Saudi Journal of Oral and Dental Research
Scholars Middle East Publishers
Dubai, United Arab Emirates
Website: http://scholarsmepub.com/

ISSN 2518-1300 (Print)
ISSN 2518-1297 (Online)

Review Article

Indian traditional medicinal herbs against dental caries – an unsung past to a bright future

Dr. Amith Adyanthaya[1], Dr. Sajeela Ismail[2*], Dr. Natta Sreelakshmi[3]
[1]Reader, [2]Postgraduate student, [3]Professor and Head, Department of Pedodontics and Preventive Dentistry, KMCT Dental, College, Calicut, Kerala, India

***Corresponding Author:**
Dr. Sajeela Ismail
Email: sajeelaismail@gmail.com

Abstract: Dental caries (tooth decay) is one of the most important global oral health problems. Tooth decay can have a negative impact on activities of daily living and consequently on a person's quality of life. Of the many species of microbes normally present in the oral cavity, Streptococcus mutans is the most significant bacterial group implicated in development of dental caries. Consequently, reducing the bacterial load is a practical prevention strategy. Various chemo-mechanical aids have been used towards achieving the goal. But many of the chemical constituents become disadvantageous due to various reasons like formation of stains and development of microbial resistance with prolonged use. As a result, researching and scientifically validating newer formulations becomes significant. This literature review briefly sums up the scientific basis of few indigenously used medicinal plants in India which have shown action against oral microorganisms like Streptococcus mutans. These studies have the potential to be converted into commercial preparations with appropriate field trials**.**

Keywords: dental caries, S. mutans, herbs, traditional medicine, India.

INTRODUCTION

Oral health is the window to an individual's overall health. Good oral health contributes positively to one's physical, mental and social well-being. Dental caries remains the most important dental health problem in developing countries [1]. Scientific reports in the past decade signal an alarming increase in the global prevalence of dental caries in children and adults, primary and permanent teeth, as well as coronal and root surfaces [2]. The multi factorial basis for development of dental caries combined with its association with low socio economic status has always remained a matter of concern for health care professionals. However, several effective, evidence based prevention strategies and various management protocols have been developed once the disease occurs. In the wake of a paradigm shift in healthcare approaches, attempts have been made in utilizing and scientifically validating more medicinally useful natural resources. In an era of extensive research for alternative natural products, phytochemicals isolated from certain plants used in traditional Indian medicine have been suggested to be potential options in combating dental caries causing microorganisms [3].

The acidogenic and aciduric Gram-positive bacteria, primarily the *mutans Streptococci* is considered the prime causative species of dental caries [4]. They metabolize sucrose to organic acids which dissolves the calcium phosphate in the teeth, causing decalcification and eventual decay [5]. Reducing the oral microbial load is a viable prevention strategy in combating the development of carious lesions.

Herbal preparations against this species of cariogenic microflora can be derived from the root, leaves, seeds, and flowers.

Since ancient times, medicinal plants have been used as traditional treatment modalities for various human diseases in many parts of the world. These natural products and plant extracts are abundant sources of biologically active compounds [6], making them effective alternatives to routinely used drugs. Many of the popular medicines have become less effective over the years due to the resistance developed by microbes.

India is a land of rich biodiversity and indigenous knowledge, particularly traditional ethnomedical practices. It is reported that the folk medicine system of India uses about 5000 different plant species with about 25,000 formulations as medicines for various ailments whereas the tribal healers use about 8000 wild plants with nearly 1,75,000 preparations. The classical indigenous Indian system of

medicine prescribes about 10,000 documented preparations [7].

Many of these unfamiliar plants have been studied for their benefits against specific oral pathogens [8].

The purpose of this review is to present few lesser known traditional Indian medicinal plants,their bioactive phytochemical, part of the herb used and their minimum inhibitory concentration (MIC) against Streptococcus mutans specifically.

The purpose of this review is to present few lesser known traditional Indian medicinal plants, their bioactive phytochemical, part of the herb used and their minimum inhibitory concentration (MIC) against Streptococcus mutans specifically.

