Phytotherapy: A Novel Approach for Treating Periodontal Disease

ABSTRACT

Over the years, periodontal therapy has been influenced by the trends of the times, and consequently treatment approaches have been modified. Our understanding of the etiology and diagnosis of the periodontal diseases is continuously evolving. Periodontitis caused by various microorganisms is often treated with common antibiotics. But antibiotic resistance is a growing problem. Thus, the global need for an alternative prevention and treatment options arises which is safe, effective and economical. So, researchers are in pursuit for new therapeutic agents from natural sources. There is a long and venerable history of the use of plants to improve dental health and promote oral hygiene. Plants contain phytochemicals such as alkaloids, tannins, essential oils and flavonoids which have pronounced antimicrobial activity. Because of its good antimicrobial activity and safety profile, it proves its use in the treatment of periodontal diseases. This suggests a potentially valuable role for phytotherapy in assisting with the management of this serious disease. The evidence and research which supports such a role for plants (or plant products) are reviewed in this study.

KEYWORDS periodontitis, antibiotic resistance, plant extracts

INTRODUCTION

From time immemorial, periodontal diseases have been considered as one of the major health problems affecting humans. Epidemiologic studies have shown that destructive periodontal diseases in the form of periodontitis with significant bone loss have affected mankind in the ancient times also. Over the years, periodontal therapy has been influenced by the inclinations of the times, and consequently treatment methodologies have been modified. Our understanding of the etiology and diagnosis of the periodontal diseases is continuously evolving. Periodontal diseases have been linked to anaerobic gram-negative bacteria (Porphyromonas gingivalis, Actinobacillus, Prevotella and Fusobacterium). Given the incidence of oral disease, increased resistance to bacteria by antibiotics, adverse effects of some antibacterial agents currently used in dentistry and financial considerations in developing countries, there is a need for unconventional prevention and treatment options that are safe, effective and economical. While several agents are commercially available, these compounds can alter oral microflora and have undesirable adverse effects such as vomiting, diarrhoea and tooth staining. Hence, the search for alternative products continues and natural phytochemicals isolated from plants used as traditional medicines are considered as good alternatives.

Therapy comes from the Latin word ‘therapia’ originally from Greek therapeia, from therapeutin which means to treat medically. The Latin prefix ‘phyto’ stands for plant and is called photon in Greek. In other words ‘phytotherapy’ can be called as herbal medicine. It is the study of the use of extracts from natural origin as medicines or health promoting agents.

A key to selecting pharmaceutical plant derivatives for use in medicinal preparations is the global availability. Plants and naturally derived products have been used to enhance health and medicinal purposes for thousands of years. Most herbal supplements have been utilised for centuries based on emperical and testimonial support for their efficacy. Plant extracts are widely used as antimicrobial agents. The global need for an alternative prevention, treatment options and products for oral disease arises due to the rise in disease incidence, increased resistance by pathogenic bacteria...
to currently used antibiotics. Thus, phytotherapy may be an answer for alternative treatment option as it is safe, effective and more economical.

**HISTORY**

There is a long and venerable history of the use of plants to improve dental health and promote oral hygiene. In a review by Lewis and Elvin, they note a quotation credited to the prophet Muhammad: ‘the Siwak (chewing stick) is an implement for the cleansing of teeth and a pleasure to God’. The precise method for the use of this equipment was recorded by the Babylonians in 5,000 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. In ancient times, plants were assigned curative powers based on shape or colour. The plants used are very carefully selected for properties such as foaminess, hardness, or bitterness and certain species are more popular than others. A great number have related medicinal properties that may be antibacterial. The Chinese began using ginseng at least 3,000 years ago, and native Americans used willow bark tea to reduce fever, when most of the ‘civilised world’ was under Roman rule. Each civilisation that has chronicled its progress produced a body of knowledge addressing the use of medicinal plants.

