Assessment of the concentration levels of some essential and toxic elements in food supplements collected from different local markets in Egypt

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ABSTRACT

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Food supplements are widespread in our country, especially whey protein, which is a by-product obtained from cheese manufacturing, contains high amounts of essential metals and amino acids. In this study, inductively coupled plasma optical emission spectrometry (ICP OES) and graphite furnace atomic absorption spectrometry (GF AAS) were used to develop analytical method for determination of Co, Ni, Sn, Cr, Cu, Mn, Zn, Fe, Al, Na, Ca, Mg, Pb, Cd, and Hg in different food supplement samples collected in Egypt. Several validation parameters, such as quantification limits, recovery test, linearity (linear dynamic ranges and method linearity), accuracy (trueness and precision), and measurement uncertainty were studied. The practical limits of quantification were found to be 0.02, 0.03, 0.03, 0.2, 0.2, 0.2, 0.5, 0.5, 1, 1, 2, 5, 50, 50, and 50 mg/kg for Cd, Pb, Hg, Mn, Ni, Sn, Cr, Co, Fe, Zn, Cu, Al, Na, Ca, and Mg, respectively. The recoveries were ranged between (74.64-120 %) with relative standard deviations varied between (1.18 -13.07%). The method trueness was confirmed by using five certified reference materials from FAPAS and WEPAL, and all measured results were within satisfactory range and had an acceptable Z-score and recovery. The method precision, in terms of relative standard deviation, was below 5.78%. The measurement uncertainty for food

Abstract

supplements method expressed as expanded uncertainty in terms of relative standard deviation at 95% confidence level for all elements were ≤ 22.99%. The validated methods were used for the determination of metals content in 168 food supplement samples. The results showed that the maximum concentration (mg/kg) of Ca (400000) > Na (17410) > Mg (8798) > Zn (564.3) > Fe (491.4) > Al (246.8) > Mn (167.6) > Cu (18.21) > Cr (3.67) > Ni (3.56) > Sn (0.65) > Cd (0.335) > Pb (0.16), while Co and Hg were varied between not determinable (N.D.) and below the limit of quantification (< LOQ) in all food supplement samples. Based on the obtained results, this study proved that there are large differences were found between the measured and the defined values for some elements. In addition to some elements, such as Mn, Fe, Cr, Na, and Cu exist in the food supplement samples, but not defined on the label. The health risk assessment was evaluated for estimated daily intake (EDI), average body weight (70 kg), hazard quotient (HQ), and hazard index (HI) using the FAO/WHO and US EPA recommendations. Based on the results of this work, the EDI and HQ values for most of elements in food supplement samples were lower than the reference dose (RfD) and 1, respectively, which indicates no adverse effects may occur. Also, the HI values for most of food supplement samples were lower than 1. Among the food supplement samples, there are some samples had EDI values slightly higher than the reference dose (RfD) values, and consequently there are HQ values >1. Besides, there are HI values higher than 1 in some food supplement samples. This indicates that more consumption of these products frequently may result in adverse non-carcinogenic health effect on consumers in the future.

Keywords: Food supplement, heavy metal, hazard quotient (HQ), hazard index (HI), Food safety, Food composition, ICP OES, GF AAS.

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