Green Tea – A Magical Herbal Therapy

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Abstract:
Green tea is one of the commonly ingested drinks in day to day routine. In vitro studies have shown that green tea polyphenols inhibit the growth and cellular adherence of periodontal pathogens and their production of virulence factors. Green tea extract has been used in the form of chewing gums, mouth rinses, gum paints and dentifrices as a part of preventive (proactive) periodontal maintenance regimen. Extracts from green tea have been shown to inhibit bacterial growth. The most important green tea polyphenols are tannins and flavonoids. Polyphenols constitute the most interesting group of green tea leaf components, and in consequence, green tea can be considered an important dietary source of polyphenols, particularly flavonoids. The main flavonoids present in green tea include Catechins. The 4 major catechins are Epigallocatechin-3-gallate of total catechins, epigallocatechin, epicatechin-3-gallate I and epicatechin. Green tea also contains gallic acid (GA) and other phenolic acids such as chlorogenic acid and caffeic acid, and flavonols such as kaempferol, myricetin and quercetin. Green tea from the leaves of plant Camellia sinensis has been shown to have wide range of antioxidant, anti-inflammatory, anti-carcinogenic and anti-bacterial activity.

Keywords: Green tea, Polyphenols, Flavonoids, Catechins, Antioxidant

Introduction:
An increasing number of people all around the world are turning to the nature by using the natural herbal products in both prophylaxis and treatment of different diseases. Tea has been linked to a group of medicaments -Ayurveda, the ancient Indian system of medicine, known as ‘Rasayanas’ that confer attainment of positive health, resistance to diseases and assured full lifespan of quality living, unlike drugs that cure after disease has struck. Tea is the most popular beverage in the world after water1. Drinking green tea, a suggestive of health beverage is gaining popularity in Asian countries. Green tea is produced from fresh leaves of Camellia sinensis and is not traditionally fermented. Green tea contains antioxidants and other beneficial nutrients such as protein, carbohydrates, minerals, vitamins, and flavonoid-like polyphenols. The most prominent effects of tea on human health have been attributed to green tea, and the health-promoting effects of green tea are mainly attributed to catechins, which belong to a family of compounds known as flavonoid-like polyphenols or flavanols2. Catechins include catechin gallate(Cg), gallo catechin, gallo catechin gallate(GGc), epicatechin, epicatechin gallate(ECg), epigallocatechin, and epigallocatechin gallate (EGCg). Normally, 10–20% of the catechins in green tea leaves are epigallocatechin and EGCg3.

This review emphasizes on the various health benefits of green tea, its effect in oral cavity and periodontal health.

Table 1: Effect of individual components of green tea.

<table>
<thead>
<tr>
<th>Component</th>
<th>%</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenolic Compounds</td>
<td>25-30%</td>
<td>➢ Antioxidant4 ➢ Anti-cancer effect4 ➢ Decreases blood cholesterol5 ➢ Anti-hyperglycemic effect6 ➢ Body fat reduction7 ➢ Anti-influenza effect8 ➢ Inhibits hypertension9 ➢ Inhibits halitosis10 ➢ Antibacterial effect11 ➢ Anticaries effect11</td>
</tr>
<tr>
<td>Caffeine</td>
<td>1-2%</td>
<td>➢ Increases alertness ➢ Increases stamina ➢ Hangover prevention ➢ Mild diuretic</td>
</tr>
<tr>
<td>Theanine</td>
<td>4-6%</td>
<td>➢ Neuronal Cell protection ➢ Relaxation effect ➢ Lowering blood pressure</td>
</tr>
</tbody>
</table>
Vitamins & Minerals
- Vitamin C
- Vitamin B₂
- β-carotene
- Vitamin E
- Minerals(Phosphorus, Potassium, Calcium, Manganese)
- Fluoride

Pigments (chlorophyll) 2% ➢ Prevents halitosis
Fiber 26% ➢ Decreases body weight
Proteins 15-20% ➢ Growth and development

