



## ORIGINAL ARTICLE

# Evaluation of Toxic Element Contents in Infant Foods Commercially Available in Iran

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### ABSTRACT

Many developmental problems in infants and children have been directly linked with exposure of the toxic elements. In present work, the concentrations of toxic elements, cadmium (Cd), nickel (Ni), manganese (Mn) and lead (Pb) were measured in different infant foods, primarily to evaluate whether the intakes comply within permissible levels of these toxic elements. The infant foods were evaluated for total contents of toxic elements, using a simple wet acid nitric digestion method. The range of the investigated toxic elements in different infant foods were 40.3–58.0 µg/kg, 4479.1–6415.0 µg/kg, 2300–4875 µg/kg and 31.83–31.85 µg/kg for Cd, Ni, Mn and Pb, respectively. The daily intakes of toxic elements for children through infant foods have also been estimated, and are well below the recommended tolerable levels, except in nickel level that was high.

**KEYWORDS:** Atomic absorption spectrometry; Infant foods; Cadmium; Toxic elements.

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### INTRODUCTION

Milk is the fundamental food for infants. The most natural and best source is from breast feeding and this is greatly encouraged for the first 6 months of life and should be continued for as long as 2 years. In certain situations, special diets are required due to different metabolic reasons or in view of increasing nutritional requirements, which are no longer met by breast milk alone. Accordingly, pediatric guidelines advocate the gradual replacement of exclusive milk feeding by complementary foods from the fifth month of life onwards [1-2].

Infant feeding deserves top priority in any plan aimed at sound child healthcare, irrespective of ethnic, cultural and religious considerations. It is anticipated that appropriate infants and children feeding can prevent millions of deaths occurring from childish gastroenteritis and malnutrition in developing and developed countries [3]. Multi-element surveys of baby foods and the need to establish limits for infant exposure to such elements from the diet have extensively studied [4].

The toxic elements found throughout the environment and are present in virtually all food, and these contaminants are more likely to affect children [5-6].

Many developmental problems in infants and children have been directly linked with exposure of toxic elements [7]. The early postnatal period of infants is characterized by rapid growth and development, their energy requirements and hence their food consumption is on average much higher in relative to their body weight than that of older children and they are more vulnerable to toxic elements present in their atmosphere and food [8]. High manganese exposure in childhood can result in a neurotoxic syndrome affecting dopamine balance and behavior control [9]. Lead in milk products and cereals is of particular concern because they are considered as first solid food for infants and children [10], and the determination of lead level in baby feed is particularly monitored by international organizations [11]. The body of children absorbs a larger percentage of lead that they ingest, and exhibit lead toxicity even at lower levels of exposure [12].

Cadmium intake via respiration of atmospheric air is minimal for the general population, and exposure is almost exclusively through ingestion of daily foods [13]. It was also made clear that, even in recent years, Cd in rice is the most influential factor of daily dietary Cd intake among the general population in world [14].

Determination of toxic elements in different environmental and biological samples requires the use of sensitive and selective techniques such as electrothermal atomic absorption spectrophotometry, inductively coupled plasma-optical emission and mass spectrometry [15-16]. These techniques require the destruction of sample matrix to render a solution of the analyte ready for analysis [17]. The determination of elements in food samples traditionally been performed by digestion with acid or acid mixtures.

The objective of this study was to determine the toxic elements (Cd, Ni, Mn and Pb) in different infant foods, to evaluate the changes in the intake pattern of toxic elements when the children switches over from milk to a solid cereal-based diet. The toxic elements were determined by Inductively Coupled Plasma –Optical Emission Spectrometry (ICP-OES), after a wet acid digestion method. The daily intake of toxic elements by infants and children through different infant foods was also calculated for possible health risks.

## MATERIALS AND METHODS

### SAMPLE ANALYSIS

In this study, five samples of infant food supplement, including three food supplement from Ghoncheh company (rice with milk, wheat with milk, almond porridge) and two food supplement from Nestle company (wheat & milk, and banana & wheat with milk) that has high consumption in Iran, were prepared (Table 1). In summary 1 gr of powdered sample weighted, 22ml of nitric acid added and predigested over night in 60°C oven. After cooling 2 ml of hydrogen peroxide were added. Concentrated HNO<sub>3</sub> and H<sub>2</sub>O<sub>2</sub> were spectroscopic grades (Merck). The container placed in 60°C oven for 1h and the temperature increased to 160°C for 8 hours.

