

An Antioxidant Mystic Herb - Green Tea

Vijaya Lakshmi Mannepalli¹, V. Amaravati², P. Venkatesh³, D. Hepcy Kalarini⁴, R. Prema⁵

¹Student, Department of Pharmaceutics, Jagan's Institutions of Pharmaceutical sciences Nellore, India

²Assistant Professor, Dept. of Pharmaceutics, Jagan's Institutions of Pharmaceutical sciences Nellore, India

^{3,4}Professor, Department of Chemistry, Jagan's Institutions of Pharmaceutical sciences Nellore, India

⁵Professor, Department of Pharmaceutics, Jagan's Institutions of Pharmaceutical sciences Nellore, India

Abstract: It is worldwide accepted that green tea has a supernatural property to find against chronic diseases such as cancer and many more. It is one of the plant-based remedies whose possible benefits include cardi-vascular health, skin protectant and anti-oxidant activity, to fight high cholesterol levels, infection, impaired immune function, diarrhoea, fatigue etc. Green tea is produced from the *camellia sinensis* plant has provided to be the most popular beverages worldwide. The credit for their useful antioxidant property lies with their huge collection of chemical substances called polyphenols and catechins. It has been found to be superior to black tea in terms of health benefits. The major polyphenols in green tea are catechins, epicatechin (EC), epigallocatechin (EGC), epicatechin gallate (ECG) and epigallocatechin gallate (EGCG). Catechins have been found in other plant derivatives such as grapes, pomegranates, those found in tea have proven to be the most effective antioxidants. There is an urgent need to check the efficacy, safety and translation guidelines for a green tea to be used as a safe, effective drug. The main objective of this review shows the advantages of green tea for its calming, cancer prevention agent potential and oral human services.

Keywords: Polyphenols, monometric catechins, *camellia sinensis* and antioxidants.

1. History



Fig. 1. The history of green tea

The origination of green tea began in China tracing all the way back to 2737 B.C. The discovery occurred by accident when the Chinese Emperor Shennong mistakenly drank water that had a dead tea leaf boiled in it. Emperor Shennong found the flavor incredibly refreshing and thus, a new beverage was created. Green tea was primarily available to the highest tiers of Chinese society and was very expensive to purchase. It was not until the 14th century that green tea became accessible to the

general public for enjoyment and medicinal purposes. His book, "The Classic of Tea" became the first work to explain culture and art of green tea. The highly favoured green tea eventually travelled west in the 19th century by European explorers. The origin place of tea plant was estimated to be around Chinese Yunnan district Sealy (1958), but it is not confirmed yet. A wild type of the variety *Assamica* in *C. Sinensis* was discovered in India at 1835 and thereafter also in Thailand and Burma.

2. Introduction

Green tea is the nature's treasure to mankind. It is next to water as the most consumed beverage in the world. It is obtained from unfermented leaves of the plant *camellia sinensis* (L) Kuntze, which is an angiosperm dicot plant. It containing complex protein, carbohydrates, lipids, vitamins, flavonoids. The plant is an evergreen shrub which is native to southeast Asia. Its ancestry begins in China. Flavonoids are a group of phytochemicals which are responsible for health effects. They generally contain higher amounts of disease-fighting antioxidants called polyphenols. Polyphenols in green tea thought to be responsible for the cancer preventive effects observed in laboratory and epidemiological studies. Daily intake of polyphenols from green tea is high in some countries. Polyphenols additionally show to diminish the thermo-beginning and fortify fat oxidation, boosting the metabolic rate without expanding the heart rate. Tea is manufactured in four basic forms, green, white, oolong and black tea these all are comes from the leaves of *camellia sinensis* plant. Green tea has the highest concentration of polyphenols compared to other tea, including epigallocatechin gallate (EGCG) which might be green tea can induce apoptotic cell death in cancer better than other teas. The extraction of green tea polyphenols into tea is both depends on time and temperature. About three billion kilograms of tea is produced and consumed every year. Green tea is mainly consumed in Japan, China and India. Green tea not only captures the taste, colour of spring and aroma, but delivers its qualities along with the highest concentration of beneficial phytonutrients and the least caffeine of all the teas. Green tea also contains condensed and hydrolysable tannins. The catechins have been found to possess antiviral and antibacterial as well as anti-carcinogenic and anti-mutagenic properties. Green tea is in highest concentration of phenolic

