

Traditional Medicinal Plants: Use in Oral hygiene

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ABSTRACT

Oral hygiene is an integral part of health of a person and when neglected it results in various oral disorders. Due to high emergence of oral infections, the fast developing resistance by bacteria to antibiotics, the adverse effects of the chemical based remedies currently used in dentistry and financial considerations there is a need for alternative prevention and treatment options that are safe, economical and effective. Oral infections have been linked to bacterial species specially the mutans group. Unhealthy diet pattern and lack of oral hygiene promote the growth of these bacteria. A number of methods are used to treat oral infections but it is important to look for the role that plants play in maintenance of oral hygiene since many of them have medicinal properties. There is a long history of the use of plants to improve dental health and promote oral hygiene. When compared to chemical based remedies plants always keep an upper hand. In many Indian and African homes even today teeth are cleaned using stems and barks of certain plants. Natural tooth brush sticks could be used by majority of people who cannot afford the western toothbrush and toothpaste. Therefore due to adverse effects of chemical based remedies and high cost western toothpaste the search for the alternative products still continues and the phytochemicals isolated from the plants proves to be a good alternatives. The present review is an attempt to create an interest among people regarding the potential of natural plants in treating the infections and disorders of oral cavity.

Keywords: Oral hygiene, Natural products, Medicinal plants, Oral diseases, Chewing sticks.

INTRODUCTION

Oral infections are one of the common health problems associated with majority of people around the globe. The prevalence of these infections is up to 90% in the school going children and even adults are also affected by them (Peterson et al 2005). Oral hygiene refers to the cleaning of mouth by brushing and flossing to prevent oral infections and gum diseases. There are various methods to keep the teeth clean and make it hygienic (Almas et al 1995). The oral infections are caused by plaque forming bacteria and yeast which reside in the oral cavity such as *Actinomyces*, *Actinobacillus*, *Streptococcus* and *Candida* species (Van et al 1987). Dental treatment is usually a high expense remedy and is out of reach of common man in developing countries. Various agents used for the treatment are bisphosphonate-antiseptics, quaternary ammonium-antiseptics, phenolic-antiseptics and other remedies such as oxygenating agents, and metal ions (Addy,

1986). Although many agents are available for the treatment of oral infections but they have many side effects associated with them such as vomiting, diarrhea and tooth staining. Apart from this bacterial resistance has been developed to various antibiotics commonly used for the treatment of oral infections such as penicillins, cephalosporins, erythromycin and tetracycline (Park et al 2003, Chung et al 2006, Bidault et al 2007). Therefore the search for alternative products continues to be a major issue and natural phytochemicals isolated from plants used in traditional medicines proved to be a good alternative to chemical remedies (Prabu et al 2006). The natural products obtained from plants contain very rich biologically active constituents which have great potential against bacterial species and they act as main ingredient in various pharmaceutical products. There have been numerous citations regarding the use of traditional plants and the products obtained from

them in maintenance of oral hygiene. Many plants have been reported in the Pharmacopeias which have efficacy to treat oral bacterial infections (Cowan, 1999, Kalemba et al 2003). Plants like Miswak has been used as chewing stick in many parts of world in various cultures with different names such as Miswak or Arak in Middle East, Datan in India and Pakistan, Miswaki in Tanzania. A number of plants like orange tree, lime tree have been used in Africa as chewing sticks whereas roots of plants like Senna were used in American continent by negroes. Neem plant has been widely used as chewing stick and in maintenance of oral hygiene throughout the Indian subcontinent (Almas et al 1995). Chewing sticks impart different tastes such as bitter, peppery etc. The most popular are those which provide good flavor, taste, have smooth texture and have potential effect on teeth and supporting tissues (Lewis, 1990). Some other plant parts are also used to maintain the oral hygiene such as Eucalyptus leaves are used to mask the bad mouth odour, onion and lime juices are used as gargles and to relieve tooth ache (Akinremisi et al 1997). The use of medicinal plants belonging to the family of Fabaceae, Ebenaceae, Bombaceae and Annonaceae has been reported for treatment of oral diseases (Hadissa et al 2005). The use of plant derived medicines in maintenance of oral hygiene is increasing day by day and many of them have been recently investigated for their efficacy against oral pathogens (Cowan, 1999, Kalemba et al 2003). Therefore the aim of the review is to point out some recent examples from the literature that have served hard to validate the use of those plants, extracts and phytomolecules against oral pathogens.

