

Green Tea: Potential Health Benefits

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Green tea has been used widely and in high doses for centuries as a health tonic in many societies. Evidence suggests that green tea is effective for treating genital warts. There is some supportive evidence for the use of green tea in cancer prevention. Drinking green tea is associated with a decrease in all-cause mortality, but not in cancer-related mortality. Small clinical studies have found that green tea may also be helpful in losing and managing weight, and lowering cholesterol. Epidemiologic evidence suggests that green tea may prevent stroke and cardiovascular disease. Green tea appears to be safe, although there have been case reports of hepatotoxicity possibly related to a specific extract in pill or beverage form. Green tea seems to be a low-risk complementary therapy for a number of conditions, but more studies are needed. (*Am Fam Physician*. 2009;79(7):591-594. Copyright © 2009 American Academy of Family Physicians.)

Tea is the most frequently consumed beverage in the world after water, and the fourth most frequently consumed beverage in the United States. The average American drinks 155 cups of tea annually,¹ and green tea extracts are a rapidly growing dietary supplement in the United States.

Legend has it that drinking tea originated when leaves from a nearby *Camellia sinensis* plant landed in a Chinese emperor's pot of boiling water.² Green tea is made by lightly steaming and drying the leaves from *C. sinensis*. Green tea, black tea, and oolong tea are all distinct preparations of this plant.

Pharmacology

Multiple substances in green tea may contribute to its health benefits. Caffeine, theanine, theaflavins, theobromine, theophylline, and phenolic acids are found in green tea.³ In vitro, animal, and human studies suggest that the polyphenols in green tea are potent antioxidants with antimutagenic, antidiabetic, antibacterial, anti-inflammatory, and hypocholesterolemic properties.³ Green tea is 20 to 45 percent polyphenols by weight, of which 60 to 80 percent are catechins. Green tea contains more catechins than oolong or black tea,³ although catechin content may vary because of processing and growing conditions. Epigallocatechin gallate (EGCG) is the most prevalent catechin in tea, and the most researched.

Uses and Effectiveness

Green tea polyphenols may play a beneficial role in several conditions. They are most commonly studied in genital warts, cancer, weight management, and cardiovascular disease. The results from epidemiologic and clinical studies are mixed.³

GENITAL AND PERIANAL WARTS

The U.S. Food and Drug Administration has approved a topical ointment (sinecatechins 15% [Veregen]) for the treatment of external genital and perianal warts caused by human papillomavirus (HPV). The active ingredient is a defined mixture of catechins extracted from green tea that acts as an immunomodulator and inhibits major viral functions.^{4,5} Preliminary trials also suggest a possible role for sinecatechins, alone or in combination with an oral extract, in treating cervical lesions caused by HPV.⁶

CANCER

Many studies suggest an inverse relationship between green tea intake and the risk of a variety of cancers, although other studies have found no association.⁷ Clinical trials have been small and heterogenous with contradictory results. Dietary, environmental, and population differences may account for these inconsistencies.

A 2006 meta-analysis of epidemiologic studies found that high intake of green tea was associated with a 20 percent reduction

SORT: KEY RECOMMENDATIONS FOR PRACTICE

<i>Clinical recommendation</i>	<i>Evidence rating</i>	<i>References</i>
Ointment derived from green tea appears to be effective in the treatment of genital warts.	B	4, 5
Drinking green tea may help prevent cancer of the breast, gastrointestinal tract, and prostate, but results are mixed.	B	8, 9, 11, 12, 14
Green tea beverages may be effective for short-term weight loss, although studies are inconsistent.	B	17, 18
Drinking green tea is associated with decreased risk of stroke and cardiovascular disease, although the evidence is conflicting.	B	10

A = consistent, good-quality patient-oriented evidence; B = inconsistent or limited-quality patient-oriented evidence; C = consensus, disease-oriented evidence, usual practice, expert opinion, or case series. For information about the SORT evidence rating system, go to <http://www.aafp.org/afpsort.xml>.

in the risk of breast cancer (odds ratio [OR] = 0.78; 95% confidence interval [CI], 0.61 to 0.98).⁸ The strongest association was in the U.S. Asian population. Large Japanese cohort studies did not reveal a reduction in breast cancer diagnoses with green tea intake, although the studies were confounded by pervasive green tea consumption among participants (i.e., 98 percent of Japanese adults drink green tea).⁸

