



Green Tea and Oral Health-A Review

Vasundhara¹, Manish Goyal², M. K. Sunil³, Dhruv Garg⁴, Nayira Johar⁵

¹PG Student, Department of Oral Medicine and Radiology, Teerthanker Mahaveer Dental College and Research Center, Moradabad, Uttar-Pradesh, India.

²Principal, Professor and Head, Department of Orthodontics and Dentofacial Orthopedics, Teerthanker Mahaveer, Dental College, and Research Center, Moradabad, U.P, India.

³Professor and Head, Department of Oral Medicine and Radiology, Teerthanker Mahaveer, Dental College, and Research Center, Moradabad, U.P, India.

⁴PG Student, Department of Oral Medicine and Radiology, Teerthanker Mahaveer Dental College and Research Center Moradabad, Uttar-Pradesh, India.

⁵PG Student, Department of Oral Medicine and Radiology, Teerthanker Mahaveer Dental College and Research Center Moradabad, Uttar-Pradesh, India.

[Review Article](#)

Address for Correspondence Author

Dr. Vasundhara; Department of Oral Medicine and Radiology, Teerthanker Mahaveer Dental College and Research Center, Moradabad, Uttar-Pradesh, India.

E-mail: preethipranav2001@gmail.com

Crossref doi: <https://doi.org/10.36437/ijdrd.2020.2.4.C>

ABSTRACT

Green tea is a popular health drink which is routinely consumed by many people. It is derived from the dried leaves of the plant **Camellia sinensis** and is a leading beverage in the Far East for thousands of years. Green tea is usually available in the form of beverage, mouthwash containing extract of green tea, and chewing gum. Green tea is an important source of polyphenol antioxidants. Polyphenols including epigallocatechin 3 gallate (EGCG) constitute the most interesting components in green tea leaves. Green tea has the potential to protect against various malignant, cardiovascular, and metabolic diseases. It has been suggested that green tea promotes periodontal health by reducing inflammation, preventing bone resorption, and limiting the growth of certain bacteria associated with periodontal diseases. Green tea is renowned for its antioxidant, anti-carcinogenic, anti-inflammatory, and antimicrobial properties. This traditional beverage is also used in the management of chronic systemic diseases including carcinoma. Recent studies have 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.

Keywords: Green Tea, Camellia Sinensis, Polyphenol, Inflammation.



Introduction

Before the event of the pharmaceutical business, seasoning products were used for activity varied conditions in earlier days. In terms of oral care, the most commonly used herbal product is "Miswak" that has become popular in several communities as an effective, cheap, and efficient way of maintaining oral hygiene.⁷⁻¹⁰ Similarly, the beneficial effects of using various types of tea leaves have been a common topic of discussion in the general public and professionals. According to Chinese legend, tea has a known history of over 4000 years ago which was discovered accidentally by an emperor, while according to other sources the Chinese have been drinking tea since 3000 B.C. and over millions of acres are devoted to its cultivation. Currently, it is being used in almost every country around the world and is now been grown in India, Sri Lanka, Iran, Java and Japan.⁵

Green tea is obtained from the leaf of a tree in Southeast Asia, *Camellia sinensis*.¹¹ It will be on the market as a ligneous plant or evergreen tree. Its leaves might vary from exstipulate, simple to undivided up to thirty cm long, 2–5 cm broad, pubescent, generally changing into hairless, serrate, acute, or acuminate.¹²

Effect of Green Tea on Oral Health

Dental Caries: Various oral pathologies such as dental caries, periodontal diseases, and teeth loss can greatly influence human health. Amongst those, dental caries are caused as a result of infectious diseases caused by numerous reasons related to nutrition and bacterial infections. According to the available literature reported that tea consumption may decrease dental caries in humans and laboratory animals. Magalhaes et al. documented that mouth rinsing with green tea extract (0.61%) protected from erosion and abrasion of the tooth dentine similarly to mouth rinsing with fluoride extract (250 ppm) or chlorhexidine extract (0.06% as found in oral hygiene products).¹³ In addition, one week of mouthwash with green tea (1.6 g of pulverised green tea in 40 ml DDW, 3 times a day) significantly reduces the salivary levels of the virulent cariogenic pathogens *Streptococcus mutans* and *Lactobacilli*. Such a reduction of those pathogen levels will very likely decrease the susceptibility to dental caries.¹

