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Investigation of the Presence of Heavy Metals in Plastic Toys Available in Sri Lankan Market

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Abstract

Many toys for children are partly or totally made of plastic. In these plastics, additives such as lead (Pb), cadmium (Cd), arsenic (As), chromium (Cr) and mercury (Hg) are added as pigments, fillers, UV stabilisers and plasticisers which are used to alter the properties of the material or to improve the production process. These additives, unreacted starting substances and impurities, can migrate from the plastic. As young children chew, lick and suck frequently on their toys, they can ingest certain amount of these compounds. The aim of this study was to identify the presence of heavy metals in plastic toy samples collected from market. Total of 145 plastic toys were screened on-site using handheld X-ray Fluorescence spectrometer (Skylay instrument-Genius 3000XRF) in Colombo Fort and Pettah area. The XRF device equipped with beryllium-window Silicon Drift Detector and 139 eV resolution was held on to the surface of the product and measurement was triggered for 45s in Plastics Mode. To eliminate the possibility of contamination, dust was removed prior to the XRF measurement. The built-in intensity correction method of the device corrects all deviations from samples of irregular geometric shape and uneven structure and density. The imported plastic toys were randomly selected from wholesale shops, retail shops and road side stalls considering accessibility to middle and low-income families. Results of the study revealed that the plastic toys contain heavy metals; Pb from 30.34 to 4,469.09 mg/kg, Cd from 15.09 to 1,140.73 mg/kg, As from 15.53 to 46.02 mg/kg, Cr from 15.21 to 247.78 mg/kg and Hg from 28.12 to 94.92 mg/kg respectively. Out of these 8.97% show high level of Cd and 1.38% show high level of Pb. However, the concentrations of Cr, As and Hg are under the permissible limits as per the testing standards by Restriction of Hazardous Substances (RoHS) directive. The permissible limits as per the testing standards by RoHS directive are 100 mg/kg for Cd and 1,000 mg/kg for Pb, Hg, and Cr and As. These results of the present study revealed that some toys are potential sources of heavy metals.

Keywords: Plastic toys, Heavy metals, XRF, Chemical screening