Speciation of arsenic and antimony

Anthony McKnight-Whitford[1], Yunlong Xia[1], Xiufen Lu[1], Kristi Lew[1], Chungang Yuan[1], Xing-Fang Li[1], Stephan Gabos[2], William R. Cullen[3], Iris Koch[4], Kenneth J. Reimer[4] and X. Chris Le[1]
xc.le@ualberta.ca

[1]Analytical and Environmental Toxicology, Department of Laboratory Medicine and Pathology, Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB
[2]Surveillance Branch, Alberta Health and Wellness, Edmonton, AB
[3]Department of Chemistry, University of British Columbia, Vancouver, BC
[4]Environmental Sciences Group, Royal Military College, Kingston, ON

The first objective of this research deals with arsenic speciation analysis in saliva and urine. Arsenic species were separated by liquid chromatography (LC) and quantified by inductively coupled plasma mass spectrometry (ICPMS). Identities of arsenic species were also confirmed by LC coupled with electrospray ionization tandem mass spectrometry (ESI-MS/MS) (Yuan et al. *Clin. Chem.* 2008, 54, 163-171). Concentrations of arsenic species in 83 saliva and 56 urine samples collected from children who played in playgrounds containing either CCA or non-CCA structures were determined. The arsenic species were detected in the urine and saliva samples from children playing on CCA and non-CCA playgrounds were similar. They included inorganic trivalent and pentavalent arsenic, dimethylarsinic acid, and monomethylarsonic acid. The sum of these arsenic species in urine was 15 ± 28 μg/L in the CCA group and 12 ± 23 μg/L in the non-CCA group (p = 0.60). The sum of these species in saliva was 1.1 ± 2.1 μg/L in the CCA group and 1.4 ± 1.1 μg/L in the non-CCA group (p = 0.32). There is no significant difference in the concentration or speciation of arsenic between the samples from children playing on CCA and non-CCA playgrounds. This suggests that contact with CCA playgrounds does not considerably contribute to the overall exposure of children, and that dietary exposure may be a main contributor to the overall exposure of arsenic in children.

The second component focuses on arsenic speciation in food and food chain. Analyses of arsenic and iron in the various components of cattail plants confirmed the co-localization of arsenic and iron in the fine roots and skin of cattail tuber (Lu et al. *Mol. Nut. Food Res.* in press). Determination of arsenic species in freshwater mussels from Quinsam River Vancouver Island showed novel thioarsenosugars as the principal arsenic species. Lipid soluble fractions in hare and squirrel tissues from two Nova Scotia mine sites showed the presence of a new arsenic species yet to be characterized. LC-ICPMS and X-ray absorption spectroscopy (XAS) analyses for arsenic in a range of insects showed that much of the inorganic arsenic in insects was present as arsenic-sulfur complexes (Smith et al. *Sci. Tot. Environ.* 2008, 390, 198–204).

LC-ICPMS and LC-ESI-MS/MS methods were developed for speciation of antimony, with sub-μg/L detection limits. Sb(V) was found the predominant antimony species in beverages stored in plastic bottles; antimony has been used as a catalyst in the polymerization of plastic.

Other components of this research include (i) the uptake of mono sodium methylarsonate by beetles and birds (Albert et al. *J. Toxicol. Environ. Health Part A*, 2008, 71, 353-360 and *Environ. Toxicol. Chem.* 2008, 27, 605-611); (ii) determination of volatile arsenic species (Yuan et al. *Environ. Sci. Technol.* 2008, 42, 3201–3206); and (iii) identification of arsenic binding sites in proteins (Lu et al. *J. Proteome Res.* 2008**, 7**, 3080-3090).