**Table1- Type and company of infant food supplement**

Samples	Type and company
M1	Ghoncheh, rice+milk
M2	Ghoncheh, wheat+milk
M3	Ghonche, Almond porridge
M4	Cerelac (Nestle), wheat+milk
M5	Cerelac (Nestle), banana & wheat with milk

### DETERMINING ESTIMATED DAILY INTAKE (EDI)

Daily intake depends on metal contamination and daily consumption of foods. In addition body weight can influence the tolerance of pollutant. EDI is concepts that take account these factors.

$$EDI = \frac{C \times Cons}{Bw} \quad (1)$$

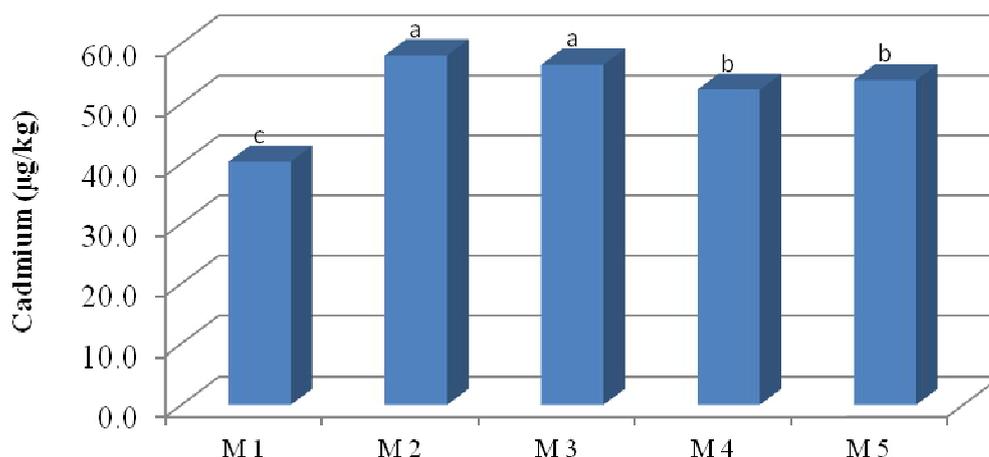
Where C is concentration of heavy metals, Cons stands for daily average consumption (100 gr/Day) and Bw indicates body weight (8.5 kg). All statistical analysis was performed with SAS 2001 for windows release.

## RESULTS AND DISCUSSION

### 1- Cadmium

For the period from the 5th to the 9th month of life, the main contribution to Cd exposure is found to be the solid foods and beverages. A cumulative exposure of 4.7±0.7 µg/kg bw/week may occur for infants during the weaning period. Furthermore, a Swedish data have manifested that more than 80% of the dietary Cd intake comes from plant foods [18], mainly cereals (especially whole grains), vegetables, root vegetables and potatoes. Cadmium absorption after dietary exposure in humans is relatively low (3–5%) but cadmium is efficiently retained in the kidney and liver in the human body, with a very long biological half-life ranging from 10 to 30 years [19].

In Figure 1, the amount of cadmium in five samples of commercial infant food supplement used in this study has been reported.



**Fig. 1- The amount of cadmium in different infant foods supplements.**

The average estimated daily intake (EDI) values in infant food supplements and compared with the permitted levels are reported in table 2. The estimated here Cd mean intakes for the mentioned above infant samples (7–12 months) was 0.47-0.68 µg/kg.day.bw.

**Table2- The average estimated daily intake (EDI) values in infant food supplements and compared with the permitted levels.**

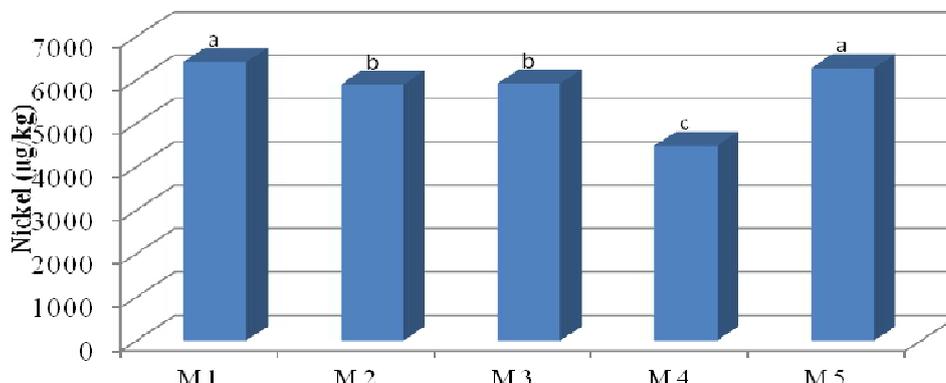
	Cadmium	Lead	Manganese	Nickel
TDI* (µg/kg.day.bw)	1	3.6	70	39
PTWI** (µg/kg.week.bw)	7	25	500	273
infant food samples	EDI (µg/kg.day.bw)			
M1	0.47	0.37	31	75.47
M2	0.68	0.37	27	69.32
M3	0.66	0.37	49	69.64
M4	0.62	0.37	557	52.70
M5	0.63	0.37	48	73.79

\* Tolerable Daily Intake (TDI)

\*\* Provisional Tolerable Weekly Intake (PTWI)

**2- Nickel**

In Figure 2, the amount of nickel in five samples of commercial infant food supplement used in this study has been reported. The estimated here Ni means intakes for the mentioned above infant samples was 52.70-75.47 µg/kg.day.bw. These values are above the WHO TDI for nickel of 39 µg/kg bw day.

