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Potentially toxic elements in ayurvedic formulations: total and bioaccessible content

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Abstract

Some formulations used in ayurvedic medicine are based on herbs deliberately combined with arsenic, metals, and minerals. Some of these preparations have been suspected to be harmful to health, due to the content of potentially toxic elements (PTE), hence it is very important to value the possible risks associated to their consumption. Such risks depend not only on the total PTE concentrations, but also on their bioaccessibility, which influences their assimilation. In this work, the total concentrations of As, Cr, Cu, Hg, Mn and Pb in nine ayurvedic medicines purchased in India were measured. After sample mineralization, concentrations were determined by atomic emission or absorption spectroscopy. The results showed the presence of high amounts of As (19-479,000 mg/Kg), Cu (27-675,000 mg/Kg), Hg (100-15,600 mg/Kg) or Pb (3-248 mg/Kg) in five of these products, whereas much smaller amounts (As, ≤ 1.3 -19 mg/Kg; Cu, 0.6-3.2 mg/Kg; Hg, ≤ 1.0 -5.3 mg/Kg; Pb, 0.5-1.8 mg/Kg) were present in the other ones. Subsequently, the bioaccessibility of PTE was estimated *in vitro* by extraction into synthetic gastric and intestinal fluids. The effect of different operating conditions was assessed. The results obtained show as elements are mainly extracted into gastric juices, and the extent of extraction is strongly influenced by the adopted conditions. The data were treated with chemometric techniques that helped to visualize the differences and similarities among samples. We calculated the daily intake of each PTE from its concentration and from the posology of each medicine, and compared it with the maximum tolerable intake levels: the intake of As, Cr, Cu and Hg from some products exceeded such limits (whose values, expressed in mg/day for a 60 kg individual, are: As, 0.018; Cr, 0.05; Cu, 30; Hg, 0.034), mainly when total concentrations were considered, but also for some bioaccessible values. Our study shows the importance of adopting homogeneous conditions to evaluate bioaccessibility.

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