Phytotherapy for Periodontal Disease and Improved Oral Hygiene

Historical Context

There is a long and venerable history of the use of plants to improve dental health and promote oral hygiene. This was highlighted in an excellent, but now dated, review by Lewis and Elvin-Lewis, the former being a botanist and the latter a dentist. In their review they note a quotation attributed to the prophet Muhammed: “the Siwak (chewing stick) is an implement for the cleansing of teeth and a pleasure to God.”

They go on to write: “In vast parts of the world where toothbrushing is uncommon, the practice of tooth cleaning by chewing sticks has been known since antiquity. The precise method for use of these implements was recorded by the Babylonians in 5000 BC.... The use of chewing sticks persists today among many African and southern Asian communities as well as in isolated areas of tropical America and the southern United States.... Users who often prefer chewing sticks to modern toothbrushing techniques attribute their dental health to the traditional practice. It is noteworthy that caries rates are often very low among such users in spite of the high carbohydrate diets they normally consume.... The plants used are very carefully selected for such properties as foaminess, hardness, or bitterness, and certain species are more popular than others. A great number have related medicinal properties that may be antibacterial...etc.”

Popular plants which are fashioned into chewing sticks include Salvadora persica (arak) and neem. In fact Salvadora is so popular that the generic term miswak is often applied exclusively to this species by some writers.

Plants have also been incorporated into dentifrices and there are several modern examples of this practice. They were also used to provide natural chewing gums for oral hygiene, to treat toothache, gingivitis and periodontal disease.

Oral Infections and Systemic Diseases

Modern research is suggesting that systemic health may be more affected by oral hygiene than previously recognized. A recent review discussed possible etiological associations between periodontitis (the progressive destruction of the supporting structures of the teeth which is triggered by bacterial plaque) and cardiovascular disease in general, and in infective endocarditis specifically, as well as rheumatoid arthritis, pneumonia and preterm birth and low birth weight. For example, a number of epidemiological studies have associated periodontitis with cardiovascular disease. These include follow-up investigations, case-control studies and cross-sectional studies. Periodontal inflammation facilitates the entrance of bacteria into the bloodstream, especially after chewing food or cleaning teeth. Either direct effects from the bacteremia or secondary effects from the inflammation which their presence may trigger could lead to thrombus formation and/or the development of atherosclerotic lesions.

Be that as it may, the greatest loss of teeth in adults is caused by periodontal disease, which can be very difficult to treat. This suggests a potentially valuable role for phytotherapy in assisting with the management of this difficult and serious disease. The evidence and research which supports such a role for a few key plants (or plant products) is reviewed below.

Chewing Sticks or Miswak

The periodontal status of more than 200 adult Sudanese who habitually used either miswak or a toothbrush were compared. Although gingival bleeding and dental calculus were highly prevalent in the test population, miswak users had significantly (p < 0.05) lower dental calculus and signs of periodontal disease and a tendency to lower gingival bleeding (p = 0.09). A Saudi Arabian study compared the effect of miswak or toothbrushing on plaque removal and dental health using a single blind, randomized, crossover design. Compared to the use of a toothbrush, the miswak resulted in significant reductions in plaque (p < 0.001) and gingival (p < 0.01) indices. Furthermore, image analysis of the plaque distribution showed a significantly greater reduction in plaque for the miswak use. Another Sudanese study compared the levels of 25 oral bacteria in miswak and toothbrush users. Certain bacteria, particularly several oral streptococci species, were lower in the miswak users. However, miswak use was associated with greater gum recession in one study, which was attributed to their abrasive properties.

The antimicrobial effects of neem (Azadirachta indica) and arak (Salvadora persica) were compared in vitro against plaque-forming bacteria. The extract of arak was slightly superior to neem at inhibiting their growth. A mouthwash made from arak was found to significantly reduce gingival bleeding (p < 0.01) in an open clinical study. Although plaque scores were not significantly reduced in the three-week study, the use of arak resulted in lower rates of Streptococcus mutans, a bacterium associated with dental plaque. A six-week clinical trial found that a neem leaf gel significantly (p < 0.05) reduced the plaque index and oral bacterial count when compared with a conventional antibacterial mouthrinse.