Tea catechins also prevent the attachment of oral streptococci to tooth surfaces and inhibit streptococcal glucosyltransferase. EGCG in specific concentration and application interval can prevent acid production by cariogenic bacteria via inhibition of lactate dehydrogenase (LDH) and increases the minimum pH of the oral cavity from 4.8 to 6.5.¹⁴ This LDH converts pyruvic acid to lactic acid. Although fluoride existing in green tea is a useful component for tooth caries resistance, it is suggested that the main component responsible for anti-cariogenic properties of green tea are polyphenols and tannins.¹⁵ Daneshyar et al. suggested that green tea varnish was used to prevent root surface caries.¹⁶ In recent studies, the antimicrobial effects of green tea against *Streptococcus mutans*, *Lactobacilli* spp. and *Candida albicans* were compared with the gold standard antibacterial material, chlorhexidine (CHX). The various authors reported that green tea was more effective than CHX for inhibition of *Streptococcus mutans* and less effective about *Lactobacilli* spp. The authors suggested green tea as a cost-effective material for caries prevention.^{4,17}

Antiviral Effects

Green tea is known for its antiviral properties which are based on the polyphenols ability to act as antioxidants, inhibit enzymes that damage cellular membranes and prevent binding and penetration of viruses to cells.¹⁴ This property of green tea is quite essential and able to prevent oral viral diseases. A study revealed that EGCG, EGC, and ECG were found potent to inhibit the influenza virus by hemagglutination inhibition. EGCG and ECG suppress the viral RNA synthesis, while EGC fails to exhibit this property. Green tea and its effect against human immunodeficiency virus type 1, herpes simplex virus, Epstein–Barr virus, and adenoviruses.⁶



Antifungal Effects

Candida albicans, is 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 the 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 as a major drawback.¹⁹ Hence, a crude substitute was considered necessary. A study showed synergic 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.⁶

Halitosis

Halitosis is one of the disturbing problems that is caused as a consequence of dental caries. Bacterial halitosis is caused mainly as a result of volatile sulphur compounds such as asH_2S and CH_3SH that is produced by decay processes that are created by oral microorganisms. breath refreshing chewing gums and mouth spray contain polyphenols, which are a major ingredient of green tea.¹³

Several studies have reported that the victimization of tea leaf gargle considerably reduces the volatile sulphur parts level in patients with periodontal disease and it also has incontestable that tea leaf extract had the power to get rid of odorant sulphur.⁶

Gingival and Periodontal Health

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. 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*.⁶

Due to the wide range of antibacterial effects of green tea against gram-positive and gram-negative microorganisms, it is suggested as a useful antiplaque agent. Catechins keep the salivary and plaque pH at about neutral, so they prevent the colony growth and activity of streptococcus mutans. EGCG may inhibit the activity of matrix metalloproteinase-9 (MMP-9) which helps the formation of osteoclasts in periodontal disease, and therefore prevents alveolar bone resorption.⁴

Protection from Oral Oxidative Stress and Cigarette Smoke Induced Inflammation

Cigarette smoke destroys oral cavity homeostasis. It decreases salivary antioxidant status, initiates oral inflammatory diseases, and promotes oral malignancies. Many authors have documented that cigarette smoke causes a significant decrease in the activity of numerous oral cavity and saliva enzymes that are responsible for the protection against oxidative damage.¹³⁻¹⁴ Preliminary experiments in labs have shown that adding green tea and EGCG to saliva in vitro or mouth rinsing with green tea infusion in vivo were beneficial in providing significant protection of these enzymes against cigarette smoke damage. Cigarette smoke contains active reactive oxygen species (ROS) such as hydrogen peroxide, hydroxyl radical, and superoxide. In addition, cigarette smoke constitutes the major source of nitric oxide (NO) that humans are exposed to. NO and superoxide may react with one another and form peroxynitrite (ONOO_\cdot). It may cause induction of the inflammatory transcription factor NF Cigarette smoke destroys oral cavity homeostasis. It decreases salivary

