Assessment of Contaminants in Environmental Samples using Mass Spectrometry and other Analytical Techniques

There is a gap in how bioaccessibility data can be contextualized within human health risk assessments, particularly for the ingestion of contaminated food sources such as seaweed. While total concentrations of toxic elements (TEs) and contaminants like arsenic (As) are commonly reported, these values alone can overestimate exposure risk. Bioaccessibility is the fraction of a contaminant available for absorption into the bloodstream and offers a more accurate reflection of potential human exposure. To address this, a risk assessment model was developed using a seaweed certified reference material (CRM), GSEA-1, to evaluate the non-carcinogenic exposure of bioaccessible fractions of selected TEs Pb, Cd, Zn and Se. Simulated gastrointestinal conditions were recreated using both a continuous on-line leaching method (COLM) and a conventional batch approach.

The risk assessment models were extended to focus on carcinogenic exposure to As, emphasizing the importance of considering the bioaccessibility of specific elemental species, as only certain forms of As are classified as carcinogenic. In the seaweed model, As speciation was carried out using high performance liquid chromatography coupled with inductively coupled plasma mass spectrometry (HPLC-ICPMS), which enabled the separation and quantification of individual As compounds. The model demonstrates how speciation data can be effectively incorporated into both cancer and non-cancer risk calculations. The findings show that without speciation, the risks associated with arsenic in seaweed and other contaminated food sources may be either underestimated or overstated, reinforcing the importance of accounting for chemical form in any comprehensive health risk evaluation.

In the second part of this seminar, As remains the focus as analytical techniques are used in the determination of complex organoarsenic species in Canadian peatlands. Literature from the United Kingdom (UK) has identified peatlands as possible "hot spots" for organoarsenical formation, but no studies have yet explored whether Canadian peatlands exhibit similar trends. This is notable because the formation mechanisms of many organoarsenicals, like arsenobetaine (AB) remain unknown. The unexpected detection of AB and other organoarsenicals in peat environments raises questions about the biogeochemical cycling of As in these environments. To investigate this, five peatbogs from across Canada (four from Ontario and one from the Northwest Territories) were extracted and analyzed using HPLC-ICPMS for the separation and identification of arsenobetaine and other organoarsenic compounds. This work contributes to our understanding of As speciation in terrestrial systems and highlights the need for further research into the environmental pathways and transformation mechanisms of organoarsenicals.