BIOCONCENTRAION OF PFOS AND PFOA ACIDS IN CARP (*CYPRINUS CARPIO*)

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Abstract

The relation between the water solubility and the nominal test concentration in the bio-concentration study was investigated for perfluorooctane sulfonate potassium salt (PFOS) and six homologous series of Perfluorinated acids (PFAs) with different number of the number of carbon (C=8, 11, 12, 14, 16 and 18). Bioconcentration factor (BCF) obtained from the study was conducted. As a result, Concerning the relation between BCFs and Log Pow, good correlative relationships were obtained on Perfulorooctanoic Acid (PFOA, Log Pow = 2.8, BCFs = <5.1 – 9.4), Perfluoroundecanoic Acid (PFUnA, Log Pow = 4.0, BCFs = 2,300 – 3,700) and Perfluorotetradecanoic Acid (PFTA, Log Pow = 5.1, BCFs = 16,000 – 17,000).
In contrast, concerning the relations between BCFs and molecular weight (MW) or molecular size (Dmax), high bioconcentration potentials were indicated for these compounds although the molecular weight or molecular size are far beyond the threshold values which have been generally reported.

Introduction

Perfluorinated compounds are a group of chemicals that has attracted increasing attention in recent years. These chemicals have been manufactured for more than 50 years, and are widely used in industry, particularly in the manufacture of electronic and textile products. Studies on the global distribution have detected perfluorooctane sulfonate (PFOS) in the tissues of humans and wildlife, including fish, birds, and marine mammals. The information that is available indicates PFOS to be persistent and toxic, and to cause cellular dysfunction. Another widespread PFC, perfluorooctanoic acid (PFOA), has been identified as a suspect carcinogen. However, there is very few reliable information about toxic potency of these chemicals in spite of world wide interest such as nominates on POPs criterial at second meeting of the Persistent Organic Pollutants Review Committee, (November 2006, Geneva, Switzerland). In this study, we estimated theoretical bioconcentration factor (BCFs) of several related chemicals using exposure study on carp (*cyprinus carpio*).

Materials and Methods

Perfluorooctane sulfonate potassium salt (PFOS) and six homologous series of Perfluorinated acids (PFAs) with different number of the number of carbon (C=8, 11, 12, 14, 16 and 18) were subjected to bioconcentration tests in Carp. The bioconcentration tests were performed according to "Bioconcentration: Flow-through Fish Test (Guideline 305) in OECD Guidelines for Testing of Chemicals. Test concentrations were less than the water solubility values of each test compound. When surfactants were used for dissolution of the test substance, these test concentrations were set under their critical micelle concentrations (CMC). The concentration of the organic solvent was less than 100 mg/L (100 μL/L) prescribed in OECD New Guidance, No. 23.

Results and Discussion

Bioconcentration factors (BCFs) on PFOS were measured as 200 - 1,500. On the other hand, increase of BCFs with increasing perfluoroalkyl chain was observed on PFAs, and Perfluoroteradecanoic acid (PFTA) showed the highest BCFs ranging from 16,000 to 17,000. In case of PAFs which contain more perfluoroalkyl chains, decrease of BCFs was observed.
Concerning the relation between BCFs and Log P_{ow}, good correlative relationships were obtained on Perfulorooctanoic Acid (PFOA, Log P_{ow} = 2.8, BCFs = <5.1 – 9.4), Perfluoroundecanoic Acid (PFUnA, Log P_{ow} = 4.0, BCFs = 2,300 – 3,700) and Perfluorotetradecanoic Acid (PFTA, Log P_{ow} = 5.1, BCFs = 16,000 – 17,000).
In contrast, concerning the relations between BCFs and molecular weight (MW) or molecular size (D_{max}), high bioconcentration potentials were indicated for these compounds although the molecular weight or molecular size are far beyond the threshold values which have been generally reported. It is thought that these specific

bioconcentration potentials are resulted from the high density of fluorine atom and the linear configuration of these compounds. In related to the molecular size (Deff) increase of Deff in proportion to the number of carbon was not observed, and no effective information was obtained from the relationship between Deff and BCFs.
In order to estimate bioconcentration potentials of PFAs into fish from the physico-chemical properties, consideration of the direct effect of configuration based on the molecular volume (MV) might be necessary in addition to the effect from the molecular weight (MW).

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