

Tea time

Robin Seymour examines the links between tea and fluoride, and reveals if drinking the world's second favourite beverage has any dental or health benefits

Tea (*Camellia sinensis*) is the most widely consumed beverage in the world after water (Hodgson and Croft, 2010). Black tea is the most popular type, representing 78% of the tea consumed worldwide; 20% is green tea; and 2% oolong (Siddiqui et al, 2004). Up to 83% of UK adults drink tea with older adults (65 years and older), drinking more than those aged 19-64 years (Ruxton, Phillips and Bond, 2015).

Tea contains an array of compounds including amino acids, organic acids, methylxanthines, flavonoids and related polyphenols, as well as small quantities of micronutrients, including B vitamins, manganese, zinc and fluorine, and also caffeine and L-theanine.

Tea polyphenols are of great interest because of their antioxidant and anti-inflammatory properties and their links with reduced mortality (Gardener et al, 2013), cardiovascular health (Zhang et al, 2015), improved cognitive function (Einothar and Martens, 2013), protection against diabetes (Ruxton and Mason, 2012), bone health (Shen, Chyu and Wang, 2013) and weight management (Bohn et al, 2014).

While fluoride in tea has been linked with very limited health concerns these are not born out by evidence, which suggests that estimated fluoride intakes from tea are well

within tolerable upper limits and that tea can contribute to both dental and bone health benefits (Ruxton and Bond, 2015).

The role of fluoride

Fluoride is a naturally occurring mineral that can be obtained from foods and fluids originating from soils containing fluoride, as well as by drinking water that has been fluoridated. According to the British Fluoridation Society, in the UK, 10% of the population receives fluoridated water at a level of 1mg/litre.

Fluoride plays a major role in the mineralisation of bones and teeth (Palmer and Gilbert, 2012), and hence has a protective effect on bone and dental health.

A chronically high intake exceeding the safe upper levels for fluoride intake can lead to dental and skeletal fluorosis but this is exceedingly rare in developed countries, and tends to be seen in countries such as Kenya and China, where soil or water contains excess fluoride.

Mild to moderate dental fluorosis causes white mottling of the tooth enamel and despite being considered unsightly actually has the effect of increasing resistance of the teeth to dental caries. According to Public Health England, moderate to severe dental fluorosis affecting between 3 and 6% of people in fluoridated areas can result

in yellow marks and pits on tooth enamel, but does not cause a danger to the tooth.

A recent review that included an evaluation of the effect of fluoride on bone and dental health found from the balance of evidence that while adverse effects on bone can occur at chronically high levels of fluoride intake, bone density and strength can be improved at recommended levels of fluoride intake.

Fluoride content of tea

Tea is a major contributor to fluoride in the UK. Other sources include fish and milk, as well as artificially fluoridated sources such as tablets, drops or chewing gum (Department of Health, 1991).

Among adults, tea has been found to provide 70% of the average daily fluoride intake (Department of Health, 1991), although this depends on the type of tea consumed and whether fluoridated tap water was used (Chan et al, 2013).

In children, a 2006 study showed that tap water, squashes and cordials were the main sources of fluoride whether tap water was fluoridated or not (Zohouri, Maguire and Moynihan, 2006).

Fluoride guidelines

Guidelines for fluoride intake have been set by official bodies including in Europe and the UK (see Table 1).



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In Europe, fluoride is considered to have a beneficial effect on dental health and an adequate intake of 0.05mg/kg/body weight has been set for adults, children and pregnant women. This reflects the chronic intake that would be expected to meet the body's requirement for fluoride (Department of Health, 1991).

The UK set a safe and adequate intake level of 0.05mg/kg/body weight/day to reflect the 'no observed adverse effect' level for dental fluorosis (a condition causing mottling of the teeth arising from excessive fluoride consumption). Safe upper levels have been set in Europe at 0.1mg/kg/body weight/day for children aged one to eight years, 5mg daily for children aged nine to 14 years and 7mg daily for adults, including pregnant and breastfeeding women.

Fluoride intakes

Fluoride intakes vary quite widely. According to the European Commission, fluoride intakes in Europe vary broadly from 0.13 to 8.40mg daily. In 2000, the Committee on Toxicology (COT) considered the results of a study conducted by the Food Standards Agency in which samples collected in the 1997 Total Diet Study (TDS) were analysed for the presence of fluorine, bromine and iodine. This analysis found, in the UK, fluoride exposure in children aged 18 months to 10 years to range from 0.023 to 0.031mg/kg/body weight/day. In youngsters aged 11-18 years, the range was 0.015 to 0.017mg/kg/body weight/day, while in adults, intake averaged 0.016mg/kg/body weight/day.

High consumers of fluoride had intakes ranging from 0.06mg/kg in children aged four to six years to 0.033mg/kg/body weight/day in adults. Urinary excretion data from the National Diet and Nutrition Survey for 2002-2003 have been used to estimate fluoride intakes and it was concluded that only 1% of men and 3% of women had fluoride intakes above the adequate intake (AI) of 0.05mg/kg/body weight/day.

Benefits of fluoride

Fluoride has beneficial effects on both teeth and bone.

