Chapter

Health Benefits of Aqueous Extract of Black and Green Tea Leaves

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Abstract

Tea, next to water, is the beverage humans consume. Drinking the beverage tea is great for joining and collecting family members and public communities since ancient times. Tea plant *Camellia sinensis* has been cultivated for thousands of years, and its leaves have been used for medicinal purposes. Various studies suggest that polyphenolic compounds present in green and black tea are associated with beneficial effects in prevention of cardiovascular diseases, particularly of atherosclerosis and coronary heart disease. Anti-ageing, antidiabetic and many other health beneficial effects associated with tea consumption are described. Evidence is accumulating that catechins and theaflavins, which are the main polyphenolic compounds of green and black tea, respectively, are responsible for most of the physiological effects of tea. This review describes the evidence from clinical and epidemiological studies in the prevention of chronic diseases like cancer and cardiovascular diseases and inhibits pathogenic bacteria and general health promotion associated with tea consumption.

Keywords: green tea, black tea, health benefit, antibacterial activity

1. Green tea

Green tea is a popular drink, especially in Asian countries, although its popularity continues to spread across the globe. The health benefits of green tea, derived from the leaves of the *Camellia sinensis* [*Camellia sinensis* is a species of evergreen shrub or small tree whose leaves and leaf buds are used to produce tea. It is of the genus *Camellia* (Chinese: 茶花; pinyin: *cháhuā*, literally: "tea flower")] plant, have been studied for many years. Fairly recently, researchers have begun to look at the possibility of using green tea in antimicrobial therapy, and the potential prevention of infections. The particular properties of catechins found in the tea have shown promise for having antimicrobial effects. There are four main catechins (polyphenols) found in green tea: (-)-epicatechin (EC), (-)-epicatechin-3-gallate (ECG), (-)-epigallocatechin (EGC) and (-)-epigallocatechin-3-gallate (EGCG). Three of these, ECG, EGC and EGCG have been shown to have antimicrobial effects against a variety of organisms [1, 2].

Among the health benefits that have been studied using green tea are: as an antioxidant, anti-inflammatory, anticarcinogenic, in cardiovascular health, oral

health, and as an antimicrobial. Antioxidant effects come from the ability of green tea to limit the amount of free radicals by binding to reactive oxygen species (ROS) [3, 4]:

1. **Anti-inflammatory** effects may be a result of increased production of IL-10, an anti-inflammatory cytokine [5]

2. **Inflammation** is involved in, among other conditions, arthritis, cardiovascular disease, ageing, and cancer [5, 6].

3. **The anticarcinogenic** effects of green tea have been seen in many types of cancer, and the mechanisms may include inhibiting angiogenesis and cell growth, and inducing apoptosis in cancer cells [5–7].

4. **Cardiovascular** effects include the antioxidant and anti-inflammatory effects, and consumption of green tea has been shown to inhibit atherosclerosis, reduce lipid levels overall, and improve the ratio of LDL to HDL [6]. The effects for oral health are related to both teeth and gums. The main cause of dental caries is the bacteria *Streptococcus mutans*.

5. **Antioxidants** in Green Tea May Lower Your Risk of Some Types of Cancer, Cancer is caused by uncontrolled growth of cells. It is one of the world's leading causes of death. It is known that oxidative damage contributes to the development of cancer and that antioxidants may have a protective effect [8].

    - Green tea is an excellent source of powerful antioxidants, so it makes sense that it could reduce your risk of cancer, which it appears to do; **Breast cancer:** A meta-analysis of observational studies found that women who drank the most green tea had a 20–30% lower risk of developing breast cancer, the most common cancer in women [9].

    - **Prostate cancer:** One study found that men drinking green tea had a 48% lower risk of developing prostate cancer, which is the most common cancer in men [10].

    - **Colorectal cancer:** An analysis of 29 studies showed that those drinking green tea were up to 42% less likely to develop colorectal cancer [11]. Many observational studies have shown that green tea drinkers are less likely to develop several types of cancer. However, more high-quality research is needed to confirm these effects [12].

1.1 Green tea can kill bacteria

- Which Improves Dental Health and Lowers Your Risk of Infection [13]

- The catechins in green tea also have other biological effects.

- Some studies show that they can kill bacteria and inhibit viruses like the influenza virus, potentially lowering your risk of infections.

- *Streptococcus mutans* is the primary harmful bacteria in the mouth. It causes plaque formation and is a leading contributor to cavities and tooth decay.

- Studies show that the catechins in green tea can inhibit the growth of *Streptococcus mutans*. Green tea consumption is associated with improved dental health and a lower risk of caries [14].

