

Role of Medicinal Herbs in Oral Health Management

Tapas Ranjan Dash¹, Nisha Singh², Devanand Gupta³,
Eesha Panwar⁴, Sabitha Ramisetty⁵

1- Private Dental Practitioner, Bhubaneswar, Odisha, India.

2- Post Graduate Student, Department of Pedodontics and Preventive Dentistry, Buddha Institute of Dental Sciences, Patna, Bihar, India.

3- Senior Lecturer, Department of Public Health Dentistry, I.D.S, Bareilly, Uttar Pradesh, India.

4- Post Graduate Student, Department of Oral Pathology, Teerthanker Mahaveer Dental College, Moradabad, Uttar Pradesh, India.

5- Reader, Department of Oral Pathology, Saint Joseph's Dental College, Eluru, Andhra Pradesh, India.

Correspondence to:
Dr. Tapas Ranjan Dash
Private Dental Practitioner,
Patna, Bhubaneswar, Odisha, India
Contact Number: +918594916350
E-mail: tapasranjan.dash569@gmail.com

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www.ijdmr.com

ABSTRACT

Diseases of the oral cavity have been considered as major diseases affecting the health of a person of which Dental Caries and Periodontal diseases are regarded as most prevalent and preventable global infectious diseases. The association between oral diseases and the oral micro biota is well established by numerous clinical studies. The adverse effects of some antibacterial agents used in dentistry and financial considerations in developing countries, have led dentists to think of some natural remedies for dental cure. The phytochemicals isolated from plants have been considered as good alternatives in various diseases of oral cavity. This review discusses the role of plant extracts or phytochemicals in inhibiting the growth of oral pathogens and reducing the development of biofilms and dental plaque, thereby reducing the symptoms of oral diseases.

KEYWORDS: Phytochemicals, Phytodentistry, Plaque

INTRODUCTION

Oral diseases persist to be a major health problem around the world.¹ Apart from dental caries and periodontal diseases which are the most important global oral health problems, other conditions like oral and pharyngeal cancers and oral tissue lesions are also of important concern.² Oral health is essential to general well-being and is related to the quality of life that extends beyond the functioning of the craniofacial complex. The relationship

between oral diseases and activities of the microbiota of the oral cavity is well established. Over 750 species of bacteria (50% of which are still to be identified) colonize the oral cavity and a number of these are responsible in oral diseases.³ The worldwide need for alternative treatment and preventive options and products for oral diseases that are effective, safe and economical comes from the rise in disease incidence, increased resistance

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by pathogenic bacteria to currently used antibiotics and opportunistic infections in immuno-compromised individuals and financial considerations of developing countries.^{4,5} Despite several chemical agents being available commercially, they can alter oral microbiota and have side-effects such as diarrhoea, vomiting and tooth staining.^{6,7} Hence, the search for other possible products continues and naturally available chemicals isolated from plants used in traditional medicine are considered as good alternatives to commercially available chemicals.⁸ The products derived from medicinal plants such as tulsi, neem, amla, dhatura, etc. have abundant source of phytochemicals, many of which have become the basis for the development of new leading chemicals for pharmaceuticals. The purpose of this review is to present some recent examples of phytochemicals or traditional medicinal plant extracts that have been proved to inhibit the growth of oral pathogens, reduce the symptoms of oral diseases and reduce the development of dental plaque.

ANTIBACTERIAL ACTIVITY OF PLANT EXTRACTS

Many studies exploring the activity of traditional medicinal plants against oral microbes have been restricted to examination of crude organic or aqueous solvent extracts. In most cases, the investigators have simply validated the traditional medicinal use of the plants. For example, the use of *Drosera peltata* (Droseraceae) leaves for the treatment of dental caries was validated by a study that showed that chloroform extracts of the aerial plant parts showed broad spectrum action against numerous bacteria of the oral cavity, with greatest activity against *S. mutans* and *S. sobrinus* (MIC = 31.25 and 15.625 $\mu\text{g/mL}$ -1, respectively).⁹ Tichy and Novak investigated a

group of 27 medicinal and random plants extracts and identified a number that inhibited the growth of *S. mutans*. The most active extracts included those from *Albizia julibrissin* (Fabaceae), *Abies Canadensis* (Pinaceae), *Chelidonium majus* (Papaveraceae), *Juniperus virginiana* (Cupressaceae), *Pinus virginiana* (Pinaceae), *Ginkgo biloba* (Ginkgoaceae), *Rosmarinus officinalis* (Lamiaceae), *Sassafras albidum* (Lauraceae), *Tanacetum vulgare* (Asteraceae) and *Thuja plicata* (Cupressaceae).