antioxidant status, initiates oral inflammatory diseases, and promotes oral malignancies. It contains active reactive oxygen species (ROS) such as hydrogen peroxide, hydroxyl radical, and superoxide. In addition, cigarette smoke constitutes the major source of nitric oxide (NO) that humans are exposed to.

Nitric oxide and superoxide may react with one another and form peroxynitrite (ONOO₂). This leads to amplification of the expression and the activity of iNOS which contributes to chronic inflammation in subjects that are exposed even to low levels of cigarette smoke⁸.

Green tea and its catechins have the ability to scavenge NO, superoxide oxide, and ONOO₂ himself (Fig A). In addition, EGCG also suppresses NF-κB activation by preventing the phosphorylation and breakdown of the inhibitory subunit IκB-α in human dental pulp cells in vitro and others. The subunit IκBα is responsible for suppressing nuclear transport of the NF-κB functional subunit (p65, p50). Activation of p65 and p50 leads to the activation of pro-inflammatory genes. Correspondingly, Syed et al. documented that EGCG led to a reduction in NF-κB expression and as a consequence, reduction in the proteins mediated by it, such as matrix metalloproteinase-9 (MMP-9) – involved in the extracellular matrix breakdown process, IL-8 (interleukin-8), and iNOS in bronchial epithelium.¹

