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Journal home page: <http://www.pharmasm.com>**GREEN TEA: A WHOLE BODY HEALTH TONIC : A REVIEW**

Rakesh Chawla^{1*}, Sandeep Goyal¹, Jasleen Kaur¹, Kulbhushan Rana², Anshu Arora³,
Ujjwal Sahoo⁴

¹University Institute of Pharmaceutical Sciences & Research, Baba Farid University of Health Sciences, Faridkot – 151 203, Punjab, India

²Department of Chemistry, S.D.College, Barnala-148 101, Punjab, India

³Dasmesh College of Pharmacy, Faridkot- 151 203, Punjab, India

⁴Department of Pharmaceutical Chemistry, Dr B. C. Roy College of Pharmacy & Allied Health Sciences, Durgapur- 713206, West Bengal, India

ABSTRACT

After water, the most consumed drink is tea. Green tea is one of the most ancient cultivated medicinal plants with a wide variety of therapeutic benefits. Also it is found to be more beneficial than black tea. Green tea is produced from leaves of *Camellia sinensis* plant which also yields variety of white and black tea. Research is done and available for the health benefits of green tea including anti-carcinogenic effect, anti-inflammatory effect, anti-microbial effect, anti-oxidant property and beneficial in cardiovascular diseases, oral health, diabetes, skin disorders, hair loss, obesity, iron load. Most of these beneficial effects are related to its constituents particularly catechins including epigallocatechin, epicatechin, epicatechin gallate. These are viewed as the most significant active constituents. These are members of the class of polyphenols known as flavonoids. The objective of this review is to illustrate various health benefits of green tea on the basis of research and clinical findings.

KEYWORDS: *Camellia sinensis*, green tea, EGCG, EC, EGC, ECG, catechins, flavonoids, health benefits.

INTRODUCTION

Green tea is one of the most popular beverages consumed worldwide. Tea, from plant *Camellia sinensis*, is consumed in different parts of world as green, black or oolong tea. Among all of these however, the most significant effects on human health have been observed with the consumption of green tea^[1]. Out of these three types of tea green tea is unfermented, oolong tea is partially fermented and black tea is fermented tea. The health benefits of green tea, including prevention of cancer^[2] and cardiovascular diseases^[3], anti-inflammatory^[4], anti-arthritis^[5], anti-bacterial^[6], anti-angiogenic^[7], anti-oxidative^[8], anti-viral^[9], neuro-protective^[10] and cholesterol lowering effects^[11] of green tea are under investigation. While all these effects are mainly attributed to its polyphenol content^[12] particularly flavonoids^[13] rich in catechin. Green tea

contains four main catechins that are epicatechin (EC), epigallocatechin (EGC), epicatechin-3-gallate (ECG) and epigallocatechin-3-gallate (EGCG)^[14].

The following table shows comparative mean composition (%) of green tea and black tea [15]

Compound	Green tea	Black tea	Infusion
Proteins	15	15	Trace
Amino acids	4	4	3.5
Fibres	26	26	0
Other carbohydrates	7	7	4
Lipids	7	7	Trace
Pigments	2	2	Trace
Minerals	5	5	4.5
Phenolic compounds	30	5	4.5

Data referred to dry weight of leaves*

BASIC DETAILS

The source of green tea is the plant *Camellia sinensis* belonging to family Theaceae. It is a non fermented tea and contains catechins which are strong anti-oxidants. It is widely used throughout India, China, Japan, Thailand.

SCIENTIFIC CLASSIFICATION

Kingdom: Plantae

Division: Magnoliophyta (flowering plants)

Class: Magnoliopsida (dicotyledons)

