

GREEN TEA AS AN ALTERNATIVE THERAPY IN MEDICINE AND DENTISTRY: A REVIEW

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ABSTRACT

Nature has bestowed on us a very rich botanical wealth and a large number of assorted types of plants grow in different parts of the country. Plants are the richest resource of drugs in traditional systems of medicine. Green Tea is one of the most ancient and popular therapeutic beverages consumed around the world. This product is made from the leaf of the plant called “*Camellia sinensis*”. Green tea is a ‘non-fermented’ tea, and contains more catechins, than black tea or oolong tea. It can be prepared as a drink, which can have many systemic health effects or an “extract” can be made from the leaves to use as medicine. green tea is considered a healthful beverage due to the biological activity of its polyphenols namely catechins. The antioxidant, antimicrobial, anticollagenase, antimutagenic, and chemopreventive properties of these catechins proved to be helpful in the treatment of chronic diseases like periodontal disease. This review gives a bird’s eye view mainly on the biological activities of the miswak and plausible medicinal and dental applications.

Key Words: Alternative therapy, Dentistry, Green tea

INTRODUCTION

Name of Medicinal Plant.: *Camellia Sinensis*

Family : Theaceae

Common Name : India : Chha

China : Cha

Russia : Chai

Africa : Itye

Italy : Te

England : Tea

United State : Tea.¹

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 ele-

vation 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. Green tea is one of the most popular beverages in the world, and it has received considerable attention because of its many scientifically

proven beneficial effects on human health.²

Historical Background

Green tea has long been believed to be beneficial to one's health and has a long history of widespread consumption. Evidence shows that green tea was consumed as early as the third century AD, yet multiple stories suggest it was brewed much earlier. One legend says that in 2737 B.C. an herbalist named Shen Nung was boiling water to drink while resting under a tree. A breeze caused green tea leaves to fall into his steaming water. When he drank the resulting liquid, Shen Nung was pleasantly surprised by the stimulating taste, and the tradition of tea consumption began.³

The drink name derives from the Chinese Amoy dialect word "t'e," pronounced "tay," which has developed into a fine art. Today, "cha" means tea in Chinese. As this word moved westward into the Middle Eastern languages, it sometimes became altered to "chai." India attributes the discovery of tea to the Buddhist monk Siddhartha in the 6th century. Inspired by divine intervention, he picked and chewed the leaves of a nearby tree, discovering, to his delight, a great sense of alertness and well being.²

Since the third century, green tea has been used for medicinal purposes, such as depression, stomach problems, and anxiety. Around 1211, a Buddhist name Eisai wrote

Kissa Yohjoh Ki, the first book discussing the health benefits of green tea on the "five vital organs." During the Ming Dynasty in China, green tea became a common drink of the Chinese populace and helped to prevent scurvy in Chinese seamen due to its vitamin C concentration. Today, China and Japan are the world's leading producers of green tea, the second most popular drink in the world after water. Publicized studies on the health benefits of green tea have only been available since the 1990's. However, green tea's popularity in the West can be attributed to the growing interest in its potential health benefits.³

Constituents

Green tea also contains Gallic acid (GA) and other Phenolic acids such as chlorogenic acid, caffeic acid, and flavanoids such as kaempferol, myricetin, and quercetin. Wu and Wei indicated a cup of green tea (2.5 g of green tea leaves/200 ml of water) may contain 90 mg of Epigallocatechin -3 gallate (EGCG). Lin et al. analyzed 31 commercial teas, and detected that the levels of EGCG and total catechins were in the following order: Green tea (old leaves) ≥ green tea (young leaves) ≥ an oolong tea ≥ black tea and Pu-Erh tea. The amounts of catechins were always higher in green tea. EGCG and EGC were major catechins present with average contents of 7.358% and 3.955%, respectively; ECG and EC values are 0.910 and 3.556% respectively.⁴

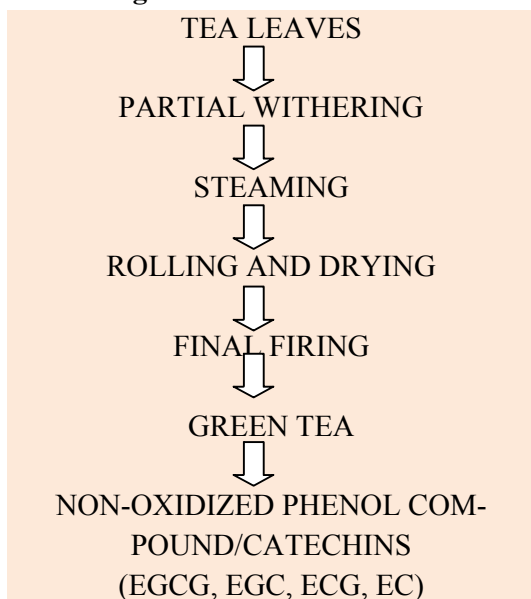
Contents	% Dry weight
Proteins	15–20
Amino acids	1–4
Fiber	26
Carbohydrates	7
Lipids	7
Pigments	2
Minerals	5
Phenolic compounds	30

