



INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

HERBAL AND ORAL HEALTH

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Abstract:

Herbal medicine has a rich history in disease prevention and management, offering an alternative to chemical products with potential side effects. However, the use of herbs is not without its challenges, primarily stemming from the insufficient knowledge about their effects within the oral cavity, their mechanisms of action, and possible side effects. This chapter highlights several herbs, including aloe vera, ginger, clove, cinnamon, garlic, neem, miswak, turmeric, tulsi, green tea, chamomile, fenugreek, anise plant, peppermint, bloodroot, caraway, eucalyptus, phyllanthus emblica, black seed, myrrh, rosemary, sage, and thyme, all of which exhibit anti-inflammatory, anti-bacterial, anti-viral, and anti-fungal properties against oral micro-organisms.

These herbs hold promise as alternative options for managing various oral conditions, including caries prevention, gingivitis, periodontitis, oral burns, ulcers, inflammation, post-extraction care, dry mouth, pain reduction, anaesthesia, intracanal medications, ill-fitting dentures, peri-implant mucositis, and peri-implantitis. They can be administered in various forms such as mouthwashes, toothpastes, topical agents, or local drug delivery devices, providing flexibility in their application.

Despite their potential benefits, it is imperative to acknowledge that more research is essential to unravel the precise mechanisms of action and potential side effects associated with these herbal remedies. This knowledge will further enhance our understanding of their clinical utility and safety, making them a valuable addition to conventional oral healthcare practices.

Keyword: aloe vera, ginger, clove, cinnamon, garlic, neem, miswak, turmeric, tulsi, green tea, chamomile, fenugreek, anise plant, peppermint, bloodroot, caraway, eucalyptus, phyllanthus emblica, black seed, myrrh, rosemary, sage, and thyme, all of which exhibit anti-inflammatory, anti-bacterial, anti-viral, and anti-fungal properties against oral micro-organisms.

1. Introduction:

Herbs, typically defined as plants lacking the woody tissue characteristic of shrubs or trees, have a longstanding history of use in traditional medicine for addressing a wide range of health issues [1, 2]. These botanical remedies have demonstrated positive effects in managing various inflammatory medical conditions such as dysphagia, gastric ulcers, wound healing, and sore throat. Herbs play a central role in the realm of Complementary and Alternative Medicine (CAM) [1, 2], offering an alternative to conventional pharmaceutical approaches.



The utility of herbs extends beyond traditional medicine; they have been employed to regulate blood-related problems, aid in waste elimination, promote circulation within the body and bloodstream, and alleviate irritation [3, 4]. Herbs are available in diverse forms, including tablets, syrups, and can even be applied externally as dressings or topically [3, 4].

In the context of oral healthcare and dentistry, herbs hold potential as valuable tools, particularly in addressing issues like gum swelling and enhancing overall oral health. Nevertheless, there is a notable scarcity of scientific studies that have rigorously examined the use of herbal supplements in these domains. This chapter seeks to bridge this gap by comprehensively reviewing the most commonly utilized herbal supplements in dentistry, including neem, ginger, clove, aloe vera, eucalyptus, garlic, miswak, turmeric, tulsi, charcoal, and cinnamon. The findings presented will be evidence-based, serving to either support or challenge the use of these herbal agents in oral care. [5, 6].

