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Influence of Biochar on Plant Uptake of Personal Care Products: Caffeine and Triclosan

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Abstract

The use of personal care products (PCPs) extends a person's longevity. Nonetheless, because of its uncontrolled burden on the environment, it is regarded as an emerging contaminant. The goal of this research is to determine the influence of cinnamon wood biochar (CWBC) on plant uptake of caffeine (CFN) and triclosan (TRI) from the soil. Ipomeoa aquatica was cultivated for 4 weeks in soil with a 2.5% CWBC amendment and spiked with 100 mg/kg CFN and 200 mg/kg TRI. Ultra-High-performance liquid chromatography (UHPLC) was used to quantify the CFN and TRI in the plant. The surface morphology of CWBC was investigated by scanning electron microscopy (SEM) and Brunauer–Emmett–Teller (BET) surface area. The gasification of biomass which increased the CWBC's surface area to 589 m²/g, due to the development of a porous structure. The CFN accumulated more in the shoot of the plant whereas TRI accumulated in the root. The addition of 2.5% CWBC significantly ($p < 0.05$) decreased the root and shoot accumulation of CFN by 40.4% and 70.9%, whilst those for TRI by 38.9% and 19.9%, respectively. The relative bioconcentration factors (RBF) of CFN and TRI in shoot and root was calculated by the ratio of bioconcentration factor (BCF) using $RBF = \frac{BCF(\text{CWBC amended soil})}{BCF_{\text{soil}}}$ and the results suggested that the addition of 2.5% CWBC decrease the RBF below the one indicating the effectiveness of CWBC towards mitigating the plant uptake of PCPs. Overall, the present study suggested the application of biochar to soil significantly decreased the plant uptake of PCPs, thus, can reduce the potential risk caused by the unintentional consumption of contaminated vegetables.

Keywords: Personal Care Products, Soil amendment, Health risk, Plant uptake