



Review

Green tea: A review on its natural anti-oxidant therapy and cariostatic benefits

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Green tea is a leading beverage in the Far East for thousands of years; it is regarded for a long time as a health product. Green tea has been consumed mainly in India, China, Japan, and Thailand. Studies are now suggesting that green tea (*Camellia sinensis*) in particular has many health benefits. Many biological effects of green tea and its constituents have been reported. In present years, tea has attracted focus for its potential for preventing cancer since it contains phytochemicals like polyphenols that act as antioxidants. Polyphenols including epigallocatechin 3 gallate (EGCG) constitute the most interesting components in green tea leaves. The antioxidant, antimicrobial, anticollagenase, antimutagenic and chemopreventive properties of these catechins proved to be helpful in the treatment of chronic diseases like periodontal disease. There is a direct bactericidal effect of Green Tea on *Streptococcus mutans*. Some catechins present in green tea interact with bacteria present on tooth surface by binding to its bacterial cellular proteins and decreasing its hydrophobicity and thus inhibits its adherence. The enzymatic activity of glucosyl transferase from *Streptococcus mutans* and *Streptococcus sobrinus* is inhibited by tea catechins and thus play cariostatic role.

Keywords: Green tea, antioxidant, cariostatic

INTRODUCTION

Plants have been used in folk medicine for thousands of years, and even with the advent of modern medicine, products derived from medicinal plants have been the basis for development of many new lead chemicals for pharmaceuticals. (Cowan,1999; Palombo,2009; Hamilton-Miller,2001) Globally, people are turning to the nature by using the natural herbal products in treatment of different diseases. There has been a rising interest in naturally derived biologically active compounds that may have potential therapeutic uses in medicine and dentistry. (Groppo,2008; Newman,2008)

Dental medicine has become especially amenable to plant-derived products, driven by evidence that shows populations that regularly incorporate foods or beverages containing certain phytochemicals into their diet have better oral health. (Groppo,2008) For example, Japanese tea drinkers have been known to have decreased incidence of caries compared to other populations. (Newman,2008;

Taylor,2005) The human oral cavity, much like the rest of the human body, is home to its own microbiota consisting of over 750 species of commensal bacteria, viruses, and fungi, including mutans streptococci (mainly *Streptococcus mutans* and *Streptococcus sobrinus*), which are associated with caries initiation and progression.(Marsh,2003; Avila,2009; Petersen,2003)

In recent years, the health benefits of consuming green tea, including the prevention of cancer, cardiovascular diseases, the anti-inflammatory, antiarthritic, antibacterial, antiangiogenic, antioxidative, antiviral, neuroprotective and cholesterol - lowering effects of green tea and isolated green tea constituents are under investigation. (McKay, 2002; Kavanagh, 2001; Sueoka, 2001; Dona,2003; Haqqi,1999; Sudano,2004; Sartippour,2002; Osada, 2001; Weber,2003; Weinreb,2004; Raederstorff, 2003) Tea contains large amounts of polyphenolic compounds with antioxidant properties, and these may prevent oxidative

damage of DNA. (Wiseman,1997) There is some evidence that green tea might cause hepatotoxicity. (Wiseman,1997; Zhang,1997; Mazzanti,2009) Mazzanti G et al studied two cases of hepatotoxicity associated with consumption of green tea for weight loss. Laboratory tests of those cases showed high values of transaminases, high alkaline phosphatase, high gamma glutamyl transpeptidase levels, and bilirubin levels 25 times more than the normal level. Apart from these laboratory findings, the histological examination showed inflammatory reactions, cholestasis, sometimes steatosis, and necrosis.

Several studies have suggested that green tea catechins, such as epigallocatechin gallate, inhibit periodontal and cariogenic pathogens and reduce the destruction of periodontal tissue. Yet, many studies tested the qualities of green tea as an antioxidant, anti-mutagenic and anti-carcinogenic, and its role in hypertension prevention, cardiovascular risk modification, ultraviolet radiation protection, bodyweight management and oral health improvement. (Cabrera,2006; Cheng,2006)

A great progress has been achieved in discovery of the potential pharmacological agents of the plants from natural sources. Natural products have been used as lead compounds because of its specific activity and low toxicity. In view of the immense medicinal importance of Green tea in various studies mentioned in literature there is great need for a review on medicinal properties of Green tea. This recent review was undertaken to collect and present the scientifically validated beneficial properties of green tea consumption under one roof.

