Mitigating Antibiotic Contamination in Aquaculture Effluents Using UVC/H_2O_2 Advanced Oxidation Process

Anna Bilida[1], Maria Antonopoulou*
[1] Department of Sustainable Agriculture, University of Patras, GR-30131 Agrinio, Greece
*Corresponding author E-mail: mantonop@upatras.gr

1. INTRODUCTION

- ✓ Rapid aquaculture expansion has led to increased antibiotic use and the subsequent contamination of aquatic environments with pharmaceuticals.
- ✓ Sulfamethoxazole (SMX) and trimethoprim (TMP), commonly applied as co-trimoxazole, are widely used in aquaculture and are frequently found in effluents [1].
- ✓ Up to 70–80% of administered antibiotics can enter surrounding waters, contributing to ecological risks and antimicrobial resistance (AMR) [2].
- ✓ Advanced oxidation processes (AOPs) generate highly reactive hydroxyl radicals (HO•), which can degrade persistent contaminants [3].
- ✓ **Objective**: To evaluate the degradation kinetics and removal efficiency of SMX and TMP under UVC/H_2O_2 treatment in aquaculture effluents.

2. METHODS

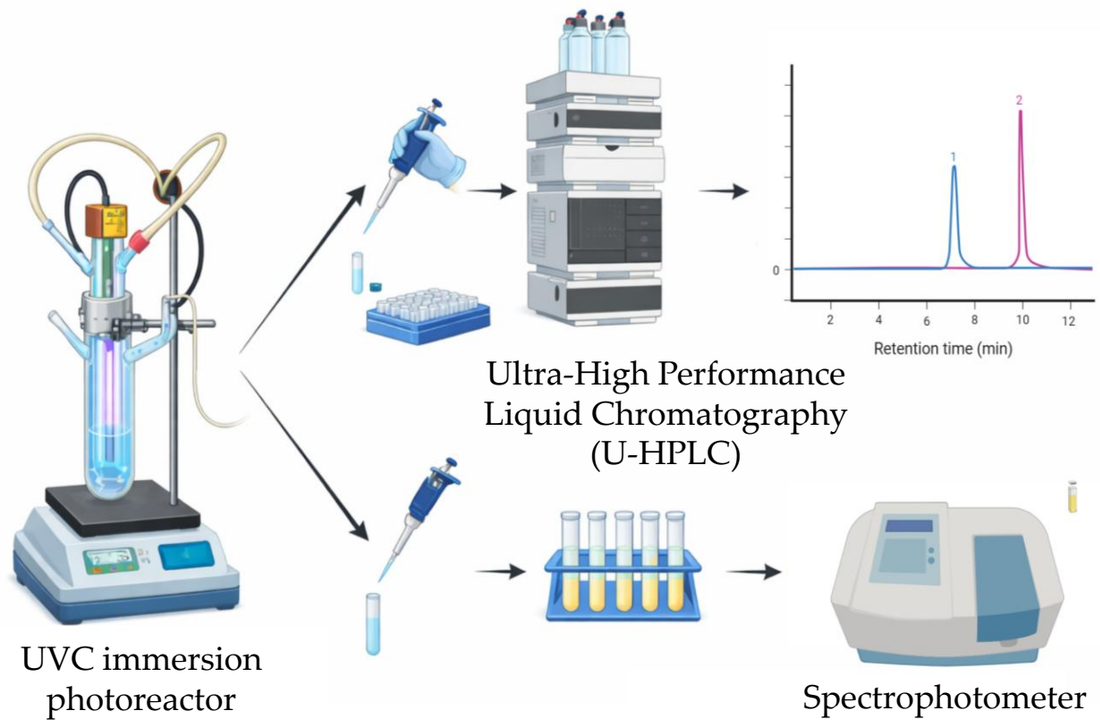

Figure 1. Experimental procedure ([SMX] = [TMP] = 0.5 mg L^{-1}; [H_2O_2] = 15 mg L^{-1}).

The experiments were conducted in a UVC immersion photoreactor. Antibiotic removal was quantified by U-HPLC, while H_2O_2 consumption was monitored photometrically at 400 nm using the Potassium Titanium (IV) Oxalate (PTO) method.

