BIOMINERALIZATION BY MICROALGAE AS A TOOL TO VALORIZE STONE EXTRACTION LEFTOVERS

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ABSTRACT

Biomineralization is a process performed in nature by several microorganisms through different metabolic pathways, like urea hydrolysis, photosynthesis, denitrification and sulphate reduction. Among the minerals produced by this process, those based on calcium carbonate are the most common (Zhu & Dittrich, 2016). Although urea hydrolysis is the most widely used in several technical applications (Dhami et al., 2013), photosynthesis by oxygenic microorganisms represents an interesting alternative for microbially induced calcium carbonate precipitation (MICP). In this respect, many studies focus on cyanobacteria, like *Synechococcus*.

This work was conducted with a multidisciplinary approach. Its aim was to identify microalgae able to perform biomineralization to produce new materials from stone extraction leftovers. A screening of several microalgal strains was performed and the selected ones were tested on inert materials to evaluate their growth capacity. Preliminary production trials of new materials from stone leftovers treated with live cyanobacteria were also performed.

The screening, including nine microalgae (mostly cyanobacteria), was performed in 100 ml flasks kept in an orbital shaker under continuous light. A culture medium enriched with Ca^{2+} and $NaHCO_3$ was used compared to a standard medium as control. Microalgal growth on inert materials was tested on three different stone leftovers (marble, travertine and pietra serena from Tuscany caves), in transparent vessels under continuous light, by mixing the inert material with a microalgal inoculum suspended in the enriched medium. New materials were prepared using stone leftovers of different granulometries mixed with microalgal inoculum and a binding substance. In both experiments, controls without microalgal addition were prepared.

All the tested microalgae were able to grow in the enriched medium, in some cases even more than in standard medium. In the culture grown in the enriched medium mineral crystals were visible under the microscope. The selected strains were able to persist or even grow on stone leftovers. The trials on new material production were only preliminary and further work is needed to scale-up and optimize the process, so as to reach a quality sufficient for a usable material.

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Keywords

Biomineralization, photosynthesis, cyanobacteria, stone leftover, biodesign

References:

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BIOGRAPHY

Natascia Biondi, PhD in Microbial Biotechnology, is a researcher at the Department of Agriculture, Food, Environment and Forestry (DAGRI) of the University of Florence. She has more than 20 years of experience in the microalgae field and has participated to several EC funded projects (FP4, FP7, H2020). She is secretary of the Italian Association for the Study and Application of Microalgae (AISAM). Main topics of research: microalgae cultivation and application in the food, nutraceutical and agricultural fields.

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