

MONITORING OF CARBAMAZEPINE PHARMACEUTICAL ACTIVE INGREDIENT IN RIVER DANUBE AND LAKE BALATON

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Carbamazepine (CBZ), a pharmaceutical active ingredient is extensively prescribed for the treatment of neurological disorders such as epilepsy, nerve pain, trigeminal neuralgia, and acute maniac or mixed episodes in bipolar disorder. As a result of its widespread use and environmental persistence, CBZ has been detected as a contaminant in aquatic environments, including rivers, ponds, and lakes. CBZ is almost entirely metabolized in humans, it is mainly excreted as hydroxylated and conjugated metabolites, with minimal (less than 2%) amounts eliminated unchanged. However, the continuous release to the environment, the low removal rate of wastewater (<45%) and sludge (<10%) treatment process resulted in a continuous pollution in surface water bodies [1–4].

In this study a systematic monitoring study was performed in 2024. To determine the concentration of CBZ in surface water bodies in Hungary, samples were collected at 10 and 8 sampling sites from River Danube and Lake Balaton were collected, respectively in 2024. Concentrations of the active ingredient were measured by an enzyme-linked fluorescent immunoassay (ELFIA) technique. In Lake Balaton, concentration of CBZ was above both the LOD value (0.02 ng/mL) and the LOQ value (0.03 ng/mL) for all samples (frequency of occurrence: 100%). The highest concentration was determined at the Révfülöp sampling site (4.77 ± 0.20 ng/mL), while the lowest concentration was measured at Zamárdi (0.03 ± 0.00 ng/mL). For the Danube River, average concentrations of CBZ on the first sampling date (2nd October 2024) during the flood period were determined mostly around the LOQ value (0.03 ng/mL). Only CBZ content of a sample from Dunaújváros was below the LOD value (0.02 ng/mL). The second sampling date (9th October 2024) was intentionally scheduled for after the flood period. Although, on that date, CBZ concentrations were below the LOD value at 3 sampling sites (Nagybajcs, Komárom, Baja), the concentrations at the remaining sites were 1.59–29.37 times higher than on the first sampling date. The results clearly demonstrated the beneficial effect of the flood on River Danube mostly diluting CBZ concentrations out.

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