

# Medicinal Plants in the Treatment of Dental Caries

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## ABSTRACT

**Aim:** This article brings an insight of known medicinal plants helpful in treatment of dental caries and thus a novel approach towards preventive oral care.

**Summary:** Dental caries, one of the globally affecting diseases of the oral cavity is still prevalent in today's era despite knowledge of most advanced sciences and technologies in dental practice. There has been constant effort to focus on interception and correction of this disease entity but today our horizon has broadened the approach and goal remains to prevent the disease process rather than to correct it. Medicinal plants have been documented for prevention and cure of many systemic diseases since ancient times. With advancements in science and scientific procedures it is now known that plants have potential curative action for oral diseases such as dental caries. The usage of these herbal extracts in clinical practice can miraculously benefit the overall health of the patient.

**Conclusion:** With complete understanding of the dental caries our approach should be based on prevention of disease process. One way to attain it is "going herbal".

**Keywords:** Dental Caries, Oral Microflora, Phytochemicals



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## INTRODUCTION

Medicinal plants have been found useful in the cure of a number of diseases including bacterial diseases owing to a rich source of antimicrobial agents.<sup>1</sup> With the knowledge of curative properties of the medicinal plants against oral microorganisms and their incorporation in clinical practice we can aim to reduce if not remove this disease entity. Due to a rapid increase in the rate of infections, antibiotic resistance in microorganisms and due to side effects of synthetic antibiotics, medicinal plants are gaining popularity over the drugs<sup>2,3</sup> Medicinal plants though produce slow recovery but their therapeutic effect is miraculous.

## METHODS

The PubMed/ Google scholar database was primarily searched till October 2011 and MeSH words used were "dental caries" and "medicinal plants". Publications were limited to English language. Secondarily hand search was conducted through the cross-references of included articles. Relevant literature in common textbooks, bibliographies of papers and review articles of suitable peer reviewed journals were also analyzed for additional information.

## ROLE OF ORAL MICROFLORA IN DENTAL CARIES

The oral cavity contains a wide variety of oral bacteria, but only a few specific species of bacteria are believed to cause dental caries namely *Streptococcus mutans*, *Lactobacillus acidophilus*, *Actinomyces viscosus*, *Nocardia spp.* *Streptococcus mutans* are most closely associated with caries.<sup>4,5</sup> A gelatinous mass of bacteria adhering to the tooth surface is termed as dental plaque, which serves as a biofilm.<sup>6</sup> These plaque bacteria produce organic acids as by-products which cause a carious lesion by dissolution of tooth's crystalline structure. The most prone site for plaque accumulation remains the areas of tooth which provide microscopic retention in the teeth. Strains of *Streptococcus sobrinus*, a gram-positive, coccoid bacterium isolated from the human tooth surface has shown to be cariogenic in experimental animals and may be associated with human dental caries.

The bacteria that produce the acids fall into the category of acidogenic bacteria and are also aciduric, which means that

they can live preferentially under acidic conditions. As caries becomes progressive and more aggressive and the environment in the plaque becomes more frequently acidic, these acid uric bacteria survive at the expense of the other benign bacteria. All the acids produced by the bacteria—including lactic, acetic, formic, and propionic acids—can readily dissolve tooth mineral.<sup>3,6</sup>

Two major groups of bacteria which produces such acids are namely *Streptococcus mutans* and *Streptococcus sobrinus* and the *Lactobacilli* species.<sup>3,7</sup> These survive well wherever they have niches to live in.<sup>8</sup>

### ROLE OF DIFFERENT PHYTOCHEMICALS AGAINST ORAL PATHOGENS

Phytochemicals are non-nutritive plant chemicals that have protective or disease preventive properties. Plants produce these to protect themselves but recent research has demonstrated that they can protect humans against diseases. They have been shown to be active against oral pathogens.<sup>9,10</sup>

