DOI: http://doi.org/10.21698/simi.2026.ab31

OCCURRENCE OF EMERGING ORGANIC CONTAMINANTS IN ROMANIAN RIVERS

Florentina Laura Chiriac*, Vasile Ion Iancu, Iuliana Paun, Florinela Pirvu, Valentina Andreea Petre

National Research and Development Institute for Industrial Ecology-ECOIND, 57-73 Drumul Podu Dambovitei, district 6, 060652, Bucharest, laura.chiriac@incdecoind.ro, Romania

**corresponding author: laura.chiriac@incdecoind.ro*

Keywords: *emerging contaminants, occurrence, pollution, Romanian rivers, surface water*

Introduction

Organic contaminants of emerging concern are increasingly detected in aquatic environments because of their extensive use in industrial applications, consumer products, pharmaceuticals and personal care products. Among them, per- and polyfluoroalkyl substances (PFAS), organophosphate flame retardants (OPFRs), organic UV filters and bisphenols have received particular attention due to their persistence, continuous release, potential bioaccumulation and endocrine-disrupting or toxic effects. Although these compounds are generally present at trace levels, their continuous input into aquatic systems and their occurrence as complex mixtures may pose risks to aquatic organisms. Municipal wastewater treatment plants (MWWTPs) represent an important pathway for the transfer of emerging contaminants into receiving surface waters, since conventional treatment processes are not specifically designed for their complete removal. At the same time, the presence of these compounds upstream of wastewater discharges indicates that diffuse urban and anthropogenic sources may also contribute substantially to river contamination. Current knowledge is still fragmented, particularly in Romania, where information on the occurrence and environmental relevance of several classes of emerging organic contaminants in major river systems remains limited. The present study provides an integrated assessment of four representative groups of emerging organic contaminants—PFAS, OPFRs, organic UV filters and bisphenols—in Romanian surface water. By combining occurrence data from major rivers with upstream/downstream comparisons around MWWTPs and ecological risk assessment, the study aims to identify dominant contaminants, evaluate the contribution of wastewater discharges and highlight compounds of potential environmental concern. The findings provide a broader understanding of emerging organic contamination in Romanian aquatic systems and help prioritize substances for future monitoring and environmental risk management.

Materials and methods

Surface water samples were collected from major Romanian rivers, mainly upstream and downstream of MWWTPs. PFAS and OPFRs were investigated in the Bahlui, Siret, Ialomita, Dambovita and Olt rivers, organic UV filters in the Bahlui, Siret, Ialomita, Somes and Dambovita rivers, and bisphenols in the Danube and Jiu rivers. The analytical targets included nine PFAS, ten OPFRs and related metabolites, ten organic UV filters, and seven bisphenol-related compounds. Water samples were extracted and concentrated by solid-phase extraction using polymeric, C18 or weak-

anion-exchange cartridges, depending on the contaminant class, followed by liquid chromatography analysis coupled with mass spectrometric detection.

Results and conclusions

All four groups of emerging contaminants were detected in Romanian surface water, showing distinct concentration profiles and environmental relevance. Among bisphenols, BPA predominated, reaching 35.8 ng/L in the Danube and 135 ng/L in the Jiu, while its main transformation product, 4-HAP, occurred at comparable levels. BPS was detected only in the Jiu River, at lower concentrations. The associated ecological risk was generally low, although the continuous occurrence of BPA and its transformation products indicate persistent anthropogenic pressure on these aquatic systems. Organic UV filters were frequently detected both upstream and downstream of WWTPs, at concentrations up to approximately 200 ng/L. The highest downstream levels were observed for BP-1 (206 ng/L), 4HBP (159 ng/L) and BP-8 (108 ng/L), while EHS reached 139 ng/L. BP-3 was detected in all investigated samples, confirming the widespread occurrence of this group in surface water.

PFAS were consistently present in the investigated rivers, with ΣPFAS generally below 35 ng/L upstream and reaching approximately 45 ng/L downstream. PFOS, PFOA and PFUnDA were the predominant compounds. Although concentrations were generally higher downstream of MWWTPs, correlation analysis indicated that treated wastewater was not the only relevant source. The presence of PFAS upstream suggests an important contribution from diffuse anthropogenic inputs.

OPFRs occurred at the highest concentration levels among the four contaminant groups investigated. TCPP was the dominant compound, ranging from 283–933 ng/L upstream and 670–1601 ng/L downstream of MWWTPs, while TCEP and TDCPP also showed increased downstream concentrations. These differences suggest that wastewater discharges may influence the occurrence of several OPFRs in receiving rivers.

The results demonstrate the widespread presence of emerging organic contaminants in major Romanian rivers and show that their environmental significance cannot be assessed based solely on concentration levels. WWTP discharges increased the concentrations of several compounds, while upstream contamination pointed to the contribution of diffuse sources. The integrated occurrence and risk assessment highlights the need for coordinated monitoring and risk-based prioritization of emerging contaminants in Romanian surface waters, particularly persistent substances, transformation products, and contaminant mixtures.

Acknowledgment

This work was carried out through the "Nucleu" Program within the National Research Development and Innovation Plan 2022–2027, with the support of Romanian Ministry of Research, Innovation and Digitalization, contract no. 3N/2022, project code PN 23 22 01 01.