PERFLUORINATED COMPOUNDS IN WATER, SEDIMENT AND WILD BIRD EGGS FROM THE ORANGE-SENQU RIVER, SOUTH AFRICA

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Introduction

During the last few decades, Perfluorinated compounds (PFCs) have gained increased scientific attention due to their widespread presence in humans and wildlife, as well as their toxicological potential. Currently data concerning these compounds is limited for the South African environment; to date only four studies have been performed targeting PFCs in the South Africa environment. These studies have identified PFCs in maternal serum and cord blood (max: 1.6 ng/mL), as well as in bird and crocodile eggs (max: 2300 ng/g).[1,2,3]. The current study focussed on the analysis of selected PFCs from multiple environmental matrices in the Orange River Catchment, one of the largest river systems in South Africa.

Materials and methods

Extraction and clean-up methods employed, varied for each matrix as these procedures were optimised to ensure the maximum removal of interfering compounds. Abiotic samples were extracted using sodium hydroxide followed by weak anion exchange solid phase extraction (SPE). Biotic samples were extracted using methanol in combination with dispersive activated carbon SPE clean-up. Thereafter, the extracts were analysed using liquid chromatography tandem mass spectrometry (LC-MS/MS) using a method adapted from Ballesteros *et al*[4].

Results and discussion

Of the 12 PFCs analysed, perfluoroheptanoic acid (PFHpA) and perfluorohexanesulfonic acid (PFHxS) were not detected in any of the matrices. The average recoveries for PFCs varied between 18 – 105% in water; 33 – 122% in sediment, soil and tailings dam waste; and between 45 – 137% in bird eggs. Only 8% of water samples analysed contained PFCs, namely perfluorobutanesulfonic acid (PFBS) and perfluoroundecanoic acid (PFUnA) with none of the other PFCs being detected. Soil, sediment and tailing sites also showed a low frequency of occurrence with only 24% of samples containing PFCs. The PFCs detected in these matrices were perfluorohexanoic acid (PFHxA), perfluorooctanoic acid (PFOA) and perflurooctane sulfonate (PFOS). These results were unexpected as one would expect measurable levels within the aquatic environment where the wild bird eggs were collected On the other hand 90% of bird eggs analysed contained measurable levels of PFCs, with PFOS having the highest prevalence followed by perfluorodecanoic acid (PFDA) > perfluorononanoic acid (PFNA) > PFUnA > PFHxA and PFDoA. The concentrations of PFOS in eggs of the same species from the same site were quite variable due to the long and distant feeding ranges of the birds analysed. This occurrence was further investigated by ensuring the validity of analytical identification, as well as looking at unique environmental exposure routes. PFOS identification was confirmed by retention time, mass transition, and isotope modelling against an authentic PFOS standard. Bird feathers were investigated as a possible unique exposure route as preening behaviour could increase PFC exposure.

Conclusion

Only 8% of the water, and 24% of the sediment and tailing samples contained PFCs, however the eggs 90% contained measurable level, with PFOS having the highest prevalence.

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