With regards to teeth, the most common benefit is prevention of dental caries. Fluoride helps to prevent caries when provided systemically in the diet or in supplements, or topically as toothpastes or mouthwashes. When given systemically, fluoride works only at the pre-eruptive stage of tooth development, before the second teeth appear, ie, at the ages of two

Official body	Guideline
British Dental Association (1997)	Fluoride is unnecessary for infants <6 months. Fluoride should not be given where the drinking water contains >700 microgram fluoride/litre
Department of Health (1991)	Safe intakes of fluoride for adults are 0.05mg/kg body weight/day
European Food Safety Authority (2013)	Adequate intake (AI) of 0.05mg/kg/body weight/day for children, adults, pregnant and breastfeeding women
European Food Safety Authority (2006)	Upper levels of fluoride: Children aged one to eight years: 0.1mg/kg/bodyweight/day (equivalent to 1.5mg/day for children one to three years; 2.5mg/day for children four to eight years) 5mg/day for children aged nine to 14 years 7mg/day for those >15 years including pregnant and breastfeeding women

Table 1: UK and European guidelines for fluoride

to eight years. In contrast, topical fluoride does not have an age limit, which is why toothpastes and other dental products contain it. According to Public Health England, in areas of water fluoridation, 28% fewer five-year-olds and 21% fewer 12-year-olds present with decay.

Fluoride also has benefits on bone, since at low doses it can embed in the bone matrix protecting against erosion (Chachra, Vieira and Grynopas, 2008), resulting in increased density and hardness. A meta-analysis of 25 studies found that 20mg/day fluoride equivalents was associated with a significant reduction in fracture risk (Vestergaard et al, 2008). However, a randomised controlled trial in 180 post-menopausal women using fluoride supplements providing 2.5mg, 5mg or 10mg/day found no significant effect on bone mineral density after a year (Grey et al, 2013).

Fluoride health claims

Dental health claims for fluoride have been approved by the European Food Safety Authority (Table 2). A 'source' claim can be made for foods and beverages that provide at least 15% of the European Nutrient Reference Value (3.5mg) per 100g. Claims could therefore be made for products containing at least 0.5mg/100g or 100ml as sold.

One example of a beverage that could make fluoride-related dental health claims is tea, since the amount of fluoride per 100g dry weight meets the criteria for a 'source' claim for many types of black tea.

Interestingly, the dental health benefits of tea have been highlighted previously since tea polyphenol compounds have

antibacterial actions (Araghizadeh, Kohanteb and Fani, 2013), and can regulate acid production in dental plaque (Goenka et al, 2013), while tea consumption has been associated with reduced tooth loss (Koyama et al, 2010).

Fluoride levels in tea

Tea naturally accumulates fluoride from soil and water during its growth and estimates of fluoride content of retail tea leaves vary considerably depending on the grade of tea, country of origin and level of fermentation (ie, whether the tea is black, green, white or oolong) (Malinowska et al, 2008).

An analysis of fluoride in retail tea bags published in 2013 by Chan and colleagues suggested that consuming typical amounts of tea from economy brands could lead to excessive fluoride exposure. This publication led to media coverage about the potential dangers of tea consumption (McArthur, 2014).

However, there were several drawbacks to the study, including the creation of a standard brew using 2g of tea in 100ml whereas 3.1g of tea in 180-200ml is more common. Long brewing times of two, 10 and 30 minutes were also used in the study. In addition, the authors determined fluoride intake from tea based on a daily intake of one litre whereas typical tea intakes in the UK are 500-600ml (McArthur, 2014). They also compared estimated fluoride intake with the US male AI level of 4mg daily rather than the tolerable upper intake level, which in Europe is 7mg daily. Different methods were used to measure fluoride in dry tea and tea infusions. All of these issues could have served to



TRENDING

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78%

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Proposed health claim	Condition of use
Fluoride strengthens the teeth/enamel Fluoride helps protect the teeth Fluoride helps the teeth to recover after meals	Must be at least a 'source' of fluoride for example 0.5mg/100g or 100ml as sold
Fluoride contributes to the maintenance of healthy teeth or tooth mineralisation	As above. Applicable to both children and adults

Table 2: Approved health claims for fluoride (European Food Safety Authority, 2015)

overestimate the potential exposure of fluoride exposure from tea.

A more recent study of the fluoride content of typical UK black-blended retail tea bags, specialty tea and decaffeinated tea used more robust and more realistic methodology, in that a single validated analytic method was used for fluoride measurement together with a standardised brew typically consumed by the UK consumer (Ruxton and Bond, 2015).

Based on the analysed content of fluoride in the teas and typical intakes of tea in the UK, daily intakes of fluoride were less than the EU recommended daily allowance and AI in this study except for those with very high tea consumption (>95th percentile) and were also within age appropriate tolerable upper intake levels at both mean and very high tea intakes. When non-consumers were excluded from the data, intakes of fluoride remained less than the safe upper limit for all groups except those aged 1.5-3 years and those over the age of 65 years with very high intakes.

The authors concluded that their findings suggest that tea can safely be consumed from the age of four years. Some of the brands they examined contained sufficient fluoride for a European health claim relating to strengthening and maintaining tooth enamel.

Conclusion

Overall, tea can be considered to be an important source of fluoride in the UK diet and in typical amounts of tea consumed in the UK of two to three servings a day contributes fluoride but not at levels that meet recommended intakes, or exceed safe limits.

Higher consumers of tea (up to five cups daily) are more likely to meet fluoride recommendations but will still generally remain below safe upper limits for fluoride.


In children aged between four and 10 years, an appropriate intake would be one to two servings and in older children up to four servings daily could be consumed (Ruxton and Bond, 2015). [OH](#)

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More references can be found online at www.teadvisorypanel.com



Enhanced CPD

Topic: Oral health and nutrition
Level: Intermediate

Educational aims and objectives

This article aims to explain tea and fluoride.

Clear expected outcomes

By the end of this article, the reader will understand that tea is a source of fluoride and how much will need to be consumed to meet recommended levels.

Verifiable CPD hours: 1