



# Green tea: a natural choice for a healthy heart and body

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# Introduction

After water, tea is the most widely consumed beverage in the world. For 5000 years, the Chinese have used tea to treat many ailments from coughs and colds through to headaches and body aches. Tea has been studied for many years, yet scientific research to substantiate the proposed health benefits of tea is continually emerging.

Green tea is a natural choice for a healthy heart and body. Drinking green tea is associated with improved **cardiovascular health** and is a perfect choice to help keep you in shape because it contains virtually no kilojoules or sugar.

The following information aims to give an overview of the benefits of green tea and its components such as **flavonoids**.



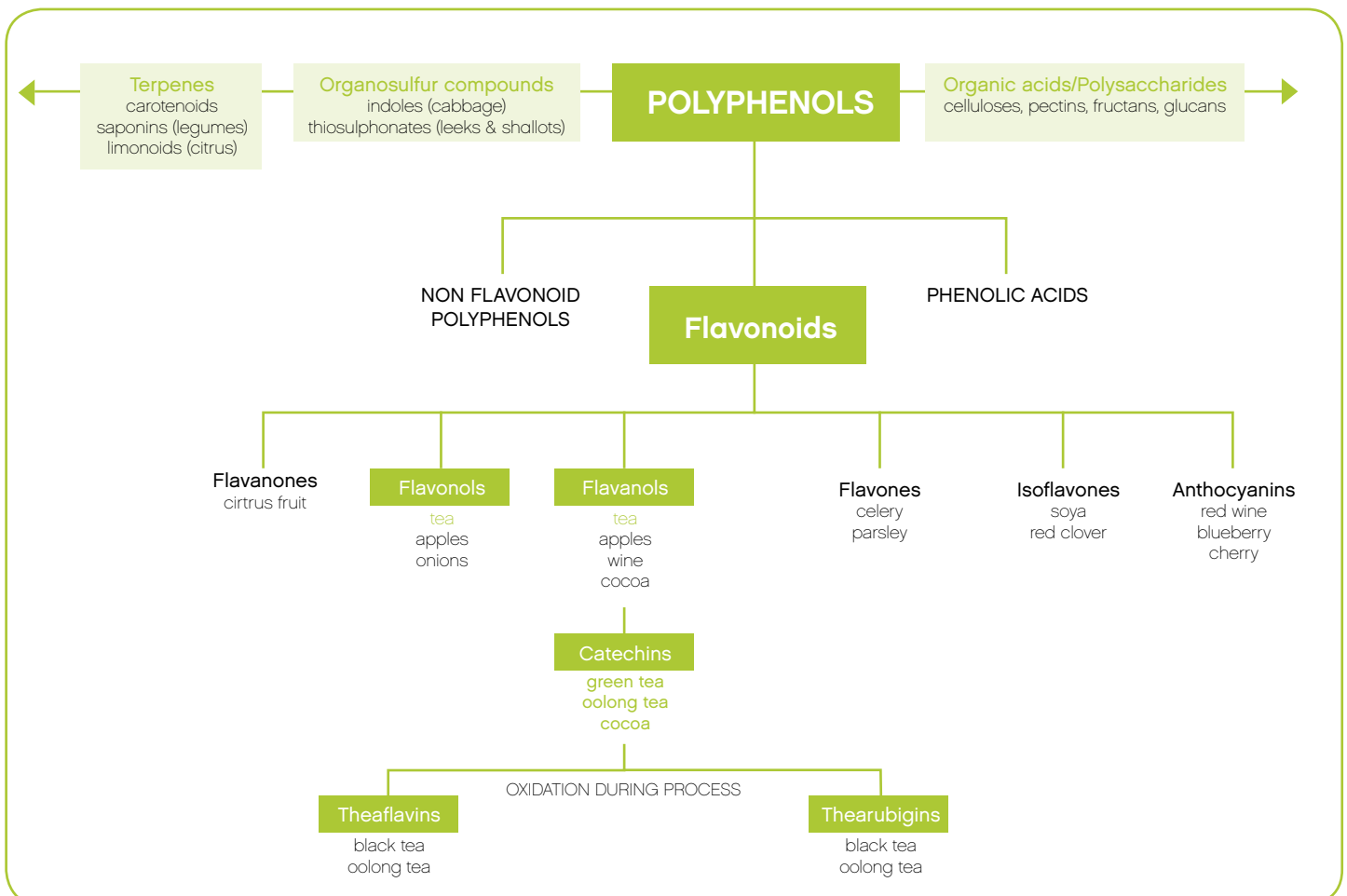
# Tea facts revealed

Green, black and oolong tea are produced from the same plant, *Camellia sinensis*, and are all a rich source of flavonoids. The difference between these types of tea lies in the way they are processed.

