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TITLE: Effects of Green Tea on Oral Bacteria Count in Humans

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Effects of Green Tea on Oral Bacteria Count in Humans

Abstract

Green tea is particularly rich in health-promoting flavonoids (which account for 30% of the dry weight of a leaf), including catechins and their derivatives. The most abundant catechin in green tea is epigallocatechin-3-gallate, which is thought to play a pivotal role in the green tea's anticancer and antioxidant effects. Catechins should be considered right alongside of the better-known antioxidants like vitamins E and C as potent free radical scavengers and health-supportive for this reason. It has been suggested that green tea also promotes periodontal health by reducing inflammation, preventing bone resorption and limiting the growth of certain bacteria associated with periodontal diseases. In the research topic we interested to do on green tea and its antioxidant effect on individual oral health problems.

Introduction

Green tea is the most ancient and popular beverage consumed around the world It is made up of leaves of the plant camellia sinensis. It is loaded with polyphenols like flavonoids and catechins, which function as powerful antioxidants. These substances can reduce the formation of free radicals in the body, protecting cells and molecules from damage. These free radicals are known to play a role in aging and all sorts of diseases. One of the more powerful compounds in green tea is the antioxidant Epigallocatechin Gallate (EGCG), which has been studied to treat various diseases and may be one of the main reasons green tea has such powerful medicinal properties. Green tea also has small amounts of minerals that are important for health. Green tea can boost the metabolic rate in the short term, it makes sense that it could help you lose weight. Green tea contains many bioactive ingredients mainly polyphenols which play a key role in the prevention and treatment of many diseases The catechins in green tea may inhibit the growth of bacteria This can lower the risk of infections and lead to improvements in dental health, a lower risk of caries and reduced bad breath (halitosis)

Materials and Methods

We have selected some randomly 10 people and we have taken two samples from each person one is before taking green tea and other is after taking green tea they had been given sterile water and asked them to goggle water and the water sample is taken in the sterile

test tube to count the number of bacteria present in the mouth and they are given green tea and again they are asked to goggle water and the water sample is taken in the test tube to check the growth of bacteria after taking green tea and the same process is done for all the ten people and sent to the laboratory for measuring the count of bacteria; the bacterial growth we measured in the colony forming units per 0.1 ml of the sample taken.

Observation

Person	Before Green Tea	After Green Tea
A	48	12
B	36	8
C	32	3
D	60	3
E	210	170
F	200	20
G	112	12
H	72	32
I	250	80
J	280	50

Bacterial Count in Persons Who take Green Tea Every day

Person	Before Green Tea	After Green Tea
B	36	8
D	60	3
J	280	50

Bacteria count in Persons who took Green Tea for a Study Period of 2 days

Person	Before Green Tea	After Green Tea
A	48	12
C	32	3
E	210	170
F	200	20
G	112	12
H	72	32
I	250	80

Discussion

Persons B,D,J who took green tea everyday have significant reduction in the bacterial count in the oral cavity than the persons A,C,E,F,G,H,I, who took two cups of green tea for the study period of two days. The persons who consume green tea everyday have significant results. Polyphenolic compounds present in green tea particularly catechins are known to have strong anti influenza activity green tea showed reduction in volatile sulphur compounds production in the oral cavity.

Growing Green Tea

Green tea is extracted from the leaves of *Camellia sinensis*. *Camellia sinensis* is shrub-like and is grown in a semi tropical environment on plantations in Southeast Asia. Heavy rainfall of 3000–7000 ft elevation is required. It is cloned or grown from seed from

cuttings obtained from the mother bush and rooted and grown in a nursery for 1 or 2 years. Green tea is grown in rows or on terraces.

Leaves are usually picked by hand. Leaves are steamed, rolled and dried immediately and completely. Then, these are packed in foil-lined chests, which prevents absorption of unpleasant odors and also prevents loss of aroma. Serve warm, but not hot, to keep the medicinal value intact.