2. Most Common Herbs Used in Dental Medicine

Herbs	Main dental use	Main oral targeted organism
Aloe vera	Periodontal index, gingival scores, inhibitory activities on some organisms, intracanal Medicaments, oral medicine, after extraction, ill-fitting denture, around implants complications.	Streptococcus mutans, Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis, Bacteroides fragilis, Enterococcus faecalis
Ginger	Pain killer, anti-inflammatory, anti-bacterial, intracanal dressing, recurrent apthous stomatitis and denture stomatitis	Streptococcus mutans, Streptococcus sobrinus, Lactobacillus
Clove	Inhibit the decalcification and promote the remineralization, topical agent, anti-bacterial	S. mutans, Porphyromonas gingivalis, Prevotella intermedia, Candida albicans, Herpes Simplex virus 1 and 2
Cinnamon	Endodontic irrigate solution, antimicrobial properties against cariogenic bacteria and fungicidal activity.	E. faecalis, Candida tropicalis and Candida glabrata
Garlic	Inhibition of the growth of the periodontal pathogens, Endodontic irrigate solution.	Aggregatibacter actinomycetemcomitans, P. gingivalis, Fusobacterium nucleatum, Streptococcus mutans and Lactobacillus acidophilus
Neem	Endodontic irrigation solution, antiviral, antibacterial, antisclerotic and antiinflammatory properties. A local drug delivery system, inhibition of oral epithelial cell carcinoma.	E. faecalis, P. gingivalis, S. mutans, S. faecalis, S. salivarius, S. mitis, and S. sanguis
Miswak	Reduction of plaque, bacterial oral germs, prevent cavities, halitosis. Dentifrice, chronic periodontitis, mouthwash, remineralization effects, anti-cariogenic, whitening properties, and orthodontic chain preservation.	Porphyromonas gingivalis and Herpes simplex virus-1.
Turmeric	Antibacterial, antitumor, antioxidant, anti-inflammatory and analgesic properties. Mouth rinse, erythematous halo, ulcer size, and pain, oral submucous fibrosis	Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis, and Tannerella forsythia.
Tulsi	Antimicrobial agents. Toothpaste or mouthwash	A. actinomycetemcomitans, P. gingivalis and P. intermedia
Green tea	Antibacterial properties. Minimize bone loss in periodontal disease cases, mouth rinse, local drug delivery, and chewing gum.	Streptococcus mutans, Streptococcus sobrin, P. gingivalis and P. melaninogenicus.
Chamomile	Anti-inflammatory property, mouth rinse for gingivitis and periodontal disease, management of burning mouth syndrome, irrigant solution.	Porphyromonas gingivalis

Fenugreek	Gingival index, plaque index, bleeding on probing, pocket depth, and clinical attachment levels.	-
Anise plant	Antibacterial properties, mouth rinse, increase healing process	E. corrodens and Prevotella spp.
Peppermint	Toothpaste or mouth rinse, antibiofilm properties. Topical analgesic and reduces pain. Treatment of gingivitis, periodontitis, oral mucosa of viral, bacterial, fungal and protozoal etiology. Decrease the treatment time, faster tissue regeneration, faster relieved pain and swelling, and improved the patients' quality of life. Mouthwash.	Streptococcus mutans
Bloodroot	Periodontal disease, toothpaste or other oral hygiene products.	P. gingivalis.
Carawa	Mouth wash in gingivitis or periodontal disease. Flavor component in toothpaste and mouthwash products.	Fusobacterium nucleatum, early and late bacterial colonizers .
Eucalyptus	Anti-bacterial, antibiotics and oral infections prevention, dissolve root canal sealer	A. actinomycetemcomitans and P. gingivalis, Streptococcus mutans, Lactobacillus acidophilus
Phyllanthus emblica	Antimicrobial, antioxidant, antiresorptive and antiinflammatory activity. Locally delivered gel	Group of bacteria
Black seed	Suppresses pro-inflammatory cytokines, anti-bacterial, and decrease oral halitosis.	Porphyromonas gingivalis, A. actinomycetemcomitans and Prevotella intermedia, S. mutans, Enterobacter cloacae, Streptococcus oralis, Streptococcus anginosus, Staphylococcus epidermide.
Myrrh	Antimicrobial properties, immune enhancer. Topical or a mouth wash, manage pharyngitis, tonsillitis, gum swelling, aphthous ulcers, intramucosal wounds, gingivitis and ulcers. Anti-inflammatory activity such as IL-1 β , IL-6, and TNF- α .	Streptococcus mutans, Lactobacillus spp, Porphyromonas gingivalis, A. actinomycetemcomitans, Treponema denticola, and Tannerella forsythia
Rosemary	Antioxidant, antibacterial, antifungal, anticancer.	Staphylococcus aureus, Staphylococcus albus, Vibrio cholerae and Escherichia coli
Sage	Mouthwash or gargle, sore throat, gingivitis, antibacterial, antifungal.	Streptococcus mutans, Lactobacillus rhamnosus, Actinomyces viscosus, Candida albicans
Thyme	Spasmodic, whooping cough, oral herpes, chronic candidiasis and halitosis.	S. aureus, E. coli, C. albicans Streptococcus mutans

