Arsenic, lead and cadmium bioavailability as influenced by co-contaminant exposure

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Incidental ingestion of contaminated soil is often a major pathway for human exposure to inorganic contaminants. However, exposure is influenced by both biotic and abiotic factors that impact contaminant bioavailability. To date, bioavailability assessment of contaminated soil has focused on arsenic (As), cadmium (Cd) and lead (Pb), however, studies have typically assessed contaminant bioavailability individually, even when multiple elements are present in the same matrix. As a consequence, it is unclear whether interactions between these elements occur within the gastro-intestinal tract (GI tract) which impact absorption and bioavailability.

As, Cd and Pb bioavailability was determined using an in vivo mouse model whereby mice (n = 12 per treatment) were exposed to the contaminant incorporated into AIN93G feed for 10 days. Initially, mice were exposed to each element individually, at three environmentally relevant concentrations; sodium arsenate (1, 5, 10 mg As kg-1), Pb acetate (3, 15, 30 mg Pb kg-1) and Cd chloride (0.2, 1, 2 mg Cd kg-1). Subsequently, binary and tertiary elemental combinations were supplied to exhaust all possible combinations. Contaminant bioavailability was assessed by determining the concentration of As, Cd and Pb in target tissue (liver, kidney) or excreta (urine). Contaminant relative bioavailability was also assessed in aged (12 years) spiked soils and 3 Australian contaminated soils, using individual and tertiary elemental doses.

When mice were exposed to As, Cd and Pb incorporated into feed, the dose-responses were linear, however, they varied depending on the contaminant and endpoint assessed. Co-exposure to Cd decreased the bioavailability of As, indicated by decreased As urinary excretion, but increased Pb bioavailability, indicated by an increase in Pb accumulation in the liver. In contrast, Cd bioavailability was unaffected in the presence of As and/or Pb at the concentrations tested. Further assessment is required to elucidate the mechanisms that drive these interactions (e.g. DMT-1).