Components of Green Tea

The active compounds in green tea are from a group of polyphenols called catechins. Four catechins present in green tea are: Epicatechin gallate (ECg), epicatechin, epigallocatechin and epigallocatechin gallate (EGCG)
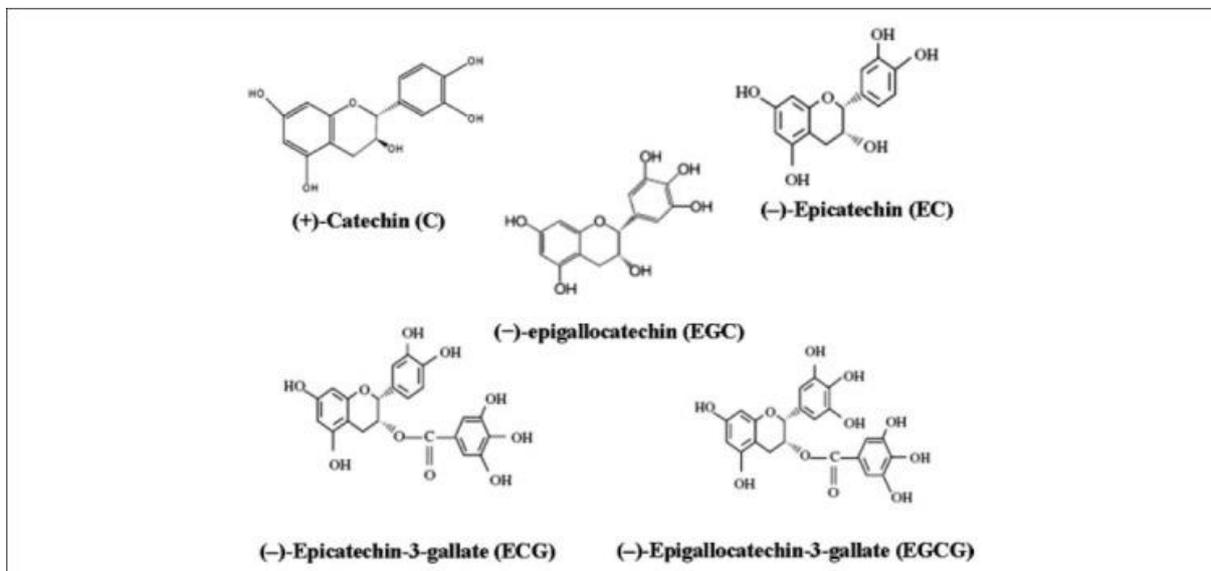
Green tea also contains carotenoids, tocopherols, ascorbic acid and minerals like chromium, magnesium, selenium and zinc.

Green tea also contains caffeine, although half of that found in coffee. The amount of caffeine in a cup of green tea will vary according to the amount of tea used, the length of time the leaves are infused and if a person drinks the first or second infusion. Most of the caffeine in green tea is extracted into water the first time the tea is infused. Table compares the average amount of caffeine found in tea and coffee.

Caffeine-containing product	Caffeine (mg/serving)
Tea	
Green, black, oolong	50 mg/190 ml serving[2]
Green (different varieties)	20–45 mg/8 oz serving[3]
Black	47 mg/8 oz serving[4]
Coffee	
Brewed (filter or percolated)	100–115 mg/190 ml serving[2]
Instant	75 mg/190 ml serving[2]

A study found that the caffeine content of 1 g of black tea ranged from 22 to 28 mg, while the caffeine content of 1 g of green tea ranged from 11 to 20 mg, reflecting a significant difference.

The safety of caffeine consumption remains a topic of major debate in the research literature. No studies have shown problems with caffeine consumption of less than 75 mg per day. Most studies have shown potentially problematic effects of caffeine consumption on intakes above 200 mg. In addition, there appears to be a significant difference in people's sensitivity to caffeine.

Two beneficial components in green tea, i.e. catechins and amino acid L-theanine, lessen the impact of its caffeine. When green tea is brewed, its caffeine combines with catechins in the water, reducing the caffeine's activity compared with that of coffee or cocoa. In addition, L-theanine, which is only found in tea plants and some mushrooms, directly stimulates the production of alfa brain waves, calming the body while promoting a state of relaxed awareness.

