

Effects of Green Tea in the Treatment of Periodontal Disease

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ABSTRACT

Periodontium comprises of investing and supporting structures of the teeth namely Gingiva, Periodontal ligament, Cementum and Alveolar bone. Periodontal disease is a chronic inflammatory disease affecting the supporting structures of the teeth. Micro organisms present in the dental plaque are considered as the primary etiological agent for periodontal diseases. Dental plaque contains anaerobic organisms such as Porphyromonas gingivalis, Fusobacterium nucleatum. They liberate endotoxins which are harmful to the host tissues. The Lipopolysaccharide layer of these bacteria can trigger hyper inflammatory response. Toxins liberated from the bacteria stimulate inflammatory reaction in hyper responsive manner. During this process, destructive enzymes such as collagenases are liberated from host cells and affected tissues also trigger the release of Prostaglandins. This leads to osteoclast activation and bone loss. To arrest the inflammation, eradicate microbes, and to control the free radicals various treatment strategies have been tried. One of the strategy is use of green tea since it has anti bacterial, antioxidant effect etc. Green tea is derived from the dried leaves of the plant Camellia sinensis. Green tea is usually available in the form of beverage, mouth wash containing extract of green tea, and as a chewing gum. Green tea catching can be affected by various factors like type of green tea leaves , type of processing before drying, growing conditions and the geographic conditions. This paper reviews the effect of green tea in the periodontal disease.

Keywords: Catechin, green tea, periodontal disease.

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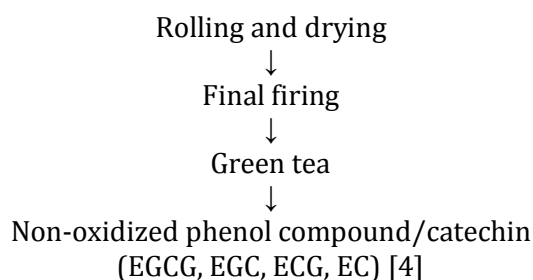
INTRODUCTION

Green tea, an aqueous infusion of dried leaves of the plant Camellia sinensis, is the most popular beverage consumed worldwide [1]. It has received considerable attention because of its scientifically proved beneficial effects on human health. The effect has been largely attributed to the poly phenol content namely epigallocatechin gallate which is known to induce apoptosis of tumor cells and has little or nil effect in normal cells [2,3]. It is consumed throughout the ages in India, China, Japan and Thailand. Several epidemiological studies have proven that green tea also has some general health beneficial properties like anti-hypertensive, anti-bacterial, anti-viral and anti-fungal activity. Traditional Chinese medicine has recommended this plant for headache, body ache, and as an energy

drink. It has cognitive function and positive impact on bone density, dental caries and periodontal health [4]. Green tea is usually available in the form of beverage, mouth wash containing extract of green tea, and as a chewing gum. Green tea catching can be affected by various factors like type of green tea leaves , type of processing before drying, growing conditions and the geographic conditions. This present article reviews the effectiveness of green tea on oral health and periodontium.

PROCESSING OF GREEN TEA:

Tea leaves
↓
Partial withering
↓
Steaming
↓

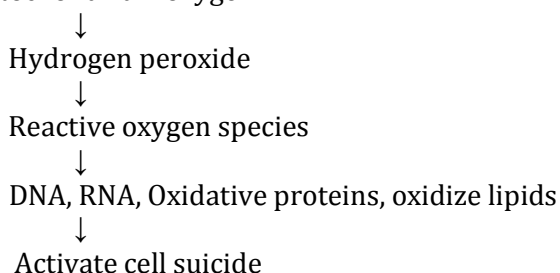
**BASIC INFORMATION ABOUT GREEN TEA:**

Depending upon the manufacturing process green tea can be classified as non-fermented, semi-fermented and fermented black or red tea. Green tea is usually available in the form of beverage, mouth wash containing extract of green tea, and as a chewing gum. Green tea catching can be affected by various factors like type of green tea leaves, type of processing before drying, growing conditions and the geographic conditions [4].

PERIODONTAL DISEASE: Periodontal disease is a chronic inflammatory disease

MECHANISM OF ACTION:

Endoplasmic reticulum + mitochondria = oxygen



Thus intake of green tea can stop all these degenerative changes by inhibiting the action of the reactive oxygen species molecules.