2.1 Aloe Vera

Aloe vera is a versatile herbal remedy that has demonstrated efficacy in managing periodontal diseases. It is available in various forms, including mouthwash, toothpaste, or gel [1]. Recent research, as summarized in a systematic review, highlights the effectiveness of aloe vera as a mouthwash in reducing plaque and gingival inflammation across all included studies (Table 1, [2]). Importantly, aloe vera showed a distinct advantage in terms of side effects when compared to conventional chemical mouthwashes, with either no or very minimal side effects reported [2].

Beyond its dental applications, aloe vera possesses multiple therapeutic properties. It serves as a potent detoxifying agent, possesses neuro-sedative properties, and acts as an immune booster. Notably, it can function as a mercury scavenger and antioxidant, contributing to its multifaceted health benefits. Additionally, aloe vera has been found to accelerate the healing process, especially after surgical extractions, including the removal of impacted third molars. The cumulative evidence suggests that aloe vera is a valuable herbal resource for oral health and dental care. [1, 2].

Table 1.

The most common herbs used in dentistry and the dental application. Aloe vera toothpaste is another form that is effective on periodontal index and gingival scores and that can be used as an alternative to traditional toothpaste [3]. Aloe vera gel has inhibitory activities on some cariogenic organisms (*Streptococcus mutans*) [4], such as periodontopathic (*Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*) and an opportunistic periodontopathogen (*Bacteroides fragilis*) [4]. It can be used as intracanal medicaments against *Enterococcus faecalis* (Table 1, [5]). It can be used to manage antiviral infection such as herpes simplex and herpes zoster, or as an antifungal agent against *Candida albicans* [3,4].

There are several other uses for aloe vera such as aid in chemical burns, dry sockets, relief of aphthous ulcers, canker sores, lichen planus, pemphigus, desquamative gingivitis, migratory glossitis, and burning mouth syndrome [5]. It can help in reducing the information related to ill-fitting dentures. It can also be used in peri-implant mucositis and peri-implantitis [5,6].

2.2 Ginger

Ginger, scientifically known as *Zingiber officinale* Roscoe, offers several valuable applications in dentistry and oral healthcare.

It is an effective painkiller, and studies indicate that its pain-relief capabilities are comparable to ibuprofen. This makes ginger a potential alternative to conventional pain medications [6].

In combination with non-surgical periodontal therapy, ginger has demonstrated its usefulness in cases of chronic periodontitis among individuals with type 2 diabetes [7].

Ginger has been found to reduce the colony forming units (CFUs/uL) of *Streptococcus mutans*, a significant cariogenic bacterium, and it is as effective as other oral rinses, including chlorhexidine. Additionally, it exhibits efficacy against *Lactobacillus* [7].

Ginger holds promise as an anti-cariogenic agent, particularly against *Streptococcus mutans* and *Streptococcus sobrinus*, key contributors to tooth decay [7]. The active compounds in ginger, such as gingerol and shogaol, hydrocarbons, and oleoresins, have been investigated and found to possess anti-inflammatory, antibacterial, and antioxidant properties against oral microorganisms, which contribute to disease prevention [8].

Using ginger as an alternative to conventional mouthwashes can help reduce costs and side effects while introducing a safe inhibitory agent [9]. It can also be employed as an intracanal dressing and in cases of recurrent aphthous stomatitis and denture stomatitis [9].

However, it's important to be aware of potential side effects and interactions with other medications. Ginger may lead to gastrointestinal irritation, heartburn, or diarrhea [9,10], and it can interfere with the effects of anticoagulants like warfarin and inhibit platelet aggregation. This underscores the importance of considering individual health factors when using ginger as part of a dental care regimen. [10].

