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Review

Effect of Herbal Medication and Supplements on Oral Health

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Abstract

Herbal medications and supplements have gained significant attention as natural alternatives for enhancing oral health, with particular benefits in managing dental caries and periodontal disease. Many herbs, such as turmeric, green tea, and chamomile, contain bioactive compounds that exhibit antimicrobial and anti-inflammatory properties, reducing harmful oral pathogens and controlling inflammation. Turmeric, rich in curcumin, inhibits pathways that trigger inflammation, while green tea, containing epigallocatechin gallate (EGCG), targets inflammatory mediators implicated in periodontal disease. Additionally, chamomile's bisabolol and apigenin provide anti-inflammatory relief for conditions like gingivitis. These herbs, among others, not only prevent the growth of bacteria responsible for dental caries but also mitigate biofilm formation, a primary contributor to plaque development. Clove oil, with its eugenol content, disrupts biofilm and reduces the prevalence of oral pathogens like Streptococcus mutans, which is associated with dental decay. Neem and licorice root similarly demonstrate efficacy in reducing microbial colonies, inhibiting plaque buildup, and modulating inflammatory responses. However, the use of herbal supplements is not without risks. Adverse effects, including mucosal irritation and potential systemic reactions, can arise from certain compounds if used in excessive concentrations or without proper standardization. For instance, cinnamaldehyde in cinnamon and glycyrrhizin in licorice can lead to adverse reactions, particularly in sensitive individuals or those with pre-existing health conditions. Variability in the concentration of active ingredients due to inconsistent extraction processes further emphasizes the importance of quality control. Balancing the therapeutic benefits of herbal interventions with potential side effects is crucial for their safe integration into oral care. While the efficacy of herbal supplements offers a valuable supplement to conventional dental practices, further research is essential to establish standardized formulations and safe dosage guidelines to maximize their clinical applicability in preventive and therapeutic oral health.

Keywords: *herbal supplements, oral health, dental caries prevention, periodontal disease, anti-inflammatory properties*

Introduction

In recent decades, there has been a growing interest in using herbal medications and dietary supplements as alternative or complementary approaches to conventional dental treatments. Herbal medicine, derived from plant sources, is considered a natural and often less invasive option for promoting oral health, alleviating pain, and managing inflammation (1). This shift towards herbal solutions can be attributed to the widespread preference for minimally processed therapies with fewer side effects, coupled with an increased awareness of the adverse effects of synthetic drugs commonly used in dental care (2). Many plants contain bioactive compounds, such as flavonoids, polyphenols, and essential oils, which exhibit antioxidant, anti-inflammatory, and antimicrobial properties. These compounds have shown promise in inhibiting the growth of oral pathogens responsible for dental caries, periodontal disease, and oral candidiasis, thereby reinforcing the potential therapeutic impact of herbal products (3).

Herbal remedies such as green tea, aloe vera, and turmeric have been widely investigated for their effectiveness in maintaining oral hygiene and preventing common dental issues (4). Green tea, rich in catechins, has demonstrated antibacterial properties against Streptococcus mutans, a primary bacterium implicated in dental caries formation, while aloe vera has shown anti-inflammatory benefits for gum health (5). Similarly, turmeric, which contains the active ingredient curcumin, has demonstrated efficacy in reducing oral inflammation and controlling plaque formation. These studies suggest that specific herbal remedies could serve as effective adjuncts to traditional dental products like toothpaste and mouthwash, enhancing oral care regimens naturally and affordably (1, 2, 4, 5).

However, while herbal medications offer potential benefits, there is a lack of standardized dosages and formulations, leading to inconsistencies in clinical outcomes. Moreover, the risk of potential interactions between herbal supplements and prescribed medications warrants caution, especially among individuals with pre-existing health conditions (2). Given these factors, further research is essential to elucidate the efficacy, safety, and optimal use of herbal products in dental care. This review paper examines the impact of herbal medications and supplements on oral health, discussing their antimicrobial, anti-inflammatory, and preventive roles while considering potential adverse effects.

