

Herbal Extracts in Dentistry - A Review of the Current Scenario and its Future Implications

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Abstract

There have been several *in vitro* studies that have investigated the activity of natural plant extracts against oral pathogens. These studies have focused on bacteria that are involved in the etiology of oral and dental diseases. Early studies have clearly established that a number of substances had potential against cariogenic bacteria in dentistry. Dental health is an inevitable part of general health. Oral diseases are chronic diseases and contribute to the major public health problems. The use of natural products for the control of oral diseases is considered as an alternative to synthetic antimicrobials and is also of great help to overcome primary or secondary resistance to the drug. To review the current evidence on the antimicrobial efficacy of several plant extracts on dental caries and plaque microbiology. Over 750 species of bacteria inhabit the oral cavity (~50% of which are yet to be identified) and a number of these are implicated in oral diseases. The initiation of dental caries involves acidogenic and aciduric Gram-positive bacteria, primarily the mutans streptococci (*Streptococcus mutans* and *Streptococcus sobrinus*), lactobacilli and actinomycetes.

Keywords: Dental caries, herbal extracts, Lactobacillus acidophilus, Streptococcus mutans

INTRODUCTION

Oral health has a direct effect on general health as it causes considerable pain and suffering.^[1] It has a negative impact on a person's speech, quality of life, and well-being. Oral diseases have an adverse impact on individuals and society.^[2] and in view of the expense of their treatment, oral diseases are considered as a major public health problem. They are common chronic diseases that affect mankind.^[3]

Despite general advances in the overall health status of the people, the prevalence of dental caries in school-aged children is up to 90% and the majority of adults are also affected.^[4] Oral health plays an integral component to general well-being and is relatable to the quality of life.^[5] There is a strong evidence linking poor oral health to chronic conditions, for example, there is a considerable association between severe periodontal diseases and chronic systemic diseases like diabetes.^[6] There is also evidence linking while periodontal diseases to the risk of pregnancy complications, such as preterm low-birth weight.^[7]

According to the World Health Organization report, dental caries is an important public health concern in many

developing countries.^[8] The statistics suggest that dental caries affect 60%–90% of school-going children in developing countries. Severe tooth loss due to periodontal conditions often causes discomfort and compromises the esthetics and function. Moreover, recent literature suggests an association between chronic infections such as periodontitis and systemic health problems such as preterm low birth weight, cardiovascular diseases, diabetes mellitus, and chronic obstructive pulmonary disease.^[9] The expenses of dental diseases are very expensive and may not be affordable especially for the economically deprived sections of the society.^[10] Treating dental caries alone for children is more than the total health budget for children in many low-income countries. Hence, there is an immediate need for promoting preventive strategies. These strategies should be socially acceptable, easily accessible, and be cost-effective.

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The association between oral diseases and the activities of the microbiota of the oral cavity is well established. Over 750 species of bacteria inhabit the oral cavity (~50% of which are yet to be identified) and a number of these are implicated in oral diseases.

PLANT EXTRACTS AND PHYTOCHEMICALS ACTIVITY AGAINST ORAL BACTERIA

There have been several *in vitro* studies that have investigated the activity of natural plant extracts against oral pathogens. These studies have focused on bacteria that are involved in the etiology of oral and dental diseases. Early studies have clearly established that a number of substances had potential against cariogenic bacteria in the dentistry. Plants that exhibited activity included spice and herb extracts, such as cinnamon bark oil, papua-mace extracts and clove bud oil and constituents of these extracts, such as cinnamic aldehyde and eugenol. The initiation of dental caries involves acidogenic and aciduric Gram-positive bacteria, primarily the mutans streptococci (*Streptococcus mutans* and *Streptococcus sobrinus*), lactobacilli, and actinomycetes.^[11] These microbes metabolize sucrose to organic acids, mainly lactic acid, which dissolve the calcium phosphate in teeth.^[12] This leads to decalcification and eventual dental caries. Dental caries is thus a supragingival condition.^[13] In addition, periodontal diseases are subgingival conditions that have been linked to anaerobic Gram-negative bacteria such as *Porphyromonas gingivalis*, *Actinobacillus* sp., *Prevotella* sp., and *Fusobacterium* sp. In periodontal diseases, the areas at or below the gingival crevice become infected causing a cellular inflammatory response of the gingiva and surrounding connective tissue. These inflammatory responses can manifest as gingivitis or periodontitis which is the inflammatory response resulting in loss of collagen attachment of the tooth to the bone and in loss of bone.^[14]

IDENTIFYING AND EVALUATING MEDICINAL PLANT PRODUCTS USED TO TREAT OR PREVENT ORAL DISEASES

Of all oral diseases, the incidence of those that have a microbial etiology is greatest in all parts across the globe. Numerous traditional medicinal plants have been evaluated for their potential application in the prevention or treatment of oral diseases. A number of studies have investigated the activity of plant extracts and products against specific oral pathogens, while others have focused on the ability of the products to inhibit the formation of dental biofilms by reducing the adhesion of microbial pathogens to the tooth surface, which is a primary event in the formation of dental plaque and the progression to tooth decay and periodontal diseases.

PHYTOTHERAPY IN PEDIATRIC DENTISTRY

Since many people believe that medicinal plants are safer than invasive methods and chemical drugs and have fewer

side effects, the tendency to use medicinal plants for children has increased.^[15] Some of the properties of plants used for this purpose are reviewed.

