Development of a Thin-Film Microextraction Method to Determine the Bioavailability of Xenoestrogens in Soil

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Biosolids applied to agricultural fields, parks, and other areas represent significant sources of the estrogen-like endocrine disrupting compound (EEDC) inputs to soil. These compounds enter waste treatment plants via household and industrial waste streams and are not removed by conventional waste treatment processes. As a result, many EEDCs have been detected in finished biosolids intended for land application. While methods to quantify the exposure of aquatic organisms to EEDCs have been established, data on the exposure of soil organisms and the factors affecting soil bioavailability are lacking. It is important to determine EEDC bioavailability in soil in order to inform risk assessment concerning their presence in the environment.

The development of an in vitro bioavailability method that is as effective as a traditional in vivo method and accurately describes the effective estrogenicity of the soil will decrease time, expenses, and use of solvents in future analyses. In this study, a thin-film solid phase microextraction (TF-SPME) method for determining the bioavailability of several EEDCs detected in biosolids (bisphenol A, diethylhexyl phthalate, triclosan and benzophenone) was developed, optimized, and compared with a traditional method employing the terrestrial organism Eisenia fetida. The TF-SPME method measures equilibrium pore water concentrations of all of the EEDCs studied in soil over a range of environmentally relevant concentrations within 88 minutes. Linear equations were generated to relate TF-SPME predicted concentrations of EEDCs with those extracted from E. fetida, indicating the ability of TF-SPME to predict concentrations in terrestrial organisms. Future research will focus on the effects of EEDC mixtures on bioavailability and estrogenicity, the latter quantified with a fluorescent polarization competitive binding assay.

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