compounds are Gallic Acid (GA), (-)- gallo catechin (GC), (+)- catechins (C), (-)- epicatechin (EC), (-)- epigallocatechin (EGC), (-)- epicatechin gallate (ECG), (-)- epigallocatechin gallate (EGCG). Over the last years, numerous epidemiological and clinical studies have revealed several physiological responses to green tea which may be relevant to the promotion of health and the prevention or treatment of some chronic diseases. Green tea polyphenols such as EGCG inhibit cell viability and induce apoptosis in a number of cancer cell lines such as osteogenic sarcoma, lymphoblastoid cells, leukemia cells, melanoma cells, T lymphocytes, and larynx carcinoma. It also can reduce inflammation in the colon, causing a decrease in oxidative and inflammatory markers in a colitis rat model. The active constituent of tea varies with climate, season, variety, horticultural practices and the age of the Green tea leaves are heated soon after harvesting so that enzymatic activity is stopped in order to retain the majority of catechin flavonoids and its green colour. Green tea is used as a hot or cold beverage. It is an evergreen shrub that can be grow up to the heights of 30 feet but is usually pruned to 2- 5 feet for cultivation.

Botanical Classification of Green Tea:

Table 1

Kingdom	Plantae – Plants
Subkingdom	Tracheobionta – Vascular plants
Superdivision	Spermatophyta – Seed plants
Division	Magnoliophyta – Flowering plants
Class	Magnoliopsida – Dicotyledons
Subclass	Dilleniidae
Order	Theales
Family	Theaceae – Tea family
Genus	Camellia L. – camellia
Species	Camellia sinensis (L.) Kuntze - tea

Green Tea Processing:

- Green Tea known as unfermented tea is a popular beverage in the world.
- Green tea is also recognized as herbal medicine.
- The more important of green tea is the flavor and smell.
- Chlorophyll content of green tea is around 1.2 – 1.5 mg/gm of a tea leaves.
- The tea industry is one of the oldest organized industries in India with a large network of tea producers, retailers, distributors, auctioneers, exporters and packers.
- Tea is globally one of the most popular and cheapest beverages with major production centres in India, China, Kenya, Sri Lanka, Turkey and Vietnam.
- The global productivity during 1991 was 1026 kg/ha which climbed to mere 1100 kg/ha in 2000. In the first decade of the 21st century, global tea productivity hovered between 1100-1160 kg/ha.
- On an average, during the last two decades in the

production front, India contributed 28% of the world tea production closely followed by China (25%), Sri Lanka (9%), - being green tea producer and Kenya (9%) - ctc producer. 23 % of the world tea is produced by other countries.

- On an average during the last two decades, in the export front, both Kenya and Sri Lanka lead the world each with 20% of their contribution followed by China (17%), India (14%) and others (25%).

Chemistry of Green Tea:

Table 2

Contents	% Dry Weight
Proteins	15-20
Amino acids	1-4
Fiber	26
Carbohydrates	7
Lipids	7
Pigments	2
Minerals	5
Phenolic Compounds	30
Oxidized Phenolic Compounds	0

On the basis of the production process, tea may be categorized into 4 types: fermented (black tea), semi-fermented or partly fermented (oolong tea), post-fermented (pu-erh), and non-fermented (white, yellow, and green tea).



