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Levels of organochlorine pesticides, polychlorinated biphenyls and polybrominated diphenyl ethers in fish species from Kahramanmaras, Turkey

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Abstract

The levels of organohalogenated contaminants, such as organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) were measured in four fish species (*Acanthobrama marmid* (kalashpa), *Cyprinus carpio* (carp), *Chondrostoma regium* (nose-carp), and *Silurus glanis* (wels)) from the Sir Dam Lake, Kahramanmaras, Turkey. These species were selected for their characteristic feeding behaviour and their importance to local human fish consumption. DDTs were the predominant organohalogenated contaminants in all species, with the *p*,*p*′-DDE contributing to more than 90% to the total DDTs. Other OCPs, such as hexachlorocyclohexane (HCH) isomers, chlordanes and hexachlorobenzene (HCB) were found at much lower levels in all five species. The levels of PCBs and PBDEs (on wet weight basis) were lower than in similar species from European or American freshwater systems. PBDE data were measured for the first time in fish species from Turkish environment. Lipid-based concentrations of OCPs, PCBs and PBDEs were higher in wels than in the other species and this was related to its piscivorous feeding mode and to its higher lipid content. Contrarily, concentrations of pollutants in nose-carp were the lowest, in agreement with its more herbivorous diet. A preferential accumulation in muscle compared to liver was observed for all OCPs, PCBs, and PBDEs in wels and carp, while in nose-carp, a preferential accumulation in liver was observed only for PBDEs, *p*,*p*′-DDT and PCBs. Racemic amounts for α-HCH were measured in all investigated muscle and liver samples, except for carp muscle.

Keywords: Fish; Polychlorinated biphenyls; Organochlorine pesticides; Polybrominated diphenyl ethers; Turkey

1. Introduction

The production and intensive agricultural or industrial use of persistent organohalogenated pollutants (POPs), such as organochlorine pesticides (OCPs) or polychlorinated biphenyls (PCBs), have led to the widespread contamination of the environment. Polybrominated diphenyl ethers (PBDEs) have come into extensive use as flame retardant additives to plastics, textiles, electronics and paints (de Boer et al., 2000). Due to their persistence, lipid solubility, and structural similarity to PCBs, PBDEs are emerging as a new class of environmental contaminants (de Boer et al., 2000; Darneurd et al., 2001).

Being lipophilic, POPs are characterised by a high bioaccumulation potential in food chains and therefore may pose a serious threat to upper trophic levels of aquatic communities (Fisk et al., 2001; Boon et al., 2002; Falandysz et al., 2002). In biological systems, several of these chemicals are potentially carcinogenic and may cause alternations in endocrine, reproductive and nervous systems (Cogliano, 1998; Brouwer et al., 1999; Darnerud, 2003; Langer et al., 2003). For these reasons, most countries have restricted or banned the use of PCBs and OCPs. However, the environmental persistence of POPs, along with the large

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volume usage of these compounds in the past (for PCBs and OCPs) and in the present (for PBDEs), suggests that they could remain a serious environmental problem for a number of years.

Fish is a suitable indicator for the environmental pollution monitoring because they concentrate pollutants in their tissues directly from water, but also through their diet, thus enabling the assessment of transfer of pollutants through the trophic web (Fisk et al., 2001; Boon et al., 2002). Data on the presence and distribution of organohalogenated contaminants in fish and especially edible fish species are therefore important not only from ecological, but also human health perspective. Humans are exposed inadvertently to POPs through numerous sources, of which the consumption of contaminated fish is one of the most important pathways (Fürst, 1993).

In Turkey, OCPs have been used since 1945, with large quantities of these chemicals being used during the 1960s and 1970s. Since 1983, the usage of OCPs has been severely restricted or banned (Çok et al., 1997). Only few studies have investigated the presence of OCPs in Turkish aquatic environment, where they have been evidenced in relatively high concentrations (Ayas et al., 1997; Coelhan and Barlas, 1998; Barlas, 1999). The principal aim of this study was to investigate the levels of organohalogenated contaminants in several fish species from Sir Dam Lake (Kahramanmaras, Turkey), an artificial lake with great economical importance for the region. Additionally, the distribution of pollutants, including the α-HCH enantiomers, between muscle and liver was also investigated.

2. Materials and methods

2.1. Study area

The Ceyhan river basin is located in the eastern Mediterranean region of Turkey and drains into the Mediterranean Sea in the South (Fig. 1). It covers 20 670 km^2 spread over three major provinces (Kahramanmaras, Osmaniye and Adana) and has a potential of up to 590 000 ha of irrigable land. Sir Dam Lake, with a surface of 4750 ha and a maximum capacity of 10 120 hm^3, was constructed between 1987 and 1991 and is the 2nd important dam in the Ceyhan river basin. The dam aimed to irrigate approximately 100 000 ha of land, to generate electrical power and to reduce the occurrence of floods. Agricultural production in the region is dominated by cotton (~50%) and wheat (36%), followed by groundnuts, maize, fodder, rice and watermelon. Annual fish production was estimated at approximately 86 ton in 1997. Several potential sources of pollution are present around the lake and they include not only paper, textile, oil and milk industries, but also waste from slaughterhouses or household.

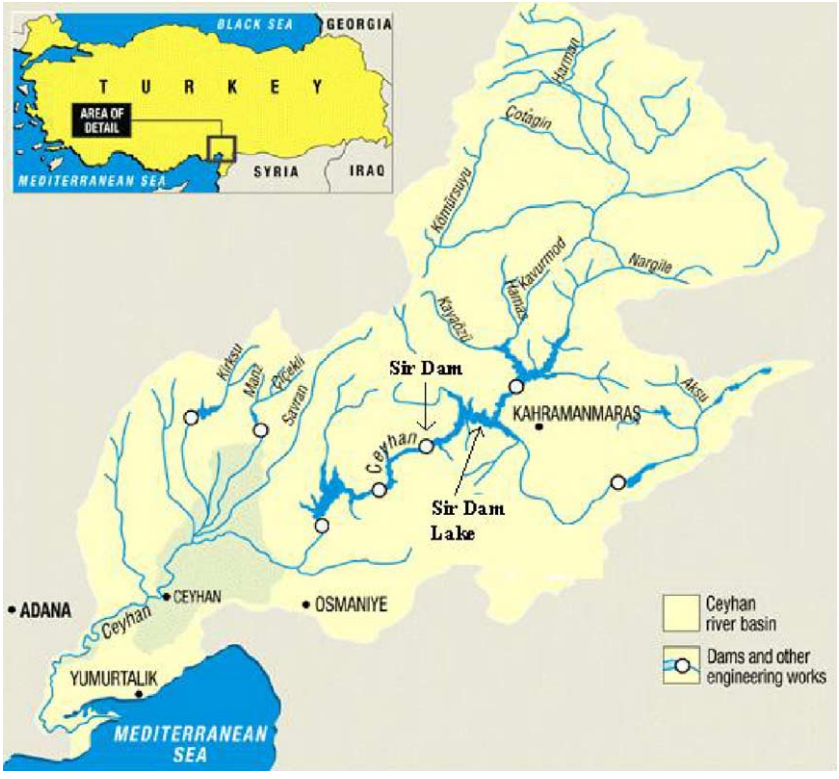

Fig. 1. The map of sampling site showing the Sir Dam Lake (Kahramanmaras, Turkey).