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Diazotrophic cyanobacteria for bioremediation of greenhouse gases in Australian coal mines: A promising source for biofuels and value-added products

S. Cires*, C. Alvarez Roa, V. Loza, O.P. Karthikeyan, K. Heimann
James Cook University, Australia

Cyanobacteria are photosynthetic prokaryotes characterized by an unusually high metabolic versatility, therefore representing a promising source for biofuels and high value bioproducts with a wide range of commercial applications. However, the enormous potential of cyanobacteria for carbon sequestration technologies and end-product development remains far more unexplored than that of green microalgae. Here we present the first results of the research project "*Bioremediation of methane from mine ventilation air*" jointly funded by the Advanced Manufacturing Cooperative Research Centres (AMCRC) and MBD Energy Ltd, Australia, which aims to remediate CH_4 and CO_2 emissions from a coal mine using a dual bioreactor system of methanotrophic bacteria and cyanobacteria. Strain selection was based on a culture collection of native cyanobacteria from tropical freshwaters and soils in Queensland, NE Australia, comprising at least 5 different genera whose phylogeny and biochemical profiles (lipid and carbohydrate composition, fatty acid methyl esters, carotenoids) were thoroughly analysed. Preliminary results depict an interesting commercial potential of cyanobacterial biomass for the production of biofuels (hydrothermal liquefaction biocrude oil; alkanes and alkenes; bioethanol), pigments (carotenes, phycocyanins) and ω-3/ω-6//ω-9 fatty acids, which may be modulated by shifting growth conditions. Furthermore, our results represent the first dataset of some cyanobacterial species not previously assessed for commercial purposes. Finally, we will show techno-economic estimates on the use of solid support photobioreactors with native benthic nitrogen-fixing cyanobacteria as an alternative to reduce bioreactor maintenance and biomass harvesting costs.

Keywords: Bioremediation, Cyanobacteria, Coal mines, Biofuels