EFFICACY OF FUMONISIN B_1 REMOVAL FROM VARIOUS SIMULATED WATER TYPES USING UV AND UV/H_2O_2 TREATMENTS

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АКАДЕМИЈА СТРУКОВНИХ СТУДИЈА ШАБАЦ

"SUNLIGHT AND WATER, OUR SOURCE OF BRIGHTER FUTURE"

INTRODUCTION

Mycotoxins are secondary metabolites of mold, and several hundred mycotoxins with very different chemical and physicochemical properties have been discovered so far [1]. Previous studies on mycotoxins have mainly focused on their production and presence in cereals. On the other hand, more and more attention is paid to the studies of fungi found in drinking water, where they and their metabolites are considered to be dangerous pollutants, due to their toxicity [2,3]. Authors regarding their distribution, i.e. occurrence in the aquatic environment, made different conclusions.

The presence of mycotoxins in water, especially in drinking water, can be a potential problem that requires monitoring, as well as removal of mycotoxins from water with the aim of their degradation or detoxification, without disturbing the physical, chemical, and organoleptic characteristics of water. The aim of this work was to simulate different water types to examine their influence on the efficacy of FB_1 removal using UV and UV/H_2O_2 treatments.

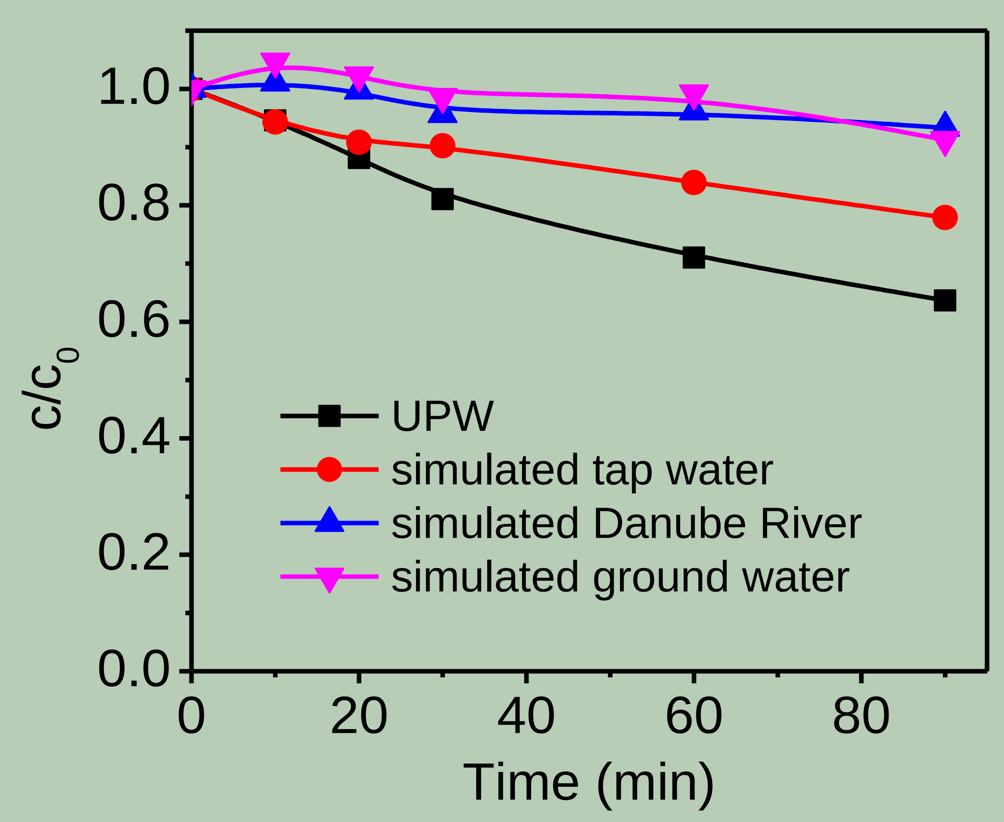
METHODS

The efficiency of FB_1 (1.39×10^{-6} mol/dm^3) removal was investigated in simulated water types by UV photolysis, as well as using UV/H_2O_2 treatment with a high-pressure mercury lamp (HPL-N, 125W, Philips). To examine the influence of mixture of some ions and humic acid on the efficiency of UV and UV/H_2O_2 treatments of FB_1 removal, their concentrations in the reaction solution were adjusted to the values determined in real water samples.

To examine the efficiency of the UV/H_2O_2 treatment, an appropriate volume of H_2O_2 (0.278 mmol/dm^3) was added to the reaction mixture. The removal of FB_1 (20 cm^3) was performed in a photochemical cell. Aliquots of the reaction mixture were taken before the irradiation, as well as during irradiation at certain time intervals in order to monitor the kinetics of FB_1 photodegradation [4]. For this purpose, samples were analyzed by liquid chromatograph with fluorescence detector, with isocratic elution. Samples were derivatized with o-phthaldialdehyde–2-mercaptoethanol before analyzing.

