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HEALTH RISK ASSESSMENT OF HEAVY METALS IN URBAN SOIL

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RESEARCH HIGHLIGHTS

- Rapid industrialization and modernization of urban cities has resulted to serious environmental contamination by metals, as a result the exposed inhabitants experienced health consequences.
- Health risk assessment through multiple pathways is required for the health safety of the population.
- Samples of urban soils were analysed for As, Cd, Cr, Cu and Pb.
- Urban soils were polluted with these metals with the order of Pb > As > Cr > Cu > Cd.
- Non-carcinogenic risk for As was higher than that of the other metals
- Both the Carcinogenic and non-carcinogenic risk values were within or lower than the tolerable limits.

Keywords: Heavy Metals, Urban, Health Risk Estimation, Soil.

RESEARCH OBJECTIVES

The aims of this study is to evaluate the impact of contaminants exposure associated with exposure pathways. This is because humans are exposed to these metal contaminants through different route. As such, exposure routes have become important gate way through which metals get into human body. Exposure to metals such as As, Cd, Cr, Cu and Pb in soils may result to serious health effects to humans, for instance As, Cr, Cd and Pb are noted to be carcinogenic whereas As, Cr, Cd, Pb and Cu have non-carcinogenic effects to humans on exposure [1] through soil. Exposure to these metals results to serious toxic effects such as metabolic disorder, cardiovascular diseases, kidney and liver diseases, mental retardation, and reproductive system damage [2]. Therefore, the objectives of this study was to determine the concentration of toxic metals in soils of Petaling Jaya, Malaysia. Quantify the exposure level. Estimate the carcinogenic and non-carcinogenic risks of metals to adults through ingestion, inhalation and dermal exposure to urban soil. This finding will help the legislature in safe guarding the health of the inhabitants by reducing contaminants from their sources.

MATERIALS AND METHODS

Soil samples were collected by the roadside in Petaling Jaya, Malaysia. The samples were collected using a plastic hand trowel and were placed in separate zipped plastic bags. The samples were then taken to the laboratory, where they were air dried and sieved. The samples were digested with concentrated suprapure HNO3 and 30% H2O2. 15 mL of HNO3 was added into the digestion vial containing the soil samples and were covered. The samples were heated on a hot plate at 95 oC until the brown fumes given off and about 5 mL of the solution remaining. After cooling 2 mL of water and 3 mL of H2O2 were added stepwise until the general sample appearance is unchanged. The heating continued until the solution reduced to about 5 mL. Cooled, diluted with ultrapure water, filtered and finally made to 50 mL mark. The solutions were analysed for total concentrations of Pb, Cr, Cu, Cd and As by inductively coupled plasma mass spectroscopy (ICP-MS). The risk assessment for all the exposure routes followed the USEPA procedure [3]

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RESULTS

The mean metal concentration in soil as follows Pb (208.08 ± 121.12 mg/kg); As (75.89 ± 42.69 mg/kg); Cr (71.76 ± 24.44 mg/kg); Cd (1.00 ± 0.62 mg/kg); Cu (56.21 ± 44.40 mg/kg). The exposure amount values for cancer for Pb, As, Cr, Cd and Cu respectively are 1.33E-04, 4.86E-05, 4.60E-05, values for Cd and Cu are not available on ingestion, 5.32E-05, 1.94E-05, 1.83E-05, 2.56E-07, 1.44E-05 on dermal exposure and 1.96E-08, 7.15E-09, 6.76E-09, 9.42E-11, 5.29E-09 for inhalation exposure. Whereas, the result for carcinogenic risk exposure for the metals are Pb > As > Cr > Cu > Cd for ingestion, dermal and inhalation exposure routes respectively. The Carcinogenic risk (CR) and non-carcinogenic risk (HQ) results were As > Pb > Cr > Cd > Cu respectively.

FINDINGS

High concentration of the metals were found in soil sample. Both the carcinogenic and non-carcinogenic risks for all exposure routes were within or below the permissible limits. The Non-carcinogenic result of As > Pb > Cr > Cd > Cu suggests that there could be more chances of non-carcinogenic risk of As than the order metals. Kamunda et al. [4] reported high non-carcinogenic risk of As on exposure to soil. The exposure for both concer and non-carcinogic risks followed the order ingestion > dermal > inhalation. This indicates that Ingestion is the main route of exposure followed by dermal and inhalation. Similar order was observed by [5].

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