3. RESULTS

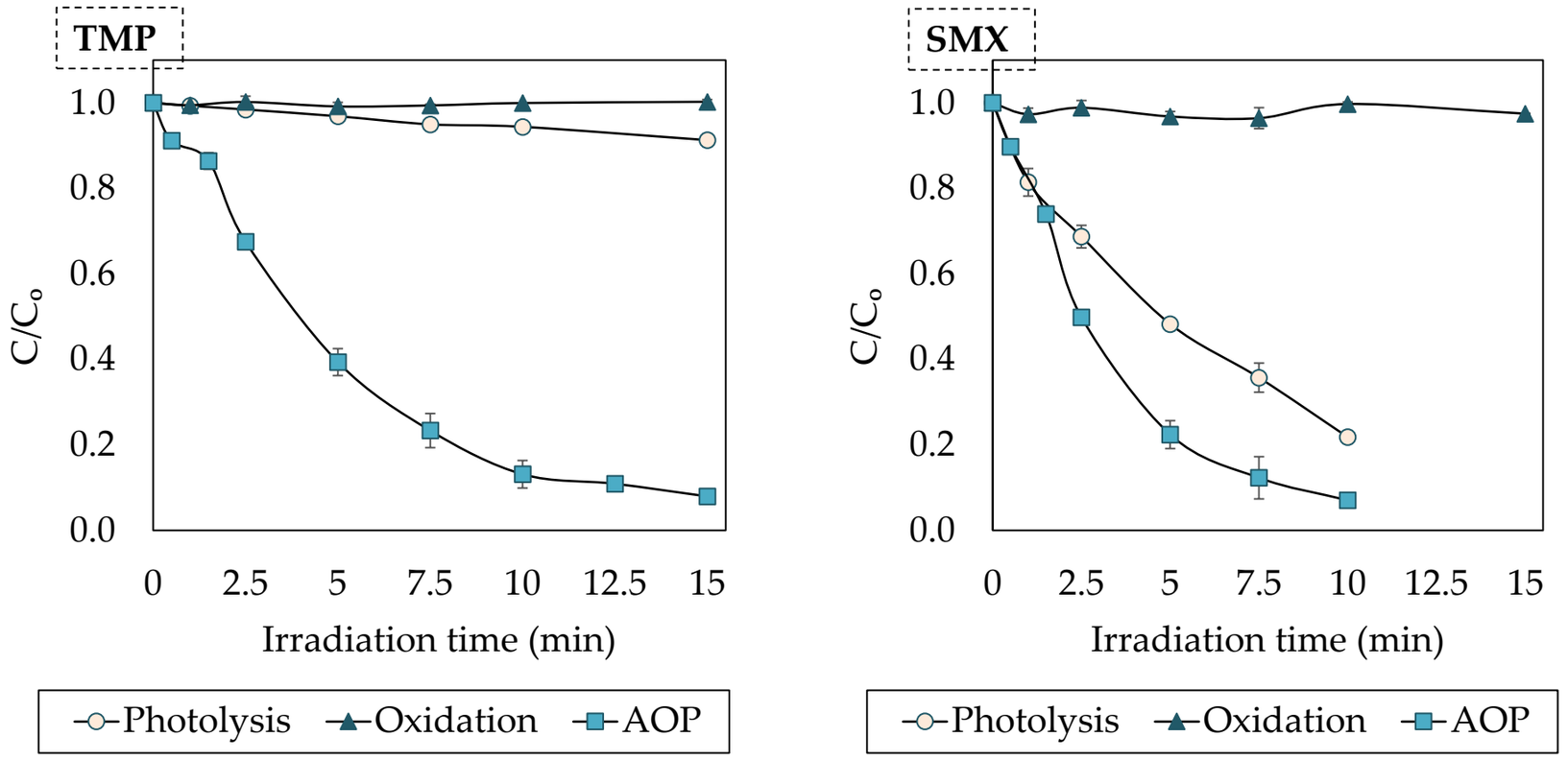

Figure 2. Degradation kinetics of TMP and SMX under (i) direct photolysis (UVC), (ii) dark oxidation (H_2O_2), and (iii) UVC/H_2O_2 process ([H_2O_2] = 15 mg L^{-1}; [SMX] = [TMP] = 0.5 mg L^{-1}).

- **Enhanced degradation kinetics under AOP**
- **~90% removal of TMP (10 min) and SMX (15 min) under AOP**
- **Consumption of H_2O_2 & HO• production**

4. CONCLUSION

- ✓ UVC/H_2O_2 markedly enhanced the degradation kinetics of TMP and SMX.
- ✓ >90% removal was achieved within 10–15 minutes at a concentration of 15 mg/L of H_2O_2.
- ✓ UVC/H_2O_2 advanced oxidation process (AOP) is a promising strategy for aquaculture effluent treatment.
- ✓ Toxicity experiments and identification of transformation products generated during AOP are in progress.

References

1. Chen, J., Sun, R., Pan, C., Sun, Y., Mai, B., & Li, Q. X. (2020). Antibiotics and food safety in aquaculture. Journal of Agricultural and Food Chemistry, 68(43), 11908-11919.
2. Cherian, T., Ragavendran, C., Vijayan, S., Kurien, S., & Peijnenburg, W. J. (2023). A review on the fate, human health and environmental impacts, as well as regulation of antibiotics used in aquaculture. Environmental Advances, 13, 100411.
3. Lofrano, G., Pedrazzani, R., Libralato, G., & Carotenuto, M. (2017). Advanced oxidation processes for antibiotics removal: a review. Current organic chemistry, 21(12), 1054-1067.

Acknowledgements

The research project is implemented in the framework of H.F.R.I. call "3rd Call for H.F.R.I.'s Research Projects to Support Faculty Members & Researchers" (H.F.R.I. Project Number: 26141).