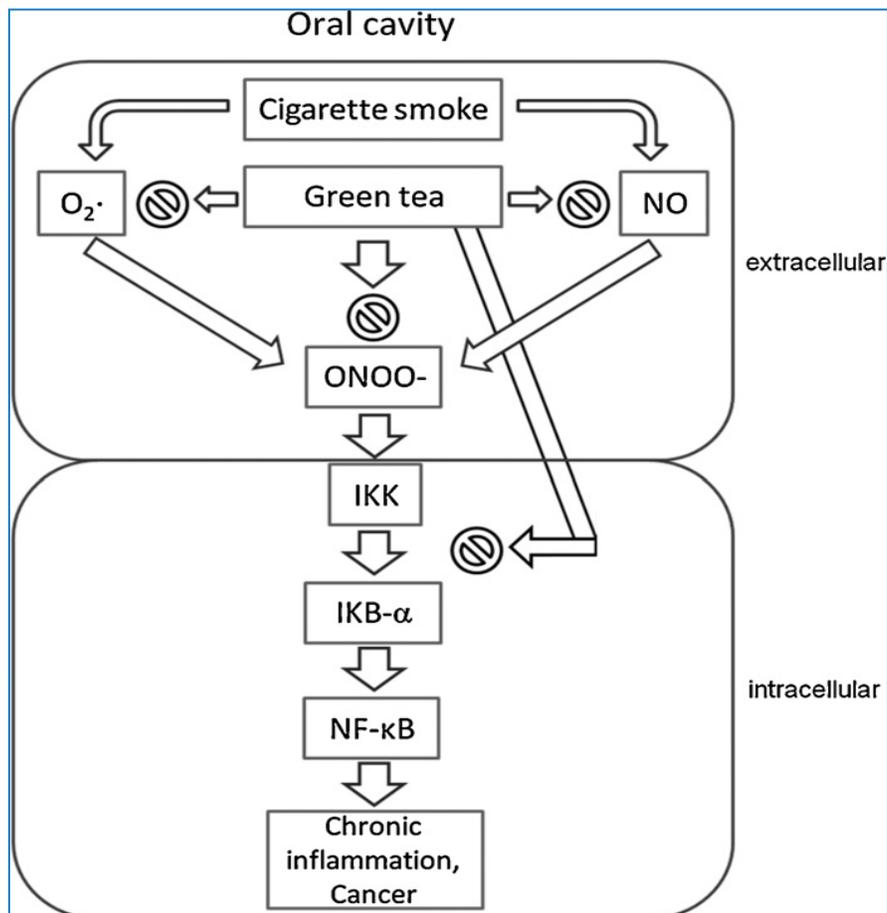


Figure. A - A putative mechanism of green tea protection against cigarette smoke damage. In cigarette smoke there is an increased production of NO and superoxide which react together to produce ONOOS. ONOOS enters the intracellular compartment and activates IKK protein. IKK phosphorylates IKB-α and consequently NF-κB is activated. Chronic NF-κB activation induces chronic inflammation and may terminate in the development of malignancy. Green tea scavenges extracellular NO and



superoxide and thus prevents the production of ONOOS. It also scavenges ONOOS. Green tea polyphenols are also able to prevent intracellular phosphorylation of the inhibitory subunit I κ B α . Thus they prevent activation of IKK and I κ B α breakdown with reduction of NF- κ B expression. All together, such mechanisms may explain the protection of green tea and its active constituents against toxic cigarettes' injury.

Dental Erosion

MMPs in dentin and saliva is responsible for the degradation of the organic matrix of dentin. They activate when the oral cavity pH drops by the acids produced during the cariogenic challenge. MMPs help the progression of dentin caries. MMPs responsible for the organic matrix degradation of dentin are MMPs 2, 8, and 9¹⁸⁻¹⁹. Using materials that inhibit MMPs, such as CHX, can be helpful for caries prevention. The proposed mechanism of action for MMP inhibitors is the maintenance of the demineralized organic matrix on dentin surface.²⁰ EGCG extract in green tea is reported as an MMP inhibitor.

Oral Malignancies Prevention & Regression

Many animal experiments using biomarkers associated with the risk of cancer or development were investigated by green tea extracts. Many of these studies reported that green tea extracts or EGCG are protected against chemical carcinogens in several organs such as the intestine, lung, liver, prostate, breast, and mouth. Oral squamous cell carcinoma (SCC) is the most common head and neck malignancy, with a worldwide incidence of more than 300,000 new cases a year. It is characterized by high rates of morbidity and mortality (over 50%). Hamsters with buccal pouch tumour that was induced by 7, 12-dimethylbenz (a) anthracene (DMBA), were given an oral dose of green tea before and until the end of the experiment.⁵

There are several authors reported that link tea polyphenols and the formation of reactive oxygen species (ROS). Yamamoto et al. suggested that a high concentration of EGCG will cause a similar effect in different cells; they tested oral cell carcinoma, normal epidermis keratinocytes, and normal salivary gland cells that have lost their ability to die (immortalised). The researchers found that high concentrations of EGCG did not lead to ROS formation and even lowered them in normal cells. In contrast, in carcinoma cells, ROS concentrations increased after adding EGCG and led to increased apoptosis in a dose-dependent manner.

Other studies suggested that tea polyphenols may induce apoptosis and cell cycle delay in tumour cells but not in normal cells thus affecting the number of biological pathways.⁵ Hepatocyte growth factor (HGF) is a stromal cell-derived mediator that involves in cancer invasion and metastasis. Overexpression of HGF leads to constitutive activation of several downstream signaling pathways, contributing to invasion and metastasis.¹

In cigarette smoke, there is an increased production of NO and superoxide which react together to produce ONOOS which enters the intracellular compartment and activates IKK protein and its phosphorylates initiates I κ B- α and consequently, NF- κ B is activated. Chronic NF- κ B activation induces chronic inflammation and may terminate in the development of malignancy. Green tea scavenges extracellular NO and superoxide and thus prevents the production of ONOOS. It also scavenges ONOOS and Green tea polyphenols are also able to prevent intracellular phosphorylation of the inhibitory subunit I κ B α . Thus they prevent activation of IKK and I κ B α breakdown with the reduction of NF- κ B expression. Altogether, such mechanisms may explain the protection of green tea and its active constituents against cigarette injury-induced tumour growth and invasion through suppression of the HGF signaling pathway. In light of this evidence, green tea may also be useful in the prevention of cancer metastasis. Despite the promising evidence on the benefits of green tea in preventing oral and other cancers in animal models and cell cultures, this potential benefit is not strong



