ICCE 2023
VENICE

18TH INTERNATIONAL CONFERENCE ON CHEMISTRY AND THE ENVIRONMENT

www.icce2023.com

11 – 15 JUNE 2023 VENICE, ITALY

Venue:

SCIENTIFIC CAMPUS

CA'FOSCARI UNIVERSITY OF VENICE (ITALY)

Book of Abstracts

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Toxins in Biofilms of Lakes and Rivers, an Emerging Threat for Public Health in a Scenario of Climate Changes

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Cyanobacteria constitute a health hazard in freshwater environments due to the ability to produce toxic metabolites. Animals and humans can be harmed upon exposure to water containing high levels of cyanotoxins that can occur during intense blooms. Toxin cyanobacteria blooms represent a relevant problem in many lakes and reservoirs worldwide and they are therefore routinely monitored by health/environmental authorities. Microcystins and anatoxins are the most common toxins produced by planktonic cyanobacteria. In the last years more and more reports are being published about the occurrence of toxic cyanobacteria in benthic mats (biofilms) growing on rocks, sediment, or macrophytes on the shores of lakes or rivers. The concentration of toxins in biofilm (especially of anatoxins) can reach very high levels, sufficient to cause the death of dogs and cattle. Differently from planktonic cyanobacteria, there is no regular monitoring of benthic cyanobacteria by authorities. It is therefore important to conduct more studies aimed at assessing the real relevance of this phenomenon in aquatic environments. Additionally, the impact of ongoing climate changes on the ecological aspects of these organisms are needed. Recent investigations conducted in the frame of local and international projects (i.e., Eco-AlpsWater project, financed by the EU-Interreg Alpine Space program) has offered the occasion of running a survey on some lakes and rivers in Europe, in particular in the Alpine region. Results have demonstrated that toxic cyanobacteria are present in biofilm collected from stones on the shores of some lakes. A comprehensive analytical effort was conducted by means of LC-MS/MS, which showed that anatoxins are the most relevant toxins in biofilms. In particular, two congeners were found to be the most represented: anatoxin-a and homoanatoxin-a. The toxin content in samples showed also a big spatial heterogeneity with up to two orders of magnitudes differences from samples taken meters away from each other.

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