

Green Tea in Health Care: A Natural Medicine, A Natural Drink

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Abstract: All over the world tea is now-a-days very popular drink. But green tea from the various viewpoints acts as natural medicine. It is due to the presence of flavonols type compounds like epigallocatechingallate (EGCG), catechin (C), epicatechin (EC), epicatechingallate (ECG), epigallocatechin (EGC). EGCG plays a great role in minimizing many physiological disorders like atherosclerosis, hypertension, diabetes mellitus, obesity and even cancer. It's a review to give an impact for having such green teas in every day life.

Key words: Epigallocatechingallate, catechin, epicatechin, epigallocatechin, flavonols

INTRODUCTION

All we are very familiar to tea and most of the people are habituated to take tea everyday. Tea is a beverage consumed in the entire world due to its aroma, taste and psycho stimulant effect. However now a days many people are reluctant due to its some backward effects for example elevation of high blood pressure in hypertensive patients, abdominal discomfort increasing gastric secretion, making complex with protein type food and so on. Especially these problems are very related with the black or red tea those are originated from Southeast Asia. Tea plants (*Camellia sinensis*) are widely cultivated in over 30 countries and are significant in their economies. China, Japan, Taiwan, India, Bangladesh, Sri Lanka and Indonesia of Southeast Asia and also some central African countries like Kenya are famous for tea production. Nowadays hundred of teas are produced. Commercially teas can be classified into three categories: the non-fermented green teas, the partially fermented oolong or paochong teas and the fully fermented black and pu-erh (red) teas. In Japan green teas are very famous and one cannot think a day without green tea (O-cha). It is also called as ryoku cha.

Here a brief discussion about green teas was outlined in health care sector as a natural medicine as well as a natural drink.

Source and constituents of green tea: Many factors can constitute important influences on the composition of tea, such as species, season, age of the leaves (plucking position), climate and horticulture conditions (soil, water, minerals, fertilizers, etc.). Green teas (sen-cha, ma-cha) have found catechin (c), epicatechin (EC), epicatechingallate (ECG), epigallocatechin (EGC), epigallocatechingallate (EGCG) and caffeine (CAF) present. These compounds are known to have antioxidant

behavior and are possibly beneficial to health. Among these caffeine is psycho stimulant and gives ones afresh, while bored or exhausted. Caffeine, theophylline and theobromine are the main methylxanthines constituting tea alkaloids, being an important factor in the quality of teas. The total polyphenol content of green tea on a dry weight basis may be 25-35%. The vitamin C content of green tea is similar to that of lemon, but most of this is lost during fermentation in production of black tea^[1]. Tea also contains minerals and trace elements such as K, Mn, Cr, Ni and Zn, which are essential to human health because most of these acts as catalyst in biochemical pathways.

The EGCG varies in concentration from zone to zone (Table 1) containing its concentrations (% w/w dry basis) along with all other important compositions of almost all teas in the world^[2]. In the table, the EGCG and caffeine vary from zone to zone. Green teas from all origin are rich in EGCG especially Japan and china (gunpowder) species. Indian (Assam) species has got high in caffeine content rather than EGCG but the species of India (Darjeeling). These teas are rich in both caffeine and EGCG.

Processing of Green Tea: There are several major categories of tea, which are distinguished by different processing methods and, consequently, different concentrations of specific tea polyphenols. Fresh tea leaves are rich in polyphenolic compounds known as catechins. When tea leaves are intentionally broken or rolled during processing, catechins become oxidized through the action of polyphenoloxidase enzymes present in the tea leaves. The oxidation of catechins, known as fermentation in the tea industry, causes them to polymerize and to form larger, more complex polyphenols known as theaflavins and thearubigins^[3].

Green tea is made from the sweetest, newest buds and tips at the top of the plant and the best varieties are

Table 1: Constituents of green teas with their geographical sources^[2].

