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Review Article

THE ROLE OF GREEN TEA IN ORAL HEALTH - A REVIEW

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ABSTRACT

Tea is the most widely consumed and a popular beverage in the world. Over the past decade, molecular components of teas and their health benefits on humans have received increasing attention from researchers. Functional foods are foods with positive health benefits that extend beyond their normal nutritional value. They interrupt the functions of the body and help in the management of specific health conditions and preventing pathologic changes. One such nature's gift is green tea. Green tea, a leading beverage in the Far East for the past thousand years, is an important source of polyphenol antioxidants. (EGCG) epigallocatechin 3 gallate, a polyphenol, constitute the most interesting components in green tea leaves. There is an increasing interest on the health benefits of green tea in the field of oral health. Green tea is renowned for its antioxidant, anti-cariogenic, anti inflammatory and antimicrobial properties. This traditional beverage is also used in the management of chronic systemic diseases including carcinoma. Recent studies has emphasized that in addition to the microbial activity, the host immuno-inflammatory reactions destroy the oral tissues to a greater extent. In such cases green tea is considered to be a natural preventive and curative agent. There is a growing search of evidence for understanding the beneficial role of green tea and its polyphenols in oral health. Numerous studies have shown the beneficial effects on the regular intake of green tea in maintaining oral health. Even though studies demonstrate the health effects of green tea polyphenols, more clinical and biological studies to support guidelines for green tea intake as part of prevention and treatment of specific oral pathologies are needed.

Keywords: Antioxidant, Green tea, Oral health, Polyphenols.

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INTRODUCTION

Green tea, an unoxidized tea, is derived from *Camellia sinensis*. Green tea is obtained from *C. sinensis* by undergoing minimal oxidation during the process [1]. Green tea first originated in China and it was first cultivated in 2737 BC during the period of Emperor Chen Nung. It is serving as a beverage as well as a medicine over the years. Green tea has been subjected to numerous scientific and medical studies to determine the extent of its health benefits in recent years [2]. There are three varieties of tea, namely, green tea, black tea, and oolong. All the three varieties are derived from *C. sinensis* plant, while the difference between them is the method of processing [3]. Green tea is unfermented (produced by drying and steaming the leaves to inactivate the polyphenol oxidase, thus no oxidation occurs), oolong is semi-fermented (produced when the leaves are subjected to partial fermentation before drying), and black tea is fully fermented (a post-harvest fermentation stage before drying and steaming). Since fermenting results in a loss of various essential components, green tea remains as the richest source of antioxidants (Table 1), explicitly polyphenols [4]. Hence, this review article elaborates on the various beneficial effects of green tea on oral health.

EFFECT OF GREEN TEA ON ORAL HEALTH

Green tea and dental caries

Dental enamel is comprised of hydroxyapatite crystals. The solubility of hydroxyapatite rises with the decrease in pH which is harmful to the tooth enamel [7]. The EGCG extract from the green tea causes a reduction in acid production and maintains pH by inhibiting the enzyme lactate dehydrogenase which is responsible for producing lactic acid from pyruvate [8]. Preventing the adhesion of bacteria to the glycoprotein layer is an additional mechanism explaining the anticariogenicity. A study has concluded that rinsing the mouth for 1 week with green tea mouthwash significantly reduces the salivary levels of *Streptococcus mutans* and Lactobacillus [3]. Reports have proved that green tea decreases the susceptibility of dental caries in both humans and animals [2]. Frequent intake of green tea can significantly decrease caries formation, even in the presence of sugar in the diet [9]. Green tea extract also reduces α-amylase activity in saliva which makes it act as an anticariogenic agent [10,11].

Green tea and halitosis

Halitosis, due to dental caries and poor oral hygiene, is attributable mainly due to volatile sulfur compounds. Few breath refreshing chewing gums and mouth spray contain polyphenols, which are a major ingredient of green tea [12]. A study has reported that using green tea mouthwash significantly reduces the volatile sulfur components level in patients with gingivitis [13]. Another study has demonstrated that green tea extract had the ability to remove odorant sulfur [14].

Green tea and antiviral property

Polyphenols which act as antioxidant inhibit the enzymes that damage the cell membrane and prevent penetration of the virus into the cells [15]. This property of green tea is quite essential as it can prevent the oral viral diseases. EGCG is said to have ability to prevent infection from influenza virus by attaching to viral hemagglutinin, thus preventing its attachment to cellular target receptors [16]. A study revealed that EGCG, EGC, and ECG were found potent to inhibit influenza virus by hemagglutination inhibition. EGCG and ECG suppress the viral RNA synthesis, while EGC fails to exhibit this property [17]. Green tea is also stated to have its effect against human immunodeficiency virus type 1, herpes simplex virus, Epstein–Barr virus, and adenoviruses [15].