- **Green tea** has a direct **antimicrobial** effect on this bacteria; plus, it seems to inhibit the attachment of the bacteria to oral surfaces. In addition, green tea is a natural source of fluoride [1, 6]. Green tea has been shown to have antimicrobial effects against a variety of gram positive and gram negative bacteria (e.g., *Escherichia coli*, *Salmonella* spp., *Staphylococcus aureus*, *Enterococcus* spp.), some fungi (e.g., *Candida albicans*) and a variety of viruses (e.g., HIV, herpes simplex, influenza) [5, 7].

1.2 Green tea composition

The medically important components of green tea are the polyphenols, most importantly the flavonoids. The main flavonoids in tea are the catechins, making up 30–40% of the water-soluble solids in green tea [3, 11]. The different types of tea vary in the amount of catechins that they contain, with green tea containing the most, then Oolong tea, then black tea. The initial steaming process in the production of green tea destroys the enzyme polyphenol oxidase, thus protecting the polyphenol content. There are four main catechins in tea: (-)-epicatechin (EC), (-)-epicatechin-3-gallate (ECG), (-)-epigallocatechin (EGC) and (-)-epigallocatechin-3-gallate (EGCG). In green tea, EGCG is the most abundant, representing approximately 59% of the total catechins. EGC is next, making up approximately 19%, then ECG, at 13.6% and EC, at 6.4% [6, 10].

Green tea contains less caffeine than coffee, but enough to produce an effect. It also contains the amino acid L-theanine, which can work synergistically with caffeine to improve brain function [8].

Multiple studies show that the catechin compounds in green tea can have various protective effects on neurons in test tubes and animal models, potentially lowering the risk of Alzheimer's and Parkinson's [15].

1.3 Black, green and white

Black, green and white teas are the most popular beverages worldwide [16].

Tea leaves are known for its antibacterial activity against any microorganisms. It is one of the most popular beverages worldwide.

Black tea has a long history of use dating back to China approximately 5000 years ago. It is made from the dried leaves of *Camellia sinensis*, a perennial evergreen shrub formerly known as *Thea sinensis*. It is native to southeastern Asia. Green tea, black tea, and oolong tea are all derived from the same plant. Black tea results from the oxidation of *Camellia sinensis* leaves.

The chemical components in tea include alkaloids (theobromine, caffeine, theophylline), polyphenols, amino acids, polysaccharides, volatile acids, vitamins, lipids as well as inorganic elements [17–19]. Black tea is used for treating headaches, low blood pressure, preventing heart disease, including atherosclerosis and heart attack, preventing Parkinson's disease, reducing the risk of stomach and colon cancer, lung, ovarian and breast cancers [20].

Currently, a growing consumption of tea is observed in western countries, where it has been considered as functional food.

Nutritional Value of Black Tea Like other types of tea, black tea contains:

- Caffeine

- Amino acids

- Carbohydrates
- Proteins
- Potassium
- Major minerals and trace minerals
- Manganese
- Fluoride
- Polyphenols

Black tea also contains catechins (the powerful antioxidants in tea that fight cancer-causing cells and help prevent heart disease), tannins (the naturally occurring chemical compounds that give black tea and red wine their astringency), guanine (a natural stimulant) and xanthine (another natural stimulant, similar to caffeine).

The many antioxidants and polyphenols in black tea are associated with a number of health benefits. Specifically, black tea contains complex flavonoids, which are polyphenols that aid in disease prevention. A single cup of black tea contains an average of 200 mg of flavonoids. Many doctors now recommend getting 600 mg of flavonoids per day for a range of health benefits. The flavonoid polyphenols in black tea known as thearubigin and theaflavin act as especially powerful antioxidants. Interestingly, these two flavonoids are more concentrated in black tea than in green tea [21].

Additionally, black tea is low in sodium and calories (if you do not add a sweetener). Plus, black tea has a bold flavor, making it a good substitute for those accustomed to soft drinks other unhealthy beverages (which also tend to have bold flavors) [22].

2. The biological properties of tea

The biological properties of tea include effects on the Central System (CNS) and antioxidant effects, attributed to the presence of methylxanthines, such as caffeine and phenolic compounds, especially catechins [23].

Black tea is more oxidised than all other types of teas. It contains antioxidants and other substances that might help protect the heart and blood vessels. It is also used for treating headache and low blood pressure; preventing heart disease, including "hardening of the arteries" (atherosclerosis) and heart attack [24].

3. Black tea fights diseases and infections; how black tea benefits

The tannins in black tea do not just give it its characteristic taste. Several studies have shown that tannins help fight viruses such as influenza ("the flu"), dysentery, and hepatitis. Black tea also contains alkylamine antigens, which help boost immune response [25]. Both Iranian non fermented (green tea) and fermented (black tea) have anti *Streptococcus mutans* activity in vitro. The anti-*Streptococcus mutans* activity of black tea appears on a lower concentration than green tea [18].

