**Green Tea**

**New Uses for An Old Medicine**

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**Part I: Green Tea — Introduction**

Green tea, as the dry leaves from the tea plant, *Camellia sinensis*, is best known as a component of the traditional Japanese diet, served as small 100 ml cups of tea. Green tea is a rich source of antioxidant flavonoids, in particular the category of flavonoids called catechins.[1, 2] Recently, green tea has received attention for its possible anticancer effects, as well as for more novel uses, including antiviral effects and anti-inflammatory effects. This series of articles will discuss the spectrum of therapeutic usage that is being studied for green tea.

Green tea has been brewed for over 50 centuries, or 5,000 years.[3] Green tea is produced from fresh leaves of the tea plant that are steamed and dried to prevent fermentation, as opposed to black tea, which is fermented.[3] According to Khan, a typical green tea beverage is prepared in a proportion of 1 g of dry leaf to 100 ml water in a 3 min brew.[3] This usually contains 250–350 mg tea solids, including 30–42% catechins (80–150 mg) and 3–6% caffeine (7.5–21.0 mg).[3] For some, even this small amount of caffeine may result in symptoms of overstimulation, such as headache, anxiety, and insomnia; for these persons, decaffeinated green tea or green tea extract (GTE) may offer the health benefits of green tea without the side effects.

Green tea contains four major catechins, including epigallocatechin gallate (EGCG), epigallocatechin (EGC), epicatechin gallate (ECG), and epicatechin (EC), which are polyphenolic in structure, as well as a small amount of caffeine.[1, 2] These catechins account for up to 30–40% of the dry weight of green tea leaves.[2] As polyphenols, they possess potent antioxidant effects, scavenging free radicals, and protecting normal cells from damage.[2] They have also been shown to have antitumor effects, resulting in the death of cancer cells when cancer cells are exposed to catechins in a lab setting (in vitro).[1]
New evidence is showing that green tea catechins may also have antiviral effects including activity against human papilloma virus (HPV) and the influenza virus.[4, 5, 6] Green tea may also have a role in reducing inflammation in conditions such as fatty liver, endometriosis, acne, and cardiovascular disease.[7, 8, 9, 10] Green tea catechins have been shown to inhibit NF-kappaB, one of the best-recognized transcription factors and mediators of inflammation at the cellular level.[8, 9] This activity introduces the potential for green tea to be helpful in a host of chronic diseases.

Subsequent parts of this series will review these novel applications of green tea and green tea extract (GTE) in order. Stay tuned!

References
Most readers who keep up with developments in the area of wellness and nutrition will already be aware of green tea as a potential anticancer agent. What is less known are the types of cancers that green tea appears to protect against, and the amount of the herb that is needed to produce such effects.

Large observational studies of populations consuming high amounts of green tea as part of their diet suggest that green tea intake is associated with reduced risk of developing several types of cancers, including breast, prostate, and lung.\(^1\) A meta-analysis of observational studies including over 5,600 breast cancer patients found that consuming three cups of green tea per day was associated with up to 20% decreased risk of breast cancer, and over 25% reduced risk of breast cancer recurrence.\(^1\) Meanwhile, the Cochrane Library has published a review on green tea for cancer prevention stating “the desirable green tea intake is 3 to 5 cups per day (up to 1200 ml/day), providing a minimum of 250 mg/day catechins”.\(^4\)

In clinical trials thus far, green tea appears to be most useful in preventing the development of cancer from existing precancerous lesions, or in persons at high risk of cancer. This suggests that green tea may be most useful in the very early stages of cancer or precancerous conditions. Evidence shows that green tea extract can reduce the risk of developing cancer among individuals who have leukoplakia (precancerous lesions of the oral mucosa); cervical dysplasia (precancerous lesions of the cervix); colon adenomas or “polyps”; early-stage prostate cancer; as well as chronic lymphocytic leukemia, a slowly progressing type of leukemia.\(^5\)–\(^10\)

For instance, in one study green tea was given to patients with a history of colon polyps (or adenomas).\(^9\) These patients had their polyps removed, and were shown to be clear after one year. Then, patients were randomized to receive 1.5 g green tea extract (GTE)
or no treatment for the following year. At the end of that year, polyps reoccurred in 15% of patients who had received GTE, compared to 31% of patients who received no treatment, a reduction of almost half.

In another study, women with cervical dysplasia were given a green tea ointment and/or oral GTE capsules containing 200 mg EGCG daily for 12 weeks. After 12 weeks, approximately 75% of women taking the ointment showed a response, and 50% of women taking the oral capsule showed a response, suggesting that green tea may be useful in treating cervical dysplasia in order to reduce the risk of progression to cervical cancer.

We anticipate that green tea will continue to be studied in the coming years for its potential anticancer effects. Stay tuned for part III of this series, a discussion of the antiviral effects of green tea.

References

Green tea catechins have been shown to exert antiviral effects against human papilloma virus (HPV, the virus responsible for genital warts and cervical cancer), as well as the hepatitis C virus, and the influenza virus.[1–3] Studies have investigated green tea as a beverage, as green tea extract, as well as a topical ointment called Polyphenon E.

