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Bioaccessibility of Lead in Long-Term Vegetable Grown Urban Soil

Samaranayake I.G.B.B.S.[1], Hemamali D.D.A.E.[2], Kodikara A.G.K.S.[1], Attanayake C.P.[3*], Vitharana U.W.A.[3]

[1]*Postgraduate Institute of Agriculture, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka*
[2]*Postgraduate Institute of Science, University of Peradeniya, Peradeniya, Sri Lanka*
[3]*Department of Soil Science, Faculty of Agriculture, University of Peradeniya, Peradeniya, Sri Lanka*
*chammiatt@pdn.ac.lk

Abstract

Vegetable cultivation has been practiced for more than fifty years in the up-country of Sri Lanka providing about 60% of country's vegetable requirement. Often, vegetable cultivations are distributed in urban areas. Moreover, agricultural inputs, gasoline and paints can contribute for lead (Pb) contamination in soils. Direct soil ingestion is the major exposure pathway of soil Pb to organisms. The risk of direct ingestion of soil Pb can be assessed by using *in-vitro* bioaccessibility tests. Objectives of the study were to assess bioaccessibility of Pb in long-term vegetable grown urban soils by using *in-vitro* bioaccessibility tests and to investigate the potential of Mehlich 3 extractable Pb as a measure of bioaccessible Pb. Simplified physiologically based *in-vitro* extraction test was conducted for extracting bioaccessible Pb in 42 surface soil samples collected from vegetable grown fields located in urban areas in Nuwaraeliya. Total Pb concentrations in soils were determined by digesting the soils using aqua regia (trace metal-grade) and analysing using Graphite Furnace Atomic Absorption Spectrophotometer. Total Pb concentration in soils ranged from 10 to 110 mg/kg. The Mehlich 3 Pb and bioaccessible Pb concentrations were low, which ranged from 2 to 12 mg/kg and 1 to 3 mg/kg, respectively. High available P (47 to 757 mg/kg) and organic C content (1.1 to 3.8%) in soils may have contributed to low bioaccessibility of Pb. The regression analysis revealed that only 44% of variation of bioaccessible Pb and 22% of variation of total Pb can be explained by Mehlich 3 Pb ($p<0.001$). Effect of total Pb on bioaccessible Pb is low. Strong relationship ($p<0.001$) was observed between bioaccessible Pb and Mehlich 3 Pb expressed as percentages of total Pb [bioaccessibility of Pb=0.17*(availability of Pb)+0.38, $R^2=0.71$]. Thus, less laborious Mehlich 3 and total Pb measurements can be used to estimate bioaccessibility of Pb. Low bioaccessibility suggested that the risk of direct exposure for soil Pb is minimal in the tested long-term vegetable grown urban soil.

Keywords: Lead, Bioaccessibility, Urban soil, Vegetable, Mehlich 3 extraction

Proceedings of the 24th International Forestry and Environment Symposium 2019 of the Department of Forestry and Environmental Science, University of Sri Jayewardenepura, Sri Lanka

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