

^{14}C radiolabelling: a sensitive tool for studying PCB bioaccumulation in echinoderms

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Polychlorinated biphenyls (PCBs) are strictly anthropogenic chemicals that constitute one of the most problematic and widespread group of marine contaminants. These xenobiotics (represented by 209 congeners) are extremely resistant to any kind of degradation, are bioconcentrated by living organisms, and can cause various adverse effects depending on their pattern and degree of chlorine substitution (e.g., Harding & Addison, 1986; Livingstone, 1992; Metcalfe, 1994).

Being under the influence of heavy industrialisation and important urbanization, the North Sea is generally considered as a region highly contaminated by numerous contaminants, including PCBs. Therefore, there is a constant need to survey and monitor the quality status of the marine environment in the North Sea. This is particularly true for the benthic ecosystems since, due to their very low solubility, PCBs mainly accumulate in the sediments where they may become a threat to organisms and ecosystems. However, information on PCB bioaccumulation rates in marine benthic organisms

is scarce and is generally of limited value, since data are mainly derived from studies using sediments experimentally contaminated with high (unrealistic) PCB concentrations (Meador *et al.*, 1995; Boese *et al.*, 1997).

The asteroid *Asterias rubens* qualifies as a potential bioindicator species of PCB contamination in the marine environment. Widely distributed, abundant, and preying upon filter-feeders, *A. rubens* is a key species of various benthic ecosystems in the North Sea (Menge, 1982; Hostens & Hammerlynck, 1994). It is also an excellent choice for ecotoxicological studies, since it is a proven bioindicator for other contaminants (e.g. heavy metals; Temara *et al.*, 1998) and it can provide early warning signals for the presence of organic contamination (Everaarts *et al.*, 1998). This species was therefore selected as a model for an experimental study of PCB bioaccumulation.

Many studies have considered PCB bioaccumulation using commercial mixtures (e.g. Arochlor) which are not always representative of environmental contamination (Metcalf, 1994). In the present work, bioaccumulation potential was investigated using a congener-specific approach and an extremely sensitive method (radio-analysis using β -spectrometry), which allowed us to study low (realistic) contaminant concentrations and to directly measure bioaccumulation in all the body compartments of the starfish (including very minute organs). PCB congener #153 (2,2,4,4',5,5'

contaminated with the radio-labelled PCB congener. Contaminant concentrations were adjusted in order to correspond to an environmentally realistic level of contamination in the North Sea (Stebbing *et al.*, 1992). During the exposure period, bioaccumulation of PCB #153 was followed in eight body compartments (oral body wall, aboral body wall, pyloric caeca, central digestive system, rectal caeca, gonads, podia, and coelomic fluid) using β -spectrometry and concentrations were expressed on a lipid weight basis.

Results showed that the observed kinetics generally tended to go through an initial latency phase and then to reach a saturation concentration (steady state) after an exponential increase. The latency phase duration and the time to reach steady state were body compartment as well as exposure mode-dependent. Both body walls (oral and aboral) accumulated the PCB most efficiently (intensity and rapidity). For each body compartment, equilibrium was always reached more rapidly during seawater exposure. Most generally, uptake fitted an asymptotic sigmoid model (corrected R^2 ranged between 0.27 and 0.84), the best fit being observed for oral body wall of starfish exposed via sea water. For each body compartment, uptake was more efficient when *A. rubens* was exposed directly in seawater than via sediments, especially in the body wall compartments.

The present study constitutes a first attempt to use a radiolabelled PCB congener to examine contaminant uptake kinetics in echinoderms. This radiotracer technique is a very promising tool for the study of PCB biokinetics. It is extremely sensitive and allows directly measuring bioaccumulation of PCBs at environmentally realistic concentrations. It also allows assessing uptake into key organs which are sometimes too minute for classical analytical measurements, such as HRGC-ECD or HRGC-MS, which require large amounts of sample material (Metcalf, 1994).

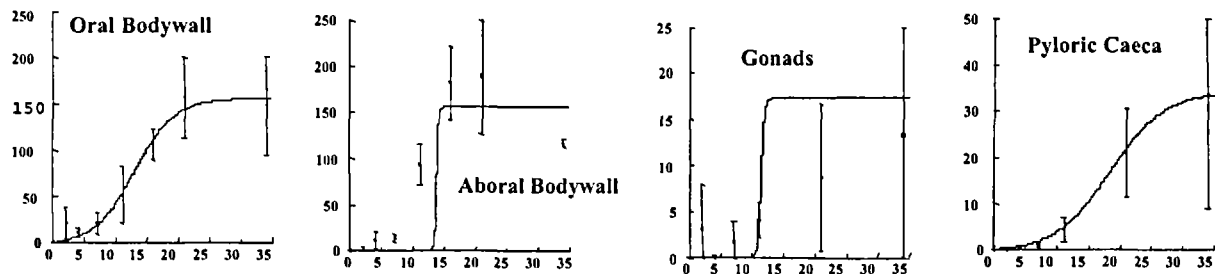


Figure 1
Uptake kinetics in *Asterias rubens* exposed via seawater (mean concentration (ng.g⁻¹ total lipids) ± SD, n=3).

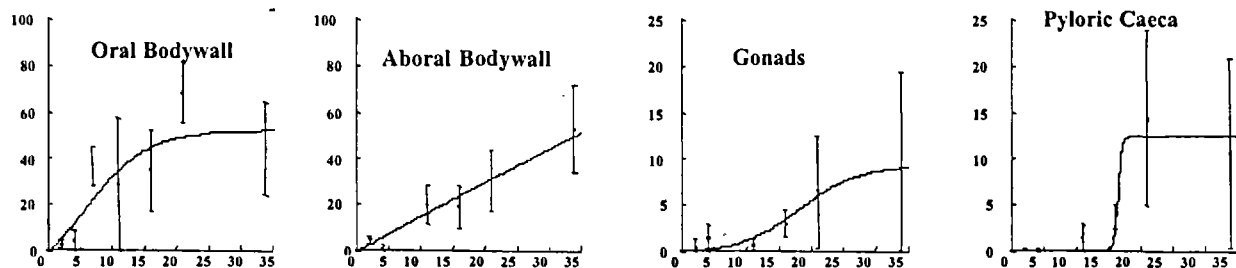


Figure 2
Uptake kinetics in *Asterias rubens* exposed via sediments (mean concentration (ng.g⁻¹ total lipids) ± SD, n=3).

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