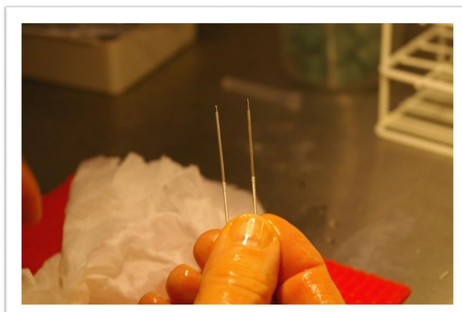
Comparison of in-tissue passive sampling and whole fish extraction to measure elimination kinetics of organic chemicals in fish

Margaretha Adolfsson-Erici, Gun Åkerman, Annika Jahnke and Michael S. McLachlan.
Department of Applied Environmental Science (ITM), Stockholm University, Sweden,
Contact: margaretha.adolfsson-erici@itm.su.se

Introduction

In fish bioconcentration tests elimination kinetics are not measured in individual fish, as fish are sacrificed to measure concentrations. This adds uncertainty to the determination of elimination kinetics and increases the number of fish that must be used.

We developed an in-tissue passive sampling method to measure elimination kinetics in individual fish



The Sampler

Deployment

Extraction

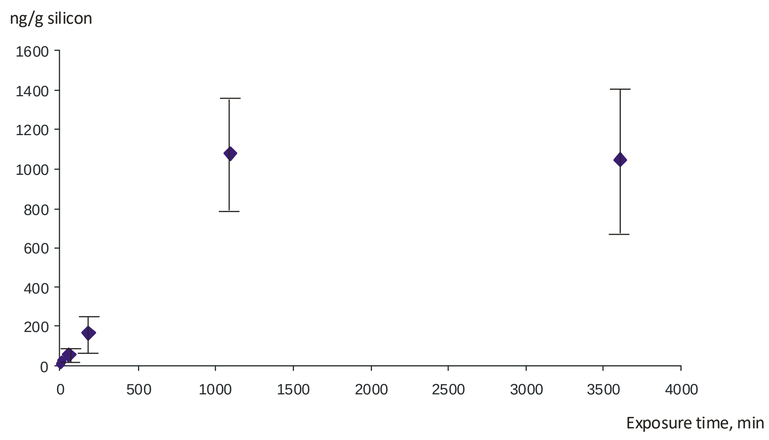


Figure 1: Concentrations of xx in passive samplers deployed in the same fish for different periods of time.

Method Development

The sampler consisted of an acupuncture needle with a piece of PDMS tubing pulled over it.

The samplers were inserted into the dorsal muscle of rainbow trout (~xx g).

After removal the samplers were extracted in 300 µL ethyl acetate and analysed without cleanup using GC/LRMS/EI.

Deployment in the same fish for different periods of time showed uptake to continue for 18 h (Figure 1).

The deployment time was standardized at 2 h.

Method Application

A fish bioaccumulation experiment was conducted according to the OECD 305 test protocol. Rainbow trout were exposed simultaneously to 10 chemicals (Table 1) using a passive dosing module (PermSelect®, see poster WE276).

The elimination kinetics in 4 fish were measured using the in-tissue sampling method. They were compared with the eliminationn kinetics measured via whole tissue analysis of 4 fish sampled at each of 9 time points (36 fish).

Table 1: Test chemicals and elimination rate constants

Chemical	Log K_{OW}	k_2 (d^{-1})	
		Passive Sam.	Whole Fish
2.3.4-trichloroanisol	4.1	0.205	0.135
m-diisopropylbenzene		0.460	0.298
musk xylene	4.4	0.033	0.036
chlorpyrifos	5.0	0.112	0.119
2.5-dichlorobiphenyl	5.0	0.029	0.024
pentachlorobenzene	5.2	0.009	0.023
2.4.6-tri-t-butylphenol	5.3	-	-
hexachlorobenzene	5.7	0.016	0.017
4-n-nonylphenol	6.1	-	-
p,p'-DDT	6.3	0.016	0.015

Results

- **Elimination kinetics could be measured with the new method for 8 of the 10 chemicals (not for the 2 phenols) (Figure 2).**
- **Variability between fish was greater for the new method.**
- **The new method was less sensitive, resulting in concentrations falling below the LOQ at an earlier time point (e.g. Chlorpyrifos, Figure 2).**
- **Nevertheless, for most chemicals there was good agreement between the elimination rate constants obtained with the two methods (Table 1)**

