

A review on green tea catechins in oral health management

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ABSTRACT

Tea is one of the common beverages used worldwide. Green tea is a commonly used beverage in the Asian countries. Tea contains constituents such as flavonoids and catechins which have wide use in several health-related problems. Green tea extract catechins have four main derivatives: Epicatechin, epigallocatechin (EGC), epicatechin gallate, and EGC gallate. These constituents have a wide range of health benefits in varied degrees, some effects of which are dosage dependent and some are not dosage dependent. Several studies provide evidence that green tea catechins have the following beneficiary effects on human body - fights cancer, lowers cholesterol, protection against heart disease, prevents diabetes, maintains a healthy circulatory system, prevents food poisoning, gives a healthier skin, and acts as a potent detoxifier. It prevents cavities, strengthens tooth enamel, reduces plaque and bacteria and prevents bad breath in the oral cavity. This article reviews the antitumorigenic, antithrombotic, antiviral, antidiabetic, antioxidant activities and anticariogenic, antifungal activity, effect on periodontal disease, and halitosis in the oral cavity.

Keywords: Catechins, green tea extract, anticariogenic, antitumorigenic, antifungal, antiviral, halitosis, antioxidants

Introduction

Catechins are phytochemical compounds found in high concentrations in a variety of plant-based foods and beverages.^[1] There are four main catechin derivatives including epicatechin (EC), epigallocatechin (EGC), epicatechin gallate (ECG), and EGC gallate (EGCG).^[2,3] EGCG is the most powerful of these catechins. High concentrations of catechin can be found in red wine, broad beans, black grapes, apricots, and strawberries. EC concentrations are high in apples, blackberries, broad beans, cherries, black grapes, pears, raspberries, and chocolate. Finally, EGC, ECG, and EGCG are found in high concentrations in both black and green tea.^[1,4]

Catechins account for 6–16% of the dry green tea leaves.^[5] Several studies on catechins report their consistent protection against several degenerative disorders and metabolic syndromes such as type-2

diabetes, cardiovascular risk factors, obesity, hypercholesterolemia, atherosclerosis, Parkinson's disease, Alzheimer's disease, and other aging-related disorders.^[6-8] Besides well-known health benefits, green tea catechins exert antimicrobial and antiviral activities against a variety of infectious agents.^[9] The polyphenols that are most well absorbed in humans are isoflavones and gallic acid, followed by catechins, flavanones, and quercetin glucosides, with different kinetics.^[10]

Catechins and General Health

Antitumorigenic activity

Several studies were conducted on the antitumorigenic effect of green tea extracts (catechins). The studies report that catechins protect various organs such as intestine, lung, liver, prostate, and breast against chemical carcinogens.^[8,11,12]

Xu *et al.* conducted a study in mice and their experiment reported that the inhibition of 8-hydroxydeoxyguanosine formation in lung DNA by green tea and EGCG is consistent with their ability to inhibit lung tumorigenesis.^[13] Supporting this was a study conducted by Zhu *et al.*, they studied the protective effects of tea and/or its components on dysfunction of immune functions during tumor growth and carcinogenesis in mice and found out that tea and its components ameliorated immune dysfunction in mice treated with the carcinogen.^[14]

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By several evident studies were conducted by many researchers, green tea catechins have antiproliferative activity and hypolipidemic activity. They were also found to prevent hepatotoxicity.^[12,15] A striking observation of a study conducted by Gupta *et al.* was that green tea polyphenol (GTP) infusion resulted in almost complete inhibition of distant site metastases. Furthermore, GTP consumption caused significant apoptosis of prostate cancer cells, which resulted in inhibition of prostate cancer development, progression, and metastasis to distant organ sites.^[16]

Green tea had significant chemopreventive effects on carcinogen-induced mammary tumorigenesis in female rats in a study conducted by Kathryn *et al.*^[17] However, green tea catechins inhibit mammary carcinogenesis only in the post-initiation stage and the effect is weak and not dose-dependent.^[18] Further studies need to be conducted to find out the exact mechanism of green tea catechins on mammary tumor.

Antithrombotic activity

A study conducted by Yang *et al.* investigated the effects of dietary green tea catechin on phospholipase A2 activity and the antithrombotic reaction of platelets in streptozotocin-diabetic rats. The study divided the rats into one normal and three diabetic groups based on their catechin content. It was found that the activity of platelet cyclooxygenase and platelet thromboxane A2 formation was higher and also, the synthesis of aortic prostacyclin (PGI2) and the PGI2/TXA2 ratio was lower in catechin-free group compared to the normal group. However, it was subsequently restored by catechin supplementation. The above results indicate that these abnormalities the abnormality can be improved by dietary catechin.^[19]

