

Assessment of Bisphenol A and 17 α -Ethinyl Estradiol Bioavailability in Soils Treated with Biosolids

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Abstract : It has been found that the addition of biosolids to soil is beneficial to soil health, enriching soil with essential nutrient elements. Although this sludge has properties that allow for the improvement of the physical features and productivity of agricultural and forest soils and the recovery of degraded soils, they also contain trace elements, organic trace and pathogens that can cause damage to the environment. The application of these biosolids to land without the total reclamation and the treated wastewater can transfer these compounds into terrestrial and aquatic environments, giving rise to potential accumulation in plants. The general aim of this study was to evaluate the bioavailability of bisphenol A (BPA), and 17 α -ethinyl estradiol (EE2) in a soil-biosolid system using wheat (*Triticum aestivum*) plant assays and a predictive extraction method using a solution of hydroxypropyl- β -cyclodextrin (HPCD) to determine if it is a reliable surrogate for this bioassay. Two soils were obtained from the central region of Chile (Lo Prado and Chicauma). Biosolids were obtained from a regional wastewater treatment plant. The soils were amended with biosolids at 90 Mg ha⁻¹. Soils treated with biosolids, spiked with 10 mgkg⁻¹ of the EE2 and 15 mgkg⁻¹ and 30 mgkg⁻¹ of BPA were also included. The BPA, and EE2 concentration were determined in biosolids, soils and plant samples through ultrasound assisted extraction, solid phase extraction (SPE) and gas chromatography coupled to mass spectrometry determination (GC/MS). The bioavailable fraction found of each one of soils cultivated with wheat plants was compared with results obtained through a cyclodextrin biosimulator method. The total concentration found in biosolid from a treatment plant was 0.150 \pm 0.064 mgkg⁻¹ and 12.8 \pm 2.9 mgkg⁻¹ of EE2 and BPA respectively. BPA and EE2 bioavailability is affected by the organic matter content and the physical and chemical properties of the soil. The bioavailability response of both compounds in the two soils varied with the EE2 and BPA concentration. It was observed in the case of EE2, the bioavailability in wheat plant crops contained higher concentrations in the roots than in the shoots. The concentration of EE2 increased with increasing biosolids rate. On the other hand, for BPA, a higher concentration was found in the shoot than the roots of the plants. The predictive capability the HPCD extraction was assessed using a simple linear correlation test, for both compounds in wheat plants. The correlation coefficients for the EE2 obtained from the HPCD extraction with those obtained from the wheat plants were $r = 0.99$ and $p\text{-value} \leq 0.05$. On the other hand, in the case of BPA a correlation was not found. Therefore, the methodology was validated with respect to wheat plants bioassays, only in the EE2 case. Acknowledgments: The authors thank FONDECYT 1150502.

Keywords : emerging compounds, bioavailability, biosolids, endocrine disruptors

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