The PubMed (MEDLINE) database of the US National Library of Medicine and the Cochrane Library of the Cochrane Collaboration (CENTRAL) were used as electronic databases, and a literature search was accomplished of articles published in English from 1980 to 2015 with the keywords Indian herbs, traditional medicine, dental caries

Spilanthes acmella

Spilanthes as a genus is composed of 60 species distributed in the tropics and the subtropics. This plant is widely distributed in the tropical and sub-tropical regions including America, North Australia, Africa, Malaya, Borneo, India and Sri Lanka [9]. Indigenously known in India as the toothache plant, eyeball plant, paracress or Akarkara, spilanthes has been widely used in traditional medical practice for alleviating toothache due to the numbness produced by chewing the flower heads, also as a loop diuretic, improving digestion, as anti-malarial, muscle relaxant, treating sore throat, flu, headache,fever and wrinkling of skin [10].

The bioactive components included lipophilic alkylamides mainlySpilanthol isolated from the flower buds are found to act against microbes including streptococcus, Enterococcus, Escherichia, Klebsiella andSalmonella species. Chloroform extract of S. acmella displayed antimicrobial activity against Streptococcus species with MIC of 256 µg/mL [11].

Prosopis spicigera

Known in various Indian languages as Jand(Hindi)/Vanni(Tamil)/Shami(Sanskrit),Prosopis spicigera is a member of Fabaceae family which grows in the arid regions of the world. The ethanolic fraction of P. spicigera leaf extract which contains the piperidine alkaloid spicigerin [12] shows significant activity against Streptococcus species including S.mutans and S.bovis with the least MIC being 4.88 µg/ml [14].

TraditionalIndian medicine system utilizes various parts of the plant for treating ailments including hypertension, rheumatism, and dysentery among many others.

Curcuma longa (Turmeric)

Turmeric is a herbaceous perennial plant belonging to the ginger family Zingiberaceae. Better known as haldi in India, turmeric has beenreferred to as the 'golden spice of life' by ancient Indian healers and folk medicine practitioners.It has proven anti-inflammatory, choleretic, antimicrobial, and carminative actions [14]. The traditional Indian system of medicine of Ayurveda uses turmeric preparations for respiratory diseases including asthma, bronchial hyperactivity, allergy, cough and runny nose [15]. Turmeric is thought to have many medicinal properties including strengthening the overall energy of the body, improving digestion and in combating various gastrointestinal problems [16].

Sortase A is an enzyme proven to play a role in modulating the surface properties and the biofilm formation capacity and influence the cariogenicity of *Streptococcusmutans*. The phytochemical Curcumin isolated from the roots of turmeric plant can inhibit purified *S. mutans* sortase A with a half-maximal inhibitory concentration (IC_{50}) of (10.2 ± 0.7) µmol/l, which is lower than minimum inhibitory concentration (MIC) of 175 µmol/l [17].

Piper cubeba

Commonly known as long pepper, tailed pepper,Java pepper or kabab-chini in India, Piper cubeba belongs to the Piperaceae family. It was also described by Hippocrates, who mentioned it as a medicament rather than a spice. A perennial plant with a climbing stem, various parts have been used since ancient times by principal contributors to the art and science of traditional Ayurvedic practice as mouthwash to cure halitosis, as an expectorant for cough, loss of voice and fever. The antioxidant [18], anti-inflammatory [19] and anti-microbial [20] properties have been researched and documented in the recent times.

Acetone, methanol and ethanol extracts of P.cubeba has shown activity against both two Streptococcal species namely, S. aureus and the caries causing S.mutans with an MIC of 50 mg/ mL [21]. The fruit of P. longum contains a large number of alkaloids and related compounds, the most abundant of which is piperine, together with methyl piperine, pipernonaline and piperettine [22].

Morus alba

Morus alba commonly known as white mulberry belongs to family Moraceae is also known as Tut,shahtoot or mulberry in India. The plant is a very good source of ascorbic acid, carotene, Vitamin B1,

folic acid, isoquercetin, quercetin, tannins, flavonoids and saponins, which are good antioxidants.Morus alba has been studied for its antidiabetic [23], antihelmintic, antimicrobial [24], antioxidant, anxiolytic, hepatoprotective and nephroprotective properties [25].

Antibacterial agent kuwanon G isolated from root bark has showed action against *Streptococcus mutans*at an MIC of 8.0 µg/ml. The bactericidal test showed that kuwanon G completely inactivated *S. mutans* at the concentration 20 µg/ml in 1 min [26].

