Plant products in Dentistry-A review
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Abstract
Renewed research into various plant products is currently in progress. This short review endeavors to bring about an understanding regarding the various applications of plant products in oral health care.

Key Words: Oral health; Onion; Ginger; Garlic; Aloevera; Turmeric; Plant products

India is the land of Naturopathy where Ayurveda forms the foundation for majority of the traditional and natural healing systems. It is a well-documented fact that natural remedies through Ayurveda owe their origin to India. The populace at various stages relies on differing methods of natural treatment modalities, whether in the form of home remedies or prescription medications from ayurvedic practitioners. There has been a rise in the awareness and interest in seeking alternative natural remedies among western populations, especially in combating the rising dilemma of side effects caused by synthetic allopathic medications. About 25% of modern pharmaceuticals are derived from plants.(1) Patients are often unaware of the similarities between medicinal herbs and prescription drugs, and they may mistakenly believe that these “natural” substances do not contain powerful bioactive ingredients. In addition, because herbs may be sold and marketed without FDA approval, there are concerns about the limited evidence on herbal side-effects, drug interactions, and product consistency.(2,3) Interest in the potential health benefits of various natural plant products like Onion (Allium cepa), Garlic (Allium sativum), Ginger (Zingiber officinaleradix Roscoe), Aloevera (Aloebarbadensis) and Turmeric (Curcumin), this paper review the systemic as well as the oral health benefits which could be derived from these natural products.

Articles for this review were obtained through MEDLINE, using a keyword search of the common and Latin botanical names for each of the 5 herbs. The search was limited to English-language articles and human and in-vitro studies. The authors reviewed the articles identified by the search, summarizing the evidence through a process of discussion and consensus. Evidence on five most commonly used plant products were as follows.

Onion (Allium cepa): Onion has the distinction of being the king of vegetables. Its extensive use in various forms due to the antibacterial and antifungal properties is well documented. It promotes good heart health because it facilitates the thinning of the blood which helps to prevent clot formation.

Studies which researched the activities of onion extracts on Streptococcus mutans and Streptococcus sobrinus, the main causal bacteria for dental caries, and Porphyromonas gingivalis and Prevotella intermedia, considered to be the main causal bacteria of adult periodontitis. The results showed that the onion extracts possess an effect on all test bacterial strains (S.mutans JC-2, S.sobrinus OMZ176, P.gingivalis ATCC 33277 and P.intermedia ATCC 25611), and the effects were bactericidal against cultured and resting bacterial cells.(4)

Several epidemiologic investigations have suggested an inverse relation between intake of allium vegetables and stomach, colorectal, and prostate cancers,(5,6) but the results for other cancer sites are scanty, especially for cancers in the head and neck region where further investigations are indicated. Studies of experimental carcinogenesis in animal models and in cell culture systems indicate that several allium-derived compounds exhibit inhibitory effects and that the underlying mechanisms may involve both the initiation and the promotion phases of carcinogenesis.(7) However, the specific components of allium vegetables involved in the specific cellular and molecular events that govern these anticancer properties are not known.(8)

The potential anticarcinogenic action of onions may also be related to their high content of organosulfur compounds or to their high antioxidant activity, which is principally due to their wide content of flavonoids. However, there are important varietal differences in the composition, concentration, and beneficial activities of these bioactive compounds, which also result by modalities of cooking.(9)

Garlic: Historically, garlic was used in China to lower blood pressure, in Egypt to increase physical strength, in Europe to prevent the plague and in India as a home remedy for various minor ailments like flu and cough. Garlic has been used not only to flavor food but also because it contains...
Garlic contains several different organo-sulfur compounds in addition to amino acids, vitamins, and micronutrients. Its anticarcinogenic actions may be explained by particular organo-sulfur compounds. Diallyl sulfide, for example, which is responsible in part for its strong taste and odor, has been shown to selectively inhibit as well as induce certain P-450 enzymes.(10)

Garlic extract is effective against S. mutans when tested both in vitro and in vivo. As S. mutans is one of the primary etiological organisms in dental caries development, and in this study garlic extract has been shown to be effective against S. mutans, garlic extract mouth rinse might be used as an effective remedy in the prevention of dental caries.(11)

Allicin is considered the most therapeutic constituent of garlic. Research performed using broth dilution method revealed that planktonic growth of the cariogenic, gram-positive species S. mutans, S. sobrinus, and Actinomyces oris was inhibited by various allicin concentrations. Planktonic growth of the tested gram-negative perio-pathogenic species a.a.a.comitans and Fusobacterium nucleatum was also inhibited by allicin. The Porphyromonas gingivalis, an anaerobic, gram-negative pathogen and the bacteria most associated with chronic periodontitis demonstrated lower levels of sensitivity to allicin in comparison to the other oral pathogens.(12)

