Tea is one of the most popular beverages in the world; an estimated 2.5 million metric tons of dried tea is processed as black tea annually, 75% of which goes to beverage use. The potential health implications of heavy metals in tea have been suggested particularly due to the fact that the tea plant is able to accumulate heavy metals. Copper and manganese are crucial components of the metalloenzyme dismutase that has been shown to scavenge hydroxyl and superoxide radicals while chromium is an important component of the glucose tolerance factor (GTF) required for glucose metabolism, its also important in lipid metabolism. However lead, aluminum and cadmium have no known beneficial role in the human body. Lead and cadmium have been classified as human carcinogens whereas aluminum accumulation has been linked to the development of Alzheimer's disease. The determination of heavy metals in tea leaves and their infusions is thus an utmost important task. This study sought to determine the heavy metals content in tea leaves, their infusions, and the effect of citric acid in their extraction into infusions.

Weighed tea samples were digested using a mixture of acids and the resulting solutions analysed for heavy metals using Atomic Absorption Spectroscopy and Differential Pulse Anodic Stripping Voltammetry. All the teas analysed contained considerable amounts of the six metals tested. Aluminum was the most predominant (481.3 - 520.5 µg/g), followed by manganese (401.3 - 437.6 µg/g), copper (9.51 - 12.25 µg/g), chromium (3.12 - 4.25 µg/g), lead (2.91 - 4.03 µg/g) and cadmium (1.21 - 2.13 µg/g). The heavy metals content of tea infusions were significantly low compared to the total metal content in tea leaves, manganese was the highest (92.4 - 130.3 µg/g), followed by aluminum (83.6 - 124.51 µg/g), copper (1.13 - 2.21 µg/g), chromium (0.35 - 0.83 µg/g), lead (0.11 - 0.16 µg/g) and cadmium (0.03 - 0.09 µg/g). The solubility coefficients of tested heavy metals in infusion extracts varied widely and ranged from 3.5% - 31.6%. The solubility of manganese was highest (22 - 31.6%), followed by that of aluminum (9.94 - 23.9%), copper (10.5 - 20.6%), chromium (9.9 - 23.5%), lead (3.5 - 5.1%) and cadmium (1.96 - 5.2%). Citric acid was shown to enhance the extraction of the heavy metals into the infusions, the solubilities of the metals were increased by between 0.2% and 1.8% in infusions prepared with citric acid. The study showed that tea is a good source of manganese, copper and chromium in diet as their levels match the acceptable daily intakes and do not therefore expose the tea user to high levels which can be toxic. The nonessential elements aluminum, lead and cadmium are in very low concentrations in tea infusions and thus do not pose any risks in terms of toxic metals in diet, their contents match permissible levels for toxic metals in food and beverages.