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TOXIC TRACE ELEMENTS IN VEGETABLES COLLECTED FROM MARKETS IN KANDY DISTRICT

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EXTENDED ABSTRACT

Toxic trace elements are environmental pollutants, particularly in areas with high anthropogenic pressure (Ghosh *et al.*, 2013). Contamination of toxic trace elements via agricultural inputs such as fertilizer, manure and pesticides could be a major problem as most of such elements are persistent in environment due to their immobile nature (Mc Bride, 2003). Such elements hence could contaminate the agricultural produce under heavy input use. The transfer of trace elements from agricultural inputs in to soil and subsequently to plants pose a potential health risks because they can enter the food chain and contaminate the environment (Ghaedi*et al.*, 2008). Vegetable growing farmers in intensive areas grow 2-3 crops per year in the same land and apply high doses of fertilizers and other agrochemicals (Wijewardena and Yapa, 1999). Chemical fertilizers manure and pesticides contain toxic trace elements either as an active ingredient or as impurities (Premarathna *et al.*, 2011). Objectives of this study were to assess toxic trace metal contents in vegetables obtained from the Kandy market and to estimate the dietary intake of different toxic trace element via vegetable consumption.

Nearly 250 g of fresh vegetable of carrot (*Daucus carota*), beet (*Beta vulgaris*), leek (*Allium ampeloprasum*), potato(*Solanum tuberosum*), beans (*Phaseolus vulgaris*), cabbage (*Brassica oleracea*), brinjal (*Solanum melongena*), bittergourd (*Momordica charantia*) and capsicum (*Capsicum annum*) were collected during the period of August to September, 2013. Total number of 182 vegetable samples from public fairs, public markets, super markets and retail outlets from 10 locations were collected covering Kandy district. Samples were brought to the laboratory and sample preparation was done immediately without being stored in a refrigerator. Samples were washed with tap water and rinsed with distilled water and root and tuber vegetables were peeled off and washed again with tap water followed by distilled water. Fresh weight of whole sample was recorded after water on the surfaces evaporated and oven dried at 60 ^{0}C until a constant weight is reached. The oven dried whole sample was ground using a metal free stainless steel grinder and passed through a 0.5 mm sieve.

Dried and ground vegetable samples were homogenated and 0.5 g of sample was digested with 8.0 ml of Conc. HNO_3 (69%, Analytical Grade) and H_2O_2(30%) in a microwave digester (Model No. Milestone Start D HPR – 100/105). Metal analysis was performed as described by USEPA 3051 (1994).A blank digestion was also performed using the digestion mixture without a sample. Toxic trace elements of Cu, Zn, Pb, Cr and Cd, were determined by Atomic Absorption Spectrometer (Model Varian AA140/240/280) while As was measured using Hydride Vapour Generator (VGA) assemblage of the

AAS. As total fresh weight of the sample was predetermined, this content was taken as the content in fresh weight of the whole sample. Standard reference material of tomato leaves (1,573a) issued by National Institute of Standard and Technology, USA was used to validate the analytical results.

There was a significant correlation (r^2=0.998) between the certified and measured values for standard reference materials. Recoveries of all metals studied were greater than 85% except for Cr. Percentage recovery of the Cr was 73%. All the vegetables used in the experiment contained more than 83% moisture on fresh weight basis. Toxic trace element contents in all vegetable samples were in the range of 0.4 -5.7 mg/kg for Cu, 0.45-13.5 mg/kg for Zn, 0.01-1.0 mg/kg for Pb, 0.0004-0.058 mg/kg for Cd, 0.03-3.8 mg/kg for Cr and 0.0-0.03 mg/kg for As. Highest mean content of toxic trace element found in all vegetables was Zn followed by Cu. Cr and Pb contents in vegetables were higher than that of the Cd and As. However, except Pb in potato, none of the toxic trace elements exceeded maximum permissible levels imposed by the WHO/FAO Joint Codex Alimentarius (2001) indicating that most of the vegetables do not contain toxic elements above the MPL. Among nine vegetables, carrot (5.0mg/kg), beet (4.7mg/kg), potato (4.6 mg/kg), leek (3.8 mg/kg) and bean (4.0 mg/kg) showed significantly high contents of Zn than other vegetables tested and lowest was found in bitter gourd (1.55 mg/kg). Significantly high level of copper was found in leek (1.47 mg/kg) and brinjal (1.25 mg/kg) followed by capsicum (0.957 mg/kg) and potato (0.937 mg/kg). The lowest Cu content was observed in cabbage which was 0.32 mg/kg. Highest mean concentration of Pb (0.40 mg/kg) was observed in potato compared to other vegetables while the lowest content was found in bittergourd (0.009 mg/kg). It should be noted here that the mean content of Pb in potato observed was greater than the maximum permissible level imposed by Codex Alimentarius (2001).

Maximum Permissible Level for potato may have been established based on the dietary habit of Europeans as they consume large quantity of potato compare to Sri Lankans Hence, although, mean Pb content in potato exceeded the maximum permissible

limit, there is no high tendency to exposure to Pb with potato for islanders as they consume lower quantity of potato than the Europeans. Bean, beet, cabbage, leek and capsicum also showed the presence of Pb contaminated samples. Therefore, it is necessary to pay attention to identify the possible sources of Pb contaminations in these vegetables.

Cadmium contents of vegetables varied from 0.001 mg/kg to 0.058 mg/kg. The highest mean content of cadmium was found in carrot (0.05 mg/kg) followed by beet (0.031 mg/kg) while the lowest cadmium content was found in capsicum (0.001 mg/kg).Chromium contents in tested vegetables varied from 0.03 mg/kg to 3.8 mg/kg. The highest mean Cr content was observed in carrot (0.97 mg/kg) followed by cabbage (0.88 mg/kg).Mean arsenic contents in all nine vegetables varied from 0.0 to 0.005 mg/kg. The highest As content was found in potato (0.005 mg/kg) and lowest was in capsicum (0.002 mg/kg).

Exposure of contaminants are usually expressed as provisional tolerable daily intake, a reference value based on body weight for an average adult (60 kg body weight) established by FAO/WHO (1999). The values were estimated assuming that each person is consuming 250 g of each vegetable. The estimated dietary intakes of toxic trace elements studied did not exceed Tolerable Daily Intake (TDI) levels stipulated by FAO/WHO (1999) and the maximum exposure via vegetables remains< 10% of the TDI except for Pb with potato. In the case of potato maximum exposure level reaches 48.6%. Hence, contamination of Pb through regular consumption of potato may pose a risk to the local population. Therefore, it is important to carry out periodic monitoring of Pb contents in potato and identification of sources of Pb contaminations in potato before it could become a problem.

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