

Tea and Heart Health

Consuming green or black tea (without sugar and without milk, or with low-fat milk) has been associated with improved heart health. Two meta-analyses^{30,31} have been conducted to determine the overall effect of black tea drinking and dietary flavonoids on cardiovascular health across populations (from 1966 - 2001). Peters and colleagues concluded that consumption of 3 240mL cups of black tea per day is associated with an 11% reduced risk of myocardial infarction³⁰. The second meta-analysis, comparing low with high flavonol intake groups, found a 20% reduction in CVD deaths³¹. An epidemiological study investigating the occurrence of heart disease concluded that a higher tea consumption (> 2 cups per day) reduces the risk of CVD mortality by over 40%³².

There are some confounding factors to consider with regards to tea and heart health:

- Overall lifestyle habit of the individuals including diet and exercise
- Heterogeneity between studies
- Publication bias
- Social factors

Overall, epidemiological studies support an inverse association between tea intake and risk of cardiovascular disease and show that people consuming black tea on a regular basis, especially when living a healthy lifestyle have healthier hearts and cardiovascular systems.

While more research is needed to further establish the specific link between tea consumption and cardiovascular health, clinical studies have shown that tea flavonoids may improve heart health through:

- **Improving endothelial function:** both acute (2 cups/d) and chronic (4 cups/d, 4 weeks) consumption of black tea improves flow-mediated vasodilatation and thus improves vascular function, both in healthy subjects and subjects with coronary artery disease³³.
- **Lowering blood cholesterol:** a cholesterol lowering effect (from 3.8% to 11.3%) of green as well as black tea has been found in some studies^{34,35}.
- **Inhibition of platelet aggregation:** research is still in its infancy³⁶.

Find out more in our Heart Health fact sheet!

Tea and Cancer

Tea's naturally occurring polyphenols have been shown to have antioxidant properties. There is some *in vitro* and *in vivo* evidence implicating tea flavonoids as chemopreventive agents against various cancers³⁷. However, data obtained from epidemiological studies^{38,39} are not all supportive of a protective role of tea in the aetiology of cancer. Much more research is needed before any link can be made between flavonoids and the maintenance of a healthy body at the structural and cellular level.

Tea and Neurodegenerative disease

Accumulating evidence suggest that oxidative stress resulting in reactive oxygen species generation and inflammation play a pivotal role in neurodegenerative diseases and support the beneficial role of radical scavengers, transition metal chelators and polyphenols. These observations are in line with the current view that polyphenolic dietary supplementation, such as green tea flavonoid antioxidants (in particular epigallocatechin gallate), may be considered as protective agents in progressive neurodegenerative disorders such as Parkinson's and Alzheimer's diseases⁴⁰. However much more research is needed before any conclusion can be drawn.



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Beverages Health and Vitality Team, Lipton, Unilever
tea.vitality@unilever.com

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Tea and Vitality

Facts

Tea Health Overview

Tea has been consumed for thousands of years and is commonly thought to have originated as a medicinal herb. The use of tea as a beverage drunk for pleasure on social occasions dates from the Tang Dynasty or earlier. The first Europeans to encounter tea were Portuguese explorers visiting Japan in 1560.

Tea remains the most consumed drink globally – after water. Black, green and oolong teas originate from the *Camellia sinensis* plant and have all been associated with health benefits. The following factsheet aims to cover many of the frequently asked questions regarding tea's health benefits.

Tea Process

Green, black and oolong teas all come from the leaves of the *Camellia sinensis* plant. The difference lies in the way they are processed (Figure 1). The *Camellia sinensis* plant is an evergreen shrub whose leaves, if not quickly dried after picking, soon begin to wilt and oxidise. The major step in the tea process is to stop the oxidation process at a predetermined stage, depending on the type of tea being aimed for. The process involves the removal of water from the leaves by heating. The tea oxidation process is termed as "fermentation" although no true fermentation takes place.

