



Isotope fractionation concepts for characterization of reactive transport processes of hexachlorocyclohexanes in food webs

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The elucidation of mechanisms governing the fate of hexachlorocyclohexane isomers (HCHs) from the former production of Lindane is a global challenge. We selected Bitterfeld, Germany and Lucknow, India as the model field sites for investigation. Carbon isotope composition of HCHs and the enantiomeric fraction (EF) of α -HCH were used as indicators to characterize in situ degradation in soil, plants and higher organisms.

Elevated concentrations of HCHs were found in a number of crops growing on contaminated soil, which is showing an important pathway of how HCHs can enter the food web. The EF of α -HCH and the $\delta^{13}\text{C}$ signature of HCHs showed that degradation processes were associated with the uptake into plants, implying degradation in the rhizosphere potentially attenuating the load of HCHs. The HCHs isotope enrichment in dung and milk samples showed that degradation of HCHs may take place in the digestive track of cows during metabolism. In addition, significant carbon isotope enrichment of HCHs was observed in the livers of deer and boar living in contaminated area, suggesting that only a residual fraction was accumulated in the fat of the liver after intensive metabolism. This leads to the hypothesis that isotope fractionation of HCHs can be used to assess biodegradation in food webs, whereas the isotope enrichment in the residual fraction reflects the metabolism in the higher organisms. Thus, this may be used as a biomarker for contamination load in the diet of the organism at a specific position of the food chain.

The isotope composition of HCHs is used to analyze potential dispersion routes on the scale of a landscape in order to understand reactive transport pathways starting at the source of HCH. To our best knowledge this is the first study using CSIA and EF to track the reactive transport processes in a complex environment and food webs.