2.3 Clove

Clove, scientifically known as *Syzygium aromaticum* (*S. aromaticum*), possesses various components with notable implications for dental care and oral health.

The principal phenolic components of clove include volatile oil, eugenol, and eugenyl acetate. However, it's essential to be aware that clove can have adverse effects on surface roughness, hardness, and transverse strength of dental materials [10, 11]. Large doses of clove oil can lead to severe health problems, including sore throat, vomiting, kidney and liver damage, epilepsy, and difficulty breathing. In contrast, when used in small doses, it exhibits the capacity to inhibit decalcification and promote remineralization, contributing to its potential use in dental care [11].

Clove can be employed as a topical agent and as a benzocaine alternative before needle insertion for pain management, with similar pain scores [12].

Crude extracts of *S. aromaticum* (clove) have shown inhibitory activity against periodontal pathogens, including *Streptococcus mutans* [13].

Clove demonstrates antibacterial activity against *Porphyromonas gingivalis* and *Prevotella intermedia* [13], and it can reduce the levels of various cytokines and factors such as IL-6, COX-2, and TNF- α .

It also exhibits antifungal activity against *Candida albicans*, and antiviral activity against Herpes Simplex virus 1 and 2 [14].

Clove can be applied in various forms, including mouthwashes, toothpastes, topical agents, and local drug delivery devices. However, it's crucial to be mindful of potential side effects and interactions [14]:

Clove has been considered generally safe, but it has demonstrated cytotoxicity towards fibroblasts and endothelial cells in vitro studies. Severe side effects such as hepatotoxicity, generalized seizures, and disseminated intravascular coagulopathy have been reported in rare cases [14,15].

Other potential side effects may include skin irritation, ulcer formation, contact dermatitis, tissue necrosis, and delayed healing. These potential side effects underscore the importance of careful consideration and consultation with healthcare professionals when using clove for dental purposes [16].

2.4 Cinnamon

Cinnamon, known scientifically as *Cinnamomum Zeylanicum* or *Cinnamomum cassia*, presents various dental applications and properties.

Cinnamon can serve as an endodontic irrigant to reduce the presence of *Enterococcus faecalis*, and its effectiveness is comparable to 3% sodium hypochlorite, a commonly used root canal irrigation solution [17].

It possesses strong antimicrobial properties against cariogenic bacteria such as *Streptococcus mutans* and *Lactobacillus casei*, and it also exhibits fungicidal activity against *Candida tropicalis* and *Candida glabrata* [18].

Chewing gum containing cinnamon may aid in managing halitosis cases by reducing the presence of volatile sulfur compounds in the oral cavity [19].

Toothpaste containing *Cinnamomum zeylanicum* has demonstrated antibacterial activity against periodontal pathogens [20].

Cinnamon can be used in dental unit water lines to reduce bacterial counts, contributing to infection control [21].

However, it's essential to be aware of potential side effects:

High exposure to cinnamon can lead to tooth discoloration [21].

Some individuals may experience allergic reactions, including swelling, inflammation, burning sensations, and soreness of the mouth and lips when exposed to cinnamon [21].

These potential side effects should be considered when incorporating cinnamon into oral care regimens, and individuals with known sensitivities or allergies should exercise caution.

2.5 Garlic

Garlic, known for its distinctive flavour and strong odour, also offers potential dental applications:

Aqueous extracts and compounds from garlic, such as allicin and diallyl sulfide, have been found to inhibit the growth of periodontal pathogens, including *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, and *Fusobacterium nucleatum* in in vitro studies [22, 23].

As an irrigant, garlic is considered effective, safe, and a natural product. It has been compared to sodium hypochlorite in root canals of primary molars, showing promise in endodontic care, especially when used over a 12-month period [24].

Garlic extracts, particularly from hard-neck garlic, have demonstrated substantial zones of inhibition against cariogenic bacteria such as *Streptococcus mutans* and *Lactobacillus acidophilus*. These zones of inhibition were even more extensive than those observed with chlorhexidine mouthwash [25].

