

Intrusion of Cd, As, Cr, Pb & Hg into selected rice varieties (*Oryza sativa* L.) in relation to their status in two different agricultural management systems

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Five traditional varieties (TRV) and five newly improved hybrid varieties of paddy (NIRV) were cultivated under both conventional and organic farming conditions during Yala and Maha seasons at selected areas in Anuradhapura district where chronic kidney disease was prevalent and Kurunegala districts where chronic kidney disease was not known to exist at the time of the study. The area used for cultivation under each organic and conventional farming condition in each district was approximately 11 m x 11 m and was well separated from each other. The contents of each of the selected toxic elements; Cd, As, Cr, Hg, and Pb in the soil, irrigation water, conventional and organic fertilizers and pesticides used for cultivation together with the relevant physicochemical parameters for soil were estimated before the beginning of the cultivation while the required physicochemical parameters and contents of the elements in irrigation water were estimated regularly during the cultivation. After the maturity periods at each cultivation, paddy were harvested and the contents of the elements in rice grains, straws and roots were determined. All samples for determination of the elements were processed and microwave acid digested according to US EPA 3052 method and analyzed using atomic absorption spectrometer. (Hitachi ZA3000 Zeeman Polarized). Analytical methods were validated using either standard reference materials or recovery tests.

The study revealed that, the contents of any of the selected elements in any of the rice varieties grown did not exceed the safe limits of 200 $\mu\text{g kg}^{-1}$ for Cd, 200 $\mu\text{g kg}^{-1}$ for As, 300 $\mu\text{g kg}^{-1}$ for Pb, 2000 $\mu\text{g kg}^{-1}$ for Cr and 20 $\mu\text{g kg}^{-1}$ for Hg recommended by the World Health Organization (WHO) and Food and Agricultural Organization (FAO) for milled rice. Hg, As and Pb were not detected in any of the rice varieties grown. The highest content of Cr detected was one tenth of the allowable WHO limit of 2000 $\mu\text{g kg}^{-1}$. The contents of cadmium were in the range below the detection limit of 159 $\mu\text{g kg}^{-1}$. Arsenic was below the detection limits in agrochemicals, soils and irrigation waters. Pb and Cr were present in fertilizers below the SLSI limits of 10 mg kg^{-1} and 250 mg kg^{-1} , respectively. Slightly elevated levels of cadmium (1.80 mg kg^{-1} to 3.44 mg kg^{-1}) were detected in Muriate of Potash (MOP) and Triple Super Phosphate (TSP) respectively. The green fertilizers contained Cd in the range from 0.44 mg kg^{-1} to 1.67 mg kg^{-1} . Irrigation water did contain Cd below the detection limits of $0.2 \pm 0.0 \mu\text{g L}^{-1}$, while Cr contents were in the range of $13.8 \pm 1.9 \mu\text{g L}^{-1}$ to $157.9 \pm 22.7 \mu\text{g L}^{-1}$. The Cd contents in paddy soils were in the range $0.41 \pm 0.02 \text{mg kg}^{-1}$ to $0.75 \pm 0.03 \text{mg kg}^{-1}$ and while the Cr contents were in the range $1.33 \pm 0.15 \text{mg kg}^{-1}$ to $1.63 \pm 0.09 \text{mg kg}^{-1}$. Cd was detected in rice straws along with roots in the range, $12.2 \pm 2.6 \mu\text{g kg}^{-1}$ to $1582 \pm 74.3 \mu\text{g kg}^{-1}$.

Keywords: Organic and conventional farming conditions, Toxic elements, Traditional and newly improved rice varieties