

ASSESSING THE EFFECTIVENESS OF HERBAL AND NATURAL REMEDIES IN ORAL DISEASE PRESENTATION

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Abstract

The global impact of oral diseases such as dental caries, periodontal disease, and halitosis on billions of people continues to be a serious public health issue. Although traditional treatments like fluoride-based products and antimicrobial mouthwashes are commonly used, interest in alternative natural remedies has increased due to concerns about their long-term safety, rising antibiotic resistance, and high cost. The antibacterial, anti-inflammatory, and antioxidant qualities of herbal remedies such as neem, miswak, turmeric, clove, green tea, and aloe vera have been thoroughly studied in relation to supporting oral health. It has been shown that these treatments are effective in preventing oral pathogens, decreasing gingival inflammation, and managing plaque. They are not widely used in contemporary dentistry, though, due to issues like inconsistent clinical results, unstandardized dosages, and differences in plant composition. The scientific literature on herbal and natural remedies for the prevention of oral disease is critically examined in this review, which also discusses the treatments, mechanisms of action, clinical efficacy, and the need for more research to incorporate them into general dental care.

Keywords: Fluoride-based products, Traditional Treatment, Miswak, Mouthwash, Halitosis.

INTRODUCTION

While oral health is integral to overall health, oral disease continues to be an important public health problem everywhere across the globe. The most prevalent oral diseases are dental caries and periodontal disease, and they affect an estimated 3.5 billion people worldwide, according to the World Health Organization (WHO) (1). They lead to compromised quality of life, pain, discomfort, and loss of function. This increasing issue is primarily caused by poor oral hygiene, high sugar intake, microbial infection, and limited access to professional dental care. In low- and middle-income nations where healthcare resources are limited, poor oral hygiene practices and the absence of preventive care, the incidence of oral disease is incredibly high (2). Oral hygiene has previously relied on professional dental therapies, fluoride-based therapy, and synthetic antimicrobial compounds to stop and cure oral illnesses. However, long-term use of these chemical agents has a few disadvantages, such as possible toxicity, tooth discoloration, alteration of the oral microbiome, and development of antibiotic resistance. Apart from this taste, mucosal irritation and hypersensitivity reactions have all been attributed to some chemical mouthwashes. Therefore, scientists and physicians are considering herbal and natural options which may provide effective prevention of oral infection without unfavorable side effects.

Herbal formulations have been of significance in traditional systems of medicine such as Ayurveda, Traditional Chinese Medicine (TCM), and Unani medicine for centuries. Different plants can be used for prevention and control of oral infection because of their antimicrobial, anti-inflammatory, antioxidant, and healing properties. The pharmacological potential of most plant components employed in oral medicine has been taken into account in recent scientific studies (3). Of these, neem (*Azadirachta indica*), miswak (*Salvadora persica*), clove (*Syzygium aromaticum*), turmeric (*Curcuma longa*), green tea (*Camellia sinensis*) and aloe vera (*Aloe barbadensis*) actions on gum inflammation, plaque control and oral hygiene have been widely examined. Absence of standardization in the dosages used in quality control formulations of herbal products is one of the major issues. Most herbal medicines are not standardized which results in heterogeneity of safety and efficacy among preparations in comparison to medicines requiring strict regulatory review processes (4). Furthermore, variable results of clinical trials are a result of

heterogeneity in study designs, sample sizes, and outcomes, making it hard to establish unequivocal guidelines for their use in oral health. Another significant drawback is that dental and patient populations are skeptical about the efficacy and consistency of herbal agents as compared with traditional synthetic medicine (5). While small-scale clinical trials and in vitro studies have shown the efficacy of some herbal extracts, more evidence is needed in the form of longer-term randomized controlled trials (RCTs) to confirm their efficacy in the prevention and management of oral disease (6). Other impediments to the widespread use of herbal-based oral products are regulatory issues and a lack of worldwide quality control standards. Recent scientific evidence on the efficacy of herbal and natural treatments in the prevention and management of oral diseases is critically appraised herein. In addition to an examination of their possible usefulness as adjunctive therapy in contemporary oral treatment, it considers their mechanisms of action, therapeutic benefits, clinical application, and limitations. By taking into account the merits and shortcomings of previous studies this review tries to offer evidence-based perspectives regarding how herbal-containing oral products may be effectively combined with conventional therapies for improved oral health results.

METHODS

This literature search was carried out based on using PubMed, ProQuest and Google Scholar to find peer-reviewed research completed between 2015 and 2024. The following search terms were used: “natural remedies for oral health antimicrobial properties of medicinal plants,” “herbal medicine in dentistry,” and “plaque control with natural extracts and periodontal disease prevention using herbal treatments.” The included studies examined the efficacy of herbal remedies in treating gingival inflammation, lowering microbial growth, managing plaque, and accelerating the healing of oral wounds. Clinical trials, *in vivo* and *in vitro* investigations, and meta-analyses assessing the effects of herbal treatments on oral diseases were all included in the inclusion criteria. Only synthetic drug-focused studies, those lacking quantitative evaluations of herbal efficacy, and articles unrelated to the prevention of oral diseases were disqualified. Type of herbal remedy, mode of action, study design, efficacy in preventing oral disease, and any documented side effects were among the extracted data. To find recurring themes, advantages, restrictions, and research gaps, the chosen studies were subjected to a critical analysis.