Boiling water extract of *Coptidis rhizoma* (Ranunculaceae), a Chinese medicinal plant, had bactericidal activity against oral bacteria with particularly good activity against periodontal pathogenic bacteria (MIC = 31–250 $\mu\text{g/mL}$ -1).¹⁰ Garlic has been shown to have action against wide range of bacteria, with specific activity against the Gram-negative oral pathogens, including *P. gingivalis*. Allicin, a garlic extract containing the major antimicrobial component, was found to be active toward gram-negative bacteria (MIC = 1.1–17.4 mg/mL -1) but less active against gram-positive bacteria (MIC = 35.7–142.7 mg/mL -1). Trypsin-like protease activity (implicated in the pathogenesis of periodontitis) of *P. gingivalis* was almost completely inhibited by the extracted allicin. These observations together, suggest that garlic extract or allicin may be of medicinal use against oral diseases.¹¹ *Harungana madagascariensis* (Hypericaceae) is a native African plant with antimicrobial properties that contains a number of antimicrobial components.¹² Crude ethanol extracts of *Piper cubeba* (Piperaceae) exhibit good medicinal properties against a wide range of cariogenic pathogens (MIC = 90–200 $\mu\text{g/mL}$ -1), although no information about the activities against periodontal pathogens were provided.¹³ Ethanol extract of powdered flowering tops was found to exert antimicrobial activity against *S. mutans*, *S. sobrinus*, and *S. sanguis* with MIC

values of 31.25–62.5 $\mu\text{g mL}^{-1}$.¹⁴ Two recent studies have investigated a number of plants used in Brazil or South Africa, respectively, for activity against oral pathogens.^{15,16} All four Brazilian plant extracts, *Ziziphus joazeiro* (Rhamnaceae), *Cocos nucifera* (Palmae), *Caesalpinia pyramidalis* (Fabaceae) and *Aristolochia cymbifera* (Aristolochiaceae), were active against the test bacteria, with the most effective being the ethanol extract of *A. cymbifera* (MIC = 0.1–4.0 mg mL^{-1}).

ANTIBACTERIAL PROPERTY OF PROPOLIS

Propolis exhibits good antimicrobial activity against a wide range of bacteria and inhibit the attachment of *S. mutans* and *S. sobrinus* to glass. It was also shown to be a strong inhibitor of water-soluble glucan synthesis.¹⁷ Propolis has antimicrobial activity greater than clove extract and similar to chlorhexidine in a study investigating the ability of the chemicals to inhibit the growth of microbes obtained from the saliva of periodontally collected from healthy subjects and those with chronic periodontitis.¹⁸ Similar to propolis, *Nidus vespae* exerts antimicrobial activity towards a number of oral microorganisms, in particular *S. mutans*.¹⁹

ANTIBACTERIAL PROPERTY OF PURIFIED PHYTOCHEMICALS

The following segment describes the studies of phytochemicals that have been shown to be active against oral microbes. The studies are grouped according to the general classes of phytochemicals investigated.

Flavonoids and Other Polyphenols

In a study of a number of methanolic plant extracts, two active, artocarpin and artocarpesin

and isoprenylflavones were isolated from *Artocarpus heterophyllus* (Moraceae). These inhibited the growth of numerous cariogenic oral bacteria, including *S. mutans* and other oral bacteria, at MIC values of 3.13–12.5 $\mu\text{g mL}^{-1}$.²⁰ Flavonone phytoalexins from *Sophora exigua* (Leguminosae) shows to inhibit the growth of a number of cariogenic bacteria, with 5,7,2,4-tetrahydroxy-8-lavandulylflavanone being the most active.²¹ *Erythrina variegata* (Leguminosae) is used in traditional medicine in tropical and subtropical regions and shows a number of biological properties, including antibacterial activity.²²

Morus alba (Moraceae) has been used as a traditional medicine in Asian countries and exhibits antibacterial activity against food poisoning microbes. The compound displayed an MIC of 8 $\mu\text{g mL}^{-1}$ against *S. mutans*, which was comparable to vancomycin and chlorhexidine (1 $\mu\text{g mL}^{-1}$).