The process also determines types and quantities of flavonoids present in the leaf (Table 1). Catechins are the main flavonoids produced by the *Camellia sinensis* plant. During the oxidation process, enzymatic activity allows the catechins to be polymerised and alter their structure.

- Typically heated soon after harvesting, **green tea** leaves undergo minimal oxidation. This stops the enzymatic activity, retaining the majority of **catechins**.
- **Black tea** receives substantial oxidation under controlled temperatures and humidity. This causes enzymatic reactions, which change the colour of the leaves from green to brown, and results in the polymerisation of catechins to **theaflavins** and **thearubigins**.
- **Oolong tea** is a result of oxidation being stopped somewhere in between that of green and black tea and hence contains flavonoids that are found in both teas.

Figure 1. Tea transformation process

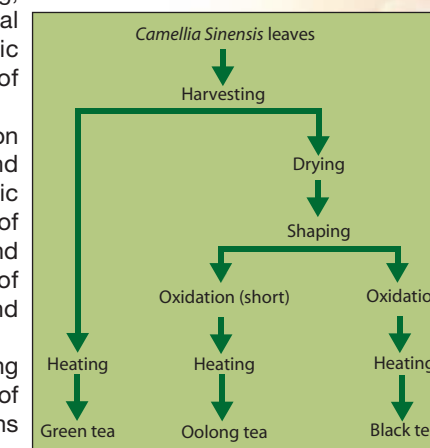


Table 1. Composition of green and black tea (g per 100g of dry tea)

	Total flavonoids	Catechins	Caffeine
Chinese Green tea	15.7	11.3	2.74
Black tea	17.4	2	3.54

Source: Scientific Information Centre, Lipton

Tea Flavonoids

The *Camellia sinensis* plant is rich in the group of flavonoids called **Catechins**. Five catechin flavonoids found in tea have been investigated and identified as¹:

- Catechin - C
 - Epicatechin – EC
 - Epigallocatechin – EGC
 - Epicatechin Gallate – ECG
 - Epigallocatechin Gallate – EGCG
- main catechin in *Camellia sinensis* and green tea

During the black tea process, the catechins are enzymatically polymerised. Two polymer groups of catechins have been identified as **Theaflavins** and **Thearubigins**. Four Theaflavins (TF) structures have been ascertained¹:

- Theaflavin - TF
- Theaflavin 3-gallate - TF3G
- Theaflavin 3'-gallate - TF3'G
- Theaflavin 3,3'-gallate - TFDG

The different levels of flavonoids found in green and black tea can be seen in Table 2. It is the tea flavonoids that have been associated with the many tea related benefits.

The level of tea flavonoids in a cup of tea will depend on many factors including: brewing time, size of the tea leaves, whether loose leaf or bag tea is used and whether the tea is agitated². Most of the flavonoids will be infused if the teabag is allowed to brew for approx. four minutes or two minutes if the teabag is first stirred at least three times and squeezed³.

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Table 2. Flavonoid content of green and black tea (% of total flavonoids in tea)

	Green tea	Black tea
Flavonols	7-9%	7-9%
Oxidised catechins	20-30%	-
Thearubigins	-	63-74%
Theaflavins	-	5-12%
Catechins	60-80%	6-24%

Source: Higdon J & Frei B. tea catechins and polyphenols: health effects, metabolism, and antioxidant functions. Clin Rev Food Sci Nutr 2003; 43(1):89-143

Tea Flavonoids as Antioxidants

Tea flavonoids have been shown to have a strong antioxidant capacity by *in vitro* and *ex vivo* studies. Standard antioxidant capacity assays have shown both black and green tea flavonoids to possess a strong antioxidant capacity, greater than some fruits and vegetables. Clinical studies have also shown a significant increase in plasma oxidative capacity after consumption of black and green tea. However, the physiological relevance of such findings are still being investigated.

Find out more in our Flavonoid fact sheet!