OXIDATIVE STRESS:

Oral peroxides consist mainly of salivary peroxides and myeloperoxidase and are involved in oral defense mechanism. Salivary peroxides secreted by salivary glands, myeloperoxidase found in polymorph nuclear leukocyte migrates into oral cavity at the gingival crevice [13]. A study conducted by Barach narotzki, aimed to establish the interaction of green tea and oral peroxidase in vitro and in vivo. Addition of green tea, black tea infusions and EGCG to saliva resulted in sharp rise of

that is more common in India, the incidence and progression of periodontal disease is related to periodontal pathogens and also various host and environmental factors related to it. Green tea catching like eppigallo catechin 3 gallate and epicatechin 3 gallate possess antioxidant, antimicrobial, anticollagenase, anti-mutagenic, and chemo preventive properties [5,-7], which are proved to be helpful in the treatment of chronic diseases like periodontitis. Periodontitis is characterized by exaggerated inflammation, involving the release of excess proteolysis enzymes [8] and reactive oxygen species [9]. A growing body of evidence implicates oxidative stress in the pathology of much human disease and recent in periodontitis. several studies demonstrated increased levels of bio markers for tissue damage induces by reactive oxygen species in periodontitis patient relative to control [10-12].

oral peroxides activity 280%, 54%, and 42% respectively and following green tea infusion mouth rinse.

ANTI-CARIOGENIC EFFECT:

Catechin is found to have inhibitory action against *Streptococcus mutans* and *Streptococcus sorbins* in the minimal inhibitory concentration of 50-1000mg/ml [14]. A study by Araghizadesh A, Kohanteb J, and Fan MM with green tea concluded that the green tea extract exhibited strong anti-bacterial activity on *S.mutans*, *A. actinomycetem comitans*, *P.gingivalis*, *P. intermedia* and therefore may be used in mouthwash or dentifrice for prevention of dental carious and periodontal diseases [15].

EFFECTS ON BONE HEALTH:

Osteoporosis is the major health problem in ageing population. Tea poly phenols increases osteoblastogenesis and suppress osteoclastogenesis. This osteoprotective effect appears to be mediated through antioxidant or anti inflammatory pathway along with their downstream signaling mechanisms [16].

HALITOSIS:

Halitosis or bad breath is caused due to volatile sulphur compound (VSCs) such as H₂S and CH₃SH produced in oral cavity, oral micro organism degrade proteinaceous substrate to cysteine and methionine, which is then converted by volatile sulfur compounds. A study conducted by Lodhia P, Yaegaki K, on effects on green tea on volatile sulfur compounds with other foods which claims to control halitosis, green tea is very effective in reducing oral malodor temporally because of its disinfectant and deodorant activity [17].

GREEN TEA AND ITS ASSOCIATION WITH PERIODONTIUM:

EGCG, a major polyphenol of green tea, reportedly exerts various biological effect including cryostatic property for preserving cells, anti-bacterial, anti-inflammatory reactions and anti-oxidant and anti-carcinogenic effect [18], due to its effect against periodontal pathogen and to inhibit the production of related cytokines and their inflammatory pathway, such as carbon tetra chloride, tumor necrosis factor α , nuclear factor K.B, cyclooxygenase 2 and inducible nitro oxygenase synthase [19-22].

The preservative potential of EGCG has been attributed to its intrinsic property and in particular its molecular structure and amphipathic property [23,24]. It neutralizes the free radical and reactive oxygen species by chelating with free radical, which cause hazard alteration of cell component and protect cells and tissue from oxidative – stress induced damage [24,25].

A recent study evaluated the relationship between the intake of green tea and periodontal disease and found that there is modest inverse association between intake of green tea and periodontal disease. The intake of green tea was inversely proportional to pocket depth, mean clinical

attachment level, and bleeding on probing [26] so continuous application of green tea catechin has been shown to have effect on treating bleeding gums and periodontitis.

Alveolar bone resorption is a characteristic feature of periodontal disease and involves removal of both the minerals and organic constituent of bone matrix, a process mainly carried out by multinucleated osteoclast cells or matrix metalloproteinases (MMPs) [26]. EGCG inhibited osteoclast formation in a culture of primary osteoclastic cells and bone marrow cells, and it induced apoptotic cell death of osteoclast-like multinucleated cells in a dose-dependent manner thus suggesting the role of green tea in the prevention of bone resorption [27].

EFFECTS ON HOST DEFENCE, HUMAN GINGIVAL CELLS AND INFLAMMATORY RESPONSE:

Green tea catechin is reported to be effective in preventing gingival and periodontal inflammation. EGCG inhibits the mRNA expression of COX-2, MMPs-1, IL-1, 6 and 8 by cultured cells. Effective concentration to achieve these was greater than equal to 1 microgram per milliliter. EGCG inhibits the activation of NF- κ B (nuclear factor- κ B), which one of the key positive regulator COX-2 expression [28].

RECOMMENDED DOSAGE:

Depending upon the brand 2-3 cups of green tea /day (for total of 240-320mg polyphenol) or 100-750mg/day of standardized green tea extract is recommended [29].

In one study the author recorded the daily intake of green tea as number of cups, and found that every one cup/day increment in green tea intake was associated with a 0.023-mm decrease in the mean probing depth ($p < 0.05$), a 0.028-mm decrease in the mean CAL ($p < 0.05$) and a 0.63% decrease in the BOP ($p < 0.05$) [30].

