Toxic PCBs in European otterpopulations in relation to biological factors

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Introduction

The number of otters (*Lutra lutra*) has declined markedly in large parts of Europe over the last decades. Many researchers [1,2] consider the accumulation of polychlorinated biphenyls (PCBs) from fish to otter to be a major factor in this decline. This suggestion was based on an observed negative correlation between total PCB levels in otter tissues and the status of the population. In general, high PCB levels were found in declining or endangered populations, while in thriving populations PCB levels were low [3]. Most studies however, reported only total-PCB concentrations in otter tissues instead of the biological active non-*ortho* and mono-*ortho* PCB congeners [3]. Experimental work with mink have shown that these CBs are responsible for adverse reproduction effects [4,5]. Especially, high biomagnification factors of non-ortho CB 126 and CB 169 were found for otter [6] and other mustelids [7]. In otter liver, CB 126 contributes for more than 60% to the Toxic Equivalent Concentration (TEQ). Therefore, a study was conducted to investigate the bioaccumulation of non-*ortho*, mono-*ortho* and di-*ortho* substituted CBs in various otterpopulations in Europe. Biological factors -such as age, sex, body condition and reproduction status, were investigated with regard to CB concentration and CB patterns.

Material and methods

Otter samples came from four countries in Europe (The Netherlands, Denmark, United Kingdom and Ireland) and were kindly provided for this research. Samples were spiked with ^{13}C labeled non-*ortho* CBs before soxhlet extraction. This was followed by a clean-up over a multilayer column filled with alumina oxide (5% deactivated with H_2O) and 33% H_2SO_4 deactivated silica gel. This extract was fractionated with silica gel (5% H_2O deactivated). The final extract was separated into three factions containing the di-, mono- and non-*ortho* substituted CBs using a PYE HPLC [8]. The di- and mono-ortho fraction were measured using GC-ECD and the non-*ortho* fraction with GC-ITD.

Results and discussion

In all populations CB 126 contributes to a large fraction (more than 60%) to the TEQ, beside mono-*ortho* CB 118 and CB 156 which are the other main contributors to the TEQ [9]. The relative concentration of CB 126 in the English otters were lower (not significant) than the ratios found in the Danish populations (see Figure 1). As this congener could not be metabolized by otters [6], it indicates

that the different populations are exposed to different levels of CB 126. This suggests that the total concentration of CB is not a good estimator of toxicity for otters.

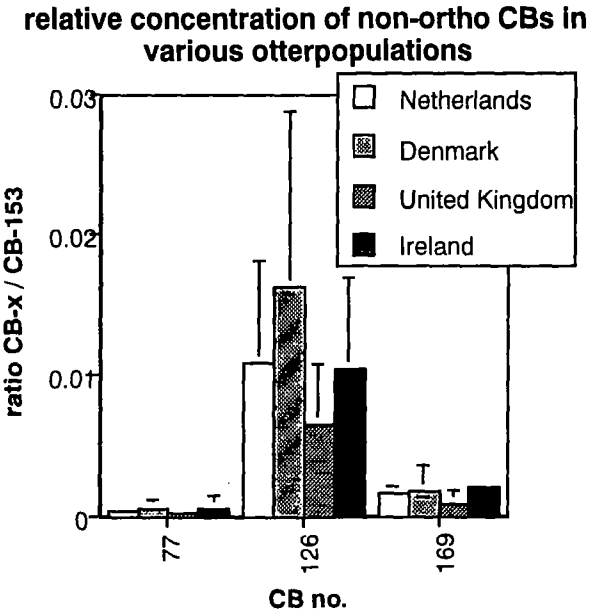

Figure 1: Mean and standard deviation of the relative concentration of non-ortho CB 77, 126 and 169 in different populations in Europe.

Recent work has shown that otters were able to metabolize congeners with vicinal H-atoms at the *meta-para* position [6]. However, CBs without vicinal H-atoms could not be metabolized by otters. The present results shows a concentration-dependent change in CB pattern for the metabolizable CBs. To illustrated this process, in Figure 2 the relative ratio of CB 101 (a congener with vicinal H-atoms in *meta-para* position) and CB 180 (without vicinal H-atoms) vs. CB 153 against the absolute concentration of CB 153 on a log-log scale is plotted. This figure shows that the relative concentration of CB 101 decreased (with a maximum of three orders) with increasing concentration of CB 153 (increase of three orders). Meanwhile, the relative concentration of CB 180 is constant with increasing concentration of CB 153. The decrease in ratio of CB 101 with increasing concentration of CB 153 was also found for other CBs with vicinal H-atoms in the *meta-para* position (CB 31, 44, 49 and 149). But also for congeners with vicinal H-atoms in *ortho-meta* position in combination with four or less chlorine atoms at the *ortho* position (such as CB 28 and CB 77). This effect is probably due to physiological processes. A first process to explain this effect is the induction of enzymes which are used for the biotransformation processes [10] (induction of Cytochrome P-450). A second explanation is starvation which may lead to a relative decrease of metabolizable CBs [10]. To investigate the last explanation principal component analyses was used with the parameters body condition of the otters (which should be a measurement of starvation), the relative concentrations of the metabolizable CBs and the absolute concentration of CB 153. This technique showed no

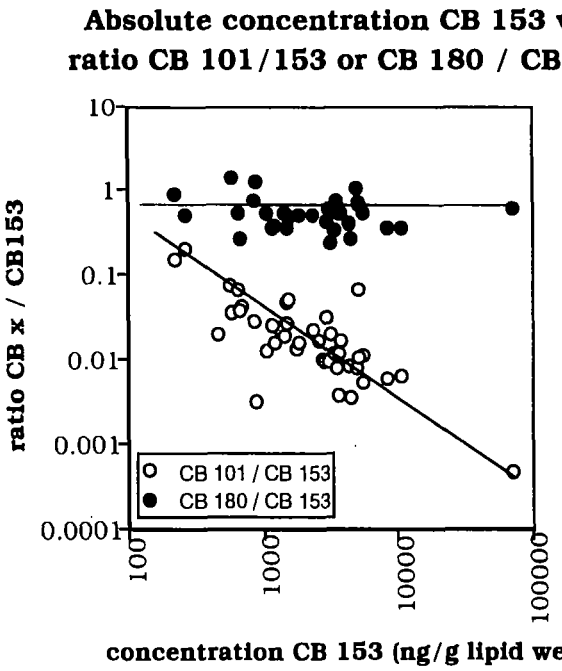

Figure 2: The relative concentration of CB-101/ CB-153 or CB-180 / CB-153 against the absolute concentration of CB 153 in otter liver from various populations in Europe.

correlation between body condition and the decrease of the ratios of metabolizable congeners. This indicates that the decrease of the relative concentration of metabolizable CB with increasing concentration of CBs is probably due to induction of cytochrome P-450. In this context, an important risk factor for the otter could be the increased metabolism of CB 77 with increasing concentration of CBs, as metabolites of CB 77 could have negative effects on the vitamin A levels in liver [11]. In otter liver a negative correlation was found between retinol levels and TEQs (CB 126 mainly contributed to the TEQ) as will be presented[12] at Dioxin '96. At this moment, the importance of metabolities of CB 77 or other CBs to the decrease of retinol in the liver is not know.

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