Black and green tea have antibacterial activity against many pathogens.

Effectiveness of aqueous extract of green, black and red tea leaves against some types of Gram positive and negative bacteria [19].

An *in vitro* study recorded that the black tea has antibacterial activity to the following pathogens:

- *Escherichia coli*
- *Klebsiella pneumonia*
- *Bacillus subtilis*
- *Micrococcus luteus*
- *Staphylococcus aureus*
- *Salmonella typhi*
- *Pseudomonas aeruginosa*

All tea extracts have shown significant antibacterial activity against *S. aureus* ATCC 25922 with Aqueous extract of Green tea exhibiting highest activity. All Green tea extracts exhibited significant activity against *E. coli* ATCC 25923 higher than Black tea extracts. As compared to Green tea extracts, Black tea extracts showed much lower activity against *P. aeruginosa* ATCC 27853. *S. aureus* was found to be most susceptible to tea extracts followed by *E. coli* and *P. aeruginosa*. Green tea and Black tea extracts have shown significant antibacterial activity with former being more effective than later. In future there is immense potential of clinical application of polyphenolic contents of tea extracts as adjuvant therapeutic agents to tackle the menace of growing antibiotic resistance [20, 23].

Black tea extract also had the ability to completely inhibit *Pseudomonas* growth on blood agar and inhibited protease activity and adhesion. There were also differences in Congo red binding seen in bacterial cell suspensions cultured in growth media that contained tea extract. The synergistic activity of tea extract with antibiotics has changed the resistance of *P. aeruginosa* (without the tea) to sensitive (in the presence of tea extract) [22].

4. Anticancer activity of black tea

Black tea is recorded to have anticolon cancer, lung, ovarian and breast cancers [21, 25]; green or black tea has polyphenols as prophylactic and therapeutic agents. Theaflavins and catechins seem to act on cancer cells largely through different pathways, so utilisation of both could offer synergistic anticancer effects, but so far no work has been done on the cumulative effects of EGCG and TF on prostate cancer. Therefore, in this study, we have investigated if EGCG in combination with TF can reduce the rate of prostate cancer growth, and we have observed greater cell death compared to application of either TF or EGCG alone.

Consumption of black tea, rich in polyphenols, has been found to reduce ovarian cancer risk. Theaflavin (TF1), theaflavin-3-gallate (TF2a), theaflavin-3′-gallate (TF2b) and theaflavin-3, 3′-digallate (TF3) are four main theaflavin derivatives found in black tea.

All four theaflavin derivatives inhibited ovarian cancer cells. Some of the effects and mechanisms of TF1 are different from those of the other three theaflavin derivatives [17, 21].

4.1 Black tea and skin health

Drinking black tea benefits the skin in three ways. First, it nourishes the skin with vitamins B2, C, and E, with minerals such as magnesium, potassium, and zinc, and essential polyphenols and tannins. Second, its caffeine and some of its other chemical components can kill oral viruses, which helps prevent skin infections (and pimples). Third, black tea has been shown to reduce "mimic wrinkles" and signs of premature ageing.

Black tea can also benefit your skin with direct contact/application. For example, placing black tea bags under your eyes helps reduce puffiness and dark circles. And using black tea for herbal baths can provide an antioxidant boost for your skin and may even provide low levels of sun protection [22, 26].

5. Black tea benefits

The healthiest tea for you is the one you will want to drink every day. By that definition, if you live in the West, the tea that is the healthiest for you is probably black tea. Over 90% of all tea sold in the West is black tea (or red tea, as it is known in the East).

Like green tea, oolong tea and white tea, black tea is made from leaves of the *Camellia sinensis* plant, so it shares many tea health benefits with other tea types. However, black tea is unique, and it is known to be especially beneficial for certain health purposes [8, 25].

The major health benefits of black tea include its nutritional value, anti-cancer benefits, digestive benefits, beneficial effects on skin and hair health, and much more. Grab a cup of tea (preferably organic tea) and learn more.

Black tea also contains catechins (the powerful antioxidants in tea that fight cancer-causing cells and help prevent heart disease), tannins (the naturally occurring chemical compounds that give black tea and red wine their astringency), guanine (a natural stimulant) and xanthine (another natural stimulant, similar to caffeine).

The many antioxidants and polyphenols in black tea are associated with a number of health benefits. Specifically, black tea contains complex flavonoids, which are polyphenols that aid in disease prevention. A single cup of black tea contains an average of 200 mg of flavonoids. Many doctors now recommend getting 600 mg of flavonoids per day for a range of health benefits. The flavonoid polyphenols in black tea known as thearubigin and theaflavin act as especially powerful antioxidants. Interestingly, these two flavonoids are more concentrated in black tea than in green tea [22, 23, 27].