The oldest written evidence of medicinal plant’s usage for treatment has been found on a Sumerian clay slab from Nippur, approx. 5,000-year-old. It comprised 12 recipes for drug preparation referring to over 250 various plants, some of them are alkaloids such as poppy, henbane and mandrake. The Indian holy books Vedas mention treatment with plants, which are abundant in that country. Numerous spice plants used even today originate from India: nutmeg, pepper, clove, etc. The Ebers Papyrus, written circa 1,550 BC, represents a collection of 800 prescriptions referring to 700 plant species and drugs used for therapy such as pomagron, castor oil plant, aloe, senna, garlic, onion, fig, willow, coriander, juniper, common centaury, etc. The works of Hippocrates (459–370 BC) contain 300 medicinal plants classified by physiological action: wormwood and common centaury (Centaurium bellatum Gilib) were applied against fever; garlic against intestine parasites; henbane, opium, deadly nightshade and mandrake were used as narcotics; fragrant heliotrope and haselwort as emetics; celery, parsley, asparagus, sea onion and garlic as diuretics; oak and pomegranate as astringents.

Theophrast (371–287 BC) founded botanical science with his books ‘De Causis Plantarum’—plant etiology and ‘De Historia Plantarum’—plant history. In these books, he generated a classification of more than 250 medicinal plants known at that time. Among others, he referred to cinnamon, iris rhizome, false heliotrope, mint, pomegranate, cardamom, fragrant heliotrope, monkshood and so forth. In the description of the plant toxic action, Theophrast underscored the important feature for humans to become accustomed to them by a gradual increase of the doses. Owing to his considerations in botany, he gained the epithet of the ‘father of botany’, given that he has great merits for the classification and description of medicinal plants.

In his work, ‘De re medica’, the renowned medical writer Celsus (25 BC to 50 AD) quoted approximately 250 medicinal plants such as aloe, henbane, poppy, pepper, flax, cinnamon, false heliotrope, the star gentian, cardamom, etc.

**PHYTOTHERAPY AND GINGIVITIS**

Primary etiology of chronic gingival inflammatory conditions is often found to be bacterial plaque and its byproducts. Numerous antimicrobial agents have been and are being tested throughout the world in order to determine which agents are efficacious and safe in preventing plaque formation and/or inhibiting the colonisation of periodontopathogens within the plaque. Dental plaque is an example of a specialised bacterial biofilm that develops on the surface of teeth, dental restorations, prostheses and implants. A number of methods have been used to evaluate the potential of natural products to reduce or eliminate oral biofilms. Anti-adhesion agents may be preferable than those that are bactericidal as selective pressure leading to resistance and overgrowth of resistant bacteria would be avoided. Plant extracts have been used to check for the biofilm. The inhibition of biofilm formation by oral pathogens has been assessed by cell culture plate assays, where bacteria are incubated in the presence or absence of test compounds. After appropriate incubation, free bacteria are removed from microtiter wells by aspiration; biofilms are stained with crystal violet and the absorbance measured to indicate the level of biofilm formation. In the biofilm assays, the log bacterial reduction was achieved within 30–60 min after contact with alcoholic extracts and within 60 min with aqueous extracts. Yamanaka et al. conducted a study in which it was concluded that cranberry polyphenol fraction inhibits biofilm formation, the Arg-gingipain and Lys-gingipain activities of P. gingivalis.

