Fate of Bisphenol AF (BPAF) in Soil-earthworm System: Role of Bioaccumulation and Biotransformation

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Abstract

Bisphenol AF (BPAF) is a substitute of bisphenol A used for polycarbonate and epoxy plastic products. Due to its strong hydrophobicity, soil is a major sink for BPAF in the environment; however little is known about its fate in the soil, especially in the presence of soil animals. Here, using ^{14}C-tracer, we studied the effects of the geophagous earthworm *Metaphire guillelmi* on the fate of BPAF in soil and the accumulation and transformation of BPAF in the earthworms. After 21 days of incubation, the earthworms significantly decreased both mineralization (from 0.73 ± 0.03% to 0.55 ± 0.03% of the initial amount) and extractable residues (ERs) in soil (from 79.99 ± 0.18% to 56.85 ± 0.01%) of BPAF in soil, and stimulated the dissipation of BPAF (from 71.39 ± 0.08% to 52.50 ± 1.64%). About 21.55% of the initially applied ^{14}C-BPAF radioactivity was accumulated in the earthworms, with the highest radioactivity in gut, followed by skin, organs, and body fluid. Earthworm tissue-bound residues (EBRs) increased during the incubation, accounting for similar amount of ERs in the earthworms at the end of incubation, and remained constant during the elimination phase, which indicated that EBRs played an important role in the BPAF bioaccumulation. Sulfate conjugate of BPAF was identified as a Phase II transformation product of BPAF, reported for the first time in the earthworms. Decomposition of earthworm bodies in the soil released BPAF and its transformation products into the soil environment. These results implied that the risk of BPAF to earthworms can be significantly underestimated if only free BPAF in earthworms is considered. This study sheds light on the effects of earthworms on the fate of BPAF in soil, providing data for assessing environmental risks of BPAF.

Keywords

Bisphenol AF, Earthworms, Non-extractable Residues, Environmental Fate