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The potential of alginate as a controlled release system for iron and complexes for symbiodinium cultivation

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Highlights

Alginate beads were developed for the controlled release of iron, aiming applications in microalgae cultivation.

Resumo/Abstract

Corals are invertebrates that, for the most part, live in symbiosis with single-celled algae known as symbiodinium. They provide most of the nutrients for the animal, in exchange for protection and continuous exposure to light. The symbiosis is disturbed by environmental stressors and anthropogenic activity, leading to coral bleaching events (the disruption of the coral-symbiodinium symbiosis). Among various nutrients, iron (Fe) plays a crucial role in enhancing symbiodinium production. However, administering simple salts of this metal in marine environments can be detrimental as they disperse rapidly and may be assimilated by competing organisms. Therefore, the controlled release of well-defined chemical species of iron is required. In this work, we developed alginate (Alg) -based beads crosslinked with Ca^{2+} or Sr^{2+} that included either free Fe or its complexes with histidine and deferoxamine (FeHis and FeDFO, respectively). FTIR-ATR spectra of lyophilized beads (Fig 1a) show interactions between alginate and Fe, evidenced by the shift of bands from 3233 cm^{-1} to 3293 cm^{-1} and from 1084 cm^{-1} to 1585 cm^{-1}, corresponding to -OH and –COOH stretches, respectively. DSC measurements showed the shift of the melting temperature from 93 °C to 115 °C after Fe load. TGA (Fig 1b) reveals significant mass losses up to 200 °C, indicative of solvent release. Polymer bond degradation occurs at 280 °C and 290 °C for Alg and FeAlg, respectively. Elemental analyses (C/H/Fe, %) of Alg is 20.03/5.56/non detected, 16.05/4.95/1.15 for FeAlg. When comparing the crosslinkers, no significant differences are observed in FTIR, TGA, and elemental determinations. However, a higher release of Fe after 24 h is noted with Ca^{2+}. FeDFO is more easily released (Fig 1c), regardless of the crosslinker, while FeHis exhibits intermediate release, also independent of the crosslinker. In contrast, Fe dispersed in alginate shows a smaller release for both crosslinkers. The release of Fe can be controlled by the proper choice of ligands and crosslinkers. Studies with symbiodinians are currently underway.

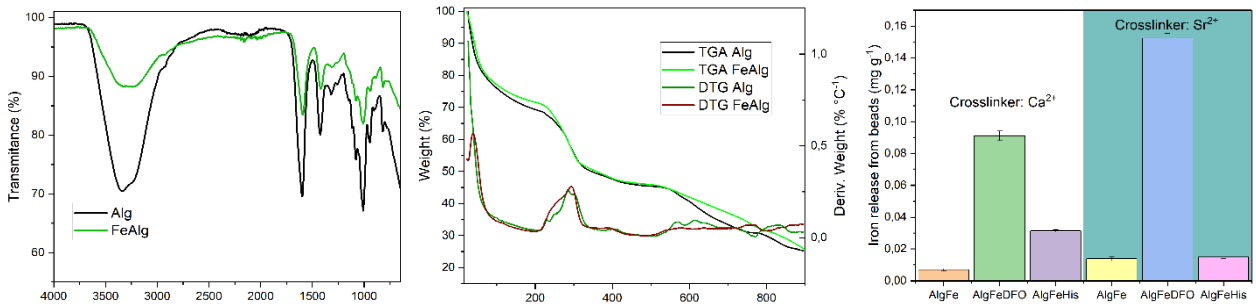

Figure 1: (a) FTIR-ATR spectra of Alg and FeAlg; (b) TGA and DTG curves of Alg and FeAlg; (c) Iron release after 24 h in artificial seawater

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