**PHYTOTHERAPY IN PERIODONTITIS**

Periodontal disease is a chronic condition which starts with gingival inflammation and progressively develops toward hard and soft tissue destruction and tooth loss. The herbs used for treatment of periodontitis are Acacia catechu wild, aloe vera (Aloe barbadensis miller) chamomile, Andirachta indica, Glycyrrhiza glabra (Liquorice root), Cinnamomum zeylanicum, Allium sativum, Propolis, Mikania leavigata, Mikania glomerata, Drosera peltata, Helichrysum italicum, Coptidis rhizome, Piper cubeba, and Syzygium aromaticum. Tea tree oil (Melaleuca alternifolia) and Coriandrum sativum essential oils are some potential antimicrobial deriving agents used in the management of various periodontal diseases.
A study done by A Jamil et al. concluded that garlic allicin extract has a potential use for prevention and treatment of periodontal disease. In that study, it was found that allicin inhibited growth of all tested bacteria (P. gingivalis, Actinobacillus [Aggregatibacter] actinomycetemcomitans [Ac], Fusobacterium nucleatum, Streptococcus mutans, Escherichia coli, Streptococcus sobrinus and Actinomyces viscosus). Allicin was also found to be an effective irreversible inhibitor of the P. gingivalis proteases. Allicin was also found capable of killing S. mutans growth in biofilm. Thus, there is considerable evidence that plant extracts, essential oils and purified phytochemicals have the potential to be developed into agents that can be used as preventive or curative agents for periodontal diseases.

**ANTIMICROBIAL EVALUATION OF POLYHERBAL EXTRACT IN THE TREATMENT OF PERIODONTITIS**

Periodontal disease is marked by bacterial overgrowth. Important periodontal pathogens are A. actinomycetemcomitans, P. gingivalis, Dialister pneumosintes, Bacteroides forsythus, Staphylococcus aureus and Treponema denticola. Other gram-negative anaerobic rods, some gram-positive bacteria and even enteric rods/pseudomonas may also play roles in the etiopathogenesis of periodontitis. Treatment generally involves mechanical therapy (non-surgical or surgical debridement) in conjunction with antibiotics. A. actinomycetemcomitans is one of the most efficient causative pathogens in this disease.

The minimum inhibitory concentration (MIC) can be used as a quantitative parameter for comparison of antimicrobial activity amongst the extract and standard. In a study done by Neelufar et al., the antimicrobial efficacy of the formulated polyherbal extract was tested on S. mutans, E. coli, Staphylococcus aureus and Proteus vulgaris by Dip well technique. The results of dip well method showed that the polyherbal extract has good antimicrobial activity. Another study by Gaetti-Jardim et al. recorded MIC and MBC values of aqueous and alcoholic extracts of Ficus enorim, Mynccodium urundevka and Psidium cattleianum against four reference strains (A. actinomycetemcomitans, F. nucleatum, P. gingivalis and P. intermedia). Alcoholic and aqueous extracts from Periplaneta americana, Maytenus ilicifolia and P. rotundifolia did not exhibit antimicrobial activity on planktonic microorganisms, while alcoholic extract from F. enorim was more active than aqueous extract against planktonic bacteria. MBC was 2 up to 16-fold higher than MIC values.

**ROLE OF FEW KEY PLANTS IN PERIODONTITIS**

**Aloe vera (Aloe barbadensis miller)**

It belongs to the family Asphodelaceae (Liliaceae). It has been used medicinally since the last few thousand years. Reported pharmacological actions of aloe vera include anti-inflammatory, antibacterial, antioxidant, antiviral and antifungal actions, as well as producing hypoglycemic effects. It is extremely helpful in the treatment of diseases like gingivitis and periodontitis. It reduces bleeding, inflammation and swelling of the gingiva. It is a powerful antiseptic in pockets where normal cleaning is difficult, and its antifungal properties helps greatly in the problem of denture stomatitis, aphthous ulcers, cracked and split corners of the mouth. It is a powerful healing promoter and can be used in the following extractions. It has been used in root canal treatment as a sedative dressing and file lubrication during biomechanical preparation. A study was done in which aloe vera gel was used as a local drug delivery. A significant reduction in pocket depth when compared to controls and reduction in gingival index, which can be attributed to its anti-inflammatory, antibacterial and wound-healing properties was seen. Thus, subgingival administration of aloe vera gel results in improvement of periodontal condition. Aloe vera can be used as a local drug delivery system because of its various benefits.

