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POLYCHLORINATED BIPHENYL ISOMERS AND CHLORINATED PESTICIDES IN THE GULF OF RIGA HERRING

by

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Abstract

The accumulation of chlorinated pesticides and polychlorinated biphenyls in the Baltic herring in the Gulf of Riga is studied unsufficiently so far. Material - the muscle tissue of 2-year-old Baltic herring (Clupea harengus membras L.) was collected from commercial catches in the Gulf of Riga in April 1992. The organochlorine compounds - PCB and their isomers, DDT and its metabolites DDD and DDE, hexachlorocyclohexane (HCH) isomers, hexachlorobenzene (HCB) and some others were determined by high-resolution capillary gas chromatography with electron capture detector. Results obtained show somewhat higher summary DDT concentrations (245.6 - 584.8 µg/kg in extractable fat) in the muscle tissue of the herring in the Gulf of Riga in 1992 than in the muscle tissue of the herring from the Gulf of Finland (186.8 µg/kg in extractable fat) analysed in 1991 (Roots, Aps-1993). The concentrations of PCB isomers, HCB and HCH isomers in the muscle tissue of herring in the Gulf of Riga seem to be close to those in herring in the Gulf of Finland.

Introduction

Polychlorinated biphenyls (PCB) and chlororganic pesticides (COP) attract attention first of all due to their long-term existence in the environment and their ability to accumulate in living organisms. A study of persistent chlorinated hydrocarbons, including PCB, DDT and its metabolites, HCH (lindane) in the Baltic herring muscle tissue in the Gulf of Riga was carried out

in 1976-1977, 1986, 1988 and 1991 (Roots 1992; Roots, Aps 1993). This report presents some results concerning the Baltic herring in the Gulf of Riga obtained in 1992.

Sampling and sample treatment

The samples were taken from herring commercial landings in the Gulf of Riga in April 1992. Fishes were aged using their otoliths (Table 1). The muscle homogenates were frozen before further treatment.

The samples were extracted with a micture of acetone/10% methyl butyl ether in hexane (3.5:1) and n-hexane/methyl butyl ether (9:1) and the lipid content was determined. Dissolved lipid (0.1-0.2 g fat) extracts were then cleaned up by method: a silica gel column treated with concentrated sulphuric acid. The organochlorines were eluated with n-hexane. Two fractions 0-5 ml and 5-10 ml were collected. The method described in the present paper has been used for analysis of a number of biological environmental samples (Jensen et al. 1983).

Internal standard IUPAC number 189 (2, 3, 3', 4, 4', 5, 5') was used. Polychlorinated biphenyls and chlororganic pesticides were analysed by cappillary gas chromatography (Varian 3400/3300) fitted with a 63 Ni electron capture detector. The chromatographic data were recorded by a data system, ELDS from Chromatography Data Systems AB (Kungshög, Sweden).

Results and discussion

The concentrations of persistent chlorinated hydrocarbons in the muscle tissue of 2-year-old Baltic herring in the Gulf of Riga in 1992 are presented in Tables 2 and 3. Good coincidence of the obtained results with the data published earlier (Roots, Aps 1993) was revealed. Only the summary DDT concentrations in muscle tissue of the herring in the Gulf of Riga in 1992 (245.6 - 584.8 µg/kg in extractable fat) were somewhat higher than those in the muscle tissue of the herring in the Gulf of Finland (186.8 µg/kg in extractable fat) in 1991 (Roots, Aps 1993).

It is important to underline that atmospheric deposition of chlorinated hydrocarbons seems to dominate their inflow to the Gulf of Riga ecosystem. Sixteen air monitoring stations have been established along the Baltic Sea coast and at islands. The stations in Estonia, Latvia, Lithuania, Poland, Finland and Sweden are included. Analysis of pollutant load at these stations is presently carried out, and preliminary results show high PCB load in Gulf of Riga area (Larsson, Okla 1991).

Studies on accumulation of PCB components in fishes may contribute to the better understanding of contaminant migration

ways in the Gulf of Riga ecosystem. Recent investigations have focused on the composition analysis of the individual chlorobiphenyls. Depending on structural differences between the various congeners, different PCBs might bioaccumulate and metabolize at different rates.

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Table 1

Fish total length (cm), weight (g), fat %, sex and age of analyzed herring in the Gulf of Riga in April 1992

Length	Weight	Age	Sex	Fat
12.3	10.3	2	M	3.84
13.6	12.3	2	F	2.25
12.4	10.0	2	F	2.55
13.0	12.2	2	F	3.92

Table 2

Concentrations of chlororganic pesticides in herring muscle tissue (µg/kg in extractable fat) in the Gulf of Riga in April 1992

Chlororganic pesticide	N of fish			
	1	2	3	4
α-HCL	26.8	8.2	14.3	21.5
HCB	11.9	34.7	36.5	13.6
β-HCH	7.8	-	-	21.0
γ-HCH	26.1	10.8	8.2	25.9
aldrin	2.5	-	-	-
p,p´DDE	88.0	302.5	183.2	168.3
p,p´DDD	110.5	169.9	62.1	200.3
p,p´DDT	47.1	112.4	45.4	48.8
Σ DDT	245.6	584.8	290.7	417.4

Table 3

Concentrations (µg/kg ×10 in extractable fat) of selected PCBs in herring muscle tissue in the Gulf of Riga in April 1992

PCB component	N of fish			
IUPAC N	1	2	3	4
52	0.9	5.5	1.9	1.9
101	3.1	16.0	5.9	4.7
118	5.8	20.5	9.7	9.3
138	4.0	22.7	8.4	7.6
153	4.7	27.0	11.2	8.3
170	0.7	6.6	1.7	1.1
180	0.7	7.1	1.9	1.0