In a study it was found that the garlic has antimicrobial properties in vitro against streptococci and anticariogenic properties against oral microorganism.(13) Experimental studies have shown that the chemo-preventive activity of Allium vegetables is related to their content of organo-sulphur compounds (OSCs). Although how these compounds achieve chemoprevention is not fully understood, several modes of action have been proposed.(14-17) These include: (i) effect on drug metabolizing enzymes (i.e. induction of phase II detoxification enzymes, including glutathione transferases, quinine reductase, epoxide hydrolase and glucuronosyl transferase, that inactivate toxic substances and facilitate their excretion); (ii) antioxidant activity (garlic preparations exhibit radical scavenging activity and decrease lipid peroxidation, which is relevant in the light of the observation that tumour promotion may involve oxygen radicals); (iii) tumour growth inhibition that has been documented in several carcinoma cell lines, including prostate carcinoma cells; (iv) induction of apoptosis, which coincides with an increase in the percentage of cells blocked in the G2/M phase of the cell cycle (possibly through a depression in p34cdc2 kinase) and (v) effective stimulation of the immune response (OSCs stimulates proliferation of lymphocytes and macrophage phagocytosis, induce the infiltration of macrophages and lymphocytes in transplanted tumours, induce splenic hypertrophy, stimulate release of interleukin-2, tumour necrosis factor-α and interferon-γ, enhance natural killer cell, killer cell and lymphokine-activated killer cell activity.(18)

Aloe Vera (Alebarbadensis) is indigenous to the Sudan and the Arabian Peninsula but is now grown in many parts of the world, including Indian subcontinent. Aloe may be dried into capsules or formulated into gels for topical application. The Aloe Vera plant has been known and used for centuries for its health, beauty, medicinal and skin care properties. The name Aloe Vera derives from the Arabic word “Alloeh” meaning “shining bitter substance,” while “Vera” in Latin means “true.” 2000 years ago, the Greek scientists regarded Aloe Vera as the universal panacea. The Egyptians called Aloe the “plant of immortality.” Aloe has been found to be effective against many dermatological conditions like herpes, and psoriasis. Although effectiveness with other conditions like radiation dermatitis are found to be questionable.(19)

Aloe Vera contains 6 antiseptic agents: Lupeol, salicylic acid, urea nitrogen, cinnamonic acid, phenols and sulfur. They all have inhibitory action on fungi, bacteria and viruses. Aloe has been found to be useful in cancer prevention,(20, 21) aphthous stomatitis,(22) mucositis,(23) and radiation dermatitis.(24) In addition studies have revealed the effectiveness of aloe in combination with other medicaments like allantoin for treatment of aphthous stomatitis.(25)

Topical application of aloe vera is not an effective prevention for radiation-induced injuries. However it can be effective for genital herpes, psoriasis, human papilloma virus, seborrheic dermatitis, aphthous stomatitis, xerosis, lichen planus, frostbite, burn, wound healing and inflammation. It can also be used as a biological vehicle and an anti-microbial and antifungal agent and also as a candidate for photodynamic therapy of some kinds of cancers.(26)

The antimicrobial effect of a dentifrice containing Alovera has been demonstrated in an in vitro study, in which this phytotherapic agent inhibited the growth of diverse oral microorganisms, such as S. mutans, S. sanguis, A. viscosus and C. albicans.(27) The only study available evaluating the clinical effects of Aloe
vera showed a significant reduction of gingivitis and plaque accumulation after use of a mouth rinse containing this natural product.(28)

Ginger: Ginger, the rhizome of “Zingiber officinalis”, one of the most widely used species of the ginger family, is a common condiment for various foods and beverages. Ginger has a long history of medicinal use dating back 2500 years. Ginger has been traditionally used from time immemorial for varied human ailments in different parts of the globe, to aid digestion and treat stomach upset, diarrhoea, and nausea. Some pungent constituents present in ginger and other zingiberaceous plants have potent antioxidant and anti-inflammatory activities, and some of them exhibit cancer preventive activity in experimental carcinogenesis.(29)

Several plant-derived extracts have been evaluated as possible inhibitors of the NF-κB pathway. Ginger root (Zingiber officinalis Roscoe) and its main polyphenolic constituents (gingerols and zerumbone) have anti-oxidant,(30-35) anti-inflammatory(36-39) and anti-carcinogenic activity.(40-44) In particular, ginger root and its constituents can inhibit NF-κB activation induced by a variety of agents(45-48) and has been shown to down regulate NF-κB regulated gene products involved in cellular proliferation and angiogenesis, including IL-8,(49) and VEGF.(50) These factors have also been shown to promote tumor cell proliferation, angiogenesis, and affect apoptotic response in ovarian cancer.

