

Ethnomedicine: use in dental caries

Singh J¹

Kumar A²

Budhiraja S¹

Hooda A²

¹Department of Pharmacology , Pt.B.D.Sharma
PGIMS,Rohtak-124001, Haryana,India.

²Department of Prosthodontics , Government
Dental Medical College, Rohtak-124001,
Haryana, India.

Received for publication: March 03, 2006

Accepted: May 10, 2007

Abstract

Ubiquitousness and increasing prevalence of dental caries makes it one of the most important problems in public health. Due to high cost and lack of resources at primary levels prevention is better in dental caries. Since the origin is related to bacteria, antibacterial is mainstay of treatment. Lack of high efficacy with antibacterial agents, unwanted effects and resistance to these agents are drawing attention of scientists to search for new and better drugs. Plants products are currently gaining attention for treatment of various ailments. Although, these has been exploited for various oral ailments this article describes use of plants products for prevention and cure of dental caries.

Key Words:

dental caries, herbal, plants, ethnomedicine

Correspondence to:

Salil Budhiraja
Shiksha kunj public school,
Chinnot colony, Rohtak, 124001,
Haryana, India.
E-mail: salil_budhi@yahoo.co.in

Introduction

Dental caries is one of the most important problems in public health because of its ubiquitousness in civilized populations. The prevalence of dental caries in industrialized countries like India is on the rise. As the treatment is very costly and requires a lot of manpower, the prevention at the primary level is the solution of choice. Dental plaque is formed by the colonization and accumulation of oral microorganisms in the insoluble glucan layer that are synthesized by glucosyltransferase (GTase) from *Streptococcus mutans*¹. De novo synthesis of water insoluble glucan is essential for the adherence of *S. mutans* and other oral microorganisms to the tooth surface, forming a barrier that prevents the diffusion of acids produced by the bacteria. The acids accumulate in situ and decalcify minerals in the enamel². *Actinomyces naeslundii* and *Actinomyces visosus* are usually associated with dental caries particularly human root surface caries³. To avoid dental caries due to cariogenic bacteria, inhibition of glucosyltransferase activity by specific enzyme inhibitor⁴, inhibition of initial cell adhesion of *S. mutans* by polyclonal and monoclonal antibodies⁵ and inhibition of cell growth of *S. mutans* by antibacterial agents have been investigated. This third line of research in particular has attracted a great deal of attention. Effective antimicrobial agents against these oral pathogens could play an important part in the prevention of dental caries. However, many attempts for prevention of dental caries were of no practical use up to the present. Antibiotics such as penicillin and erythromycin have been reported to effectively prevent dental caries in animal and humans⁶ but they are never used clinically because of many adverse effects such as hypersensitivity reaction, suprainfections and teeth staining. Furthermore, *viridans* group *streptococci* including *S. mitis*, *S. sanguis* and *S. mutans*, the most representative human cariogenic bacteria are moderately resistant to antibiotics⁷. These drawbacks justify further research and development of natural antibacterials that are safe for the host or specific for oral pathogens. The natural phytochemicals could offer an effective alternative to antibiotics and represent a promising approach in prevention and therapeutic strategies for dental caries and other oral infections. Although, plant products are greatly exploited for therapeutic potential to cure various oral ailments, this article describes natural medicines/products beneficial only in dental caries.

Natural products have been used for thousands of years in folk medicine for several purposes. As most of the oral diseases are due to bacterial infections and it has been well documented that medicinal plants confer considerable antibacterial activity against various microorganisms including bacteria responsible for dental caries⁸. The spice extracts, Cinnamon bark oil, Papua mace extract and Clove bud oil were reported to inhibit the growth of many oral bacteria⁹. Green tea extracts which is customarily drunk after

every meal in Japan is known to contain several polyphenols that inhibit the growth of *S. mutans*¹⁰. *Sanguinaria* is an alkaloid extract from the rhizome of the *Sanguinaria canadensis*. It has been reported to possess a broad spectrum antibacterial activity against a variety of oral bacteria¹¹. Antibacterial activity of some plant species like *Melia azadirachta*, *Calotropis gigantea*, *Leucas aspera*, *Vitex negundo* and others have been tested¹².