Trachyspermum ammi

Trachyspermum ammi is a native of Egypt and is cultivated in Iraq, Iran, Afghanistan, Pakistan, and India.Referred to as Ajwain in India, belongs to family Apiaceae is a highly valued medicinally important seed spice [27].

The indigenous Indian system of medicine uses Ajwain as an antimicrobial [28], antihypertensive, anti-spasmodic, broncho-dilating, antilithiasis [29], carminative, antipyretic [30] among numerous other uses. Real-time RT-PCR analyses showed that 2-Isopropyl-5-methyl-phenol isolated from these seeds were found to significantly suppress of the genes involved in biofilm formation and thus affect the cariogenicity of S.mutans [32].

Acacia nilotica

Acacia nilotica commonly known as babul, kikar or Indian gum Arabic tree, has been recognized as a versatile tree. A member of the family Leguminosae, it is widely distributed throughout arid and semi-arid zones of the world. The phytochemicals contribute chemically to a number of groups among which are alkaloids, volatile essential oils, phenols and phenolic glycosides, resins, oleosins, steroids, tannins and terpenes [32].

The extracts have anti-hypertensive, anti-mutagenic, anti-carcinogenic, anti- spasmodic,anti-inflammatory, anti-oxidant and anti-platelet aggregatory properties [33]. A. nilotica has anti-plasmodial, anti-fungal, anti-microbial activity, inhibitory activity against HCV and HIV [34].

Acacia nilotica stem bark extracts contain alkaloids, saponins, cardiac glycosides, tannins, flavonoids and anthraquinones which have high inhibitory activity against Streptococcus mutans with a MIC in the range of 9.75-313µg/ml [35].

Morinda citrifolia

This small evergreen shrub is native from Southeastern Asia to Australia, but now has a pantropical distribution. Commonly known as Noni or Indian mulberry, M.citrifolia belongs to family Rubiaceae.

The whole Noni plant in various combinations have been used for more than 2000 years for herbal remedies including arthritis, diabetes, high blood pressure, muscle aches and pains, menstrual difficulties, headaches, heart disease, gastric ulcers, sprains, mental depression, poor digestion and atherosclerosis. Scientific evidence of the benefits of the Noni fruit Juice is limited but there is some anecdotal evidence for successful treatment of colds and influenza [36].

A recent study confirms that a crude aqueous extract (1000µg/ ml) of ripe M. citrifolia fruits effectively inhibited the growth of S. mutans and S. mitis with an MIC of 125 µg and 62.5 µg, respectively [37].

Almost 160 phytochemical compounds have been isolated from the M. citrifolia plant, the majority of are organic acids, phenolic compounds, and alkaloids the most important ones being anthraquinones, aucubin, asperuloside, and scopoletin [38].

Droserapeltata

Better known as the insectivorous shield/pale sundew, this member of Droseraceae family is an endangered plant species in India [39]. Drosera contains naphthoquinones such as plumbagin, 7-methyljuglone and flavonoides, which have pharmacological value. Plumbagin isolated from the chloroform extract of aerial parts of Droserapeltata is reported to possess significant antibacterial activity against S.mutans at an MIC of 31.25 µg/ml [40].

Azadirachta indica

Azadirachta indica of family Meliaceae, or the renowned Indian neem (margosa tree) or Indian lilac, is one of the most versatile medicinal plants having a wide spectrum of biological activity [41]. The importance of the neem tree has been recognized by the US National Academy of Sciences, which published a report in 1992 entitled 'Neem – a tree for solving global problems'. The medicinal utilities of various parts of the plant have been described of which the leaf, fruit, bark and oil are most important. Neem oil finds use in controlling various skin infections, leprosy, respiratory and intestinal ailments [42].

Neem also possesses anti-inflammatory, antipyretic, analgesic activities, immunostimulant activity, hypoglycaemic, antiulcer effect and antimalarial activity [43].

MIC of methanolic extract of A. indica against S.mutans has been estimated to be 60.5mg/ml [44].

Evidence of antimicrobial activities of Neem twig extracts against cariogenic pathogens indicates the presence of bioactive components which need to be isolated and identified in the incorporation in the modern oral health care system. A large number of

compounds including Nimbidin, Nimbolide, Gedunin, Azadirachtin, Mahmoodin, Condensed tannins with gallinacid,epicatechin and catechin have been isolated from various parts of neem [45].