Fig. 2. General Processing of Green Tea

Cultivation:



Indigenous to East Asia, South East Asia and Indian sub-

continent, *Camellia sinensis* is cultivated today in tropical and subtropical regions throughout the world. The tea plant thrives in sunny climates where the temperatures are hot and rain is regular and plentiful, with a growing season that stretches for at least eight months of the year. The spring shoots grow from the end of March to the beginning of May when the plant is most bountiful. From early June to the beginning of July the second growing stage takes place and the season comes to an end with final flush of growth occur in from mid-July to October. Tea is reported to tolerate an annual precipitation of 70 to 310 cms, an average annual temperature range of 14 to 27 °C and a pH in the range of 4.5 to 7.3.

Plucking:



This is the process of harvesting green tea leaves from the tea plants. Tea flushes consist of a terminal bud along with two young leaves. The tea flushes along with tea leaves are hand-picked twice a year. It is divided into three groups : Imperial greater than bud plus one leaf, Fine greater than bud plus two leaves and Course greater than bud plus three or more leaves. Hand picking is the best method for plucking though in some cases machines may also be used for the same process. When machines are used there are more broken leaves than while leaves which reduce the quality of tea. Time of plucking is mostly in early spring and early summer but depends on the location as well. After plucking, tea leaves undergo withering. Withering is the process which is done to remove moisture and soften the leaves.

A. Deactivation of Enzymes

In this process of enzyme deactivation the tea leaves are steamed so that enzymatic degradation will be stopped. The goal is to heat the tea to stop fermentation. If fermentation is not completely stopped, that tea liquor will be red. In some countries the boiling water is also used de-enzyming.

Fixation:

Fixing process is also known as ‘Kill-Green’ because it is the step in which controlled browning of leaves happens through the application of heat. In this way, enzymatic oxidation of tea polyphenols is prevented as well as unnecessary changes of leaf inclusions. The other steps in fixing involve steaming, pan-frying, baking and other forms of heating. While fixing tea leaves will soften for a good rolling, while the moisture content

is reduced and the fragrance fixed. For instance, pan-fired teas have a more toasted taste while the steam heated teas have a more vegetal flavor. This step deactivates their oxidative enzymes and also removes unwanted scents without damaging the flavor of tea. After fixation, the leaves should be spread in thin layers on clean spaces for natural or forced cooling.

Rolling:



Rolling is a crucial step for shaping the appearance. Rolling or twisting of tea leaves is performed by both manually and machines. This is the process that gives the tea leaves the tight shaped form in which we see them in the final state. Tea should look brightly green instead of yellowish and they should smell fragrant instead of stuffy. The procedure involves gentle rolling of leaves to enable it to take forms such as wiry, kneaded, spirals or tight pellets. The tea leaf quantity, time and pressure, are major technical factors during rolling. The rolling process causes certain sap, essential oils and juices to squeeze out of the tea leaves which further intensify the flavor. They are usually rolled tightly to retain their freshness. This involves two major types of processing: orthodox and cut-tear-curl (CTC).

Drying:

It involves few types of drying process:

1. Traditional drying
2. Conventional drying
3. Microwave drying
4. Infra-red drying
5. Hybrid drying

1) Traditional drying

Some types of drying involved in these traditional drying they are:

Sun drying, Shade drying, Conduction drying, Rotary drum dryers.

Sun drying:



- Moisture is reduced upto 4-6 %
- This is the same thing that most civilizations have done with their food since before written history : laying down the produced to dry under the sun for preserving to use later. Tea was not any exception. Since prehistory, the chinese has had an especially strong heritage of the use of dried plant materials and tea begin as one of the medicinal herbs.

Shade drying:

- In these method of drying the green tea leaves are kept away from direct contact of sun to avoid loss of overall quality by providing required amount of heat from the sun.



Conduction drying:

- In these types of drying the tea leaves are dried by directly roasting on the heated metal or non-metal surface.
- This is heating of green tea leaves on the metal plate above fire.
- These parameters which controls the drying phenomena are temperature, time and amount of green tea leaves to dry.
- The final quality obtained by this drying method has darker color and low sensory attributes.

