CONGENER-SPECIFIC DETERMINATION OF PCBs IN HERRING: COMPARISON WITH DATA FROM "TOTAL PCB" ANALYSIS

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In several countries the regulatory evaluation of PCBs in biological and environmental materials has always been based on the quantification of total PCBs by packed column, using , for example, Clophen A-50 as reference standard[1]. This implies that an assessment of risk, associated with human consumption of foodstuffs of animal origin, which, in fact, represents the main route of exposure to PCBs, is based entirely on technical PCB formulations. Evidence abounds, however, that quantification of environmental samples as equivalents of technical PCB formulations can result in substantial qualitative and quantitative errors[2,3]. This is because the correlation between the chromatogram of a technical standard and that of a PCB mixture from an environmental sample is variable[4-6]. Furthermore total PCB concentration data do not necessarily provide any information about the potential biological significance of the particular mixture of congeners in a given sample[7]. Toxicological data indicate that the potency of PCB congeners varies widely[8], and therefore specific congener analyses provide the most meaningful information with regard to exposure assessment. In several countries (e.g. Germany and the Netherlands) monitoring of selected congeners has replaced the monitoring of "total PCB" concentrations in environmental programmes. In this study specific congener analysis has been performed on a number of herring samples from previous studies, the purpose of which is to find a correlation between the analytical data for total PCBs, obtained with packed column gas chromatography, and the new data based on congener specific determination. In this way discontinuities due to method improvements will be eliminated, and the overall trends remain accurate despite changes in methodology.

Method: Extraction, cleanup, identification and quantification procedures were carried out as earlier reported[9]. The application of dual column system allows simultaneous and unambiguous quantification of some of the otherwise interfering PCB congeners.

Results and Discussions: Table 1 shows the analytical data obtained with both packed and capillary column chromatography. Statistical evaluation of the data shows a significant correlation between the most abundant congener CB 153 in all the samples examined and the total PCB expressed as clophen A-50. This correlation is demonstrated in **fig 1** where the correlation coefficient is found to be 0.85. Considering the diversity in the sizes of the herring samples, locations and time of catch, this coefficient is deemed to be very significant. CB 153

accounts for about 10% of the total PCB (Clophen A-50). It is therefore possible to convert to "total PCB" (Clophen A-50 equivalent) by using a conversion factor for herring samples from the Baltic sea and the Gulf of Bothnia. Similarly, the results obtained also indicate that the sum of the PCB congeners, 52,101,110,149,153,138,128, and 180 account for about 35% of the total PCB while the three important mono-ortho congeners (CB 105,118 and 156) account for about 5%. Furthermore the ratio of CB 105 to CB 118 which remains at about 0.35 for the various samples can be used as a measure for the correctness of the values obtained for these congeners in similar samples. These findings and conclusions are only applicable in the absence of "fresh" inputs of PCB to the local environment. Asplund et al[10] also found a linear relationship (r^2 = 0.94) between the levels of coplanar (non-ortho) CBs 77,126, and 169 and the total PCB levels (Clophen A-50 equivalent) in herring samples from the Baltic sea.

More analytical data on different sample matrices from different locations are still being processed to validate the soundness or reliability of the various conversion factors.
For a limited number of whitefish and salmon-trout samples also from the Baltic sea, the correlation between the levels of CB 153 and total PCB is quite significant (r^2 = 0.97), and even in these cases CB 153 accounts for about 10% of the total PCB.

References

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Table 1 Levels of PCB-congeners in Herring from Gulf of Bothnia and the Baltic sea (1989 - 1990), µg/kg fresh weight. (The non-ortho PCBs were analysed at the Institute of Environmental Chemistry, University of Umeå)

PCB-congener (IUPAC)	n[1]	mv[2]	min-max[3]
31	38	0.9	0.2-1.6
28	38	1.2	0.5-3.1
52	38	4.0	1.1-9.1
101	38	14	5.7-32
110	38	12	5.0-25
149	38	17	8.8-36
153	38	30	17-62
138	38	26	14-55
158	38	2.1	0.9-4.4
128	38	3.5	1.5-8.4
180	38	11	4.4-19
105	38	3.9	2.3-7.1
118	38	11	5.5-21
156	38	1.9	1.1-4.4
77	10	0.086	0.057-0.16
126	10	0.081	0.052-0.14
169	10	0.026	0.013-0.053
Total PCB[4]	38	294	130-540

[1] - number of samples analysed
[2] - mean value
[3] - range for samples with quantifiable level of congeners
[4] - as determined by packed column and with Clophen A-50 as reference standard

Fig 1 Correlation of concentrations of CB-153 (ug/kg fresh weight) and total PCB (Clophen A-50, mg/kg) in Herring samples (1989-1990)