enough for a universal recommendation to drink green tea in order to prevent oral cancer.¹ Tea polyphenols have also been shown to inhibit tumor cell proliferation and induce apoptosis in laboratory and animal studies. In other laboratory and animal studies, tea catechins have been shown to inhibit angiogenesis and tumor cell invasiveness. Although many of the potential beneficial effects of tea have been attributed to the strong antioxidant activity of tea polyphenols, the precise mechanism by which tea might help prevent cancer has not been established.²¹

Other Health Benefits

Apart from oral health, a review of the literature shows various general health benefits of consuming green tea. Some of them include Anti-inflammatory activity, antimicrobial activity, antidiabetic activity, anti-obesity effect, antihypertensive effect, cardiac effects, blood pressure control, gastro and hepatoprotective effect, and neuroprotective effect.⁶

Conclusion

Drinking green tea is a healthy habit to maintain a healthy life. Various studies have proved that green is an antioxidant, antimutagenic, antidiabetic, anti-inflammatory, antibacterial, and antiviral, and above all, cancer-preventive properties. Exposure of certain virus species to green tea may interfere with viral activity in the oral cavity. It might be interesting to explore the effects of green tea drinking on specific viruses in experimental animals. Additional in vitro studies on this issue is necessary.

Green tea also has the ability to oxidise odorant sulphur compounds, resulting in the abolition of halitosis; therefore some commercial oral hygiene products contain green tea extracts.¹ Green is a miracle medicine for oral health as it can be used in a variety of conditions affecting the oral cavity as well as our body.

References

1. Baruch Narotzki, Yishai Levy. Green tea: a promising natural product in oral health. Arch Oral Biol; Archives of oral biology · January 2012, 429-435. <https://doi.org/10.1016/j.archoralbio.2011.11.017>
2. Mohsen Hormozi . Effects of green tea and its products on dental caries and periodontal diseases: A review; International Journal of Contemporary Dental and Medical Reviews (2016), Article ID 020516. Doi: 10.15713/ins.ijcdmr.102
3. Vineet Nair, Prasanta Bandyopadhyay, Debabrata Kundu. Green Tea: A Friendly Oral Beverage?; INTERNATIONAL DENTAL JOURNAL OF STUDENT'S RESEARCH| Oct 2012-Jan 2013| Volume 1| Issue 3; 6-12.
4. Zahra Khamverdi, Mohadese Azarsina; The Beneficial Effects of Green Tea in Oral Health and Dentistry; Biomed J Sci & Tech Res; Volume 19- Issue 4 , July 15, 2019. <http://dx.doi.org/10.26717/BJSTR.2019.19.003333>
5. Khurshid Z et al.; Green Tea (Camellia Sinensis): Chemistry and Oral Health; The Open Dentistry Journal, 2016, Volume 10 166-173. <https://dx.doi.org/10.2174%2F1874210601610010166>
6. Meenakshi mohan, ganesh jeevanandan, mithun raja s; the role of green tea in oral health - a review; asian j pharm clin res, vol 11, issue 4, 2018, 1-3. <https://doi.org/10.22159/ajpcr.2018.v11i4.23628>
7. Almas K. Miswak (chewing stick) and its role in oral health. Postgrad Dent 1993; 3: 214-8.