Origin	Class	GA	TB	TP	EGC	C	CAF	EC	EGCG	ECG
China (Fujian)	Black	0.14-0.32	0.05-0.1	0.004	0.406	0.07-0.23	2.95-3.9	0.06-0.42	0.34-1.62	0.19-0.76
China (Gunpowder)	Green	0.07-0.16	0.05-0.2	Nd	0.16-4.28	0.09-0.56	2.22-3.87	0.74-2.16	4.94-10.2	0.92-3.56
Japan	Green	0.004-0.08	0.002-0.08	Nd	3.68-6.52	0.08-0.36	1.47-2.9	0.81-1.22	5.69-7.53	0.91-1.38
Kenya	Black	0.19-0.3	0.196-0.25	0.04-0.05	0.18-0.32	0.18-0.24	3.7-4.47	0.19-0.41	1.07-1.69	0.51-0.81
India (Assam)	Black	0.15-0.35	0.25-0.46	0.02-0.03	0.187	0.07-0.11	4.07-4.86	0.01-0.07	0.49-0.94	0.26-0.47
India (Darjeeling)	Black	0.23-0.36	0.11-0.19	0.03	0.27-1.1	0.15-0.47	3.74-4.23	0.18-0.51	2.28-8.23	0.98-2.43
Sri Lanka (Ceylon)	Black	0.19-0.28	0.1-0.22	0.03-0.04	0.32-2.96	0.14-0.26	3.36-4.03	0.16-1.74	0.522-4.81	0.61-1.81
China (Pu-erh, Yunnan)	Red	0.1-2.54	0.12-0.3	0.04-0.05	0.15-1.07	0.04-0.32	2.42-3.86	0.09-0.97	0.06-0.38	0.06-0.28

(GA, gallic acid; TB, theobromine; TP, theophylline; EGC, epigallocatechin; C, Catechin, CAF, caffeine; EC, epicatechin; EGCG, epigallocatechin gallate; ECG, epicatechin gallate; Nd, not detected)

only harvested in the spring. Green tea is not fermented (or oxidized - exposed to air), but is fired in pans and completely dried whilst fresh, which produces the leaf's green color and the tea's distinct, vegetable taste. During the processing of black teas, tea leaves are rolled and allowed to oxidize or ferment fully, resulting in high concentrations of theaflavins and thearubigins and relatively low catechin concentrations. Oolong teas are only partially fermented—they are allowed to oxidize for shorter periods than black teas. Consequently, oolong teas fall between green and black teas with respect to their catechin concentrations. Since different categories of tea contain different amounts of catechins, theaflavins and thearubigins, it is important to distinguish between the consumption of different categories of tea when examining studies of tea consumption and chronic disease risk.

EGCG and other flavonols in various diseases: It has been reported that tea flavonols were the most powerful natural antioxidants; the antioxidant activity of epigallocatechin gallate (EGCG) was 20 times that of ascorbic acid. An in-vitro model for lipoprotein oxidation simulated the oxidation of low-density lipoproteins, which is associated with atherosclerosis^[4].

Increased consumption of green tea was associated with decreased serum concentrations of total cholesterol and triglyceride, an increase in the proportion of high-density-lipoprotein cholesterol and a decreased proportion of low and very-low-density-lipoprotein cholesterol, producing a decreased atherogenic index. Decreased concentration of hepatological markers in serum were also related to increased consumption of green tea^[5].

There is increasing interest in the health benefits of green tea. Chemistry of green tea considers the nutritional and pharmacological effects to green tea polyphenols. It was claimed that health benefits of green tea included reduction in dental caries, lowering of blood pressure, antioxidant activity, anticarcinogenic effects and reduction of radiation-induced injury (findings from a mouse study are reported)¹. Low levels of isoflavonoids

in green tea were found in protecting against diseases such as coronary heart disease and cancer is discussed^[6].

Recently it had been reported that epigallocatechin gallate (EGCG), a major component of Japanese green tea, significantly had increased the survival rate of paraquat (Pq) poisoned mice^[7]. Fujiki, H. *et al.*^[8] reported green tea and (-)-epigallocatechin gallate (EGCG) were now acknowledged cancer preventives in Japan and had made it possible for them to establish the concept of a cancer preventive beverage⁸. For the general population, they recommended 10 cups of green tea daily supplemented with green tea tablets. An approach to develop green tea capsules as a cancer preventive drug in the US is discussed, aiming at taking full advantage of this cancer preventive beverage.

Green tea which is widely consumed in China, Japan and India, contains polyphenolic compounds, which account for 30% of the dry wt. of the leaves. Most of the polyphenols are flavanols, of which (-)-epigallocatechin-3-gallate (EGCG) is most abundant. Epidemiological studies revealed that the incidences of stomach and prostate cancers are the lowest in the world among a population that consumes green tea on a regular basis. It has also been reported that the quantity of green tea consumed, plays an important role in reducing cancer risk and in delaying cancer outbreak and recurrence.

It has been shown that green tea and its active components interfere with signal transduction pathways. Thus the activities of various protein kinases are inhibited, the expression of nuclear proto-oncogenes declines and the activity of ornithine decarboxylase (ODC) is reduced. ODC, which catalyzes the rate-limiting step in the biosynthesis of polyamines is closely linked with cellular proliferation and carcinogenesis^[9].