A second meta-analysis by the same authors found that high consumption of green tea was associated with an 18 percent reduction in the risk of colorectal cancer (summary OR = 0.82; 95% CI, 0.69 to 0.98).⁹ Another large prospective cohort study of more than 40,000 Japanese adults found that green tea beverage consumption was inversely associated with all-cause mortality at 11 years, but not specifically with cancer-related mortality.¹⁰

Some data are available on green tea and its effect on stomach and esophageal cancers. One Chinese study of more than 18,000 men found that those who drank green tea were about one half as likely to develop stomach or esophageal cancer as men who drank little tea.¹¹ The authors reported an inverse relationship between EGCG intake and the risk of gastric cancer, or gastric and esophageal cancers combined (OR = 0.52; 95% CI, 0.28 to 0.97, and OR = 0.58; 95% CI, 0.34 to 0.90).¹¹

Other studies have examined the relationship between green tea and prostate cancer. A small controlled trial followed 60 patients with high-grade prostate intraepithelial neoplasia.¹² Patients were grouped randomly to receive green tea catechins extract (200 mg three times a day) or placebo for one year.¹² Nine cancers were found in the placebo group, whereas only one cancer was detected in the green tea group.¹² Another small clinical trial found no benefit from the use of green tea extract (500 mg per day for two to four months)¹³; however, a recent epidemiologic study of nearly 50,000 Japanese men found a dose-dependent relationship between green tea consumption and a reduction in the risk of advanced prostate cancer.¹⁴

WEIGHT MANAGEMENT

Several small clinical trials have investigated the effect of green tea on weight loss and weight management.^{15,16} Some controlled trials suggest a benefit from green tea, whereas others do not. None of the studies demonstrate persistent effects.

In one randomized placebo-controlled double-blind trial, investigators tracked the effects of green tea in 76 men and women who were overweight or obese.¹⁷ The effects of a green tea/caffeine mixture (two capsules, each containing 45 mg of EGCG and 25 mg of caffeine, taken before meals) on persons who habitually consumed large amounts of caffeine (more than 300 mg per day) were compared with the effects on those who consumed small amounts of caffeine. There appeared to be no effect on the high consumers, but the low consumers regained significantly less weight ($P < .01$) than participants receiving placebo.¹⁷

A 12-week double-blind controlled trial compared the effects of a green tea extract beverage high in catechins with a lower catechin placebo beverage in 240 Japanese adults who were obese.¹⁸ The results showed that the active treatment group had greater reductions in body weight, body mass index, body fat ratio, body fat mass, and waist and hip circumference ($P < .05$).¹⁸

CARDIOVASCULAR FUNCTION

Epidemiologic studies suggest that green tea intake is associated with a reduced risk of cardiovascular disease, but the mechanisms remain uncertain. Clinical trials show inconsistent results in the effect of green tea on lipid levels, blood pressure, and coronary artery disease.

A prospective cohort study of more than 40,000 Japanese adults found that green tea consumption was inversely associated with cardiovascular disease mortality.¹⁰ Women who consumed five or more cups per day had a 31 percent lower risk of dying from cardiovascular disease.¹⁰ Participants who consumed five or more cups per day had a significantly reduced incidence of stroke.¹⁰

Table 1. Commonly Studied Dosages and Formulations of Green Tea

Use*	Formulation	Dosage†	Cost‡
Treatment of external genital and perianal warts caused by human papillomavirus	Sin catechins 15% ointment (Veregen)	0.5 cm per wart three times per day for 16 weeks	15-g tube ranges from \$250 to \$300
Reduction of breast cancer risk	Green tea beverage	Three or more cups per day	Green tea ranges from \$5 for 30 tea bags to \$23 for 240 tea bags; loose green tea leaves range from \$7 to \$45 for 75 servings of average to good quality tea
Reduction of colorectal cancer risk	Green tea beverage	Five to 10 cups per day	—
Weight reduction and management	Capsules or beverage	Two capsules three times a day before meals (45 mg of EGCG plus 25 mg of caffeine per capsule) 340 mL (one cup) of green tea containing 600 mg of catechins and 70 mg of caffeine	Extracts with 45 mg EGCG and 25 mg caffeine are roughly \$5 to \$10 for 100 capsules —
Reduction of cholesterol	Theaflavin-enriched green tea extract (Teaflavin)	375-mg capsule daily (75 mg of theaflavins, 150 mg of green tea catechins, and 150 mg of other tea polyphenols)	30-day supply ranges from \$18 to \$25
	Green tea beverage	10 or more cups per day	—
Reduction of cardiovascular risk	Green tea beverage	Five or more cups per day	—

EGCG = epigallocatechin gallate.

