

Degradation of Sulfamethazine and Trimethoprim in Aquaculture Wastewaters: Kinetics, Pathogen Inactivation, and Toxicity Assessment

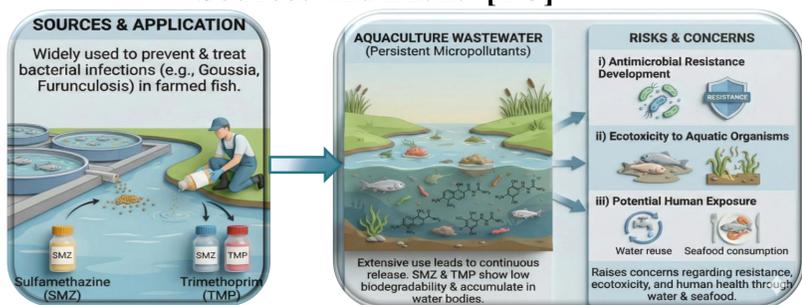
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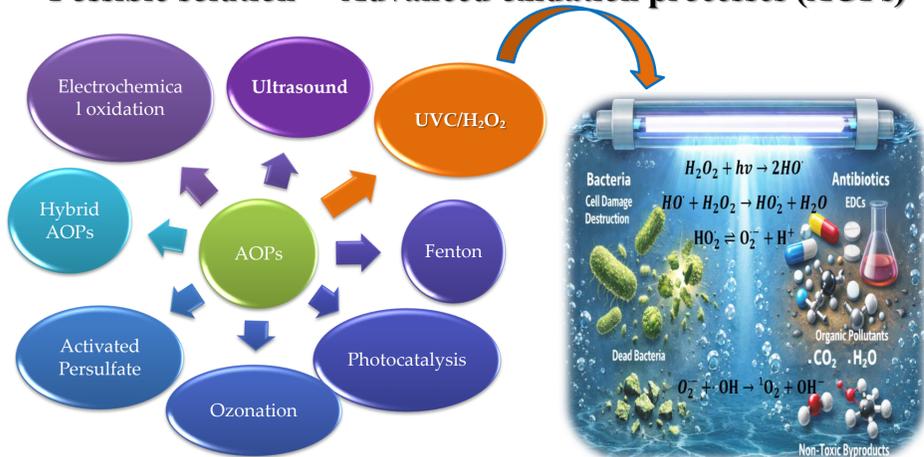
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INTRODUCTION & AIM

Antibiotics in Aquaculture Wastewater Sources and Risks [1-3]



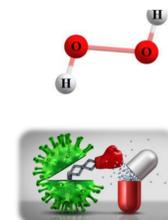
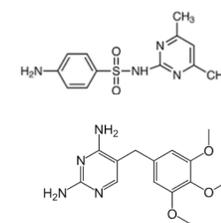
Possible solution → Advanced oxidation processes (AOPs)



EXPERIMENTAL PROCEDURE

Materials

- Antibiotic 1: Sulfamethazine (SMZ)
- Antibiotic 2: Trimethoprim (TMP)
- Oxidant: Hydrogen Peroxide
- Pathogen: *E. coli*
- Water matrix:
 - Aquaculture Influent 1 (IF1)
 - Aquaculture Effluent 1 (EF1)
 - Aquaculture Influent 2 (IF2)
 - Aquaculture Effluent 2 (EF2)



Experimental conditions

- Low-pressure UVC lamp at 8 W
- Reactant mixture volume: 100 mL
- Constant temperature at 25 °C
- Atmospheric pressure
- High-performance liquid chromatography (Waters Alliance 2695)



Table 1: Physicochemical characterization of water matrices

Water matrix	pH	Conductivity μS/cm	COD mg/L	TC mg/L	IC mg/L	TOC mg/L	TSS mg/L	HCO ₃ ⁻ mg/L	Cl ⁻ mg/L	SO ₄ ²⁻ mg/L	Ca ²⁺ mg/L	NO ₃ ⁻ mg/L
IF1	7.89	350.00	1	35.01	34.64	0.37	1.45	161.09	10.10	16.60	57.20	3.60
EF1	7.75	351.00	0	35.18	34.99	0.19	2.42	209.91	10.30	16.70	59.90	3.60
IF2	7.75	424.80	6	54.21	52.49	1.725	1.40	209.91	3.70	4.60	67.50	3.20
EF2	7.86	429.80	4	53.74	52.83	0.915	2.62	262.39	3.70	4.60	67.90	3.10

The aim of this study is to investigate, for the first time, the degradation of an SMZ–TMP mixture and the pathogen inactivation in aquaculture influents and effluents from two different farms by UVC/H₂O₂.

