Title: Chitosan- alginate-based hydrogels for agricultural and horticultural applications

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Introduction: The transboundary pollution of aquatic ecosystems, promoted by the excessive utilization of nitrogen and phosphorus-based fertilizers, is causing an overgrowth of algae. Therefore, the development of controlled-release systems is necessary to avoid the wastage of agrochemical compounds. In this context, this study develops chitosan-alginate-based hydrogels for potential use as a direct nutrient source for plants and for improving water retention, which is crucial in intensifying climate change, thereby mitigating the effects of drought on crop production.

Methods: Physicochemical properties were determined through Fourier Transform Infrared Spectroscopy (FTIR) and Thermogravimetric Analysis (TGA). Mechanical performance was evaluated using strain and frequency sweep tests, as well as temperature ramps, analyzing the modification through the gelation process (including the after-mixing stage, the gelation of chitosan and the immersion in calcium chloride for the gelation of alginate). Moreover, microstructural characterization was determined using Scanning Electron Microscopy (SEM). Finally, the water uptake capacity was measured after several cycles.

Results: Chitosan-alginate-based hydrogels formed a polyelectrolyte complex, worsening their hydrophobicity due to the incorporation of alginate, while chitosan allows the enhancement of the mechanical properties. Particularly, hybrid systems exhibit intermediate behavior, combining good mechanical properties with a substantial water absorption capacity, as well as an intermediate microstructure that remains stable during successive cycles. Finally, the material possesses good integration and thermal stability.

Conclusions: Chitosan-alginate-based hydrogels demonstrate potential for redefining agricultural practices, thereby mitigating ecological damage caused by conventional fertilization methods.

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