

Abstract

Pharmaceuticals belong to the group of emerging environmental contaminants and are frequently detected in aquatic environments, where they may affect organisms, including cyanobacteria, which play an important role in the functioning of aquatic ecosystems. Basic ecotoxicological tests based on the assessment of cyanobacterial growth may not fully reflect their responses to contaminants. The aim of this doctoral dissertation was to assess the biochemical and physiological responses of cyanobacteria to selected pharmaceuticals and the suitability of selected parameters for detecting their sublethal effects. Additionally, the influence of environmental conditions on the response of cyanobacteria exposed to pharmaceuticals was assessed.

The study was conducted using five cyanobacterial strains, evaluating the suitability of biomarkers including biomass increase, photosynthetic apparatus functioning, pigment composition, cyanotoxin production, reactive oxygen species, and biogenic volatile organic compounds (BVOCs). The toxicological studies examined the effects of non-steroidal anti-inflammatory drugs (NSAIDs), also considering the influence of salinity and the availability of biologically available forms of nitrogen. It was demonstrated that the absence of a clear effect of pharmaceuticals on cyanobacterial growth does not exclude the occurrence of sublethal changes. In the case of diclofenac (DCF), changes in photosynthetic apparatus functioning and cyanotoxin production were observed despite its limited effect on growth. It was demonstrated that the suitability of cyanobacterial response markers depends on the organism, stressor, and experimental conditions. Studies using DCFH₂-DA indicated limitations of this probe and the need for method verification before its application. Analysis of BVOCs demonstrated that light stress alters the profile of volatile metabolites, indicating their potential as stress markers.

An important part of the study was to determine the influence of environmental conditions on the toxicity of pharmaceuticals. No clear effect of salinity on the toxicity of the tested NSAIDs was demonstrated, whereas limited nitrate availability clearly increased the toxicity of DCF toward *A. cylindrica*. The results therefore indicate that the assessment of pharmaceutical effects on cyanobacteria requires consideration not only of growth parameters, but also of physiological and biochemical responses and the environmental conditions under which exposure occurs. Taking these relationships into account may contribute to a more realistic assessment of the risks associated with the presence of pharmaceuticals in the aquatic environment.