Mechanism of Action

The endoplasmic reticulum and mitochondria release oxygen. This oxygen gets converted into hydrogen peroxide, which in turn releases reactive oxygen species molecules. These reactive oxygen species molecules can lead to damage of DNA, RNA, oxidize proteins (enzymes, histones), oxidize lipids and can also activate cell suicide.

Intake of green tea can stop all these degenerative changes by inhibiting the action of the reactive oxygen species molecule.

Role of Green Tea

Weight loss

EGCG prevents the breakdown of norepinephrine thus causing a rise in metabolism. It may also inhibit adipocyte hypertrophy and hyperplasia and, possibly, inhibit gastrointestinal enzymes involved in nutrient uptake; the mechanisms have yet to be deciphered for these processes. It helps to lose 7 ounce per year. A 12-week study was performed including two groups of men with similar body mass index and waist circumference: One group ingested tea containing 690 mg catechins while the second group received only 22 mg catechins. The average weight loss in group 1 was 2.4 kg, whereas in the second group it was only 1.3 kg. Low-density lipoprotein levels of group 1 decreased by about 11.5%; in group 2, this was only by about 5.2%.

Anti-aging

Antioxidants in green tea protect the skin from the harmful effects of free radicals, which cause wrinkling and skin aging.

Immunity

Polyphenols and flavenoids found in green tea help boost our immune system, making our health stronger in fighting against infection.

Human γδ T cells mediate innate immunity to microbes via T cell receptor-dependent recognition of unprocessed antigens with conserved molecular patterns. These nonpeptide alkylamine antigens are shared by tumor cells, bacteria, parasites and fungi, and also by edible plant products such as tea, apples, mushrooms and wine. Priming of γδ T cells with alkylamine antigens *in vitro* results in a memory response to these antigens. Such priming results also in a non-memory response to whole bacteria and to lipopolysaccharide, characterized by IL-12-dependent secretion of IFN-γ by γδ T cells and by γδ T cell proliferation. Drinking tea that contains 1-theanine, a precursor of the nonpeptide antigen ethylamine, primed peripheral blood γδ T cells to mediate a memory response on re-exposure to ethylamine and to secrete IFN-γ in response to bacteria. This unique combination of innate

immune response and immunologic memory shows that γδ T cells can function as a bridge between innate and acquired immunity.

Therefore, drinking tea may be able to prime the body's immune system against these agents by teaching disease-fighter immune cells to recognize and remember alkylamines.

Cardiovascular disease

Green tea prevents heart disease and stroke by lowering the level of cholesterol. Even after heart attack, it prevents cell deaths and speeds up the recovery of heart cells. Drinking green tea helps keep our blood pressure down by repressing angiotensin, which leads to high blood pressure.

Liver disease

Population-based clinical studies have shown that men who drink more than 10 cups of green tea per day are less likely to develop disorders of the liver. Green tea also seems to protect the liver from the damaging effects of toxic substances such as alcohol.

Results from several animal and human studies suggest that catechin, isolated from green tea, may help treat viral hepatitis. It is not clear whether green tea confers these same benefits to people with hepatitis.

Green tea prevents transplant failure in people with liver failure. Researches showed that green tea destroys harmful free radicals in fatty livers.

Cancer

EGCG has been shown to inhibit angiogenesis of tumor cell thus not allowing them to become cancerous. This is achieved by stopping the production of angiogenic compounds in the tumor cells.

Ahmad *et al*. reported that green tea polyphenols modulate NF-κB in several cancer cell lines, rendering them susceptible to apoptosis.

Green tea is used in cancer prevention as it stops angiogenesis and stops blood flow to the tumor. Green tea-induced apoptosis increases normal cell growth while promoting programmed cell death.

Epidemiological studies suggest that regular consumption of tea reduces the risk of cancer. In support of this contention, tea, or, more specifically, the polyphenol fraction, has been reported to decrease the incidence of carcinogen-induced malignancies in animal models.One proposed mechanism of action is the finding that polyphenols induce apoptosis more readily in cancer cells than in their natural counterparts.