Oxidized phenolic compounds

0

Commercially Available

1. Tea bags
2. Tea packs

Processing of Green Tea⁴**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.²

Biological Activity of Tea Components (Catechins)**A. Anti oxidative**

Green tea polyphenols are responsible for its antioxidant activity either directly by scavenging of reactive oxygen and nitrogen species and chelating redox-active transition of metal ions like iron and copper or indirectly by inhibition of pro oxidant enzymes, redox sensitive transcription factors, and induction of antioxidant enzymes.⁵

B. Capacity to modulate the physical structure of cell membranes

This mechanism may be influenced by the influence of catechins with the cellular phospholipid palisade. EGCG has shown to induce apoptotic cell death and cell cycle arrest in tumor cells.

C. Anti-microbial mechanism

EGC, EGCG, and ECG constitute the most important antibacterial agents on methicillin resistant *Staphylococcus aureus*, *Helicobacter pylori* and α -Hemolytic streptococcus.

D. Anti-cariogenic mechanism

Catechins are found to be inhibitory against *Streptococcus mutans* and *Streptococcus sobrin* at minimum inhibitory concentration (MIC) ranging between 50–1000 $\mu\text{g/ml}$.⁴

Classification Depending on the manufacturing process, teas are classified into three major types:

- 1) Non-fermented green tea (produced by drying and steaming the fresh leaves to inactivate the polyphenol oxidase by non-oxidation).
- 2) Semi-fermented oolong tea (produced by partial fermentation of fresh leaves before drying)
- 3) Fermented black and red tea (Pu-Erh) by post harvest fermentation before drying and steaming.⁴

Modes of Consumption

- As beverage
- As mouth wash
- As local drug delivery
- As chewing gum

Factors Affecting The Contents of Catechins

- 1) Type of processing before drying.
- 2) Type of green tea (e.g., Blended, decaffeinated, instant)
- 3) Preparation of infusion (e.g. Amounts of the product used, brew time, temp).

4) Growing conditions (soil, climate, agricultural practices, fertilizers).

5) Geographical location.

McKay and Blumberg reported that decaffeination slightly reduces the tea catechin content; also instant preparations and iced and ready-to-drink teas present less content of catechins. The production of bottle green tea beverage encountered a brewing problem mainly caused by oxidation of catechins.⁴

Medical Implications

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.

Anti-aging

Antioxidants in green tea protect the skin from the harmful effects of free radicals, which cause wrinkling and skin aging.²

Immunity

Polyphenols and flavanoids found in green tea help boost our immune system, making our health stronger in fighting against infection. Human $\gamma\delta$ (gamma delta) 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 $\gamma\delta$ 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-1-dependent secretion of IFN- γ (interferon gamma) by $\gamma\delta$ T cells and by $\gamma\delta$ T cell pro-

liferation. This unique combination of innate immune response and immunologic memory shows that $\gamma\delta$ T cells can function as a bridge between innate and acquired immunity.⁶

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 diseases

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. 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. 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.⁷ 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.⁸

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 b-amyloidosis. In an in vitro study, it was found that green tea inhibited human acetylcholinesterase, with an IC50 value of 0.03 mg/ml and, at an assay concentration of 0.03 mg/ml, inhibited b-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.⁹

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. Green tea possesses neuroprotective effects, suggesting its role in the prevention of Parkinson's disease. The green tea polyphenols protect dopamine neurons, which increases with the amount of green tea consumed. They also stated that this protective effect is medi-

ated by inhibition of the ROSNO pathway, a pathway that may contribute to cell death in Parkinson's.¹⁰

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.²

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.²

Halitosis

Halitosis is caused mainly by volatile sulfur compounds (VSCs) such as H₂S (hydrogen sulfide) and CH₃SH (Methanethiol) produced in the oral cavity. Oral microorganisms degrade proteina-

aceous 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 H₂S and CH₃SH gases, especially CH₃SH, which also demonstrated a better correlation with odor strength than H₂S.¹¹