Green Tea Plant

The tea plant (*Camellia sinensis* L.) is grown in about 30 countries worldwide. (Graham,1992) It grows best in tropical and subtropical areas with adequate rainfall, good drainage, and slightly acidic soil. (Nugala,2012) There are three main varieties of tea — green, black, and oolong, all derived from the leaves of the *Camellia sinensis* plant. As Green tea is made from unfermented leaves it contains the highest concentration of powerful antioxidants called polyphenols. Green tea is prepared from unfermented leaves, the oolong tea leaves are partially fermented, and black tea is fully fermented. (Araghizadeh,2013; Mankovskaia, 2013; Narotzki,2012)

Green Tea- A potent anti cariogenic agent

Dental caries, periodontal diseases and teeth loss are the oral pathologies that have a great effect on human health. Dental caries is caused as a result of infectious diseases due to bacterial infections. (Narotzki,2012; Moezizadeh,2013) Dentrifices are generally use for cleansing of teeth. Many active principles extracted by plants are included in the preparation of dentrifices as abrasive, and also to ensure a stronger antibacterial action. (Lewis,1977; Bone,2005;

Parmar,2012) Many compounds from natural products capable of controlling dental caries have been extensively surveyed, only a very restricted number of these is available for clinical applications because of effectiveness, stability, odour, taste and economic feasibility. (Goenka,2013; Suzuki,2012) Literature states that, those who continuously drink a large amount of green tea have less tooth decay and drinking green tea makes the mouth clean have spurred research into the potential of tea as an anti-caries agent. (Chatterjee,2012; Araghizadeh, 2013)

Experimental evidence suggests that catechins prevent the attachment of oral streptococcal pathogens to surfaces. (Otake,1991) found that Sunphenon (a commercial mixture of catechins extracted from green tea leaf) prevented the attachment of *Streptococcus mutans* to saliva-coated hydroxyapatite discs. Comparable data was obtained by (Xiao,2000) again using *S. mutans*. Similarly, ECG (Epicatechin 3 gallate) and EGCG (Epigallocatechin 3 gallate) adsorbed to protein components of salivary pellicles, modified their physical properties and prevented their further development. (Gadagi,2013; Kashket,1985) found the catechin fraction of tea and other beverages to be effective inhibitors of the enzyme. Extracts of commercial tea inhibited salivary amylase (Kashket,1988) although later work indicated this might be due to the presence of high molecular weight compounds. According to Zhang (1998), tea extract reduced α -amylase activity in human saliva and thus, green tea consumption exerts an anti-cariogenic effect which reduces the cariogenic potential of starch containing food. However, it was found that monomeric catechins displayed this activity. (Hara,1990) Studies have also shown that extracts of various teas inhibit amylase from *S. mutans*. (Radji,2013) Anticariogenic effects of tea extracts have been found in rats and hamsters; these observations have encouraged the difficult task of searching the effects of tea drinking on the development of dental caries in man. It was found that using a 0.2% green tea solution to rinse reduced the plaque index significantly, (You,1993) while similar findings were made both by Kaneko(1993) with a 0.25% catechin mouthwash Liu and Chi (2000) using tablets consisting of tea polyphenols. Hara,(1992) obtained a US patent for the use of mixtures containing EGCG, ECG and other catechins as anti-plaque agents. Significantly lower caries and plaque scores were reported in 106 American children who drank tea (1–3 cups/day) than in those who did not. (Lewis,1986) In studies involving almost 800 Japanese children there was a significantly lower incidence of pits and fissures in the teeth of the juvenile tea drinkers who consumed one cup of 'bancha' tea daily compared to the control group. (Hattarki,2013) A more recent study from the UK by investigated the use of tea, and of sugared and carbonated drinks, on dental health in over 6000 children; they clearly established that the drinking of tea was associated with lower levels of caries. (Jones,1999) Taken together, these

studies provide a strong body of evidence to suggest that tea drinking has the capacity to lower the incidence of dental caries.

