Carbon stable isotope fractionation during uptake of hexachlorocyclohexane (HCH) form HCH contaminated soil into plant samples

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The Stockholm Convention on Persistent Organic Pollutants classified HCHs as Persistent organic pollutants (POPs), due to their persistent toxic hazards to the environment, bio-accumulative, biomagnifying and long-range transport capacity. HCHs contain eight isomeric forms and of all the isomers only γ-HCH known as Lindane possess the insecticidal activity. Rest of the isomers that form during the purification of γ-HCH remains unused and their unmanageable dumping has led to the formation of HCH dump sites throughout the world and thus being persistent in nature act as a toxic pollutant.

Uptake of toxic pollutants into plant is an important process for evaluating its exposure of human and animals. It mainly follows two pathways: uptake from soil to plant directly by root and from air to shoot and leaves. Plants act as solar-driven pumping and filtering systems as they take up contaminants (mainly water soluble) from soil by roots and transport into various plant tissues. We studied the isotope and enantiomeric fractionation upon uptake of the HCHs from soil to different plants. We used *Brassica campestris* (mustard) as a model plant, since mustard is widely used in producing the edible oil and it grows well in temperate regions. Major producers of mustard seeds include Canada, Hungary, Great Britain, India, Pakistan and the United States. Contamination of HCH insecticides in mustard oils is likely because of its lipophilic nature when compared to other pesticides.

We analyzed plants and corresponding soil samples taken from a HCH-contaminated field site in Lucknow (India) for enantiomeric and isotope composition in order to investigate the processes governing uptake into plant in highly HCHs contaminated area by the Compound-specific stable isotope analysis (CISA) and enantiomer-specific stable isotope analysis (EISA) methods. For the analysis of enantiomeric fractionation a Dex 120 chiral column was used to separate the (+) *α*-HCH and (-) *α*-HCH prior analysis by GC-C-IRMS.

The results showed that the carbon isotope discrimination ($\Delta\delta^{13}C=\delta^{13}C_{plant\ sample}-\delta^{13}C_{soil}$) from soil to plant was up to 1.09‰. The enantiomeric fraction (EF) of α-HCH changes from 0.50 in the soil to 0.41/0.59 in the plants. The enantiomeric fractionation was associated with the stable carbon isotope enrichment for -24.55 and –23.37 for α-HCH (-) and α-HCH (+) respectively. This indicates that HCHs has been degraded during the uptake from soil into plants. Further studies are needed to evaluate whether HCHs are degraded in by the microbial community of the rhizosphere or during uptake into the plants by unknown processes.