Rotary drum dryers:

- These are one of the dryers which are used in tea drying for small scale production of green tea.
- Controlling parameters for drum dryers are drum rotation speed, drum internal temperature and processing time.

Conventional drying:

- In this method of drying the green tea leaves are dried by using heated air with different arrangements of drying section.
- This includes cross flow, concurrent, circulatory and forced circulatory etc...
- The controlling parameters are air inlet and exhaust temperature, drying time, feed rate.
- There are two types of conventional drying:

- ✓ Conventional air dryer
- ✓ Fluidized bed dryer

Microwave drying

- Microwave drying is a relatively new drying method.
- The fundamental mechanism of microwave heating is the agitation of polar molecules which oscillate under the influence of an oscillating electric and magnetic field.
- Microwave energy deposition in the dielectric loss mode of heating can cause spatially uniform heating.
- Microwave energy is transported as an electromagnetic wave in certain frequency bands in the range between about 0.3GHz and 300GHz.
- When applying microwave energy to tea, water and other polar molecules of tea are induced for simultaneous high-speed rotation due to microwave irradiation, leading to the surface and interior heating at the same time, and resulting in a large no of water molecules from the tea (Lou,2002).
- The key advantage of microwave heating over conventional heating method is the nature of fast internal heating by microwave energy.
- The major food components- water, carbohydrates, lipids, proteins, and salts (Minerals) - interact differently with microwave.

Infra-red drying:

- Uniform heating of green tea leaves.
- Infrared radiant heat transfer is often more efficient than convective heat transfer large amount of controlled heat for heating tea leaves.
- It takes about one minute in heating and 60 degree centigrade.
- 15-20 minutes reduce mc upto 2% (if layer thickness is around 5-10 cms).



Different types of tea processing

The different types are categorised by the level of oxidation or fermentation that takes place during the processing of the leaves and buds with white tea being the least oxidised and

black being the most. Oxidation is what happens, when the juices in the tea leaves react with oxygen in the air around them. As this happens, the leaves turn from green to brown. For instance, if you cut an apple or a pear and watch the flesh of the fruits turn white to brown as it oxidises. The longer the leaves allowed to oxidized the browner they will become and when the tea is brewed, the darker the liquor will be.

White Tea: White tea always go through very light natural oxidation. The finest white tea are picked early in the spring before the leaf buds have opened and whilst they are still covered with silky white hair. When we make white tea try not to cause any oxidation to take place and so it is really important that the pickers use the utmost care to avoid damaging the cells of the leaves and buds. It is totally natural process making white tea the purest of all teas.

Yellow Tea: Yellow tea go through a light oxidation stage to mellow and smooth flavour. To make yellow tea the leaves are panned to the-enzyme them, then while still warm and damp, they are wrapped are heaped and left for two to three days and so it continuously panned and wrapped for three to four days. Then they are panned for a third time to remove most of the remaining water in the leaves.

Green Tea: Amongst all types of tea, green tea is the richest in the catechins. Green tea is not oxidised at all, we intervene during process to stop any oxidation. When we make green tea, we try to capture the green color and the green character of the leaves. So we must stop all natural oxidation from taking place in the leaves and leaf buds. This is done by applying heat (dry heat, called panning or steam) which kill the enzymes that would otherwise have allowed oxidation to take place. This application of heat is called 'De-enzyming the leaf' or 'Fixing the green'.

In chinese green tea, dry heating is employed in order to deactivate oxidase.

In Japanese green tea, steaming is employed to deactivate oxidase. This variety of green tea is typically shadow grown, and it contains a lower content of catechins and more amino acids compared to Chin

Oolong Tea: 'oolong' means 'Black dragon' and the name comes from traditional oolongs which have large twisted dark brown or black leaves that can look exactly like dragons or serpents. It is the most complicated tea to produce requiring great skill, experience and time to create a range of flavours, fragrances and liquor colors that make this tea so special. There are two main types of oolong:

- Dark brown open-leafed oolongs
- Green balled oolongs

Black Tea: Black tea are 100% oxidised. This makes oxidation happen by breaking or cutting the tea leaves. There are two different methods of rupturing the leaf cells.

