

Plant Extracts with Activity against Oral Bacteria

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ABSTRACT

The association between oral diseases and oral microbiota is well established. The development of dental caries involves Gram-positive bacteria (mutans streptococci, lactobacilli, and actinomycetes). Periodontal diseases have been linked to anaerobic Gram-negative bacteria (*Porphyromonas gingivalis*, *Actinobacillus*, *Prevotella*, and *Fusobacterium*). Given the incidence of oral disease, increased resistance by bacteria to antibiotics, adverse affects of some antibacterial agents currently used in dentistry there is a need for alternative prevention and treatment options that are safe, effective, and economical. While several agents are commercially available, these chemicals can alter oral microbiota and have undesirable side-effects. In this review, plant extracts or phytochemicals that inhibit the growth of oral pathogens, reduce the development of biofilms and dental plaque, influence the adhesion of bacteria to surfaces, and reduce the symptoms of oral diseases will be discussed.

KEY WORDS: Antibacterial, Oral bacteria, Oral disease, Plant extracts

INTRODUCTION

There have been numerous reports of the use of traditional plants and natural products for the treatment of oral diseases. Many plant-derived medicines used in traditional medicinal systems have been recorded in pharmacopeias as agents used to treat infections and a number of these have been recently investigated for their effect against oral microbial pathogens. The antimicrobial properties of medicinal plants and plant products are reviewed here. Traditional medicinal plant extracts that have been shown to inhibit the growth of oral pathogens, reduce the development of dental plaque, influence the adhesion of bacteria to surfaces, and reduce the symptoms of oral diseases will be discussed.

PLANT EXTRACTS WITH ACTIVITY AGAINST ORAL BACTERIA

There have been numerous studies that have investigated the activity of plant substances against

oral bacteria. These studies have focused on bacteria known to be involved in the etiology of orodental diseases. Many studies have clearly established that a number of substances had potential to be utilized in the dental industry, given their activity against cariogenic bacteria, and those bacteria associated with periodontal diseases. Substances that exhibited activity included extracts such as cinnamon bark oil, papuamace extracts, and clove bud oil and constituents of these extracts.^[1]

Many studies investigating the activity of traditional medicinal plants against oral pathogens have been done for examination of crude aqueous or organic solvent extracts. In most cases, the investigators have sought to validate the traditional medicinal use of the plant. For example, the use of *Drosera peltata* (Droseraceae) leaves as a traditional treatment for dental caries was validated by a study which showed that chloroform extracts of the aerial plant parts showed broad-spectrum activity against numerous bacteria of the oral cavity, with greatest activity against *Streptococcus mutans* and *Streptococcus sobrinus*.^[2] Plumbagin was identified as the active component of this extract.

Tichy and Novak^[3] investigated a collection of 27 medicinal and random plants extracts and identified

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a number that inhibited the growth of oral streptococci. The most active extracts included those from *Abies Canadensis* (Pinaceae), *Albizia julibrissin* (Fabaceae), *Chelidonium majus* (Papaveraceae), *Ginkgo biloba* (Ginkgoaceae), *Juniperus virginiana* (Cupressaceae), *Pinus virginiana* (Pinaceae), *Rosmarinus officinalis* (Lamiaceae), *Sassafras albidum* (Lauraceae), *Tanacetum vulgare* (Asteraceae), and *Thuja plicata* (Cupressaceae). Bioautography indicated that a number of extracts contained common antimicrobial components, while other extracts possessed chemically different constituents.

Garlic, *Allium sativum* (Liliaceae), has been used as a medicine since ancient times because of its antimicrobial properties. While garlic has been shown to have activity against a wide range of bacteria, the specific activity against the Gram-negative oral pathogens including *P. gingivalis* has only recently been demonstrated.^[4] A garlic extract containing the major antimicrobial component, allicin, was active toward Gram-negative pathogens less active against Gram-positive bacteria. The extract almost completely inhibited trypsin-like protease activity (implicated in the pathogenesis of periodontitis) of *P. gingivalis*. Taken together, these observations suggest that garlic extract or allicin may be of therapeutic use against periodontal diseases or other oral diseases.

