



Health risk estimation of potentially toxic elements in complementary fruit-based food

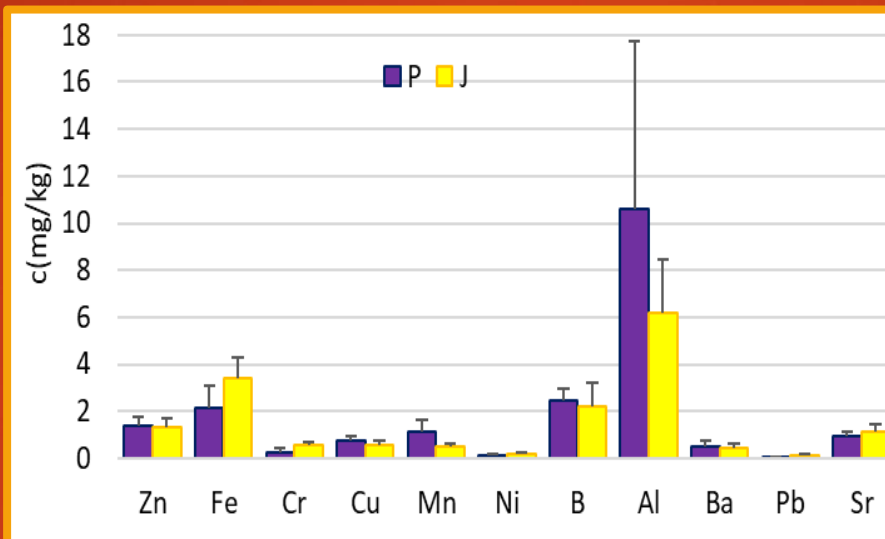
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Abstract

The inductively coupled plasma emission spectrometric (ICP-OES) method was used for the simultaneous determination of ten elements (Zn, Fe, Cr, Cu, Mn, Ni, Al, Ba, Pb, B and Sr) in 23 samples of purees and juices. Potentially toxic elements can be harmful to health if present in food. Even essential and probably essential elements can be toxic if present in excessive amounts. Infants and toddlers are particularly vulnerable due to their smaller body size, developing brains and organ systems. The determination of mineral content in baby purees and juices is very important (for both manufacturers and consumers) due to their positive as well as negative impact on children's health. Health risk assessment of potentially toxic elements on infants and toddlers was estimated by calculating the average daily dose (ADD), hazard quotient (HQ) and hazard index (HI). The values of HI < 1 for all analyzed fruit products suggest that none of the quantified potentially toxic elements may pose a health risk for selected groups of children. Health risk for lead was not estimated since EPA have not yet established the chronic oral reference dose (RfD) for this metal. Also, previous official provisional tolerable weekly intake (PTWI) value of 25 µg Pb/kg body weight/day was withdrawn. New PTWI value that would be considered health protective has not been possible yet to establish. However, the lead exposure was evaluated based on the size of daily consumption of sample with highest lead content and average toddlers body weight. The value of 2.02 µg Pb/kg body weight/day is in the lead exposure interval (1.1 – 3.10 µg Pb/kg body weight/day) estimated by EFCA.



Concentrations ($\bar{x} \pm SD$, mg/kg) of elements in analyzed fruit purees and juices

The higher amounts of Fe, Cr, Ni, Pb and Sr were determined in juices, while higher concentrations of Zn, Cu, Mn, B, Al and Ba were found in purees. The amounts of B and Sr in these types of products were reported for the first time. The quantity of lead above 0.08 mg/kg (maximum allowable concentration) was determined in 30% of analyzed samples.

Parameters for calculating ADD.					
Type of food	Young children	ED (years)	EF (days)	AT (years · days)	IR (per capita) g/kg bw/day
Fruits	Infants	0.5	350	0.5 · 365	5.7
Fruits	Toddlers	0.5	350	0.5 · 365	6.2
Juices	Toddlers	0.5	350	0.5 · 365	10

$$ADD = \frac{c \cdot IR \cdot EF \cdot ED}{BW \cdot AT} \quad HQ = \frac{ADD}{RfD}$$

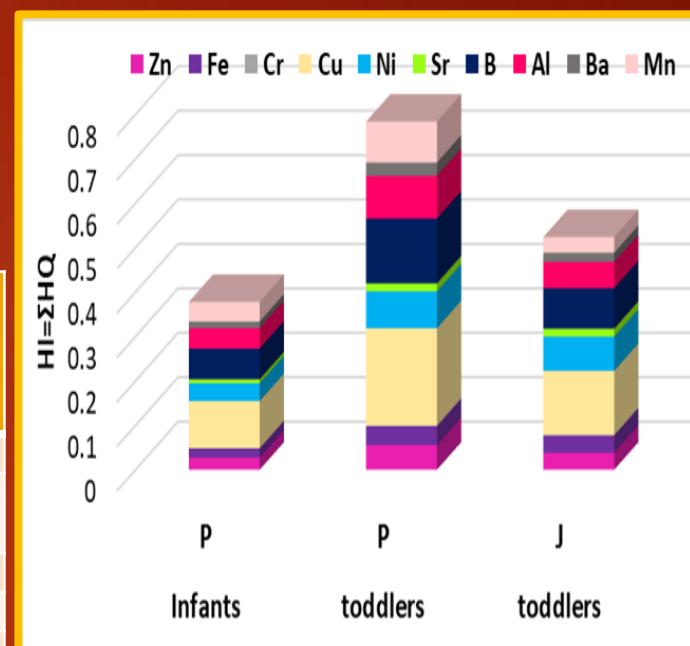
$$ADD \text{ (total toddlers)} = ADD \text{ (infants)} + ADD \text{ (toddlers)}$$

Average ADD values (mg/kg/day) of metals for infants and toddlers consuming fruit products (non-carcinogenic risk calculations).

Element	Infants		Toddlers	
	ADD purees	ADDtotal purees	ADD purees	ADD juices
Zn	7.98E-03	1.67E-02	1.15E-02	1.15E-02
Fe	1.45E-02	3.03E-02	2.75E-02	2.75E-02
Cr	9.40E-04	1.96E-03	2.11E-03	2.11E-03
Cu	4.21E-03	8.79E-03	5.75E-03	5.75E-03
Ni	7.93E-04	1.66E-03	1.53E-03	1.53E-03
Sr	5.25E-03	1.10E-02	1.10E-02	1.10E-02
B	1.39E-02	2.91E-02	1.84E-02	1.84E-02
Al	4.61E-02	9.62E-02	5.90E-02	5.90E-02
Ba	2.90E-03	6.05E-03	4.22E-03	4.22E-03
Mn	6.17E-03	1.29E-02	4.99E-03	4.99E-03
Pb	6.56E-05	1.37E-04	1.25E-03	1.25E-03

ADDs for Zn, Fe, Cr, Cu, Mn, Ni, Al, Ba, B and Sr in both types of samples are lower than their RfDs.

Acknowledgements: This research was financially supported by the project of the Ministry of Education, Science and Technological Development of Republic of Serbia (Agreement No 451-03-9/2021-14/200124).



HQ values for essential and potentially toxic elements for infants and toddlers via intake of fruit products.

Conclusion

HQ and HI values for both age groups of consumers were below 1. The results showed that none of the analyzed potentially toxic elements may pose a health risk for both infants and toddlers if consuming analyzed fruit purees. This data certainly does not diminish the obligation of the manufacturer to carefully select fruits through the application of quality control in each step of the production process.