**Garlic**

Garlic (A. sativum) belongs to the oldest traditional medicinal plants. Garlic is mentioned in the Bible and the Talmud. Hippocrates, Galen, Pliny the Elder and Dioscorides all mentioned the use of garlic for many conditions, including parasites, respiratory problems, poor digestion and low energy. The anti-infective properties of garlic have long been known to Chinese and Indian civilisations and were first described in Europe by Louis Pasteur. Garlic is one of the most extensively researched medicinal plants and its typical odor and antibacterial activity depends on allicin produced by enzymatic activity of allinase (a cysteine sulphotidelyase) on allin after crushing or cutting garlic clove. The antifungal, antiparasitic, antiviral, antimicrobial, antihypertensive, blood glucose lowering, anti-thrombotic, antimutagenic and antiplatelet properties of garlic have been reported and many of these claims have been scientifically corroborated. Garlic has an unusually high concentration of sulphur-containing compounds, and its antibacterial properties are largely due to one particular class of sulphur-containing compounds, the thiosulphinates. Garlic is also alleged to help regulate blood sugar levels and is an effective way to prevent scurvy, due to its vitamin C content.

**Miswak**

Miswak chewing sticks are prepared from the roots or twigs of Salvadora persica plants. The periodontal status of more than 200 adult Sudanese who habitually used either miswak or a toothbrush was compared. Miswak users had significantly lower dental calculus and signs of periodontal disease and a tendency to lower gingival bleeding. 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.  

**Azadirachta indica (Neem)**

*Azadirachta indica* is well known in India. More than 135 components have been isolated from neem. The main ingredients are nimbins, nimbinin and nimbidin. The neem leaves contain 6-desacylamilimbine, nimbandiol, nimbolide and quercetin, n-hexacosanol and nonacosenol. Beta-sitosterol is present in all parts of the plant. Neem leaf extracts have anti-arrhythmic, anti-arthritis, antiviral, anti-diabetic and antioxidant. It has anti-ulcer, anti-malarial, antifungal and anti-carcinogenic activities. A study showed that neem leaf extract is used to treat dental plaque and gingivitis. Micro-organisms found in inflamed gingiva are resistant to tetracycline and penicillin but not to the neem leaf extracts. Also neem leaf extracts cause no allergic reaction in the gingiva. The herbal formulation comprising of active fractions from *A. indica*, *Citrus limon* and *Cucumber sativa* is useful for preventing dental plaque and gingivitis in humans and is also used as an antimicrobial agent for preventing disease.

**Tulsi**

Tulsi extract have been widely used in traditional medicine and human clinical trial without significant side effects. The methanol extract and the aqueous extract of *Ocimum sanctum* have shown to inhibit acute as well as chronic inflammations in rats. Eugenol (1-hydroxy-2-methoxy-4-allylbenzene), the active constituent present in *O. sanctum* has been found to be largely responsible for the anti-inflammatory property of tulsi. A study was done using fluid extract of tulsi leaves for 2% *O. sanctum* gel preparation. It demonstrated 97% cyclooxygenase-1 inhibitory activity when assayed at 1,000 μM concentration. Hence concluded that 2% tulsi (*O. sanctum*) gel can be used as useful adjunct to enhance the results of conventional periodontal therapy.

**Tea tree oil**

Tannins are defined as a vegetable substance capable of tanning animal bides to produce leather. This is used as a method to preserve the hide and at a molecular level is affected via the crosslinking by the tannins of hide proteins. Green tea (*Camellia sinensis*, a rich source of tannins) appears to be much more potent as an antimicrobial agent than black tea. In general, antimicrobial activity decreases when the extent of tea fermentation increases. The antimicrobial activities of extracts of tea products with different extents of fermentation also varied with test organisms. Green tea and 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. The antimicrobial activity of tea has been attributed to its tannin (polyphenolic) phytochemicals.

