Polybrominated diphenyl ethers (PBDEs) in chickens from an e-waste recycling area in Southeast China

Qin X F, Zhao Y X, Qin Z F, Xu X B

Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, P.O. Box 2871, Beijing, 100085, China

Abstract

The levels of PBDEs (BDE-47, 100, 99, 154, 153, 183, 209) in various tissues of Sanhuang chickens from an e-waste recycling area of China were examined. Based on lipid-normalized PBDEs concentrations, the rank order of various tissues was blood ＞ fat ＞ intestine ＞ liver ＞ muscle ＞ kidney ＞ lung ＞ testis ＞ brain. The large difference in PBDEs concentrations among various tissues suggested that the tissue distribution of PBDEs might depend on tissue-specificity rather than the "lipid-compartment", where PBDEs are supposed to distribute uniformly. BDE-209 was the predominant congener (89.1-94.0% of total PBDEs) in all chicken tissues except brain (37.9% of the total PBDEs). These results indicated that BDE-209 can be bioaccumulated in terrestrial animals, and PBDE-congener patterns in terrestrial animals might depend on background exposure rather than other factors. The difference of congener patterns between brain and other tissues maybe result from blood-brain barrier, which might protected more effectually from higher brominated congeners than lower brominated congeners.

Introduction

It has been reported that 50–80% of the global e-wastes are legally or illegally imported to Asia, and 90% of the exported e-wastes have been sent to China[1]. It also has been estimated that 50-70% of e-wastes generated in U.S. were exported to China [2]. In the process of primitive recycling treatment of e-wastes, various hazardous chemicals have released in the environment and led to serious pollution in local and surrounding regions[3-5]. In a cluster of villages in Wenling area, Zhejiang Province in China, e-wastes containing PBDEs are disassembled and shattered into powder to select the usable materials for approximately ten years. The aim of the present study was to monitor PBDEs pollution statues of human habitat in Wenling by measuring PBDEs levels in chickens.

Materials and Methods

Free-range SanHuang chickens were obtained from a typic e-wastes recycling village in Wenling area. All the tissues were cleaned with deionized water, wrapped in aluminum foil twice, and sealed in plastic bags to minimize the possibility of contamination. Then, tissue samples were transported to the analysis laboratory in an ice box and stored at -20°C and darkness until analysis. After the samples were freeze-dried and homogenized with anhydrous sodium sulfate, 1 ng PCB 209 were spiked into the sample and equilibrated for 2 h at desiccator. Then, the samples were extracted with 30 mL of hexane/dichloromethane. The concentrated extracts were cleaned up with multilayer silica gel column and then the elution was then evaporated with a rotary evaporator and then reduced to 20 ¡ÌL under a gentle stream of purity N_2.

All sample extracts were analyzed by Agilent 6890 series gas chromatograph coupled with Agilent

5973 mass spectrometer (Agilent Technologies, Palo Alto, CA, USA) using electron capture negative ionization (ECNI) source in the selected ion monitoring (SIM) mode. The identification of PBDE congeners was depended on comparison of retention times and mass spectrum with appropriate standards. Quantification was performed by external standard method with multi-level calibration curve spanning the range of anticipated analyte concentrations in the samples.

Results and Discussion

In the present study, the values of PBDEs in chicken muscle were 10-100 times higher than those in chicken breast from markets of U.S.[6] and Belgium[7]. And the levels of PBDEs in muscle and liver of chicken were about 100 times higher than those reported in male chickens and ducks collected from an e-waste recycling site in Guangdong Province, South China, respectively.

Based on lipid-normalized PBDEs concentrations, the rank order of various tissues was blood ＞ fat ＞ intestine ＞ liver ＞ muscle ＞ kidney ＞ lung ＞ testis ＞ brain. The large difference in PBDEs concentrations among various tissues suggested that the tissue distribution of PBDEs might depend on tissue-specificity rather than the “lipid-compartment”, where PBDEs are supposed to distribute uniformly. BDE-209 was the predominant congener (89.1-94.0% of total PBDEs) in all chicken tissues except brain (37.9% of the total PBDEs). These results indicated that BDE-209 can be bioaccumulated in terrestrial animals, and PBDE-congener patterns in terrestrial animals might depend on background exposure rather than other factors. The difference of congener patterns between brain and other tissues maybe result from blood-brain barrier, which might protected more effectually from higher brominated congeners than lower brominated congeners.

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