

Assessment of bioavailability of PAHs by comparison of uptake in earthworm (*Eisenia foetida*) and different techniques including leaching, HPCD, SPME and SPMD

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Introduction

Being able to measure bioavailability has great importance from both a scientific and regulatory view as accurate assessment of bioavailability of chemicals in soil could lead to better estimates concerning risk posed to human health and ecological processes. Bioavailability is the three-way interaction between the chemical of interest, the matrix, and the organisms in the matrix. Hence, bioavailability is chemical, site, and organism specific. A common technique for assessing bioavailability is measuring uptake in earthworm. However, studies including earthworms are work and time consuming, display biological variation, are sensitive towards pH and other soil related properties, and can not be used for measurements of some substances or concentration ranges. Hence alternative techniques are of great interest. The focus of the study was to examine if the studied techniques sampled polycyclic aromatic hydrocarbons (PAHs) to the same extent as earthworm.

Results

Availability of PAHs at a former gasworks site was studied using leaching experiments with different solvents; water, water/methanol 99:1, water/n-butanol 99:1, methanol, 50 mM Hydroxypropyl- β -cyclodextrin¹ (HPCD), and 3 mM detergent (Tween 80); passive uptake in earthworm (*Eisenia foetida*); and two passive sampling techniques; solid phase micro extraction (SPME), and semi permeable membrane devices (SPMDs). 2 g of soil was used in all experiments except for earthworm (400g) and SPMD (30 g). Results are presented in Table 1. As the studied techniques are very diverse, the amount extracted (%) should be viewed in a strictly qualitative way.

Table 1.

	MeOH*	Tween*	SPMD#	HPCD*	MeOH* (1%)	n-but* (1%)	Worm#	SPME#	Water*
%	83,30	6,27	1,27	0,99	0,16	0,13	0,04	0,04	0,02
PAH (ng/g _{lipid})			955				397	473	

% = Amount extracted (ng). * = Amount (ng/g_{Dry Weight}) can be calculated using 100 % = 1600 ng/g_{Dry Weight}. # = Amount can not be calculated on soil_{Dry Weight} basis.

Principal component analysis² (PCA) showed that the different techniques had distinct PAH patterns and that the ratio of carcinogenic PAHs (containing 4-6 fused rings) to non-carcinogenic PAHs decreased in the order earthworm > total PAHs, methanol > Tween 80 > methanol (1 %) > n-butanol (1 %), HPCD > SPME >> SPMD.

References

1. Reid, B. J.; Stokes, J. D.; Jones, K. C.; Semple, K. T. *Environ. Sci. Technol.* **2000**, *34*, 3174-79.
2. Wold, S.; Esbensen, K.; Geladi, P. *Chemometrics Intell. Lab. Syst.* **1987**, *2*, 37-52.