Order: Ericales

Family: Theaceae

Genus: *Camellia*

Species: *C. Sinensis*

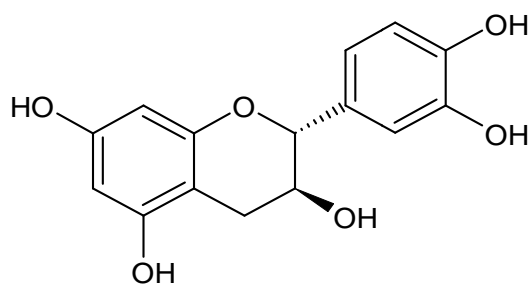
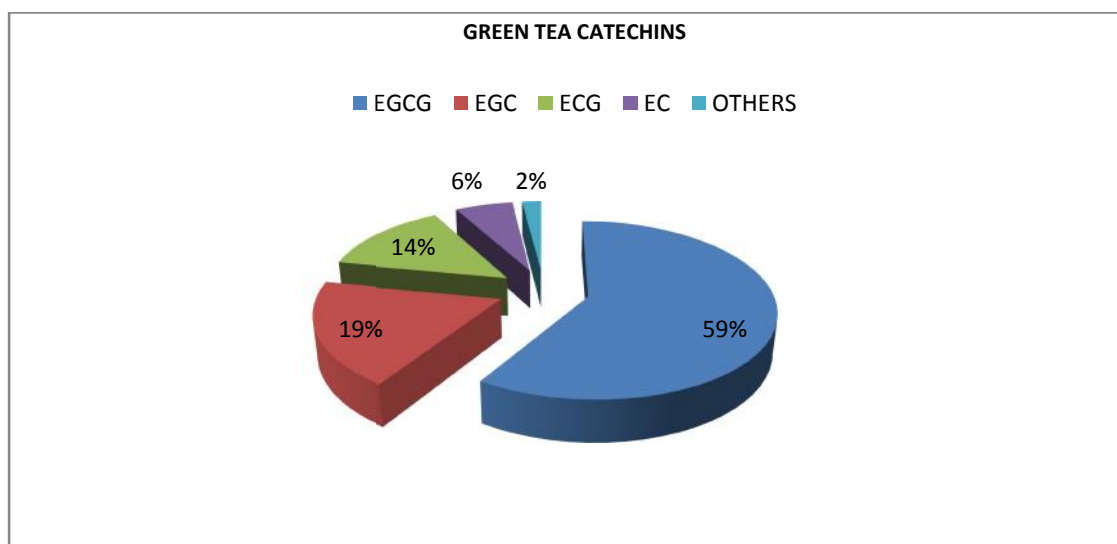
Binomial name: *Camellia sinensis* (L.) Kuntze

It is an evergreen shrub that is cultivated for its leaves. The leaves are 4-5 cm long and 2-5 cm broad. Different leaf ages produce differing tea qualities, since their chemical compositions are different.

