Applying the Oral Bioaccessibility Testing to Refine the Human Health Risk Assessment of Contaminated Land in Urban Area of Belfast

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Urban environments have been changed significantly, especially during the industrial revolution due to the release of many Potentially Toxic Elements (PTEs) and their accumulation in topsoil. Belfast, the largest city in Northern Ireland, faced an intensive process of industrialisation, being historically recognised for linen production and shipbuilding.

Previous studies that used Tellus geochemical data demonstrated a relationship between historical development zones and the presence of PTEs, that suggests the origin of PTEs in Belfast are both geogenic and anthropogenic. In some areas of the city, concentrations of PTEs (including As, Cd, Cr, Ni, Pb, V, and Zn) exceed the current soil Generic Assessment Criteria (GAC) for the protection of human health. However, not all these contaminants in soil are bioavailable to humans; therefore, oral bioaccessibility testing is used to refine the risks posed to human health by measuring the contaminant fraction that is released in the digestive tract.

In this investigation, a subset of 103 samples from across the metropolitan area of Belfast was selected from the Tellus archive held by Geological Survey of Northern Ireland (GSNI). This subset was chosen to be spatially representative of the city while covering different development zones, land uses, bedrock geology, and soil type. The Unified BARGE Method (UBM), an in-vitro method which simulates the human gastro-intestinal tract and is validated against in-vivo studies for As, Cd, Pb, and Sb, was used to undertake bioaccessibility testing on selected samples. The bioaccessibility results were investigated and compared to identify the controlling factors over the PTEs bioaccessibility in different soil parent materials and development zones. The outcomes of this research have potential applications for policy makers, urban developers, and risk assessors of contaminated land.

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