POLYCHLORINATED DIBENZO-P-DIOXINS (PCDD), DIBENZOFURANS (PCDF) AND BIPHENYLS (PCBs) IN DUTCH FISHERY PRODUCTS

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Introduction

Currently, discussions on new residue limits of polychlorinated dibenzo-p-dioxins (PCDDs), benzofurans (PCDFs) and dioxin-like polychlorinated biphenyls (PCBs) are taking place at national levels and in the European Union. Recently, the EU has adopted a new tolerable weekly intake of the total intake of dioxins, furans and dioxin-like PCBs at a maximum of 7 pg TEQ/kg bw[1], and has proposed new maximum levels of PCDD/Fs in food items. Recent studies in The Netherlands on levels of PCDD/F in food and dietary intake of these compounds by the average Dutch consumer have shown that the consumption of fish accounts for 14% of the total intake[2]. For regular fish consumers this value will be about twice as high. However, levels of PCDD/Fs and dioxin-like PCBs in fishery products based on a limited number of samples and areas. A proper risk assessment and risk management of these compounds in fishery products for the Dutch population could, therefore, not be made. Only data from 1990 and 1991 for mainly freshwater fish from The Netherlands and a few data on marine fish species are available[3]. The main aim of this study was to provide baseline information on the levels of PCDD/Fs and dioxin-like PCBs in fishery products that are eaten by the Dutch population.

Methods and Materials

Fishery products were collected in 1999 and 2000 from the North Sea, Celtic Sea, Channel, Atlantic Ocean, Wadden Sea, Dutch rivers, and Lake IJssel. Samples of herring, cod, mackerel, horse mackerel, dab, sole, plaice, whiting, blue whiting, sardinella, pollack, haddock, anchovy, turbot, gourlomtis, grey gurnard, anglerfish, wild eel, and pike-perch were taken. Also fish imported from France (tuna and bass), Italy (tuna and swordfish) and Sri Lanka (tuna) was collected. In addition, eel, trout, Norwegian and Scottish Salmon, and halibut from fish farms were sampled. In total 63 samples were analysed for PCDD/Fs and dioxin-like PCBs.

Mono-ortho substituted PCBs (CBs 105, 118 and 156) were determined by drying the sample with sodium sulfate, and a Soxhlet extraction with dichloromethane/pentane, followed with a cleanup with Al_2O_3 and silica gel. Extracts were measured using gas chromatography (GC) with electron capture detection (ECD). Lipids from Bligh and Dyer extractions were removed and a number of cleanup and fractionation steps were performed for the PCDD/Fs and dioxin-like PCBs (CBs 77, 126 and 169) analyses. These compounds were determined with GC and high resolution MS.
For the conversion of concentrations to TEQs, the WHO-TEF values have been used[4].

Results and Discussion

Marine and freshwater fish

TEQ levels for dioxin-like PCBs in fishery products varied between 0.02 en 33 pg TEQ / g wet weight (ww), and between 3 en 513 pg TEQ/g on a lipid weight basis (Figure 1). For PCDD/Fs only, TEQ levels varied between 0.01 and 3.9 pg TEQ/g ww, and 0.7 to 129 pg TEQ/g on lipid weight. For the sum of PCDD/Fs and dioxin-like PCBs (ΣTEQ) the levels ranged from 0.03 tot 37 pg TEQ/g ww, and on a lipid weight basis from 3.7 to 565 pg TEQ/g. Highest levels were reported for fish from locations Channel, Dutch freshwater systems (Lake IJssel and Great rivers), farmed fish and imported fish from Italy and France. In eel from Lake IJssel the highest concentration (37 pg TEQ/g ww) was found, however, a width range in levels of eels within the lake was observed (8.7 – 37 pg TEQ/g ww). For tuna a large variation in levels between the location was observed; 0.03 pg TEQ/g ww in tuna from Sri Lanka, 4 pg TEQ/g from France, and 10 pg TEQ/g ww from Italy. Herring collected at various times in 1999 and 2000 and locations (Channel and North Sea) showed less variation (2.4 – 5.7 pg TEQ/g ww).

Dioxin-like PCBs contribute on average 69% to the ΣTEQ levels in fish. Especially, the non-ortho substituted CB 126 has a large contribution to the ΣTEQ. In eel the contribution from the mono-ortho CBs is also important (38 – 52%) and equal to the contribution from the non-ortho CBs.

