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Review Article

Review Of Antioxidant Properties of Green Tea

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ABSTRACT

Green tea is known for its strong antioxidant and health-promoting properties. This review focuses on the compounds in green tea—mainly catechins and polyphenols—that contribute to its antioxidant and anti-radical effects. Various extraction methods such as ultrasonic and microwave techniques are used to identify these bioactive compounds. Studies show green tea supports metabolic health, helps manage obesity, and improves cardiovascular function. It also holds promise in skincare and liver health, making it valuable in both healthcare and cosmetology. Further research is encouraged to understand its full therapeutic potential.

INTRODUCTION

Tea is one of the most widely consumed beverages in the world. Tea plant *Camellia sinensis* (family-Theaceae) has been originated from Southeast China, gradually expanded to India, Sri Lanka and further into many tropical and sub-tropical countries. The tea plant is grown in about 30 countries Worldwide. It grows best in tropical and subtropical areas with adequate rainfall, good drainage and slightly acidic soil. There are two varieties of tea. *Camellia sinensis var. sinensis* (China tea) is grown extensively in China, Japan, and Taiwan, while C. assamica var. assamica (Assam tea) predominates in south and south East Asia, including Malaysia and more recently, Australia. Green tea is widely considered as a health promoting beverage, and the beneficial effects generally associated with green tea have been attributed to its polyphenol content, particularly to catechins and their antioxidant activity. Green tea contains more catechins than black tea or oolong tea. Catechins are in-vitro and in-vivo strong antioxidants. In addition, its content minerals and Vitamins increase the antioxidant potential of this type of tea. It is a widely used medicinal plant throughout India, China and popular in the various indigenous system of medicine like Ayurveda, Unani and Homoeopathy. Green tea has been consumed in all

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respective ages in India, China, Japan and Thailand. Green tea is believed to be a potent source of beneficial antioxidants, like that found in fruits and vegetables. Tea is particularly rich in polyphenols, including catechins, theaflavins and thearubigins, which are thought to contribute to the health benefits of tea. Oxygen is an element indispensable for life. When cells use oxygen to generate energy free radicals are produced by the mitochondria. A free radical is defined as any chemical species that contains unpaired electron(s) in its outer orbit. They are formed from molecules via the breakage of a chemical bond such that each fragment keeps one electron, by cleavage of a radical to give another radical and, also via redox reactions. ROS (reactive oxygen species) and RNS (reactive nitrogen species) are the terms collectively describing free radicals and other non-radical reactive derivatives also called oxidants. Radicals are less stable than non-radical species, although their reactivity is generally stronger.

MATERIALS AND METHODS

1. MATERIALS

Green Tea Extract: Commercially available green tea (Camellia sinensis) leaves were used. The leaves were dried and powdered, and an ethanolic extract was prepared using 70% ethanol. Chemicals and Reagents: All analytical-grade chemicals including 2,2-diphenyl-1-picrylhydrazyl (DPPH), Folin-ciocalteu reagent, gallic acid,ascorbic acide,abd other solvents were purchased from standard suppliers such as Sigma-Aldrich. Biological Samples (if applicable): Laboratory animals (e.g., Wistar rats) or human plasma samples, depending on the experimental design, were used to assess in vivo antioxidant activity.

2. Preparation of Green Tea Extract

Green tea leaves were washed, air-dried, and ground into fine powder. About 10 g of the powder was extracted with 100 mL of 70% ethanol using a Soxhlet apparatus or maceration at room temperature for 24–48 hours. The extract was filtered, evaporated under reduced pressure using a rotary evaporator, and stored at 4°C for further analysis.

3. Determination of Antioxidant Activity

a. DPPH Radical Scavenging Assay

A solution of DPPH (0.1 mM) in methanol was prepare Different concentrations of green tea extract were added to the DPPH solution .The mixture was incubated in the dark for 30 minutes at room temperature. Absorbance was measured at 517 nm using a UV-Vis spectrophotometer. The scavenging activity was calculated as a percentage of DPPH radical inhibition compared to a control.

b. Total Phenolic Content (TPC)

TPC was determined using the Folin–Ciocalteu method.0.5 mL of extract was mixed with 2.5 mL of 10% Folin–Ciocalteu reagent and 27.5%sodiumcarbonate. The mixture was incubated for 30 minutes at 37°C.Absorbance was measured at 765 nm, and results were expressed as mg gallic acid equivalents (GAE) per gram of extract.

c. Ferric Reducing Antioxidant Power (FRAP) Assay (optional)

The reduction of Fe^{3+} to Fe^{2+} was measured by the change in absorbance at 593 nm after reaction with green tea extract.