Arthritis

Green tea can help prevent and reduce the risk of rheumatoid arthritis. Green tea benefits our health as it protects the cartilage by blocking the enzyme that destroys cartilage. The very key to this is the high fluoride content found in green tea. It helps to keep bones strong and helps to preserve density of the bone.

Another potential benefit of tea is as an anti-inflammatory agent. Studies in animal models show that green tea polyphenols decrease inflammation. A study reported that mice fed an extract of green tea polyphenols had decreased tumor necrosis factor-α (TNF α) production in response to an injection of lipopolysaccharide (LPS) and prevented death after administration of an otherwise lethal dose of LPS. Haqqi *et al.* reported that the ingestion of a green tea polyphenol extract reduced joint disease in mice with adjuvant-induced arthritis.

Several studies have focused on the potential mechanisms responsible for the anti-inflammatory effects. One potential mechanism of action is the inhibition of nuclear factor-κB activation, which is an oxidative stress-sensitive transcription factor that regulates the expression of a variety of genes important in cellular responses, including inflammation, innate immunity and growth. It was suggested that EGCG decreased LPS-induced TNFα production in the macrophage cell line RAW264.7 and peritoneal macrophages by blocking NF-κB activation.

Diabetes

Green tea improves lipid and glucose metabolism, prevents sudden increase in blood sugar levels and balances our metabolic rate.

Alzheimer's

EGCG decreases production of beta-amyloid, a protein that forms the plaques that clog the brains of Alzheimer's victims. The primary target for treatment of Alzheimer's

disease is inhibition of enzyme acetylcholinesterase and β-amyloidosis. In an *in vitro* study, it was found that green tea inhibited human acetylcholinesterase, with an IC_{50} value of 0.03 mg/ml and, at an assay concentration of 0.03 mg/ml, inhibited β-secretase by 38%. These findings suggest that tea infusion contains biologically active principles, perhaps acting synergistically, that may be used to retard the progression of disease assuming that these principles reach the brain.

Parkinson's

Antioxidants in green tea help prevent against cell damage in the brain, which could cause Parkinson′s, and thus prevent it.

Parkinson's disease is a progressive, degenerative disorder of the central nervous system, resulting from the loss of dopamine-producing brain cells, and there is presently no cure. Certain researchers have indicated that green tea possesses neuroprotective effects, suggesting its role in the prevention of Parkinson's disease. The authors discovered that green tea polyphenols protect dopamine neurons, which increases with the amount of green tea consumed. They also stated that this protective effect is mediated by inhibition of the ROS-NO pathway, a pathway that may contribute to cell death in Parkinson′s.

Cold and flu

EGCG, a powerful catechin antioxidant found in green and white teas, can directly kill bacteria and viruses, including the influenza virus.EGCG is also highly anti-inflammatory. This activity is potentially important in cold and flu infections, because soluble mediators of inflammation cause symptoms. EGCG inhibits the production of pro-inflammatory mediators such as chemokines. prostaglandins. and TNF. EGCG also inhibits adhesion molecule expression. MAP kinases. and neutrophil migration.A study used specific proprietary formulation of these key tea components *Camellia sinensis* formulation (CSF) with a primary endpoint of reduction in the number of subjects who developed illness due to cold and flu. The study included healthy adults who were 18–70 years old. Proprietary formulation of *Camellia sinensis* (green tea) capsules, or a placebo, twice a day, for 3 months was used. By daily symptom logs, the percentage of subjects experiencing cold and flu symptoms, number of days subjects experienced symptoms and percentage of subjects seeking medical treatment were assessed. The mean *in vivo* and *ex vivo* proliferative and interferon gamma responses of subjects' peripheral blood mononuclear cells to γδ T cell

antigen stimulation were also assessed. Results indicated that among subjects taking CSF, there were 32.1% fewer subjects with symptoms (P=0.035), 22.9% fewer overall illnesses of at least 2 days duration (P=0.092) and 35.6% fewer symptom days (P<0.002) compared with subjects taking placebo. γδ T cells from subjects taking CSF proliferated 28% more (P=0.017) and secreted 26% more IFN-γ (P=0.046) in response to γδ T cell antigens as compared with γδ T cells from subjects taking placebo. Thus, it was concluded that this proprietary formulation of CSF is a safe and effective dietary supplement for preventing cold and flu symptoms and for enhancing γδ T cell function.