However, the methanolic component of garlic had no antibacterial effects on *Staphylococcus aureus* and *Pseudomonas aeruginosa* [26].

It's important to be aware of potential side effects and interactions when using garlic:

One of the most common side effects of garlic use is unpleasant breath or body odor [26, 27].

Other side effects may include heartburn and a burning sensation in the mouth or throat [27].

Individuals taking specific medications, such as acetaminophen, birth control pills, or warfarin, should seek medical advice before using garlic, as it may interact with these medications [28].

Considering these potential side effects and interactions, individuals should exercise caution and consult with a healthcare professional when incorporating garlic into their dental care routine.

2.6 Neem

Neem, scientifically known as *Azadirachta indica*, is a versatile herb with several applications in dental care:

Neem can be utilized as an endodontic irrigation solution, effectively reducing the presence of *Enterococcus faecalis*, and its performance is on par with 3% sodium hypochlorite, a common root canal irrigation solution [17].

Neem exhibits various properties, including antiviral, antibacterial (effective against *Streptococcus mutans*, *Streptococcus faecalis*, *Streptococcus salivarius*, *Streptococcus mitis*, and *Streptococcus sanguis*), anti-sclerotic, and anti-inflammatory characteristics [17].

A local drug delivery system using a 10% neem oil chip has statistically reduced *Porphyromonas gingivalis* and improved all clinical parameters in patients with periodontal disease [28].

Highly pure neem leaf extract shows potential for inhibiting oral epithelial cell carcinoma by downregulating pro-inflammatory pathways within tumors [29].

However, neem was found to be less effective in reducing plaque scores among orthodontic patients compared to a *Salvadora persica* miswak-based mouthwash [30].

Neem displays anti-candidal activity against *Candida albicans* and inhibits *Streptococcus mutans* and *Enterococcus faecalis*, which are implicated in root canal failures during endodontic procedures [29, 30].

Neem's multifaceted properties make it a valuable addition to oral healthcare. It's important to consider the specific dental concern and individual needs when incorporating neem into a dental care regimen.

2.7 Miswak

Salvadora persica, commonly known as miswak, offers a range of potential benefits in dental care:

Miswak has shown potential in reducing plaque, countering bacterial oral pathogens, preventing cavities, and managing halitosis [31]. It is rich in essential minerals such as calcium, chloride, phosphate, and thiocyanate, which can positively influence saliva and oral health [32].

When used in dentifrices, miswak has been found to significantly reduce plaque index scores in comparison to conventional toothpaste [33].

The raw extract of miswak demonstrates efficacy against *Porphyromonas gingivalis* and herpes simplex virus-1 in patients with chronic periodontitis [34].

Miswak in mouthwash form has been investigated as an effective means to reduce plaque. It can also be used as a chewing gum, mouthwash, and chewing stick [35].

Miswak is associated with remineralization effects after dental caries. It can accelerate wound healing following oral or periodontal surgery and extractions. It possesses potential anti-cariogenic and teeth-whitening properties, and it aids in preserving orthodontic chains [35].

Miswak's diverse properties and applications make it a valuable resource for oral health and dental care. It can be employed in various forms, offering flexibility in its utilization to address specific dental concerns.

2.8 Turmeric

Turmeric, specifically its active compound curcumin, possesses a range of properties that are beneficial for dental care and oral health:

Curcumin has demonstrated anti-bacterial, anti-tumor, antioxidant, anti-inflammatory, and analgesic properties [36]. It can be applied topically, used as a mouthwash, employed as a subgingival irrigant, or utilized as a local drug delivery system to treat periodontal diseases. In some cases, it has been found to have equivalent or even higher efficacy compared to chlorhexidine in reducing periodontopathic bacteria, including *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, and *Tannerella forsythia* [36].

Turmeric extract gel is effective for treating erythematous areas, ulcers, and pain in the oral cavity. It can also provide benefits in cases of oral submucous fibrosis, leukoplakia, lichen planus, and has shown better results compared to systemic treatment alone or antioxidants [37]. Additionally, curcumin exhibits anticancer activity [36, 37].

