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# Sustainable photolytic and photocatalytic removal of antibiotic and antipsychotic from the aquatic medium in the presence of $H_2O_2$, $KBrO_3$, and $(NH_4)_2S_2O_8$

Dušica Jovanović, Daniela Šojić Merkulov, Vesna Despotović, Sabolč Bognar, Nina Finčur

University of Novi Sad Faculty of Sciences, Department of Chemistry, Biochemistry and Environmental Protection
Trg D. Obradovića 3, 21000 Novi Sad, Serbia

e-mail: dusica.jovanovic@dh.uns.ac.rs

## INTRODUCTION

The continuous growth of population calls for the production and consumption of pharmaceuticals in large quantities. However, these compounds do not disappear after excretion. Instead, they enter the aquatic environment through wastewater from households, hospitals, and pharmaceutical industries, as well as from agriculture and livestock. For instance, antibiotics can foster the development of antibiotic-resistant bacteria, while antipsychotics can interfere with the brain chemistry of non-target organisms. Photolysis and photocatalysis are eco-friendly processes based on the formation of reactive species that participate in the degradation/removal of various (in)organic pollutants present in (waste)waters.

## EXPERIMENTAL

The efficiency of indirect photolysis and heterogeneous photocatalysis in removing one antibiotic (ciprofloxacin, CIP) and one antipsychotic (sulpiride, SUL) from an aquatic medium, in the presence of $H_2O_2$, $KBrO_3$, and $(NH_4)_2S_2O_8$, was investigated under ultraviolet (UV) and simulated solar irradiation (SSI). The effect of three initial molar $H_2O_2$ concentrations on SUL removal efficiency was explored under SSI.

## RESULTS & DISCUSSION

### INDIRECT PHOTOLYSIS

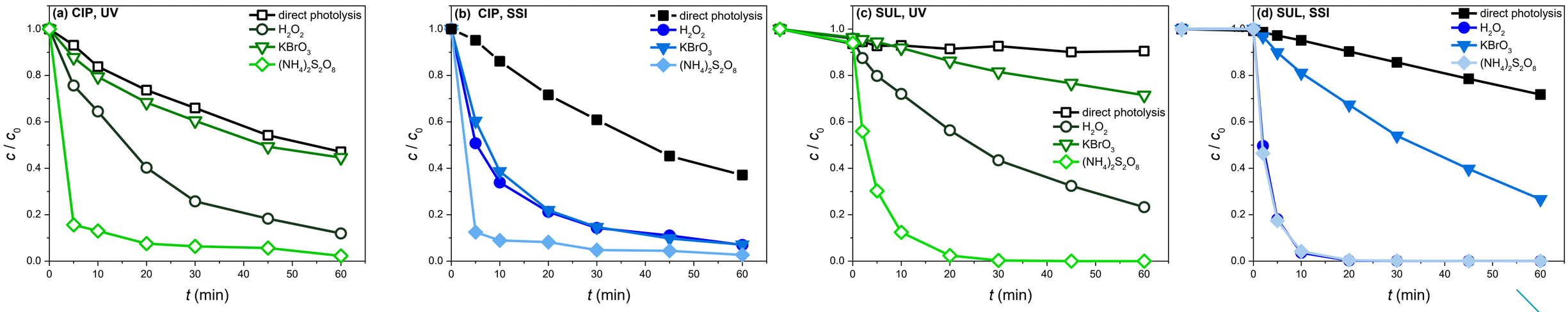


**Fig. 1.** The efficiency of direct and indirect photolytic removal of CIP/SUL (0.05 mmol/dm$^3$) in the presence of $H_2O_2$/$KBrO_3$/$(NH_4)_2S_2O_8$ (3 mmol/dm$^3$) under: UV (**a**, **c**) and SSI (**b**, **d**).