Asthma

Theophylline in green tea relaxes the muscles that support the bronchial tubes, reducing the severity of asthma.

Stress

L-theanine, which is a kind of amino acid in green tea, can help to relieve stress and anxiety.

Food poisoning

Catechin found in green tea can kill bacteria that causes food poisoning and kills the toxins produced by those bacteria.

Human immunodeficiency virus

With Human immunodeficiency virus (HIV), the EGCG acts as a block to the HIV transport protein on the host cell.

Dental Implications

Caries

The effects of green tea extract on caries inhibition of hamsters and on acid resistance of human tooth enamel have been suggested by both *in vivo* and *in vitro* studies. The dialyzed tea solution in which the fluoride was removed almost completely also showed remarkable effects, similar to the original tea extract. The results obtained from this study suggested that

fluoride in green tea may play a role in increasing the cariostatic action along with other components in tea. However, the action of fluoride does not seem to be so important because its concentration is very low. The effect of green tea on caries inhibition as well as on the increment of acid resistance appears to be more correlative with the nondialysable substances in tea.

Periodontal implication

Various authors have studied the inhibitory effects of catechin contained in green tea on periodontal pathogens, which may provide the basis for beneficial effect of daily intake of green tea on periodontal health.

Green tea catechin inhibit the growth of *P. gingivalis*, *Prevotella intermedia* and *Prevotella nigrescens* and adherence of *P. gingivalis* on to human buccal epithelial cells

Green tea catechins with steric structures of 3-galloyl radial, EGCG, ECg and gallocatechin gallate, which are major tea polyphenols, inhibit production of toxic end metabolites of *P. gingivalis*. A study showed that green tea catechin, EGCG and ECg inhibit the activity of *P. gingivalis*-derived collagenase.

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 status. The peptidase activities in the gingival fluid were maintained at lower levels during the experimental period in the test sites, while it reached 70% of that at baseline in the placebo sites

Alveolar bone resorption is a characteristic feature of periodontal disease and involves removal of both the mineral and the organic constituents of the bone matrix, a process mainly carried out by multinucleated osteoclast cells or matrix metalloproteinases (MMPs). EGCG inhibited osteoclast formation in a coculture 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]

The Gram-negative bacterium, *Porphyromonas gingivalis*, has been reported to stimulate the activity and expression of several groups of MMPs, whereas EGCG has inhibitory effects on the activity and expression of MMPs.

EGCG may prevent alveolar bone resorption that occurs in periodontal diseases by inhibiting the expression of MMP-9 in osteoblasts and formation of osteoclastOxidative stress plays an important role in the pathogenesis of periodontal disease as well as many other disorders, and it is believed that antioxidants can defend against inflammatory diseases.

Daily intake of green tea was significantly associated with bleeding on probing (BOP), probing depth (PD) and clinical attachment loss (CAL), such that the more frequently subjects drank green tea, better was their periodontal condition. As in a study in which the author involved 940 men and examined their PD, CAL and BOP, the relationship between the intake of green tea and periodontal parameters was examined. The intake of green tea was defined as the number of cups per day. Results showed that the intake of green tea was inversely correlated with the mean PD, mean CAL and BOP.

Smoking habit and frequency of tooth brushing, which are important lifestyle factors for periodontal disease, were significantly associated with periodontal parameters and were also found to be associated with intake of green tea.

