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The Effects of Plant Extracts on Dental Plaque and Caries

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1. Introduction

Daily use of an efficient anti-plaque compound, especially a formulated form in toothpaste, can be very beneficial in plaque control. Some groups of antimicrobial compounds have been studied thus far. The most important of these compounds are herbal extracts, metallic salts and phenol compounds. Each of these three groups has demonstrated positive results in clinical and laboratory studies. Herbal extracts have received special attention because of being non-chemical and non-synthetic, and they have been long used in traditional medicine (Elvin 1980, Marsh & Bradshaw 1993).

In this section will be discussed about most important of plant extracts that have shown good effects on dental plaque and caries.

2. Salvadora Persica

The Salvadora Persica tree drives its Persian name, Darakht-e-Miswak or tooth brush tree. South of Iran, next to Persian Gulf, is the main growing area of this plant. This plant belongs to the Salvadoraceae family, a crowded evergreen shrub that has a soft inclined to a white wood. Since the brushes made of its wood strengthen the gums, it has been called "Miswak tree" (Meswak tree) in traditional medicine (Poureslami 2007).

Chemical compounds such as sodium chloride, calcium oxalate, silica, fluoride, sulfated compounds, vitamin C and tannic acid have been found in this plant. Moreover, this plant contains saponin, flavonoid, an alkaloid named Salvadorin, Trim ethylamine, an herbal steroid named beta-sit sterol and benzyl isothiocyanate. It is claimed that the vitamin C and sit sterol content of this plant have great roles in strengthening the gum capillaries and preventing gum inflammation. calcium salts and fluoride are quite effective in preventing dental caries. Moreover, the silica and calcium salts in the plant act as grinder and detergent. Trim ethylamine is known to be effective in reducing surface adhesion and also in decreasing plaque accumulation. Tannins, tannic acid, Sulfated compounds and benzyl isothiocyanate, are reported to have antimicrobial effects and help the healing of gum inflammation. Leaves, fruits and seeds of this plant have been used in traditional medicine as appetizer, mild laxative, diuretic and anti-fungal medication and people in some Asian and African countries have used it for many years (Akhtar & Ajmal 1981 , Al Sadhan &

Almas 1999 , Almas et al 2005 , Ezmirly et al 1981 , Darmani et al 2006 , Darout et al 2002 , Al-Otaibi et al 2003).

During recent years, many researchers throughout the world have studied Miswak as a helpful plant in oral hygiene. Clinical trials have shown that regular use of chewing stick of Salvadora Persica reduces plaque. It has been reported that incidence of caries among users of chewing sticks is low despite the intake of a carbohydrate rich diet and a lack of modern dental prophylactic measures. The Arabian researchers concluded from a comprehensive survey of several thousands of Saudi school children that the low incidence of gingival inflammation was attributable to the practice of using Miswak for teeth cleaning (Gazi et al 1992).

In vitro studies indicate that, of a variety of common oral bacteria, members of the genus streptococcus (including the mutans streptococci) are especially sensitive to the antimicrobial activities of S. Persica (Al-lafi & Ababneh 1995).

In a study the efficacy of Miswak in the prevention of dental caries has been investigated and compared with the efficacy of ordinary toothbrush and toothpaste. The data collected at the end of the study showed that the risk of dental caries for each tooth in the control group was 9.35 times more than the case group (Aldini & Ardakani 2007).

It has been told rinsing with Miswak extract stimulated parotid gland secretion and raised the plaque PH, suggesting a potential role in caries prevention (Sofrata et al 2007).

It has been observed that miswak was as effective as a toothbrush for reducing plaque on buccal surfaces of teeth both experimentally and clinically (Mohammed et al 2006).

Another study compared the oral health efficacy of persica mouthwash with that of a placebo. The results showed that use of persica mouthwash improves gingival health and lower carriage rate of cariogenic bacteria when compared with the pretreatment values (Khalessi et al 2004).

Scientific evaluation of use of miswak revealed that it is at least as effective as toothbrushing for reducing plaque and gingivitis and that the antimicrobial effect of S. persica is beneficial for prevention/treatment of periodontal diseases (Al- Otaibi 2004).