Propolis

Propolis is a resin rich in flavonoids which is manufactured by bees from plants. The in vitro antimicrobial activity of flavonoids and propolis is well documented. In the context of cariogenic bacteria, flavonoids have been shown to be active and especially the well known antimicrobial and flavonoid-rich herb Scutellaria baicalensis (Baical skullcap). The effect of irrigation with propolis extract as an adjuvant treatment after scaling and root planing for chronic periodontitis was evaluated in a placebo-controlled clinical trial. It was
Porphyromonas gingivalis. All the essential oils tested inhibited healthy volunteers. During each 3-day study period the conjunction with conventional treatment was more effective than observed that subgingival irrigation with propolis extract in conjunction with conventional treatment was more effective than conventional treatment alone in terms of both clinical and microbiological assessments. A Russian study found that a 4% alcoholic solution of propolis added to root canal filling demonstrated good efficacy in periodontitis. A silicate toothpaste containing propolis demonstrated good plaque-cleaning, plaque-inhibiting and anti-inflammatory activities in an open clinical study over 4 weeks. The effect of a propolis mouthrinse on 3-day dental plaque accumulation was assessed in a double-blind, crossover study which enrolled six healthy volunteers. During each 3-day study period the volunteers refrained from all oral hygiene and rinsed with a 20% sucrose solution five times a day to enhance plaque formation. The mouthrinse was used twice a day. The plaque index for the propolis treatment was significantly lower than placebo (0.78±0.17 vs. 1.41±0.14). The insoluble polysaccharide content of plaque was also reduced by 61.7% compared to placebo (p < 0.05). However, another study found only a marginally positive effect on dental plaque formation, which could reflect on the wide variation in the chemical composition of propolis. The antibacterial action of propolis against oral bacteria has been demonstrated both in vitro and in vivo. Tea Tree Oil

The in vitro antibacterial effects of several essential oils were tested on oral bacteria. Periodontopathic bacterial strains were killed completely by exposure for 30 seconds to 0.2% Manuka oil, tea tree oil or eucalyptus oil. Tea tree oil and Manuka oils also showed significant adhesion-inhibiting activity against Porphyromonas gingivalis. All the essential oils tested inhibited the adhesion of S. mutans. Another in vitro study confirmed that P. gingivalis was highly susceptible to tea tree oil.

The effects of a topically applied tea tree oil gel on dental plaque and chronic gingivitis were assessed in a double-blind study. Volunteers (n=49) received treatment with either the tea tree oil gel, a chlorhexidine gel or a placebo gel. The group receiving tea tree oil gel experienced a significant reduction in papillary bleeding and gingivitis, but the plaque score was not reduced. Similarly a pilot clinical study found that tea tree oil mouthrinse did not favorably affect supragingival plaque.

Tea (especially Green Tea)

Tannins are defined as vegetable substances capable of tannining animal hides to produce leather. This is used as a method to preserve the hide and at a molecular level is effected via the crosslinking by the tannins of hide proteins. This definition is prescriptive and powdered hide is still used as a chemical test for tannins. Like flavonoids, tannins are polyphenolic compounds which have an affinity for proteins. However, the higher number of phenolic groups and the larger molecular size of tannins mean that they are capable of binding strongly to proteins at several sites and can precipitate them from solution.

One of the most notable effects of tannins in the gut is their dramatic effect on diarrhea. It can be proposed that the effect of tannins is to produce a protective (if temporary) layer of coagulated protein on the mucosa along the upper levels of the gut wall, so numbing the sensory nerve endings and reducing provocative stimuli to additional peristaltic activity. Supporting this central astringent activity, tannins will also inhibit the viability of infecting micro-organisms, check fluid hypersecretion and neutralize inflammatory proteins. Because of their affinity for free protein, they will concentrate in damaged areas. Condensed tannins were able to bind to and inactivate the hypersecretory activity of cholera toxin.

Green tea (Camellia sinensis, a rich source of tannins) appears to be much more potent as an antimicrobial agent than black tea. Bacillus subtilis, Escherichia coli, Proteus vulgaris, Pseudomonas fluorescens, Salmonella sp. and Staphylococcus aureus were used to test the antimicrobial activity of extracts of various tea products. Among the six test organisms, P. fluorescens was the most sensitive to the extracts, while B. subtilis was the least sensitive. In general, antimicrobial activity decreased when the extent of tea fermentation increased. The antimicrobial activities of extracts of tea products with different extents of fermentation also varied with test organisms. Green tea, the unfermented tea, exerted the strongest antimicrobial activity followed by the partially fermented tea products such as Longjing, Tieh-Kuan-Ying, Paochung, and Oolong teas. On the other hand, black tea, the completely fermented tea, showed the least antimicrobial activity. It was also noted that extracts of Oolong tea prepared in summer exhibited the strongest antimicrobial activity, followed by those prepared in spring, winter and fall.