DISCUSSION

Herbal Treatments for Plaque Reduction and Microbial Control

To prevent dental caries and periodontal disease, it is essential to regulate the growth of oral microbes and the formation of plaque. Though they are frequently used in dental care, conventional antimicrobial agents like fluoride, chlorhexidine, and triclosan have caused concerns due to their side effects, which include staining, taste disturbances, and antibiotic resistance (7). A safer biocompatible substitute with broad-spectrum antimicrobial action is offered by herbal-based solutions (8, 9). For oral microbial inhibition, Neem (*Azadirachta indica*) is one of the most researched herbal remedies (10). According to studies, mouthwashes containing neem are just as effective as those containing chlorhexidine at lowering the number of bacteria, gingival inflammation, and plaque (11, 12). The bioactive substances Nimbin and Azadirachtin have strong antibacterial properties against the two main bacteria that cause dental cavities, *Streptococcus mutans* and *Lactobacillus acidophilus* (13). Neem extracts also prevent microbial adhesion to enamel surfaces by inhibiting the formation of biofilms (14, 15).

The traditional oral hygiene tool Miswak (*Salvadora persica*) combines biochemical antimicrobial properties with mechanical plaque removal (16, 17). According to clinical research using miswak instead of traditional toothbrushes, results in noticeably lower plaque scores, a lower risk of caries, and better gum health (18). Without the use of artificial additives, miswak's natural tannins, alkaloids and silica improve oral hygiene by inhibiting bacteria and remineralizing enamel (19).

Epigallocatechin gallate (EGCG), a polyphenol-rich component of green tea (*Camellia sinensis*) is well known for its antibacterial and antioxidant qualities (20). Green tea catechins decrease oxidative stress in gingival tissues, prevent cariogenic bacteria from producing acid and prevent bacteria from adhering to tooth surfaces (21). Green tea mouthwashes, when used in conjunction with routine oral hygiene procedures, have been shown in clinical studies to significantly reduce halitosis, plaque formation, and bacterial load (22, 23).

Herbal treatments have targeted antimicrobial effects while maintaining healthy oral bacteria in contrast to chemical antimicrobials that may change the natural oral microbiome (3, 24). However, obtaining consistent antibacterial efficacy is hampered by variations in formulation methods and herbal extraction techniques (25).

Herbal remedies have anti-inflammatory and wound-healing properties

Chronic inflammation, gum recession, and tissue destruction are the main symptoms of gingivitis and periodontitis brought on by bacterial plaque buildup over time (26). Corticosteroids and nonsteroidal anti-inflammatory drugs (NSAIDs) are examples of conventional anti-inflammatory treatments. Although they are effective, they can have immunosuppressive and gastrointestinal side effects. Without these adverse side effects, herbal substitutes offer organic anti-inflammatory and wound-healing qualities. One bioactive substance found in turmeric (*Curcuma longa*),

a popular medicinal herb, is curcumin, which has strong anti-inflammatory, antibacterial, and antioxidant qualities (27). Two important modulators of inflammatory pathways, cyclooxygenase-2 (COX-2) and nuclear factor-kappa B (NF- κ B), are inhibited by curcumin (28). Clinical studies assessing mouthwashes and gels containing turmeric show notable decreases in inflammatory markers, plaque buildup, and gingival bleeding (29). Curcumin is a useful supplement to traditional periodontal therapy because it also shields periodontal tissues from oxidative stress and collagen deterioration (30).

Aloe vera, also known as *Aloe barbadensis*, is another herbal remedy that has been shown to have anti-inflammatory and restorative properties (31). One polysaccharide found in aloe vera gel, acemannan promotes collagen synthesis, fibroblast proliferation, and immune response modulation (32). Aloe vera mouthwashes have been shown in studies to dramatically lower gingival inflammation, hasten the healing process following surgery, and relieve pain in patients with gingivitis and oral ulcers (33, 34). Aloe vera's cooling and calming qualities have led to its popularity as an ingredient in herbal toothpaste gels and post-extraction remedies (35, 36).