8. Al-Bayaty FH, Al-Koubaisi AH, Ali Naw, Abdulla MA. Effect of mouth wash extracted from *Salvadora persica* (Miswak) on dental plaque formation: A clinical trial. *J Medicinal Plants Res* 2010; 4(14): 1446-54.
9. Sofrata A, Lingström P, Baljoon M, Gustafsson A. The effect of miswak extract on plaque pH. An *in vivo* study. *Caries Res* 2007; 41(6): 451-4. <https://doi.org/10.1159/000107931>
10. Batwa M, Bergstrom J, Batwa S, Al-Otaibi MF. The effectiveness of chewing stick miswak on plaque removal. *Saudi Dent J* 2006; 18(3):125-33. https://applications.emro.who.int/imemrf/sdj_2006_18_3_125.pdf
11. Arakawa H, Maeda M, Okubo S, Shimamura T (2004) Role of hydrogen peroxide in bactericidal action of catechin. *Biol Pharm Bull* 27(3): 277- 281. <https://doi.org/10.1248/bpb.27.277>
12. Scholl C, Lepper A, Lehr T, Hanke N, Schneider KL, et al. (2018) Population nutrkinetics of green tea extract. *PLoS One* 13(2): e0193074. <https://doi.org/10.1371/journal.pone.0193074>
13. Magalhaes AC, Wiegand A, Rios D, Hannas A, Attin T, Buzalaf MA. Chlorhexidine and green tea extract reduce dentin erosion and abrasion *in situ*. *J Dent* 2009; 37(12):994-8. <https://doi.org/10.1016/j.jdent.2009.08.007>
14. Hirasawa M, Takada K, Otake S (2006) Inhibition of acid production in dental plaque bacteria by green tea catechins. *Caries Res* 40(3): 265- 270. <https://doi.org/10.1159/000092236>
15. Matsumoto M, Minami T, Sasaki H, Sobue S, Hamada S, et al. (1999) Inhibitory effects of oolong tea extract on caries-inducing properties of mutans streptococci. *Caries Res* 33(6): 441-445. <https://doi.org/10.1159/000016549>
16. Daneshyar F, Khamverdi Z, Toliat T, Alikhani MY (2018) Effect of green tea varnish on depth of root caries. *J Contemp Dent Pract* 19(2):137-142. <https://doi.org/10.5005/jp-journals-10024-2227>
17. Thomas A, Thakur SR, Shetty SB (2016) Anti-microbial efficacy of green tea and chlorhexidine mouth rinses against *Streptococcus mutans*, *Lactobacilli* spp. and *Candida albicans* in children with severe early childhood caries: A randomized clinical study. *J Indian Soc Pedod Prev Dent* 34(1): 65-70. <https://doi.org/10.4103/0970-4388.175518>
18. Shepherd MG. The pathogenesis and host defence mechanisms of oral candidosis. *N Z Dent J* 1986; 82:78-81. <https://europepmc.org/article/med/3461348>
19. Pfaller MA, Diekema DJ, Jones RN, Messer SA, Hollis RJ, SENTRY Participants Group. et al. Trends in antifungal susceptibility of *Candida* spp. Isolated from pediatric and adult patients with bloodstream infections: SENTRY antimicrobial surveillance program, 1997 to 2000. *J Clin Microbiol* 2002; 40:852-6. <https://doi.org/10.1128/jcm.40.3.852-856.2002>
20. Barbosa CS, Kato MT, Buzalaf MA (2011) Effect of supplementation of soft drinks with green tea extract on their erosive potential against dentine. *Aust Dent J* 56(3): 317-321. <https://doi.org/10.1111/j.1834-7819.2011.01338.x>
21. Vyas T, Sood P, Kaur M. Antioxidants in Oral Diseases and Future Prospects and their Application in Dentistry. *J Adv Med Dent Scie Res* 2018;6(5):53-62.

How to cite this Article: Vasundhara, Manish Goyal, M. K. Sunil, Dhruv Garg, Nayra Johar; *Green Tea and Oral Health-A Review*; *Int. J. Drug Res. Dental Sci.*, 2020; 2(4): 17-23, doi: <https://doi.org/10.36437/ijdrd.2020.2.4.C>

Source of Support: Nil, **Conflict of Interest:** Nil.

Received: 13-8-2020 **Revised:** 20-9-2020 **Accepted:** 22-9-2020