Various studies showing effect of green tea on periodontal health are shown in table 2

<table>
<thead>
<tr>
<th>Year</th>
<th>Authors</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>Masaharu, Masatomo et al⁰²</td>
<td>Inhibits collagenase activity</td>
</tr>
<tr>
<td>1993</td>
<td>Kaneko et al⁰³</td>
<td>Decreases halitosis associated with periodontal disease</td>
</tr>
<tr>
<td>1995</td>
<td>Yasuda And Arakawa¹⁴</td>
<td>Reduction of halitosis by deodorizing methyl mercaptan</td>
</tr>
<tr>
<td>1996</td>
<td>Sakanaka et al⁰⁵</td>
<td>Inhibition of growth and adherence of P.gingivalis to buccal epithelial cells</td>
</tr>
<tr>
<td>2004</td>
<td>Okamato et al⁰⁷, Sakanaka And Okada et al⁰⁸</td>
<td>Neutralizes etiological agent like gingipains, protein tyrosine phosphatase.</td>
</tr>
<tr>
<td>2007</td>
<td>Yunh, Pang et al⁰⁹, Yun, Kim et al¹⁰</td>
<td>Inhibits bone resorption by preventing expression of MMP-9 from osteoblasts induced by P. gingivalis extracts.</td>
</tr>
<tr>
<td>2009</td>
<td>Nakamura, Ukai et al¹¹</td>
<td>Inhibition of bone resorption by inducing apoptotic cell death of osteoclasts via caspasases. Inhibition of nuclear translocation of NF kappa β activated by lipopolysaccharide. Inhibits IL-1β production, directly inhibits osteoclastogenesis. Inhibit Oncostatin M induced CXCL-10 production in human gingival fibroblasts. Inhibits IL-17 which induces CCL-20 production in human gingival fibroblasts.</td>
</tr>
<tr>
<td>2011</td>
<td>Maryama T et al¹²</td>
<td>Topical application of green tea catechin containing dentifrice reduced inflammatory cell infiltration in periodontal lesions. Gingival showed lower levels of expression of hexanoyl-lysine, nitro tyrosine and TNF-α.</td>
</tr>
<tr>
<td>2012</td>
<td>Hara K et al¹³</td>
<td>EGCg inhibited activity of α-amylase by non-competitive inhibition. Therefore, EGCg inhibits the formation of fermentable carbohydrates involved in caries formation. α-amylase decreased antimicrobial activity of EGCG against periodontal bacteria A. actinomycetemcomitans</td>
</tr>
<tr>
<td>2013</td>
<td>Lei Zhao, Vu Dang La, Daniel Grenier¹⁴</td>
<td>Inhibits secretion of IL-6, 8 and chemokine ligand S by P.gingivalis- stimulated oral epithelial cells.</td>
</tr>
<tr>
<td>2014</td>
<td>TB Lombardo Bedran et al¹⁵</td>
<td>Induce hBD Genes secretion by epithelial cells and to protect hBDs from proteolytic degradation by P.gingivalis, have potential to strengthen epithelial antimicrobial barrier.</td>
</tr>
</tbody>
</table>

**Other effects of green tea:**

On chondrocytes⁰⁶: EGCg inhibits IL-1β induced cartilage proteoglycan degradation and expression of MMP-1 and MMP-13 in human chondrocytes at micromolar concentration. Studies show complete inhibition of MMP-1 and MMP-13 at a concentration of 100 μg EGCg. This concentration can be achieved only by local administration. This inhibitory effect is by inhibition of IL-1β induced expression of m-RNAs signifying that the effect is at transcriptional level.
Therefore, EGCg may inhibit the activities of MMPs involved in the degradation of native collagen which may further have suppressive effects on the cartilage degradation in arthritic joints.