Halitosis

Halitosis is caused mainly by volatile sulfur compounds (VSCs) such as H_2S and CH_3SH produced in the oral cavity. Oral microorganisms degrade proteinaceous substrates to cysteine and methionine, which are then converted to VSCs. Because tea polyphenols have been shown to have antimicrobial and deodorant effects, researchers investigated whether green tea powder reduces VSCs in mouth air, and compared its effectiveness with that of other foods that are claimed to control halitosis. Immediately after administering the products, green tea showed the largest reduction in concentration of both H_2S and CH_3SH gases, especially CH_3SH, which also demonstrated a better correlation with odor strength than H_2S; however, no reduction was observed at 1, 2 and 3 h after administration. In an *in vitro* study, toothpaste, mints and green tea strongly inhibited VSCs production in a saliva-putrefaction system, but chewing gum and parsley-seed oil product could not inhibit saliva putrefaction. Toothpaste and green tea also demonstrated strong deodorant activities, but no significant deodorant activity of mints, chewing gum or parsley-seed oil product were

observed. Therefore, it was concluded that green tea was very effective in reducing oral malodor temporarily because of its disinfectant and deodorant activities, whereas other foods were not effective.

Dosage

Most green tea products are sold as dried leaf tea. The best way to get the catechins and other flavonoids in tea is to drink it freshly brewed. The recommended consumption is three to four cups of tea a day. The average cup of green tea contains about 50–150 mg polyphenols. However, some research suggests that up to 10 cups per day is needed to receive enough polyphenols to notice a marked increase in health.

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 PD ($P<0.05$), a 0.028-mm decrease in the mean CAL ($P<0.05$) and a 0.63% decrease in the BOP ($P<0.05$.

The risks associated with a high dose of green tea are:

1. Increased bleeding time

2. Green tea contains caffeine, catechins and tannic acids. All three substances have been linked to pregnancy risks. In addition, drinking a large amount may cause neural tube birth defect in babies due to folic acid antagonism and, therefore, pregnant women should not take green tea

3. Increased risk of bladder cancer

4. If a person is sensitive to caffeine, symptoms to watch out for are: Restlessness, irritability, sleeping problems, tremor, heart palpitations, loss of appetite, upset stomach, nausea, frequent urination and skin rash

5. Stomach upset is the second most common complaint after caffeine. A 1984 study concluded that "tea is a potent stimulant of gastric acid, and this can be reduced by adding milk and sugar"

6. Tea is known as a "negative calories" beverage. Not only does it contain virtually no calories, it also blocks the absorption of certain nutrients like iron and thiamine (Vitamin B).

A study was conducted to determine the effects of eating grape seed extract and epigallocatechin-3-gallate found in green tea. They used cells from the intestine – where iron absorption takes place — to assess the effect of polyphenol, and found that polyphenols bind to iron in the intestinal cells, forming a nontransportable complex. This iron–polyphenol complex cannot enter the blood stream. Instead, it is excreted in the feces when cells are sloughed off and replaced. Iron is necessary to carry oxygen from the lungs throughout the body and for other cellular functions. People already at risk for iron deficiency increase that risk if they consume high amounts of grape seed extract or EGCG.

7. Drinking tea or coffee stains or discolors the dental plaque, but not the teeth itself. If the plaque is not completely brushed and flossed away within 24 h, it begins to harden and becomes what is commonly known as tartar.

Conclusion

Taking two cups of green tea as a daily routine is good for the health as the results show that intake of green tea which contains catechins like epigallocatechin-3-gallate and polyphenols which show negative effect to the growth of bacteria and inhibit the growth of bacteria in the oral cavity which reduces the oral bacterial count and improves the oral health care so green tea plays a key role in prevention and treatment of many diseases.

Periodontists believe that maintaining healthy gums is absolutely critical to maintain a healthy body; that is why it is so important to find simple ways to boost periodontal health, such as regularly drinking green tea that is already known to possess health-related benefits.

By interfering with the body's inflammatory response to periodontal bacteria, green tea may actually help promote periodontal health and ward off further disease.

Continuous use of green tea catechin on a daily basis may be a useful and practical method for the prevention of periodontal disease, but should be carried out with caution to avoid side-effects. Therefore, let us start sipping green tea and grow healthier.

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