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Organochlorine Insecticides and Heavy Metals in Fish from Mutek Lake, N.E. Poland

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The ability of organochlorine insecticides to accumulate in fat tissue and their stability in the environment has created threat for correct functioning of biocenoses and indirectly, for health of man. Similarly, compounds of heavy metals, due to their stability in the environment and tendency to cumulation in living organisms, cause the danger for human and animal health.

The subject of our interest is the quality of food. The aim of the present work was to determine the level of residues of HCH, DDT and its metabolites and of compounds of heavy metals /Hg, Pb, Cd, Zn and Cu/ in fish which, on the one hand are the indicator of toxic substance' presence in their environment, and on the other hand they may become a food for man.

MATERIALS AND METHODS

The material for the experiment were 45 fish: 2 breams /Abramis brama L./ considered as big pieces /mean weight of fish 0,70 kg/, 7 small breams - mean weight 0,09 kg, 7 big roaches /Rutilus rutilus L./ - mean weight 0,12 kg, 7 small roaches - mean weight 0,03 kg, 7 big perches /Perca fluviatilis L./ - mean weight 0,13 kg, 3 small perches - mean weight 0,01 kg, 7 white breams /Blicca bjoerkna L./ - mean weight 0,10 kg and 5 rudds /Scardinius erythrophthalmus L./ - mean weight 0,09 kg. The fishes were fished out on October 1982 in Mutek lake. It is a small lake /10,7 ha/ situated in Łężany village among the field and meadows owned by the Experimental Centre of Academy of Agriculture and Technology in Olsztyn.

The samples of muscle tissues and wastes were analysed separately from each fish. The content of organochlorine insecticides was determined by the method of Stec and Juszkiewicz /1972/. Gas chromatography analysis was carried out in Pye Unicam Model 104 in-

strument with electron capture detector. Determination of mercury content was made by the method of Hatch and Ott /1978/ with the application of mercury analyser Perkin-Elmer Coleman MAS-50. The levels of lead, cadmium, zinc and copper in mineralizates of the samples were determined with the use of double-beam spectrophotometer of Instrumentation Laboratory IL 353 with the mouth-piece IL 455 for flameless determinations.

RESULTS AND DISCUSSION

The level of organochlorine insecticides in muscles and wastes of the examined fishes is given in table I. Organisms of all studied fishes contained residues of insecticides in quantities dependent on the species of fish, type of tissue and size of the analysed individuals.

Table 1. Average organochlorine insecticide content in fish /ng/g/

No of fish	species	kind of sample	HCH	DDE	DDD	DDT	ΣDDT
7	big roach	meat	2	5	4	3	12
		waste	3	7	3	2	12
7	small roach	meat	1	3	trace	1	4
		waste	2	4	2	2	8
2	big bream	meat	7	4	2	3	9
		waste	9	18	6	9	33
7	small bream	meat	9	4	2	4	10
		waste	11	9	4	6	19
7	white bream	meat	6	4	2	6	12
		waste	6	15	8	8	31
7	big perch	meat	7	7	3	7	17
		waste	18	67	22	14	103
3	small perch	meat	11	8	6	6	20
		waste	18	38	10	10	58
5	rudd	meat	1	1	1	2	4
		waste	1	8	2	2	12

According to the expectations, the smallest quantities of pesticides were stated in muscle tissue of rudd, the greatest one were found in the tissues of perch. The remaining species revealed intermediate quantities of these compounds in their muscles. Similar dependence may be also observed in case of wastes from various fishes. The smallest quantities of pesticides were found in wastes from roaches and rudds, the

greatest levels were noted for wastes from perch. The results can be easily justified by the way of nutrition of the particular species of fishes. Rudd which has a differentiated diet with a big share of plankton and of vegetable parts containing few lipid compounds, is dangered to lower concentration of chlorinated hydrocarbons than bream or white bream which feed with animal organisms from the bottom of water where in the sediments more contamination may be found than in water depth. Perch is a representative of preyers and in connection with this fact it takes insecticides cumulated in the organisms of its victims together with his food.

From the comparison of the levels of organochlorine insecticides in muscle tissue and in other parts of the organism treated as wastes it results that the degree of cumulation of these compounds in muscles is considerably lower than in the remaining parts of the fish. It results from the higher fat content in wastes than in muscles as well as from the fact that parenchymatous organs take part in metabolism of chlorinated hydrocarbons, so they are more dangered to cumulation of these compounds.