In India plant wealth is greatly exploited for its therapeutic potential and medicinal efficacy to cure dental caries. RN Chopra has described many plants being used in prevention of dental caries. These include *Melia azadirachta*, *Moringa pterygosperma* and *Balsamodendron mukul*. The stem, bark, root and young fruits of *Melia azadirachta* are used as bitter, tonic, antiseptic, astringent and antibacterials. In several indigenous tooth powders, toothpastes, toilet soaps, the extract from various parts of this tree is used. The use of Neem twigs as tooth brush has been endorsed by the dentists to prevent caries¹³. *Azadirachta indica* mouth wash is reported to inhibit growth of *S. mutans* and carious lesions¹⁴. The medicinal virtues of *Moringa pterygosperma* (*Moringaceae*) have long been known and appreciated in India. Almost all parts of the plant (root, leaves, seeds, flowers) have been used in indigenous system. Seed oil is used externally for relieving pain of joints in gout and rheumatism. The root has been recommended by Hakims (Ayurvedic practitioner) in the treatment of soreness of the mouth and throat and pain in the gum due to dental caries. It has also been used as an abortifacient, rubefacient and counter irritant¹³. *Balsamodendron mukul* (*Burseraceae*) grows in the arid zones of Rajputana, Khandesh, Sind, Kathiawar, East Bengal and Assam. The oleogum resin from the plant known as guggul is used as a demulcent, carminative and alternative. It is stated to be useful in leprosy, rheumatism, syphilis, nervous system and skin diseases. The drug has a wide range of usefulness in the indigenous medicine. It is used in the form of lotion for ulcers and as a gargle in caries of teeth, weak and spongy gums, pyorrhoea alveolaris, chronic tonsillitis, pharyngitis and ulcerated throat¹³.

Hebber et al.¹⁵ reported the results of a survey carried out in western ghat region of Dharwad district of Karnataka (India). These workers suggested the use of some plants in the treatment of dental caries for example dried whole plant of *Calotropis gigantea* (*Asclepiadaceae*) is burnt to get ash which is used to massage the tooth and gum after brushing in the morning and evening for curing of plaque, caries and pyorrhea. Powdered seeds of *Cassia hirsute* (*Caesalpinaceae*) are used to massage the teeth and gums to protect from plaque and caries. Dried seeds of *Cassia tora* are fried and powdered. It is also used to massage the teeth and gums to protect from plaque and caries. *Leucas aspera* (*Lamiaceae*) whole plant is powdered and used to

massage on the teeth and gums for plaque and caries. Namba et al.¹⁶ isolated two compounds magnolol and honokiol from the ether and methanol extract of bark of *Magnoliae cortex*. These workers reported potent antibacterial activity of these compounds against cariogenic bacterium, *S. mutans* (MIC 6.3 mg/ml). Kohda et al.¹⁷ isolated and identified oleonolic acid and ursolic acid as active principles from chloroform extract of *Zizyphi fructus*. These workers demonstrated inhibitory activity of these compounds against insoluble glucan formation by glucosyltransferase from cariogenic bacterium *S. mutans*. Toukairin et al.¹⁸ isolated polyphenolic 5'-nucleotidase inhibitors from the seed and skin of the wine grape "Koshu" designated as NPF-88 BU-IA, NPF-88 BU IB, NPF-88 BU IIA and NPF-88 BU IIB. These compounds displayed inhibitory effects on the growth of *S. mutans*, a primary cariogenic bacterium. Furthermore, they inhibited the glucan formation from sucrose. Therefore, 5-nucleotidase inhibitors can prevent cause of caries of tooth. Chewing sticks (Miswak) which are roots of *Salvadora persica* plant have been used for centuries as oral hygiene tool in many parts of the world particularly in south Arabia. Many studies have demonstrated antiplaque, anticaries, antiperiopathic and antibacterial effects of these sticks¹⁹. Phytoalexins purified from *Sophora exigua* (*Leguminosae*) has been shown to possess significant anticaries and antibacterial activity²⁰. A new cariostatic compound named eucalyptone has been isolated from the leaves of *Eucalyptus globules* by Osawa et al.²¹ Sato et al.²² reported that methanolic extract from *Artocarpus heterophyllus* showed most intensive antibacterial activity against cariogenic bacteria. These workers suggested that isoprenyl flavones from this plant would be potent compounds for prevention of dental caries. Antibacterial activity of onion (*Allium cepa*) extract against *S. mutans* and *S. sobrinus* has also been reported²³. Plumbagin isolated from the chloroform extract of aerial parts of *Drosera peltata* is reported to possess significant antibacterial activity against cariogenic bacteria²⁴. Jagtap and karkera²⁵ reported that aqueous and alcoholic extracts from *Juglandaceae regia*, used as chewing sticks inhibited the growth and physiological functions of *S. mutans*. Bakuchiol was isolated from the seeds of *Psoralea corylifolia* a tree native to China with various uses in traditional oriental medicine²⁶. Further, antibacterial activity of Bakuchiol observed against *S. mutans* suggested great potential of this compound in preventing and treating dental caries²⁶. Wongkhan et al.²⁷ demonstrated antibacterial activity in ethanolic extract of *Streblus asper*. These workers suggested use of *Asper* leaf extract in controlling dental caries. A few recent studies have demonstrated antibacterial activity against selected oral pathogens from the native American plant *Ceanothus americans*, *Ceanothic acid* and *Ceanothetric acid*. These plants demonstrated growth

