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

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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].

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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 subtropical regions including America, North Australia, Africa, Malaya, Borneo, India and Sri Lanka [9]. Indigenous to 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 mainly Spilanthenol isolated from the flower buds are found to act against microbes including streptococcus, Enterococcus, Escherichia, Klebsiella and Salmonella 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].

Traditional Indian 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 been referred to as the ‘golden spice of life’ by ancient Indian healers and folk medicine practitioners. It has proven anti-inflammatory, choleric, 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 *Streptococcus mutans*. The phytochemical Curcumin isolated from the roots of turmeric plant can inhibit purified *S. mutans* sortase A with a half-maximal inhibitory concentration (IC₅₀) 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 pipertetine [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,
Morus alba and oil are rich in kaixoquinones, aucubin, -naphthoquinones such as plumbagin, and anthraquinones, which have pharmacological value. 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, antmutagenic, 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

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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 Theophrastus (Paracelsus) “All that man needs for health and healing has been provided by God in nature, the challenge of science is to find it.”

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