Oral Hygiene and its Importance

Oral hygiene refers to the act of keeping the teeth clean to prevent dental problems, most commonly dental cavities, gingivitis and bad breath. There are also oral pathologic conditions in which good oral hygiene is required for healing and regeneration of the oral tissues. These conditions included gingivitis, periodontitis,

and dental trauma such as subluxation, oral cysts and following wisdom tooth extraction (Zadik, 2008, Flores et al 2007, Zadik et al 2011). Dental infections are caused by plaque forming bacteria primarily the mutans streptococci (*Streptococcus mutans* and *S. sobrinus*) which metabolize sucrose to organic acids (mainly lactic acid) that dissolve the calcium phosphate in teeth, causing decalcification (Figure 1) and eventual decay (Hu et al 2000). The health of our teeth and mouth are linked to overall health and well being in number of ways. The ability to chew and swallow our food is essential for obtaining the nutrients we need for good health. Apart from the impact on nutritional status, poor dental health can also adversely affect speech and self-esteem. Dental diseases impose both financial and social burdens as treatment is costly and both children and adults may miss time from school or work because of dental pain (Jenkinson et al 2005).

Cleaning of teeth

Teeth cleaning is the removal of dental plaque and tartar from teeth to prevent cavities, gingivitis, and gum disease. Severe gum disease causes at least one-third of adult tooth loss. Tooth decay is the most common global disease affecting every family. Over 80% of cavities occur inside pits and fissures on chewing surfaces where brushing cannot reach food left trapped after every meal or snack, and saliva or fluoride have no access to neutralise acid and remineralised demineralised teeth, unlike easy-to-reach surfaces, where fewer cavities occur. Indian medicine (Ayurveda) has used the neem tree, or daatun, and its products to create teeth cleaning twigs and similar products; a person chews one end of the neem twig until it somewhat resembles the bristles of a toothbrush, and then uses it to brush the teeth. In the Muslim world, the miswak, or siwak, made from a twig or root, has antiseptic properties and has been widely used since the Islamic Golden Age. Good oral hygiene is essential for preventing tartar build-up which causes the problems mentioned above. This is done through

careful, frequent brushing with a toothbrush, combined with the use of dental floss to prevent accumulation of plaque on the teeth (Curtis, 2007).

Removing plaque

Plaque is a yellow sticky film that forms on the teeth and gums and can be seen at gum margins of teeth with a food dye. The bacteria in plaque convert carbohydrates in food (such as sugar) into acid that demineralises teeth, eventually causing cavities. Daily brushing and flossing removes plaque and can prevent tartar from forming on the teeth.

Brushing

This should be performed with a toothbrush and a toothpaste at least twice a day and preferably after every meal or snack. Effective brushing must clean each outer tooth surface, inner tooth surface, the tooth-brush should be held at a 45° against the gum and moved back and forth in short strokes (not more than one tooth width distance)(Harley et al 2002).

Flossing

Flossing once a day helps prevent gum disease by removing food particles and plaque at and below the gumline as well as between teeth. To begin, most of an 18-in (45 cm) strand of floss is wrapped around the third finger of one hand. A 1-in (2.5 cm) section is then grasped firmly between the thumb and forefinger of each hand. The floss is eased between two-teeth and moved gently up and down several times with a rubbing motion. At the gumline, the floss is curved first around one tooth and then the other with gentle sliding into the space between the tooth and gum. After each tooth contact is cleaned, a fresh section of floss is unwrapped from one hand as the used section of floss is wrapped around the third finger of the opposite hand. Flossing proceeds between all teeth and behind the last teeth. Flossing should also be performed around the abutment (support) teeth of a bridge and under

any artificial teeth using a device called floss threader (Bethany, 2001).

Oral diseases

Periodontal diseases and dental caries are two main common dental pathologies affecting humankind. Both caries and gingivitis emerge at an early stage but childhood is the most prompt age when caries are active as use of sweeteners accelerates the process. Caries development is almost non-reversible process and is difficult to treat whereas gingivitis at early stage is curable if brushed effectively. Irregularities in teeth create difficulties in controlling plaque and create stagnation. As discussed earlier caries is the chief dental disease found in children but few other disorders are also noticed such as Dentinogenesis imperfecta, Tetracycline pigmentation, Fluorosis, Hereditary gingival fibromatosis, Juvenile periodontitis, Congenital epulis, Herpetic stomatitis. The diseases in adults are many times the result of diseases not treated in the childhood. The oral disorders in adults occur due to age changes in tissues, difficulties with dentures or systematic disease associated with age. At older age the changes which occur in mouth are results of age advances and problems like dry mouth, glossitis, erosion, abrasion etc. start showing their effects (Cawson, 1984).