inhibitory effects against *S. mutans*, *Actinomyces viscosus* and *P. gingivalis*²⁶. Perilla seed extract (*Perilla Frutescaris* Britton Var Japonica Hara) has been shown to possess antimicrobial activity against oral cariogenic *Streptococci* and periodontopathic *Porphyromonas gingivalis*²⁸. Therefore, Perilla seed extract could prevent dental caries and periodontal diseases. Addai et al.²⁹ reported that *Garcinia manii* (stick chewing) confers a caries preventing/control benefit by reversing acidogenic challenge to teeth. Antibacterial agent Kuwanon-G has been isolated from the ethylacetate fraction of methanol extract of *Morus alba* by Park and coworkers³⁰. MIC of Kuwana-G against *S. mutans* was determined to be 8 µg/ml. The bactericidal test showed that Kuwanon-G completely inactivated *S. mutans* at the concentration of 20 µg/ml. It also significantly inhibited the growth of other cariogenic bacteria such as *S. sobrinus*, *S. sanguis* and *Porphyromonas gingivalis* causing periodontitis. *Gymnema sylvestre* extracts are widely used in Australia, Japanese, Vietnamese and Indian folk literature. The plant is used in the treatment of diabetes mellitus and food additives against obesity and caries³¹. Sato et al.³² reported antibacterial activity of isoflavonoids isolated from *Erythrina variegata* (*Leguminosae*). These workers suggested the potential use of erycristagallin for prevention of dental caries.

In several animal experiments and human trials, green tea and black tea have been shown to reduce plaque score and caries index. Catechins and theaflavins, polyphenolic compounds derived from tea (*Camellia sinensis*, family *Theaceae*) have been reported to prevent tooth decay and oral cancer³³. These workers suggested possible use of tea in prevention of dental caries. Xiao et al.³⁴ reported the anticaries effects of five natural chinese medicine such as *Radix et Rhizoma rhei*, *Semen areca*, *Rhizoma ligustici chuanxiong* and *Catechu*. These products prevented the adherence of *S. mutans* and suggested to be beneficial in preventing dental caries. Oil of *Syzygium aromaticum* (clove) and *Zanthoxylum limonella* (makaen) were widely used essential oils for dental caries or flavoring of food in Thailand and other countries³⁵. Isopanduratin A, isolated from *Kaempferia pandurata* has shown to possess marked antibacterial activity against cariogenic *S. mutans*. Therefore, Isopanduratin A could be employed as a potential antibacterial agent for preventing dental caries³⁶.

