Bull Environ Contam Toxicol
DOI 10.1007/s00128-015-1544-2

Health Risk Assessment of Heavy Metal in Urban Surface Soil (Klang District, Malaysia)

Nurul Syazani Yuswir[1] · Sarva Mangala Praveena[1] · Ahmad Zaharin Aris[2] · Sharifah Norkhadijah Syed Ismail[1] · Zailina Hashim[1]

Received: 7 November 2014 / Accepted: 7 April 2015

Abstract Urban environmental quality is vital to be investigated as the majority of people live in cities. However, given the continuous urbanization and industrialization in urban areas, heavy metals are continuously emitted into the terrestrial environment and pose a great threat to human. In this study, a total of 76 urban surface soil samples were collected in the Klang district (Malaysia), and analyzed for total and bioavailable heavy metal concentrations by inductively coupled plasma-optical emission spectrometry. Results showed that the concentrations of bioavailable heavy metals declined in the order of Al, Fe, Zn, Cu, Co, Cd, Pb, and Cr, and the concentrations of total heavy metals declined in the order of Fe, Al, Cu, Zn, Pb, Cr, Co, and Cd. Principal component analysis (PCA) showed that heavy metals could be grouped into three principal components, with PC1 containing Al and Fe, PC2 comprising Cd, Co, Cr, and Cu, and PC3 with only Zn. PCA results showed that PC1 may originate from natural sources, whereas PC2 and PC3 most likely originated from anthropogenic sources. Health risk assessment indicated that heavy metal contamination in the Klang district was below the acceptable threshold for carcinogenic and non-carcinogenic risks in adults, but above the acceptable threshold for carcinogenic and non-carcinogenic risks in children.

Keywords Bioavailable · Health risk assessment · Heavy metal · Total · Urban surface soil

✉ Sarva Mangala Praveena
smpraveena@gmail.com

Nurul Syazani Yuswir
joshisyazani88@gmail.com

Ahmad Zaharin Aris
zaharin@upm.edu.my

Sharifah Norkhadijah Syed Ismail
norkhadijah@upm.edu.my

Zailina Hashim
zailina@upm.edu.my

[1] Department of Environmental and Occupational Health, Faculty of Medicine and Health Sciences, Universiti Putra Malaysia (UPM), 43400 Serdang, Selangor Darul Ehsan, Malaysia

[2] Environmental Forensics Research Centre, Department of Environmental Sciences, Faculty of Environmental Studies, Universiti Putra Malaysia (UPM), 43400 Serdang, Selangor Darul Ehsan, Malaysia

Urban soil pollution by heavy metals, such as aluminum (Al), iron (Fe), zinc (Zn), copper (Cu), cobalt (Co), cadmium (Cd), lead (Pb), and chromium (Cr), is an ongoing environmental concern (Foo et al. 2008; Lee et al. 2006 in Korea; Chen et al. 2005 in Beijing, China; Li et al. 2001 in Hong Kong). Pollution sources in urban areas are both anthropogenic (industrial emission, traffic emission, coal combustion, waste incineration, and agriculture waste) and natural. Urban surface soil acts as sinks for heavy metals and many other pollutants that persist for long time periods (Kelly et al. 1996). With continued exposure, heavy metal concentrations in urban surface soil become elevated and may lead to toxic effects in humans and the environment. To evaluate the toxicity of heavy metal concentrations in soils, both total and bioavailable heavy metal concentrations may be assayed. Typically, the total heavy metal concentrations are used to measure the pollution status of the environment, spatial statistics, and speciation, whereas the concentrations of bioavailable heavy metals are used to assess the possible impact of these heavy metals on human health (Kamaruzzaman et al. 2008; Sany et al. 2012; Naji and Ismail 2012; Oomen et al. 2003). Although both total and bioavailable

Published online: 24 April 2015