A clinical study was conducted using patients` saliva and measuring the effect of miswak (chewing stick), miswak extract, toothbrush, and normal saline on mutans and lactobacilli. The results showed that there was a marked reduction in Strep. Mutans among all groups. When the groups were compared, the reduction in Strep. Mutans was significantly greater using miswak in comparison to toothbrushing and there was no significant differences for lactobacilli reduction. The investigators concluded that miswak has an immediate antimicrobial effect. Strep. Mutans were more susceptible to miswak antimicrobial activity than lactobacilli (Almas & Al-Zeid 2004).

It seems persica mouthwash doesn`t have any side effects. Results of a study has shown the mouthwash significantly lowers the gingival index, plaque index, and bleeding index in case group without any reported side effects (Kaur et al 2004).

The results of the three serial studies showed that miswak extract, alone or in combination with toothpaste, can affect the growth of plaque bacteria. The investigators concluded that

miswak extract can be used in mouth rinses and toothpastes for control dental plaque and caries (Poureslami 2007).

The results of a study showed that miswak extract could be a promised natural material as an additive to glass ionomer cements (El- Tatari et al 2011).

Almas and co-workers compared the antibacterial effects of Miswak extract with eight commercial mouth rinses. They evaluated the antimicrobial effects on Pyogenes Faecalis, Mutans Streptococci, Candida Albicans plus Aureus and Epidermidis staphylococci by determining the inhibition zones. In their study, none of the solutions was considered a gold standard; they compared the antimicrobial effect of Miswak with that of each mouth rinse and the antimicrobial effects of the eight mouth rinses with each other. According to their results, mouth rinses containing chlorhexidine had the greatest antibacterial effects, while mouth rinses containing cetylpyridinium had moderate effect; Miswak extract had a low effect (Almas et al 2005).

3. Bloodroot plant (Sanguinarine)

Chemically, sanguinarine is a benzophenanthridine alkaloid derived from the alcoholic extraction of powdered rhizomes of the bloodroot plant, Sanguinaria Canadensis, that grow in central and south America and Canada. Sanguinarine contains the chemically reactive iminium ion which is probably responsible for its activity. It appears to be retained in plaque for several hours after use, and is poorly absorbed from the gastrointestinal tract. Several clinical studies have been carried out into its effects. A sanguinarine mouth rinse and toothpaste regime given for 6 months during orthodontic treatment reduced plaque by 57% and gingival inflammation by 60% compared with figures of 27% and 21% for the placebo control group. Reviews on antimicrobial mouth rinses including sanguinarine conclude that short-term studies have shown variable but significant plaque inhibitory effects but the effect on gingivitis appears to be equivocal. In respect of its possible modes of action, it has also been shown that sanguinarine at a concentration of 16 microgram per milliliter completely inhibited 98% of microbial isolates from human dental plaque and that sanguinarine and zinc act synergistically in suppressing the growth of various oral strains of streptococci (Eley1999).

4. Sage & Myrrh

A wide range of toothpastes are commercially available and recently interest in naturally based products ,such as Qualimiswak and Prodontax, has increased. Parodontax (Madaus. Cologne. Germany)is composed of sodium bicarbonate and various herbal extracts including Camomile, Echinacea, Sage, Myrrh, Rhatany, and Peppermint oil. The individual components are reputed to have a variety of medicinal properties. Chamomile is claimed to have anti-inflammatory characteristics and Echinacea to have activating effect on leukocytes. Sage is reputed to be an antiseptic while both Myrrh and Rhatany are astringents that have been recommended for incorporation in to dentifrices and mouthwashes. The antibacterial effect of these herbal extracts on anaerobes has been reported (Yankell 1988).

Mullally and colleagues reported that Parodontax toothpaste was as effective as the conventionally formulated dentifrice in the control of plaque (Mullally et al 1995).

5. Licorice root

Licorice is the name applied to the roots and stolons of Glycyrrhiza species. Licorice roots extract contains Glycyrrhizol A, a compound that has strong antimicrobial activity against cariogenic bacteria,. Two pilot human studies indicate that a brief application of Licorice roots extract lollipop led to a marked reduction of cariogenic bacteria in oral cavity among most human subjects tested (Hu et al 2011).