Propolis, a resinous hive product is reported to prevent dental caries since it demonstrated significant antimicrobial activity against microorganisms such as *S. mutans*, *S. sobrinus* and *C. albicans* which involves in oral diseases³⁷. Propolis is a natural product that may prevent dental caries. *Baccharis dracunculifolia* D.C. (*Asteraceae*), a native plant from Brazil, is the most important botanical origin for the production of green propolis (Brazilian propolis) by honey bees. Leitao et al.³⁸ made a comparative evaluation of the

effects of extracts from green propolis and *B. dracunculifolia* (BD) on the glucan synthesis and acidogenic potential of *S. mutans*. These workers demonstrated that BD leaf rinse and green propolis extracts have similar inhibitory effects on the *S. mutans* cariogenic factors. They suggested that BD leaves may be a potential product for use against dental caries. Yatsuda et al.³⁹ demonstrated cariostatic potential of Cupressenic, Kurenoic and diterpenic acids isolated from *Mikania laevigata* and *M. glomerata* plants. Further, these workers showed antibacterial activity of these acids against *S. mutans*, *S. sobrinus* and *Actinomyces naeslundii*.

References

1. Gibbons RJ, Van Houte J. Bacterial adherence in oral microbial ecology. *Ann Rev Microbiol.* 1975; 29: 1-44.
2. Loesche WJ. Role of *Streptococcus mutans* in human dental decay. *Mecrobiol Rev.* 1986; 50: 353-80.
3. Chen LI, Lili MA, Heepark NO, Shi W. Cariogenic actinomyces identified with a β -glucosidase dependent green colour reaction to *Gardania Jasminoides* extract. *J Clin Microbiol.* 2001; 39: 3009-12.
4. Yanagida A, Kanda T, Tanabe M, Matsndaira F, Cordeiro JGO. Inhibitory effects of apple polyphenols and related compounds on cariogenic factors of *mutans Streptococci*. *J Agric Food Chem.* 2000; 48: 5666-71.

Table 1- Plants useful in dental caries

Plants	Family	Part used/ Alkaloid
<i>Melia azadirachta</i>	Meliaceae	All parts, Twigs, Extract ¹⁴
<i>Moringa Ptergosperma</i>	Moringaceae	All parts (root, leaves, seeds, Flowers) ¹³
<i>Balsamodendron mukul</i>	Burseraceae	Oleogum, resin, lotion ¹³
<i>Calotropis gigantea</i>	Asdepiadaceae	Dried whole plant ¹⁵
<i>Cassia hirsuta</i>	Caesalpiniaceae	Powdered seeds are used to massage on gums and teeth
<i>Cassia tora</i>	Caesalpiniaceae	Powdered seeds are used to massage on gums and teeth ¹⁵
<i>Leucas aspera</i>	Lamiaceae	Powered whole plant ¹⁵
<i>Magnolia obovata</i>	Magnoliaceae	Ether & methanolic extract of Bark ¹⁶
<i>M. officinalis</i>	Magnoliaceae	Ether & methanolic extract of bark
<i>Zizyphi fructus</i>		Chloroform extract of dried fruits of oleanolic and ursolic Acid ¹⁷
Wine grape "koshu"		Seed & skin of wine grape ¹⁸
<i>Salvadora persica</i> (Miswak)		Root used as chewing sticks ¹⁹
<i>Sophora exigua</i>	Leguminosae	Phytoalexins ²⁰
<i>Eucalyptus globus</i>	Myrtaceae	Leaves- Eucalyptone ²¹
<i>Artocarpus heterophyllus</i>	Moraceae	Methanolic extract of heart wood (Isoprenyl flavones) ²²
<i>Allium cepa</i>	Liliaceae	Extract ²³
<i>Drosera peltata</i>	Droseraceae	Chloroform extract of aerial parts (Plumbagin) ²⁴
<i>Juglandaceae regia</i>	Juglandaceae	Aqueous & alcololic extract, chewing sticks ²⁵
<i>Psoralea corylifolia</i>	Leguminosae	Bakuchiol ²⁶
<i>Streblus asper</i>	Moraceae	Ethanolic extract Asper leaf ²⁷
<i>Garcinia manii</i>	Guttiferae	Chewing sticks ²⁹
<i>Morus alba</i>	Moraceae	Ethyl acetate fraction of root bark (Kuwanon G) ³⁰
<i>Gymnema sylvestre</i>	Asclepiadaceae	Whole plant extract ³¹
<i>Erythrina variegata</i>	Leguminosae	Isoflavanoids-Erycristagallin ³²
<i>Camellia sinensis</i>	Theaceae	Green tea, black tea, catechins, theaflavins, polyphenols ³³
<i>Kaempferia pandurata</i>	Zingiberaceae	Isopanduratin A ³⁴

