

ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHENYLS IN HYDROBIONT TISSUES, ASSESSMENT OF THEIR TOXICITY AND BIOAVAILABILITY

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Organochlorine pesticides (OCPs) and polychlorinated biphenyls (PCBs) are persistent pollutants (POPs) of anthropogenic origin. Their distinctive properties – high toxicity and resistance to degradation under the influence of physicochemical and biological natural factors – cause great interest in the determination of these compounds in environmental objects and foodstuffs. PCBs pose a great threat to aquatic ecosystems, where they can accumulate in bottom sediments and tissues of aquatic organisms (hydrobionts). PCBs enter the human body mainly with drinking water and food. These compounds, due to their lipophilicity, are able to accumulate in the lipid tissues of living organisms, concentrate along the trophic chain and, ultimately, accumulate in the human body and cause various general toxic and carcinogenic diseases.

Systematic data on the identification of OCPs and PCBs and their levels in aquatic systems are very limited. There are relatively few data obtained by highly efficient and highly informative physicochemical methods of analysis, for example, by chromato-mass spectrometry, in Ukraine due to the limited number of laboratories involved in the monitoring of these compounds. To assess the threat to humans and aquatic ecosystems posed by OCPs and PCBs, they were extracted from the muscle tissue of fish by the method of accelerated liquid extraction and reliable results were obtained on the content of these compounds. The preparative isolation of coplanar PCBs from the muscle tissue of fish from the Dnieper river basin was performed by reverse phase high performance liquid chromatography (HPLC) on a microanalytical scale.

Coplanar PCBs are the most toxic among the compounds of this class. In aquatic ecosystems, the contribution of coplanar PCBs (dioxin-like substances) to total dioxin equivalent toxicity exceeds that of polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) combined. Although the indices of equivalent toxicity of coplanar PCBs are orders of magnitude lower than those of PCDD and PCDF, their concentration in the tissues of aquatic organisms and bottom sediments is significantly higher and reaches the level of ppm, ppb, ppt values (mg/kg, µg/kg, ng/kg of dry matter mass). Their contribution to the total dioxin toxicity in the tissues of hydrobionts can reach 80 %. The remaining 20 % is accounted for by PCDD and PCDF. The toxicity of 12 coplanar PCBs is orders of magnitude greater than that of all other isomers.

The results obtained indicate that these toxicants accumulate in significant amounts in bottom sediments, and their content in the tissues of hydrobionts characterizes the bioavailability of POPs. The bioavailability of POPs was assessed: the results of exceeding their critical level (CTL), the bioconcentration factor (BCF) for OCPs and PCBs for fish muscle and other tissues, and the dioxin equivalent for biota PCBs for the period 2003–2021 were obtained in water systems of Ukraine.