- Orthodox
- CTC [Cut, Tear, Curl]

The 'Orthodox' method is the traditional way in which tea is

rolled by hand or machine. This rolling breaks and twists the leaf, rupturing the cells and causing the juices to come to the surface and react with oxygen. This style of manufacture gives large, medium and very small pieces of leaf.

The 'CTC' [Cut,Tear,Curl] method was invented in the year 1930's to make small particles of tea for tea bags. Smaller particles brew faster and give greater color and strength more quickly and so are perfect to put inside paper tea bags.

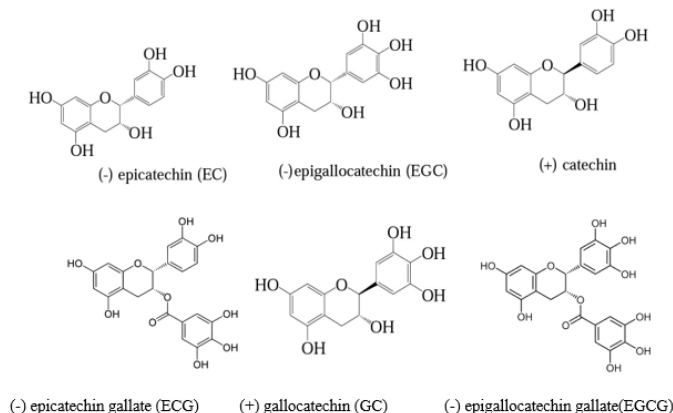
Medicinal value of green tea:

The use of herbs is as old as mankind and people used them as medicine, cosmetic and for cooking for thousands of years. Ancient cultures wrote plentiful use of herbs, which included flowers, leaves, trees and bark, that are used for improving the taste of food, making medicines or herbal tea. One of the most popular and long-term use of herbs is the making of herbal tea. Herbal teas have a long history of helping people to stay healthy. Green tea consumption has been linked to the prevention of many types of cancer, including lung, colon, esophagus, mouth, stomach, small intestine, kidney, pancreas and mammary glands. Archaeological studies also report that herbal concoctions have been used to indulge bodily grievances many years before the writing of history. Around history, herbs have had their place in every civilization in the world, with their usage changes very little as the centuries passed. Several epidemiological studies and clinical trials have shown that green tea (and black and oolong teas to a lesser extent) may reduce the risk of many chronic diseases. Before the 18th century, when most people where living on farms, infusion of wintergreen, willow or birch were prepared from nearby growing herbs to calm down someone's pain. Nowadays people are having knowledge with herbs and this tradition continues in 80% of the world and they are rediscovering blessings of whole herbal medicines used overall generations. Green tea catechins also act as antitumorigenic agents and as immune modulators in immuno dysfunction caused transplanted tumors are by carcinogen treatment. Some animal studies suggested that green tea might protect against the development of coronary heart disease by reducing glucose levels in the blood and body weight. Some studies indicated that green tea has an antiproliferative activity on hepatoma cells and hypolipidemic activity in hepatoma-treated rats, as well as prevention of hepatotoxicity and as a preventive agent against mammary cancer post-initiation. All these studies are based on middle-aged animal's populations, not the elderly influenced by age-related biological and socioeconomic factors.

Chemical Composition:

Green tea contains polyphenols, which include flavanols, flavanoids, flavonoids and phenolic acids; these compounds may account for upto 30% of the dry weight. The major flavonoid of green tea are various catechins, which are found in greater amounts in green tea than black or oolong tea. Most of the green tea polyphenols are flavanols, commonly known as catechins. Products which derived from green tea are namely

extracts of green tea in liquid or powder form that vary in the proportion of polyphenols (45-90 %) and caffeine content (0.4-10%). There are four kinds of catechins in green tea: epicatechin, epigallocatechin, epicatechin-3-gallate and EGCG.



