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Microbial metal recovery from anthropogenic waste

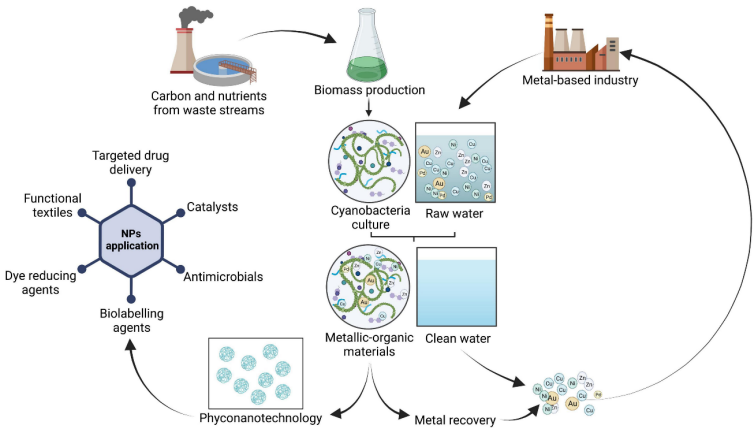

Figure: Schematic representation of heavy metal biosorption adopting cyanobacteria coupled with metal recovery and phyconanotechnology through a circular process. From: Ciani & Adessi 2023.

Context: Metals, such as copper, gold, silver or lithium, are important for the functioning of our modern societies. Currently, in order to sustain our socioeconomic needs, these resources are mined from natural environments with high ecological and ethical costs. Non-conventional sources for such metals that are still to be further investigated are of anthropogenic origin and include industrial waste waters. In highly metal-polluted fluids produced in industrial settings, metals need to be removed from the aqueous phase using costly and energy-consuming processes. Another drawback is that these metals are then accumulated as a waste fraction and are hence lost to the industrial circuit. An alternative to remove metals from fluids, with the possibility to recover them, is to use biological surfaces, such as microorganisms, as sorbents. Cyanobacteria are phototrophic bacteria that are found ubiquitously in all waterbodies around the globe. In the canton of Graubünden in Switzerland, cyanobacterial mats have been isolated from highly concentrated iron springs. Such observations suggest that these specific strains might be resistant to high metal concentrations and may thus be good candidates to interact with toxic metals.

Aims of the study: The specific aim of this master project will be to assess the tolerance of different cyanobacterial strains to different metal concentrations and to further test their capacity of removing metals from specific fluids. A secondary aim will be to test whether sorbed metals can be selectively recovered to be reused, following a circular economy scheme. For this, you will: **1)** Test the growth and tolerance of different isolated cyanobacterial strains to different metal solutions; **2)** Evaluate the adsorption capacity of the selected strains to remove the metals from the different fluids; **3)** Recuperate the sorbed metals into a form that can further used in different applications.

Knowledge and skills required: High motivation for experimental work, interests in cyanobacteria and metals. Good knowledge of both French and English.

Keywords: Cyanobacteria, heavy metals, adsorption, bioreactor

Working place: Laboratory of Microbiology, University of Neuchâtel

References: 1) Ciani, M., & Adessi, A. (2023). Cyanoremediation and phyconanotechnology: cyanobacteria for metal biosorption toward a circular economy. Frontiers in Microbiology, 14, 1166612. **2)** Kalita, N., & Baruah, P. P. (2023). [Cyanobacteria as a potent platform for heavy metals biosorption: Uptake, responses and removal mechanisms. Journal of Hazardous Materials Advances, 100349. **3)** Ghorbani, E., Nowruzi, B., Nezhadali, M., & Hekmat, A. (2022). Metal removal capability of two cyanobacterial species in autotrophic and mixotrophic mode of nutrition. BMC microbiology, 22(1), 58.

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