The growth of numerous cariogenic bacteria were found to be inhibited by flavonone phytoalexins from *Sopphora exigua* (Leguminosae) with 5,7,2',4'-tetrahydroxy-8-lavandulylflavanone being most active.<sup>11</sup> Many cariogenic bacteria including mutans and other oral streptococci, actinomyces and lactobacilli were inhibited by two active isoprenylflavonones namely Artocarpin and artocarpesin which were isolated from *Artocarpus heterophyllus* (Moraceae). It has been shown that Erycrystagallin completely suppressed the incorporation of radiolabeled thymidine and glucose in *S. mutans*, suggesting that compound interferes with bacterial uptake of metabolites.<sup>12</sup> Tea, *Camelia sinensis* (Theaceae) has bactericidal effects on oral bacteria by inhibiting glucan production and amylases thus preventing adherence of bacteria to tooth surfaces. These biologic effects are due to monomeric polyphenols, in particular simple catechins such as epicatechin, epicatechin gallate, and epigallocatechin gallate.<sup>13,14</sup> The pastes of tender leaves of guava, *Psidium guajava* were traditionally used to maintain oral hygiene.<sup>15</sup> The menthol extract of this plant exhibits inhibitory activity against two strains of *S. mutans* owing to reduction of cell surface hydrophobicity observed in 'early settler' plaque bacteria (*S. mitis*, *S. sanguinis* and *Actinomyces*) exposed to 1mg/ml of *P. guajava* extract.<sup>16</sup>

A polymethoxylated flavonoid commonly found in grapefruit, *Naringin*, which is FDA-approved health supplement has shown to inhibit the growth of periodontal pathogens and other common oral microorganisms especially against *Actinobacillus actinomycescomitans* and *P. gingivalis* with significant growth inhibition within 3 hours and greater inhibition with increasing incubation time and *Naringin* concentration.<sup>17</sup>

Terpenes in the form of Bakuchiol isolated from the Chinese medicinal plant, babachi, *Psoralea corylifolia* (Fabaceae), was found to inhibit the growth of *S. mutans* under a range of sucrose concentrations, pH values and in the presence of organic acids in a temperature-dependent manner and also inhibited the growth of cells adhered to a glass surface.<sup>18</sup> Xanthorrhizol, a methanol extract of tumeric plant roots, *Curcuma xanthorrhiza*, has shown to have high levels of antibacterial activity against oral pathogens which in some cases equal or similar to that of chlorhexidine.<sup>19</sup>

The alkaloid berberine isolated from *C. rhizoma* (Ranunculaceae) shows bactericidal activity against oral bacteria especially by inhibiting collagenase activity of *A. actinomycescomitans* and *P. gingivalis*.<sup>20</sup>

Xylitol, which is a sugar alcohol and an artificial sweetener naturally found in plants shows anticariogenic properties against strains of *S. mutans*, *S. salivarius* and *S. sanguis*.<sup>21</sup>

The antibacterial activity against *S. mutans*, *S. salivarius* and *S. sanguis* has been found to display in disc diffusion assays as seen in hops, *Humulus lupulus* (Cannabaceae).<sup>22</sup> The antimicrobial properties of a number of commercially available dentifrices containing herbal products have been constantly evaluated against oral pathogens which were found to be effective against activity of all test bacteria (*S. mutans*, *S. sanguis* and *A. viscosus*), but only some of these were able to inhibit the yeast *C. albicans*.<sup>23</sup>

### ANTI-ADHESION ACTIVITY OF CRUDE OR TOTAL PLANT EXTRACTS

Cranberry, *Vaccinium macrocarpon* (Ericaceae), has been recognized for its beneficial effects on human health.<sup>24</sup> Cranberry juice or cranberry constituents prevents adhesion of oral pathogens to surfaces and related phenomena, such as the production of glucans and fructans, and the formation of biofilms which has been suggested to be related to the inhibition of glucan-related processes (inhibition of glucosyltransferase, blocking of bacterial adhesion mediated by surface glucans and reduction of insoluble glucan content). Recently, the cranberry juice constituents active against *S. mutans* biofilms have been identified as polyphenols, specifically proanthocyanidins and flavonols. *In vitro* experiments showed that cacao bean husk extract markedly reduced the growth rate and inhibited insoluble glucan synthesis of *S. mutans* and sucrose-dependent adhesion of *S. mutans* and *S. sobrinus* to a glass surface.<sup>25,26</sup>

