

# Tea and hydration the caffeine myth



Tea is recognised as an ideal fluid choice for hydration, and its consumption is recommended up to 8 cups per day. Current scientific evidence does not support the suggestion that incorporation of caffeine-containing beverages in a normal lifestyle is associated with poor hydration status.



Fluid is vital for life and maintaining a proper fluid balance is critical for general health and well-being. Acute dehydration can result in impaired cognition, moodiness, poor thermoregulation, reduced cardiovascular function and impaired physical work capacity.<sup>1</sup> Fluid balance can be compromised by either failure to consume sufficient fluid to meet ongoing water losses or by ingestion of diuretic agents.<sup>2</sup>

Commonly consumed diuretics contain methylxanthine compounds like caffeine, theophylline and theobromine, which are found in coffee, tea, cola drinks and chocolate products. The common perception is that caffeinated beverages have adverse effect on fluid balance, lead to dehydration and should be avoided in situations where fluid balance is critical. This potential negative effect on fluid balance is one of the most frequently cited barriers to tea recommendation amongst health professionals. Although this belief is widespread, it is difficult to find a solid foundation of evidence on which it is based.

**Table 1. Caffeine content of different beverages**

Source	Caffeine content per serving*			
	MAFF (1998)	Ziegler <i>et al.</i> (1996)	McArdle <i>et al.</i> (1999)	Thomas
Tea	40	59	12-67	15-75
Instant coffee	58	76	53-144	61-70
Filter coffee	61-125	105	85-200	97-725
Hot chocolate	-	21	8-13	-
Cola	23	70	36-59	43-65

\*Serving size is corrected to 200 ml for tea, coffee and hot chocolate and 330 ml for cola

## Tea drinking and fluid balance: Evidence from the studies

This negative perception is based on studies that demonstrated an increase in urine production following caffeine ingestion. The frequently cited studies that recommend to avoid caffeinated beverages are those of Robertson *et al.* (1978),<sup>3</sup> Passmore *et al.* (1987)<sup>4</sup> and Neuhauser-Berthold *et al.* (1997).<sup>5</sup>

Neuhauser-Berthold *et al.* (1997) showed that ingestion of 642 mg of caffeine spread over the day and after 6 days of coffee deprivation resulted in an increase in urine output compared with a control trial. Robertson *et al.* (1978) also found an increase in urine output compared to placebo trial in subjects who consumed one single dose of 250 mg caffeine after 3 weeks of caffeine deprivation. Passmore *et al.* (1987) who examined the effect of caffeine at doses of 45, 90, 180, and 360 mg found a higher urine output than on the placebo trial only at the highest dose of caffeine.

Some other studies challenged this belief and showed that caffeine when consumed under more naturalistic conditions does not have a diuretic effect. Grandjean *et al.* (2000)<sup>6</sup> studied the effect of water vs water and a combination of caffeine-containing drink consumed over the day. No difference in urine output was observed between trials where water, a low dose of caffeine (114 mg) or a higher dose of caffeine (253 mg) was given.



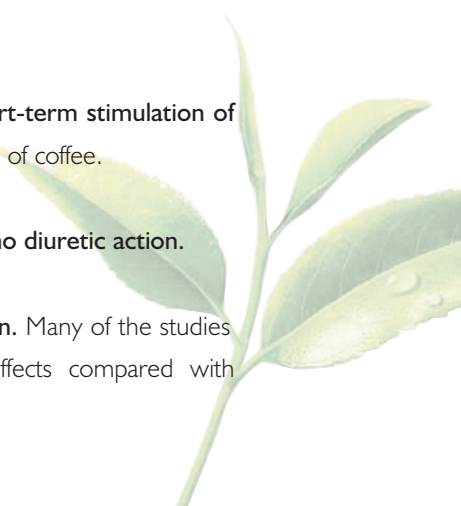
Table 2. Summary of the studies investigating the diuretic effect of caffeine

Studies	Number of subjects	Caffeine withdraw period before study	Caffeine (mg/d)	Administration of caffeine	Diuretic effect
Neuhauser-Berthold (1997) <sup>5</sup>	12	6 days	642 mg	Over the day	yes
Robertson <i>et al.</i> (1978) <sup>3</sup>	9	3 wks	250 mg	Acute	yes
Nussberger <i>et al.</i> (1990) <sup>8</sup>	8	1 wk	250 mg	Acute	yes
Wemple <i>et al.</i> (1996) <sup>9</sup>	6	4 days	490-680mg	In 4 hours	yes at rest no with exercise
Passmore <i>et al.</i> (1987) <sup>4</sup>	8	240 mg/d caffeine during 5d 24 h caffeine abstinence	45 mg	Acute	no
			90 mg		no
			180 mg		no
			360 mg		yes
Dorfman and Jarvik (1970) <sup>7</sup>	10	no	300 mg	Acute	no
Grandjean <i>et al.</i> (2000) <sup>6</sup>	18	no	114 mg	Over the day	no
			253 mg		no
Riesenhuber <i>et al.</i> (2006) <sup>10</sup>	12	no	240 mg	In 30 min	yes
Armstrong <i>et al.</i> (2005) <sup>11</sup>	59	3 mg/kg/d during 3 days prior trials	3 mg/kg	Acute	no
			6 mg/kg		no
Scott <i>et al.</i> (2004) <sup>12</sup>	15	Overnight (12h)	? (8 to 9 cups tea)	Over the day	no
Fiala <i>et al.</i> (2004) <sup>13</sup>	10	4 days	~ 244 mg	Over 3 days	no

