DOI: http://doi.org/10.21698/simi.2026.ab20

SHORT-TERM TOXICITY OF SUNSCREEN-RELATED: UV FILTERS TO *CYPRINUS CARPIO*

Andreea-Valentina Petre[1,2], Camelia Ungureanu[1], Stefania Gheorghe[2], Florentina-Laura Chiriac[2,*]

[1]National University of Science and Technology Politehnica Bucharest, andreea.petre@ecoind.ro, Romania
[2]National Research and Development Institute for Industrial Ecology-ECOIND, 57-73 Drumul Podu Dambovitei, district 6, 060652, Bucharest, andreea.petre@ecoind.ro, Romania

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

Keywords*: acute toxicity, benzophenone-3, Cyprinus carpio, LC-MS/MS, UV filters*

Introduction

Organic UV filters are widely used in sunscreens and personal care products to protect against UVA and UVB radiation. Their extensive use has led to continuous releases into aquatic environments through recreational activities and wastewater discharges. Consequently, these compounds are increasingly recognized as emerging contaminants due to their persistence, endocrine-disrupting properties, and potential for bioaccumulation in aquatic organisms. Among them, benzophenone-3 (BP-3) is one of the most frequently detected UV filters in surface waters, while its major metabolites, benzophenone-1 (BP-1) and 4-hydroxybenzophenone (4HBP), have also been identified in environmental and biological samples. Previous investigations in Romanian surface waters confirmed the presence of BP-3 and several hydroxylated metabolites, underscoring the need for ecotoxicological assessment.

The present study aimed to evaluate the acute toxicity of BP-3 and its major metabolites (BP-1 and 4HBP) in *Cyprinus carpio* according to OECD Test Guideline 203 and to provide the basis for selecting environmentally relevant concentrations for subsequent bioaccumulation experiments (Figure 1).

Materials and methods

Juvenile common carp (*Cyprinus carpio*, 8–12 g) were acclimatized under laboratory conditions before testing. Acute toxicity tests were conducted in accordance with OECD Test Guideline 203, using a static exposure design for 96 h. Fish were exposed in 10 L glass aquaria containing 5 L of test solution. Five fish were used per concentration, along with a control group.

Nominal exposure concentrations were 1, 10, 25, and 50 mg/L for BP-3 and 4HBP, while BP-1 was tested at 1, 10, and 25 mg/L. Test solutions were prepared from ethanol stock solutions, the final ethanol concentration being maintained below 1% in all experimental aquaria. Water quality parameters (temperature, dissolved oxygen, pH, and conductivity) were monitored throughout the experiments. Mortality and behavioral changes were recorded every 24 h.

Concentrations of BP-3 and its metabolites in water and biological samples were determined using a validated LC-MS/MS method operating in multiple reaction monitoring (MRM) mode. Biological samples were extracted by ultrasound-assisted extraction followed by clean-up before instrumental analysis.

Results and conclusions

No mortality or abnormal behavior was observed in the control group, confirming the validity of the experiments. Behavioral alterations, including hyperactivity, occasional swimming disturbances, and increased opercular movements, appeared at concentrations of 25 mg/L and above.

The estimated 96 h LC_{50} values were 18.45 mg/L for BP-3, 17.5 mg/L for BP-1, and 19.0 mg/L for 4HBP, indicating comparable acute toxicity among the investigated compounds. Exposure to 50 mg/L produced 100% mortality within a few hours for all tested substances, whereas complete mortality for BP-1 occurred within 24 h at 25 mg/L. In contrast, exposure to 25 mg/L 4HBP caused only 20% mortality after 96 h, suggesting differences in toxicity dynamics despite similar LC_{50} values.

Based on the LC_{50} values and environmental occurrence data, a concentration of 0.1 mg/L BP-3 was selected for subsequent bioaccumulation experiments, representing a sublethal exposure suitable for evaluating uptake and metabolization in fish organs.

Overall, the study demonstrates that BP-3 and its major metabolites exert measurable acute toxic effects on freshwater fish at relatively low concentrations and elicit behavioral responses before mortality. These findings support the inclusion of UV filters among contaminants of emerging concern and provide an experimental basis for further investigations on bioaccumulation, biotransformation, and ecological risk assessment in aquatic ecosystems.

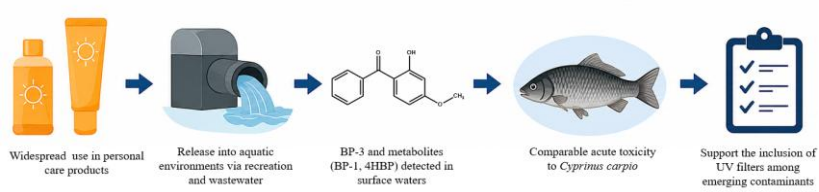


Figure 1 - Environmental pathway and acute toxicity of BP-3 and its metabolites in *Cyprinus carpio*.

Acknowledgement

This work was supported by a grant of the Ministry of Education and Research, CCCDI - UEFISCDI, through the project Center of Excellence in water management, materials, by-products and waste valorisation for circular bioeconomy implementation, proposal number PN-IV-P6-6.1-CoEx-2024-0056, contract 6 CoEx/02.06.2026, within PNCDI IV.