Chitosan/oxidized chitin composite films with potential applications in food packaging

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In the last decades, a growing concern has been targeting the accumulation of non-degradable biomasses derived from petrochemical-based plastics. This has increased the interest in bio-degradable and bio-based disposable packaging, mainly in the food sector. A wide range of natural biopolymers (e.g., starch, cellulose, chitosan, pectin) has been proposed as food packaging materials able to enhance the shelf life of food products.[1]
The aim of this study is to obtain a composite material, to use as a green packaging alternative, combining the properties of chitin and chitosan.
Chitin occurs in nature in the crystalline state as three polymorphs: alpha, beta, and gamma. In this study, we focused on β- chitin, since its crystalline structure allows a higher interaction with species in solution, thus enhancing the reactivity of the polymeric chains.[2] Since pure chitin is insoluble in most solvents,[3] in this work its solubility is increased by performing a selective oxidation to carboxylic acid on C6. The oxidation reaction is carried out using 45% ammonium persulphate for 24 hours at 40 °C. From this synthesis, a dispersion of fibrils with a negative surface charge given by the carboxylate groups is obtained.
The second component of this blend is chitosan, a chitin derivative where the amide of the N-acetyl glucosamine has been mostly deacetylated obtaining an amine-rich polymer. The combination of these two components presents a reinforcement at the interface between chitin and chitosan due to electrostatic interactions between the positive amino group of chitosan and the negative carboxylate group of the oxidized chitin.
When a mixture of chitosan and chitin fibers is air-dried, it produces films with tunable properties potentially suitable for food packaging applications, but not only. In this study different mass ratios of oxidized chitin and chitosan are investigated. The investigations on their mechanical properties (tensile tests), crystalline structure (X-ray diffraction and FTIR spectroscopy), thermal stability (TGA), and morphology (SEM) showed the functional role of the two components and their cooperative effects.

References

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