A study on toxic and essential elements in rice from the Republic of Kazakhstan: comparing the level of contamination in rice from the European Community

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Abstract Selected toxic elements (total As, Cd, Cr, Hg, Pb, Sr, U and V) and essential elements (Co, Cu, Fe, Mn and Zn) were analyzed using an inductively coupled plasma mass spectrometry (ICP-MS) in unpolished and milled rice collected from Kazakhstan and milled rice from Spain and Portugal to evaluate the potential health risk to the population. Arsenic species (arsenite, arsenate, arsenobetaine, dimethylarsinate and monomethylarsionate) were analyzed using HPLC-IC-MS. From 146 samples analyzed, none of them exceeded the maximum limit set by the European Legislation for Cd or Pb or values recommended by the Codex Alimentarius. Concentrations of Sr, U and V were below LOD and those of Hg, Pb, Co and Cr between <LOD and 0.54 mg/kg (highest concentration of Cr) in milled rice. Portuguese rice samples contained the highest mean concentration of As, Hg, Pb, Co, Cr, Cu, Mn and Zn. The highest mean of arsenobetaine (0.001 mg/kg), dimethylarsinate (0.27 mg/kg) and monomethylarsionate (0.02 mg/kg) was found in Spanish rice and that of arsenic (0.30 mg/kg) in Kazakh rice. Inorganic As in samples from Kazakhstan was above the ML (0.2 mg/kg) proposed by FAO/WHO, but in seven samples from Spain and in four from Portugal were above the limit. The estimated weekly intake of total or inorganic As(III, V), Cd, Hg and Pb for rice consumption by Kazakh, Spanish and Portuguese adults and children was lower than the provisional tolerable weekly intake established by Joint FAO/WHO Expert Committee on Food Additives and the European Food Safety Authority.

Keywords Rice · Toxic elements · Essential elements · Weekly intake · Kyzylorda Province · Kazakhstan

Introduction

Rice is the dominant staple food for over half of the world’s population, especially in developing Asian countries, where it contributes to over 70% of the energy provided by their daily food intake (Qian et al. 2011). According to market research on cereals in the Republic of Kazakhstan, 53% of the total consumption of cereals consists of rice and accounted for several cereals, except for wheat consumption, during