Construction and characterization of two bioluminescent cyanobacterial bioreporters for the assessment of the oxidative stress caused by metallic nanoparticles.

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Abstract

Recent evidence on mechanistic studies indicate that oxidative stress is involved in most environmental toxicity processes. One example of pollutants that could induce oxidative stress are nanoparticles (NPs). Metallic NPs release metal ions that contribute to their toxic effect and to the formation of reactive oxygen species (ROS). Due to their ecological relevance, low cost and easy maintenance, cyanobacteria have been used for whole-cell bioreporter development which has demonstrated to be useful to assess toxicity, nutrient bioavailability in fresh waters, as well as specific families of pollutants like heavy metals. At present, there exist whole-cell bioreporters for oxidative stress detection mostly based on recombinant heterotrophic bacteria such as *Escherichia coli*. Despite the complex and interesting genetic regulation of oxidative stress in cyanobacteria, at present no cyanobacterial whole-cell bioreporters for oxidative stress exist. We constructed two novel self-luminescent bioreporter strains of the cyanobacterium *Nostoc* sp. PCC 7120 by fusing the promoter region of the *sodA* and *sodB* genes (encoding the superoxide dismutases MnSod and FeSod, respectively) to *luxCDABE* from *Photorhabdus luminescens* aimed at detecting pollutants that generate ROS, particularly superoxide anion. The bioreporters were tested with methyl viologen (MV) as the inducer of superoxide anion. Both bioreporters were specific for superoxide anion and Limits of detection (LODs) and Maximum Permissive Concentrations (MPCs) were calculated. Furthermore, to validate the bioreporters, they were tested in real environmental samples spiked with MV. In addition we evaluated superoxide anion generating potential of TiO2 NPs, AgO NPs, CuO NPs and ZnO NPs. The results confirm the validity of both bioreporters to detect oxidative stress-generating pollutants in fresh-waters. **Acknowledgements**: This research is supported by CTM2013-45775-C2-1-R and CTM2013-45775-C2-2-R grants from MINECO. JHG is working under FPI contract (MINECO-EU).

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