Not surprisingly, the antimicrobial activity of tea has been attributed to its tannin (polyphenolic) phytochemicals. Aqueous extracts of teas of different types and from various sources were found to inhibit a wide range of pathogenic bacteria, including methicillin-resistant Staphylococcus aureus. Tea extracts were bactericidal to staphylococci and Yersinia enterocolitica at well below 'cup of tea' concentrations. Activity was confined to one of four fractions obtained from a green tea extract by partition chromatography. Testing of pure tea compounds and closely related chemicals suggested that the antibacterial activity of extracts of green tea can be explained by its content of epigallocatechin, epigallocatechin gallate and epicatechin gallate (tannin-like molecules). In black tea extracts, theaflavin and its gallates are additional antibacterially active components.

A recent review proposed that various components in green and black tea have properties in vitro that suggest an anticariogenic activity. These include a direct bactericidal effect against S. mutans and S. sobrinus, prevention of bacterial adherence to teeth, inhibition of the enzyme glucosyltransferase, thereby limiting the biosynthesis of an adherence factor, and inhibition of human and bacterial amylases. Studies in animal models have confirmed that these in vitro effects can translate into caries prevention. The review also noted that a limited number of clinical trials suggest that regular tea drinking may reduce the incidence and severity of caries.

The usefulness of application of green tea catechins (tannins) for periodontal disease was investigated in a placebo-controlled trial. Strips containing the catechins as a slow release local delivery system were applied to gum pockets in patients once a week for 8 weeks. The pocket depth and amount of bacteria were markedly decreased in the catechin group, whereas there was no change for the placebo group.

A double-blind study investigated the effect of chewing green tea candy on gingival inflammation. A total of 47 volunteers (23 male, 24 female) were randomly assigned to chew either eight green tea or placebo candies per day for 21 days. While there was an improvement in the green tea group, the placebo group deteriorated slightly. Oolong tea extract was found to significantly inhibit plaque formation in a controlled clinical trial.

A study was undertaken to determine the usefulness of green or black tea for delivering polyphenols into the oral cavity. Volunteers were instructed to hold either green tea leaves or brewed black tea in the mouth for 2 to 5 minutes and then rinse thoroughly. High concentrations of tea polyphenols were observed in saliva in the first hour thereafter.
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Sanguinarian and Blood Root
Blood root (Sanguinaria canadensis) contains a mixture of benzophenanthridine alkaloids, mainly sanguinarine. The value of blood root, and particularly sanguinarine, in dentifrices and mouthrinses has been extensively explored. A conservative review published in 1995 conceded that sanguinarine has some value in curbing supragingival plaque and is more effective as a mouthrinse than in a toothpaste. However, like other mouthrinses it does not affect subgingival plaque.

Clinical trials subsequent to this review have yielded conflicting results. Results from one trial supported the combined use of a chlorhexidine mouthrinse for a short term (2 weeks), followed by Sanguinaria mouthrinse and toothpaste up to 3 months, to optimize the effectiveness of the chlorhexidine following scaling and root planing treatment for periodontitis.

However, another trial found no significant advantage from using Sanguinaria treatment following such procedures.

Miscellaneous Herbs
Other herbs which have shown antibacterial activity against oral bacteria, or more specifically cariogenic bacteria, include Coptis chinensis and its component berberine, cocoa and onions. Dental plaque depends in part on interspecies bacterial adhesion (or coaggregation). A cranberry constituent reversed the coaggregation of 58% of oral bacterial strains tested.

Echinacea has been used in the topical treatment of gingivitis and periodontitis suggests it can offer substantial clinical benefit. In particular, the use of a mouthrinse containing an Echinacea extract rich in alkylamides would be preferred, since the alkylamides promote saliva flow, which is a natural defense against plaque-forming bacteria.

Conclusions
Plants contain phytochemicals such as alkaloids, tannins, essential oils and flavonoids which have pronounced antimicrobial activity. This underlies the use since antiquity of herbs to improve oral hygiene and prevent tooth decay, gum disease and periodontitis. The miswak or chewing stick is an underestimated tool for dental hygiene which is only beginning to be explored in controlled clinical studies. Herbs or herbal products which should play a key role in the future of dental hygiene include propolis, tea tree oil, green tea and Echinacea.

There is now a question mark over the role of blood root, although oral preparations containing this herb still enjoy relatively widespread use.

References