Review

Herbal medications and supplements have shown varied efficacy in promoting oral health, largely due to their diverse bioactive components. These natural compounds, including flavonoids, terpenoids, and polyphenols, exhibit antimicrobial properties effective against oral pathogens, such as Streptococcus mutans, which are responsible for dental caries (5). Studies suggest that compounds like catechins in green tea or eugenol in clove oil can inhibit bacterial growth and biofilm formation, thereby reducing the risk of dental plaque accumulation and subsequent gum disease (4-6). Additionally, some herbal supplements, such as turmeric with its active ingredient curcumin, have demonstrated anti-inflammatory effects that may alleviate gingivitis and periodontal disease symptoms, potentially serving as adjunct therapies to conventional treatments.

Despite these promising benefits, challenges remain in integrating herbal medications into standard dental care. One concern is the inconsistency in dosage and formulation, which can result in variable therapeutic outcomes. Furthermore, there is a risk of interactions with prescribed medications, especially in patients with systemic health conditions, which necessitates careful consideration and consultation with healthcare providers (5, 6). Therefore, while herbal medications offer valuable properties that can enhance oral health, further studies are needed to ensure their safety and efficacy in clinical practice.

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Antimicrobial Properties of Herbal Medications in Oral Health

The antimicrobial effects of herbal medications on oral pathogens have attracted considerable attention, especially as resistance to synthetic antibiotics become increasingly prevalent. Various herbs and plants contain compounds that effectively target and inhibit the growth of bacteria, fungi, and viruses in the oral cavity. Research on essential oils derived from plants such as tea tree, clove, and thyme demonstrate their potency against harmful oral pathogens, reducing bacterial colonies that contribute to diseases like dental caries and periodontitis (5). Specifically, tea tree oil has shown remarkable antibacterial properties due to its high terpinen-4-ol content, a compound that disrupts bacterial cell walls, leading to cell lysis. This action is particularly effective against Porphyromonas gingivalis, a pathogen implicated in periodontal disease (6).

Another herb known for its antimicrobial benefits in oral health is neem (Azadirachta indica), often used in traditional Indian medicine for treating oral infections. Studies have indicated that neem extracts inhibit Streptococcus mutans and Lactobacillus acidophilus, both of which play a crucial role in dental plaque formation and enamel demineralization (7). By reducing these bacteria's presence in the oral cavity, neem may help prevent the onset of caries and support overall dental health. Its efficacy in controlling these bacteria is attributed to bioactive components like nimbin and nimbidin, which interfere with bacterial adhesion to tooth surfaces, reducing biofilm development.

Beyond bacteria, certain herbs exhibit antifungal effects that are particularly valuable in managing oral candidiasis, a common infection in immunocompromised individuals. Oregano oil, rich in phenolic compounds like carvacrol and thymol, is noted for its antifungal activity against Candida albicans, a fungus frequently associated with oral thrush (8, 9). Carvacrol's mechanism appears to involve disruption of fungal cell membranes, making it an effective agent against resistant strains. In vitro, studies reveal that oregano oil not only halts fungal growth but also hinders fungal adhesion, which is vital for reducing infection recurrence. This antifungal capacity offers an additional tool for clinicians, particularly for patients who may be prone to recurrent infections due to compromised immune systems.

Herbs like licorice (Glycyrrhiza glabra) have been shown to provide broad-spectrum antimicrobial activity, targeting both Gram-positive and Gram-negative bacteria. The active compound glycyrrhizin found in licorice root exhibits a synergistic effect with other antibacterial agents, enhancing their efficacy. Research suggests that when used in mouthwashes or toothpaste, licorice root extracts can reduce oral bacteria associated with plaque formation and gingivitis without the harsh side effects linked to traditional chemical agents (10). This positions licorice as a valuable addition to preventive dental products, especially for individuals seeking gentler alternatives to alcohol-based mouthwashes.

The incorporation of such herbal agents into oral care formulations represents a promising strategy in preventive dentistry. However, while laboratory studies have shown substantial antimicrobial effects, translating these results into effective clinical outcomes is challenging. Variability in herbal composition due to factors such as plant growth conditions, extraction methods, and storage can impact potency, underscoring the need for standardized formulations. Despite these challenges, herbal medications remain a compelling area of research, with the potential to supplement or even replace synthetic antimicrobials in oral health applications.