*—Independent testing of green tea dietary supplements is available at <http://www.consumerlab.com>.

†—More condition-specific dosing recommendations are available at National Medicines Comprehensive Database (<http://www.naturaldatabase.com>) and National Standard (<http://www.naturalstandard.com>).

‡—These costs are estimates based on a search of commonly used Internet sites (<http://www.amazon.com>, <http://www.inpursuitofoftea.com>, <http://www.naturesstore.com>, <http://www.vitacost.com>, and <http://www.vitaminshoppe.com>).

A cross-sectional study of nearly 1,000 Japanese adults in their 40s found no association between green tea intake and total cholesterol level.¹⁹ However, a double-blind randomized placebo-controlled trial of 240 Chinese adults with mild to moderate hypercholesterolemia (low-density lipoprotein [LDL] cholesterol = 130 to 190 mg per dL [3.36 to 4.91 mmol per L]) who received a once-daily theaflavin-enriched green tea extract reduced their LDL by 16.4 percent \pm 1.1 percent ($P < .01$) and their total cholesterol by 11.3 percent \pm 0.9 percent compared with placebo.²⁰ Participants' high-density lipoprotein cholesterol and triglyceride measurements were not changed significantly.²⁰

Dosing, Adverse Effects, Interactions, and Contraindications

Green tea is available in various formulations. Typical consumption is about three cups per day (1 teaspoon of tea leaves in 8 oz of boiling water), which provides 240 to 320 mg of polyphenols. Green tea in extract form should be taken in recommended doses and with a meal. The cost of green tea varies by quality, type, and preparation (Table 1).

Green tea is safe for most adults when used in moderate quantities. The most common adverse effects of

consuming green tea orally are gastrointestinal upset and central nervous system stimulation from caffeine content (Table 2⁴⁻²¹). There are several case reports of hepatotoxicity linked to green tea extract products in pill or beverage form. The mechanism for this is unknown.²¹ Allergic reactions have been reported with topical green tea ointment, which may cause cervical and vaginal inflammation, irritation, and vulvar burning.⁶

Green tea contains a small amount of vitamin K. There are conflicting reports about whether green tea interferes with anticoagulant or antiplatelet medications. In one case report, large amounts of green tea (0.5 to 1.0 gallon) antagonized the effects of warfarin (Coumadin).²²

Because catechins seem to inhibit dihydrofolate reductase, there is concern that consuming large amounts of green tea might cause antifolate activity, which could potentially increase the risk of birth defects related to folic acid deficiency.²³

Bottom Line

The National Cancer Institute is actively exploring tea compounds as cancer-chemopreventive and adjuvant-treatment agents in human trials. Although further studies are needed, green tea appears to be a low-risk, inexpensive complementary therapy for a number of conditions.

Table 2. Key Points About Green Tea

Effectiveness

Effective for treatment of genital warts^{4,5}
Conflicting evidence for prevention and treatment of cancer⁷⁻¹⁴
Conflicting evidence for weight loss¹⁵⁻¹⁸
Possibly effective for prevention of stroke¹⁰
Conflicting evidence for decreasing risk of cardiovascular disease^{10,19,20}

Adverse effects

Central nervous system stimulation; gastrointestinal upset; case reports of hepatotoxicity involving green tea extract in pill or beverage form²¹
Topical ointment may cause local irritation⁶

Interactions

Additive effect with stimulants (caffeine component)

Dosage

Available as tea, liquid and solid extracts, and ointment

Cost

Prices vary widely for tea and extracts by brand and quality, but potentially as low as \$5 to \$18 for one-month supply; ointment pricing varies by pharmacy, currently in \$250 range or higher for 15-g tube

Bottom line

Safe alternative to treat genital warts; inconsistent evidence for use in cancer prevention, cardiovascular disease and stroke prevention, and weight management

Information from references 4 through 21.

Members of various family medicine departments develop articles for "Complementary and Alternative Medicine." This is one in a series coordinated by Sumi Sexton, MD, and Benjamin Kligler, MD, MPH.

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Author disclosure: Nothing to disclose.

REFERENCES

1. Schardt D. Does tea ward off disease? *Nutr Action Healthletter*. 2007; 34(2):9-11.
2. Patel SH. *Camellia sinensis*: historical perspectives and future prospects. *J Agromedicine*. 2005;10(2):57-64.

