شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

بسم الله الرحمن الرحيم

Ain Shams University Information Network

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قسم

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HANAA ALY

RISK ASSESSMENT OF TRACE ELEMENTS IN CHILD FOOD AND HOW TO MITIGATE THEIR RISKS

Submitted By

Maha Ahmed Mohammed Ibrahim

B.Sc. of Agricultural Sciences, Faculty of Agriculture, Cairo University, 1998

Diploma in Environmental Sciences, Institute of Environmental Studies & Research, Ain Shams University, 2004

M. Sc. in Environmental Sciences, Institute of Environmental Studies & Research, Ain Shams University, 2015

A Thesis Submitted in Partial Fulfillment
Of
The Requirement for the Doctor of Philosophy Degree
In
Environmental Sciences

Department of Environmental Agricultural Sciences
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APPROVAL SHEET

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ABSTRACT

Inductively Coupled Optical Emission Spectrometer (ICP-OES) was chosen to be validated and applied in routine method of analysis for the determination of Cd, Cr, Co, Cu, Fe, Ni, Mn, Pb, Sb, Sn, and Zn in child food. Several validation parameters such as [detection limits, quantification limits, recovery test, linearity (linear dynamic ranges and method linearity), accuracy (trueness and precision), and measurement uncertainty] were studied under optimised (ICP-OES) conditions. The method showed that, the estimated detection limits varied between 2 and 159 µg/kg and the estimated quantification limits varied between 1 and 532 µg/kg, while the quantification limits varied between 20 µg/kg and 1 mg/kg. The mean recoveries ± standard deviations at different spiking levels were varied between 81.95 ± 3.89 and 112.56 ± 3.31% with coefficients of variation expressed as relative standard deviations ranged from 1.95 and 5.91 %. The dynamic linear range found to be linear from 0.05 up to 6 mg/L for Cr, Co, Fe, Ni, Zn, Cu, Mn and Sn, and from 1 up to 100 ug/L for Pb, Cd and Sb. The method linearity was found to be linear from LOQs up to 10 mg/kg for Mn, Cr, Co, Sn, Ni, Fe, Cu, and Zn, up to 2 mg/kg for Sb, and up to 1 mg/kg for Cd and Pb. All dynamic linear range and method linearity correlation coefficients values were greater than 0.995. The methods trueness were confirmed by using three different certified reference materials (IPE 783 Wheat powder, IPE 998 Potato powder, and IPE 200 Maize powder) purchased from Wageningen Evaluating Programmes For Analytical Laboratories (WEPAL) and all obtained results were within satisfactory ranges and had acceptable recovery and Z-score values. The method precision, in terms of relative standard deviation (RSD), was found to be below 5.16 %.The method uncertainty expressed as expanded uncertainty of child food method was found to be ≤ 22.68 %. The results obtained indicated that, this method was suitable for a precise and accurate determination of these chemical elements in different kinds of child food samples at these low concentration values. Validated method used for the determination of metallic contaminants in 200 commercial child food samples and the results were compared with the provisional guideline of the elements stated by Egyptian and Europeans standards in food. The results indicated that various elements concentrations were detected in analysed child food samples. 57.50 % and 22.00 % of the analysed samples contained detectable amount of antimony and cobalt, respectively, and all these antimony and cobalt levels that were found to be less than quantification limit. On the other hand, the concentrations of Cd, Cr, Cu, Fe, Mn, Ni, Pb, Sn, and Zn in all child food ranged between (< 0.02 – 0.26, < 1 – 4.90, < 1 – 29.60, < 1 – 386.20, < 1 – 22.80, < 1 – 6.40, < 0.05 – 0.19, < 1 – 3.50, and < 1 – 269.10 mg /kg), respectively. 51.50 % and 16.50 % of all analysed child food contained concentrations levels of Cd and Pb, of which 3.00 % and 5.00 % exceeded the maximum permissible limit of Cd and Pb stated by Egyptian standards in food. The estimated provisional tolerable weekly intakes (EPTWI), the target hazard quotient (THQ), the hazard index (HI), and the target cancer risk (TCR) of detected elements was calculated to estimate the health risk due to child food consumption. The results showed that all EPTWI, THQ, and TCR values were found to be less than the acceptable guideline value stated by **(JECFA, 2005; Food and Nutrition Board, 2001; and USEPA, 2011).** This indicates that even over a long time period consumption of child food there are no any carcinogenic effect resulting from metals ingestion through child food consumption.

Keywords: Trace and toxic elements, Analytical method, ICP-OES, Child food, Risk exposure, Egypt.

LIST OF ABBREVIATIONS

Abbreviations	Synonyms
µg	Micro-gram, 10^{-6}g.
mg	Milli-gram, 10^{-3}g.
kg	Kilogram, 10^{3}g.
b.w	Body weight.
nm	Nanometer.
cm	Centimeter.
L/min	Litter per minute.
FAO	Food and Agriculture Organization.
WHO	World Health Organization.
JECFA	Joint FAO/WHO Expert Committee on Food Additives.
WHO/GEMS	WHO/Global Environment Monitoring System.
EFSA	European Food Safety Authority.
EU	European Union.
EGY	Egyptian Standards.
FAPAS	Food Analysis Performance Assessment Scheme
ICP-OES	Inductively Coupled Plasma Optical Emission Spectrophotometer.
ICP-MS	Inductively Coupled Plasma Mass Spectrophotometer.
GFAAS	Graphite Furnace Atomic Absorption Spectrometer.
LOD	Limit of detection.
LOQ	Limit of quantification.
S	Standard deviation.
N	Number of replicates
RSD	Relative standard deviation.
$U_{STANDARD}$	Standard Uncertainty.
U_{BIAS}	Uncertainty due to bias.
K	Degree of freedom.
$U_{PRECISION}$	Uncertainty due to precision experiments.
$U_{REFERENCE}$	Uncertainty due to reference standard preparation.
$U_{COMBINED}$	Combined uncertainty.
CRM	Certified reference material.
EPTDI	Estimated provisional tolerable daily intake.
EPTWI	Estimated provisional tolerable weekly intake.
APTDI	Accepted provisional tolerable daily intake.
APTWI	Accepted provisional tolerable weekly intake.

Abbreviations	Synonyms
AMU	Atomic mass unit.
cps	Count per second.
KED	Kinetic energy discrimination
THQ	The target hazard quotient
HI	The hazard index
TCR	The target cancer risk
LOQs	limit of quantifications
WEPAL	Wageningen Evaluating programmers' analytical laboratories
Lu	Lutetium

Contents

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