Results were expressed as µmol Fe^{2+} equivalents.

4.Statistical Analysis

All experiments were conducted in triplicate. Results were expressed as mean ± standard deviation (SD). Statistical significance was determined using one-way ANOVA followed by Tukey's post hoc test, with $p < 0.05$ considered significant.

5.Test Tubes and Beakers

Beakers were used to prepare the green tea extract by mixing green tea powder with distilled water or ethanol .The mixture was gently heated in the beaker for about 30 minutes. After cooling, the extract was poured through a filter paper into clean test tubes. Test tubes were then used to mix a specific volume of green tea extract with DPPH solution or other reagents for antioxidant testing. The contents of the test tubes were kept in the dark for 30 minutes and later analyzed using a spectrophotometer.

6.Distilled Water or Ethanol

10 grams of dried and powdered green tea leaves were taken. The powder was mixed with 100 ml of distilled water or ethanol in a beaker. The mixture was heated at 60–80°C for about 30 minutes to allow extraction of bioactive compounds. After heating, the solution was cooled to room temperature. It was then filtered using filter paper to obtain a clear green tea extract, which was later used for antioxidant testing.

RESULT AND DISCUSSION

Results indicated that green tea possesses strong antioxidant activity, with high free radical scavenging ability observed in assays such as DPPH, ABTS, and FRAP. The presence of key bioactive compounds, particularly catechins like EGCG, contributed significantly to this activity. The extract also showed potential in enhancing the levels of antioxidant enzymes such as superoxide dismutase (SOD) and catalase (CAT). Discussion revealed that green tea's antioxidant effects are due to its ability to neutralize harmful free radicals, prevent lipid peroxidation, and support the body's natural defense systems. These properties highlight its potential role in reducing oxidative stress and lowering the risk of chronic diseases such as heart disease, cancer, and aging-related disorders. The findings support the traditional and scientific recognition of green tea as a functional beverage with notable health benefits.

Morphological Characteristic: Leaves are typically light green

o Lanceolate in shape.

o Have a serrated margin

o young leaves are pubescent on the outer side

o Mature leaf becomes smooth and leathery

o Flowers are white and fragrant

o Ranging from 2.5 to 4 cm diameter

Anatomical Features: The presence of poly phenols, particularly catechins which are abundant and contributed to its anti-oxidant properties.The leaves are light green and have short white hairs on the outer side especially young .

Pharmacological Action:

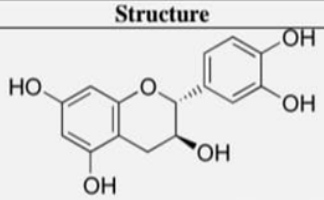
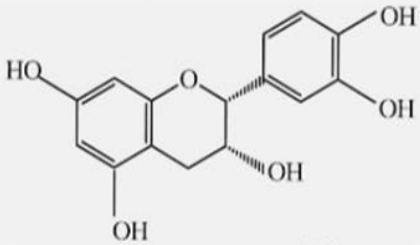
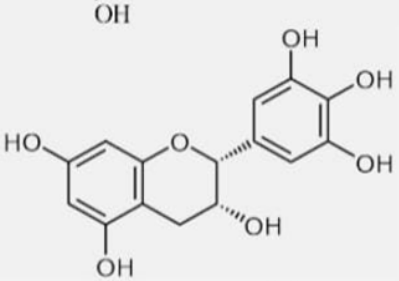
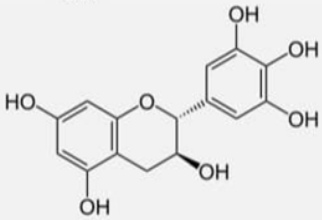
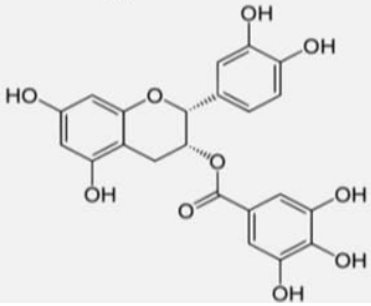
Primarily stems from its rich content of anti oxidant polyphenols , especially catechins ,like EGCG and reducing inflammation ,impacting various aspects of health. Beyond antioxidant properties, green tea has been linked to anti cancer ,anti aging and broader antibacterial effects , Green tea poly phenol, particularly catechins ,are potent anti-oxidants that neutralize free radicle and prevent cell

