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Effects of biochar-derived organic matter on the uptake of As by paddy rice

JINGZI BEIYUAN

Foshan University

As one of potentially toxic elements (PTEs), arsenic (As) has captured significant research interest especially in contamination of paddy soil. Biochar, as a porous carbon-rich material, is commonly used as soil amendment and immobilizer for mitigating the contamination. However, the pristine biochar may increase the As mobility and plant-availability by releasing biochar-derived organic matter (BDOM). Previous studies showed that lignin contents of the feedstock could be a crucial factor affecting the component of BDOM, and therefore influence the As mobility and availability in soil. Yet, the roles of cellulose and hemicellulose, the other two important organic components of the feedstock, in the variation of BDOM and their subsequent effects on As mobility in soil are not fully clear. Therefore, in the current study, we evaluated biochar produced by two different feedstocks, soybean straw and sorghum straw, owing to their similar contents of lignin and hemicellulose but different cellulose content. Quenching titration experiments of As were conducted first with the addition of Fe(III). Then, the three-dimensional fluorescence excitation-emission matrix coupled parallel factor analysis (3D-EEMs-PARAFAC), fluorescence spectroscopy and Fourier transform infrared spectroscopy (FTIR) with the combination of two-dimensional correlation spectroscopy (2D-COS) were used to study the binding effects of As(V) and BDOM with the help of Fe(III). Lastly, a hydroponic experiment of paddy rice plant was used to study the effects of BDOM on As transportation. Our results suggested that different contents of cellulose play an important role in the composition of BDOM, and interestingly BDOM inhibited the entrance of As in paddy rice probably via forming As-Fe-DOM complexes. The results of this study can help in selecting the feedstock of biochar.