**Safflower seed extract (SSE)**

The regeneration of the periodontiumis coped up by forming new cementum, periodontal ligament and regrowing the alveolar bone. For occurrence of this regeneration, cells with the capability to synthesise cementum, bone and periodontal ligament needs to occupy the periodontal defect and produce these specialised tissues, as required. Recently, safflower seed extract (*Carthamus tinctorius* L.), a herbal medicine, has attracted attention with reference to some of the cellular events like chemotactic response, proliferation and alkaline phosphatase activity of periodontal ligament cells, and osteoblasts to promote the mineralisation process. In a study, safflower extract was placed in two-walled infrabony defects. Significant reduction in mean probing pocket depth, gain in mean clinical attachment level and significant mean defect fill of 2.86 ± 0.69 mm was observed. Regarding the regeneration induced by SSE, it is supposed to be caused by (a) increasing the chemotactic response, proliferation and alkaline phosphatase activity of periodontal ligament cells and osteoblasts (b) stimulating the formation of calcification nodules and mRNA expression of bone sialoprotein in periodontal ligament and MC3T3 E1 cells (c) facilitating the influx of Ca²⁺ from the extracellular fluid to the intracellular fluid and thus activates Ca²⁺ channel of osteoblastic cells. Thus, they concluded that safflower seed extract may be a novel approach in regeneration of the periodontal tissues.

**Grape seed proanthocyanidins extract**

Grape seed proanthocyanidins extract (GSPE), a type of flavonoid, is an antioxidant obtained from the seeds of *Vitis vinifera*. Its active constituents are proanthocyanidins, and these represent a variety of flavan-3-ol, catechin, which is a scavenging free-radical required for absorption of calcium. A study was done on 40 Wistar male rats. It was found that GSPE had an effect on mechanical properties associated with rat mandibular condyle bone debility. It induced extra bone formation in rat mandibular condyles, increase in bone mass and increase in bone strength. The activity of GSPE has been attributed to antioxidants present in its flavan-3-ol or catechin that showed free radical scavenging activity. It is also well known that free radicals promote calcium resorption within bone. Studies on enzyme...
demonstrated that proanthocyanidin is found to inhibit the proteolytic enzyme, and proteolytic enzyme has an essential role in initiating bone resorption. Thus, it is suggested that GSPE has a potential role in the inhibition of bone resorption.

**Pineapple extract**

Pineapple is the universal name of *Ananas comosus*. It belongs to the member of the family bromeliaceae, which is grown in a number of subtropical and tropical countries including, India. It has been widely used as a therapeutic plant. Several resident cultures and these therapeutic qualities of pineapple are accredited to bromelain, which is an elementary extract from pineapple that contains, along with other compounds, various proteinases. Bromelain has shown to exhibit various fibrinolytic, anti-edematous, anti-thrombotic and anti-inflammatory activities both in vitro and in vivo. This qualitative in vitro analysis was conducted to evaluate the antibacterial efficacy of bromelain tablets (500 mg) on potent periodontal pathogens. Bromelain showed antibacterial efficacy against all the isolated strains of both aerobic and anaerobic microorganisms (*S. mutans, E. coli, P. gingivalis and A. actinomycetemcomitans*). Bromelain is one such agent which has been widely used as anti-inflammatory and antibacterial drug in the field of medicine and dentistry.

**ADVERSE EFFECTS**

Along with multiple advantages of phytotherapy, there are some adverse effects also associated with it. Certain herbs or herbal products may cause direct effects on oral tissues like burning of tongue, numbness and throat/oral irritations. Toxicity is usually seen only when excessive amounts of phytochemicals are ingested. This is rarely encountered because phytotherapy for gingival inflammation usually involves only topical application and systemic administration is not required.

**CONCLUSION**

Thus, the need for an alternative treatment options for periodontal diseases which is safe, effective and economical arises due to the rise in disease incidence and increased resistance by pathogenic bacteria to currently used antibiotics. Natural remedies are more acceptable by the population with a belief that they are safer with fewer side effects than the synthetic ones. Phytotherapy, the most ancient medication, is still useful today because of its benefits.

**REFERENCES**