

Risk assessment of Nephrotoxic Metal Contaminations of Rice (*Oryza sativa*) in a CKDu Prevalence Area, Sri Lanka

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Sri Lanka is categorized in the G14 cluster of global dietary consumption groups according to the WHO GEMS diet categorizations based on the high consumption of cereals, especially rice, in diets and rice significantly provided 30% of the dietary energy supply and 20% of the dietary protein intake. Chronic low levels of exposure to nephrotoxic metals can be occurred via rice consumption and the magnitude of such exposures have to be understood in order to assess the risk of adverse health effects such as CKDu and to propose suitable public health interventions. Therefore, present study attempts to assess the nephrotoxic metal contamination of rice (*Oryza sativa*) in a CKDu prevalence area; Girandurukotte Grama Niladhari Division (GND), Badulla District, Sri Lanka. 20 rice samples were collected from the households who are consuming rice from their own paddy fields and the dietary survey was carried out using a semi-quantitative food frequency questionnaire (FFQ) during the period of June 2019 to determine the approximate quantity and frequency of rice intake over specific time periods. Rice samples were analyzed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) for nephrotoxic metals; Lead (Pb), Cadmium (Cd), Arsenic (As), and Chromium (Cr) followed by the Microwave digestion. Descriptive statistics were performed by SPSS statistics software. Non-carcinogenic health risk from rice consumption was estimated using the hazard quotient (HQ - the ratio of determined dose of a pollutant to a reference dose level) and total hazard index (THI). The estimated weekly intake (EWI) values for selected metals were determined to assess the health risks. The mean metal concentrations ($\mu\text{g/g}$) of rice grains were 259.20 ± 54.00 (Pb), 216.00 ± 34.40 (Cd), 20.79 ± 3.65 (As) and 131.80 ± 35.90 (Cr). The rice ingestion and the exposure frequency was recorded as 330 g/person/day and 350 days/year respectively according to the FFQ. Calculated EWIs ($\mu\text{g/kg}$ body weight) for the concerned metals were 25.92 (Pb), 21.56 (Cd), 0.42 (As) and 2.64 (Cr). EWIs for Pb and Cd were exceeding the provisional tolerable weekly intake values (PTWI) which have been set up by the WHO and EWI for Cr was complied with the PTWI level. The oral reference doses for the metals which used to estimate the hazard quotient (HQ) in mg/kg/day were: Pb = 0.004, Cd = 0.001, As = 0.014 and Cr (III) = 1.500 (USEPA 2000). The hazard quotient of 60 kg adult from rice consumption was in the order of Cd > Pb > As > Cr. Amongst the toxic metals, ingestion of Cd have the highest potential for adverse effect while Cr ingestion have the minimal potential. The total hazard index for rice consumption was 7.623 with relative contributions of selected nephrotoxic species; Pb (22.98%), Cd (76.46%), As (0.53%), and Cr (0.03%). Hence, rice is accumulating heavy metals with the use of heavy metal-laden chemicals for paddy cultivation and rice can be considered as a major exposure route for the dietary intake in Girandurukotte GND which is considered as a CKDu prevalence areas in Sri Lanka.

Keywords: "G14 cluster; Risk assessment; hazard quotient; dietary intake; *Oryza sativa*"

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