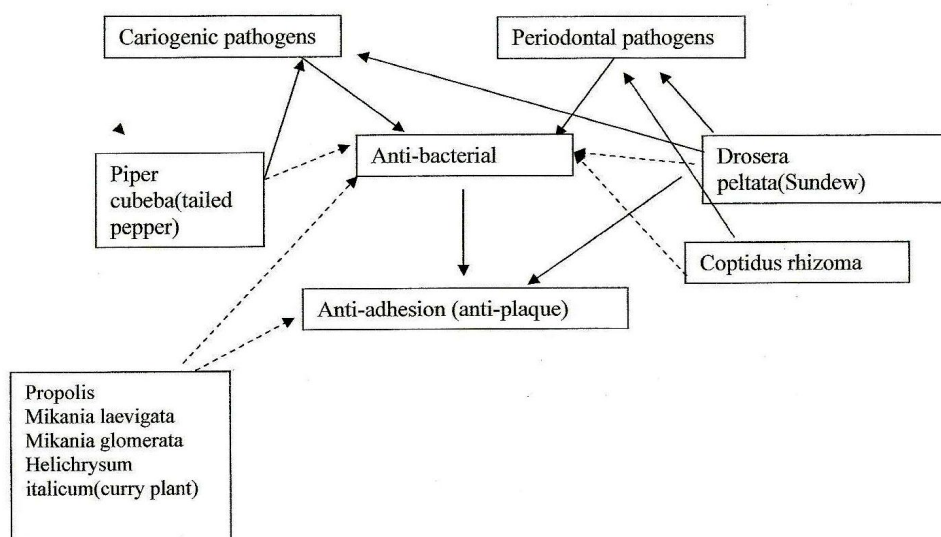
The antimicrobial activity against *S. mutans*, *S. sanguis* and *S. sobrinus* was found in an ethanol extract of a flowering plant of daisy family *Helichrysum italicum* (Compositae) owing to reduction in cell surface hydrophobicity, adherence to glass and cellular aggregation of *S. mutans* in the presence of dextran.<sup>27</sup> The extracts of Ariel part of plants of the genus

**Table 1: Generic names of various medicinal plants and thier and medicinal extracts used against oral microorganisms (Adapted from Primala *et al.*<sup>39</sup> Dental caries and medicinal plants – an overview, J Pharma Res 2009; 2: 1669-75).**

Microorganisms	Source	Medicinal plants
<i>Streptococcus mutans</i>	Bark	<i>Acacia leucophloea, Albizia lebbeck, Syzygium cumini</i>
	Bulbs	<i>Allium sativum</i>
	Root	<i>Anacyclus pyrethrum, Glycyrrhiza glabra, Citrus medica, Erythrina variegata, Polygonum cuspidatum</i>
	Fruit	<i>Caesalpinia martius, Embelia ribes, Rheedia brasiliensis</i>
	Roots and Dried Rhizomes	<i>Kaemperia pandurata</i>
	Leaves	<i>Harungana madagascariensis, Legenaria sicerania, Mentha arvensis, Nicotiana tabacum</i>
	Aerial parts	<i>Mikania lavigata, Fiscus microcarpa</i>
	Flower	<i>Physalis angulata</i>
	Nuts	<i>Areca catechu</i>
	Whole plant	<i>Aristolochia cymbifera, Annona senegalensis, Albizia julibrissin, Breynia nivosus, Coptidis rhizoma, Cocos nucifera, Caesalpinia pyramidalis, Chelidonium majus, Drosera peltata, Euclea natalensis, Helichrysum italicum, Ginkgo biloba, Juniperus virginiana, Melissa officinalis, Magnolia grandiflora, Melissa officinalis, Magnolia grandiflora, Pinus virginiana, Rhus corriaria, R.corriaria, Rosmarinus officinalis, Rhus corriaria, Sassafras albidum, Solanum xathaocarpum, Thymus vulgaris</i>
	<i>Streptococcus sanguis</i>	Root
Whole plant		<i>Helichrysum italicum, Thymus vulgaris, Rhus corriaria, Rhus corriaria, Melissa officinalis, Magnolia grandiflora, Melissa officinalis</i>
<i>Streptococcus sobrinus</i>	Leaves	<i>Harungana madagascariensis</i>
	Root	<i>Erythrina variegata, Polygonum cuspidatum</i>
	Aerial Part	<i>Mikania lavigata</i>
	Leaves	<i>Harungana madagascariensis, Mentha arvensis</i>
<i>Lactobacillus casei</i>	Whole plant	<i>Helichrysum italicum</i>
	Fruit	<i>Caesalpinia martius</i>
<i>Actinomyces odontolitycus</i>	Leaves	<i>Hamamelis virginiana, Harungana madagascariensis</i>
<i>Preveotella spp.</i>	Leaves	<i>Hamamelis virginiana, Harungana madagascariensis</i>
<i>Fusobacterium</i>	Leaves	<i>Harungana madagascariensis</i>
<i>Propioni bacterium</i>	Leaves	<i>Harungana madagascariensis</i>
<i>Porphyromonas gingivalis</i>	Mastic gum	<i>Pistacia lentiscus</i>
<i>Streptococcus aureus</i>	Whole plant	<i>Tanacetum vulgare, Thuja plicata, Ziziphus joazeiro</i>
	Dried flower	<i>Syzygium aromaticum</i>
<i>S.cricetus</i>	Whole plant	<i>Mikania glomerata</i>

