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Assessment of contaminant levels of hazardous toxic metals and subsequent risk analysis in agricultural soil and selected comestibles within a region afflicted by CKDu in Sri Lanka

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Agricultural commodities constitute a pivotal component of the human daily sustenance, yet they are susceptible to contamination by pernicious heavy metals, notably Hg, Cd, Pb, and As. Consequently, agricultural products represent a substantive source of apprehension for human well-being and health. This study aims to evaluate related risk indices of agricultural soils (n=25) and selected comestible grains, namely *Oryza sativa* (n=25), *Vigna radiata* (n=25), *Vigna unguiculata* (n=25), and *Vigna unguiculata* subsp. (n=25), within the endemic region of Nikawewa Grama Niladhari Division (GND) in North Western Province (NWP) and the reference region, Wewagedara GND in NWP where no evidence for Chronic Kidney Disease of unknown etiology (CKDu). The concentrations of metals in the collected samples were determined by using Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and based on that risk indices were calculated. The mean geo-accumulation index (I_{geo}) for four metals in soil was As - 0.82, Cd - 1.47, Cu - 0.91, and Pb 1.31. That indicates no anthropogenic activities related to As, Cd and Cu while Pb is responsible for moderate pollution in endemic area. Estimated Daily Intake (EDI) values for these heavy metals were calculated with respect to the all grains. EDI means of As and Pb in the endemic and the reference areas for all grain samples were within the Tolerable Daily Intake (TDI) set by United States Environmental Protection Agency (USEPA) (As-0.300 $\mu\text{g}/\text{kg}/\text{day}$) and World Health Organization (WHO) (Pb-3.600 $\mu\text{g}/\text{kg}/\text{day}$) while Cd (EDI in endemic area; *Oryza sativa*-6.385 $\mu\text{g}/\text{kg}/\text{day}$, *Vigna unguiculata*-3.386 $\mu\text{g}/\text{kg}/\text{day}$ and *Vigna unguiculata* subsp.-3.866 $\mu\text{g}/\text{kg}/\text{day}$) highly exceeded the tolerable weekly intake (TWI) of European Food Safety Authority (EFSA) (Cd-2.5 $\mu\text{g}/\text{kg}/\text{week}$) in both areas. EDI of Cr in rice samples (1.138 $\mu\text{g}/\text{kg}/\text{day}$) in endemic area exceeded the TDI set by EFSA (1.0 $\mu\text{g}/\text{kg}/\text{day}$) and all other values of Cr were below the TDI in both areas. According to the USEPA (intolerable cancer risk (CR) - $> 1 \times 10^{-4}$) cancer risk exist for all these staple grains. I_{geo} of Pb in the soil, raising concerns about their bioavailability and uptake by the food crops and EDI were indicated the long-term consumption of these foods especially *Oryza sativa* poses a serious threat to human health. Implementing proper soil management practices, monitoring heavy metal levels in crops, and raising public awareness about safe consumption practices are crucial steps towards mitigating the risk of CKDu.

Keywords: CKDu, Heavy metals, Rice, Risk assessment