Factors affecting Dental infections

1. Individual factors

Susceptibility to dental caries varies between individuals and between different teeth within one person's mouth. The shape of the jaw and oral cavity, tooth structure and the quantity and quality of saliva are all important in determining why some teeth are simply more susceptible to decay than others. For example, some teeth may have pits, small cracks or fissures that allow bacteria and acids to infiltrate more easily. In some cases, the structure of the jaw/dentition renders teeth more difficult to clean or floss. The quantity and quality of saliva determines the extent to which teeth remineralise. For example relatively fewer caries are generally found in the lower front part of the mouth where teeth are more exposed

to saliva. The type and number of caries-causing bacteria present in the mouth is also relevant. All bacteria can turn carbohydrates into acids but certain families of bacteria such as Streptococci and Lactobacilli are more powerful acid producers. The presence of this type of bacteria in plaque increases the risk of decay. Some people have higher levels of decay-causing bacteria than others due to neglected or inappropriate oral hygiene.

2. Dietary Factors

Although the decline in tooth decay in many countries has been largely linked to improved dental hygiene, eating habits still affect the risk of tooth decay.

a) Fermentable Carbohydrates

Over the last few decades sugar intake in many countries has remained constant whilst caries levels have declined. This suggests that where appropriate oral hygiene is practiced the role of sugars in tooth decay is less manifest. Food containing fermentable carbohydrates contributes to tooth decay. This means that as well as sweets and confectionery, pasta, rice, potato crisps, fruits, and even bread can set the scene for demineralization. For example, a study testing the acid-producing potential of various starchy foods including pasta, rice and bread, found that these foods produced the same amount of acid as a 10% sucrose (table sugar) solution. Another study found that acid formation in plaque after eating soft bread or potato chips was greater and lasted longer than after eating sucrose.

b) Protective Foods

Some foods help protect against tooth decay. For example hard cheese increases the flow of saliva. Cheese also contains calcium, phosphate and casein, a milk protein, which protects against demineralization. Finishing a meal with a piece of cheese helps counteract acids produced from carbohydrate foods eaten at the same meal. Milk also contains calcium, phosphate and casein, and the milk sugar, lactose, is less cariogenic (caries causing) than other sugars (OPCS, 1994).

Treatments available

In recent years there has been a reduction in the incidence of dental caries in most European countries. An increase in oral hygiene including regular brushing and flossing to remove plaque and the use of fluoridated toothpaste, combined with regular dental check-ups is thought to be responsible for the improvement. The proper amount of fluoride helps prevent and control caries. Fluoride can be supplied systemically through fluoridated community drinking water, other fluoridated beverages or by supplementation. Alternatively it can be provided topically direct to the tooth surface via toothpaste, mouth rinses, gels and varnishes. In some countries, salt, milk or other beverages have fluoride added and supplements in the form of tablets or liquid are also available. The level of fluoride in drinking water and food needs to be taken into account when assessing the need for fluoride supplementation. This is especially important in young children under the age of 6 whose teeth are still developing. Tooth brushing with fluoridated toothpaste is thought to be the most important factor in the observed decline in dental caries in many countries. Brushing and flossing helps concomitantly to the fluoride application to remove bacteria from the mouth and reduce the risk of both caries and periodontal disease. The regular application of fluoride varnishes by dental practitioners is an established caries preventive measure in many countries. This practice is especially suitable for children at high risk of dental caries. Regular dental check-ups can help detect and monitor potential problems. Regular plaque control and removal can help diminish the incidence of dental caries. If very little plaque is present, the amount of acid formed is insignificant and decay cannot occur. Other remedies used are bisguanide-antiseptics, quaternary ammonium-antiseptics, phenolic-antiseptics, oxygenating agents, cetylpyridinium chloride, chlorhexidine, amine and metal ions. Apart from these agents fewer antibiotics like penicillins and cephalosporins, erythromycin, tetracycline and derivatives and metronidazole have

also been used to treat oral diseases (Addy, 1986, Bidault et al 2007).