Clove (*Syzygium aromaticum*) is most known for its analgesic, antibacterial, and anti-inflammatory properties (37). Because it inhibits prostaglandin synthesis and pain receptors, the active ingredient eugenol functions as a natural anesthetic and is therefore very effective in treating dry socket gum pain and toothaches (38, 39). Mouthwashes, gels, and oil-infused dental fillings are examples of clove-based formulations that have been demonstrated to lessen gum swelling, get rid of bacterial infections, and speed up the healing of oral wounds (40, 41). Standardizing formulations and guaranteeing consistency in active compound concentrations are still significant obstacles to incorporating herbal anti-inflammatory treatments into mainstream dental care even though they offer long-term benefits with fewer side effects.

Herbal remedies and traditional oral care methods can work in concert

Herbal remedies can be used in conjunction with contemporary oral care products to improve therapeutic and preventive results rather than taking the place of traditional dental treatments (42, 43). Fluoride toothpaste alone has not been as effective at controlling plaque as hybrid formulations that incorporate fluoride and herbal extracts (44, 45). According to clinical research, fluoride toothpaste containing neem and green tea considerably enhances enamel remineralization and bacterial inhibition (46). Likewise, root canal medications and dental fillings enhanced with clove oil offer organic antimicrobial defense, lowering the risk of secondary infections during restorative procedures (47, 48). The balance of the oral microbiome has also drawn attention to recent developments in herbal-probiotic therapy (49). Incorporating lactobacilli with herbal extracts like neem oil and green tea polyphenols has been shown to enhance microbial diversity, inhibit the growth of harmful bacteria, and lessen bad breath (50). More clinical research on hybrid treatments, ideal dosages and long-term effects is required to completely integrate herbal and conventional therapies.

Adjunctive Aids to Increase Herbal Remedies Oral Health Effectiveness

Herbal remedies have great potential, but there are still significant issues with their bioavailability, absorption, and retention period in the oral cavity. Enhancing the stability and prolonged release of active herbal compounds can improve their therapeutic effects through advancements in formulation and drug delivery technology. **Herbal Nanoparticles:** Deeper penetration into gum tissues is made possible by the enhanced antibacterial activity and controlled release of neem, turmeric, and green tea extracts nanoencapsulated in liposomes or polymeric nanoparticles (51). **Hydrogels Infused with Herbs:** Hydrogels based on aloe vera and curcumin have demonstrated potential for long-term anti-inflammatory effects by releasing drugs into periodontal pockets (52, 53). **Mucoadhesive Herbal Patches:** Clove oil or miswak extract oral patches deliver antimicrobial agents locally and maintain long-term contact with infected bone marrow (54, 55). Green tea and turmeric-based mouthwashes with biodegradable polymer coatings provide longer-lasting antibacterial properties by lengthening the time that herbs are retained in the mouth (56).

Obstacles and Prospects for Herbal Oral Healthcare

Herbal remedies have been shown to be effective in reducing inflammation, controlling microorganisms and healing wounds. However, several obstacles need to be overcome before these treatments can be completely incorporated into contemporary dentistry. The absence of uniformity in herbal formulations is a significant worry (57). Plant species cultivation conditions, extraction methods and preparation techniques all affect the concentrations of active ingredients in herbal products, which differ from pharmaceutical drugs (58). This variability makes it challenging to determine the best dosages and levels of efficacy and compromises therapeutic consistency. For example, although mouthwashes containing neem leaves have been found to be effective in controlling plaque, the antibacterial potency of these mouthwashes can vary depending on the extraction technique used. A significant obstacle is the requirement for extensive, meticulously planned clinical trials (59). It is challenging to make firm judgments regarding the long-term efficacy of herbal remedies because many studies relied on small sample sizes, brief trial durations, and non-standardized outcome measures. Validating herbal treatments requires thorough double-blind placebo-controlled trials to guarantee broader acceptance in mainstream dentistry. The commercialization of herbal-based oral care products is also significantly hampered by regulatory approval. Unlike pharmaceutical drugs, herbal remedies are subject to less stringent quality control measures in many countries because they are classified as supplements or alternative medicines (57). Poor-quality herbal products may enter the market as a result of the lack of standardized regulatory

frameworks, compromising their safety and credibility. To promote the safe and efficient use of herbal treatments in dentistry, it will be essential to strengthen laws governing herbal medicines, guarantee the consistency of active compounds, and carry out toxicological evaluations. Combination therapies that combine herbal and conventional treatments may also provide more benefits by combining their antimicrobial and anti-inflammatory properties (60). To improve patient outcomes, future studies should investigate herb extract-based Nano formulations, bioactive dental materials, and hybrid herbal-pharmaceutical oral care solutions.

CONCLUSION

With strong evidence for their antimicrobial, anti-inflammatory, and wound-healing qualities, herbal and natural remedies offer promising alternatives for the management and prevention of oral diseases. Although neem, miswak, turmeric, green tea, clove, and aloe vera show great promise for enhancing oral health, more study, standardized formulations, and regulatory approval are required to guarantee their broad use in professional dental care. In complementary oral healthcare approaches, herbal-based therapies may be crucial in improving long-term oral health outcomes and lowering reliance on artificial chemicals.

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