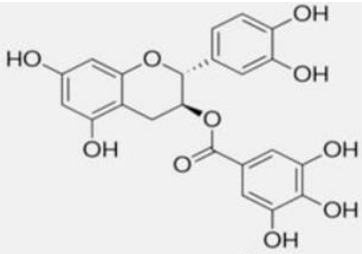
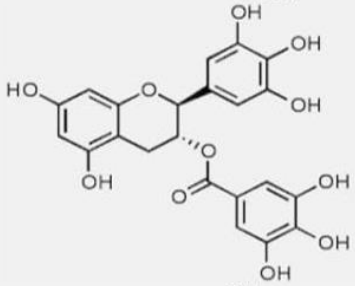
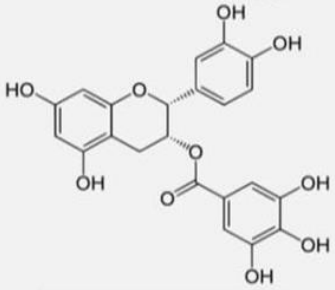
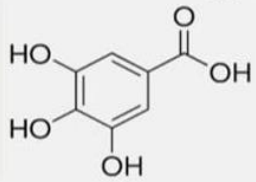
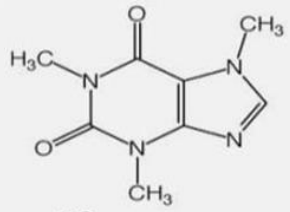
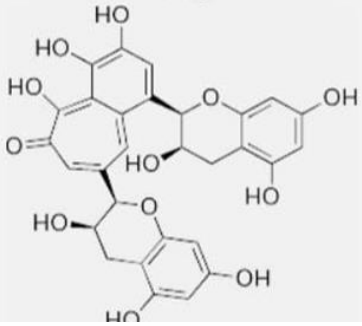
Mechanism Of Action:

There exists a wealth of knowledge about the role catechins play in tumor cells and their mechanisms of action in vitro, but little as to the role catechins play in the neurodegeneration and inflammatory response initiated after an ischemic event. Due to the fact that catechin metabolites are biologically active in fact, more so than their parent compounds, it would be meaningless to compare the observed effects of a catechin in vitro with the effects in vivo. We have therefore highlighted key areas of the neurodegenerative and neuroinflammatory cascade that the catechins may be targeting to produce a neuroprotective effect after cerebral ischemia, with an emphasis on in vivo mechanisms.

Bioactive Compounds:

Poly phenols like catechins with epigallocatechins -3-gallet being the most abundant and studied .Other notable componds include caffeine, theanine, chlorophyll, vitamins ,and minerals. These compounds contribute to green tea's various health benefits including anti-oxidant, anti-inflammatory and potential anti-cancer properties. The catechins, particularly epigallocatechin's -3-gallate .These polyphenols along with other flavanols, flavanonols and phenolic acid, contribute to the overall anti-oxidant capacity of green tea.

S. no.	Structure	Name	Formula
1		Catechin, C, (+)-Catechin	$C_{15}H_{14}O_6$
2		Epicatechin, EC, (-)-Epicatechin (cis)	$C_{15}H_{14}O_6$
3		Epigallocatechin, EGC, (-)-Epigallocatechin	$C_{15}H_{14}O_7$
4		Gallocatechin, GC, (+)-Gallocatechin	$C_{15}H_{14}O_7$
5		Epicatechin gallate, ECG, (-)-Epicatechin Gallate	$C_{22}H_{18}O_{10}$

6		Catechin gallate, CG, (+)- catechin gallate	$C_{22}H_{18}O_{10}$
7		Gallocatechin gallate, GCG, (+)- Gallocatechin gallate	$C_{22}H_{18}O_{11}$
8		Epigallocatechin gallate, EGCG, (-)-Epigallocatechin gallate	$C_{22}H_{18}O_{11}$
9		Gallic Acid	$C_7H_6O_5$
10		Caffeine	$C_8H_{10}N_4O_2$
11		Theaflavin	$C_{29}H_{24}O_{12}$

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