Antidiabetic effect

A handful of studies is conclusive of the antidiabetic effect of green tea catechins. The following study was conducted by Tsuneki *et al.* on diabetic mice and healthy human volunteers. The study provides evidence that green tea has an antidiabetic effect.^[20,21]

Antioxidant activity

Antioxidants are agents which block the harmful effects of free radicals on body cells. Green tea catechins showed different trends in relative antioxidant activity in different lipid systems. The study was conducted to find out the effect of catechins on liposomes and emulsions. There was improved antioxidant activity on liposomes than on emulsions which is explained by greater affinity of the polar catechins toward the polar surface of the lecithin bilayers, thus affording better protection.^[22] Another study conducted on the antioxidant activity resulted that GTP may exert an antiatherosclerotic action by virtue of its antioxidant properties and by increasing HDL cholesterol levels.^[23]

Further studies put forward that the antioxidant effect of green tea catechins was well correlated with their antimutagenicity but varied with their mutagen and antioxidative properties.^[24]

Catechins and Oral Health

Effect on oral cancer

The antitumorigenic activity of green tea, tea pigments, and mixed tea was studied on hamsters. In this study, 7,12-dimethylbenz[a]anthracene-induced oral carcinogenesis in golden Syrian hamsters was studied. The results showed that oral administration of 1.5% green tea, 0.1% tea pigments, and 0.5% mixed tea reduced the mean tumor burden and the incidence of dysplasia and oral carcinoma.^[25]

Supporting this study is another study conducted by Li *et al.*. In this study, green tea also decreased the number of dysplastic lesions.^[26] Green tea and curcumin, either singly or in combination, decreased the proliferation index in hyperplasia, dysplasia, and papillomas.

These results suggest that green tea catechin definitely has inhibitory effect on oral carcinogenesis.

Anticariogenic activity

Effect of green tea catechins on bacteria responsible for caries in the mouth was studied by several researchers. Catechins effectively inhibited the *Streptococcus mutans* strain in the experimental rats.^[27]

Another study put forth by Xu *et al.* also supported this activity. The findings suggest that EGCG is a natural anticariogenic agent in that it exhibits antimicrobial activity against *S. mutans* and suppresses the specific virulence factors associated with its cariogenicity.^[28]

There is convincing evidence that the different components of catechins have their action on different species of microorganisms responsible for caries production.

Antifungal activity

The antifungal activity of catechin was pH-dependent based on a study conducted by Hirasawa and Takada.^[29] Among catechins, pyrogallol catechin showed stronger antifungal activity against *Candida albicans* than catechol catechin.

The combined use of EGCG with amphotericin B and fluconazole in appropriate concentrations inhibited amphotericin B and fluconazole resistant *C. albicans*.

Antiviral effect

Various components of catechins from green tea were evaluated for their ability to inhibit influenza virus replication in a study conducted. The study suggests that the antiviral effect of catechins on influenza virus is mediated not only by specific interaction but altering the physical properties of viral membrane.^[30]

Effect on periodontal disease

Anaerobic black-pigmented bacteria such as *Prevotella* spp. and *Porphyromonas gingivalis* are constantly associated with periodontal disease. The usefulness of green tea catechin in the improvement

of periodontal disease was studied. Green tea catechin showed a bactericidal effect against *Porphyromonas gingivalis* and *Prevotella* spp. *in vitro*, and in the *in vivo* study, the pocket depth and the proportion of Gram-negative anaerobic rods (BPR) were markedly decreased.^[31]

GTPs, especially EGCG which is a dominant component of tea polyphenols, completely inhibited the growth and adherence of *P. gingivalis* in a study conducted to assess the inhibitory effect of GTPs on the growth of *P. gingivalis*.^[32]

Furthermore, green tea catechin, particularly EGCG inhibited the production of phenylacetic acid, which is a toxic substance produced by *P. gingivalis*.^[33] Recent studies have concluded that catechins have an inhibitory action on the causative agents as well as the end metabolites of the agents producing periodontal diseases.

Effect on halitosis

Methyl mercaptan is considered as the main source of halitosis. An *in vitro* study was conducted on the effect of tea catechins on halitosis.^[34] The results of this study indicated that tea catechins showed remarkable effect on the elimination of methyl mercaptan, and chewing of gum containing tea catechins was useful to depress the bad breath.

Kaneko *et al.* found that a 4-week regimen of mouth washing with a dilute catechin solution reduced the mouth odor (halitosis) associated with periodontal disease.^[35]

Conclusion

This article extensively reviews the antitumorigenic, antithrombotic, antiviral, antidiabetic, antioxidant activities and anticariogenic, antifungal activity, effect on periodontal disease, and halitosis in the oral cavity. Green tea catechins being a potent antioxidant agent is used both in medical and dental disorders. More clinical trials are required to prove its efficacy as an anticancer agent.

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