

## **Plant products in dental and periodontal disease: An overview**

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### **ABSTRACT**

*Dental diseases if left unchecked can lead to major health problems, on the other side periodontal diseases are recognized as a major public health problem throughout the world and is the most common cause of tooth loss in adults. Plant products are recently introduced herbal formulations that are more beneficial than the conventional therapies. There are number of traditional herbal remedies for the treatment and management of diseases related to teeth, gum and oral hygiene. The aim of this review is to present a brief overview of the various herbal formulations and their application in prevention, treatment and maintenance of oral health.*

**Key Words:** Oral health, plant products, dental caries, gingivitis, periodontitis, microorganisms

### **Introduction**

Periodontal disease is recognized as a major public health problem throughout the world and is the most common cause of tooth loss in adults. Periodontal disease is a general term used to describe several pathological conditions that affect the supporting structures /tissues of teeth. [1] The success of periodontal therapy depends upon dealing with the negative environmental and behavioral factors and the reduction or elimination of periodontal pathogens. [2] Mechanical therapies, including scaling root planing and surgery are aimed at improving clinical conditions by lowering microbial

load either by physical removal of plaque or by radical alteration of the sub gingival habitat. Alteration in the sub gingival habitat is achieved by administration of antimicrobial agents, either systemically or locally, that directly targets sub-gingival species residing in the plaque biofilm. [3] Hence a wide range of anti-microbial agents have been evolved in recent years.

There has been a rise in the awareness and interest in pursuing alternative natural preparations among population; especially to avoid the rising dilemma of side effects caused by synthetic allopathic medications. [3] Deployment of

natural substances for use in dentistry is just gaining momentum. Medicinal plants are part and parcel of humans since the dawn of civilization. [4] The screening of plant extract and plant products for antimicrobial activity, has shown that plants represent a potential source of new anti-infective agents. [4]. Various studies have proven to show excellent medicinal properties of different herbal products in various medical and dental diseases. This review lists in brief about various herbal products, their medicinal properties and their uses in the field of dentistry.

### **Azadirachata indica (Neem)**

Azadirachta indica is the most commonly used traditional medicinal plant of India. Almost all parts of plants are endowed with medicinal properties and have been used as traditional medicines of household remedies against various human ailments, from antiquity. [4] A neem-extract dental gel reduced bacteria present in plaque i.e. Streptococcus mutans and Lactobacilli species significantly. [6] Biological activity of Neem is reported with the crude extracts and their different fractions from leaf, bark, root, seed and oil. Neem shows antiulcer, anti-inflammatory, anti-fungal, anti-bacterial, anti-viral, anti-carcinogenic, antiarrhythmic, antiviral, antioxidant, antidiabetic activity and antioxidant properties. [7, 8, 9]

### **Punica granatum (Pomegranate)**

Punica granatum belonging to family Punicaceae is more commonly known as pomegranate. [10] Pomegranate fruit extract contains anthocyanins, glucose, ascorbic acid, ellagic acid, gallic acid, caffeic acid, catechin, epigallocatechin, quercetin, rutin, iron and amino acids processing excellent anti-inflammatory, anti-oxidant, anti-

inflammatory, anti-proliferative, apoptotic [11] effects and possibly immuno-regulatory action on macrophages and T and B lymphocytes. [12] Pomegranate fruit extract gel was active against *S. sanguis*, *S. mutans* and *S. mitis* by inhibiting their adhesion on to the glass surface and that it could be used to prevent adherence of various microorganisms in the oral cavity. [13] Sastravaha et al. concluded in their preliminary study that local delivery with *Centella asiatica* and *Punica granatum* extracts following scaling and root planing showed significant improvements in pocket depth and attachment level compared to placebo. [14]

### **Psidium guajava (Guava)**

*Psidium guajava* commonly known as Guava is a phytotherapeutic plant belongs to the family Myrtaceae, which is considered to have originated in tropical South America. The bioactive components of guava are present in its leaves that can fight against pathogens. The leaves of guava contain an essential oil rich in cineol, tannins, triterpenes, flavonoids, resin, eugenol, malic acid, fat, cellulose, chlorophyll, mineral salts, and a number of other fixed substances. [15, 16, 17] The active flavonoid compound guaijaverin - extracted from leaves has high potential antiplaque activity by inhibiting the growth of *S. mutans* [18] and *S. aureus* in a study carried out by disc diffusion method. [19]