Green tea extract (GTE) has not been well-studied in patients with hepatitis C, apart from an exploratory study showing that patients with hepatitis C and stage A or B cirrhosis appear to tolerate up to 400 mg EGCG well, and metabolism of EGCG was not affected by having cirrhosis.[4] Areas that have been better-studied are treatment of HPV and prevention of influenza.

EGCG has been shown to inhibit the infective process of influenza virus, reducing viral membrane integrity and reducing the cell penetration ability of the virus.[3] Another study shows that other catechins inhibit a viral enzyme called endonuclease that plays a role in the incorporation of viral DNA into the cell.[5] and hence helps inhibit viral replication.

In humans, a green tea–derived ointment called Polyphenon E has been shown to be effective in the treatment of HPV-related genital warts, also known as condylomata acuminata.[6] Genital warts are commonly caused by HPV strains 6 and 11, whereas cervical cancer is commonly associated with strains 16 and 18.[6, 7] Two studies were conducted in patients with external genital warts, with patients instructed to apply the ointment three times daily until regression of the warts, or a maximum of 16 weeks.[6] Complete resolution of warts occurred in approximately 54% of patients using Polyphenon E, compared to 35% of patients using a placebo ointment.

With respect to influenza, green tea consumption has been shown to reduce infections
among health-care workers as well as among healthy adults.[8, 9] A randomized, double-blind, placebo-controlled trial examined the use of green tea catechins (378 mg/d) and theanine (210 mg/d) for five months among 197 workers. [8] Over this period of time, the green tea group had a 4% incidence rate of flu, compared to a 13% incidence rate among the placebo group. The duration of time that each group spent being free of the flu was also significantly different for those receiving green tea compared to placebo.

In a second study, participants took a capsule of green tea extract twice daily for three months. Over the course of this time, subjects taking green tea experienced 22.9% fewer overall illnesses of at least two days duration, and 35.6% fewer days with flu symptoms, compared to subjects taking placebo. [9] Immune-cell activity was also approximately 25% higher among patients taking green tea.

Keep reading for part IV of this series, a discussion of the anti-inflammatory effects of green tea.

References
In previous sections, we reviewed the anticancer and antiviral effects of green tea. Here we discuss the antioxidant, anti-inflammatory effects of green tea. This effect encompasses a broad range of chronic health concerns, including fatty liver, heart disease, and acne. In each of these conditions, organ damage is perpetuated by an ongoing state of inflammation; and green tea may be a therapeutic agent for each of these based on human level research.

Fatty liver disease is an early stage liver condition in which excess fat accumulates within liver cells, leading to inflammation and cell death, elevated liver enzymes, liver damage, and replacement with scar tissue. Over a period of many years, this condition may result in liver cirrhosis. This study examined green tea catechins in 17 patients with nonalcoholic fatty liver disease (NAFLD).[1] High-dose green tea catechins (1 g catechins, equivalent to 700 ml green tea), low-dose catechins, or a placebo were given for 12 weeks in a randomized, double-blind study. After 12 weeks, body fat was significantly decreased in the high-dose catechin group compared with the placebo and low-dose catechin groups. All the patients in the high-dose catechin group showed a significantly improved steatosis, or fat storage in the liver, on CT scans. The high-dose catechin group also decreased liver enzyme levels and decreased oxidative stress measured as urinary 8-isoprostane excretion compared with the placebo.

Secondly, it is well-recognized that chronic inflammation plays a major role in the development of atherosclerosis (“plaques”) and heart disease. Green tea has been shown to reduce markers of inflammation in conjunction with markers of heart disease. In a double-blind, placebo-controlled trial, 56 obese subjects with high blood pressure were randomized to receive either 379 mg of GT extract (GTE) or a placebo for three months.[2] After three months of supplementation, blood pressure, fasting blood
glucose, insulin levels, total cholesterol, low-density cholesterol (LDL), and high-density cholesterol (HDL) were improved in subjects consuming green tea. Similarly, markers of inflammation including tumor necrosis factor $\alpha$ and C-reactive protein (CRP) were significantly lower, whereas total antioxidant status increased in the GTE group compared with the placebo. This study shows that GTE favorably influences several markers of cardiovascular function as well as inflammation and oxidative stress, in patients with obesity-related high blood pressure.

Lastly, acne vulgaris is a very common skin disorder characterized by excess sebum or oil production, inflammation, and overgrowth of the bacteria Propionibacterium acnes. This study examined the effects of EGCG in patients with acne as well as in the sebum-producing cells called sebocytes.[3] In sebocytes, EGCG reduced sebum and inflammation by suppressing specific signaling pathways including the NF-κB and AP-1 pathways. EGCG was also able to decrease the viability of $P.$ acnes, showing antibacterial effects, and thereby targeting almost all of the features of acne. Clinically, EGCG significantly improved acne in an eight-week randomized trial, where patients applied EGCG to half their face, using the other half as the “control.”

As a whole, these diverse studies demonstrate the therapeutic potential of green tea in a host of chronic, inflammatory conditions. The benefits of green tea in these conditions will no doubt continue to be the subject of much further study in coming years.

References