17.5% reductions in gingivitis and 27.5% reductions in gingival bleeding relative to the NaF dentifrice. The combination of NaF dentifrice and EO mouthrinse produced statistically significant reductions of 7.4% in gingivitis and 10.8% in plaque as compared with the NaF dentifrice. The stabilized stannous fluoride dentifrice produced statistically significant reductions in both gingivitis (10.8%) and gingival bleeding (23.0%) relative to the combination of NaF dentifrice and EO mouthrinse. The baking soda and peroxide (NaF) dentifrice did not provide reductions in gingivitis, plaque or gingival bleeding as compared with the conventional NaF dentifrice. This shows the efficacy and superior activity of a combination of NaF dentifrice and EO mouthrinse for the prevention of gingivitis (Beiswanger et al., 1997).

3.2.1.4. Chlorhexidine (CHX). A study that compared the efficacy of a 0.12% CHX mouthrinse and an EO mouthrinse on plaque accumulation and gingivitis in mentally disabled adults over a 1-year period showed no further significant improvement in the gingival index after the 1st month. A statistically significant improvement in the plaque index occurred in the CHX group at month 1, but returned to baseline 2 levels over the 12 months. No improvement in the plaque index occurred in the EO group. The probing depths remained the same over the 12 months. In addition, undesired effects such as tooth staining has been reported with the use of CHX (McKenzie et al., 1992).

A study was conducted to determine whether antimicrobial mouthrinses with different formulations could affect the com-

position of the subgingival microbiota and clinical parameters of adjacent tissues in 116 periodontal maintenance subjects. Results emphasized that CHX ($p < .001$) and herbal ($p < .05$) rinses significantly reduced plaque. In addition, the observed microbial changes were accompanied by improvements in clinical parameters in the periodontal maintenance subjects (Haffajee et al., 2009).

Another study compared antimicrobial effects of EO, either alone or in combination with CHX digluconate, against planktonic and biofilm cultures of *Streptococcus mutans* and *Lactobacillus plantarum*. The EO agent included cinnamon, tea-tree oil (*Melaleuca alternifolia*), manuka (*Leptospermum scoparium*), *Leptospermum morrisonii*, arnica, eucalyptus, grapefruit, the EO mouthrinse Cool Mint® LISTERINE® and two of its components, menthol and thymol. Cinnamon exhibited the greatest antimicrobial potency (1.25–2.5 mg/ml). Manuka, *L. morrisonii*, tea-tree oils, and thymol also showed antimicrobial potency but to a lesser extent. The combination effect of the EO-CHX group was greater against biofilm cultures of both *S. mutans* and *L. plantarum* than against planktonic cultures. The amount of CHX required to achieve an equivalent growth inhibition against the biofilm cultures was reduced 4–10 folds in combination with cinnamon, manuka, *L. morrisonii*, thymol, and LISTERINE®. They concluded that there may be a role for EO in the development of novel anti-carries treatments (Filoche et al., 2005).

3.2.2. Studies in orthodontic patients

A study that assessed the effectiveness of chemical and mechanical control of dental biofilm in 30 orthodontic patients showed that the use of EO-containing mouthwash LISTERINE®, together with mechanical oral hygiene, orientation, and motivation, proved to be adequate for the maintenance of oral health in orthodontic patients (Alves et al., 2010).

In a study that tested the use of LISTERINE® mouthrinse in maintaining proper oral health for orthodontic patients, LISTERINE® mouthrinse was shown to reduce the amount of plaque and gingivitis. The authors concluded that adding LISTERINE® to the standard oral hygiene regimen may be beneficial for orthodontic patients in maintaining proper oral health, thus reducing the likelihood of developing white spot lesions and gingivitis (Tufekci et al., 2008).

4. Conclusions

Gingivitis is a common oral condition resulting from gingival inflammation due to accumulation of bacterial plaque, especially in the interdental area. Conventional mechanical methods (i.e. tooth brushing and flossing/interdental cleaning) may result in an incomplete removal of interdental plaque. The published evidence from short- and long-term clinical trials support the benefit of adding an EO-containing mouthwash LISTERINE® to the daily oral regimen to maintain personal oral hygiene.

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