Uptake of polybrominated diphenyl ethers by carrot and lettuce crops grown in compost amended soils

EKHINE BIZKARGUENAGA[1], ARANTZA IPARRAGUIRRE[1], ELISABETH OLIVA[1], HAIZEA ZIARRUSTA[1], JOSE BENITO QUINTANA[2], ROSARIO RODIL[2], LUIS ANGEL FERNÁNDEZ[1], OLATZ ZULOAGA[1], AILETTE PRIETO[1]

[1] Department of Analytical Chemistry, Faculty of Science and Technology, University of the Basque Country (UPV/EHU), P.O. Box 644, 48080 Bilbao (Spain), ebizkarguenaga@gmail.com

[2] Department of Analytical Chemistry, Nutrition and Food Science, IIAA-Institute for Food Analysis and Research, University of Santiago de Compostela, 15782 Santiago de Compostela, Spain

Due to their intensive use in commercial, consumer and household products as flame-retardants, polybrominated diphenyl ethers (PBDEs) are global contaminants in the environment [1-2]. They are readily biomagnified in food webs due to their high lipophilicity with potential toxic effects for the living organisms. The European Water Framework Directive (WFD, 2013/39/EC) referenced in 2013 PBDEs as priority hazardous substances, leading to concerns of human health risks from the consumption of food crops irrigated with reclaimed water and/or cultivated in compost amended soils. Within this context, and taking into account that plants form an essential basis of the animal and human diet, an evaluation of the uptake and accumulation of potential harmful organic contaminants in plants is of importance for risk assessment.

This study was performed to investigate the uptake of polybrominated diphenyl ethers (PBDEs), commonly present in sewage sludge, by vegetables such as carrot (*Daucus carota*) and lettuce (*Lactuca sativa*) used for human consumption from different compost-amended soil mixtures. Degradation of PBDEs in soil in the absence of the plants was discarded, probably due to the anaerobic conditions of the experiments carried out. Different carrot (*Nantesa* and *Chantenay*) and lettuce (*Batavia Golden Spring* and *Summer Queen*) varieties were grown in fortified and/or naturally contaminated compost-amended soil mixtures under greenhouse conditions.

In the case of carrot and, after plant harvesting, roots (core and peel) and leaves were analyzed separately, while for lettuce leaves and hearts were analyzed together. The corresponding bioconcentration factors (BCFs) were calculated. In carrots, a concentration gradient of 2,2',3,4,4',5'-hexabromodiphenyl ether (BDE-138) became evident that decreased from the root peel via root core to the leaves, while, in the case of decabromodiphenyl ether (BDE-209) at the low concentration level (7-20 ng g^{-1}), the leaves incorporated the highest concentration of the target substance.

In the case of lettuce samples, in general terms, a decrease in the BCF value (0.24, 0.20, 0.20, 0.19, 0.02, 0.06 for BDE-28, -47, -100, -99, -154 and -153, respectively) was observed the higher the octanol-water partition coefficient (Kow), except in the case of BDE-183 (BCF=0.51) and BDE-209 (BCF values from 0.41 to 0.74, depending on the experiment) congeners. While the uptake in lettuce was in general higher than in carrot, significant influence of the different soils and varieties of crop species on the uptake rates could not be supported by our data. Metabolic debromination, hydroxylation or methylation of the target PBDEs in the soil-plant system was not observed.

References:

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