While turmeric is generally considered safe, it's important to be aware of potential side effects and interactions:

Some individuals may experience gastric irritation, nausea, diarrhea, allergic reactions, and it may interfere with blood clot formation [37].

Given these potential effects, individuals should exercise caution and consult with a healthcare professional when incorporating turmeric or curcumin into their dental care regimen, especially if they have any underlying health conditions or are taking medications that may interact with turmeric.

2.9 Tulsi

Tulsi, which contains various metabolites with antimicrobial properties, offers several applications in dental care, such as toothpaste and mouthwash. It exhibits antimicrobial properties similar to chlorhexidine, making it a suitable alternative for patients who cannot use chlorhexidine [38]. Tulsi extracts have demonstrated antimicrobial activity against *A. actinomycetemcomitans*, *P. gingivalis*, and *P. intermedia*, with different inhibition zones [38].

2.10 Green Tea

Green tea and its primary compound, epigallocatechin-3-gallate (EGCG), have protective effects against several diseases and display anti-bacterial properties [39]. They can help reduce bone loss in conditions like osteoporosis and periodontal disease by inducing apoptotic cell death in osteoclasts and osteoclast-like cells [40].

Green tea extract, rich in EGCG, has been shown to minimize alveolar bone loss in rats with periodontal disease. It can be utilized in various forms, including mouthwash, local drug delivery, and chewing gum. Green tea's catechins exhibit anti-bacterial activity against *Streptococcus mutans*, *Streptococcus sobrinus*, *P. gingivalis*, and *P. melaninogenicus* [41].

2.11 Chamomile

Chamomile, scientifically known as *Matricaria recutita*, contains volatile oils, flavonoids, and compounds like apigenin, luteolin, and quercetin [42]. It possesses anti-inflammatory properties that are as effective as a mouthwash in addressing gingivitis and periodontal disease. While it demonstrated a zone of inhibition against *P. gingivalis*, other essential oils like eucalyptus and tea tree oil proved to be more effective [43]. Chamomile can be used to manage conditions like burning mouth syndrome and as an irrigating solution [43]. It can also be applied topically to treat eczema and has been found equivalent to hydrocortisone cream in a randomized clinical trial. However, chamomile use can lead to allergic reactions, including bronchial constriction and skin reactions. Its use during pregnancy is controversial, as it was associated with a newborn death in a single case report [44].

2.12 Fenugreek

Fenugreek has demonstrated significant reductions in various parameters, including gingival index, plaque index, bleeding on probing, pocket depth, and clinical attachment levels when used clinically [45]. It exhibits antibacterial activity against *S. mutans*, biofilm formation, and acid production. It can increase salivary pH and reduce tooth surface demineralization. However, fenugreek is considered unsafe during pregnancy, breastfeeding, and for children. It should not be used without medical advice if you are pregnant. It may interact with blood sugar levels and cause hypoglycemia or lead to bleeding and blood clotting disorders.

The rest of the herbal components (2.13 Anise Plant to 2.23 Thyme) in the provided text have been briefly described and their applications, effects, and potential side effects are mentioned. If you have specific questions about any of these components or would like more details, please let me know.

2.13 Anise Plant

Anise contains anethole, which grants it potent antibacterial properties. It is effective against *Staphylococcus aureus*, as well as certain gram-positive and gram-negative microorganisms. In the oral cavity, it acts on anaerobic and facultative aerobic periodontal bacteria such as *E. corrodens* and *Prevotella* spp. When used as a mouthwash, it was comparable to chlorhexidine in reducing bleeding on probing and enhancing the healing process. Anise is generally considered safe for most adults [46].

2.14 Peppermint

Peppermint (*Mentha piperita*) can be used in toothpaste or mouthwash, demonstrating anti-biofilm properties against *Streptococcus mutans* and dental plaque. It can also be applied topically as an analgesic to reduce pain, including toothaches. Peppermint exhibits antimicrobial, analgesic, anti-inflammatory, immunomodulatory, and astringent properties. It is effective in the treatment of conditions such as gingivitis, periodontitis, and various oral infections caused by viruses, bacteria, fungi, and protozoa. However, it may interfere with iron absorption, cause burning and gastrointestinal distress in some individuals, and should be avoided in cases of chronic heartburn, severe liver damage, gallbladder inflammation or obstruction. Additionally, peppermint oil should be avoided in any facial application on children and infants [47].

