

Dietary Exposure Assessment of Potentially Toxic Trace Elements in Fruits and Vegetables Grown in Akhtala, Armenia

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Abstract : Mining industry is one of the priority sectors of Armenian economy. Along with the solution of some socio-economic development, it brings about numerous environmental problems, especially toxic element pollution, which largely influences the safety of agricultural products. In addition, accumulation of toxic elements in agricultural products, mainly in edible parts of plants represents a direct pathway for their penetration into the human food chain. In Armenia, the share of plant origin food in overall diet is significantly high, so estimation of dietary intakes of toxic trace elements via consumption of selected fruits and vegetables are of great importance for observing the underlying health risks. Therefore, the present study was aimed to assess dietary exposure of potentially toxic trace elements through the intake of locally grown fruits and vegetables in Akhtala community (Armenia), where not only mining industry is developed, but also cultivation of fruits and vegetables. Moreover, this investigation represents one of the very first attempts to estimate human dietary exposure of potentially toxic trace elements in the study area. Samples of some commonly grown fruits and vegetables (fig, cornel, raspberry, grape, apple, plum, maize, bean, potato, cucumber, onion, greens) were randomly collected from several home gardens located near mining areas in Akhtala community. The concentration of Cu, Mo, Ni, Cr, Pb, Zn, Hg, As and Cd in samples were determined by using an atomic absorption spectrophotometer (AAS). Precision and accuracy of analyses were guaranteed by repeated analysis of samples against NIST Standard Reference Materials. For a diet study, individual-based approach was used, so the consumption of selected fruits and vegetables was investigated through food frequency questionnaire (FFQ). Combining concentration data with contamination data, the estimated daily intakes (EDI) and cumulative daily intakes were assessed and compared with health-based guidance values (HBGVs). According to the determined concentrations of the studied trace elements in fruits and vegetables, it can be stressed that some trace elements (Cu, Ni, Pb, Zn) among the majority of samples exceeded maximum allowable limits set by international organizations. Meanwhile, others (Cr, Hg, As, Cd, Mo) either did not exceed these limits or still do not have established allowable limits. The obtained results indicated that only for Cu the EDI values exceeded dietary reference intake (0.01 mg/kg/Bw/day) for some investigated fruits and vegetables in decreasing order of potato > grape > bean > raspberry > fig > greens. In contrast to this, for combined consumption of selected fruits and vegetables estimated cumulative daily intakes exceeded reference doses in the following sequence: Zn > Cu > Ni > Mo > Pb. It may be concluded that habitual and combined consumption of the above mentioned fruits and vegetables can pose a health risk to the local population. Hence, further detailed studies are needed for the overall assessment of potential health implications taking into consideration adverse health effects posed by more than one toxic trace element.

Keywords : daily intake, dietary exposure, fruits, trace elements, vegetables

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