Advantages and Disadvantages of these treatments

Fluoride inhibits demineralization, encourages remineralization and increases the hardness of the tooth enamel making it less acid soluble. It is one of the easy available cost effective therapies to control oral diseases. Fluoride makes the tooth structure stronger, so teeth are more resistant to acid attacks. It also helps repair the early stages of tooth decay (before the formation of a cavity). Fluoride strengthens teeth by penetrating the tooth structure and replacing lost minerals to repair acid damage. Antibiotics provide a quick relief in a short span of time and are useful in severe conditions. Although these remedies have benefits of high extent but they have some anomalies associated with them. A known adverse effect of fluoride over-usage is dental fluorosis. Enamel or dental fluorosis is a condition caused by 'excessive' intake of fluoride. The most common symptom of dental fluorosis is a chalk-like discoloration of teeth with white spots or lines on tooth enamel. In more severe cases the affected areas have a yellow or brown discoloration. In extreme forms, fluorosis may result in a pitted tooth surface. The drawback to the evident benefits of antibiotic treatment is represented by the undesired effects of their use. On one hand there are side effects with repercussions for the patient, such as gastric, hematological, neurological, dermatological, allergic and other disorders. On the other hand, the development of bacterial resistances is of great importance for both individual patient and public health (Knoll et al 2002, Kuriyama et al 2000).

Role of plants in oral care

Due to adverse effects of chemical based remedies the use of plants and plant based products emerged out as a best alternative. Medicinal plants have been used as traditional treatments for numerous human diseases for thousands of years and in many parts of the world. In rural areas of the developing countries,

they continue to be used as the primary source of medicine. A number of plants are used as chewing sticks in various parts of world which help in cleaning the buccal cavity (Lewis, 1990). These days a number of plants are used to prepare plant based tooth pastes and gels, since plant contains chemical constituents which are active against microbes, example Propolis which is a resin rich in flavonoids, it is manufactured by bees from plants. There are many essential oils that form an important constituent of toothpastes, example oils of Eucalyptus, tea tree, clove, cinnamon etc. Equally promising were tests done on a couple of plant substances widely used for dental hygiene in the Middle East and Indian subcontinent. A 1999 study published in the Indian Journal of Dental Research focuses on the antimicrobial effects of two plant species: *Salvadora persica*, known locally as miswak or arak, and *Azadirachta indica*, usually called neem. Both proved extremely effective against common oral bacteria. A later study, published in a 2003 issue of Oral Health & Preventive Dentistry, showed miswak outperformed toothbrushing in the reduction of plaque and gingivitis.

Few forms of oral hygiene using plants Dentrifices

Plants like *Acorus calamus*, *Rumex crispus*, *Cinchona officinalis*, *Vitis vinifera* are used as dentrifices in many parts of world to promote oral hygiene (Hardie et al 1995).

Chewing Gums

Gum exudates of few plants are used in form of chewing gums for maintaining the cleanliness of teeth. Plants like *Myroxylon balsamum*, *Croton xalapensis* and *Ficus platyphylla* are used as constituents in these gums to clean the teeth and as well as tighten them. Although these gums and latex have bitter taste and awful flavour but they have high advantage over commercial gums because they reduce the dental caries and mask bad mouth odour.

Chewing Sponges

The stems and vines of plants are collected from the coast region. The bark

is removed and beaten on rocks until they become fibrous. They are then washed and made into sponges that are about five inches in diameter. Now these sponges are used to clean the teeth by placing a small portion in mouth and chewing it vigorously and finally rinsing with water. Plants like *Acacia pennata*, *Hibiscus rostellatus* and *Lasianthera Africana* are used for this purpose.

Few examples of plants used to treat oral disorders

Table 1 shows few of the plants and phytochemicals with potent activity against oral bacteria and Table 2 shows few plants used presently for oral care.

CONCLUSION

After the study of chemical based oral products and plant based products it is obvious that use of plant based or herbal products is more effective and safe. The use of chewing sticks, sponges etc. prove to be very effective means of preventing

and controlling oral disorders. If used continuously the incidence of oral diseases would reduce to its minimal level. This study demonstrates that plant molecules and extracts could be developed into products which could be used by common man to treat oral infections. Use of fluoride based toothpaste has been found to associate with adverse effects and disadvantages of using hard brush which cause abrasion in adults. Plants have been found to be safer and effective in curing oral diseases. The use of plants for oral hygiene cannot be overemphasized because they have abilities to act on plaque, bacterial and inflammations as it has been mentioned in earlier.