5.1 Black tea and cardiovascular health

Black tea is abundant in antioxidants, such as flavonoids. These antioxidants have been demonstrated to lower the risk of heart disease. They do this by preventing the oxidation of LDL cholesterol and preventing damage in both the bloodstream and at artery walls. Additionally, black tea flavonoids can both improve coronary vasodilation and reduce clots, and its manganese may reduce the risk of coronary heart disease by helping cardiac muscle function. Studies have shown that as few as three cups of tea per day can improve heart health [25].

5.2 Cancer prevention

Perhaps the most-studied tea health benefit is its anti-cancer benefit. While most of the study has been on green tea, there is a growing body of evidence that black tea also plays a role in cancer prevention [25].

It appears that the polyphenols in tea help prevent the formation of potential carcinogens in the body. This is particularly true with certain types of cancer, such as ovarian cancer, lung cancer, prostate cancer, colorectal cancer, and bladder cancer. Some studies also show that black tea may help prevent stomach cancer, prostate cancer, breast cancer and oral cancers (especially for those who use tobacco products) [25–28].

The mechanism with which black tea prevents cancer is an interesting one. Black tea contains a compound called TF-2. This chemical causes apoptosis ("programmed death") of cancer cells without harming normal, healthy cells. This helps to stop cancer growth before it even becomes noticeable, and may help in cases where cancer has already been diagnosed. Additionally, black tea also prevents cancer by inhibiting the formation and growth of malignant tumors [25].

5.3 Black tea benefits the immune system

The tannins in black tea do not just give it its characteristic taste. Several studies have shown that tannins help fight viruses such as influenza ("the flu"), dysentery, and hepatitis. Black tea also contains alkylamine antigens, which help boost immune response [25].

5.4 Black tea and oral health

There are many folk tales about tea, freshening the breath and cleansing the mouth. It turns out that they are true. Research has found that black tea may reduce oral cancers. Additionally, tea's polyphenols and tannin's kill and prevent the bacteria that cause tooth decay, and to drastically reduce the oral bacteria that cause bad breath [25].

5.5 Black tea's digestive benefits

The tannin in tea in general (and black tea in particular—it has more of them than other tea types) offer digestive benefits. They soothe gastric and intestinal illnesses, generally aid in digestion and decrease intestinal activity (making them useful for those with diarrhea) [24, 25].

5.6 Black tea and hair health

Although it may seem rather vain compared to some of the other more life-altering health benefits of black tea, black tea is fantastic for your hair.

The high levels of antioxidants and caffeine in black tea both benefit hair health. The caffeine decreases a hormone that causes hair loss (known as DHT or dihydrotestosterone), while the antioxidants promote healthy hair growth. However, excess caffeine may stunt hair growth, so be careful not to overdo it. Black tea can also add shine, luster, and darkness to your hair if you incorporate it into your hair care regimen [25].

5.7 Bone and connective tissue benefits of black tea

If you drink tea regularly, you are more likely to have stronger bones and connective tissue than someone who does not drink tea regularly. Scientists believe this may be due to tea's phytochemicals [25].

5.8 The effect of black tea on brain (and nervous system)

The caffeine in black tea has been shown to improve mental focus and concentration by promoting blood flow in the brain. Unlike drinks with higher levels

of caffeine and other stimulants (i.e., coffee and energy drinks), the caffeine in black tea is less likely to over-stimulate the heart and cause other unpleasant side effects.

Caffeine aside, studies show that L-theanine (an amino acid found in black tea) balances the effects of caffeine in a unique way, helping you concentrate more fully on tasks and act in a focused but relaxed manner. Furthermore, studies show that 1 month of four cups of black tea a day reduces levels of the stress hormone cortisol enough to boost your memory function, and some studies suggest that regular black tea consumption may prevent Parkinson's disease [8].

5.9 Black tea increases your energy level

Moderate caffeine consumption not only stimulates metabolism, but it also increases alertness and overall brain function. The caffeine in tea is mitigated by the naturally occurring chemical L-theophylline, which makes the effects of tea on energy level more smooth and continuous than the sometimes jarring effects of coffee and caffeinated sodas. Additionally, while caffeine mainly stimulates the muscles, L-theophylline targets the heart, kidneys and respiratory system, so the overall impact on the body is more evenly distributed and balanced [25].

6. Conclusion

Our review shows that tea have great health benefit for human body, the nutritional value of tea components shows great health benefit for heart and vascular system, fight cancer, inhibit pathogens, healthy for skin, hair, bone regulate metabolism and more.

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