6. Quercus infectoria gall

Quercus infectoria (Fabaceae) is a small tree, the galls arise on young branches of this tree as a result of attack by the gall-wasp, Adleria gallae-tinctoria. The plant is known as Mayaphal and Majufal in Hindi. Quercus infectoria gall extract has the potential to generate herbal metabolites. the crude extracts demonstrating anti-dental caries activity could result in the discovery of new chemical classes of antibiotics. These chemical classes of antibiotics could serve as selective agents for the maintenance of human health and provide bio-chemical tools for the study of infectious diseases (Vermani & Navneet 2009).

7. Nidus Vespae

Nidus Vespae is widely distributed in China and is typically harvested in the autumn & winter seasons and dried in the open air, after removal of dead wasps, for use in traditional Chinese medicine, where it has been used in the treatment of a variety of diseases, including cardiovascular, digestive and urinary disorders. The well-known pharmacopoeia of traditional Chinese medicine also lists the use of Nidus vespae For toothaches, through tooth brushing. A study showed significant inhabitation of glucosyltransferases activity and biofilm formation by Nidus Vespa extract. The researchers concluded it to be a promising natural product for the prevention of dental caries. Nidus Vespa have been extensively used in traditional Chinese medicine, given their multiple pharmacological activities, including antimicrobial, anti-inflammatory, anti-virus and anesthetic properties (Xiao et al 2007).

8. Cratoxylum formosum gum

The gum of Cratoxylum formosum, commonly known as mempat, is a natural agent that has been used extensively for caries prevention by hill tribe people residing in Thailand. A research showed Cratoxylum formosum gum has high antimicrobial activity against S. mutans and may become a promising herbal varnish against caries (Suddhasthira et al 2006).

9. Acacia Arabica

This evergreen tree is of medium height around 25 to 30 feet. It looks like a bush and is commonly foun in dry forest areas. This ayurvedic herb is great astringent and is equally useful as dentifrice, anti-hemorrhagic agent, and anti-diarrheal.A clinical trial was designed to evaluate the short-term clinical effects of Gumtone ,a commercially available gel containing Acacia Arabica in the reduction of plaque and gingival inflammation. Gumtone gel showed significant clinical improvement in gingival and plaque index scores as compared to a placebo gel. Gumtone gel was not associated with any discoloration of teeth or unpleasant taste (Pradeep et al 2010).

10. Chicory

Ancient ayurevedic literature contains several references on the medicinal uses of Cichorium intibus Linn (Chicory). Its usage has been for topical application in the treatment of acne, ophthalmia and inflammation of throat. The root is supposed to have aromatic cooling and healing properties. It is believed to purify and enrich blood, reduce inflammation of soft tissues and prevents pain in the joints. Some pharmacological actions of aqueous and alcoholic extracts of roots of chicory were reported. It was found that the extracts of chicory possess therapeutic properties in animal experimental models. In an *in vitro* study per formed by Patel on the anti-plaque effects of chicory extract, after adding herbal extract to the combination of four different commercial toothpastes, the anti-plaque effects of the mentioned toothpastes in comparison with the same toothpastes without herbal extract were evaluated using bacterial sensitivity tests and discs. Results of this study demonstrated a greater anti-plaque effect in all toothpastes containing herbal extract in comparison to the same toothpastes without extract. In another study, Patel compared the antiplaque activity of chicory extract with the antiplaque activity of penicillin, tetracycline, chloramphenicol, and streptomycin using microbial sensitivity tests and discs. In his study, bacteria in plaque samples showed high sensitivity to chloramphenicol and streptomycin, and their sensitivity to chicory extract was between the sensitivity to chloramphenicol and streptomycin (Patel & Venkatakrishna-Bhatt 1983).