Green tea and antifungal property

Candida albicans, a part of the indigenous microbial flora in humans, is unique among opportunistic pathogens because it is a part of the normal microbial flora of the host [18]. Candidiasis is a most common outbreak of *C. albicans* in the oral cavity. Amphotericin B (polyene antibiotics) and fluconazole (azole antifungal agent) have the strongest antifungal activity, especially against *C. albicans*. Antimycotic-resistant isolates of *C. albicans* have appeared which act a major drawback [19]. Hence, a crude substitute was considered necessary. A study showed synergic

Table 1: Composition of green tea [1,4-6]

Macronutrients	Micronutrients	Organic substance
Protein such as enzymes- 15-20% of dry weight	Vitamins B, C, E.	Most important component of green tea is polyphenols
Carbohydrates: Cellulose, pectin, glucose, fructose, and sucros e-1–7% of dry weight	Xanthic bases such as chlorophyll and carotenoids	Polyphenols of green tea are catechins (flavan-3-ols).
Lipid components: Linoleic and linolenic acids	Volatile components - aldehydes and alcohols.	The four main catechins are:
Sterols such as stigmasterol	Minerals and trace elements- Ca, Mg, Mn, Cr, Fe, Al, F, K, Cu, Zn, Mo, Se, Na, P, Co, Sr, Ni	(EGCG) Epigallocatechin-3-gallate-59%
		(EGC) Epigallocatechin-19%
		(EGC) Epicatechin three gallate-13.6%
		(EC) Epicatechin-6.4%

antifungal activity when a combination of EGC and antimycotics was used against *C. albicans*. It also concluded that the combined use of EGC and low dosage of amphotericin-B inhibited the growth of *C. albicans*, and the action was proved to be fungicidal [20].

Green tea and periodontitis

Gingival sulcus, which harbors numerous microorganisms (mainly anaerobes), deepens forming a periodontal pocket in cases of periodontitis. In periodontitis, local infiltration of polymorphs and serum exudates takes place. Anaerobic black-pigmented bacteria such as *Prevotella* sp. and Porphyromonas digitalis are commonly associated with periodontal disease [21]. *In vitro* studies showed that green tea catechin inhibits the growth of *Porphyromonas gingivalis*, *Prevotella intermedia*, and *Prevotella nigrescens*, by inhibiting the adherence of *P. gingivalis* onto human buccal epithelial cells and also by inhibiting the production of toxic metabolites of *P. gingivalis* [22]. Green tea polyphenol also increases osteoblastogenesis and suppresses osteoclastogenesis, thus preventing the bone from destruction and preserving the periodontium [23]. Green tea catechin given by local delivery system using hydroxypropyl cellulose strips is said to inhibit the growth of bacteria. Continuous application of green tea catechin was reported as an effective method for improvement of periodontitis [24]. EGCG, with its ability to inhibit the formation of osteoclasts and induce apoptosis cell death of osteoclasts, is also considered for improving periodontal health [25]. Green tea is also recognized for their roles in host defense, human gingival cells, and inflammatory response [26,27].

Green tea and oral malignancy

Oral squamous cell carcinoma, a most common head and neck malignancy, is characterized by high rates of morbidity and mortality [28]. Hamsters with induced buccal pouch tumor were given green tea till the end of the experiment. It was noticed that hamsters of the study group when compared with the control group showed lesser pathological changes and tumor size [29,30]. Studies have been conducted to show that green tea polyphenols may induce apoptosis and delay in the cell cycle in tumor cells while not disturbing the normal cells [31]. Another study showed that tongue carcinoma culture supplemented with EGCG causes inhibition of cell invasion. This was furthermore confirmed by administering EGCG in SCC-induced mice, which showed dose-dependent tumor growth inhibition and reduced hepatocyte growth factor expression [32].

Over consumption of green tea

Over consumption of green tea is least likely to disrupt sleep quality at night. Pregnant and breastfeeding women should drink no more than 1–2 cups/day, as it can cause an increased heart rhythm. It is also important to control the consumption of green tea in renal disorders, due to its diuretic effects [4]. Aluminum present in green tea, as revealed by few studies, has a high capacity to cause neurological diseases [34]. Over intake of green tea catechins decreases the iron bioavailability from the diet. *In vivo* study has proved that green tea polyphenols can cause oxidative stress and liver toxicity at certain concentrations. Patients on Warfarin are contraindicated to take green tea as green tea contains Vitamin K. Green tea should also not be taken with aspirin because it prevents platelets from clotting [34].

Other health benefits

Apart from oral health, review of literature shows various general health befits of consuming green tea [3,35]. Some of them includes: Anti-inflammatory activity, antimicrobial activity, antidiabetic activity [36,37], anti-obesity effect [36], antihypertensive effect, cardiac effects, blood pressure control, gastro and hepatoprotective effect, and neuroprotective effect [33,37,38].

CONCLUSION

Drinking green tea is a healthy habit to maintain a healthy life. Various studies have demonstrated that green tea possesses antioxidant, antimutagenic, antidiabetic, anti-inflammatory, antibacterial, and antiviral, and above all, cancer-preventive properties. Yet it is not entirely clear whether green tea potency is because of its phenolic ingredients or other nutritional components. More research is needed to advocate the beneficial mechanisms of green tea. Review of the literature concluded that green tea taken as a daily supplement can improve the health status. Hence, it is considered to be a wholesome drink for a healthy living.

AUTHORS CONTRIBUTION

Concept and collection of data - Meenakshi Mohan, Ganesh Jeevanandan. Writing the article and critical review of article - Meenakshi Mohan, Mithunraja. Final approval of the article - Ganesh Jeevanadan.

CONFLICT OF INTEREST

Nil.

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