3. Cabrera C, Artacho R, Giménez R. Beneficial effects of green tea—a review. *J Am Coll Nutr*. 2006;25(2):79-99.
4. Gross G, et al. A randomized, double-blind, four-arm parallel-group, placebo-controlled Phase II/III study to investigate the clinical efficacy of two galenic formulations of Polyphenon E in the treatment of external genital warts. *J Eur Acad Dermatol Venereol*. 2007;21(10):1404-1412.
5. U.S. Food and Drug Administration. Veregen (Kunecatechins) ointment, 15%. <http://www.fda.gov/cder/foi/label/2006/021902lbl.pdf>. Accessed December 22, 2008.
6. Ahn WS, Yoo J, Huh SW, et al. Protective effects of green tea extracts (polyphenon E and EGCG) on human cervical lesions. *Eur J Cancer Prev*. 2003;12(5):383-390.
7. Bushman JL. Green tea and cancer in humans: a review of the literature. *Nutr Cancer*. 1998;31(3):151-159.
8. Sun CL, Yuan JM, Koh WP, Yu MC. Green tea, black tea and breast cancer risk: a meta-analysis of epidemiological studies. *Carcinogenesis*. 2006;27(7):1310-1315.
9. Sun CL, Yuan JM, Koh WP, Yu MC. Green tea, black tea and colorectal cancer risk: a meta-analysis of epidemiologic studies. *Carcinogenesis*. 2006;27(7):1301-1309.
10. Kuriyama S, Shimazu T, Ohmori K, et al. Green tea consumption and mortality due to cardiovascular disease, cancer, and all causes in Japan: the Ohsaki study. *JAMA*. 2006;296(10):1255-1265.
11. Sun CL, Yuan JM, Lee MJ, et al. Urinary tea polyphenols in relation to gastric and esophageal cancers: a prospective study of men in Shanghai, China. *Carcinogenesis*. 2002;23(9):1497-1503.
12. Bettuzzi S, Brausi M, Rizzi F, Castagnetti G, Peracchia G, Corti A. Chemoprevention of human prostate cancer by oral administration of green tea catechins in volunteers with high-grade prostate intraepithelial neoplasia: a preliminary report from a one-year proof-of-principle study. *Cancer Res*. 2006;66(2):1234-1240.
13. Choan E, Segal R, Jonker D, et al. A prospective clinical trial of green tea for hormone refractory prostate cancer: an evaluation of the complementary/alternative therapy approach. *Urol Oncol*. 2005;23(2):108-113.
14. Kurahashi N, Sasazuki S, Iwasaki M, Inoue M, Tsugane S, for the JPHC Study Group. Green tea consumption and prostate cancer risk in Japanese men: a prospective study. *Am J Epidemiol*. 2008;167(1):71-77.
15. Kovacs EM, Lejeune MP, Nijs I, Westertep-Plantenga MS. Effects of green tea on weight maintenance after body-weight loss. *Br J Nutr*. 2004;91(3):431-437.
16. Diepvens K, Kovacs EM, Vogels N, Westertep-Plantenga MS. Metabolic effects of green tea and of phases of weight loss. *Physiol Behav*. 2006;87(1):185-191.
17. Westertep-Plantenga MS, Lejeune MP, Kovacs EM. Body weight loss and weight maintenance in relation to habitual caffeine intake and green tea supplementation. *Obes Res*. 2005;13(7):1195-1204.
18. Nagao T, Hase T, Tokimitsu I. A green tea extract high in catechins reduces body fat and cardiovascular risks in humans. *Obesity (Silver Spring)*. 2007;15(6):1473-1483.
19. Tsubono Y, Tsugane S. Green tea intake in relation to serum lipid levels in Middle-aged Japanese men and women. *Ann Epidemiol*. 1997;7(4):280-284.
20. Maron DJ, Lu GP, Cai NS, et al. Cholesterol-lowering effect of a theaflavin-enriched green tea extract: a randomized controlled trial. *Arch Intern Med*. 2003;163(12):1448-1453.
21. Gloro R, Hourmand-Ollivier I, Mosquet B, et al. Fulminant hepatitis during self-medication with hydroalcoholic extract of green tea. *Eur J Gastroenterol Hepatol*. 2005;17(10):1135-1137.
22. Taylor JR, Wilt VM. Probable antagonism of warfarin by green tea. *Ann Pharmacother*. 1999;33(4):426-428.
23. Navarro-Perán E, Cabezas-Herrera J, García-Cánovas F, Durrant MC, Thorneley RN, Rodríguez-López JN. The antifolate activity of tea catechins. *Cancer Res*. 2005;65(6):2059-2064.