Health Benefits:

Green tea has been used in traditional Indian and Chinese medicine. In recent years, it has also gained popularity as a health drink. It can be enjoyed hot, cold or even in powder form, and its recognized for its high antioxidant content and health benefits. Green tea is loaded with nutrients and plant compounds that can have positive health effects. In fact, multiple studies show that people who drink green tea are significantly less likely to get many types of cancer, compared to those who don't drink it.

- The cancers that green tea may help protect against include prostate and breast cancer which are the two most common cancers in men and women, respectively.
- Some of the studies have shown the positive impacts of green tea on cancer types are: Breast, Bladder, Ovarian, Lung, Prostate, Colorectal (Bowel), Skin, Stomach.
- Green tea may lower your risk of developing type 2 diabetes and heart disease.
- The caffeine and catechins it contains have been shown to boost your metabolism and increase fat burning and fights obesity.
- Green may even help you lose weight.
- Prevents nerve degeneration in parkinson's and alzheimer's disease.
- It proves healthier for hair growth.
- Protects eyes and effective in skin damages.
- Suppress platelet aggregation and prevents thrombosis heart attacks and brain strokes.
- Improves glucose tolerance and insulin sensitivity.
- Decreases inflammatory disorders like Rheumatoid arthritis and osteoarthritis.
- Promotes healthy teeth and gums.
- Promotes a healthy sleep.

- It works as a powerful antioxidant.
- Some studies show health benefits in people who drink as little as one cup per day, while other studies deem five or more cups per day to be optimal.
- One thing most studies have found is that green tea drinkers are in better health than those who do not drink at all.

Side Effects:

The caffeine and catechins in green tea are well known for their health benefits, but they can also cause side effects for some people, especially in large doses.

- Caffeine affects: Those with severe caffeine sensitivities can increase feelings of anxiety, insomnia, irritability, nausea, or stomach upset and headaches in some people.
- Reduce the absorption of iron: Make liver disease worse.
- Osteoporosis: can increase the amount of calcium, essential for bone health, which gets flushed out in the urine.
- Diabetes: consumption might affect blood sugar control.
- High blood pressure: can increase blood pressure in people with high blood pressure.
- Irritable bowel syndrome (IBS): can worsen diarrhea and symptoms of IBS.
- In particular, pregnant or breastfeeding women, those with heart problems, high blood pressure, kidney or liver problems, stomach ulcers or anxiety disorders should not take green supplements.

3. Units

Green tea is consumed all around the world in different structures. At present, there has been an expanded intrigue all-inclusive to distinguish cancer prevention agent possibilities of green tea which is pharmacologically intense and have low or no side effects for use in defensive solution and the sustenance industry. This has succeeded in fetching the consistent interest of people toward the health benefits associated with this herbal gift of nature to mankind. From antibacterial to antifungal, antiviral potentials, from skin, vision, hair loss, overweight issues, diabetes, kidney disorders, to parkinson's and Alzheimer's disease, cancer and many more, green tea has proved its potential and still many parameters are still need to be explored. It is not surprising that day by day green tea and its products are capturing the global market and its use has also increased incredibly. It is very important to have future research with frequent epidemiological studies and to conduct human trials which can further explore hidden credentials of green tea and confirm their actual magnitude of potential for humans. Definitely, these findings are promising, but many of these properties of green tea have been revealed through several animal trials and human clinical evidence is lacking on their

behalf. It is essential to study the safe dose of green tea consumption to acquire their health benefits and to have a better understanding of their mode of action. Thus, there is an urgent need to check the efficacy, safety and translational guidelines for a green tea to be used as a safe, effective drug. This article shows the advantages of green tea for its calming, cancer prevention agent potential and oral human services.