### **Aloe barbadensis (Aloe vera)**

The botanical name of Aloe vera is *Aloe barbadensis miller*. It belongs to Asphodelaceae (Liliaceae) family, and is a shrubby or arborescent, perennial, xerophytic, succulent, pea-green color plant. It grows mainly in the dry regions of Africa, Asia, Europe and America. The

parenchymal tissues makes up the inner portion of the aloe leaves which contains 75 potentially active constituents: enzymes, vitamins, minerals, salicylic acids, sugars, lignin, saponins, and amino acids.<sup>[20-22]</sup> Various medicinal properties of Aloe vera include positive effects on wound-healing, anti-viral property, anti-tumor effect, anti-inflammatory effects, anti-bacterial property, anti-fungal property, anti-oxidant property and immunomodulating effects.<sup>[23]</sup> In an in vitro study aloe vera demonstrated inhibition of the growth of a wide range of oral microbes such as *S. mutans*, *S. sanguis*, *A. viscosus* and *C. albicans*.<sup>[24]</sup> In a clinical study aloe vera mouth rinse showed significant reduction of gingivitis and accumulation of plaque.<sup>[25]</sup>

#### **Curcuma longa (Turmeric)**

*Curcuma longa* bears a common name Turmeric which has been used for thousands of years as a dye, a flavoring and a medicinal herb. It is a rhizomatous herbaceous perennial plant of family Zingiberaceae a native to Southeast Asia. Turmeric has also been widely used in ayurvedic medicine for its anti-microbial, anti-oxidant, anti-inflammatory astringent, anti-septic and analgesic properties.<sup>[26]</sup> Lee et al demonstrated that an essential oil isolated from *Curcuma longa* efficiently inhibited *S. mutans* species which is important microflora in formation of dental plaque and dental caries.<sup>[27]</sup> Curcumin, a major curcumanoid found in the spice turmeric, exhibits anti-inflammatory properties against *Porphyromonas gingivalis* which is considered as major periodontopathic bacterium.<sup>[28]</sup>

#### **Ocimum Sanctum Linn (Tulsi)**

*Ocimum sanctum* linn plant with a common name Tulsi belongs to the family Labiatae,

characterized by square stem and specific aroma. It is abundantly found in India, Malaysia, Australia, West Africa and some of the Arab countries. Even though different parts of Tulsi e.g. leaves, flowers, stem, root seeds etc. are known to have many medicinal potentials, most of therapeutic properties accounts for the leaves. The leaves of Tulsi contain 0.7% volatile oil comprising about 71% eugenol and 20% methyl eugenol.<sup>[29]</sup> It has been observed that fixed oil and linolenic acid of Tulsi possess anti-inflammatory activity against prostaglandin E2 (PGE2) as well as leukotriene and arachidonic acid-induced edema.<sup>[30]</sup> Tulsi acts as anti-bacterial especially *E. coli*, *S. mutans* and *S. aureus*.<sup>[31]</sup> It also possesses anti-fungal, anti-viral, anti-cariogenic and anti-ulcerogenic properties.

#### **Vaccinium macrocarpon (Cranberry)**

*Vaccinium macrocarpon* is commonly known as cranberry, belongs to genus *Vaccinium* (Ericaceae), sub-family Vaccinioideae. This shrub is commonly grown in Northern hemisphere regions. Cranberry is a particularly rich source of (poly) phenols, which have been associated in vitro with anti-bacterial, anti-viral, anti-mutagenic, anti-carcinogenic, anti-tumorigenic, anti-angiogenic, anti-inflammatory, and anti-oxidant properties<sup>[32, 33]</sup> Several studies conducted on cranberry till date have used NDM (Non-dialyzable material) which is obtained by dialysis of concentrated cranberry juice extract. Bodet and colleagues reported that the NDM fraction in cranberries inhibited the proteolytic activities of *P. gingivalis*, *Treponema denticola* and *Tannerella forsythia* which are the main periodontopathogenic microorganisms.<sup>[34]</sup> The NDM fraction of cranberries inhibits the secretion of MMP-3 and MMP-9 by the

gingival fibroblasts and macrophages following stimulation by the lipopolysaccharides of *A. actinomycetemcomitans*.<sup>[35]</sup> Polyphenols of cranberries, specifically the proanthocyanidins in the NDM fraction have potential avenues for controlling and preventing periodontitis.

