

Occurrence of persistent organic pollutants in Atlantic cod (*Gadus morhua* L.) in Icelandic waters

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Aim

> To analyse the concentration of 11 POPs in the Atlantic cod, (muscle and liver) from Icelandic waters, the marker PCBs or PCB7 (CB-28, 52, 101, 118, 138, 153 and 180), HCB, p,p'-DDE (main degradation product of DDT) and Toxaphene 26 and 50
> To investigate the variation in the POPs levels in cod and relate to age, sex, length and weight
> To investigate the relationship between the concentration of POPs in muscle and liver
> To evaluate the effect of processing on the PCB concentration in the fillet

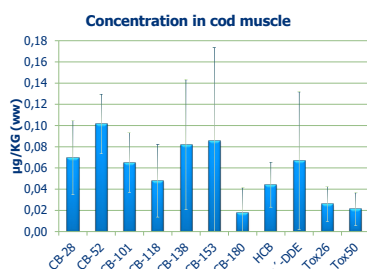


Figure 1. Geometric mean value of the eleven organic compounds analysed in cod muscle +/- SD

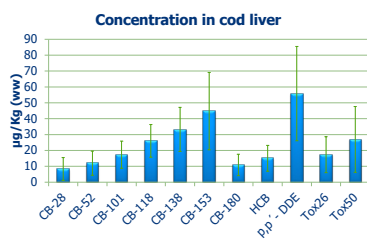


Figure 2. Geometric mean value of the eleven organic compounds analysed in cod liver +/- SD

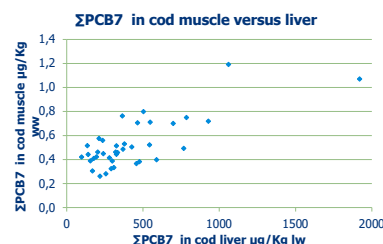


Figure 3. Concentration of ΣPCB7 in cod muscle (ww) versus liver (lw)

	Muscle	Liver
ΣPCB7	0.51	158
range	0.24-1.2	73-325
HCB	0.044	15.1
range	0.02-0.13	3.3-31.1
p,p'-DDE	0.067	55.8
range	0.017-0.3	24.2-134.1
Tox26	0.026	17.3
range	0.01-0.11	2.7-47.5
Tox50	0.021	26.9
range	0.01-0.086	5.4-82

Table 1. Geometric mean of the POPs analysed and range (min-max) in µg/kg

Introduction

Persistent organic pollutants (POPs) are compounds that can affect the environment and many of them have long half-lives, some many years and even up to decades. These compounds are lipophilic as well as very stable and therefore they magnify easily up the food chain.^{1,2} Further, many of the POPs can undergo long-range transport in that several of the POPs can be found in higher concentration in the northern region than in the region they were mostly used.³ The POPs are often placed in three categories i.e. pesticides such as Dichlorodiphenyltrichloroethane (DDT) and Toxaphene, industrial chemicals and by-products. Some POPs can be categorized both as industrial chemicals and by-products such as Polychlorinated biphenyls (PCBs) and Hexachlorobenzene (HCB).⁴ When POPs are released into the environment they are extremely stable and are transported from the sources south and north and finally enter the Arctic and Antarctic environment.⁵

Materials and methods

Extraction of POPs

To extract the POPs from the fish an ASE (Accelerated Solvent extraction) is used with n-hexane as a solvent. After the extraction the samples are cleaned further with sulfuric acid to remove all fat from the samples. After clean up the PCBs are analysed with gas chromatography (GC-ECD) with two different columns, DB-5 and DB-1701.

Results and Discussion

Figure 1 shows the geometric mean amount of each of the eleven POPs in cod muscle samples, PCBs were analysed in 64 samples and pesticides in 52 samples. Figure 2 shows the geometric mean amount of each of the eleven POPs in 38 cod liver samples analysed.

In the Icelandic environment, the PCB-153 is usually the most abundant PCB substance. When using pooled samples as done in most investigations the individual congener concentration is an average of the levels of that congener in many individuals. In the present study, CB-153 was not always the PCB congener of the highest concentration in cod muscle, the levels of CB-52 were higher in some of the samples. The geometric mean is higher for CB-52 than CB-153 in the cod muscle (Figure 1) but in the liver samples, geometric mean for CB-153 was higher (Figure 2).

Total PCBs concentration

Table 1 shows the geometric mean and the range of the concentration analysed for the ΣPCB7, HCB, p,p'-DDE, Tox26 and Tox50 in both cod muscle and liver.

The ΣPCB7 analyzed in this project is very low compared to the Icelandic maximum limit that was set by the Ministry for the Environment from 2004-2010 which is 170 µg/kg in fish muscle.⁶

Statistical evaluation

No significant difference was observed between processed and un-processed samples. There is no significant difference in concentration of the POPs in relation to age, sex, weight, and length. There is a linear correlation between PCB concentration and the fat content in the liver of the same individuals. PCB levels decrease with increased fat content of the liver. Therefore a linear correlation can be found between the ΣPCB7 in muscle wet weight and the ΣPCB7 in liver lipid weight (Figure 3) of the same individuals.

Conclusions

The concentration of selected POPs in the edible part of Icelandic cod is very low and results show no variation in the level in relation to age, sex, length and weight. There is also no effect caused by processing on the PCB concentration in the muscle.

References

- Borja, J., et al., *Polychlorinated biphenyls and their biodegradation*. Process Biochemistry, 2005. 40(6): p. 1999-2013.
- Lohmann, R., Breivik, K., Dachs, J. & Muir, D., *Global fate of POPs: Current and future research directions*. Environmental Pollution, 2007. 150 (1): p. 150-165.
- Wania, F., Haugen, J. E., Lei, Y. D. & Mackay, D. (1998). Temperature dependence of atmospheric concentrations of semivolatile organic compounds. *Environmental Science & Technology*. 32 (8), 1013-1021.
- Stockholm Convention on Persistent Organic Pollutants. Available from <http://chm.pops.int/Convention/ThePOPs/tabid/673/language/en-US/Default.aspx>
- Bard, S.M., *Global transport of anthropogenic contaminants and the consequences for the Arctic marine ecosystem*. Marine Pollution Bulletin, 1999. 38(5): p. 356-379.
- Reglugerð um breytingu á reglugerð nr. 411/2004 um ýmis aðskotaefni í matvælum. nr. 056/2005. 2005.

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