BIOACCESSIBILITY AND HUMAN HEALTH RISK: CHROMIUM IN GLASGOW

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The assessment of risk to human health from contaminated land is based on a comparison of predicted human exposure to a contaminant with a Health Criteria Value (HCV) that represents an exposure below which there is thought to be little or no risk to human health. Most assessment tools, such as the Contaminated Land Exposure Assessment Model (CLEA), use estimates of exposure based on intake (consumption rate) rather than on measures of uptake (the amount of contaminant which enters the bloodstream), thus allowing comparison with HCVs, which are also based on intake apposed to uptake. Soil Guideline Values (SGVs) derived using the CLEA model assume that a soil contaminant will be taken up into the body to the same extent as from the medium of exposure used to derive the oral HCV (e.g. soluble salts of Cr(VI)). This is a conservative assumption as contaminants can be tightly bound to other soil components, thus reducing bioavailability (the fraction of a contaminant that can be absorbed by the body).

There is increasing interest in the potential for information on the bioavailability of soil contaminants to be used to refine a risk assessment. Bioavailability, unfortunately, is a difficult quantity to measure because of the need to model contaminant absorption in humans. This inevitably involves *in vivo* animal testing, thus making it impractical for routine site specific risk assessment. Oral bioaccessibility (the fraction of a contaminant that is soluble in the gastrointestinal environment and is available for absorption), however, can be measured using laboratory-based *in vitro* methods, making it better suited to routine risk assessment.

Between 1830 and 1968 Glasgow was home to one of the world's largest producers of chromium based chemicals. Chromite ore processing residues (COPR) arising from the factory were used as infill material across large areas of SE Glasgow, resulting in widespread land contamination with Cr(VI), a known carcinogen of significant mobility. As part of a current research project into bioaccessibility and the human health risks posed by urban chromium contaminated land, it is planned to identify a small number of locations in Glasgow with elevated Cr(VI) concentrations that are readily accessible to the public. These sites will undergone bioaccessibility assessment using a refined Physiologically Based Extraction Test (PBET), first proposed by Ruby *et al*. (1996), which is essentially a two-stage sequential extraction using various simulated biofluids. This project will extend previous work performed under the NERC URGENT Programme on chromite ore processing residue issues in Glasgow (Farmer *et al*., 2002: Geelhoed *et al*., 2002).

To this end twenty-seven surface soil samples (the top 15 cm) have been collected from a range of land types across Greater Glasgow, including city parks, recreational ground and tended open land. These samples have undergone microwave assisted acid digestion, using HF/HNO_3 (1:9), and analysed for Cr by ICP-OES. Total Cr concentrations were found to range from 87 to 3560 mg/kg, thirteen of which showed concentrations of Cr over 130 mg/kg, with six over 200 mg/kg. Under the CLEA model these sites could be considered to pose a possible human health risk, 130 and 200 mg/kg being the SGVs for residential land with and without plant uptake. Further investigation, using an alkaline digestion method (USEPA method 3060A) and UV/vis spectrophotometry (diphenylcarbazide at 540nm), has shown that of these thirteen samples one has a Cr(VI) concentration in excess of 1000 mg/kg, while another was measured at 171 mg/kg.

The next step will be to investigated the bioaccessibility of Cr(VI) in these samples using a refined PBET method. This method will simulate the physical and chemical conditions of the gastrointestinal environment, therefore providing information about the solubility of Cr(VI) in contaminated soil following ingestion.

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