RISK ASSOCIATION: [31]

- 1) Excess consumption of green tea increases bleeding time.
- 2) Caffeine, catechin and tannic acids constituents of green tea can cause neural tube defect in babies due to folic acid antagonism and therefore, pregnant women should not take green tea.
- 3) Increase risk of bladder cancer.

4) Restlessness, irritability, sleeping problem, tremor, heart palpitations in people with caffeine sensitivity.

5) Green tea is a potent gastric acid stimulant and causes stomach upset.

CONTRAINDICATING CONDITION: [31]

- Patients under warfarin
- Patients under chemotherapy
- Antibiotic therapy
- Oral contraceptives

CONCLUSION

It has been reported that there are numerous health benefits related to consumption of green tea. Various studies have reported that the daily use of green tea may be beneficial to cure or prevent inflammatory disease. It can also be beneficial for certain age group people such as adolescents, who are more affected by periodontal inflammation. EGCG a major constituent of green tea represents a natural and alternative anticariogenic agent because it inhibits both *S. mutans* planktonic and biofilm cultures and also inhibits various cariogenic virulence factors of *S. mutans* at the transcriptional and enzymatic levels, leading to reduce acidogenicity [32].

Green tea catechin (EGCG) significantly reduced the expression of matrix metalloproteinase-9 in osteoblast, thus, EGCG may prevent alveolar bone resorption that occurs in periodontal disease [33]. Another inhibitory effect of green tea catechin on the adherence of *Porphyromonas gingivalis* is onto the buccal epithelial cells [33].

Numerous studies conducted on animals model with green tea catechin demonstrated antioxidant, antimutagenic, anti-inflammatory, antidiabetic, antibacterial, and above all, cancer-preventive properties [18].

Thus the evidence is strong that daily intake of green tea has a beneficial effect in prevention and treatment of chronic inflammatory diseases like periodontitis.

REFERENCES

1. Graham, H. N. 1992. Green tea composition, consumption, and polyphenol chemistry. *Prev. Med.* 21:334-350.
2. Ahmad N, Gupta S, Mukhtar H. Green tea polyphenol epigallocatechin-3-gallate differentially modulates nuclear factor KappaB in cancer cells versus normal cells. *Arch Biochem Biophysics.* 2000; 376:338-46.
3. Chen ZP, Schell JB, Ho CT, Chen KY. Green tea epigallocatechin gallate shows a pronounced growth inhibitory effect on cancerous cells but not on their normal counterparts. *Cancer Lett.* 1998; 129:173-9.
4. McKay DL, Blumberg JB. The role of tea in human health: an update. *J Am Coll Nutr.* 2002; 21:1-13.
5. Hamilton-Miller, J. M. 1995. Antimicrobial properties of tea (*Camellia sinensis* L.). *Antimicrob. Agents Chemother.* 39:2375-2377.
6. Mitscher, L. A., et al. 1997. Chemoprotection: a review of the potential therapeutic antioxidant properties of green tea (*Camellia sinensis*) and certain of its constituents. *Med. Res. Rev.* 17:327-365.
7. Wu, C. D., and G. X. Wei. 2002. Tea as a functional food for oral health. *Nutrition* 18:443-444.
8. Chapple IL, Matthews JB. The role of reactive oxygen and anti-oxidant species in periodontal tissue destruction. *Periodontol* 2000.2007; 43:160-232.
9. Figueredo CM, Gustafsson A, Asman B, Bergstrom K. Increased release of elastase from in vitro activated peripheral neutrophils in patients with adult periodontitis. *J Clin Periodontol.* 1999; 26:206-11.
10. Sculley DV, Langley-Evans SC. Periodontal disease is associated with lower antioxidant capacity in whole saliva and evidence of increased protein oxidation. *Clin Sci.* 2003; 105:167-72.
11. Panjamurthy K, Manoharan S, Ramachandran CR. Lipid peroxidation and antioxidant status in patients with periodontitis. *Cell Mol Biol Lett.* 2005; 10:255-64.
12. Sugano N, Kawamoto K, Numazaki H, Murai S, Ito K. Detection of mitochondrial DNA Mutations in human gingival tissues. *J Oral Sci.* 2000; 42:221-3.
13. Baruch Narotzki, Yishai Levy, Dror Aizenbud, Abraham Z. Reznick, Green Tea and Its Major Polyphenol EGCG Increase the Activity of Oral Peroxidases, *Adv Exp Med Biol.* 2013; 756:99-104.
14. Sakanaka S, Kim M, Taniguchi M, Yamamoto T. Antibacterial substances in Japanese green tea extract against *Streptococcus mutans*, a cariogenic bacterium. *Agric Biol Chem.* 1989; 53:2307-11