5. Raamsdonk M, Mei HC, Soet JJ, Busscher HJ, Graff J. Effect of polyclonal and monoclonal antibodies on surface properties of *Streptococcus sorbrinus*. *Infec Immun*. 1995; 63: 1698-1702.
6. Kubo I, Muroi H, Himejima M. Antimicrobial activity against *Streptococcus mutans* of mate tea flavor components. *J Agric Food Chem*. 1992; 40: 245-8.
7. Venditti M, Baiocchi P, Santini C, Brandimarte C, Serra P, Gentile G, et al. Antimicrobial susceptibilities of streptococcus species that cause septicemia in neutropenic patients. *Antimicrob Agents Chemother*. 1989; 33: 580-2.
8. Jonathan EK, Anna KJ, Johannes VS. Zulu medicinal plants with antibacterial activity. *J Ethnopharmacol*. 2000; 69: 241-6.
9. Saeki Y, Ito Y, Okuda K. Antimicrobial action of natural substances on oral bacteria. *Bull Tokyo Dent Col*. 1989; 30: 129-35.
10. Sakanaka S, Kim M, Taniguchi M, Yamamoto T. Antibacterial substances in Japanese green tea extract against *Streptococcus mutans*, a cariogenic bacterium. *Agric Biochem*. 1989; 53: 2307-11.
11. Joann LD, Sigmund SS. Comparative in vitro activity of *Sanguinariane* against oral microbial isolates. *Antimicrob Agents Chemother*. 1985; 27: 663-5.
12. Rao K. Materials for the database of medicinal plants. Bangalore: Karnataka State Council for Science and Technology; 2000.
13. Chopra RN, Chopra IC, Handa KL, Kapur LD. Chopra's indigenous drugs of India. 2nd ed. Calcutta: UN Dhur and Sons; 1958.
14. Vanka A, Tandon S, Rao SR, Udupa N. The effect of indigenous neem (*Azadirachta Indica*) mouth wash on *Streptococcus mutans* and lactobacilli growth. *Ind J Dent Res*. 2001; 12: 133-44.
15. Hebbar SS, Harsha VH, Shripathi V, Hegde GR. Ethnomedicine of Dharwad district in Karnataka India. Plants used in oral health care. *J Ethnopharmacol*. 2004; 94: 261-6.
16. Namba T, Tsunozuka M, Hattori M. Dental caries prevention by traditional Chinese medicines. *Planta Med*. 1982; 44: 400-6.
17. Kohda H, Kozai K, Nagasaka N, Miyake Y, Suginaka H, Hidaka K. Prevention of dental caries by oriental folk medicines- active principles of *Zizyphi fructus* for inhibition of insoluble glucan formation by cariogenic bacterium *Streptococcus mutans*. *Planta Med*. 1986; 2: 119-20.
18. Toukairin T, Uchino K, Iwamoto M, Murakami S, Tatebayashi T, Ogawara H, et al. New polyphenolic 5-nucleotidase inhibitor isolated from the wine grape "Koshu" and their biological effects. *Chem Pharm Bull (Tokyo)*. 1991; 39: 1480-3.
19. Gazi M, Davies TJ, AL-Bagiah N, Cox SW. The immediate and medium term effects of Meswak on the composition of mixed saliva. *J Clin Periodontal*. 1992; 19: 113-7.
20. Tsuchiya H, Sato M, Linuma M, Yokoyama J, Chyama M, Tanaka T, et al. Inhibition of the growth of cariogenic bacteria in vitro by plant flavanones. *Experientia*. 1994; 50: 846-9.
21. Osawa K, Yasuda H, Morita H, Takeya K, Itokawa H. Eucalyptone from Eucalyptus globules. *Phytochemistry*. 1995; 40: 183-4.
22. Sato M, Fujiwara S, Tsuchiya H, Fujii T, Linuma M, Tosa H, et al. Flavones with antibacterial activity against cariogenic bacteria. *J Ethnopharmacology*. 1996; 54: 171-6.
23. Kim JH. Antibacterial action of onion (*Allium cepa*) extracts against oral pathogenic bacteria. *J Nihon Univ Sch Dent*. 1997; 39: 136-41.