Cocos Nucifera oil

The traditional medicine native to the Indian subcontinent has made use of oil pulling using coconut for curing and relieving many oral problems. The procedure involves swishing oil in the mouth for 15–20 minutes for oral and systemic health benefits. Oil pulling has been used extensively as a traditional Indian folk remedy for many years to prevent decay, oral malodor, bleeding gums, dryness of throat, cracked lips and for strengthening teeth, gums and the jaw [46].

The phytochemical analyses carried out on the milled kernel showed the presence of terpenoids, alkaloids, resins, glycosides and steroids [47].

MIC of *Cocos nucifera* husk against S.mutans has been estimated to range mainly between 50 mg/ml and 100 mg/ml [48].

CONCLUSION

Today according to the World Health Organization (WHO), as many as 80% of the world's people depend on traditional medicine for their primary healthcare needs. There are considerable economic benefits in the development of indigenous medicines and in the use of medicinal plants for the treatment of various diseases [49].
Ethnobotany is not new to India because of its rich ethnic diversity.

In the developed countries, 25 per cent of the medical drugs are based on plants and their derivatives [50] (Principe 1991)

This review quotes valuable research on phytochemicals present in certain plants which have shown action against oral microorganisms like Streptococcus mutans. These studies have the potential to be converted into commercial preparations with appropriate field trials.

It was rightly stated by Philippus Theophrastrus(Paracelsus) *"All that man needs for health and healing has been provided by God in nature, the challenge of science is to find it."*

REFERENCES

1. Patro, B. K., Kumar, B. R., Goswami, A., Mathur, V. P., & Nongkynrih, B. (2008). Prevalence of dental caries among adults and elderly in an urban resettlement colony of New Delhi. *Indian Journal of Dental Research*, *19*(2), 95.
2. Prabu, G. R., Gnanamani, A., & Sadulla, S. (2006). Guaijaverin–a plant flavonoid as potential antiplaque agent against Streptococcus mutans. *Journal of Applied Microbiology*, *101*(2), 487-495.
3. Alviano, D. S., & Alviano, C. S. (2009). Plant extracts: search for new alternatives to treat microbial diseases. *Current Pharmaceutical Biotechnology*, *10*(1), 106-121.
4. Charantimath, S., & Oswal, R. (2013). Herbal therapy in dentistry: a review. *Innovative Journal of Medical and Health Science*, *1*(1).
5. Pushpangadan, P., & George, V. (2010). Ethnomedical practices of rural and tribal populations of India with special reference to the mother and childcare. *Indian Journal of Traditional Knowledge*, *9*(1), 9-17.
6. Palombo, E. A. (2011). Traditional medicinal plant extracts and natural products with activity against oral bacteria: potential application in the prevention and treatment of oral diseases. *Evidence-Based Complementary and Alternative Medicine*, *2011*.
7. Yadav, K., & Singh, N. (2010). Micropropagation of Spilanthes acmella Murr.–An important medicinal plant. *Nature and Science*, *8*(9), 5-11.
8. Jirovetz, L., Buchbauer, G., Wobus, A., Shafi, M. P., & Abraham, G. T. (2005). Essential oil analysis of Spilanthes acmella Murr. Fresh plants from Southern India. *Journal of Essential Oil Research*, *17*(4), 429-431.
9. Prachayasittikul, S., Suphapong, S., Worachartcheewan, A., Lawung, R., Ruchirawat, S., & Prachayasittikul, V. (2009). Bioactive metabolites from Spilanthes acmella Murr. *Molecules*, 14(2), 850-867.
10. Ahmed, J., Bharkad, V. B., & Gond, N. Y. (2014). Phytochemical Investigation Of Ethno Medicinal Prosopis Spicigera Leaves. *Indo American Journal of Pharmaceutical Research*, 4(2), 1094-1097.
11. Khan, R., Zakir, M., Afaq, S. H., Latif, A., & Khan, A. U. (2010). Activity of solvent extracts of Prosopis spicigera, Zingiber officinale and Trachyspermum ammi against multidrug resistant bacterial and fungal strains. *The Journal of Infection in Developing Countries*, 4(05), 292-300.
12. Bone, K., & Mills, S. (2013). Principles and practice of phytotherapy: modern herbal medicine. *Elsevier Health Sciences.*
13. Araujo, C. A. C., & Leon, L. L. (2001). Biological activities of Curcuma longa L. *Memorias do Instituto Oswaldo Cruz*, *96*(5), 723-728.
14. Hanai, H., & Sugimoto, K. (2009). Curcumin has bright prospects for the treatment of inflammatory bowel disease. *Current pharmaceutical design*, *15*(18), 2087-2094.
15. Hu, P., Huang, P., & Chen, M. W. (2013). Curcumin reduces Streptococcus mutans biofilm formation by inhibiting sortase A activity. *Archives of oral biology*, *58*(10), 1343-1348.
16. Natarajan, K. S., Narasimhan, M., Shanmugasundaram, K. R., & Shanmugasundaram, E. R. B. (2006). Antioxidant activity of a salt–

