

# Highlighting the possible side effects of consuming green Tea: A Herbal Drink

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## ABSTRACT

Green tea is among the most consumed beverage worldwide. With increasing awareness regarding its health attributes, green tea has become a part of our daily diet. The unfermented green tea leaves retain most of its vital bioactive polyphenols (catechins), responsible for conferring multiple health benefits of consuming green tea. However, recent clinical studies have demonstrated several health complications associated with green tea consumption. In the present review, we have highlighted the health benefits and probable risks linked with green tea consumption and have proposed the possible measures to prevent the side effects of green tea. The experimental evidence based on published research articles have been examined to overview the possible detrimental effects of intake of green tea.

**Key words:** Green tea, Catechins, EGCG, Over-consumption, Health, Negative effects.

## Introduction

The “Green tea” is an extensively consumed beverage associated with miraculous health attributes. It is one of the types of tea derived from leaves of an evergreen angiosperm dicot plant *Camellia sinensis* (L.) Kuntze, which belongs to family Theaceae (Nawab and Farooq, 2015). Green tea not only captures the taste, aroma and colour of spring, but delivers its qualities along with highest concentration of beneficial polyphenols and least caffeine content. Green tea in its purest and most unadulterated form has greatly persuaded human health from generations (Anand *et al.*, 2015).

In our previous review, we have highlighted multiple health benefits associated with green tea Anand *et al.*, (2012). Also, there are plethora of scientific evidence, which have unveiled impressive health benefit allied to the beneficial anti-oxidant properties of green tea polyphenols (Zhao *et al.*, 2013; Gupta and Prakash, 2015; Vishnoi *et al.*, 2017).

The catechins particularly epigallocatechin gallate (EGCg), epigallocatechin (EGC), epicatechin (EC) and epicatechin gallate (ECG) confers green tea with high antimicrobial activity (Anand and Rai, 2017) anticancer activity (Kim *et al.*, 2014; Butt *et al.*, 2015; Miyata *et al.*, 2019). Besides, the catechins aids in burning fat (Ueda and Ashida, 2012; Yan *et al.*, 2013) curing oral health (Venkateshwara *et al.*, 2011; Gaur and Agnihotri, 2014), neurogenerative disorders (Schmidt *et al.*, 2014) protects renal damage (Yi *et al.*, 2017), diabetes (Yu *et al.*, 2017), cardio-vascular diseases (Lau *et al.*, 2018).

Although, green tea has emerged as a promising medicinal herb with miraculous health benefits, recent scientific studies have reported some dose dependent detrimental outcomes of green tea overconsumption. Therefore, in the present review, we have focused on highlighting some of the side effects linked with excessive intake of green tea.

## Renal and hepatic toxicity

The *in vivo* study has reported renal, gastrointestinal

and hepatotoxicity in animals subjected to green tea intake during fasting. The study also suggested probable development of similar symptoms in humans in case of green tea consumption during fasting (Wu *et al.*, 2011).

A frequent intake of green tea has been linked with hepatic toxicity and exacerbation of diabetes suggesting larger inter-individual variations in the green tea effect (Jae-Hyung *et al.*, 2014; Gabriela *et al.*, 2015; Park, 2018). Similarly, high dose of green tea polyphenols (up to 1%) has been reported to have association with renal and hepatic dysfunctions including increased kidney weight, serum creatinine levels, and thiobarbituric acid-reactive substances in mice (Inoue *et al.*, 2013).

### Hormonal imbalance

A study has reported a significant decrease in the level of basal testosterone levels (approximately 50%) in rat leydig cells treated with green tea extract (GTE) and polyphenols (-)-epigallocatechin-3-gallate (EGCG). However, it has been indicated that these low testosterone levels could be reversed by reducing the consumption of green tea (Figueiroa *et al.*, 2009).

Another study conducted at the University College of Science and Technology, Kolkata, India, revealed an impairment of functional status of testis in albino rats exposed to high doses of GTE. Their investigations have reported that consumption of GTE at mild concentration (equivalent to 5 cups of tea/day), moderate (identical to 10 cups of tea/day) and high (identical to 20 cups of tea/day) doses, for a period of 26 days, could alter the morphology and histology of testis and accessory sex organ (Chandra *et al.*, 2011). Undoubtedly, their study has raised serious health concerns over the detrimental effects of excess green tea consumption on the male reproductive functionality.

### Reduced growth and development

In a recent breakthrough, report from University of California suggested up-regulation of apoptosis and reduced development and reproduction of *Drosophila melanogaster* in response to high green tea dose (Lopez *et al.*, 2016). Although the present study does not clarify the adverse effect on humans, there investigations certainly demand a thorough investigation with respect to adverse effects of over consumption of green tea.

### Miscarriage or fetal abnormalities

It is also evident from several clinical investigations that a high level of green tea consumption during pregnancy has been linked to an increased risk of miscarriages and fetal growth restrictions. These studies have indicated that over 200mg of caffeine consumption during pregnancy is directly linked with reduced birth weights. The study also reported that caffeine is rapidly absorbed and freely cross the placenta. Since, cytochrome P450 1A2, the principal enzyme involved in caffeine metabolism is absent in the placenta and the fetus, caffeine is not neutralized from blood and reduces intervillous blood flow in placenta by 25% (Justin *et al.*, 2008; Ling *et al.*, 2014; Laelago *et al.*, 2018).

### Nutrition absorption interference

In a study conducted on young women aged 19–39 year, Samman *et al* have reported 25% reduction in absorption of non-heme iron in the presence of high GTE dose (Samman *et al.*, 2011). Based on their *in vivo* analysis, chelation of iron is considered to be the mechanism involved in reduction of nonheme-iron absorption in GTE presence. Similar study has demonstrated that EGCG prevents the basolateral iron export in *human* epithelial colorectal adenocarcinoma cells, and almost completely blocked the absorption of heme (Qianyi *et al.*, 2011).

Other notable negative effects of consuming large quantity of green tea include excessive urinations, dehydration and loss of electrolytes. Green tea, being a source of vitamin K can interfere with blood clotting and interfere with anticoagulants like Warfarin (Taylor and Wilt, 1999).

### Interaction with drugs and antibiotics

There are evidence which supports the efficacy of green tea in elevating the therapeutic potential of several drugs and antibiotics. However contradictory to their synergistic effect, scientific investigations have reported inhibitory potential of drugs/antibiotics in the presence of green tea. The interaction between green tea and antibiotics like amoxicillin has shown to selectively down regulate the mode of action of amoxicillin in MRSA infected mice model (Peng *et al.*, 2010).

Likewise, negative implications of green tea and antitumor drugs combinations have been reported in animal studies. These studies have discovered antagonistic effect of green tea catechins (EGCG)

against tumor cell death induced by antitumor drug like Bortezomib, Sunitinib and have also suggested their reduced bioavailability in the presence of green tea catechins (Golden, 2009; Jun *et al.*, 2011).

## Conclusion

Green tea is one of the most consumed beverages after water and it relishes millions of its consumers due to its multiple health benefits. However, with the persuasive epidemiological evidence, we cannot neglect the repercussion linked with the over consumption of green tea. In this review, we have drawn attention to the possible negative impact of green tea on human health. Thus, it is implicated that the current study will enable to understand the pros and cons related with green tea consumption.

Further, it is required to undergo thorough considerations and investigations to validate the detrimental effects of high green tea consumption. Also, the daily dose and intake directions of green tea in form of extracts, supplements or herbal drinks must be regulated by the food and health safety authorities. Considering the dose dependent health aspects of green tea, its patients should be recommended for consuming herbal and dietary supplement possibly under supervision of healthcare professionals.

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