#### **Acacia arabica (Thorny plant)**

Acacia is the most significant genus of family: Leguminosae. Though it is native to Australia, it is also found around tropical and subtropical regions of the world. The fresh plant parts of *Acacia arabica* is known to have anti-microbial astringent with good nutritional value in Indian traditional medicine system.<sup>[36]</sup> The antimicrobial activity of the extracts of *Acacia* was assayed against *S. viridans*, *S. aureus*, *E. coli*, *Bacillus subtilis* and *Shigella sonnei* using the agar diffusion method.<sup>[37]</sup>

#### **Allium sativum (Garlic)**

This herb, commonly known as garlic, is one of recommended alternatives to antibiotics.<sup>[38, 39]</sup> Allicin, one of the chief phytochemical components of freshly crushed garlic homogenates has a variety of antimicrobial activities. Allicin in its pure form was found to exhibit anti-bacterial activity against a wide range of Gram-negative and Gram-positive bacteria including *Klebsiella pneumoniae*, *Escherichia coli*, *Lactobacilli*, *Helicobacter pylori*, *Pseudomonas aeruginosa* and *Mycobacterium tuberculosis* and anti-fungal activity, particularly against *Candida albicans*, anti-parasitic activity and antiviral activity. The main antimicrobial effect of allicin is due to its chemical reaction with thiol groups of various enzymes.<sup>[40]</sup> Groppo et al. have observed a remarkable reduction of

*S. mutans* after gargling with a 2.5% garlic mouthwash solution.<sup>[41]</sup>

#### **Salvadora persica (Meswak)**

Teeth-cleaning sticks, commonly known as Miswak or Siwak, are popular oral hygiene aids in India, Pakistan, most of the Arabian countries, and many African countries whereas toothbrushes with nylon bristles are the most common oral hygiene aid in most of the developed countries. The World Health Organization (WHO) has also recommended and encouraged the use of miswak as an effective tool for oral hygiene.<sup>[41]</sup> Benzyl isothiocyanate, a major component of *Salvadora persica*, exhibited rapid and strong bactericidal effect against oral pathogens involved in periodontal disease as well as against other Gram-negative bacteria, while Gram-positive bacteria mainly displayed growth inhibition or remained unaffected.<sup>[42]</sup> It is known to have anti-bacterial, anti-fungal, anti-plaque and anti-caries activity.<sup>[43]</sup> Al-Lafi and Ababneh in 1995 reported that the use of miswak inhibits the formation of dental plaque chemically and also exerts antimicrobial effect against many microorganisms.<sup>[44]</sup>

#### **Emblica officinalis (Indian Goose berry)**

*Emblica officinalis* commonly known as Indian gooseberry is a medium sized deciduous tree belonging to family Euphorbiaceae. It has application as antioxidant, immunomodulatory, antipyretic, analgesic, cytoprotective, diuretic, laxative, carminative and stomachic, antitussive and gastroprotective agent.<sup>[45]</sup> This herb has many substances, including apigenin, gallic acid, ellagic acid, chebulinic acid, quercetin), contains the highest vitamin C. It has antiviral properties

and also functions as an antibacterial and anti-fungal agent.<sup>[46]</sup>

### **Eucalyptus globulus (Eucalyptus)**

Eucalyptus, which is native to Australia, is a widely planted genus. *Eucalyptus globulus* is a representative of *Eucalyptus* species. The extracts exhibit potent antibacterial activity against cariogenic bacteria, such as *S. mutans*, *St. sobrinus*.<sup>[47]</sup> Studies by Nagata et al concluded that eucalyptus extract chewing gum may promote periodontal health by having a meaningful effect on plaque, gingivitis, and bleeding on probing indices in human clinical trials.<sup>[48]</sup> The antibacterial activity of eucalyptus extract against several periodontopathic bacteria including *P. gingivalis* and *P. intermedia* has been documented.<sup>[49]</sup>