spice–herbal mixture against free radical induction. *Journal of ethnopharmacology*, *105*(1), 76-83.
17. Choudhary, G. P. (2006). Mast cell stabilizing activity of piper longum Linn.*Indian J Allergy Asthma Immunol*, *20*(2), 112-16.
18. Ali, M. A., Alam, N. M., Yeasmin, M. S., Khan, A. M., Sayeed, M. A., & Rao, V. B. (2007). Antimicrobial screening of different extracts of Piper longum Linn. *Res J Agri Biol Sci*, *3*(6), 852-857.
19. Aneja, K. R., Joshi, R., Sharma, C., & Aneja, A. (2015). Antimicrobial efficacy of fruit extracts of two Piper species against selected bacterial and oral fungal pathogens. *Brazilian Journal of Oral Sciences*, *9*(4), 421-426..
20. Atal, C. K., Zutshi, U., & Rao, P. G. (1981). Scientific evidence on the role of Ayurvedic herbals on bioavailability of drugs. *Journal of ethnopharmacology*, *4*(2), 229-232.
21. Mohammadi, J., & Naik, P. R. (2012). The histopathologic effects of Morus alba leaf extract on the pancreas of diabetic rats. *Turkish Journal of Biology*, *36*(2), 211-216.
22. Aditya, R. S. J., Ramesh, C. K., Riaz, M., & Prabhakar, B. T. (2012). Anthelmintic and antimicrobial activities in some species of mulberry. *Int J Pharm Pharm Sci*, *4*, 335-8.
23. Kalantari, H., Aghel, N., & Bayati, M. (2009). Hepatoprotective effect of Morus alba L. in carbon tetrachloride-induced hepatotoxicity in mice. *Saudi Pharmaceut J*, *17*(1), 90-94.
24. Park, K. M., You, J. S., Lee, H. Y., Baek, N. I., & Hwang, J. K. (2003). Kuwanon G: an antibacterial agent from the root bark of Morus alba against oral pathogens. *Journal of ethnopharmacology*, *84*(2), 181-185.
25. Bairwa, R., Sodha, R.S., Rajawat, B.S. (2012). Trachyspermum ammi. *Pharmacognosy reviews*, 1, 6(11),56.
26. Bonjar, G. S. (2004). Anti yeast activity of some plants used in traditional herbal medicine of Iran. *J Biol Sci*, *4*, 212-5.
27. Ahsan, S. K., Shah, A. H., Tanira, M. O. M., Ahmad, M. S., Tariq, M., & Ageel, A. M. (1990). Studies on some herbal drugs used against kidney stones in Saudi folk medicine. *Fitoterapia*, *61*(5), 435-438.
28. Umadevi, I., & Daniel, M. (1990). Phenolics of some fruit spices of the Apiaceae. *National Academy Science Letters*, *13*(12), 439-441.
29. Khan, R., Adil, M., Danishuddin, M., Verma, P. K., & Khan, A. U. (2012). In vitro and in vivo inhibition of Streptococcus mutans biofilm by Trachyspermum ammi seeds: an approach of alternative medicine.*Phytomedicine*, *19*(8), 747-755.
30. Banso, A. (2009). Phytochemical and antibacterial investigation of bark extracts of Acacia nilotica. *Journal of Medicinal Plants Research*, *3*(2), 082-085.
31. Singh, B. N., Singh, B. R., Sarma, B. K., & Singh, H. B. (2009). Potential chemoprevention of N-nitrosodiethylamine-induced hepatocarcinogenesis by polyphenolics from Acacia nilotica bark. *Chemico-Biological Interactions*, *181*(1), 20-28.
32. Sultana, B., Anwar, F., & Przybylski, R. (2007). Antioxidant activity of phenolic components present in barks of Azadirachta indica, Terminalia arjuna, Acacia nilotica, and Eugenia jambolana Lam. trees. *Food Chemistry*,*104*(3), 1106-1114..