2.15 Bloodroot

Bloodroot, known as *Sanguinaria canadensis*, contains an alkaloid and is used for addressing periodontal disease due to its ability to inhibit the growth of oral bacteria, including *P. gingivalis*. It is available in toothpaste and other oral hygiene products and is considered safe for long-term use. However, a recent report has suggested a potential association between dental preparations with bloodroot and leukoplakia, which is a precancerous lesion. It is contraindicated in children, pregnant or lactating women. Overdose of bloodroot can lead to side effects like stomachache, diarrhea, visual impairment, glaucoma, miscarriage, paralysis, and heart disease [48].

2.16 Caraway

Caraway, derived from *Carum carvi*, can be used as a mouthwash for gingivitis or periodontal disease. It can also be used as a flavor component in toothpaste and mouthwash products. It effectively targets *Fusobacterium nucleatum* and early- and late-bacterial colonizers on tooth surfaces. However, it should not be used in children under 2 years old, as it may cause skin and mucous membrane irritation [49].

2.17 Eucalyptus

Eucalyptus is effective against *A. actinomycetemcomitans* and *P. gingivalis* and can be used as a promising alternative to antibiotics for preventing oral infections [49]. It has demonstrated the ability to stimulate the innate cell-mediated immune response and tumor chemotherapy. Eucalyptus oil can dissolve root canal sealer, making it suitable for use in endodontic procedures. It also exhibits anti-cariogenic activity against *Streptococcus mutans* and *Lactobacillus acidophilus*. However, there are potential side effects associated with the use of eucalyptus, including allergies, rashes, burning sensation, drowsiness, difficulty in breathing, and in rare cases, cardiovascular collapse and multi-organ failure due to substantial ingestion of eucalyptus mouthwash [50].

2.18 Phyllanthus Emblica

Emblica officinalis has various properties, including cytoprotective, antimicrobial, antioxidant, anti-resorptive, and anti-inflammatory activity. It can be used as a locally delivered gel and as an adjunct to scaling and root planning, reducing periodontal inflammation in chronic periodontitis cases compared to scaling alone. It can also reduce yeast adhesion to buccal epithelial cells compared to a normal saline solution. *Phyllanthus emblica* can be used as a mouthwash to treat mouth ulcers and aphthous lesions. It is an effective remedy for scurvy due to its vitamin C content and can provide pain relief. However, potential side effects may include stomach upset and diarrhea. It should be avoided in children, pregnant women, breastfeeding mothers, and patients with Wilson's disease. It can also inhibit blood clotting and should not be used with clopidogrel (Plavix) as it may increase bleeding [51].

2.19 Black Seed

Black seed, also known as *Nigella sativa*, is often referred to as a "miracle herb." It has been found to reduce nitric oxide levels and inhibit pro-inflammatory cytokines such as IL-1b, IL-6, TNF- α , IFN- γ , and PGE2 while increasing the anti-inflammatory cytokine IL-10. Black seed is effective against oral pathogens such as *Porphyromonas gingivalis*, *A. actinomycetemcomitans*, and *Prevotella intermedia*. It also decreases oral halitosis and exhibits bactericidal effects on surfaces against *S. mutans*. Black seed can be used as an intracanal antiseptic in root canal therapy due to its activity against bacteria such as *Enterobacter cloacae*, *Streptococcus oralis*, *Streptococcus anginosus*, and *Staphylococcus epidermidis*. Additionally, it has beneficial effects on oral ulcerations, oral mucositis, bone healing, and wound healing after dental extractions or surgery [52,53].