A study revealed that the ethanol and n-hexane extracts of ginger exhibited antibacterial activities against three anaerobic Gram-negative bacteria, Porphyromonas gingivalis ATCC 53978, Porphyromonas endodontalis ATCC 35406 and Prevotella intermedia ATCC 25611, causing periodontal diseases. Authors concluded that two highly alkylated gingerols, [10]-gingerol and [12]-gingerol effectively inhibited the growth of these oral pathogens at a minimum inhibitory concentration (MIC) range of 6-30 microg/mL. These ginger compounds also killed the oral pathogens at a minimum bactericidal concentration.(51)

Turmeric (Curcumin): India has been recognized all over the world for spices and medicinal plants. Both exhibit a wide range of physiological and pharmacological properties. Current biomedical efforts are focused on their scientific merits, to provide science-based evidence for the traditional uses and to develop either functional foods or nutraceuticals. The Indian traditional medical systems use turmeric for wound healing, rheumatic disorders, gastrointestinal symptoms, deworming, rhinitis and as a cosmetic. Studies in India have explored its anti-inflammatory, cholekinetic and anti-oxidant potentials with the recent investigations focusing on its preventive effect on precarcinogenic, anti-inflammatory and anti-atherosclerotic effects in biological systems both under in vitro and in vivo conditions in animals and humans. Both turmeric and curcumin were found to increase detoxifying enzymes, prevent DNA damage, improve DNA repair, decrease mutations and tumour formation and exhibit antioxidative potential in animals.(52)

Curcumin (diferuloylmethane) is the chief component of the spice turmeric and is derived from the rhizome of the East Indian plant Curcuma longa. Curcuma longa is a member of the Zingiberaceae (ginger) family of botanicals and is a perennial plant that is native to Southeast Asia.(53) Turmeric has also been widely used in Ayurvedic medicine for its anti-oxidant, anti-septic, analgesic, anti-malarial and anti-inflammatory properties.(54) Curcumin has been consumed as a dietary supplement for centuries and is considered pharmacologically safe.(55) Curcumin is a lipophilic polyphenol and thus is insoluble in water, but is readily soluble in organic solvents such as dimethylsulfoxide, acetone and ethanol.(54, 56)

The antioxidant activity of the curcinoids comes by virtue of their chemical structure. The curcinoids consist of two methoxylated phenols connected by two a, B unsaturated carbonyl groups that exist in a stableenol form.(57) Curcumin’s inhibitory effect on the NF-κB pathway is central to providing the compound with its anti-inflammatory properties.(58-60) Epidemiological studies attribute the low incidence of colon cancer in India to the chemopreventive and antioxidant properties of diets rich in curcumin.(61) Curcumin’s inhibitory effect on carcinogenesis has been demonstrated in several animal models of various tumor types including oral cancer, mammary carcinoma and intestinal tumors.(62-64) In addition to the potential synergistic effect of curcumin with platinum based chemotherapy, the spice may also have potential utility as an enhancer of radiation therapy. A recent study by Khafif et al the combination of both therapies resulted in an additive growth suppressive effect.(65)

Low incidence of colon cancer among Indians has been attributed to the use of turmeric in Indian cooking.(66) Curcumin appears to suppress oxidative damage, inflammation, cognitive deficits, and amyloid accumulation in Alzheimer’s disease.
In addition, curcumin appears to show protective effects in cystic fibrosis, human immunodeficiency virus, and experimental alcoholic liver disease.(67) *Porphyromonas gingivalis*, a major periodontopathic bacterium, is necessary for periodontitis to take place. The lipopolysaccharide (LPS) of *P. gingivalis* stimulates cytokine secretion in immune cells, and thereby initiates the inflammation related to periodontitis. Macrophages are the important immune cells that are prominent at inflammatory periodontal sites. Curcumin, a major curcuminoid found in the spice turmeric, exhibits anti-inflammatory properties against these microorganisms.(68)

Natural Xan natural Curcuma xanthorrhiza extract (Xan) has strong bactericidal activity, inhibitory effects on acidogenesis, and alters the microstructure of *S. mutans* biofilm. In conclusion, Xan has potential in anti-*S. mutans* therapy for the prevention of dental caries.(69)

The renaissance into the study and use of plant products is an eye opener to increased awareness of the myriad of side effects associated with allopathic medications. Though extensive research has brought to light several benefits of plant based medications on oral pathogens further human studies are essential relating to oral disorders in particular. Judicious use of these remedies under the guidance of Ayurvedic health care providers with extensive knowledge would certainly aid patients in their pursuit of safer health care.

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