33. Kalaivani, T. (2013). Antimicrobial Property Of Potent Medicinal Plant Acacia Nilotica (L.) Wild. Ex. Delile Subsp. Indica (Benth.) Brenan. *International J. Pharmacy and Pharmaceutical. Sciences*, *5*(2), 467-470.
34. Solomon, N. (1999). The tropical fruit with 101 medicinal uses. *Allergy*, *3*, 86.
35. Kumarasamy, B., Manipal, S., Prabu Duraisamy, A. A., Mohanaganesh, S. P., & Jeevika, C. (2014). Role of Aqueous Extract of Morinda Citrifolia (Indian Noni) Ripe Fruits in Inhibiting Dental Caries-Causing Streptococcus Mutans and Streptococcus Mitis. *Journal of Dentistry (Tehran, Iran)*, *11*(6), 703..
36. Wang, M. Y., & Su, C. (2001). Cancer preventive effect of Morinda citrifolia (Noni). *Annals of the New York Academy of Sciences*, *952*(1), 161-168.
37. Jayaram, K., & Prasad, M. N. V. (2006). Drosera indica L. and D. burmanii Vahl., medicinally important insectivorous plants in Andhra Pradesh-regional threats and conservation. *Current science*, *91*(7), 943-947.
38. Didry, N., Dubreuil, L., Trotin, F., & Pinkas, M. (1998). Antimicrobial activity of aerial parts of Drosera peltata Smith on oral bacteria. *Journal of ethnopharmacology*, *60*(1), 91-96.
39. Chatterjee, A., & Pakrashi, S. C. (1991). The treatise on Indian medicinal plants: vol. 1. *New Delhi: Publications and Information Directorate, CSIR 172p.-illus., col. illus.. ISBN 8172360118 En Icones. Includes authentic Sanskrit slokas in both Devnagri and Roman scripts. Plant records. Geog*, *6*..
40. Kirtikar, K. R. (1935). *Indian Medicinal Plants, Vol. 2. Lalit Mohan Basu, Allahabad, India*. P-1527-28..
41. Vohora, S. B., & Dandiya, P. C. (1992). Herbal analgesic drugs. *Fitoterapia*,*63*, 195-207.
42. Adyanthaya, S., & Pai, V. (2014). Antimicrobial potential of the extracts of the twigs of Azadirachta indica (Neem): an in vitro study. *Journal of Medicinal Plants*, *2*(6), 53-57.
43. Biswas, K., Chattopadhyay, I., Banerjee, R. K., & Bandyopadhyay, U. (2002). Biological activities and medicinal properties of neem (Azadirachta indica). *CURRENT SCIENCE-BANGALORE-*, *82*(11), 1336-1345..

44. Hebbar, A., Keluskar, V., & Shetti, A. (2010). Oil pulling–Unraveling the path to mystic cure. *J Int Oral Health*, *2*(4), 11-15.
45. Obidoa, O., Joshua, P. E., & Eze, N. J. (2010). Phytochemical analysis of Cocos nucifera L. *Journal of Pharmacy Research*, *3*(2), 280-286..
46. Jose, M., Cyriac, M. B., Pai, V., Varghese, I., & Shantaram, M. (2014). Antimicrobial properties of Cocos nucifera (coconut) husk: An extrapolation to oral health. *Journal of natural science, biology, and medicine*, *5*(2), 359.
47. Azaizeh, H., Fulder, S., Khalil, K., & Said, O. (2003). Ethnobotanical knowledge of local Arab practitioners in the Middle Eastern region.*Fitoterapia*, *74*(1), 98-108.
48. Principe, P. (1991). Monetizing the Pharmacological Benefits of Plants, US Environmental Protection Agency. *Washington DC*.