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Gaganpreet Kaur
Department of Biotechnology &
Medical Sciences, Baba Farid
Group of Institutions, Bathinda

Prabhjot Kaur
Department of Biotechnology &
Medical Sciences, Baba Farid
Group of Institutions, Bathinda

Muskan
Department of Biotechnology &
Medical Sciences, Baba Farid
Group of Institutions, Bathinda

Correspondence
Gaganpreet Kaur
Department of Biotechnology &
Medical Sciences, Baba Farid
Group of Institutions, Bathinda

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**Green tea (*Camellia sinensis*): It's promising health
benefits for the welfare of humans**

Gaganpreet Kaur, Prabhjot Kaur and Muskan

Abstract

Green tea also known as *Camellia sinensis* possess many antimicrobial properties helps in killing the microorganisms that threaten human health, apart from this it also promotes growth of normal microflora in oral cavity, intestine etc. Polyphenols present in green tea are very effective in reducing the levels of mutans in saliva like *Streptococci* and *Lactobacillus*. Rinsing mouth with green tea helps to prevent the growth of oral carcinogenic bacteria. Moreover, the regular consumption of it can convert gut microbiota into the useful ones. Catechins present in green tea helps to reduce our body weight by interacting with gut microbiota hence, act as antiobesity substance. Green tea also possess many immunological, antiradiation, anticancer, antiblood coagulation and antioxidant properties. It also prevents the attachment of a bacteria to the epithelial cells and prevents infection because attachment is the key step in initiation of infection. The aim of this paper is to focus on the benefits of green tea which helps us in optimizing human health.

Keywords: Green tea, Catechins, Polyphenols, epicatechin-3-gallate (ECG), epigallocatechin (EGC), epicatechin, and epigallocatechin-3-gallate (EGCG)

Introduction

Green tea is a natural substance which is commonly drunk worldwide, as a popular beverage throughout Asia and has been recognized as a herbal remedy for the cure and prevention of many diseases [1-2]. There are four main types of tea produced from *Camellia sinensis* plant, depending on how the leaves are processed i.e. white, green, Oolong, and black tea. Green tea, which makes around 20% of tea production worldwide, is consumed most often in China, Korea, and Japan. Oolong tea is consumed most in China and Taiwan. Black tea (around 78% of tea production) is mostly consumed in the United States and the United Kingdom [3, 4]. White tea is produced from very young leaves and buds that have not yet turned green and it is semi-fermented. Green tea is produced from mature leaves with minimal processing (only drying). To produce green tea, freshly harvested leaves are rapidly steamed or pan-fried to inactivate enzymes, thereby preventing fermentation and producing a dry, stable product. Oolong tea is produced semi-fermented mature leaves, and black tea is produced from fully fermented mature leaves. Black tea contains up to three times the amount of caffeine as green tea. Two beneficial components in green tea are catechins and amino acid L-theanine lessen the impact of caffeine. When green tea is brewed, its caffeine combines with catechins in the water reducing the caffeine's activity compared to coffee or cocoa [4]. The components of green tea that are the most relevant medically are the polyphenols, with the flavonoids being the most important [3, 5-6]. It provides a dietary source of biologically active compounds considered to be beneficial to human health [2]. The chemical composition of green tea consists of:

- 1) Proteins
- 2) Enzymes
- 3) Free Amino acids (1–5.5%) [Theanine (4%)]
- 4) Carbohydrates (lignin (6.5%),
- 5) Minerals and trace elements

- 6) Trace amounts – lipids, pigments, steroids, vitamins and volatile compounds.
- 7) Fresh tea leaves contain alkaloids [Theobromine (0.15–0.2%), theophylline (0.02–0.04%), methylxanthines], catechins, flavones, phenolic acids polyphenols, caffeine (approximately 3.5% of the total dry weight), organic acids (1.5%), chlorophyll (0.5%), and numerous flavor rich compounds [5, 7]. Green tea is also currently used in the preparation of a variety of foods, pharmaceutical preparations, dentifrices, and cosmetics. Green tea is a popular nutraceutical as an antioxidant [8]. Besides these, its beneficial health effects and components have been extensively reviewed for health promoting potential [9]. This review focus on the study of health benefits of Green Tea on normal microflora as well as its potential as a panacea against certain diseases.

