Bioavailability and bioaccessibility of polycyclic aromatic hydrocarbons from (post-pyrolytically treated) biochars

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Bioaccessibility data of PAHs from biochar produced under real world conditions is scarce and the influence of feedstock and various post-pyrolysis treatments common in agriculture, such as co-composting or lacto-fermentation to produce silage fodder, on their bioavailability and bioaccessibility has hardly been studied. The total ($C_{\text{total}}$), and freely dissolved (i.e., bioavailable) concentrations ($C_{\text{free}}$) of the sum of 16 US EPA PAHs of 43 biochar samples produced and treated in such ways ranged from 0.4 to almost 2000 mg/kg, and from 12 to 81 ng/L, respectively, which resulted in very high biochar-water partition coefficients ($4.2 \leq \log KD \leq 8.8$ L/kg) for individual PAHs. Thirty three samples were incubated in contaminant traps that combined a diffusive carrier and a sorptive sink. Incubations yielded samples only containing desorption-resistant PAHs ($C_{\text{res}}$). The desorption resistant PAH fraction was dominant, since only eight out of 33 biochar samples showed statistically significant bioaccessible fractions ($f_{\text{bioaccessible}} = 1 - C_{\text{res}}/C_{\text{total}}$). Bioavailability correlated positively with $C_{\text{total}}$/surface area. Other relationships of bioavailability and -accessibility with the investigated post-pyrolysis processes or elemental composition could not be found. PAH exposure was very limited (low $C_{\text{free}}$, high $C_{\text{res}}$) for all samples with low to moderate $C_{\text{total}}$, whereas higher exposure was determined in some biochars with $C_{\text{total}} > 10$ mg/kg.

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Contributors: Hilber, I., Mayer, P., Gouliarmou, V., Hale, S. E., Cornelissen, G., Schmidt, H. P., Bucheli, T. D.
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