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Table 1: Plant extracts and phytochemicals with potential application against oral bacteria
(Enzo, 2011)

Extract (solvent)	MIC ^a	Phytochemical (class)	MIC ^a
Propolis (ethanol)	2.0–64.0	Macrocarpals A,B,C (terpenes)	0.5–1.0
<i>Mikania laevigata</i> (ethanol)	12.5–100.0	Bakuchiol (terpene)	1.0–4.0
<i>Mikania glomerata</i> (ethanol)	12.5–100.0	Erycristagallin (flavonoid)	1.6–6.3
<i>Drosera peltata</i> (chloroform)	15.6–31.3	Beta acid	2.0
<i>Helichrysum italicum</i> (ethanol)	31.3–62.5	Xanthorrhizol (terpene)	2.0–4.0
<i>Coptidis rhizoma</i> (water)	31.0–250.0	Artocarpin (flavonoid)	3.1–12.5
<i>Piper cubeba</i> (aqueous ethanol)	90.0–200.0	Artocarpesin (flavonoid)	3.1–12.5
		Macelignan (flavonoid)	3.9
		Catechol (phenolic)	6.5
		Kuwanon G (flavonoid)	8.0
		Xanthohumol (flavonoid)	12.5
		Tetra iso-alpha acid	12.5
		Berberine (alkaloid)	13.0–20.0
		Compound 2 ^b (terpene)	15.6
		<i>Chlorhexidine</i> ^c	1.0
		<i>Triclosan</i> ^c	0.1–20.0

^aMinimum inhibitory concentration (µg/mL); ^b18-β-D-3',6'-diacetoxyglucopyranosyl-ent-kaur-16-ene;

^cThe MIC values for chlorhexidine and triclosan have been added for comparative purposes

Table 2: Plants used in oral care

Plant	Use	Property	Reference
Liquorice(<i>Glycyrrhiza labra</i>)	Used in oral care products	antibacterial, anti-plaque, anti-caries	Segal et al 1885
Scutellaria(<i>Scutellaria baicalensis</i>)	Effective against oral bacteria	Combats-gum disease, anticaries	Chung et al 1995
Tea (<i>Camellia sinensis</i>)	Good activity versus oral bacteria	anti-caries, anti-inflammatory	Rasheed, 1998
Marigold (<i>Calendula officinalis</i>)	Used in oral care, especially mouth washes	anti-inflammatory, antibacterial	Schmidgall et al 2000
Mangosteen(<i>Garcinia mangostana</i>)	used in mouthwashes	Astringent	Rassamee-masmaung et al 2007
Oregano (<i>Origanum vulgare</i>)	Used in mouth washes	Antibacterial, antiseptic	Saeed et al 2009
Strawberry leaves (<i>Fragaria fresco</i>)	Used to treat infections of the mucous membrane	anti-plaque, anti-caries	Dr. Dukes database
Balm Mint (<i>Melissa officinalis</i>)	Used to treat infections	soothing, antiseptic, antibacterial,	Hăncianu et al 2008
Propolis	Used in oral care	anti-caries, anti-plaque	Steinberg et al 1996
Miswak(<i>Salvadora persica</i>)	Called "toothbrush tree" Used as chewing sticks	antimicrobial, anti-plaque, anti-caries	Sofrata et al 2008
Paracress (<i>Spilanthes/ Acmellaoleracea</i>)	Used in traditional medicine to treat toothache	tones gums, anti-inflammatory	Wu et al 2008
Hops (<i>Humulus lupulus</i>)	Used in tooth paste	inhibits adherence of <i>Streptococcus mutans</i>	Tagashira et al 1997

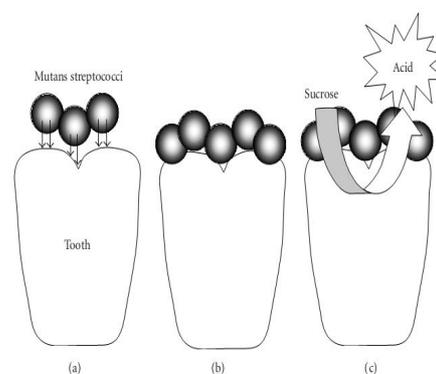


FIGURE 1: The development of tooth decay. (a) Initial adhesion-mediated attachment of mutans streptococci; (b) aggregation mediated by synthesis of extracellular polysaccharide; (c) metabolism of carbohydrates results in acid production, leading to demineralization and cavitation of the tooth. Plant extracts and phytochemicals have been demonstrated to inhibit any or all of these stages. That is, tidal activity against cariogenic bacteria, inhibition of adherence/aggregation/biofilm formation and inhibition of glycolytic acid production.

Fig. 1:



Fig. 2: Various Plants used in oral care

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