The data summarized in Table 2 suggest that a diuretic response of caffeinated beverages is likely to occur in response to an acute dose of caffeine of about 250-300 mg or more in individuals previously caffeine-deprived, but is unlikely at doses of about 250 mg or less. There is some overlap in those results that can be ascribed to differences in experimental designs (body mass of subjects, period of withdrawal imposed, urine collection periods varying from 3 to 24 hours).<sup>2</sup>

The review of Maughan and Griffin (2003)<sup>2</sup> evaluates the literature concerning the effect of caffeine ingestion on fluid balance and they conclude that:

- **Ingestion of large dose of caffeine - above 250 mg/300 mg - at one sitting results in short-term stimulation of urine output.** This dosage is equivalent to the amount present in 5-8 cups of tea and 3-5 cups of coffee.
- **Single caffeine doses at the levels found in commonly consumed beverages have little or no diuretic action.**
- **Regular caffeine users become habituated to the effects of caffeine, diminishing its action.** Many of the studies imposed extended caffeine-withdraw periods and therefore may exaggerate caffeine effects compared with consumption by regular users under normal conditions.





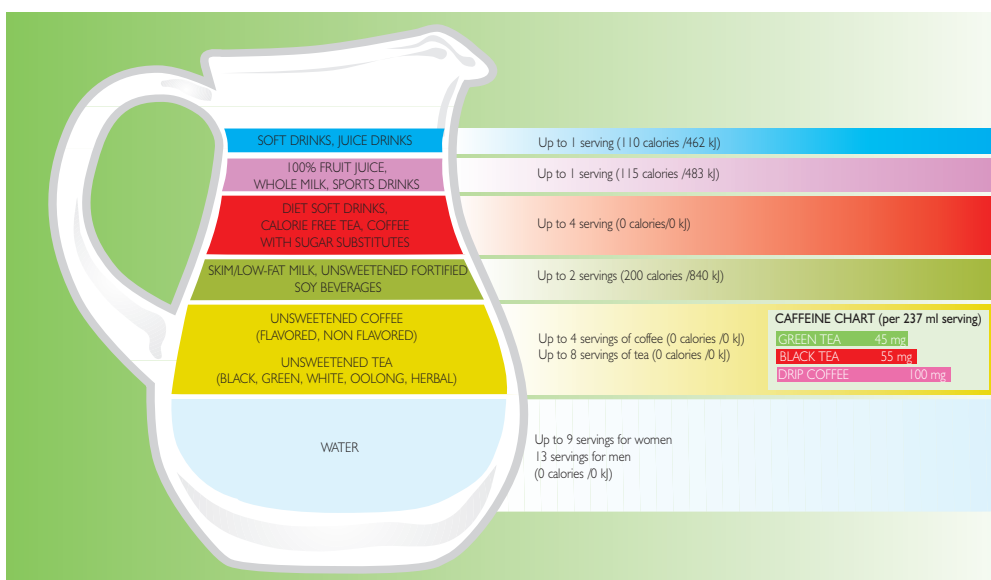
This review concludes that the published studies offer no support for the suggestion that the incorporation of caffeine containing beverages in a normal lifestyle is associated with poor hydration status. Furthermore, the review of Armstrong (2002),<sup>14</sup> which investigates the effects of caffeine on dehydration and exercise performance, concludes that athletes and recreational enthusiasts will not incur detrimental fluid-electrolyte imbalance if they consume caffeinated beverages in moderation and eat a well-balanced diet. Another study<sup>13</sup> looking at rehydration after two-a-day exercise sessions found no differences in an athlete's ability to rehydrate with a caffeinated vs non caffeinated beverage. This challenges the common belief that caffeine-containing drinks are less efficient at correcting post exercise dehydration than water or isotonic drinks.

The effect of drinking tea on hydration status has been further explored in a study where fluid balance of the body was stressed.<sup>12</sup> Nine males and four females members of an expedition at Mt Everest were subjected to a cross over experimental design comprising two 24-hour dietary interventions: 'tea condition' where hot brewed tea was a major part of fluid intake and the 'no tea' condition where tea was excluded from the diet. In both cases, other caffeinated beverages were prohibited. No differences in urine volume or other hydration status were observed between the two conditions. This study showed therefore that even when fluid balance is stressed, there is no evidence that tea acts as a diuretic when consumed by regular tea drinkers.

Thus, the evidence suggests that tea consumption does not produce a diuretic effect unless the amount of tea consumed at one sitting contains more than 300 mg caffeine (equivalent to 5-8 cups of tea).

## The Healthy Beverage Guidelines: Tea as an ideal beverage choice

A new guidance system for beverage consumption has been recently published in the American Journal of Clinical Nutrition<sup>1</sup> to provide consumers with an easy guide to select healthier beverages, based on their energy density, nutrient density and eventual health effects. This guideline supports the previous findings and ranks **tea as second to water as an ideal beverage choice for hydration. The authors recommend the consumption of up to 8 cups of tea per day** (caffeine being the limiting factor).



## Tea's contribution to fluid intake

Finally, tea is the most consumed beverage in the world after water and a cup of tea is 99.5% water. Thus, tea contributes significantly to daily fluid requirements and body's hydration status. In Great Britain, the National Drinks Survey (2003) suggests that tea contributes significantly to fluid intakes, particularly in those aged 65 years and over where it represents 85% of beverage consumption.

The current scientific evidence does not support the advice to the general population to avoid consumption of caffeine-containing drinks on the grounds of their diuretic effects. Tea can significantly contribute to body's hydration and recommendations are to consume up to 8 cups of tea a day.



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