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3D Tailored Design as a Bioremediation Strategy for a Lagoon in Matanza-Riachuelo Basin

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Extended Abstract

A native strain of the microalgae *Chlorella vugaris* was shown to be effective for the reduction of several chemical and microbial contaminants present in polluted streams from the Matanza-Riachuelo Basin (M-R, 1). The microalgae immobilization in calcium alginate beads protects the cells from the toxic effects of numerous substances and from extreme pH and temperatures, allowing better survival and greater efficiency in the production of biomass [2, 3]. However, cells trapped in the matrix are easy to be devoured by the fauna existent. Saladita Norte lagoon is part of M-R, this watercourse exhibits a wide range of contaminants levels along the year, mainly depending on the seasonal regime. At certain periods of the year, these levels usually exceed the limits established in international standards of water quality [4-6]. Similarly to that observed in other streams of M-R, several nitrogenated compounds, phosphorus, metals, and saprophytic and pathogenic bacteria are the main contaminants of Saladita Norte. In order to protect the alginate beads from the birds and fishes predation, a 3D-printed PLA (polylactic acid) device was designed. PLA is a biocompatible and biodegradable material that has been described as suitable for biotechnological applications. [7]. Bioprocesses carried out with this material must be checked for mechanical stability and optimal pore size to allow an effective bioremediation process. For this purpose, we used a stirred-tank bioreactor supplied with a marine propeller and aeration during 6 days. Growth index and biomass production were compared between algae immobilized in alginate beads versus immobilized in alginate beads placed into a complex 3D printed PLA device.

As previously observed, our native isolate of *C. vulgaris* could grow inside the alginate beads based on the consumption of several of the above-mentioned contaminants, such as phosphorus and nitrogenated ions [1]. The results obtained in control treatments with immobilized cells in alginate beads were: **A-** MS synthetic culture media supplemented with sucrose (3% w/v) and indolacetic acid (1 mg/L) as growth regulator [1] (μ=0.737, dt= 24 h) and **B-** as A- but growing in Saladita Norte water (μ=0.668, dt= 24 h). Also, treatments using 3D-device were: **C-** like B, but Chlorella cultures immobilized in alginate beads growing into a PLA3D scaffold coloured red (μ=0.341, dt= 2 d); **D-** like C, but coloured white (μ=0.206, dt= 3 d); and **E-** like C, but uncoloured (μ=0.342, dt= 2 d) were effective and successful to bioremediation *in vitro*. All cultures were kept at 24±2ºC, with a photoperiod of 16 h under PAR (above 400 μmol photon m-2 s-1). The data obtained were complemented with standardized cytotoxicity tests using *Allium cepa* and *Lactuca sativa* seeds. Germination rate and mitotic index of onion seeds and germination rate and length of lettuce seeds using polluted water or bioremediated water were compared. The results obtained demonstrate the potential of this technology to be used in integrated processes that seek removal of xenobiotics.

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