**Green Tea and Periodontal health:** Porphyromonas gingivalis, a gram-negative anaerobe, a major periodontopathic organism, has the virulent factors, cysteine proteinases, which include Arg-gingipain (Rgp) and Lys-gingipain (Kgp), are regarded as important virulence determinants as demonstrated by various in vitro assays. Previous in vitro studies showed that green tea catechin inhibits the growth of *P. gingivalis, Prevotella intermedia,* and *Prevotella nigrescens*16. It inhibits the adherence of *P. gingivalis* onto human buccal epithelial cells15. In addition, green tea catechins inhibit the production of toxic metabolites of *P. gingivalis*. A study showed that green tea catechins, EGCg and Ecg, inhibit the activity of *P. gingivalis*-derived collagenase12. EGCg completely inhibits the growth of three strains of *P. gingivalis* at concentration of 250 or 500 μg/ml and that of *P. melaninogenicus* at MICs of 2000 μg/ml. Other polyphenols were not as effective as EGCGs and their MICs against *P. gingivalis* and *P. melaninogenicus* were 1000 μg/ml or >2000 μg/ml. This mechanism is mainly by binding of polyphenols to fimbriae of *P. gingivalis*. EGCg has been shown to inhibit the activity and expression of collagenase or gelatinase [matrix metalloproteinase (MMP)-2 and MMP-9]. Studies suggested that EGCg caused the reduction in MMP activities by inhibiting the gene expression of MMP-2 and MMP-9 by suppressing the phosphorylation of extracellular signal regulated kinase in cancer cells. The protein kinase belongs to the mitogen-activated protein kinase (MAPK) family of enzymes, which is known to regulate MMP expression. Furthermore, several studies have provided evidence suggesting that EGCg inhibits MAPK, resulting in the down regulation of MMPs27. EGCg inhibits protein tyrosine phosphatase activity in *P. intermedia*. It also possesses bactericidal activity against a variety of microorganisms like Helicobacter pylori.

Bone resorbing activity of osteoclasts plays a crucial role in bone resorption. EGCg, with its ability to inhibit the formation of osteoclasts, might have the potential to be used in the treatment of bone diseases such as periodontitis. Furthermore, it has been reported that EGCg could induce the apoptotic cell death of osteoclasts. However, the biological effect of EGCg on alveolar bone destruction has not been documented. These findings suggest that *P. gingivalis* may contribute to the alveolar bone loss observed in periodontal diseases by stimulating host osteoclastic cells to produce MMP28.

Green tea catechin showed a bactericidal effect against black-pigmented, Gram-negative anaerobic rods, *Porphyromonas gingivalis* and *Prevotella* species, and the combined use of mechanical treatment and the application of green tea catechin using a slow-release local delivery system was effective in improving the periodontal status16, 29. It has also been suggested that epigallocatechin-3-gallate, the major polyphenol in green tea, may represent a novel preventive/therapeutic agent for smoking-related periodontitis30. It has also been reported that green tea polyphenols is of prime importance in treatment of gingivitis. Continuous application of tea catechins on a daily basis can be considered as a useful and practical method for the prevention of periodontal diseases12.

Green tea is safe for most of the people when used in moderate quantities. The most adverse effects of green tea administered orally are gastrointestinal upset and central nervous system stimulation from the caffeine content in the tea. Allergic reactions have been reported with topical green tea ointment, which may cause cervical and vaginal inflammation, irritation and sensation16. The caffeine in green tea, when taken in large amounts, can worsen diarrhea and also might worsen symptoms of Irritable Bowel Syndrome. Green tea extract supplements have been linked to several cases of liver damage and liver disease worse.

**Conclusion:**

There is an increasing interest in the health benefits of green tea in the field of oral health. The non tea drinkers can switch over to green tea oral care products and the ones who relish their cup of tea should turn on the kettle to brew the green tea only. However, although all the evidence from research on green tea is very promising, future studies are necessary to fully understand its contributions to human health.

**References:**