The effects of green tea and EGCG were tested by Fassina *et al.* in a highly vascular Kaposi's Sarcoma (KS) tumor model and on endothelial cells in a panel of in vivo and in vitro assays¹⁰. EGCG inhibited KS-IMM cell growth and endothelial cell growth, chemotaxis and invasion over a range of doses; high concentrations also induced tumor cell apoptosis. EGCG inhibited the

metalloprotease-mediated gelatinolytic activity produced by endothelial cell supernatants and the formation of new capillary-like structures in vitro. Green tea or purified EGCG when administered to mice in the drinking water inhibited angiogenesis in vivo in the Matrigel sponge model and restrained KS tumor growth. Histological analysis of the tumors were consistent with an anti-angiogenic activity of EGCG and green tea. These data suggest that the green tea gallate or its derivatives may find use in the prevention and treatment of vascular tumors in a chemoprevention or adjuvant setting. Liao J. et al. reported that inhibition of angiogenesis and the induction of apoptosis by green tea may be closely related to the inhibition of pulmonary carcinogenesis¹¹.

Catechins compounds derived from green tea, have been shown to reduce plasma cholesterol levels and the rate of cholesterol absorption¹². They investigated the dose response and the mechanism of action of epigallocatechin gallate (EGCG) on these parameters in rats. Wistar rats were fed a diet containing high cholesterol and fat, containing neither of these, 0.25% (0.2 g/day/kg BW), 0.5% (0.4 g/day/kg/BW) or 1.0% (0.7 g/day/kg BW) of EGCG. After 4 wk of treatment, total cholesterol and low-density lipoprotein levels were significantly reduced in the group fed 1% EGCG when compared to the no treatment group.

An aqueous solution of green tea polyphenols (GTP) was found to inhibit lipid peroxidation (LP), scavenge hydroxyl and superoxide radicals in vitro¹³. The concentration needed for 50% inhibition of superoxide, hydroxyl and LP radicals were 10, 52.5 and 136 mg/mL, respectively. Administration of GTP (500 mg/kg b. wt.) to normal rats increased glucose tolerance significantly ($P < 0.005$) at 60 min. GTP was also found to reduce serum glucose level in alloxan diabetic rats significantly at a dose level of 100mg/kg body weight. Continued daily administration (15 days) of 50, 100 mg/kg b. wt. produced 29 and 44% reduction in the elevated serum glucose level produced by alloxan administration. Elevated hepatic and renal enzymes produced by alloxan, were reduced ($P < 0.001$) by GTP administration. Green tea promoted glucose metabolism in healthy human volunteers at 1.5 g/body in oral glucose tolerance tests. It also lowered blood glucose levels in diabetic db+/db+ mice and streptozotocin-diabetic mice 2-6 h after administration at 300 mg/kg without affecting serum insulin level, whereas no effect was observed in control mice (+m/+m and normal ddY mice)¹⁴.

Black, green and oolong teas but not herbal teas, which are not teas in the traditional sense because they do not contain leaves of *Camellia sinensis*, were all shown to increase insulin activity¹⁵. High-performance liquid chromatography fractionation of tea extracts utilizing a Water Symmetry Prep C18 column showed that the majority of the insulin-enhancing activity for green and oolong teas was due to epigallocatechin gallate (EGCG).

For black tea, the activity was present in several regions of the chromatogram corresponding to, in addition to epigallocatechin gallate, tannins, theaflavins and other undefined compounds. Several known compounds found in tea were shown to enhance insulin with the greatest activity due to epigallocatechin gallate followed by epicatechin gallate, tannins and theaflavins. Caffeine, catechin and epicatechin displayed insignificant insulin-enhancing activities. Addition of lemon to the tea did not affect the insulin-enhancing activity. Addition of 5 g of 2% milk per cup decreased the insulin-enhancing activity one-third and addition of 50 g of milk per cup decreased the insulin-enhancing activity approx. 90%. Nondairy creamers and soybean-milk also decreased the insulin-enhancing activity. These data demonstrate that tea contains in vitro insulin-enhancing activity and the predominant active ingredient is epigallocatechin gallate (EGCG).

Conclusion: In conclusion it could be said that green teas are all enrich in EGCG and many patients of recently suffering from above unexpected diseases can be treated with EGCG or green tea as addition. Green tea also acts as a quality healthy drink as it lowers cholesterol, triglycerides, LDL and also the blood sugar, providing refreshing-effect while exhausted. Black tea of only India (Darjeeling) origin might be treated a very good quality tea in Asia Sub-continental zone. In the days ahead, people of south-east Asia may produce green teas in large scale through Pan-fire followed by freeze-drying process, without damaging the vital constituents like EGCG and thereby make practice for having green teas everyday.

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