Contribution to the study of the encapsulation of microorganisms (cyanobacteria and yeasts) in clay and silica based matrices

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Abstract

Encapsulation of microorganisms in inorganic matrices is being widely studied in recent years [1]. One of the key objectives is to achieve cell protection that facilitates their its use in various applications, e.g. for biocatalytic preparation of specific products. Ideally, to protect them, the matrices generated must be biocompatible, resistant and translucent, allowing the maintenance of their metabolic functions while limiting cell division. The advantage of the immobilization of microorganisms as a biocatalytic system lies in its ease of handling, and especially in the simplicity and efficiency of the recovery of the produced compounds. In this communication it is compared the characteristics and performance of biohybrid materials based on silicic matrices prepared via sol-gel and bionanocomposites based on biopolymers and clays (sepiolite), for the encapsulation of cyanobacteria (Synechococcus elongatus PCC7942) and yeasts (Saccharomyces cerevisae). On the one hand, it has been evaluated the potential use of matrices based on bionanocomposites of chitosan and alginate that incorporate sepiolite produced as films, beads or foams for the immobilization of cyanobacteria, analyzing the problems that they may present for the long-term survival of the encapsulated microorganisms. On the other hand, it has been analyzed the use of silica-based matrices generated by sol-gel. The use of silica gels to encapsulate bioactive microorganisms, such as algae and cyanobacteria, have demonstrated a good way to obtain biocompatible, resistant and translucent matrices [2]. In the present study the silica gel matrix was generated from sodium silicate and treated to reduce its sodium content in view to directly entrap cyanobacteria and yeasts or once modified to produce “yolk-shell” type systems [3]. The so-called "yolk-shell" structures seek to create a silica cover around the cells in a system similar to that of an egg by protecting the cell with a protein (protamine) around which the silicic capsule is created. In particular, it has been verified how the coating of unicellular microorganisms with a silica shell reduces contact between the cells and the inorganic matrix and increases their durable survival by maintaining bioactivity more efficiently [4]. Thus, for example, encapsulated yeast is capable of producing ethanol for several days, confirming the potential of this approach for applications related to biocatalysis.

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