Tea and Caffeine

Caffeine is an alkaloid found in coffee, tea, chocolate and coke based drinks. The level of caffeine in tea depends on many factors, including the type of tea, brewing time, quantity of tea leaves used and the size of tea leaves. The table below provides the caffeine levels in coffee and tea. A typical cup of tea contains approximately half the caffeine of a typical cup of brewed/filtered coffee.

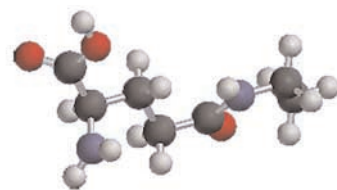
Caffeine in moderation i.e. up to 300mg per day which is equivalent to approximately 6 cups of tea (UK brew), fits perfectly into a healthy balanced diet and has well documented physiological and behavioural effects (i.e. stimulates blood pressure and heart rate, enhances endurance performance and also increases metabolic rate). In addition, it has also been noted that the physiological effects of tea cannot be completely attributed to the caffeine it contains⁶. On the psychological level, caffeine has been shown to have beneficial effects on mood and mental performance without any side effects such as disrupted sleep^{7,8}. When people drink tea, they generally feel as alert as consumers who drink coffee.

Table 3. Caffeine content of some beverages as reported by various sources

	Volume	Average or Range (mg)
Roasted and ground Coffee (percolated)	150 mL	75 – 155 ⁴ percolated: lower part drip: upper part
Instant coffee	150 mL	66 ⁴
Black Tea (brewed leaf or tea bag)	150 mL	30 ⁵
Instant Black Tea	150 mL	20 ⁵
Green Tea	150 mL	15 Unilever data
Lipton Yellow Label Tea	150 mL	37 Unilever data

Tea and Theanine

Theanine is an amino acid found naturally and almost exclusively in species of the *Camellia sinensis*. It can be found in similar amounts in green, black and oolong teas, and also in the edible bay boletes mushroom (*Xerocomus badius*). Theanine constitutes between 1 and 2 % of the dry weight of tea leaves, corresponding to levels of between 18 and 22 mg per 200 ml serving of a typical Lipton Yellow Label Tea. The level of Theanine will vary



depending on a number of factors including the brewing time, the amount of tea leaves and variety of tea used.

Ingestion of theanine has been shown to significantly increase oscillatory brain activity in the so-called alpha-band, 8-13 Hz⁹. This brain rhythm has traditionally been associated with a relaxed state¹⁰, and also with the general state of mental alertness or arousal¹¹. It implies in turn that theanine may exert a **relaxed and alert** mental state. The single effective dose of L-theanine is yet to be defined but data from clinical studies^{9,12} suggest that it is between 200mg and 250mg. Effects are likely to appear from 45mins post ingestion and last for up to 105mins.

Further studies are being undertaken to investigate the effect of L-theanine at lower and more tea relevant levels and more research is needed to fully understand how theanine works at molecular levels.

Find out more in our Theanine fact sheet!

Tea and Weight Maintenance

Tea, when served without milk or sugar, contains virtually no calories, and is also fat free. It can therefore be integrated in a weight maintenance programme. Furthermore, a high green tea consumption (catechins: 375 mg/d; caffeine: 150 mg/d) has been shown to help increase energy expenditure and fat oxidation in both animal and human studies¹³. While caffeine by itself may enhance short-term fat oxidation and thermogenesis, the effects are likely to be apparent in individuals who are caffeine-deprived or non-users^{14,15}. A number of long term studies^{16,17} have indicated that longer-term consumption of green tea components can have benefits for body weight or fat mass/distribution. However a few other well-designed long-term studies have failed to show any effect^{18,19}.

Tea and Iron Absorption

Tea naturally contains polyphenols that, like phytates in whole grain cereals, have been shown to be potential inhibitors of iron absorption²⁰. This effect may be countered somewhat, by consuming foods rich in vitamin C which will enhance iron absorption. Additionally, animal studies have shown that by allowing at least one hour to elapse between the end of the meal and the consumption of tea, any effects of tea consumption are likely to be minimised²¹.