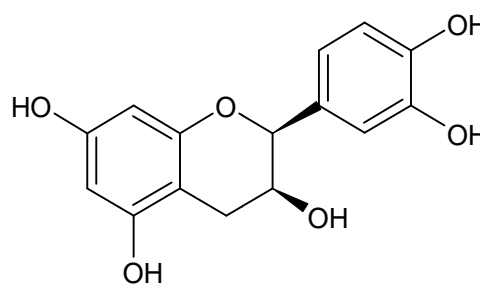


GREEN TEA CHEMICAL COMPOSITION

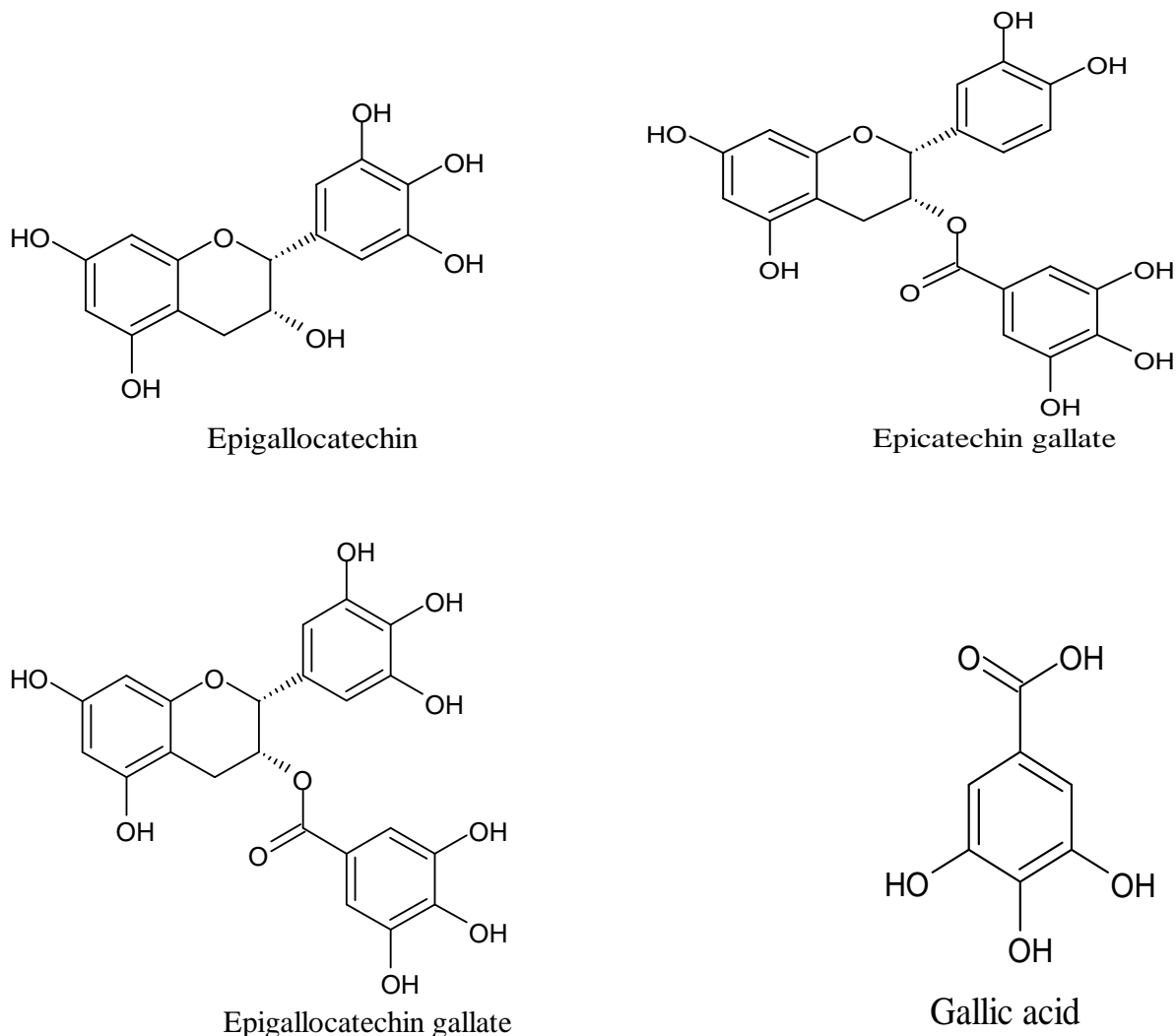
Green tea contains nearly 4000 bioactive constituents and one-third of which is contributed by polyphenols^[16]. Other constituents are alkaloids such as caffeine, theophylline and theobromine. Amino acids, carbohydrates, proteins, chlorophyll, volatile organic compounds, fluoride, aluminium, minerals and trace elements are also present^[17]. Major constituents of interest are polyphenols mainly flavonoids^[18] including catechins^[19] and the major ones are (-)-epicatechin (EC), (-)-epicatechin gallate (ECG), (-)-epigallocatechin (EGC) and (-)-epigallocatechin gallate (EGCG)^[20].



Catechin



Epicatechin



BASIC STRUCTURES OF DIFFERENT GREEN TEA POLYPHENOLS

BOONS OF GREEN TEA

1. Protective in cardiovascular diseases:

Cardiovascular diseases appear to be the most prevalent cause of deaths in western world probably as a result of lifestyle of population that includes:

- (a) Eating habits
- (b) Low physical activity
- (c) Smoking
- (d) Alcohol consumption

But on the other hand consumption of green tea exhibits cardio protective activity^[21, 22] that is known to inhibit atherosclerosis, decreased susceptibility of plasma and LDL to oxidation and

also modulated cholesterol metabolism^[23]. Those consuming three cups of green tea daily has 2% lower risk of suffering a stroke than those consuming less than a cup daily^[24]. Chance of getting high blood pressure also reduces^[25].

2. Effective in combating cancer:

Animal and clinical studies suggests that catechins that are present in green tea helps in inhibiting cell proliferation and also promotes the termination of leukaemia cells^[26]. In a study when non-Hodgkin's lymphoma cells were transplanted into mice, green tea prevented 50% of tumours from taking hold^[27]. In a study held at Kyushu University in Japan by Hirofumi Tachibana's team, it was found that green tea protects from a range of cancers, including oral, stomach, intestine, lungs, prostate and breast cancers due to presence of EGCG. Since, a cell receptor called 67 LR present in human lung cancer cells slowed significantly after consuming 2-3 cups of green tea^[28]. It has also been shown that because of green tea consumption, DNA damage caused by smoking decreased, cell growth was inhibited and cellular triggers for apoptosis (cell suicide) in abnormal cells increased^[29]. A recent large study showed a relationship between breast cancer risk and tea consumption, with the risk being highest in the groups that did not consume tea and lowest in groups that consumed tea daily^[30]. Yet, the various mechanisms antiproliferative, antiangiogenic and anti-invasive activities of green tea and catechins in prevention of cancer represent a monumental challenge yet to be addressed^[31].

3. An asset for a diabetic patient:

Green tea was found to be active against diabetes. When it was studied on mice it showed lowering of glucose levels without affecting insulin levels^[32]. In an investigation it has been shown that EGCG mimics insulin, increases tyrosine phosphorylation of the insulin receptor and insulin receptor substrate. Recently, green tea was demonstrated to modify glucose metabolism beneficially in experimental models of Type II diabetes mellitus^[33, 34].