Periodontal Health

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 catechins with steric structures of 3-galloyl radical, EGCG, ECG and gallo-catechin gallate, which are major tea polyphenols, inhibit production of toxic end metabolites of *P. gingivalis*.¹²

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.¹³

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.²

Oxidative 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.¹⁴

Effects on chondrocytes:- EGCG inhibits IL-1 β induced cartilage proteoglycan degradation and expression of MMP-1 and MMP-13 in human chondrocytes at micromolar concentration. Complete inhibition of MMP-1 and MMP-13 at a concentration of 100 μ g EGCG was observed. This concentration can be achieved only by local administration and not by oral consumption. MMP-13 is more sensitive to the inhibitory effect even at lower conc. This inhibitory effect is by inhibition of IL-1 β induced expression of m-RNAs signifying that the effect is at transcriptional level. So EGCG may inhibit the activities of MMPs involved in the degradation of native collagen and this may have suppressive effects on the cartilage degradation in arthritic joints.

Effect on collagenase activity:- Among the tea catechins ECG and EGCG with galloyl radical, showed the most potent inhibition effect on collagenase activity when an optimal concentration of tea catechins (100 μ g/ml) was added to reaction mixture containing collagenase and collagen⁴

Side-Effects of Green Tea

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).
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.

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 associ-

ated 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 ($P < 0.05$).²

CONCLUSION

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 sideeffects. Therefore, let us start sipping green tea and grow healthier.

REFERENCE

1. Namita P, Mukesh R, Vijay K J. *Camellia Sinensis* (Green Tea): A Review. *Global J Pharmacol* 2012;6:52-9,
2. Chatterjee A, Saluja M, Agarwal G, Alam M. Green tea: A boon for periodontal and general health. *J Indian Soc Periodontol* 2012;16:161-7.
3. Axelrod M, Berkowitz S, Dhir R, Gould V, Gupta A, Li E, et al. The inhibitory effects of green tea (*Camellia Sinensis*) on the growth and proliferation of oral bacteria. available from: www.drew.edu/wp-content/uploads/sites/99/Team3.pdf [assessed march 2014]
4. Venkateswara B, Sirisha K, Chava VK. Green tea extract for periodontal health. *J Indian Soc Periodontol* 2011;15:18-22.

5. Carmen C, Reyes A, Rafael G. Beneficial Effects of Green Tea- A Review; Journal of the American College of Nutrition 2006;25:79-99.
6. Kamath AB, Wang L, Das H, Li L, Reinhold VN, Bukowski JF. Antigens in tea-beverage prime human Vg2Vd2 T cells in vitro and in vivo for memory and nonmemory antibacterial cytokine responses. Proc Natl Acad Sci U S A 2003;100:6009-14.
7. Azam S, Hadi N, Khan NU, Hadi SM. Prooxidant property of green tea polyphenols epicatechin and epigallocatechin-3-gallate: Implications for anticancer properties. Toxicol in vitro 2004;18: 555-61.
8. Devine A, Hodgson JM, Dick IM, Prince RL. Tea drinking is associated with benefits on bone density in older women. Am J Clin Nutr 2007;86:1243-7.
9. Okello EJ, Savelev SU, Perry EK. In vitro anti-b-secretase and dual anticholinesterase activities of Camellia Sinensis L. Relevant to treatment of dementia. Phytother Res 2004;18:624-7.
10. Guo S, Yan J, Yang T, Yang X, Bezar E, Zhao B. Protective effects of green tea polyphenols in the 6-OHDA rat model of parkinson's disease through inhibition of ROS-NO pathway. Biol Psychiatry 2007;62:1353-62
11. Lodhia P, Yaegaki K, Khakbaznejad A, Imai T, Sato T, Tanaka T, et al. Effect of green tea on volatile sulfur compounds in mouth air. J Nutr Sci Vitaminol (Tokyo) 2008;54:89-94.
12. Sakanaka S, Okada Y. Inhibitory effects of green tea polyphenols on the production of a virulence factor of the periodontal-disease- causing anaerobic bacterium Porphyromonas gingivalis. J Agric Food Chem 2004;52:1688-92.
13. Hirasawa M, Takada K, Makimura M, Otake S. Improvement of periodontal status by green tea catechin using a local delivery system: A clinical pilot study. J Periodont Res 2002;37:433-8.
14. Coimbra S, Castro E, Rocha-Pereira P, Rebelo I, Rocha S, Santos- Silva A. The effect of green tea in oxidative stress. Clin Nutr 2006;25:790-6.

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