Green Tea and Normal Microflora

The human body has a rich diversity of microbial flora, composed particularly of bacteria. The number of microbial flora is far more than the actual number of cells in the rest of the human body. This normal microflora in the respiratory and gastrointestinal tracts, as well as on the skin, helps in the development of innate immunity. These microflora also generate metabolites which works as essential nutrients for proper functioning of human body and provides protection against more pathogenic bacteria [2]. A little has been discovered that consumption of green tea enhances the human intestinal microbiota (HIM), which plays a vital role in human defence. Hence, Green tea may proved to be very beneficial for the health of HIM of the host. Because of green tea and its constituents having important effects on the host, several studies have examined about its influence on the human intestinal bacteria [9].

Role of green tea components on human health

Green Tea contains very beneficial constituents such as flavanols, mainly (quercetin, kaempferol, myricetin, and their glycosides), Polyphenols and Catechins. The processing technique of green tea involves no fermentation, hence its components are well preserved, especially polyphenol ingredients which have antioxidant effect. Polyphenols are found in wide groups of substances present in plants, especially all vegetative plant organs: flowers and fruits. Moreover, the main sources of the polyphenols present in the daily human diet are plants like tea, coffee, cereals, and fruit. Despite their wide distribution, the health effects of dietary polyphenols have come under the consideration of nutritionists only in the last decades. The main reason for the delayed research on polyphenols is the variety and the complexity of their chemical structures. The most beneficial components of green tea have been found and are collectively called polyphenolic catechins. The various types of catechins in green tea are (–) epicatechin-3-gallate (ECG), (–) epigallocatechin (EGC), (–) epicatechin, and (–) epigallocatechin-3-gallate (EGCG) [5, 10-12]. Among these, Epigallocatechin gallate (EGCG) is a polyphenol that makes up 30% of the solids in green tea [13]. Green tea extracts are more stable than pure epigallocatechin gallate, due to the presence of other antioxidant constituents in the extract [8]. Green tea leaves are steamed, to prevent the oxidation of compound EGCG [14]. The reported benefits of catechins are their antimicrobial effect against oral, intestinal and food-

borne bacteria, alongwith its antitoxicity against various bacterial haemolysins and viral activity [15]. Green Tea contain a range of natural flavor-rich components such as terpenes, oxygenated terpenes, sesquiterpenes and organic acids of the catechins exhibit antioxidant activity [5]. Besides direct role as antioxidants polyphenols have additional mechanisms to reduce oxidation level that are:

- a) Binding of metal ions such as iron and copper in order to prevent their participation in oxidation reactions.
- b) Prevent the activation of redox sensitive transcription factors that act as mediators of inflammatory reactions [3].

It is indicated through epidemiologic observations and laboratory studies have that polyphenolic compounds present in tea may reduce the chances of number of illnesses, including cancer and coronary heart disease [6]. It has anti-carcinogenic, anti-inflammatory and positive effect on cardiovascular diseases [10]. Some mode of actions of Polyphenol catechins are discussed below:

1. Polyphenols are agents that inhibit clinical symptoms of Urinary Tract Infections as they are anti-inflammatory in nature.
2. Catechins induces the production of cytokines such as IL-12
3. Green tea polyphenols decrease tumor necrosis factor- α (TNF- α) gene expression, which is reason for pathogenesis of *E. coli* infection.
4. Catechins, block the connection of conjugated R plasmid in *E. coli* which have bactericidal and antitoxin effects.
5. Catechins-copper (II) complexes harm the cytoplasmic membrane of Bacteria especially, *E. Coli*.
6. EGC decreases the activity of DNA gyrase enzyme by binding to the ATP site of the b subunit of DNA gyrase enzyme.
7. The bactericidal action of catechins is due to the generation of hydrogen peroxide.
8. Catechins interfere with the expression of b-lactamases in *Staphylococci* [16].