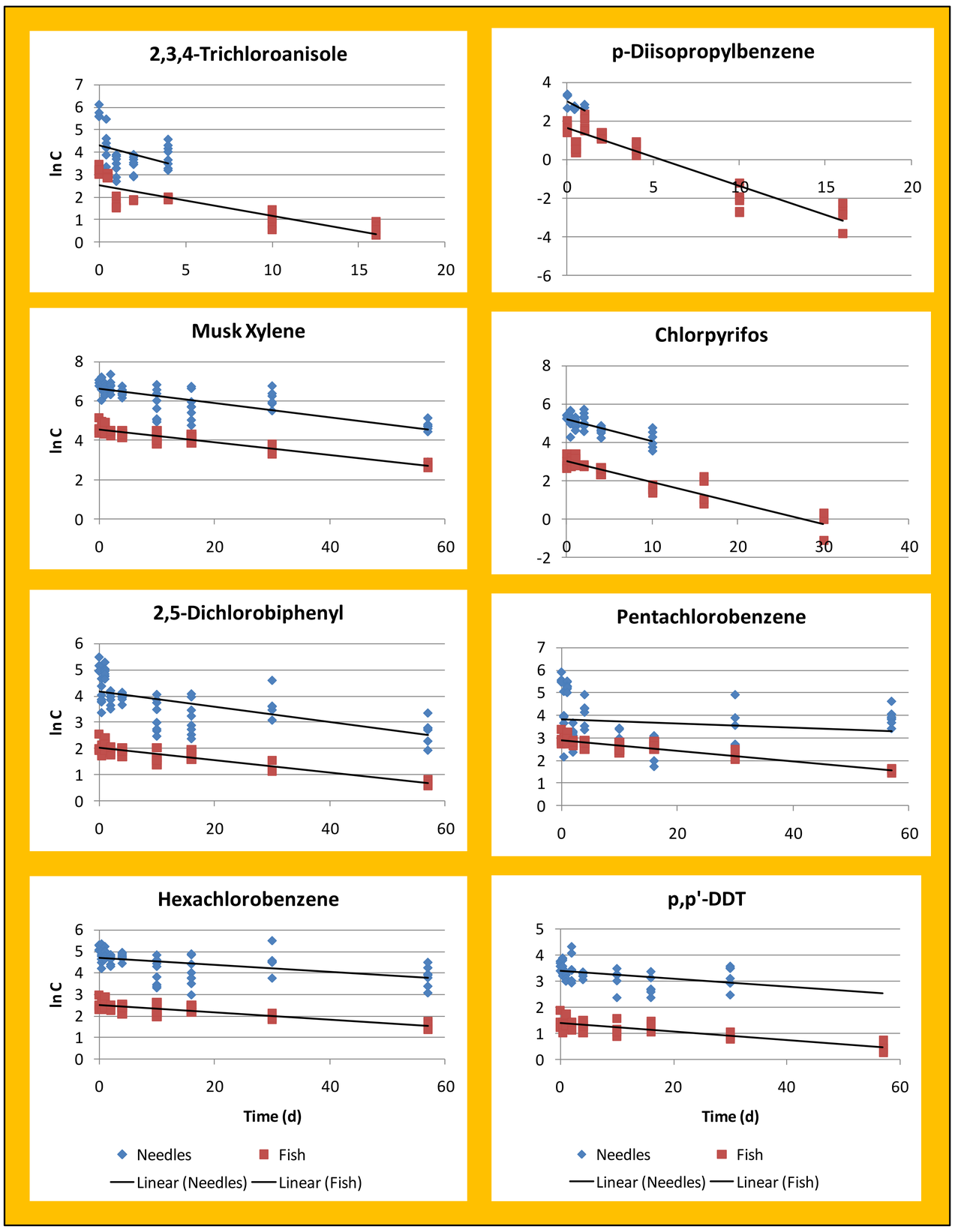


Figure 2: Elimination kinetics in fish measured using in tissue passive sampling compared to extraction of whole fish homogenates

Conclusions

The in-tissue passive sampling method can be used to measure elimination kinetics of organic contaminants in fish, greatly reducing the number of fish required and the cost of sample preparation.

However, the method cannot be applied for all chemicals, and it requires the use of larger fish and higher exposure concentrations.

Acknowledgements

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