11. Prunella vulgaris & Macleya cordata

In recent years has studied the biological activity of an extract of Prunella vulgaris L. (Labiatae), and it found marked cytoprotective, antioxidant/radical scavenging, antiviral and anti-inflammatory effects both in vitro and in vivo. This plant, known as the "self-heal", was popular in traditional European medicine during the 17th century as a remedy for alleviating sore throat, reducing fever, and accelerating wound healing. A major constituent of P. vulgaris is rosmarinic acid, a phenolic antioxidant whose content can be as high as 6 %. Phytochemical studies indicate that P. vulgaris further contains oleanolic, betulinic, ursolic, 2α,3α-dihydroxyurs-12-en-28-oic and 2α,3α-ursolic acids, triterpenoids, flavonoids, tannins and anionic polysaccharide prunelline. Isoquinoline alkaloids from Macleya cordata R. Br. (Papaveraceae) are another group of biologically active components studied recently. The main alkaloids of this plant, quaternary benzo[c]phenanthridines (QBA) sanguinarine and chelerythrine, are among the most active of antimicrobials natural substances. These alkaloids display a plethora of species- and tissue-specific actions but the molecular basis of their pharmacological activities remains obscure. They exhibit antimicrobial, anti-inflammatory, antimitotic, adrenolytic, sympatholytic, cytostatic and local anesthetic effects. A double blind, placebo-controlled clinical trial was performed to investigate the effectiveness of a herbal-based dentifrice, containing Prunella vulgaris and Macleya cordata, in the control gingivitis. The result showed the dentifrice was effective in reducing plaque and symptoms of gingivitis (Adamkova et al 2004).

12. Chitosan plus herbal extracts

Chitosan, an abundant natural polymer, is obtained by alkaline N-deacetylation of chitin. Chitosan being a binding agent, bio-adhesive, bio-compatible, bio-degradable, and non-toxic

polymer also possessing medicinal activities, such as antifungal, antibacterial, antiprotozoal, anticancer, antiplaque, ant tartar, hemostatic, wound healing, and potentiates anti-inflammatory response, inhibits the growth of cariogenic bacteria, immunopotentiation, antihypertensive, serum cholesterol lowering, increases salivary secretion (anti-xerostomia), and helps in the formation of bone substitute materials. The adherence of oral bacteria on the tooth surface leads to plaque formation. It is believed that the adhesion between the bacteria and the tooth surface is due to electrostatic and hydrophobic interactions. These interactions are disrupted by chitosan derivatives because of competition by the positively charged amine group. The antibacterial activity of chitosan could be due to the electrostatic interactions between the amine groups of chitosan and the anionic sites on bacterial cell wall because of the presence of carboxylic acid residues and phospholipids. Use of most of the currently used gelling agents, such as tragacanth, Irish moss, and sodium alginate mucilage, in the toothpaste was limited only to their gelling capacity and also require antimicrobial preservatives due to their carbohydrate nature, whereas chitosan being a good gelling agent, does not require any preservatives as chitosan possess antimicrobial activities. Chitosan nanoparticles have found as drug carriers. In a study was evaluated anti-plaque activity a chitosan-based poly herbal toothpaste. The toothpaste significantly reduced the plaque index by 70.47% and bacterial count by 85.29%(34). (Mohire & Yadav 2010).

13. Conclusion

In conclusion, the herbal extracts can be effect on the growth of dental plaque bacteria and dental caries. Therefore, the herbal extracts can be used in mouth rinses and toothpastes and can be beneficial in controlling dental caries.

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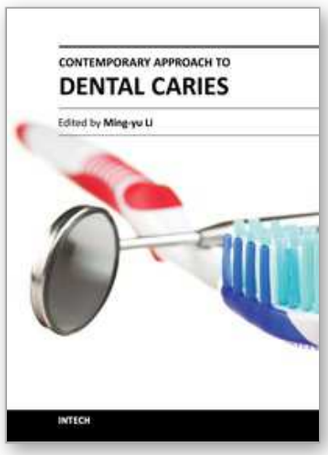

Contemporary Approach to Dental Caries
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With an update of the recent progress in etiology, pathogenesis, diagnosis, and treatment of caries, it may be said that the final defeat of dental caries is becoming possible soon. Based on the research in this area in recent decades, "Contemporary Approach to Dental Caries" contained the caries in general, the diagnosis of caries, caries control and prevention, the medical treatment of caries, dental caries in children and others such as secondary caries. This book provides the reader with a guide of progress on the study of dental caries. The book will appeal to dental students, educators, hygienists, therapists and dentists who wish to update their knowledge. It will make you feel reading is profitable and useful for your practice.

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