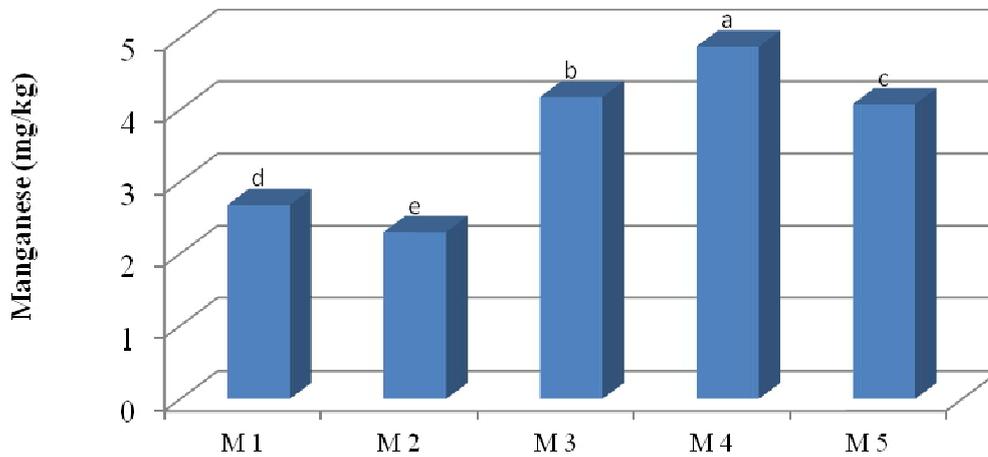


**Fig. 2- The amount of nickel in different infant foods supplements.**

**3- Manganese**

Since there is no recommended Mn tolerable upper level, the ATSDR (Agency for Toxic Substance and Disease Registry) estimated adequate intake level of 0.003 and 0.6 mg/day for infants aged 0–6 and 7–12 months, respectively [19]. In Figure 3, the amount of manganese in five samples of commercial infant food supplement used in this study has been reported.

The estimated here Mn mean intakes for the mentioned above infant samples was 27-57 µg/kg.day.bw. In agreement with our results, several other studies have found a newborn’s overexposure to Mn through ingestion of infant formula that may be associated with adverse neurotoxic effects [20-21].



**Fig. 3- The amount of manganese in different infant foods supplements.**

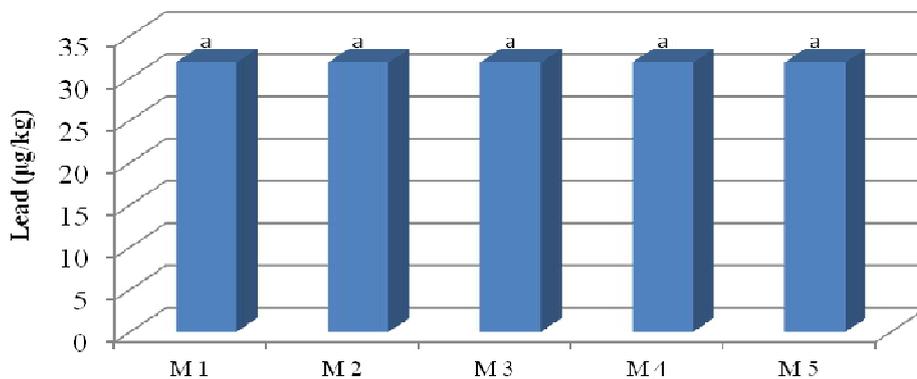
**4- Lead**

Mean Pb intakes of 2.6±1.6 and 5.8±2.1 µg/kg bw/week for infants during the formula-feeding (0–4 months old) and weaning period (5–9 months old), respectively, were suggested [22].

In Figure 4, the amount of lead in five samples of commercial infant food supplement used in this study has been reported.

Cadmium and lead are toxic and can be cumulative. The high level of TEs in air, water and food are detrimental to human health and children are more sensitive to these metals than adults [23].

The estimated here Pb mean intakes for the mentioned above infant samples was 0.37 µg/kg.day.bw. Several studies conducted in Germany [24], Australia [25] and Canada [26] manifested higher Pb level determined in cows’ milk-based infant formula than human milk. Therefore, the control of Pb in infant formulae seems to be essential.



**Fig. 4- The amount of lead in different infant foods supplements.**

**CONCLUSIONS**

The control of toxic elements (cadmium, nickel, manganese and lead) in infant formulae seems to be essential. The high levels of the toxic elements in infant foods may avoid the intestinal barrier, while due to renal immaturity of neonates and children (less than 12 months) impairs their elimination. The levels

of the cadmium, manganese and lead elements in analysed infant food samples were found to be under legal limits. It is essential to take special care throughout the entire process of manufacturing foods for infants and young children, as the fragility of them requires an increased safety. We suggest that contaminations with metals should be routinely monitored in foods for babies in order to reduce food-borne hazards in infants and young children.

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