Green tea- full of antioxidants

Antioxidants are compounds that protect cells against the damaging effects of reactive oxygen species, such as singlet oxygen, superoxide, peroxy radicals, hydroxyl radicals, and peroxy nitrite. Green tea is a popular nutraceutical as an antioxidant. An imbalance between antioxidants and reactive oxygen species results in oxidative stress, leading to cellular damage. (Halliwell, 1985)

The healthful properties of green tea are largely attributed to polyphenols, phytochemicals with potent antioxidant properties. Polyphenols contained in teas are classified as catechins. Green tea contains six primary catechin compounds: catechin, gallate, epicatechin, epigallocatechin, epicatechin gallate, and epigallocatechin gallate (also known as EGCG). Studies have reported that some of the protective health effects by taking green tea were reducing the oxidation of low density lipoprotein, thus lowering the risk of coronary artery disease and reducing oxidized metabolites, which could result in lowering the incidence of cancer. On reception of 4 electrons, oxygen is reduced to water. This process leads to the generation of Superoxide, hydroxyl free radical, hydrogen peroxide and singlet oxygen. This process leads to lipid peroxidation of cell membrane. The ability to scavenge these active oxygen has been present in Green tea. To measure the antioxidant ability of Green Tea Polyphenols, their scavenging effects on free radicals, abilities to chelate with iron ions, stabilities of semiquinone free radicals formed after reaction with free radicals has to be checked and analyzed the active sites of Green Tea Polyphenols when react with free radicals. (Weisburger, 1999; Whalley, 1990; Luo, 1997)

Tea polyphenols have the ability to scavenge reactive oxygen species (ROS), known as "free radicals," and nitrogen species. Our bodies are exposed to environmental sources of free radicals, such as cigarette smoking and chemical pollutants. ROS and nitrogen species are known to attack the lipid membranes and damage cell DNA. Antioxidants can deactivate or destroy ROS, thus preventing them from damaging cells. Green Tea Polyphenols and Vitamin C shows a synergistic effect in scavenging the free radicals and breaking the chain reaction of lipid peroxidation in biological membrane. In a study, green and black tea were found to have a much higher antioxidant activity against peroxy radicals than garlic, kale, spinach, and Brussels sprouts, which are the vegetables with the highest ORAC (Oxygen Radical Absorbance Capacity) values. To understand the mechanism behind the actions of Green Tea Polyphenols, active sites of its different components has to be identified. On performing the The ESR (Electron Spin Resonance) spectra of the semiquinone radicals formed from reaction

with the oxygen radical and active sites is the process to know the mechanism of action of Green Tea Polyphenols. In the literature, it was found that the active site of EGCG was the orthohydroxyl group in the gallate acid; the active site for ECG was the orthohydroxyl group in the galloylated gallate acid; there were two active sites for EC (Epicatechin), one was the hydroxyl group in chromane ring and the other was the hydroxyl group in pyrone ring; for EGC (Epigallocatechin), there were also two active sites, one was the orthotrihydroxyl group in the galloylated gallate acid and the other was the hydroxyl group in chromane ring. (Whalley, 1990; Luo, 1997; Cao, 1996)

Beneficial dose of green tea

In May 2006, researchers at Yale University School of Medicine looked at more than 100 studies on the health benefit of green tea. They pointed to what they called an "Asian paradox," which refers to lower rates of heart disease and cancer in Asia despite high rates of cigarette smoking. They theorized that 1.2 liters of green tea that is consumed by many Asians each day provides high levels of polyphenols and other antioxidants. (Dullo, 2008)

John Weisburger of the Institute for Cancer Prevention recommends drinking 6 to 10 cups daily as this is the amount demonstrated effective in improving health in population studies. However, many other studies conducted on the health benefits of tea are based on an intake of three cups of tea. Howard Sesso, researcher at Harvard School of Public Health, warns it is too premature to make specific recommendations regarding tea intake. (Saranow, 2004)

Conclusion

Various studies have been conducted on the Anti cariogenic and Anti Oxidant activity of Green Tea. Growing body of evidence suggest that green tea may reduce dental caries through different mechanisms. It is not completely clear whether green tea potency is because of its active phenolic ingredients or other nutritional components. As the human clinical evidence is still limited, future research needs to define the actual magnitude of health benefits, establishes the safe range of tea consumption associated with these benefits, elucidates the mechanisms of action and to advocate for green tea for prevention and treatment of specific oral morbidities. The development of biomarkers for green tea consumption, as well as molecular markers for its biological effects, will facilitate future research in this area.

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