Role of Herbal Supplements in Managing Oral Inflammation

Herbal supplements are increasingly recognized for their effectiveness in controlling oral inflammation due to their bioactive compounds that modulate inflammatory pathways. One prominent example is turmeric, which contains curcumin, a compound known for its ability to interfere with the inflammatory process at multiple levels. Curcumin specifically acts by inhibiting the nuclear factor kappa B (NF-κB) signaling pathway, which is

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central to the body's inflammatory response. This interference reduces the release of cytokines like tumor necrosis factor-alpha (TNF-α) and interleukin-6 (IL-6), both of which contribute significantly to the inflammation observed in periodontal disease (11). Clinical studies demonstrate that curcumin-based mouth rinses and gels help alleviate gingivitis symptoms, reduce plaque buildup, and improve general periodontal health by targeting the molecular pathways of inflammation.

In addition to turmeric, green tea offers significant anti-inflammatory benefits for oral health. The key compound, epigallocatechin gallate (EGCG), is a polyphenol with notable antioxidant and anti-inflammatory properties. EGCG targets inflammatory mediators such as cyclooxygenase-2 (COX-2) and prostaglandin E2 (PGE2), which are often upregulated in periodontal disease (12). Furthermore, EGCG's antioxidant effects help neutralize reactive oxygen species (ROS) that aggravate inflammation and tissue destruction in the gums. Studies reveal that regular consumption of green tea or its use in oral care products can reduce bleeding, gingival inflammation, and even the rate of periodontal attachment loss. In this way, green tea's active compounds serve both a preventive and therapeutic function, curbing inflammation and protecting gum health.

Chamomile is another herbal supplement with a long history of use in managing inflammation, including in oral health applications. This herb contains bisabolol and apigenin, two compounds that exhibit strong anti-inflammatory effects by modulating pathways associated with cyclooxygenase and lipoxygenase enzymes. These pathways are critical in the production of inflammatory mediators such as leukotrienes and prostaglandins, which are abundant in periodontal disease (13). Chamomile extracts, often used in mouthwash formulations, have been shown to effectively decrease gum swelling and pain, providing relief from the discomfort associated with gingivitis. Additionally, chamomile's soothing properties and mild taste make it suitable for people who prefer natural alternatives to chemical-based mouthwashes, particularly those with chronic inflammatory oral conditions. Although the efficacy of these supplements is supported by research, there are challenges to achieving standardized results due to variations in preparation, concentration, and bioavailability of the active ingredients. Different extraction and processing methods can significantly affect the potency and therapeutic impact of these herbal supplements, emphasizing the importance of standardized formulations for clinical use.

Herbal Interventions for Dental Caries and Periodontal Disease Prevention

Herbal remedies have shown promise as preventive strategies against dental caries and periodontal disease, two of the most prevalent oral health issues globally. These conditions are heavily influenced by microbial colonization, biofilm formation, and inflammatory responses in the oral cavity. Various herbs, such as clove, neem, and licorice, contain bioactive compounds that inhibit the growth of pathogenic bacteria involved in caries and periodontal disease, disrupt biofilm development, and modulate inflammation. Clove, rich in the active compound eugenol, has been traditionally used for its analgesic and antimicrobial properties, particularly in oral health applications. Eugenol acts as an effective inhibitor of oral pathogens like Streptococcus mutans and Lactobacillus acidophilus, both of which play critical roles in the development of dental caries (14). Additionally, eugenol has been observed to disrupt biofilm formation, which is essential in caries prevention, as biofilms facilitate the adherence of bacteria to tooth surfaces, leading to plaque buildup and eventual tooth decay. Due to its anesthetic properties, clove oil is also frequently used in dental practices to alleviate tooth pain, providing both symptom relief and antimicrobial benefits in one application.

Neem (Azadirachta indica), a staple in Ayurvedic medicine, is another herb widely studied for its role in preventing dental caries and periodontal disease. Neem contains several bioactive compounds, including nimbin and nimbidin, which exhibit antibacterial effects against oral pathogens like Porphyromonas gingivalis, a primary agent in periodontal disease (15). Neem extracts have been

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shown to inhibit bacterial adhesion to tooth surfaces and reduce plaque accumulation. Some studies have indicated that neem-based mouthwashes can significantly decrease plaque and gingival indices, positioning neem as a natural alternative or complement to conventional mouthwashes. Its antibacterial properties not only support caries prevention but also reduce inflammation associated with gum diseases.