*Camellia sinensis* is an evergreen shrub and if its leaves are not dried quickly after picking, they will soon begin to wilt and oxidise. The major step in making tea is to stop the oxidation process by heating tea leaves at different stages depending on the type of tea that is being made:

- > Green tea leaves are heated soon after harvesting so undergo minimal oxidation. This stops enzymatic activity, retaining the majority of **catechin flavonoids** and its green colour.
- > Black tea leaves undergo substantial oxidation, which changes the colour of the leaves from green to brown. This results in the polymerisation of flavonoids into **theaflavin** and **thearubigin flavonoids** (see Figure 1).
- > Oolong tea is a result of oxidation being stopped somewhere between that of green and black tea. Thus, it contains the types of flavonoids found in both green and black tea.

**FIGURE 1. Phytochemicals – The Polyphenolic Family\***



\*Figure compiled by Unilever Research

# Green tea flavanoids

Green tea is a rich natural source of flavonoids. Flavonoids are a group of non-nutrient phytochemicals found universally in plant foods.

Flavonoids belong to the polyphenol family (see Figure 1). The main types of flavonoids found in green tea are catechin flavonoids. Catechins are colourless, water-soluble compounds that contribute to the bitterness and astringency of green tea. Catechins make up about 30% of the dry weight of green tea leaves, but the amount differs depending on the variety of leaf, the growing environment, processing, manufacturing, particle size of ground tea leaves and infusion preparation<sup>(1)</sup>.

Green tea is one of the major sources of flavonoids in the Australian diet<sup>(2)</sup>. A cup of green tea (200ml) provides approximately 140mg of flavonoids<sup>(3)</sup>. Daily flavonoid intake varies widely, but has been estimated for the Australian population to be around 450mg<sup>(4)</sup>.

Flavonoids are found in other foods and beverages like apples, broccoli, garlic, onions, grape juice, cocoa and wine. Certain individual types of flavonoids can be restricted to only a small number of foods<sup>(5)</sup>.

Tea flavonoids are different to those found in most fruits and vegetables. Tea is not a substitute for fruit and vegetables, which provide a wide range of essential vitamins and minerals.

## Antioxidants

Flavonoids have previously been defined as a type of 'antioxidant', which is an umbrella term used to describe a nutrient (e.g. vitamin C and E) or non-nutrient (e.g. flavonoids) which behave to prevent or slow oxidative damage. 'Antioxidants' were thought to provide health benefits by scavenging free radicals in the body. We are beginning to understand that 'antioxidants' actually provide benefits via different mechanisms. Many dietary compounds, including flavonoids, have been shown to have powerful antioxidant actions within *in vitro* test systems. However, these actions do not necessarily predict actions *in vivo* or a related health effect<sup>(6,7)</sup>.

There are hundreds of compounds found in foods and beverages and they have important structural differences. Since structure determines function, where structure differs physiological effect can differ too.

For example, tea and coffee are two commonly consumed beverages.

Being sourced from different plants, tea and coffee contain different antioxidant compounds. The most abundant phenolic compounds in tea are flavonoids whereas in coffee they are chlorogenic acids<sup>(8)</sup>. Because these compounds are structurally different, they also possess different properties.

The health benefits associated with flavonoids are supported by accumulating scientific evidence while scientific data on the benefits of chlorogenic acid is so far limited.

Based on available evidence, as part of a healthy diet, drinking tea has been suggested as a better dietary choice than drinking coffee<sup>(10)</sup>.

**Many dietary compounds, including flavonoids, have been shown to have powerful antioxidant actions within *in vitro* test systems. However, these actions do not necessarily predict actions *in vivo* or a related health effect<sup>(11)</sup>.**

Measuring the 'antioxidant' content of individual foods does not take into account bioavailability or physiological effect. The health benefit of some compounds classified as antioxidants based on *in vitro* analysis may not be related to antioxidant activity *in vivo* at all.

The antioxidant activity of tea flavonoids is often suggested as a mechanism of action for the benefits associated with tea drinking. However, emerging science suggests that the health benefits associated with tea drinking are not simply related to free radical scavenging. Instead, flavonoids may work to improve blood vessel function helping blood vessels relax.