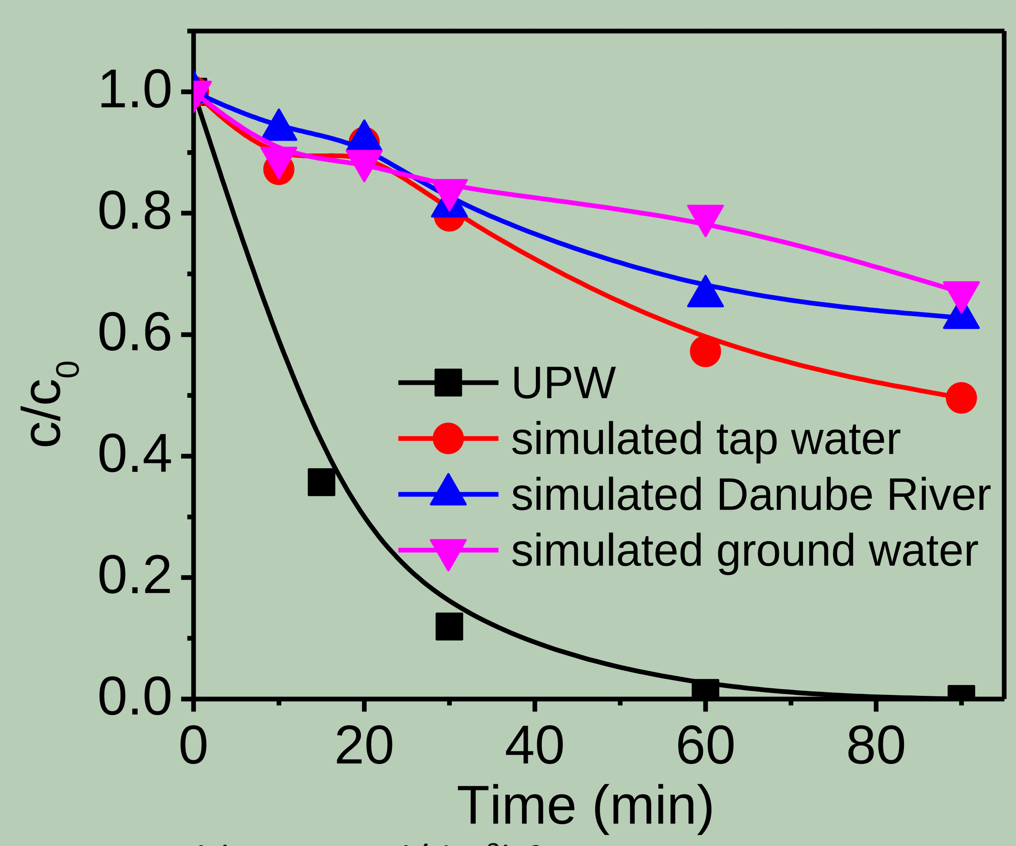
RESULTS AND DISCUSSION

Figure shows the efficiency of FB_1 removal using UV photolysis in simulated water samples. As it can be seen, in the case of all simulated water types, the efficiency of FB_1 removal was lower compared to upltrapure water (UPW). If the obtained results with simulated waters are compared with the results of FB_1 photolysis in real water samples, the removal efficiency of FB_1 was lower in simulated waters. Namely, in real waters, the highest efficiency was recorded in Danube River water (68%) [4]. On the other hand, the efficiency of removal in tap and ground water was almost the same, 52%, and 50%, respectively [4].



Kinetics of FB_1 removal (1.39 μmol/dm^3) from various water types using UV photolysis.

Given that in previous research [5] the UV/H_2O_2 treatment has proven to be very effective in removing of FB_1, this treatment was also applied to simulated waters. As it can be seen, in the case of all simulated water types, the efficiency of FB_1 removal was lower compared to UPW. If the obtained results with simulated waters are compared with the results of in real water samples, the removal efficiency of FB_1 using UV/H_2O_2 treatment was also lower in simulated waters. Namely In these systems, the highest FB_1 removal efficiency was recorded in tap water (91%). The removal of FB_1 in ground water (85%) and Danube River water (82%) [4].



Kinetics of FB_1 removal (1.39 μmol/dm^3) from various water types using UV/H_2O_2 treatment, c(H_2O_2) = 0.278 mmol/dm^3.

CONCLUSION

In the samples of simulated Danube River, tap and ground water, a lower efficiency of UV photolysis of FB_1 was observed compared to removal in UPW. However, in the case of UV/H_2O_2 treatment in simulated waters, the removal efficiency was significantly lower as in UPW. In the case of real waters, using UV and UV/H_2O_2 treatments the efficiency of FB_1 removal was higher in comparison with simulated water types. These results provide insight into the influence of the matrix of different water types on the efficiency of FB_1 removal and contribute to the development of adequate water purification methods for potentially carcinogenic fumonisins removal.

REFERENCES

1. Schenzel, J., Hungerbühler, K., Bucheli, T.D. Mycotoxins in the environment: II. Occurrence and origin in Swiss river waters. Environ. Sci. Technol. 2012, 46, 13076–13084
2. Hedayati, M.T., Pasqualotto, A.C., Warn, P.A., Bowyer, P., Denning, D.W. Aspergillus flavus: human pathogen, allergen and mycotoxin producer. Microbiology 2007, 153, 1677–1692.
3. Al-gabr, H.M., Zheng, T., Yu, X. Occurrence and quantification of fungi and detection of mycotoxigenic fungi in drinking water in Xiamen City, China. Sci. Total Environ. 2014, 466-467, 1103–1111.
4. Jevtić, I., Jakšić S., Šojić Merkulov, D., Bognár, S., Abramović, B., Ivetić, T. Matrix effects of different water types on the efficiency of fumonisin B1 removal by photolysis and photocatalysis using ternary-and binary-structured ZnO-based nanocrystallites. Catalysts 2023, 13, 375.
5. Jevtić, I., Jakšić, S., Simin, D. Č., Uzelac, M., Abramović, B. UV-induction of photolytic and photocatalytic degradation of fumonisins in water: reaction kinetics and toxicity. Environ. Sci. Pollut. Res. 2021, 28, 53917–53925.

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