TRACE ELEMENTS IN COMMERCIAL INFANT FOOD: A SIMPLIFIED RISK ASSESSMENT

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Introduction

Children are the most vulnerable segment of the population to environmental contamination. Compared with adults, children have higher intake rates relative to their body weight, their organs and tissues are in an earlier stage of development and they show unhealthy behavioural habits, as they frequently put their hands and objects into their mouth (Charlesworth et al., 2011). Among the different exposure routes in urban environments, the ingestion pathway generally accounts for the highest proportion of the overall risk (De Miguel et al., 2007). Therefore, there is a credible need to estimate the level of exposure of children to pollutants in their diet. The objective of this study was to determine the heavy metal concentration in commercial infant food and the dietary habits of the infant population in order to conduct a simplified human-health risk assessment.

Methods

Two types of baby foodstuff from four different brands were selected to reproduce the recommended children's daily dietary intake: food jars of five varieties (i.e. cereals, chicken, fish, fruit and vegetables) and infant formula. Semiliquid samples were lyophilized and milled, while powdered samples were dried, and moisture content was determined in both cases. A 2.5 g portion of each sample was digested with 30 mL of a solution $3HNO_3$ (65%) : $1H_2O_2$ (30%) using an open graphite block system (DigiPREP™) at 90 ºC for four hours (Saracoglu et al., 2007), subsequently filtered and the volume adjusted to 50 mL. Trace element concentrations (Cd, Co, Cr, Cu, Mn, Ni, Pb, Zn) were measured by graphite-furnace atomic absorption spectrophotometry. QA/QC procedure included blank reagents, triplicates, a multi-element standard solution and a certified standard reference rice material. The risk assessment involved three groups of receptors: children in age ranges 6-8, 9-11 and 12-23 months.

Results

Zinc was the most abundant element, with contents following the order: milk > meat > fish ~ vegetables > cereals > fruit. Among the different food categories, Cu and Pb concentrations were highest in powdered milk, only exceeded by fruit in the case of Pb. Mn was the second most common element, with similar quantities in all food classes, except for milk in which concentrations were much lower. Likewise, the distribution of Cd was homogeneous and was under the limit of detection for milk and some fruit samples. Lastly, Ni was found primarily in fish and vegetables. A pair difference test between the mean concentrations of the different brands showed no significant differences for Cu, Pb and Zn. In contrast, it was found there was an important variability for Cd and Cr for almost all brands. Results from the risk assessment showed, that for Pb, the only element with a reported slope factor, carcinogenic risk was within the tolerable range for human health ($< 10^{-6}$). On the other hand, the Hazard Index exceeded 1 for children aged 6-8 months due to milk ingestion. Similarly, the aggregate systemic risk for each individual element indicated potential health effects for babies aged 6-8 and 9-11 months by Zn and for children from 12 to 23 months by Ni. The main contributors to the overall risk were Zn and Cd, among the elements analysed, and milk and meat for the different food types (Figure 1).

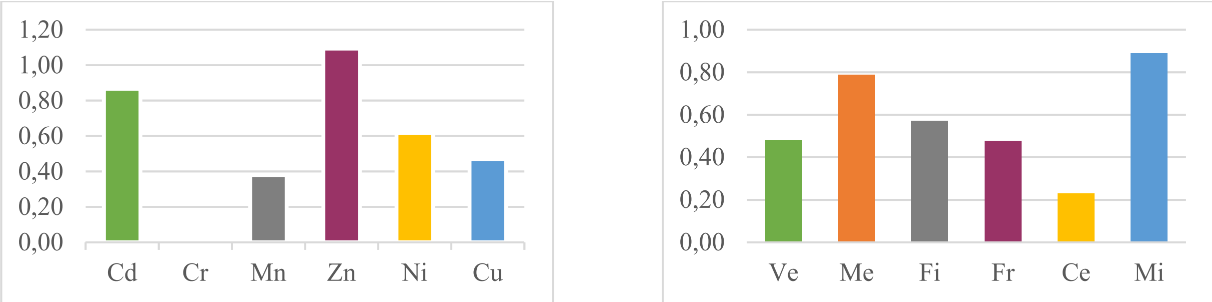

Figure 1. Averaged contribution of each heavy metal and food category to the overall non-cancer risk (Ve = vegetable, Me = meat; Fi = fish, Fr = fruit, Ce = cereal, Mi = milk).

Conclusion

This study concluded that the intake of commercial infant food could implicate adverse health effects. However, the heavy metals bioaccessibility was not considered in the assessment, which would reduce the risk values estimated.

References

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