A boiling water extract of *Coptidis rhizoma* (Ranunculaceae), a traditional Chinese medicinal plant, showed bactericidal activity against oral bacteria with particularly good activity against periodontopathogenic bacteria.^[5] Iauk *et al.*^[6] assessed the ability of 10% decoctions and methanol extracts of a number of medicinal plants to inhibit bacterial isolates obtained from crevicular fluid of the periodontal pockets of periodontic patients. In general, the methanol extracts showed greater activity than the decoctions. The extract from the leaves of *Hamamelis virginiana* (Hamamelidaceae) had the greatest overall activity against all bacteria tested, particularly against *Porphyromonas* spp., *Prevotella* spp., and *Actinomyces Odontolyticus*.

The resin exuded by the *Pistacia lentiscus* (Anacardiaceae) tree, known as mastic gum, is used in the preparation of foods and as a remedy for oral malodor and has been shown to have antimicrobial activity. The activity of a mastic gum extract against *P. gingivalis* was demonstrated using disc diffusion assays, but its low solubility suggested that it may be useful for local application rather than as a mouthrinse.^[7] The antibacterial activity of *Pistacia vera* extracts against oral streptococci has also been demonstrated, including the inhibition of adherence and glycolysis.^[8]

Harungana madagascariensis (Hypericaceae) is a native African plant with antimicrobial properties that contains numerous antimicrobial components. Using successive Soxhlet solvent extractions, an ethyl acetate extract of leaves was prepared and tested against numerous oral pathogens. While the extract was able to kill all oral bacteria tested (including *Actinomyces*, *Fusobacterium*, *Lactobacillus*, *Prevotella*, *Propionibacterium*, and *Streptococcus* species), poly (d,l-lactide-co-glycolide) nanoparticles containing extract showed enhanced activity. The authors suggested that this may have been due to the bioadhesive properties of the polymer resulting in the extract being in contact with the bacteria for prolonged periods.^[9]

Smullen *et al.*^[10] determined the ability of commercially available extracts or fresh aqueous propanone extracts (PE) of foods with high polyphenol content to inhibit the growth of *S. mutans* and other oral pathogens. All the extracts showed activity, with the PE of red grape seeds exhibiting the greatest activity against *S. mutans*. The green tea and unfermented cocoa PE were most active against other oral pathogens. Overall, the commercial extracts were not as active as the PE. Various PEs were also able to prevent adhesion of *S. mutans* to glass. These data suggest that extracts of polyphenol-containing foods may have a preventative role against dental caries.

Helichrysum italicum (Compositae) is widely found in the Mediterranean region and has been shown to have a variety of biological properties. An ethanol extract of powdered flowering tops was found to exert antimicrobial activity against *S. mutans*, *Streptococcus Sanguis*, and *S. sobrinus*.^[11]

Two recent studies have examined a number of plants traditionally used in Brazil^[12] and South Africa,^[13] respectively, for activity against oral pathogens. Plant extracts of *Cocos nucifera* (Palmae), *Ziziphus joazeiro* (Rhamnaceae), *Caesalpinia pyramidalis* (Fabaceae), and *Aristolochia cymbifera* (Aristolochiaceae) were active against the test bacteria, with the ethanol extract of *A. cymbifera* being the most effective.

Crude ethanol extracts of *Piper cubeba* (Piperaceae) exhibited good antimicrobial properties against a range of cariogenic pathogens, although no information about the activity against periodontal pathogens was provided.^[14]

Cold and hot water and ethanolic extracts of *Breynia nivosa* (Euphorbiaceae) and *Ageratum conyzoides* (Asteraceae) were tested for activity against *S. mutans*.^[15] While the hot water and ethanol extracts of *B. nivosa* showed activity, none of the *A. conyzoides* extracts were active.

CONCLUSION

There is a lot of evidence that plant extracts have the potential to be developed into agents that can be used as preventative or treatment therapies for oral diseases. Further studies of the safety and efficacy of these agents will be important to establish whether they offer therapeutic benefits, either alone or in combination with other therapies, that can help to reduce the overall burden of oral diseases.

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