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Radionuclides distribution in roach and pike organs

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Fish is part of the food chain and actively involved in radionuclides migration processes. The investigations of real samples from radioactively contaminated water reservoirs were studied. The reservoir R-4 of the "Mayak" Production Association using as a low-level waste (LLW) storage and it is unique in the number and radionuclides composition. The study purpose was to establish the radionuclide distribution parameters within the artificial reservoir R-4 fishes.

The reservoir R-4 characteristics: the water area is 1.3 km², the water volume is 3.8 mln.m³, the average depth is 3.1 m. The total activity is 555·10⁶ Bq. As a result of field work, the following samples were selected: water, bottom sediments and fish (pike, roach). Investigated fish are the main species of the reservoir ichthyofauna. Samples of fish were divided into organs: scales, muscles, liver, gills and frozen.

Samples preparation for alpha (U, Pu, Am) and gamma (Cs) measurements included the following steps: ashing in a muffle furnace (8 hours, 450°C), acidic autopsy (HNO₃ conc., 4 hours) and co-precipitation ((NH₄)₂HPO₄ + NH₄OH). All samples were analysed using gamma-spectrometry (Canberra GR 3818). Alpha spectrometry was used for alpha-emitted nuclides determination (CANBERRA Model 7401) after separation using extraction chromatography (UTEVA, TRU (TrisKem International).

It was investigated three sample of each fish species. The mass of the pike was varied from 2 to 3,5 kg; mass of roach –100-180 g. The summary activity of dose-forming ¹³⁷Cs is higher in pike (1930 Bq/g), than in roach (1590 Bq/g), that is typical for the accumulation of radionuclides along the food chain. Distribution of activity through the organs is equal for pike and roach, accumulation occurs by chain: muscles → gills → scales → bones → blood. Activity in muscles is equal, the greatest difference in values related to accumulation of radionuclides by external organs.

The alpha-emitted nuclides total activity in external organs is to 2-3 orders higher than in internal organs. The highest americium activity in all studied roach's organs indicates its bioavailability. The greatest content of plutonium (141,3 Bq/g) and americium (5,8 Bq/g) observed in roach gills; uranium –in scales (3,4 Bq/g). For pike also highest activity was found in gills (10 Bq/g) and scales (2,9 Bq/g).

The radionuclides concentration ratio (CR) was calculated. ¹³⁷Cs CR (total activity in fish/activity in reservoir water) 835 for pike and 1100 for roach are approximately the same, that indicates ion form sorption from water by external organs and accumulation in muscles. Calculate uranium coefficient is impossible because of its absence in water, that indicate other proceed ways to organs. For other alpha-emitted radionuclides CR is one order different (for pike is less, than for roach). To explain this distribution additional calculations and analysis of accumulation Pu and Am by each organ are needed.

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