

Addition of milk does not affect the absorption of flavonols from tea in man.

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Tea is a major source of flavonols, a subclass of antioxidant flavonoids present in plant foods which potentially are beneficial to human health. Milk added to tea, a frequent habit in the United Kingdom, could inhibit absorption of tea flavonoids, because proteins can bind flavonoids effectively. Eighteen healthy volunteers each consumed two out of four supplements during three days: black tea, black tea with milk, green tea and water. A cup of the supplement was consumed every 2 hours each day for a total of 8 cups a day. The supplements provided about 100 micromol quercetin glycosides and about 60 - 70 micromol kaempferol glycosides. Addition of milk to black tea (15 ml milk to 135 ml tea) did not change the area under the curve of the plasma concentration-time curve of quercetin or kaempferol. Plasma concentrations reached were about 50 nM quercetin and 30 - 45 nM kaempferol. We conclude that flavonols are absorbed from tea and that their bioavailability is not affected by addition of milk.

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Bioavailability of soluble oxalate from tea and the effect of consuming milk with the tea.

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OBJECTIVES: To measure the availability of oxalate normally extracted when making tea from two commercially available black teas bought from a supermarket in Christchurch, New Zealand in July 2001. **DESIGN, SUBJECTS AND INTERVENTION:** A randomized double crossover study. Six students and four staff consumed six cups of each brand of tea both with and without added milk over a 24 h period. A total urine collection was taken for the initial 6 h followed by a further 18 h. The oxalate content of the urine voided was measured using an enzyme kit method and the availability of the soluble oxalate consumed was measured for the 6 h and the total 24 h sample. **SETTING:** University campus. **RESULTS:** The mean soluble oxalate content of black tea in the two different commercial tea bags was respectively 6.1 and 6.3 mg soluble oxalate/g tea. The mean availability of the oxalate extracted from tea measured over a 6 h period ranged from 1.9 to 4.7% when tea was consumed without milk. The availability of the soluble oxalate from tea ranged from -3.0 to 2.3% for each of the two brands of tea investigated over a 24 h period. **CONCLUSION:** These studies show that consuming black tea on a daily basis will lead to a moderate intake of soluble oxalate each day, however the consumption of tea with milk on a regular basis will result in the absorption of very little oxalate from tea.

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Influence of milk on the antimutagenic potential of green and black teas.

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BACKGROUND: The objective of this study was to evaluate whether addition of milk to green, black and decaffeinated black teas alters their antimutagenic activity.

MATERIALS AND METHODS: Two model mutagens were used, the direct-acting N'-methyl-N'-nitro-nitrosoguanidine (MNNG) and the indirect-acting 2-amino-3-methylimidazo-[4,5-f]quinoline (IQ), and their mutagenic activity was determined in the Ames test, in the presence of tea and milk/tea mixtures. Solids from the milk/tea mixtures were removed by centrifugation and the supernatant analysed by HPLC for individual catechins and gallic acid in green tea, and thearubigins, theaflavins and flavonol glycosides in black teas. **RESULTS:** Addition of skimmed milk to all the teas failed to influence their antimutagenic activity towards the two mutagens. Addition of milk to green tea resulted primarily in loss of (-)-epigallocatechin gallate whereas in the black teas it primarily reduced theaflavins levels. **CONCLUSION:** The antimutagenic activity of green and black teas is not modulated by the presence of skimmed milk, even at high concentrations.

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A single dose of tea with or without milk increases plasma antioxidant activity in humans.

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OBJECTIVE: To investigate the effect of black and green tea consumption, with and without milk, on the plasma antioxidant activity in humans. **DESIGN:** In a complete cross-over design, 21 healthy volunteers (10 male, 11 female) received a single dose of black tea, green tea (2 g tea solids in 300 ml water) or water with or without milk. Blood samples were obtained at baseline and at several time points up to 2 h post-tea drinking. Plasma was analysed for total catechins and antioxidant activity, using the ferric reducing ability of plasma (FRAP) assay. **RESULTS:** Consumption of black tea resulted in a significant increase in plasma antioxidant activity reaching maximal levels at about 60 min. A larger increase was observed after consumption of green tea. As anticipated from the higher catechin concentration in green tea, the rise in plasma total catechins was significantly higher after consumption of green tea when compared to black tea. Addition of milk to black or green tea did not affect the observed increases in plasma antioxidant activity. **CONCLUSIONS:** Consumption of a single dose of black or green tea induces a significant rise in plasma antioxidant activity in vivo. Addition of milk to tea does not abolish this increase. Whether the observed increases in plasma antioxidant activity after a single dose of tea prevent in vivo oxidative damage remains to be established. *European Journal of Clinical Nutrition* (2000) 54, 87-92

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Bioavailability of catechins from tea: the effect of milk.

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OBJECTIVES: To assess the blood concentration of catechins following green or black tea ingestion and the effect of addition of milk to black tea. **DESIGN:** Twelve volunteers received a single dose of green tea, black tea and black tea with milk in a randomized cross-over design with one-week intervals. Blood samples were drawn before and up to eight hours after tea consumption. **SETTING:** The study was performed at the Unilever Research Vlaardingen in The Netherlands. **SUBJECTS:** Twelve healthy adult volunteers (7 females, 5 males) participated in the study. They were recruited among employees of Unilever Research Vlaardingen. **INTERVENTIONS:** Green tea, black tea and black tea with semi-skimmed milk (3 g tea solids each). **RESULTS:** Consumption of green tea (0.9 g total catechins) or black tea (0.3 g total catechins) resulted in a rapid increase of catechin levels in blood with an average maximum change from baseline (CVM) of 0.46 micromol/l (13%) after ingestion of green tea and 0.10 micromol/l (13%) in case of black tea. These maximum changes were reached after (mean (s.e.m.)) $t=2.3$ h (0.2) and $t=2.2$ h (0.2) for green and black tea respectively. Blood levels rapidly declined with an elimination rate (mean (CVM)) of $t_{1/2}=4.8$ h (5%) for green tea and $t_{1/2}=6.9$ h (8%) for black tea. Addition of milk to black tea (100 ml in 600 ml) did not significantly affect the blood catechin levels (areas under the curves (mean (CVM)) of 0.53 h. micromol/l (11%) vs 0.60 h. micromol/l (9%) for black tea and black tea with milk respectively. **CONCLUSION:** Catechins from green tea and black tea are rapidly absorbed and milk does not impair the bioavailability of tea catechins.

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