



Intrusion of heavy metals/metalloids into rice (*Oryza sativa* L.) in relation to their status in two different agricultural management systems in Sri Lanka

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ABSTRACT

The contentious results of elevated As and Cd levels, in both Sri Lankan rice and in agrochemicals have recently raised tremendous attention. These claims could not stand alone due to the study's poorly designed sampling and analytical methodologies. In this work, selected traditional Sri Lankan rice and hybrid rice varieties were cultivated (under fertilized and organic conditions) using a split-plot design during Yala (May to August) and Maha (September to March) seasons in two regions: Anuradhapura and Kurunegala. As, Cd, Cr, Hg, Pb, and Se contents were determined in harvested rice grain and straws for Chronic Kidney Disease of unknown etiology (CKDu) risk assessment. In addition, analysis of these elements in water, soil, and agrochemicals was used to estimate their geochemical behavior. The majority of agrochemicals and fertilizers had Cd, Cr, and Pb. Grain Cd contents in rice varieties were ranged from not detectable to $158.9 \mu\text{g kg}^{-1}$ in both cultivation seasons, and soil was sought to be the primary Cd source. As, Se, Hg, and Pb were also not detectable in both rice grain and straws. Native variety Pachcha Perumal rice grain showed a low Cd accumulation in both seasons at both regions. Kuruluthuda and Madathawalu showed a moderate accumulation versus other varieties. Cultivating and consuming these native traditional rice varieties practicing organic farming could be a possible way to combat CKDu risks. The correlations (between the rice grain Cd content and farming condition, location, or season of cultivation) were tested linear regression to fit data on to Freundlich model, and no distinct statistical correlations were observed ($p > 0.05$). Mean chromium contents ($38.5\text{--}112.1 \mu\text{g kg}^{-1}$) detected in the rice grain were not alarming. Soil, irrigation water, and agrochemicals were free from As and Hg. However, rice straws contained substantial amounts of Cd. Therefore, use of it as organic manure should be limited.

1. Introduction

Rice is the staple food in Sri Lanka, with an average per capita consumption of 108 kg of milled rice per year (Department of Senses and Statistics, 2015). Cultivation of paddy has become the major agricultural industry in the country, and it is mainly cultivated as a wetland crop during the two seasons; Yala and Maha. Rice can uptake various forms of

both toxic and nutritional elements from the soil solution. These elements are translocated from roots to straw and ultimately to the rice grain (Payus and Talip, 2014). Different types of rice crops may have divergent abilities to absorb and accumulate elements in their different parts.

In ancient times, over 400 different traditional rice varieties (TRV) are said to have been grown all over Sri Lanka (Gunaratne et al., 2013).

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