2.20 Myrrh

Myrrh, derived from *Commiphora molm*, contains three components: resin, gum, and volatile oil. It possesses antimicrobial properties and enhances the immune system. Myrrh can be used topically or as a mouthwash to manage conditions like pharyngitis, tonsillitis, gingivitis, and oral ulcers with 2-3 applications per day. It effectively targets caries bacteria, such as *Streptococcus mutans* and *Lactobacillus spp*, as well as periodontal disease microbes like *Porphyromonas gingivalis*, *A. actinomycetemcomitans*, *Treponema denticola*, and *Tannerella forsythia*. Myrrh has anti-inflammatory properties and reduces proinflammatory cytokines like IL-1 β , IL-6, and TNF- α . It can be used to address gum swelling, aphthous ulcers, and intramucosal wounds, and it leads to a significant reduction in plaque and gingival inflammation compared to 0.2% Chlorhexidine Gluconate mouthwash [54,55].

2.21 Rosemary

Rosemary (*Rosmarinus officinalis*) exhibits antioxidant activity and is effective as an antibacterial and antifungal agent. It has demonstrated the ability to inhibit cancer development in animal studies. It works against bacteria such as *Staphylococcus aureus*, *Staphylococcus albus*, *Vibrio cholerae*, and *Escherichia coli*. However, it should be avoided during pregnancy to minimize the risk of abortion and may lead to iron deficiency in some cases [56].

2.22 Sage

The main components of *Salvia officinalis* are alpha and beta-thujone, rosmarinic acid, camphor, tannins, flavonoids, and cineole. Sage can be used as a mouthwash or gargle several times to treat a sore throat and gingivitis. It has antibacterial effects against *Streptococcus mutans*, *Lactobacillus rhamnosus*, and *Actinomyces viscosus*, as well as antifungal effects against *Candida albicans*. Prolonged use of sage can lead to increased heart rate, mental confusion, and convulsions. It should be avoided during pregnancy and in cases with fever [57].

2.23 Thyme

Thymus vulgaris (thyme) is a commonly recommended herb in Europe for conditions such as spasmodic and whooping cough. It can be used to treat oral herpes, chronic candidiasis, and halitosis. Thyme is effective against bacteria such as *Staphylococcus aureus*, *Escherichia coli*, and fungi like *Candida albicans*. Patients with orthodontic brackets can use it as a varnish to reduce *Streptococcus mutans* near the bracket [58].

3. Conclusions

In conclusion, herbal medicine shows promise in various dental applications, including dental caries, periodontal disease, candida and viral infections, and the management of oral ulcers and lesions. It offers several advantages, such as easy accessibility, the use of natural products, lower costs, lower toxicity, and potentially faster healing times.

However, it's crucial to approach herbal medicine with caution and responsibility. While it has significant potential benefits, there are also potential risks associated with its use, especially if used inappropriately. To ensure the safe and effective use of herbal remedies in dentistry, the following considerations are important:

Physician Consultation: Before using herbal medicines for dental purposes, it is essential to consult with a healthcare professional or dentist. They can provide guidance, consider individual health conditions, and ensure there are no interactions with other medications or treatments [59,60].

Safety and Quality Control: Herbal products should be sourced from reputable suppliers and manufacturers to ensure their safety and quality. The purity and potency of herbal preparations can vary, so choosing trusted sources is crucial.

Clinical Research: While many herbal remedies have shown promise in preclinical studies, more extensive clinical research is necessary to establish their safety and efficacy definitively in dental applications.

Regulation and Standardization: Herbal medicines should be subject to regulation and standardization to ensure consistency in quality and effectiveness. This can help protect patients from substandard or adulterated products [61].

Patient Education: Dental professionals should educate patients about the proper use of herbal remedies, including dosages, application methods, and potential side effects.

Interdisciplinary Approach: Collaboration between dental professionals, herbalists, and healthcare providers can help ensure that herbal medicines are used safely and effectively as part of a comprehensive dental care plan [61].

In summary, herbal medicine has the potential to offer valuable contributions to dental care, but it should be integrated into clinical practice with care, consideration, and professional oversight to maximize its benefits while minimizing potential risks. Further research and collaboration among healthcare disciplines are necessary to harness the full potential of herbal medicine in dentistry [62].

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