ORAL MOUTH RINSE

Mouthwashes are efficient and convenient for use to improve oral hygiene. *Salvia officinalis*, *M. piperita*, menthol, *Matricaria chamomilla* (chamomile), *Commiphora myrrha* (myrrh), *Carum carvi* (caraway seed), *S. aromaticum*, and *Echinacea purpurea* (purple coneflowers).^[16,17] It should be noted that each of these oral rinses has therapeutic effects as well as side effects of its own: Aloe vera, *indica*, *C. longa*, *Echinacea*, *M. chamomilla*, *M. piperita*, *Pistacia atlantica*, propolis, *Sanguinaria canadensis*, *S. officinalis*, *Salvadora persica*, *C. carvi*, *C. myrrha*, *Stellaria media* (chickweed), *Sambucus* (elderberry), *Hydrastis Canadensis* (goldenseal), *Equisetum* (horsetail), *Calendula officinalis* (common marigold), violet, *Achillea millefolium* (yarrow).

ADVERSE EFFECTS

Side effects and toxicity of medicinal plants can be discussed in general, and specifically for each plant and depend on factors such as their chemical composition, contaminants, and adulterants.^[18] However, few plants have synergistic effects on one another. The lack of knowledge of plants named in different geographic areas. This led to the emergence of new problems.

The next most considerable thing is to access the concentration of active components in the plant, which varies based on the parts of plants used. Hence, it is of utmost importance to have an in depth knowledge on the harvesting time of the plant, soil, and weather conditions and also the dose of active components variable.

ESSENTIAL OILS WITH ACTIVITY AGAINST ORAL BACTERIA

The antibacterial properties of essential oils are well-known and activity against bacteria found in the oral cavity has been documented. Indeed, there is evidence that commercial mouthwashes containing essential oils are useful in the long-term control of plaque and gingivitis and are preferred to chlorhexidine for daily use.^[19] A number of recent studies add to the evidence that essential oils may be suitable additives for the maintenance of oral hygiene or prevention of dental disease.

The essential oil of *Melaleuca alternifolia* (Myrtaceae), known as tea tree oil (TTO), has been used medicinally for many years. TTO has antimicrobial properties and is used in the superficial treatment of skin infections.^[20] The activity of TTO against an extensive collection of oral bacterial isolates was investigated by Hammer *et al.* who determined MIC and MBC values in the range 0.003%–2.0% (v/v). Further, time-kill assays showed that exposure of *S. mutans* and *Lactobacillus rhamnosus* to 0.5% (v/v) TTO resulted in >3 log reduction of viable cells within 30 s. The activity of TTO against oral

pathogens was supported in a study involving this and other essential oils, including manuka oil, eucalyptus oil, lavandula oil, and rosmarinus oil. In addition to their inhibitory and bactericidal activities, most of the oils were able to inhibit the adhesion of *S. mutans* and *P. gingivalis*.^[21]

Essential oils are also capable of enhancing the activity of chlorhexidine. When used in combination, the essential oils of cinnamon and manuka were able to significantly reduce the amount of chlorhexidine required to inhibit the growth of oral pathogens.

While these *in vitro* results are very encouraging, the known toxicity of TTO when ingested suggests that further studies of the safety of essential oils for use in the oral cavity need to be addressed. In this context, Takarada *et al.* showed that the essential oils used in their study had little effect on human umbilical vein endothelial cells *in vitro* when tested at a concentration of 0.2% (v/v), well within the MIC and MBC values of several oils against some of the bacteria tested.

In Vivo Testing of Dental Products Containing Plant Derived Chemicals

Some of the studies described below have examined their *in vivo* efficacy in human clinical trials.

In a single-blind study, a mouthrinse containing an extract of the leaves of *Streblus asper* (*Moraceae*) tested in 30 volunteers resulted in a significant and selective reduction in salivary *S. mutans*.^[22] The study assessed the viable bacterial counts in saliva samples with no effect on total salivary bacteria. Similarly, a randomized placebo-controlled clinical study of a mucoadhesive dental gel containing an extract of *Azadirachta indica* (*Meliaceae*) involving 36 participants showed a significant reduction in salivary *S. mutans* and *Lactobacillus* sp. bacterial counts after 6 weeks (Test group) compared to the placebo group, which was greater than the reduction seen with a chlorhexidine mouthwash (positive control group).^[23] A randomized placebo-controlled study in which two commercial tea extracts were used as mouthrinses showed that each was able to significantly reduce the microbial load of the oral cavity. A significant reduction in the number of bacteria per milliliter of liquid expectorated 5 and 60 min after gargling for 60 s was observed. A randomized controlled study utilizing a single-blind cross-over design involving 29 participants demonstrated that twice daily rinsing with an essential oil-containing mouthrinse led to significant reductions in total recoverable streptococci and total recoverable *S. mutans* (70% and 75%, resp.) in interproximal plaque.^[24] Saliva samples also showed significant reductions in the recoverable levels of total streptococci and *S. mutans*. A single-blind, randomized cross-over study involving 15 volunteers demonstrated that chewing sticks from *Salvadora persica* had similar effects on the levels of subgingival plaque microbiota as regular toothbrushing without toothpaste.^[25] However, the level of *A. actinomycetemcomitans* was significantly reduced by the use of

chewing sticks. In a similar study investigating a commercial herbal mouthwash containing *Salvadora persica* extract, significant reductions in gingival bleeding were observed in both test and placebo subjects. However, a significant reduction in the carriage of cariogenic bacteria was observed only in the test subjects.

CONCLUSION

There is considerable evidence that plant extracts, essential oils, and purified phytochemicals have the potential against cariogenic bacteria and can be used as preventive or treatment therapies for oral diseases. While it is encouraging to see a number of clinical trials of such products, 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 conventional therapies.

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Conflicts of interest

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