RESULTS & DISCUSSION

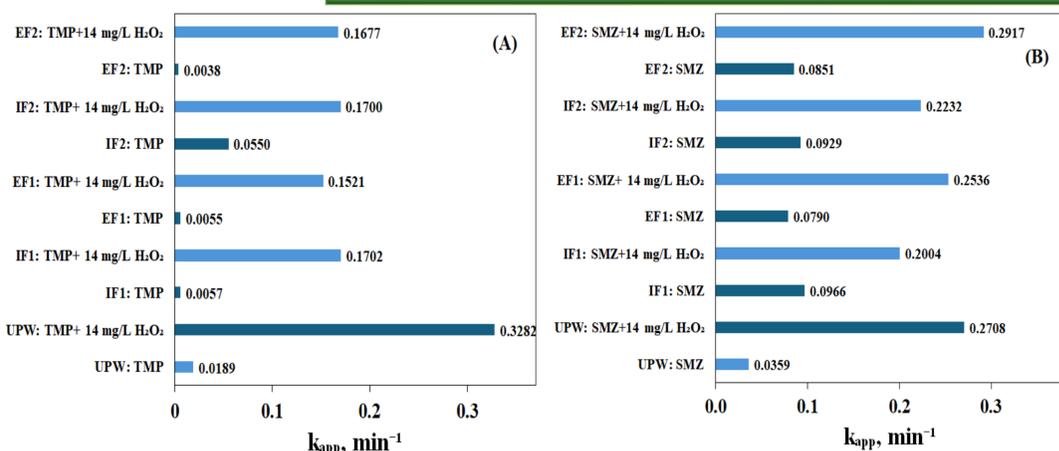


Figure 1: Effect of the water matrix on the degradation kinetics of the TMP/SMZ mixture in the presence and absence of H₂O₂ under UVC (254 nm) irradiation (A) TMP and (B) SMZ. Experimental conditions: [TMP] = [SMZ] = 0.5 mg/L and [H₂O₂] = 14 mg/L.

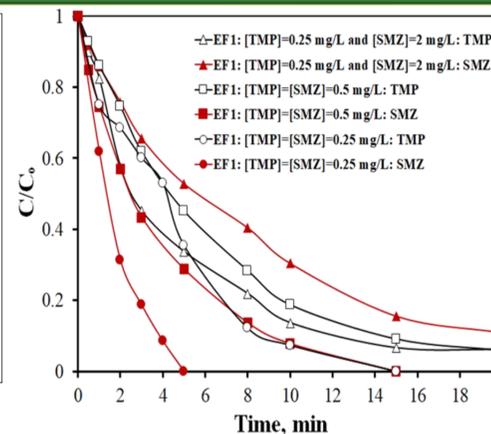


Figure 2: Effect of initial mixture concentration on its degradation with 14 mg/L H₂O₂ under UVC (254 nm) irradiation.

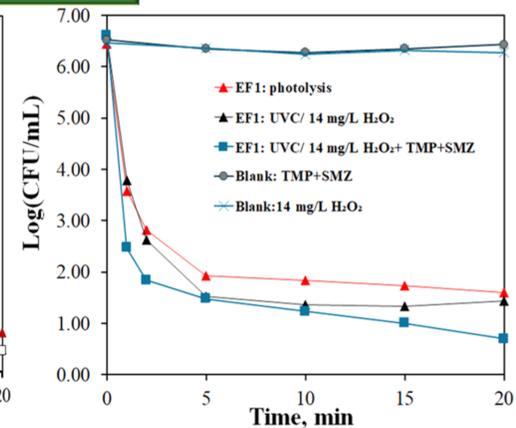


Figure 3: Inactivation of *E. coli* in the presence and absence of H₂O₂ and the TMP/SMZ mixture under UVC (254 nm) irradiation ([TMP] = [SMZ] = 0.5 mg/L).

CONCLUSION

UVC alone achieved <15% TMP and ~50% SMZ removal after 10 min, whereas at 14 mg/L H₂O₂ the k_{app} increased 44- for TMP and 27-fold for SMZ in EF2 and EF1, respectively. For SMZ, the increase was more moderate (3.4- and 3.2-fold for EF2 and EF1). *E. coli* inactivation was mainly governed by UVC, with slight enhancement by H₂O₂, while the presence of TMP and SMZ did not significantly affect disinfection efficiency.

Future work: Identification of transformation products, and toxicity assessment of the treated effluents using freshwater microalgae species.

ACKNOWLEDGMENT

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