15. Araghizadeh A, Kohanteb J, Fani MM. Inhibitory activity of green tea (Camellia Sinensis) extract on some clinically isolated cariogenic and periodontopathic bacteria. *Med Pract.* 2013; 22(4):368-72.
16. Shen CL, Chyu MC, Wang JS, and Tea and bone health: steps forward in translational nutrition. *Am J Clin Nutr.* 2013 Dec; 98(6):1694S-9S.
17. Lodhia P, Yaegaki K, Khakbaznejad A, Imai T, Sato T, Tanaka T, Murata T, Kamoda T, Effect of green tea on volatile sulfur compounds in mouth air. *J Nutr Vitaminol (Tokyo).* 2008 Feb; 54(1):89-94.
18. Gaur S, Agnihotri R, Green tea: A novel functional food for the oral health of older adults. *Geriatr Gerontol Int.* 2013 Nov 21.
19. Lee YL, Hong CY, Kok SH, Hou KL, Lin YT, Chen MH, et al. An extract of green tea, epigallocatechin-3-gallate, reduces periapical lesions by inhibiting cysteine-rich 61 expression in osteoblasts. *J Endod.* 2009; 35:206-211.
20. Ahmed S, Wang N, Lalonde M, Goldberg VM, Haqqi TM. Green tea polyphenol epigallocatechin-3-gallate (EGCG) differentially inhibits interleukin-1 beta-induced expression of matrix metalloproteinase-1 and -13 in human chondrocytes. *J Pharmacol Exp Ther.* 2004; 308:767-773.
21. Yang F, Oz HS, Barve S, de Villiers WJ, McClain CJ, Varilek GW. The green tea polyphenol (-)-epigallocatechin-3-gallate blocks nuclear factor-kappa B activation by inhibiting I kappa B kinase activity in the intestinal epithelial cell line IEC-6. *Mol Pharmacol.* 2001; 60:528-533.
22. Hosokawa Y, Hosokawa I, Ozaki K, Nakanishi T, Nakae H, Matsuo T. Catechins inhibit CCL20 production in IL-17A-stimulated human gingival fibroblasts. *Cell Physiol Biochem.* 2009; 24:391-396.
23. Hyon SH. A non-frozen living tissue bank for allotransplantation using green tea polyphenols. *Yonsei Med J.* 2004; 45:1025-1034.
24. Liao S, Kao YH, Hiipakka RA. Green tea: biochemical and biological basis for health benefits. *Vitam Horm.* 2001; 62:1-94.
25. Han DW, Suh H, Park YH, Cho BK, Hyon SH, Park JC. Preservation of human saphenous vein against reactive oxygen species-induced oxidative stress by green tea polyphenol pretreatment. *Artif Organs.* 2003; 27:1137-1142.
26. Kushiyaama M, Shimazaki Y, Relationship between intake of green tea and periodontal disease. *J Periodontol.* 2009; 80:372-7.
27. Nakagawa H, Watchi M, Wooo JT, Kato M, Kasai S, Takahshi F, et al. Fenton reaction is primarily involved in a mechanism of (-)-epigallocatechin-3-gallate to induce osteoclastic cell death. *Biochem Biophys Res Commun.* 2002; 292:94-101.
28. Yang F, Oz HS, Barve S, de Villiers WJ, McClain CJ, vanlek GW. The green tea polyphenol (-)-epigallocatechin-3-gallate blocks nuclear factor-kappa B activation by inhibiting I kappa B kinase activity in the intestinal epithelial cell line IEC-6. *Mol Pharmacol.* 2001; 60:528-533.
29. Sarma DN, Barrett ML, Chavez ML, Gardiner P, ko R, Mahady GB, et al. safety of green extracts: A systematic review by the US pharmacopeia. *Drug saf.* 2009; 31:469-84.
30. Kushiyaama M, Shimazaki Y, Murakami M, Yamashita Y. Relationship between intake of green tea and periodontal disease. *J Periodontol.* 2009; 80:372-7.
31. Anirban Chatterjee, Mini Saluja, [...], and Mahtab Alam, Green tea: A boon for periodontal and general health. *J Indian Soc Periodontol.* 2012 Apr-Jun; 16(2):161-167.
32. Yen JH, Pang EK, Kim CS, Yoo YJ, Cho KS, Chai JK. Inhibitory effects of green tea polyphenol (-)-epigallocatechin gallate on the expression of matrix metalloproteinase-9 and on the formation of osteoclasts. *J Periodontol Res.* 2004; 39:300-7.
33. Sakanaka S, Aiwaza M, Kim M, Yamamoto T. Inhibitory effects of green tea polyphenols on growth and cellular adherence of an oral bacterium, *Porphyromonas gingivalis*. *Biosci Biotechnol Biochem.* 1996; 60:745-9.