24. Didry N, Dubreuil L, Trotin F, Pinkas M. Antimicrobial activity of aerial parts of *Drosera peltata* smith on oral bacteria. *J Ethnopharmacology*. 1998; 60: 91-6.
25. Jagtap AG, Karkera SG. Extract of *Juglandaceae regia* inhibits growth, in vitro adherence, acid production and aggregation of *Streptococcus mutans*. *J Pharm Pharmacol*. 2000; 52: 235-42.
26. Katsura H, Tsukiyama RI, Suzuki A, Kobayashi M. In vitro antimicrobial activity of Bakuchiol against oral microorganism. *Antimicrobial Agents Chemother*. 2001; 45: 3009-13.
27. Wongkham S, Laupallarakasaem P, Pienhawechai K, Areejitranusorn P, Wongkham C, Techanitiswad T. Antimicrobial activity of *Streblus asper* leaf extract. *Phytother Res*. 2001; 15: 119-21.
28. Yamamoto H, Ogawa T. Antimicrobial activity of perilla seed polyphenols against oral pathogenic bacteria. *Biosci Biotechnol Biochem* 2002; 66: 921-4.
29. Addai FK, Nuamah IK, Parkins GE. Brief chewing of *Garcinia manii* stick reverses reduced saliva pH after a glucose rinse. *Med Sci Monit* 2002; 8: CR746-50.
30. Park KM, You JS, Lee HY, Baek NI, Hwang JK. Kuwanon G: An antibacterial agent from the root bark of *Morus alba* against oral pathogens. *J Ethnopharmacol* 2003; 84: 181-5.
31. Porchezian E, Dobrival RM. An overview on the advances of *Gymnema sylvestre*: chemistry, pharmacology and patents. *Pharmazie* 2003; 58: 5-12.
32. Sato M, Tanaka H, Fujiwara S, Hirata M, Yamaguchi R, Etoh H, Tokuda C. Antibacterial property of isoflavonoids isolated from *Erythrina variegata* against cariogenic oral bacteria. *Phytomedicine* 2003; 10: 427-33.
33. Lee MJ, Lambert JD, Prabhu S, Meng X, Lu H, Haliakal P, et al. Delivery of tea polyphenols to the oral cavity by green tea leaves and black tea extract. *Cancer Epidemiol Biomarkers Pre* 2004; 13: 132-7.
34. Xiao Y, Liu TJ, Huang ZW, Zhou XD, Li JY. The effect of natural medicine on adherence of *Streptococcus mutans* to salivary acquired pellicle. *Sichuan Da Xue Xue Bao*. 2004; 35: 687-9.
35. Trongtokit Y, Rongsriyyam Y, Komilamisra N, Krisackphong P, Apiwathnasorn C. Laboratory and field trial of developing medicinal local Thai plant products against four species of mosquito vectors. *Southeast Asian J Trop Med Public Health* 2004; 35: 325-33.
36. Hwang JK, Chung JY, Baek NI, Park JH. Isopanduratin A from *Kaempferia pandurata* an active antibacterial agent against cariogenic *Streptococcus mutans*. *Int J Antimicrob Agents* 2004; 23: 377-81.
37. Uzel A, Sorkun K, Oncag O, Cogulu D, Gencav O, Salih B. Chemical compositions and antimicrobial activities of four different *Anatolian propolis* samples. *Microbial Res* 2005; 160: 189-95.
38. Leitao DP, Filho AA, Polizello AC, Bastos JK, Spadaro AC. Comparative evaluation of *in vitro* effects of Brazilian green propolis and *Baccharis dracunculifolia* extracts on cariogenic factors of *Streptococcus mutans*. *Biol Pharm Bull* 2004; 27: 1834-9.
39. Yatsuda R, Rosalen PL, Silva F, Fujita MG, Cury JA, Rehder VG, et al. Antimicrobial activity of compounds isolated from *Mikania laevigata* and *M. glomerata* on oral pathogens. *Caries Res* 2005; 39: 312.