References

- [1] Ahmed S, Marotte H, Kwan K, Ruth J.H, Campbell P.L, Rabquer B.J et al (2008); Epigallocatechin-3-gallate inhibits IL-6 synthesis and suppresses transsignaling by enhancing soluble gp130 production; Proceedings of the National Academy of Sciences; 105(38); 14692–14697.
- [2] Awadalla H.I, Ragab M.H, Bassuoni M.W, Fayed M.T, Abbas M.O (2011); A pilot study of the role of green tea use on oral health; International Journal of Dental Hygiene; 9(2); 110–116.
- [3] Baptista JAB, Tavares JFD, Carvalho RCB. Comparison of catechins and aromas among different green teas using HPLC/SPME-GC. Food Res Int. 1998; 31:729–736.
- [4] Lin YS, Tsai YJ, Tsay JS, Lin JK. Factors affecting the levels of tea polyphenols and caffeine in tea leaves. J Agric Food Chem. 2003; 51:1864–1873.
- [5] Long LH, Lan ANB, Hsuan FTY, Halliwell B. Generation of hydrogen peroxide by "antioxidant" beverages and the effect of milk addition. Is cocoa the best beverage? Free Radic Res. 1999; 31:67–71.
- [6] Azam S, Hadi N, Khan NU, Hadi SM. Prooxidant property of green tea polyphenols epicatechin and epigallocatechin-3-gallate: implications for anticancer properties. Toxicol Vitro. 2004; 18:555–561.
- [7] Kavanagh KT, Hafer LJ, Kim DW, Mann KK, Sherr DH, Rogers AE, Sonenshein GE. Green tea extracts decrease carcinogen-induced mammary tumor burden in rats and rate of breast cancer cell proliferation in culture. J Cell Biochem. 2001; 82:387–398.
- [8] Zhou B, Pan J, Dai F, Zhao CY, Zhang LP, Wei QY, Yang L, Zheng RL, Liu ZL. Redifferentiation of human hepatoma cells induced by green tea polyphenols. Res Chem Intermed. 2004; 30:627–636.
- [9] Kuroiwa Y, Ishii Y, Umemura T, Kanki K, Mitsumori K, Nishikawa A, Nakazawa H, Hirose M. Combined treatment with green tea catechins and sodium nitrite selectively promotes rat forestomach carcinogenesis after initiation with N-methyl-N'-nitro-N-nitrosoguanidine. Cancer Sci. 2007; 98:949–957.
- [10] Yamamoto T, Hsu S, Lewis J, Wataha J, Dickinson D, Singh B, Bollag WB, Lockwood P, Ueta E, Osaki T, Schuster G. Green tea polyphenol causes differential oxidative environments in tumor versus normal epithelial cells. J Pharmacol Exp Ther. 2003; 307:230–236.
- [11] Yang JY, Wei DZ, Liu JW. Repressions of MMP-9 expression and NF-kappa B localization are involved in inhibition of lung carcinoma 95-D cell invasion by (-)-epigallocatechin-3-gallate. Biomed Pharmacother. 2005; 59:98–103.
- [12] Benzie IFF, Szeto YT, Strain JJ, Tomlinson B. Consumption of green tea causes rapid increase in plasma antioxidant power in humans. Nutr Cancer. 1999; 34:83–87.
- [13] Young JF, Dragsted LO, Haraldsdottir J, Daneshvar B, Kall MA, Loft S, Nilsson L, Nielsen SE, Mayer B, Skibsted LH, Huynh-Ba T, Hermetter A, Sandstrom B. Green tea extract only affects markers of oxidative status postprandially: lasting antioxidant effect of flavonoid-free diet. Br J Nutr. 2002; 87:343–355.
- [14] Katiyar SK, Matsui MS, Elmets CA, Mukhtar H. Polyphenolic antioxidant (-)-epigallocatechin-3-gallate from green tea reduces UVB-induced inflammatory responses and infiltration of leukocytes in human skin. Photochem Photobiol. 1999; 69:148–153.
- [15] Malik A, Azam S, Hadi N, Hadi SM. DNA degradation by water extract of green tea in the presence of copper ions: Implications for anticancer properties. Phytother Res. 2003; 17:358–363.