**We are beginning to understand that compounds thought to be providing health benefits via antioxidant activity (free radical scavenging) actually provide benefits via different mechanisms. Emerging science is now focusing on the direct action of flavonoids on blood vessel function.**

# Green tea and cardiovascular health

Accumulating data suggests green tea may have a role in reducing risk of heart disease and stroke. Numerous epidemiological studies have investigated the association between green tea consumption, surrogate markers of cardiovascular disease and cardiovascular events. Most of these studies have been conducted among Asian populations and their findings suggest a cardio-protective effect of green tea intake<sup>(12-15)</sup>.

In one meta-analysis, the association between dietary flavonol (a subclass of flavonoid) intake and subsequent risk of coronary heart disease mortality was analysed. There was a 20% reduction in risk of a fatal event when comparing the flavonol intake of individuals in the top and bottom tertiles. This was after adjustment for known confounding factors<sup>(16)</sup>. Another meta-analysis investigating tea consumption in relation to cardiovascular health, estimated that the incidence rate of myocardial infarction decreased by 11% with tea consumption of three cups per day<sup>(17)</sup>.

A recent meta-analysis demonstrated that daily consumption of green tea could prevent the onset of stroke. Individuals consuming three or more cups of green (or black) tea per day could lower the risk of stroke by 21%, regardless of their country of origin<sup>(18)</sup>.



Accumulating data suggests green tea is associated with a reduced risk of heart disease and stroke. Meta-analyses have demonstrated consuming just three cups (600ml) of tea a day appears to be protective.

# Green tea and blood vessel health

Research suggests that green tea can help keep blood vessels healthy and relaxed. Green tea and green tea flavonoids have been shown to improve endothelial function, which may be the mechanism by which green tea helps protect against cardiovascular disease<sup>(19)</sup>.

The endothelium is the inner lining of all blood vessels and functions as a selectively permeable barrier between blood and tissues. Normal endothelial function regulates vasomotor tone, platelet activity and vascular smooth muscle cell proliferation. Nitric oxide is the key endothelium derived relaxing factor that plays a pivotal role in the maintenance of vascular tone and reactivity, hence is responsible for vasodilation.

Endothelial dysfunction is a broad term that implies diminished availability of nitric oxide and/or an imbalance in the relative contribution of endothelium derived relaxing and contracting factors. When endothelial function is impaired, the capacity of blood vessels to dilate is decreased which increases the risk of cardiovascular disease.

The health benefits of green tea are believed to be due to the presence of high levels of flavonoids. Accumulating scientific research has demonstrated the wide range of health benefits that flavonoids can bring.

Experimental studies have demonstrated that flavonoids can enhance the synthesis and release of endothelial derived nitric oxide<sup>(20)</sup>. A recent human intervention study showed that the dietary flavonoids present in green tea could augment nitric oxide status and reduce the concentrations of the potent vasoconstrictor, endothelin-1<sup>(21)</sup>.

There is good evidence from human intervention trials that green tea consumption improves endothelial function as assessed by flow-mediated dilatation (FMD). FMD measures the ability of an artery to relax, when exposed to increased flow such as after the release of an inflatable cuff <sup>(22-25)</sup>. The improvement in endothelial function has been observed in healthy subjects, after short term and long term tea consumption <sup>(22-24)</sup>.

Another study showed that acute supplementation of one of the major catechins found in green tea, epigallocatechin (EGCG), improved endothelial function in subjects with coronary artery disease<sup>(26)</sup>. Black tea has also been shown to improve endothelial function in humans<sup>(27, 29, 30)</sup>. And one study found improvements in endothelial function even at low intake levels of less than one cup of tea per day<sup>(28)</sup>.

Further, these results are supported by studies showing similar improvement in nitric oxide status and endothelial function using flavonoids derived from other flavonoid rich foods such as cocoa<sup>(19)</sup>.