In addition to all these activities, green tea EGCG have been shown to be anti-angiogenic (prevention of tumor blood vessel growth) and anti-mutagenic properties, as well as also proved to be hypocholesterolemic and anti-atherosclerotic plaque forming. It has Potential to offer significant protection against age-associated pathologies and neurodegenerative diseases such as Parkinson's disease, Alzheimer's disease and ischemic damage [5]. EGCG also mimics metabolic actions of insulin to decrease hepatic glucose production and increase fatty acid oxidation in skeletal muscle, thus consumption of Green tea reduces the risk of cardiovascular disease in diabetic patients depending, upon the ability of EGCG to mimic or augment both metabolic and vasodilator actions of insulin, leading to simultaneous improvement in both insulin sensitivity and endothelial function of the blood vessels [13]. Green tea EGCG can suppress the formation of osteoclasts by inhibiting the release of matrix metalloproteinases (MMPs) by osteoblasts and inhibits the activities of MMPs involved in degradation of collagen therefore they have inhibitory effects on cartilage degradation in arthritic joints and reduces the severity of an autoimmune disease called rheumatoid arthritis [4]. In general, green tea has been found to be superior to black tea in terms of antioxidant activity, due to the presence of higher content of EGCG [14].

Green tea and focus on health benefits

Significant progress has been made in understanding diseases that cause alarming mortality and morbidity in humans to prevent using therapies. Among them cancer and coronary heart disease are the most important of these disorders. Because of research efforts over the past 3 decades, it is now well appreciated that although the causes of the major diseases are diverse and countless, changes in dietary habits and lifestyles may reduce their risk upto huge extent. A number of epidemiologic studies showed the preventive effect of green tea consumption against cardiovascular disorders such as coronary heart disease, atherosclerosis, high blood cholesterol and hypertension. It has also been effective in lowering Low Density Lipoproteins cholesterol levels, inhibiting the abnormal formation of blood clots, reduction of platelet aggregation, lipid regulation and inhibition of proliferation and migration of smooth muscle cells. Inhibition of abnormal blood clots formation takes on added importance when you consider that thrombosis (the formation of abnormal blood clots) is the leading cause of myocardial infraction and stroke [6, 14]. Green tea has also been shown to be effective against the immunosuppression as well as derma problems caused by ultraviolet radiation B. Green tea polyphenols have also proved to be protective against cytokines induced by tumors [6]. Other health beneficial aspects include anti-bacterial, anti-HIV, anti-aging and anti-inflammatory activity. Green tea is also known for its antiviral properties which are based on the ability of polyphenols to act as antioxidants, inhibit enzymes that damage cellular membranes and prevent binding and penetration of viruses into the cells. Effects of green tea against, especially in its earliest stage of the Herpes simplex virus have also been demonstrated. Green tea plays a role in maintaining oral health. These properties are significant since green tea may encounter various viruses which are found the in oral cavity to prevent dental caries for decades and it reduces the incidence of dental caries through different mechanisms including enzymes activity and bacterial growth. Some antioxidant and antimicrobial agents of green tea could increase the life and efficiency of teeth. Tannins are biosynthetic materials which have a potent antibacterial effect. EGCG prevents infection from influenza virus by attaching to viral haemagglutinin and preventing its attachment to cellular target receptors, thus it also beneficial for patients suffering from common cold [5, 7-8, 15-17]. Application of green tea causes significant reduction of *S. mutans* and *Lactobacillus* present in saliva and plaque, and increases saliva pH by increasing its basicity [16]. Due to the presence of high content of antioxidants, green tea functions as dietary supplement and ingredient in cosmetics, shampoos, sweet waters, masks and anti-aging emulsions [5]. Drinking green tea may also help prevent getting sore throats since it helps fight the bacteria harboring in the throat [16]. It protects cellular damage by inhibiting DNA damage and the oxidation of low-density lipoprotein (LDL) due to its antioxidant effects [18]. Cancer chemo preventive activity of green tea consumption has also been demonstrated which is linked to the prevention of many types of cancer, including lung, colon, esophagus, mouth, stomach, small intestine, kidney, pancreas, and mammary glands. Green tea catechins have an inhibitory effect on *Helicobacter pylori* infection. Green tea strengthens the immune system action because it protects it against oxidants and radicals. Green tea is considered to be useful for insect stings mainly due to its anti-inflammatory effects and its capacity to stop bleeding [8, 19].

Conclusion

From all the above discussion, it can be concluded that green tea plays a crucial role in proper functioning of vital organs such as heart, gastrointestinal tract etc. Apart from this it also helps normal microflora of oral cavity and human intestinal microbiota for the prevention of attachment of pathogenic organisms, thus provides protection against many pathogenic diseases. Moreover, it also prevents obesity and inflammation related disorders by enhancing the immune response. Studies recommend that normal consumption of green tea is beneficial but excessive intake may be toxic for the health for e.g.: it may lead to degradation of bones, insomnia, resistance to normal microbiota etc.

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