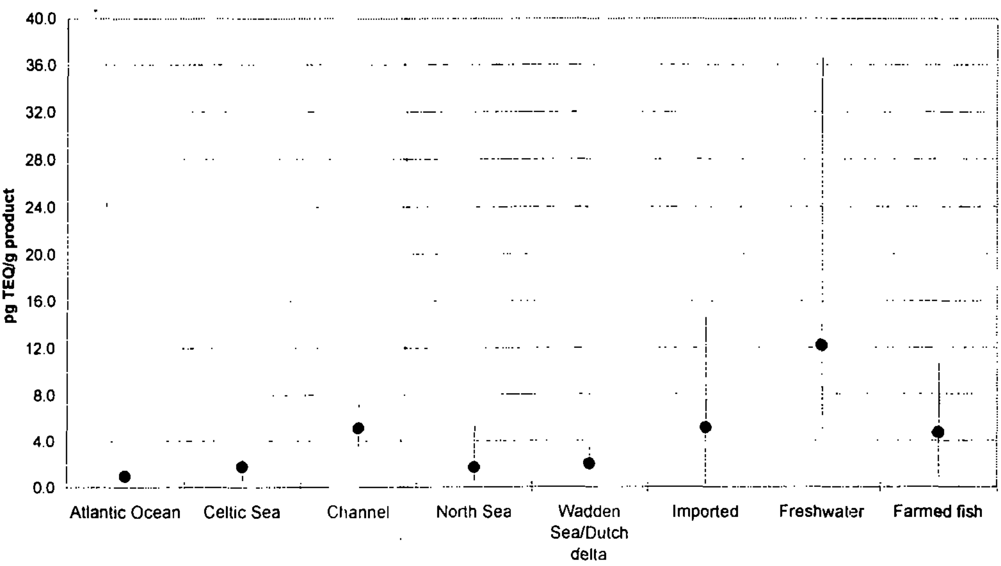

Figure 1. Levels of ΣTEQ (pg TEQ/g wet weight) in various fish products from the Atlantic Ocean, Celtic Sea, Channel, North Sea, Wadden Sea, imported fish, freshwater and farmed fish.

Farmed fish

In fatty farmed fish (eel and salmon) relative high ΣTEQ levels were observed, 3.9 to 11 pg TEQ/g ww, and 3.3 to 4.3 pg TEQ/g, respectively. However, the levels in farmed eel were lower than in eel from Lake IJssel. Interesting to note was the small variation in TEQ levels between two

In fatty farmed fish (eel and salmon) relative high ΣTEQ levels were observed, 3.9 to 11 pg TEQ/g ww, and 3.3 to 4.3 pg TEQ/g, respectively. However, the levels in farmed eel were lower than in eel from Lake IJssel. Interesting to note was the small variation in TEQ levels between two samples of Scottish salmon and two samples of Norwegian salmon, which indicates that these animals are probably consuming feed with a similar contamination. In addition, a positive correlation was observed between the lipid weight of the fish (halibut, trout, salmon, and eel) and the TEQ levels on wet weight basis (Figure 2). This observation, also, indicates that most of the farmed fish probably are fed with similar feed leading to a similar intake of contaminants.

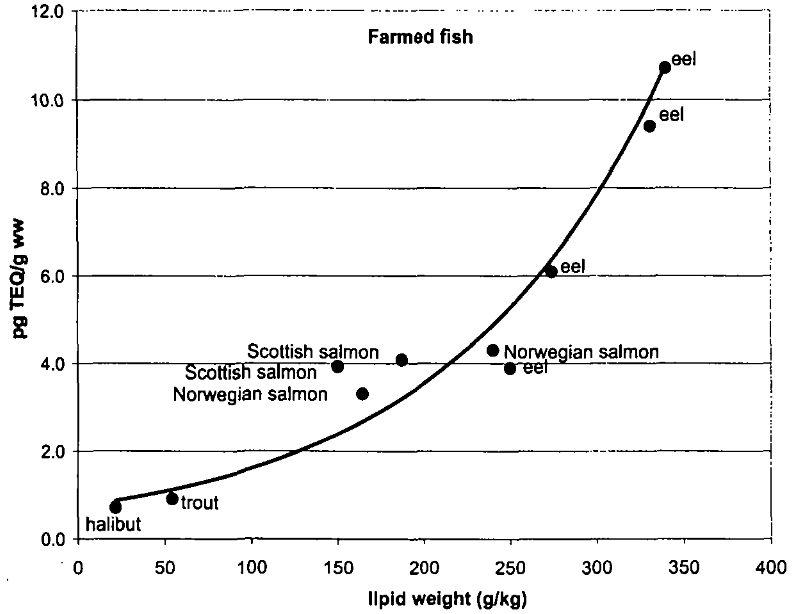

Figure 2. Levels of ΣTEQ (pg TEQ/g ww) in farmed fish species.

In conclusion, the highest levels of PCDD/Fs and dioxin-like PCBs were found in fatty fish (eel, herring, mackerel), especially from freshwater. A large variation in TEQ levels in tuna was observed with a relative high level in Italian tuna. In fatty farmed fish (eel and salmon) relative high TEQ levels were found.

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