Regarding **indirect photolysis**, after 60 min of irradiation, the **$(NH_4)_2S_2O_8$/UV** system removed **97.8%**, while the **$(NH_4)_2S_2O_8$/SSI** system removed **97.3%** of **CIP**. Furthermore, complete **SUL** removal was reached with the **$(NH_4)_2S_2O_8$/UV**, **$(NH_4)_2S_2O_8$/SSI**, and **$H_2O_2$/SSI** systems. Additionally, the highest **SUL** removal efficiency was observed with **3.0 mmol/dm$^3$ of $H_2O_2$**.

### HETEROGENEOUS PHOTOCATALYSIS

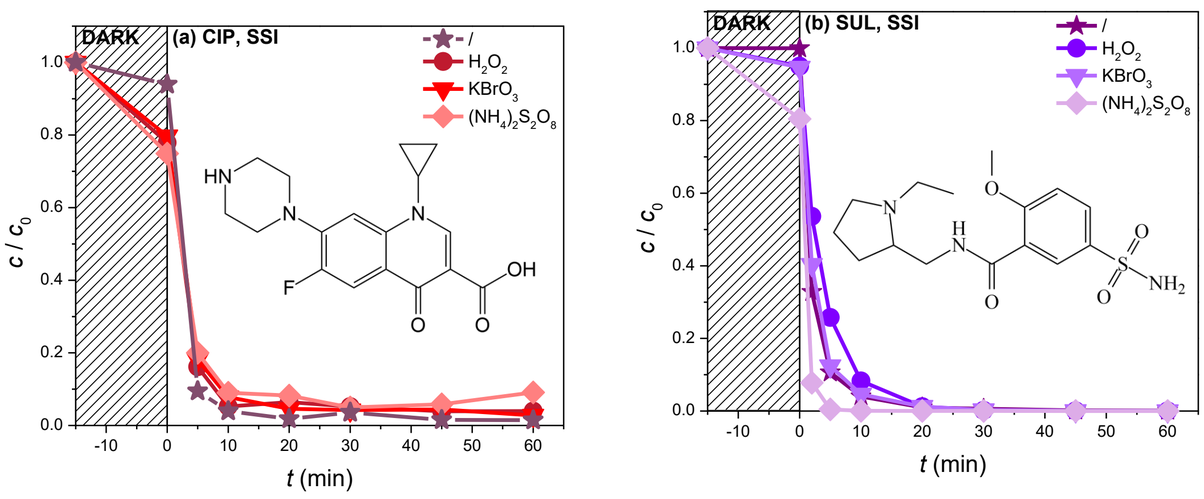


**Fig. 2.** The efficiency of photocatalytic removal of CIP/SUL (0.05 mmol/dm$^3$) in the presence of ZnO (0.5 mg/cm$^3$) and $H_2O_2$/$KBrO_3$/$(NH_4)_2S_2O_8$ (3 mmol/dm$^3$) under SSI.

The results of the **heterogeneous photocatalysis**, conducted under 60 min of SSI using **ZnO** as a photocatalyst, revealed no significant difference in **CIP** and **SUL** removal efficiencies in the case of all three studied electron acceptors.

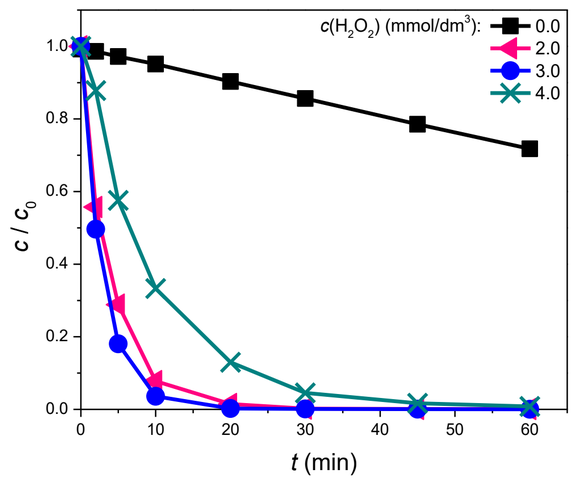


**Fig. 3.** The effect of the initial molar $H_2O_2$ concentrations on the SUL (0.05 mmol/dm$^3$) removal efficiency under SSI.

## ACKNOWLEDGEMENTS

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