*Mikania* (Asteraceae) has been found to inhibit the growth of mutans streptococci.<sup>28</sup> Aqueous and methanol extracts of cloves from *Syzygium aromaticum* (Myrtceae) were shown to be anticariogenic owing to the ability of the extracts to

inhibit adhesion of the bacteria to glass, reduce cell surface hydrophobicity and inhibit the production of glucosyl transferase.<sup>29</sup> Crude aqueous extracts of *Piper betle*, were also noted to inhibit the growth, adherence and glucan production of *S.mutans*.<sup>30,31</sup>



**Figure 1: Potential application of plant extracts in the prevention and treatment of oral diseases caused by cariogenic and periodontal microbial pathogens. Where known, the likely uses of extracts and phytochemicals are indicated with respect to their target pathogens (solid arrows) and biological activities (dashed arrows)**

Effects of macrocarpals (phloroglucinol-sesquiterpene-coupled compounds) extracted from eucalyptus leaves on periodontopathic bacteria demonstrated that these compounds were able to inhibit the growth of the majority of bacterial strains tested of which *Porphyromonas gingivalis* was the most sensitive bacterium.<sup>32</sup>

#### APPLICATION OF HERBAL EXTRACTS IN DENTAL CLINIC

Use of plant resources for medicinal purpose is used in all civilizations and cultures and hence plants have played a key role in health care systems worldwide. Benzoin derived from *Styrax tonkinensis* is used as an oral disinfectant. Eugenol commonly used in day to day clinical practice to alleviate pain is derived from *Syzygium aromaticum*. Neem (*Azadirachta indica*) is commercially available as dental gels for routine prophylactic care.<sup>33,34</sup> Combining the extracts with the surfactant lauryl sodium sulfate resulted in a potentiation of antimicrobial action, probably as a result of the combined effects of the surfactant and tea polyphenols on microbial cell walls and polyphenols.<sup>35</sup> In another study pomegranate, *Punica granatum* (Punicaceae), in the prevention of dental plaque was investigated and it was concluded that the plants extract was useful in prevention of diseases caused by plaque bacteria.<sup>36</sup> These results also supported an *in vitro* study of a phytotherapeutic gel containing *P. granatum* plant powder, which was able to inhibit the adherence of *S. mutans*, *S. mitis* and *S. sobrinus* (as well as *C. albicans*) to glass in the presence of sucrose.<sup>37</sup> Listed below is the figure to show the potential application of plant extracts in the prevention and treatment of oral diseases caused by cariogenic and periodontal microbial pathogens.

#### FUTURE OF PLANT EXTRACTS IN DENTISTRY

A major bulk of plant species used for medicinal purpose remained endemic to certain regions or people. This was due to lack of communication and breeding of ideas as many of these remedies survived only by word of mouth from generation to generation. In recent years herbal medicines flourish as method of therapy of choice as they are fueled by a growing consumer interest in the natural products ensuring safety and efficacy of these herbal products. The role of medicinal plants can provide effective health care services in most parts of the world far beyond the emerged 21<sup>st</sup> century.

#### CONCLUSION

The medicinal plants find application in pharmaceutical, cosmetic, agricultural and food industry. The use of the medicinal herbs for curing disease has been documented in history of all civilizations. Before onset of synthetic era, man was completely dependent on medicinal herbs for prevention and treatment of diseases. With introduction of scientific procedures the researchers have concluded that the plants contain active principles responsible for curative action of the herbs. After reviewing, there is considerable evidence that plants extracts, and purified phytochemicals have potential to be developed into agents which can be used as a preventive or treatment therapies for oral diseases such as dental caries.

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