Recently, Nelson *et al.*²² and Temme *et al.*²³ evaluated the literature on the impact of tea consumption on the iron status of different population groups. These evaluations resulted in an overview of a wide variety of studies with different designs, from different countries and carried out across different age and gender groups. It shows that no consistent data is available with respect to the effect of tea drinking on iron status in different population groups. Only in populations of individuals with marginal iron status does there seem to be a negative association.

Tea consumption has not been shown to result in iron deficiency in healthy consumers who follow a varied and balanced diet, hence it is not necessary to restrict tea drinking in these populations. However, individuals who already have poor iron status or who are at risk of low iron status (e.g. pregnant women, young girls [aged 11 – 18], women aged 75 and over and individuals with anaemia) should seek advice from their practitioner or registered dietitian/nutritionist.

Tea and General Health

Tea is a rich and unique source of a number of actives such as flavonoids and L-theanine. In addition, tea is an excellent source of fluid and contains virtually no calories making it an excellent component of a balanced diet and healthy lifestyle:

- Consumer studies have shown tea to be as thirst quenching as water and yet more pleasurable. This provides individuals with a more appealing way to meet their 1.5L – 2L fluid requirements without having to resort to sweetened or carbonated drinks.
- Tea when drunk on its own, without milk or sugar, not only tastes great but contains virtually no calories. This means that tea is an excellent accompaniment to a healthy balanced diet and lifestyle, or to weight maintenance programmes.
- Tea naturally contains flavonoid antioxidants. These make tea an excellent addition to other antioxidant rich foods such as fruit and vegetables.
- Population studies, in general, show a link between regular tea consumption (no milk or sugar) and better heart health.
- Tea flavonoids have also been associated with better endothelial function, which may explain the benefit to heart health.
- The flavonoids found in tea have demonstrated antibacterial properties. Some studies have shown that tea can inhibit the growth of bacteria. Therefore, tea drinking may help maintain good dental health. In addition, flavonoids have the ability to make tooth enamel more resistant to acids, another consideration in maintaining dental health.
- Tea contains L-theanine and low levels of caffeine, which, research is beginning to show, may have positive effects in helping individuals keep alert. Tea is the major dietary source of L-theanine, which may help to produce a **relaxed and alert** mental state. Moreover, caffeine has been shown to improve physical performance, and therefore can **revitalise the body and mind**.

Tea and Oral health

Oral diseases may significantly impact on a person's overall health. Dental caries is a multifactorial infectious disease in which diet, microbial infection and host response play an important role. Tea has been reported to have antibacterial effects and reduces dental caries in humans through fluoride and/or flavonoids²⁴.

The *Camellia sinensis* plant naturally extracts fluoride from the soil, which then accumulates in its leaves. For this reason, dry tea leaves may contain **fluoride** ranging from 1-2 ppm in green tea leaves, whereas that of black tea is reported to be 5 times higher²⁵. The UK Food Standards Agency²⁶ found that fluoride intake is heavily influenced by tea consumption accounting for 1mg/day, or 85% of the total fluoride intake, excluding the contribution of fluoride in the water used to make the tea. When the water is from a fluoridated supply this approximately doubles the fluoride intake for consumers drinking 4 to 5 cups of tea per day.

Fluoride intake through tea consumption has been investigated by the WHO and the US FDA and all have concluded these levels not only to be extremely safe, but also to be of benefit in maintaining dental health and are known to protect against dental caries²⁷.

In addition to the beneficial effects of fluoride, flavonoids found in tea have been reported to have antibacterial effects and to inhibit human salivary amylase, resulting in a reduction of the cariogenic potential of starch-containing foods²⁸. Additionally flavonoids have been shown to be effective in increasing the acid resistance of tooth enamel²⁹.