A similar mode of antibacterial activity has been reported for isopanduratin isolated from *Kaempferia pandurata* (Zingiberaceae).²³

Components of tea (*Camelia sinensis*, Theaceae), exhibit anticariogenic effect through various modes of action, including prevention of adherence of bacteria to tooth surfaces, inhibition of production of glucan, bactericidal effects on oral bacteria and amylases inhibition.²⁴ Monomeric polyphenols, particularly simple catechins such as epicatechin, epicatechin gallate, and epigallocatechin gallate are believed to be the culprit for these biological effects.^{24,25} The paste of leaves of *Psidium guajava* (Myrtaceae) has been used traditionally to maintain oral hygiene. The anti-adherent properties of this plant were supported by the reduction of cell-surface hydrophobicity observed in “early settled” plaque bacteria (*S. sanguinis*, *S. mitis* and

Actinomyces) exposed to guava extract (1mgmL-1 P).²⁶

Recently, a proteomics approach a low concentration (1.6%, v/v) of a Psidium cattleianum water extract resulted in the down regulation of genes involved in lactic acid production, general metabolism and glycolysis.²⁷ At higher concentrations (25–100%, v/v), the extract inhibited *S. mutans* biofilms. Macelignan (20 µgmL-1) displayed pronounced antibacterial activity and eliminated viable *S. mutans* within 1 min. Macelignan also displayed antibiofilm action against *S. mutans*, *S. sanguis* and *A. viscosus*.²⁸ Naringin, a polymethoxylated flavonoid found in citrus fruits and an FDA-approved health supplement, inhibits the growth of periodontal pathogens and other common oral microorganisms (9.8–125mg mL-1).²⁹

Terpenes

Bakuchiol isolated from Ayurvedic medicinal plant, *Psoralea corylifolia* (Fabaceae), has shown activity against numerous Gram-positive and Gram-negative oral pathogens (MIC = 1–4 µgmL-1). It was able 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.³⁰

Sugar Alcohols

Xylitol is a sugar alcohol found in plants used as an artificial sweetener in varieties of foods.³¹ It has anticariogenic properties which were investigated by adding 0.78–50% xylitol to broth cultures of *S. mutans*, *S. sanguis* and *S. salivarius* incubated at 37° C for 18 hrs optical density of the cultures were determined. *S. mutans* was the only bacterium inhibited by xylitol at 1.56%, while all other bacteria showed

statistically significant inhibition at levels above 1.56%. The study revealed that xylitol exhibited anticariogenic effects by inhibiting the growth of *S. mutans* while not affecting other streptococci as part of the normal oral flora.³¹

Other Phytochemicals

Constituents found in hops (female flower clusters of a species *Humulus lupulus* from Cannabaceae), have been found to display antibacterial action against *S. mutans*, *S. sanguis* and *S. salivarius* in disc diffusion assays.³² These antibacterial actions intensified in the presence of ascorbic acid, suggesting that this effect was due to the acidic nature of ascorbic acid. The antimicrobial properties of a number of commercially available dentifrices containing natural products have been evaluated against oral microorganisms.³⁴ The information about the traditional uses of the medicinal plants has been compiled in Table No. 1.

	Name	Parts and their Roles
1	Acorus calamus	Paste of the Rhizome is applied to painful teeth and gums
2	Allium Sativum	The paste of the bulb is applied to the gums and cavities of infected teeth.
3	Bonbax ceiba	Gum is used to treat tooth care
4	Cinamomum	Stem bark juice is applied to the teeth to treat tooth decay and toothache.
5	Citrus medica	Due to high content of Vitamin-C, used to treat bleeding gums in scurvy.
6	Datura stramonium	Seeds mixed with butter are burnt and smoke is inhaled into the mouth.
7	Juglens regia	Oil & fruits are used in making traditional tooth powder to cure toothache and Pyorrhoea.
8	Justicia adhatoda	The twigs of the plant are used as tooth picks / brushes to treat Pyorrhoea.
9	Myrica esculenta	The bark is chewed to relieve toothache.
10	Ocimum sanctum	Powder of dry leaves along with salt is applied to painful

		teeth.
11	<i>Punica granatum</i>	It is very useful in bleeding gums caused due to scurvy
12	<i>Ricinus communis</i>	Tender shoots are used as tooth brushes in dental caries. Leaf juice is used to gargle in Pyorrhea
13	<i>Urtica dioica</i>	2-3 drops of root extract are applied to hollow tooth cavities to treat toothache.
14	<i>Vitex negundo</i>	Leaf is used as a mouthwash to relieve toothache.
15	<i>Zanthoxylum</i>	Powder of the fruits is used as a remedy for toothache. Small twigs of the branches are used to treat toothache
16	<i>Zingiber officinale</i>	Paste of rhizomes is applied to the teeth to treat toothache and tooth decay.

Table No.1

CONCLUSION

As demonstrated by various examples included in this review, there are considerable evidences that plant extracts, essential oils and purified plant chemicals have the potential to develop into agents that can be used as curative agents for oral diseases. While it is encouraging to see a number of clinical trials of such products, further studies on efficacy of these agents will be important to establish their therapeutic benefits, either alone or in combination with conventional therapies.^{33,34} In particular, studies that address research issues of standardization of extracts or purified compounds, and quality control would be of great importance to improve dental care with the help of available natural resources.

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