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 flavonoid from the polyphenol family (see figure 1). Tea flavonoids are different to those found in most fruits and vegetables.

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. 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.

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Figure 1. The Polyphenol family (compiled by the Lipton Institute of Tea)
Five catechin flavonoids (major flavonoids in the tea plant and green tea) have been investigated and identified as:

- 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.¹ ³
The levels of caffeine in tea will not dehydrate individuals and it is recommended that Caffeine sensitive individuals, pregnant / lactating women or children, should seek specific advice from their registered nutrition expert and or doctor.

It is a common myth that tea acts as a diuretic because of its caffeine content and may cause dehydration. Drinking tea causes dehydration.

There is a great deal of consumer confusion surrounding caffeine and tea. Caffeine is an alkaloid that can be found in varying quantities in coffee, tea, chocolate and cola based drinks. However, 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. A typical cup of tea contains approximately half the caffeine of a typical cup of instant coffee (see Table 1).

Caffeine in moderation i.e. up to 300-400mg per day has no adverse effects on health and may have beneficial effects on mood, mental and physical performance. Moreover, a number of caffeine reviews have demonstrated that caffeine at levels found in commonly consumed beverages is not dehydrating. New guidelines advise Pregnant women to limit daily caffeine intakes to 200mg. This equates to 3-4 cups of tea. Caffeine sensitive individuals, lactating women and children, should seek specific advice from their registered nutrition expert and or doctor.

Table 1. The caffeine content of beverages as consumed

<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>Brewed 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/250ml serving</td>
</tr>
</tbody>
</table>
Tea and hydration

Independent scientists agree that tea is an excellent hydration fluid\(^5,6\). A healthy adult should aim to consume a daily intake of 2.2 to 2.5 litres of fluid every day\(^7\). It is a common myth that tea acts as a diuretic because of its caffeine content and may therefore compromise hydration. Large amounts of caffeine taken in one sitting (i.e. 250-500mg) can increase urine output and increase the risk of dehydration, however this has not been seen when caffeinated drinks are consumed\(^3\). Review of the literature highlights that:

- Only water surpasses tea as the healthiest hydration fluid\(^5,6\). A recent clinical study showed that 4 cups of tea per day are equally hydrating to an equivalent amount of tap water\(^8\).
- Tea is hydrating - not dehydrating\(^3,5,6\). The levels of caffeine in tea will not dehydrate individuals and it is recommended to consume up to two litres of tea per day\(^6\). A tolerance to caffeine develops so any initial diuretic effect seen is diminished in people who regularly drink tea\(^3,5\).
- Hydration is fundamental to a number of physical and mental performances - concentration, alertness, memory, speed and sports performance\(^5,6\).

Tea and iron

The flavonoids in tea, similar to the phytates in wholegrain cereals, have been shown to be potential inhibitors of iron absorption from non-animal sources (non-haeme 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-haeme 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

The largest body of evidence on tea and health relates to cardiovascular disease. 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)\(^11,12\).

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\(^12\). Evidence on stroke is also strong. One meta-analysis reported a 21% reduced risk of developing, or dying from, a stroke when three or more cups of tea were consumed\(^13\). Another meta-analysis found a 20% reduction in stroke when higher intakes of dietary flavonoids were consumed (i.e. 16-47mg per day)\(^14\).

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

- Overall lifestyle habit of the individuals including diet and exercise
- Heterogenicity 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 better heart health. 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 the ability of blood vessels to dilate: Perhaps the strongest available evidence lies in tea’s ability to relax blood vessels as measured by flow-mediated dilatation (FMD)\(^15,37\).
- Lowering blood cholesterol: although a popular theory, the evidence is far from conclusive – a few studies show a cholesterol lowering effect (from 3.8% to 11.3%) of green as well as black tea\(^16,17,38,39\).

However, a fair number of studies show no benefit or effect from either green or black tea consumption.

- Inhibition of platelet aggregation: research is still in its infancy\(^18\).

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.
Tea and weight management
In addition to the calorie-free properties of tea (when consumed without sugar and milk), there is evidence that green tea may be beneficial as part of a weight management programme. This is possibly because caffeine, and catechins (the particular flavonoids found in green tea), work synergistically to promote body fat loss and increase energy expenditure. In Asian populations, research shows that a regular intake of catechin-enriched green tea reduces total body fat, in particular the fat around the waist, especially when combined with exercise. Evidence is still building in Western populations but could have important implications since excess body fat around the waist relates more strongly to health risks e.g. type 2 diabetes, than body weight alone.

Tea and dental health
Tea can be a source of fluoride depending on cultivation and preparation factors. It has been estimated that 1 litre of tea prepared with fluoridated water could provide around 2.2mg of fluoride per day. 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
Studies have shown consuming a few cups of tea during the day helped to sustain alertness. More recent studies have linked regular tea drinking, at around 4 servings daily, with reduced stress and increased relaxation, or an enhanced ability to focus attention. Ruxton (2008) found that moderate caffeine intakes of 38mg to 400mg/day, the equivalent intakes of one to eight cups of tea, appeared to deliver the benefits of improved mood and mental performance without adversely affecting sleep quality. Other studies have also shown that moderate intake of caffeine can improve physical performance. Taken together with data above showing tea to be a good source of hydration, this evidence supports tea's ability to revitalize both mind and body.

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 when performing a cognitive task. This may help explain why consumers often report to be both revitalized and relaxed when they consume tea. Research continues in this area.

Diabetes
A new area of research has seen some studies linking tea consumption with a reduced risk of type 2 diabetes. In a large-scale Chinese survey, drinking one or more cups of tea per day was associated with a 14% reduction in diabetes risk. This was confirmed by two met-analyses. It is thought that tea flavonoids could support normal glucose metabolism by lowering inflammation and by promoting insulin activity but further human studies are needed before drawing any conclusions.

Cancer prevention
Laboratory tests generally show that tea flavonoids stimulate normal cell turnover and inhibit tumour development. While these actions would be expected to help cancer prevention or management in the long-term, evidence from human trials is lacking. Some surveys have reported a lower risk of colon cancer in regular tea drinkers, but the results are inconsistent. Until further research is done, no firm conclusions can be drawn about cancer prevention properties of tea.

Bone health
A review found that tea had a modest beneficial effect on bone mineral density (BMD), particularly in older women where significant increases were seen when four or more cups of tea were consumed daily. A survey of 1500 elderly women reported that BMD was higher in regular tea drinkers, and declined more slowly over time, compared with BMD in non-consumers of tea. These data now need to be confirmed by controlled trials. It is not clear why tea may affect bone health but there is speculation, based on animal and cell studies, that the flavonoids in tea, particularly green tea, act by enhancing bone creation and inhibiting bone breakdown.
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 in the diet.** Although large variations in content can occur due to differing sources, preparation methods etc., it has been shown that in tea drinking populations, tea provides a significant contribution to daily flavonoid intake.

- **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 together may have positive effects in helping individuals keeping alert.** The major source of L-theanine and when consumed independently of tea may help to produce a relaxed and alert mental state. Moreover, caffeine has been shown to improve mental and physical performance. Taken together data supports teas ability to revitalize the body and mind.

- **Tea contains fluoride and tea flavonoids have demonstrated antibacterial properties. Therefore, tea drinking may help maintain good dental health.**

Reference List