The levels of organochlorine insecticides in muscle tissue of the examined fishes as well as in wastes, though being slightly differentiated, are considerably lower than the admissible limit of their tolerance in food products. In the total sum of the DDT determined DDE has the greatest share what is an evidence of the high degree of transformation to which DDT is subjected. It may be a forecast of gradual decay of these pesticides in the environment. The obtained results correlate with the data of Kraśnicki et al. /1977/ and of Kraśnicki /1979/ for fishes from Mazurian lakes and with those of Falandysz /1980/ for salt-water fishes from the Pacific coasts of the North America.

In the muscle tissue of all examined species of fishes the presence of heavy metals was stated and their quantities were dependent on the species and size of the individuals subjected to analysis.

The highest level of mercury was found in perch, the lowest one in bream. It correlates with the results of studies by the other authors /Buliński 1979; Chodyniecki et al. 1980/. The appearing interspecific differences in mercury content are determined, first of all, by the way of nutrition of the particular species of fishes. The predacious fishes /perch/ contained more mercury in comparison with benthos-eating or omnivorous fishes. The fishes with the similar food spectrum, e.g. bream and white bream or roach and rudd, contained similar quantities of mercury.

Table 2. Average and range of heavy metals content in fish meat /µg/g/

Species	Hg	Pb	Cd	Zn	Cu
7 roaches	0,077 0,046-0,114	0,75 trace-1,15	nd	14,03 6,10-20,77	0,23 nd-0,35
2 big breams	0,046 0,042-0,050	1,45 1,14-1,75	nd	5,33 5,01-5,64	0,29 0,20-0,38
7 small breams	0,043 0,038-0,073	0,31 nd-1,17	nd	5,24 3,42-6,82	0,16 nd-0,26
7 white breams	0,056 nd-0,154	0,55 nd-1,51	nd	5,76 3,74-8,34	0,16 nd-0,28
7 perches	0,123 0,078-0,236	0,79 nd-1,21	nd	6,14 5,35-6,99	0,21 nd-0,31
5 rudds	0,094 0,050-0,136	0,36 nd-0,99	nd	7,62 5,44-9,28	0,26 0,21-0,32

nd - below detection limits: Cd - 0,02 ppm, Pb - 0,10 ppm, Cu - 0,10 ppm, Hg - 0,002 ppm

From the literature data /Protasowicki 1978; Scott 1974/ it results that a correlation exists between the lenght of the body of fish /its age/ and the level of mercury in its muscles. The results obtained in this work confirm this dependence in the case of bream while the other species of fishes were not differentiated in respect of the lenght, therefore such analysis could not be performed.

Generally speaking it may be stated that the quantities of mercury determined in the examined fishes were relatively low and only in one case /perch, 0,236 ppm/ the limit of tolerance recommended by FAO/WHO amounting to 0,2 ppm had been exceeded.

Great variations of lead level within one species of fishes were stated, e.g. in case of small breams from trace amounts to 1,17 ppm. It results, probably, from the nonuniform contamination of a given basin with the lead compounds. It is an interesting fact that the analysed fishes contained more lead than those ones from the Pucka bay where the level of lead was from 0,08 to 0,294 ppm /Gajewska and Nabrzyski 1977/. Also data obtained by Gajewska et al. /1976/ for fresh-water fishes from Vistula river and from other lakes

point to the lower level of Pb in the fishes examined by these authors. It would be an evidence of higher degree of contamination of Mutek lake with the lead compounds than in case of other lakes. In any case, however, the tolerance limit i.e. 2 ppm was not exceeded.

In all examined samples presence of cadmium compounds was not found. Similarly, low levels of this metal in fishes from fresh water are reported by Nikonorow /1976/ what would give an evidence of small degree of cumulation of this metal in the organisms of fishes.

The levels of zinc and copper in fishes were low, considerably below the admissible limit of their content in food products. Mean levels of zinc and copper were similar for the particular species of fishes. No interdepœndence was observed between the level of these metals in muscle tissue of fishes and the way of their nutrition. The obtained results correlate well with the data of Nabrzyski /1978/ for the same species of fresh-water fishes.

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