4. Benefits in skin disease:

Green tea has been found to be effective in curing the symptoms of acne and eczema and also is found to be helpful in treatment for patients suffering skin damage due to radiotherapy for cancer. It is also known for prevention of solar UVB light induced skin disorders including photoaging, melanoma and non melanoma skin cancers after more clinical trials in humans.^[35]

5. Prevention of hair loss:

Green tea polyphenols are recently found as positive factor in hair growth and follicle health^[36].

6. Combats obesity:

Green tea helps in combating the obesity by burning the extra calories, reducing fat levels and preventing weight gain. This is associated with the significant reduction in total and low density lipoprotein cholesterol levels by green tea [37]. Since catechins have shown to reduce adipocytes differentiation and proliferation [38]. The effects of tea on obesity have received increasing attention. Since obesity is one of the causes for diabetes, tea catechins, especially EGCG, appear to have anti obesity and anti diabetic effects [39].

7. Oral health:

Green tea is effective in preventing dental problems. Tea leaves are rich in fluorides and several catechins which enhance dental health [40]. Green tea has anti-streptococcus mutans activity, which is responsible for most of the dental caries [41]. A study has analysed the periodontal effect of 940 men, and found that those drinking green tea regularly had superior periodontal health [42]. Periodontopathic bacteria are known for producing volatile sulphur compounds causing bad breath (halitosis). Whereas, antimicrobial polyphenols in green tea can improve bad breath by suppressing these bacteria [43]. These anti-microbial effects are also beneficial for the main bacteria involved in gingivitis that is *Porphyromonas gingivalis* [44, 45, 46, 47].

8. Anti-microbial effect:

Green tea has a wide spectrum of activity against a large number of microbes, some of which are summarised in the given table.

Organisms affected by green tea [48]

Bacteria	Viruses	Fungi	Parasites
<i>Pseudomonas aeruginosa</i>	Epstein- Barr virus	<i>Acrtinomyces spp.</i>	<i>Trypanosome cruzi</i>
<i>Salmonella typhi</i>	Hepatitis B	<i>Aspergillus niger</i>	
<i>Salmonella typhimurium</i>	Hepatitis C	<i>Candida albicans</i>	
<i>Staphylococcus aureus</i>	HIV-1		
<i>Methicillin-resistant</i>	HSV-1		
<i>Staphylococcus aureus</i>	Influenza A H1N1		
<i>Staphylococcus epidermidis</i>	Influenza A H3N2		
<i>Stenotrophomonas maltophilia</i>	Influenza A H5N2		
<i>Streptococcus mutans</i>	Influenza B		
<i>Streptococcus pyogenes</i>			
<i>Vibrio cholerae</i>			
<i>Yersinia enterocolitica</i>			
<i>Proteus mirabilis</i>			
<i>Prevotella intermedia</i>			
<i>Porphyromonas gingivalis</i>			
<i>Listeriamonocytogenes</i>			
<i>Helicobacter pylori</i>			
<i>Enterococcus faecalis</i>			
<i>Escherichia coli</i>			
<i>Bacillus cereus</i>			
<i>Acinetobacter baumannii</i>			

Antimicrobial activity of the green tea is attributed to its capacity of damaging bacterial cell membrane, inhibition of bacterial fatty acid synthesis, inhibition of enzymes such as protein tyrosine kinase, cysteineproteinases, DNA gyrase, ATP synthase and inhibition of efflux pump activity^[49]. Hence, this resulted in fewer fever illnesses, few cold or influenza symptoms and fewer infections with Influenza A or B^[50].

9. Antioxidant property:

Flavonoids, a class of polyphenols are disease fighting anti-oxidants abundantly present in green tea which makes green tea more beneficial in protecting the body from oxidative damage due to free radicals. These anti-oxidants also halt the initiation of cancer, heart disease, suppress immune function and accelerated aging^[51]. In addition green tea is also rich in certain minerals and vitamins that also increase the anti-oxidant potential of green tea^[52].

BAD EFFECTS OF GREEN TEA

The only negative effect till date reported is “insomnia” due to the fact that green tea contains caffeine although the amount is less than that of coffee. Also it contains vitamin K which may interrupt the activity of warfarin^[53]. Some studies revealed that green tea is responsible for accumulating aluminium which can cause neurological disorders^[54].

CONCLUSION

Green tea proved to be beneficial and versatile in health aspects. The information, clinical findings and various researches on green tea are found to be quite resourceful and favourable for everyone. Expansion of more specific and sensitive methods with more representative methods with more representative models will give more detailed understanding of effects of green tea. Overall green tea is an affordable natural medicine. This article shows that green tea has its place in future medicine therapy.

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