Licorice (Glycyrrhiza glabra) also plays a significant role in oral health, particularly in controlling dental caries. The active compounds in licorice, such as glycyrrhizin, possess potent antimicrobial properties that specifically target caries-causing bacteria, including Streptococcus mutans and Actinomyces viscosus (16, 17). Glycyrrhizin's mechanism appears to involve the disruption of bacterial cell walls, inhibiting the growth and spread of these pathogens. In recent years, licorice root extracts have been incorporated into toothpastes and chewing gums as preventive agents for dental caries, providing an easy-to-use and accessible method for promoting oral health. Unlike some chemical agents, licorice is gentle on the oral tissues, making it suitable for prolonged use, particularly in children and individuals with sensitive gums. Although these herbal interventions demonstrate significant preventive benefits for dental caries and periodontal disease, factors such as standardization, concentration, and extraction methods are crucial in optimizing their efficacy. In clinical applications, consistent formulation is essential to harness the full potential of these herbs, providing a natural, effective alternative to traditional preventive measures in oral health.

Potential Adverse Effects of Herbal Supplements on Oral Tissues

While herbal supplements offer numerous benefits in oral health, they are not without potential risks, particularly when used in high concentrations or over extended periods. Some of the adverse effects of herbal supplements may arise from allergic reactions, cytotoxicity, and interactions with other medications. Cinnamon, for example, is commonly used in oral health products for its antimicrobial properties, yet high doses of cinnamaldehyde, its active compound, can lead to oral mucosal irritation and contact stomatitis in susceptible individuals (18). The severity of these reactions can vary depending on individual sensitivity and the concentration of cinnamaldehyde in products like mouthwashes and toothpaste. Prolonged exposure has also been associated with desquamation of the oral mucosa, a condition in which the upper layers of mucosal cells peel away, leading to discomfort and increased susceptibility to infections.

Aloe vera, popular for its anti-inflammatory and soothing effects, is another herb widely used in oral care. However, while aloe vera gels and mouthwashes are generally safe, certain compounds, such as anthraquinones, present in unpurified aloe extracts, may have laxative effects and, in rare cases, cytotoxic effects on oral tissues when applied in high concentrations (19). These effects, though rare, are a concern for patients with compromised oral mucosa or pre-existing inflammatory conditions. For patients with sensitive oral tissues, overuse of aloe-based products can result in burning sensations, redness, and even ulcerations, especially if the product lacks proper formulation controls to remove anthraquinones.

Licorice root, another popular herbal supplement for its anti-inflammatory and antimicrobial properties, contains glycyrrhizin, which may lead to pseudoaldosteronism—a condition characterized by symptoms such as high blood pressure, hypokalemia, and muscle weakness—when consumed in excess (20). In oral applications, licorice-based products are often considered safe due to low glycyrrhizin levels, but excessive use or ingestion of concentrated forms can lead to systemic effects. These adverse effects are particularly relevant for individuals with hypertension or cardiovascular issues, as glycyrrhizin may exacerbate these conditions. Additionally, while topical licorice applications in the oral cavity rarely cause adverse reactions, some individuals may experience mild irritation or an allergic response.

The variability in herbal supplement formulations presents another risk factor, as inconsistencies in concentration and extraction methods can impact

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safety and effectiveness. For instance, herbal products that are not standardized may contain varying levels of active compounds, leading to unpredictable outcomes. Moreover, impurities or contaminants in poorly regulated herbal products can introduce additional risks, including infections or toxic reactions in the oral tissues. Such concerns highlight the importance of quality control in herbal formulations intended for oral use, especially as their popularity in the field of dental care continues to rise.

Conclusion

Herbal supplements present valuable potential in enhancing oral health through antimicrobial and anti-inflammatory properties. However, their use requires caution due to possible adverse effects on oral tissues, especially in unstandardized formulations. The benefits of herbal interventions are significant, but further research is essential to establish safe dosage guidelines and ensure consistent quality. Integrating herbal products into oral care must balance efficacy with safety, promoting a holistic approach to dental health.

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Conflict of interest

There is no conflict of interest.

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Ethical Consideration

Not applicable.

Data availability

Data that support the findings of this study are embedded within the manuscript.

Author Contribution

The authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

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