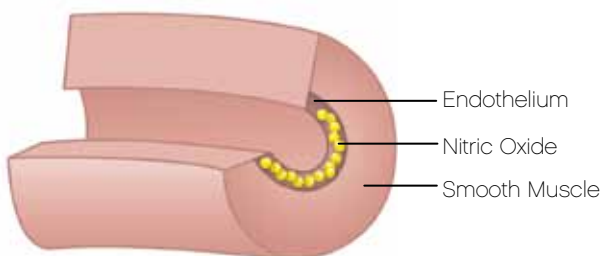


Green tea may help keep arteries relaxed which is critical for cardiovascular health

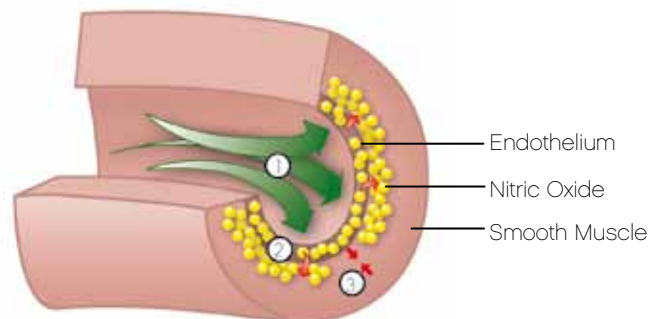
## RESEARCH SUGGESTS GREEN TEA IMPROVES VASCULAR FUNCTION

### Proposed Mechanism of Action\*

Human artery before Green Tea



Human artery after Green Tea



- ① Green Tea intake effects Endothelium
- ② Endothelium releases Nitric Oxide
- ③ Artery relaxes which improves it's elasticity

\*Further research is required to confirm this proposed mechanism of action.

# Green tea and weight management



Drinking green tea as part of a healthy diet can support a healthy shape because it contains virtually no sugar or kilojoules. Green tea is an ideal choice for a weight management plan, especially when substituted for sweetened drinks.

The possibility that green tea may exert a beneficial effect on body composition and weight management has been a recent topic of interest. Emerging data suggest that regular consumption of green tea may increase energy expenditure and reduce visceral fat<sup>(31-33)</sup>.

In a recent study, high catechin intake (625mg per day) was shown to significantly reduce abdominal fat in overweight or obese adults when combined with moderate physical activity<sup>(34)</sup>. In a recent meta-analysis, catechin flavonoids were shown to have a small positive effect on weight loss and weight maintenance<sup>(35)</sup>.

However, studies in this area have been conducted predominately in Asian populations and it is still too early to confirm a specific action of green tea catechins in weight management.

# Green tea and hydration

A healthy adult requires 2-2.5L of fluid every day<sup>(36)</sup>. In many populations, a substantial proportion of total fluid intake is derived from tea.

Tea has all the hydrating properties of water, so it's a great way to keep up daily fluid intake. Despite the popular misconception, caffeine containing beverages, such as tea, do not cause dehydration in regularly consumed amounts. It appears that a tolerance to caffeine develops so any initial diuretic effect seen is diminished in people who regularly drink caffeine containing beverages<sup>(37)</sup>.

A guidance system which ranks beverages according to energy density, nutrient density and health benefits has been developed in the United States<sup>(38)</sup>. This guidance system suggests that up to 4 cups of tea per day can be consumed as a contribution to your overall daily fluid requirements. Green tea is a great way to keep your body refreshed and quench your thirst.

## Summary

While green tea has traditionally been consumed because of its perceived health benefits, clinical trials to substantiate these benefits have only recently been undertaken. The evidence for a beneficial effect of green tea on cardiovascular health is particularly promising. The mechanisms underlying the observed effects remain uncertain, but improved blood vessel function is an area that is accumulating in evidence.

Green tea is a rich source of flavonoids and offers many health benefits.

Drinking green tea is a simple step in the right direction towards a healthy lifestyle.

## Glossary

**Catechins:** Green tea is rich in these types of flavonoids. Catechins are colourless, water soluble compounds that contribute to the bitterness and astringency of green tea.

**Endothelium:** The inner lining of all blood vessels, such as arteries and veins.

**Endothelial function:** When endothelial function is improved, the capacity of blood vessels to expand and contract is increased. When endothelial function is decreased, the capacity of blood vessels to dilate is decreased which contributes to the development of cardiovascular disease.

**Flavonoids:** A group of non-nutrient phytochemicals found universally in plant foods.

**Flow-mediated dilatation:** The ability of a conduit artery to relax when exposed to increased blood flow. A healthy artery will dilate with increased blood flow.

**Vasodilation:** Increase in the diameter (widening) of the blood vessels, especially in arteries

**This brochure has been developed by Unilever Australasia to provide health professionals with up to date information on green tea and health. The information has been independently reviewed by the Dietitians Association of Australia (DAA). For expert nutrition and dietary advice look no further than an Accredited Practising Dietitian (APD). Visit the 'Find an APD' section at [www.daa.asn.au](http://www.daa.asn.au) or call 1800 812 942.**

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