Tea remains the most widely consumed beverage in the world - after water. New research highlights the health benefits of tea\(^1\) and places it second only to water as the healthiest hydration fluid in the world.\(^2\)

The following tea information aims to answer many of the frequently asked questions regarding tea and health.
What is tea?
Green, black and oolong tea are produced from the same plant, Camellia sinensis. The difference lies in the way they are processed. The Camellia sinensis plant is an evergreen shrub. Its leaves, if not dried quickly after picking, soon begin to wilt and oxidise. The major step in making tea is to stop the oxidation process by heating the leaves at different stages depending on the tea type - flavoured leaf teas, green, oolong, white, black.

Tea and flavonoids
Black, green and oolong teas are a rich source of flavonoids from the polyphenol family (see figure 1). Tea flavonoids are different to those found in most fruits and vegetables. While the flavonoids in tea have been shown to have antioxidant properties in vitro, tea is not a substitute for fruit and vegetables, which provide a wide range of essential nutrients, including vitamins and minerals.

The types and amounts of flavonoids found in tea differ depending on the variety of leaf, the growing environment, processing, manufacturing, particle size of ground tea leaves and infusion preparation.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.

- Green tea leaves are heated soon after harvesting so undergo minimal oxidation. This stops the enzymatic activity, retaining the majority of catechin flavonoids and its green colour.

- Black tea undergoes substantial oxidation, which changes the colour of the leaves from green to brown, and results in the polymerisation of catechins into theaflavins and thearubigins flavonoids.

- Oolong tea is a result of oxidation being stopped somewhere in between that of green and black tea and therefore contains flavonoids that are found in both green and black teas.

Five catechin flavonoids (major flavonoids in the tea plant and green tea) have been investigated and identified as:4

- 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 - theaflavins and thearubigins. Four theaflavins (TF) structures have been ascertained:

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

An average cup of black or green tea provides 140-300mg of flavonoids.3,4 Flavonoids have been shown to have a strong antioxidant capacity in vitro. Several human studies have also found that black and green tea consumption can increase plasma antioxidant capacity.4 Whether tea flavonoids are solely responsible for this increase, or other tea components may also have a significant effect is a matter of current investigation.

Figure 1. The Polyphenol family (compiled by the Lipton Institute of Tea)

Figure 2. The type of flavonoids found in green vs black tea (compiled by the Lipton Institute of Tea)
Tea and hydration

Independent scientists agree that tea is an excellent hydration fluid.\(^1\) A healthy adult should aim to consume a daily intake of 2.2 to 2.5 litres of fluid every day.\(^4\) It is a common myth that tea acts as a diuretic because of its caffeine content and may therefore compromise hydration. Review of the literature highlights that:

- Only water surpasses tea as the healthiest hydration fluid.\(^1\)
- Tea is hydrating - not dehydrating.\(^1\)\(^,\)\(^5\)\(^,\)\(^7\) The levels of caffeine in tea will not dehydrate individuals and it is recommended to consume up to two litres of tea per day.\(^1\) A tolerance to caffeine develops so any initial diuretic effect seen is diminished in people who regularly drink tea.\(^1\)\(^,\)\(^7\)
- Hydration is fundamental to a number of physical and mental performances - concentration, alertness, memory, speed and sports performance.\(^1\)\(^,\)\(^5\)

Tea and iron

The flavonoids in tea, similar to the phytoestrogens in wholegrain cereals, have been shown to be potential inhibitors of iron absorption from non-animal sources (non-haem iron). Tea drinking does not adversely affect iron status in healthy individuals with no risk of iron deficiency.\(^9\)\(^,\)\(^10\) Groups at risk of low iron status such as vegetarians, pregnant women and teenage girls, would be advised to choose foods rich in iron and consume vitamin C rich foods to enhance non-haem iron absorption. Foods containing iron include red meat, eggs, legumes, fortified cereals, nuts, seeds and green leafy vegetables. In addition, they would be advised to drink tea between meals rather than with meals.

Tea and heart health

Epidemiological data indicate that individuals who regularly consume green or black tea (without sugar or milk) are more likely to have better heart health than individuals who do not consume tea as part of a healthy balanced diet and lifestyle. Two meta-analyses of epidemiological studies have been conducted to determine the overall effect of black tea drinking and dietary flavonoids on cardiovascular health across populations (from 1966 - 2001).\(^13\)\(^,\)\(^14\) Peters and colleagues concluded that consumption of 3 x 240ml cups of black tea per day is associated with an 11% reduced risk of myocardial infarction.\(^13\) The second meta-analysis, comparing low with high flavonol intake groups, found a 20% reduction in CVD deaths.\(^15\) An epidemiological study investigating the occurrence of heart disease concluded that a higher tea consumption (> two cups per day) reduces the risk of CVD mortality by over 40%.\(^27\)

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

Tea and calorie intake

Tea is a good source of dietary fibre and contains no added sugars or synthetic preservatives. The total flavonoid content of black and green tea is similar (see Figure 2) however they contain different types of flavonoids that may have different modes of action and bioavailability (see figure 1). Human studies have shown an increase in blood antioxidant capacity after consumption of black tea.\(^14\)

Drinking tea causes dehydration.\(^1\)\(^,\)\(^5\)\(^,\)\(^7\) Tea is an important source of fluids and does not cause dehydration in regularity consumed amounts.\(^1\) Independent scientists have placed tea second only to water as the best hydration fluid\(^2\) and recommend up to 2 litres of tea per day.

