Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.15479

Formation of ferric iron hydroxides on Cyanidiales under anaerobic conditions

YU-TING LIU, YEN-LIN CHO, YU-HSIEN CHEN AND NHU ANH THI THAN

National Chung Hsing University

Presenting Author: yliu@nchu.edu.tw

Cyanidiales are thermoacidophilic microalgae, which are capable to survive in extreme environments (20–56 °C and pH 0.5–5.0) enriched with concentrated metals. Our previous works [1, 2] evidenced their outstanding tolerance for Pb and Cr(VI). Strategies adopted by Cyanidiales against heavy metals stresses including in vivo and in vitro processes. For Cr(VI), a portion of initial added Cr(VI) was reduced to less mobile and toxic Cr(III) by Cyanidiales under aerobic conditions. Such results arouse the possibility that Cyanidiales might be able to carry out redox reactions spontaneously. In the case that some species of Cyanidiales have been reported to perform horizontal gene transfer (HGT) from prokaryotes, it is promising that Cyanidiales hold newly uncharacterized enzymes that dominate the redox fluctuations of elements. Ferric iron [Fe(III)] hydroxide, a material rich in the environment, has great adsorption capacity for heavy metal removal. However, Fe(III) hydroxide is easily reduced to ferrous iron [Fe(II)] and dissolved into solution under the acidic and anaerobic condition, resulting in the release of heavy metals sorbed on Fe(III) hydroxide. The Fe(III) hydroxide shows the advantage to occur as nanoparticles, however such attribute was often overwhelmed by the Fe aggregation, subsequently decreasing the activity. Therefore, in this study, we aimed to develop the novel biocomposite consisting of Fe and Cyanidiales under acidic and anaerobic conditions. Results showed that assemblages of Cyanidiales and Fe(III) precipitates, mainly ferrihydrite, were formed not only in the Fe(III) but also the Fe(II) system under acidic and anaerobic conditions. The enhanced formation of Fe(III) hydroxides on Cyanidiales under acidic and anaerobic conditions enlarges the feasibility and practicability to apply the nanoparticles of Fe(III) hydroxides as green and sustainable material for metal removal.

[1] Cho, Y.L. et al, Removal and concurrent reduction of Cr(VI) by thermoacidophilic Cyanidiales: a novel extreme biomaterial enlightened for acidic and neutral conditions (2022), Journal of Hazardous Materials, 130334.

[2] Cho, Y.L., et al, Molecular mechanisms for Pb removal by Cyanidiales: a potential biomaterial applied in thermo-acidic conditions (2020), Chemical Engineering Journal, 125828.