### **Melaleuca alternifolia (Tea Tree)**

Tea tree oil (TTO) is extracted from the tree *Melaleuca alternifolia*, a native of Australia, and has been known to have many valuable medicinal uses as an antiseptic, antifungal and antibacterial agent.<sup>[50]</sup> TTO is composed of terpene hydrocarbons, like monoterpenes, sesquiterpenes their associated alcohols and other several varieties, or chemotypes.<sup>[51]</sup> Tea Tree Oil is widely used in periodontal diseases as it helps in controlling bad breath, plaque formation, bleeding gums.<sup>[52]</sup> The in vitro activity of *Melaleuca alternifolia* against 161 isolates of oral bacteria from 15 genera was determined. The study indicated that a range of oral bacteria which includes *Actinomyces* species, *Lactobacillus*, *S. mitis*, *S. sanguis*, *Prevotella*, *Fusobacterium* and *Lactobacillus* are susceptible to tea tree oil, suggesting that tea tree oil may be of use in oral health care products and in the maintenance of oral hygiene.<sup>[53]</sup>

### **Cymbopogon Citratus (Lemon grass)**

Lemon grass belongs to the family Poaceae and genus *Cymbopogon*, bears a scientific name *Cymbopogon citratus*. It is distributed in regions like India, Tropical Asia and Africa. The active ingredients present in this grass are Citronellol Geraniol which is responsible for its anti-bacterial, astringent, anti-fungal, anti-oxidant, anti-septic, anti-inflammatory properties.<sup>[54]</sup> In a study it has been proved that essential oil of lemon grass is effective in busting through the tough biofilm that hides *Candida* and hence it can be used as a mouth wash and toothpaste to remove biofilm, which ultimately forms plaque.<sup>[55, 56]</sup> In an invitro study it has been demonstrated that the essential oil in lemon grass has significant anti-microbial potential against oral microorganisms *S. mutans*, *P. intermedia* and *P. gingivalis*.<sup>[57]</sup>

### **Murraya koenigii (Curry leaves)**

*Murraya koenigii* famously known as Curry leaves are popular leaf-spice used in very small quantities for their distinct aroma. The curry leaf tree is native to India, Sri Lanka, Bangladesh and the Andaman Islands. The major constituent responsible for the aroma and flavor has been reported as pinene, sabinene, caryophyllene, cadinol and cadinene. Curry leaves are known for their antimicrobial activity, antiulcer activity, anti-oxidative property, cytotoxic activity, phagocytic activity.<sup>[58]</sup> Chlorophyll present in curry leaves has been proposed as an anti-cariogenic agent and it also helps to reduce halitosis.<sup>[59]</sup> N-alkylated 3, 6-dihalogenocarbazoles a series of substituted carbazoles, present in *Murraya koenigii* exhibits fungicidal activity against *C. albicans* and also against the emerging pathogen *C. glabrata*.<sup>[60]</sup>

### **Conclusion**

Periodontal disease is a chronic inflammatory disease affecting the supporting tissues of the periodontium. Periodontitis is a multifactorial disease microorganisms being the major etiological factors. Pharmacologically active phytochemicals useful for the prevention, treatment and maintenance of periodontal diseases have been widely acknowledged. Over the last decade, herbal and ayurvedic drugs have become a subject of world importance, with both medicinal and economic implications. Use of herbal extracts in the form of dentifrice, medicated gel, local drug delivery systems proved to be efficient in preventing and treating periodontal disease. Hence in this review a brief explanation of pharmacologically active herbal plants like *Azadirachata indica*, *Punica granatum*, *Psidium guajava*, *Aloe barbadensis*, *Curcuma longa*, *Ocimum Sanctum* Linn etc. are found to be useful in the prevention, treatment and maintenance of various dental diseases.

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