Tea contains the same amount of caffeine as coffee.\(^2\)\(^,\)\(^5\) Tea typically contains less than half the caffeine per cup compared to coffee.

### Table 1. The caffeine content of beverages as consumed\(^2\)

<table>
<thead>
<tr>
<th>Beverage</th>
<th>Caffeine content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instant coffee</td>
<td>75mg/190ml cup</td>
</tr>
<tr>
<td>Blended coffee (filtered or percolated)</td>
<td>100-115mg/190ml cup</td>
</tr>
<tr>
<td>Decaffeinated coffee</td>
<td>4mg/190ml cup</td>
</tr>
<tr>
<td>Tea</td>
<td>50mg/190ml cup</td>
</tr>
<tr>
<td>Cola drinks</td>
<td>11 - 70mg/330ml can</td>
</tr>
<tr>
<td>Hot chocolate</td>
<td>1.1 - 8.2mg/200ml serving</td>
</tr>
<tr>
<td>Energy drinks (with added caffeine or guarana)</td>
<td>28 - 87mg/350ml serving</td>
</tr>
</tbody>
</table>

At this point in time, the scientific evidence suggests that tea consumption may be a protective factor in heart health. However, the exact mechanism and dosage has to be identified. Improvement in endothelial function may be a possible mechanism.

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**Dispelling the myths**

- **Black tea is not a good source of flavonoids.**\(^1\)\(^,\)\(^5\)\(^,\)\(^7\) Green and black tea both come from the same plant - *Camellia sinensis*. The total flavonoid content of black and green tea is similar (see Figure 2) however they contain different types of flavonoids that may have different modes of action and bioavailability (see figure 1). Human studies have shown an increase in blood antioxidant capacity after consumption of black tea.\(^14\)

- **Drinking tea causes dehydration.**\(^1\)\(^,\)\(^5\)\(^,\)\(^7\) Tea is an important source of fluids and does not cause dehydration in regularity consumed amounts.\(^1\) Independent scientists have placed tea second only to water as the best hydration fluid\(^2\) and recommend up to 2 litres of tea per day.

- **Tea contains the same amount of caffeine as coffee.**\(^2\)\(^,\)\(^5\) Tea typically contains less than half the caffeine per cup compared to coffee.
Tea and weight management

Tea, when served without milk or sugar, contains virtually no calories. This makes tea an ideal choice for a healthy weight maintenance plan especially when substituting for sweetened beverages. Moreover, emerging science suggests that long term consumption of high catechin green tea improves body composition and fat distribution in Asian populations, through reduction in visceral fat and waist circumference. The more human trials are needed to validate this effect. High green tea consumption (catechins: 375mg/d; caffeine 150mg/d) has also been shown to help increase energy expenditure and fat oxidation in both human and animal studies.

Tea and dental health

Tea is a unique source of fluoride and therefore can contribute to healthy teeth. Additionally, some studies have demonstrated tea flavonoids to increase acid resistance of enamel, to act as an antibacterial and to inhibit human salivary amylase resulting in a reduction of the cariogenic potential of starch-containing food. These factors may further add to the link between tea and good dental health, however, further clinical studies are required.

Tea revitalises both mind and body

Regular black tea consumption has been shown to improve alertness and mood without adversely affecting sleep quality. The low levels of caffeine found in tea have also been investigated and found to improve both physical and mental performance.

Tea and L-theanine

Tea is a unique source of a naturally occurring amino acid L-theanine. L-theanine, at doses found in two to three cups of tea, has been shown to increase alpha brainwaves which are associated with a relaxed but alert mental state. Alpha activity also plays an important role in the ability to focus attention. This may help explain why consumers often report to be both revitalised and relaxed when they consume tea. Research continues in this area.

In summary:

Tea has traditionally been consumed because of its perceived health benefits and from the evidence to date, it is clear that tea consumption does contribute to health:

- Tea as an excellent hydration source is now undisputed. 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 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, and to a weight management programme.
- Tea is a rich source of flavonoids which have been shown to possess antioxidant properties in vitro, and tea consumption has been shown to increase blood antioxidant capacity. The impact dietary antioxidants may have on health is under investigation.
- In general, the epidemiological data to date points towards a positive association between regular tea consumption (without milk and sugar) and better heart health. Some studies indicate that tea flavonoids are associated with better endothelial function, which may explain the benefit to heart health.
- Tea contains L-theanine and low levels of caffeine which may have positive effects in helping individuals keep alert. L-theanine, the major source of L-theanine which may help to produce a relaxed and alert mental state. Moreover, caffeine has been shown to improve mental and physical performance, and therefore can revitalise the body and mind.
- Tea contains fluoride and tea flavonoids have demonstrated antibacterial properties. Therefore, tea drinking may help maintain good dental health.