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Assessment of DDT and Metabolites in Soil and Sediment of Potentially Contaminated Areas of Belém, Amazon Region, Brazil

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Abstract The aim of this study was to evaluate the distribution of DDT and metabolites in surface soils and soil profiles from two areas containing deposits of obsolete pesticides in Belém, Amazon Region, Brazil. DDT and metabolites were extracted by microwave assisted extraction and analyzed by gas chromatography with electron capture detection. Concentrations of total DDT in surface soil samples ranged from 64.22 mg kg^{-1} in area 1 (A1) to 447.84 mg kg^{-1} in area 2 (A2). Lower levels were found in soil profiles than at the surface (6.21–21.17 mg kg^{-1} in A1 and 36.13–113.66 mg kg^{-1} in A2). pp'-DDT, pp′-DDE and pp′-DDD were detected in sediments at levels of 2.01, 0.96 and 0.35 mg kg^{-1}, respectively. The ratio (DDE + DDD)/ ΣDDT was low indicating the recent introduction of DDT to the environment in the two study areas, through the volatilization and atmospheric deposition of the obsolete pesticides.

Keywords Contamination · DDT · Rivers · Sediment · Soil

DDT (1,1,1-trichloro-2,2-di(4-chlorophenyl) ethane) was used very effectively for several years to control pests and diseases such as malaria. The Stockholm Convention on Persistent Organic Pollutants banned DDT in several countries, including Brazil, due to its harmful effects, which include high environmental persistence and chemical stability, toxicity, and bioaccumulation (Turusov et al. 2002; ATSDR 2005). It has low solubility in water due to its hydrophobic characteristics, and a high adsorption capacity (Falandysz et al. 2001). In 1991, the International Agency for Research on Cancer classified DDT as a possible human carcinogen, with potential links to pancreatic cancer, breast cancer, and leukemia, and it can act as an endocrine disruptor as well (Beard 2006; Cohn 2011).

Residues of DDT and other organochlorine pesticides are present in almost all ecosystems and various environmental matrices. Their high environmental persistence and low degradability, which result from their high soil half-life (Zhao et al. 2010), allow them to remain in the environment for long periods, and to contaminate water, soil, and food (Kim and Smith 2001). DDT can be transported from one environment to another through volatilization, leaching, erosion, and chemical decomposition (Aigner et al. 1998).

Soil is an important site for the deposit of persistent organic pollutants and it may become contaminated through atmospheric deposition or direct contact. Atmospheric deposition is one of the most influential factors in environmental exposure to organochlorine pesticides (Tarcau et al. 2013). In the past, through spraying, manufacturing processes, storage, and disposal, large amounts of DDT have been deposited in the ground, where it infiltrated the soil and the water table (Villa et al. 2006; Guo et al. 2009). Accidents during transport and storage have been the main cause of pesticide contamination (Felsot et al. 2003).

In Brazil during the early 1940s, more than 6 million cases of malaria, corresponding to 15% of the population, occurred annually. A Brazilian government program, the malaria eradication campaign (CEM), reduced the annual number of cases to approximately 40,000 by the end of the 1960s (Loiola et al. 2002). Thousands of tons of DDT were used in the Amazonian states to combat malaria, as 99% of Brazil's confirmed malaria cases

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