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Casein and polysaccharide-based films: an alternative for food packaging

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Highlights

Casein and polysaccharide reticulation for the production of biodegradable films via sustainable processes. Covalent crosslink for durable material production. Sustainable water-based process.

Abstract

The development of biodegradable materials has become a common goal in various industrial and research sectors. Due to their properties such as wide availability, high abundance, low cost, non-toxicity, biodegradability, biocompatibility, and renewability, polysaccharides are considered promising candidates. Similarly, casein is one of the most abundant proteins in milk and possesses high nutritional value. However, the supramolecular structure of its micelles, which is sensitive to environmental changes, limits its applications beyond the food industry. Another limitation of these polymers is their characteristic of being water-soluble and forming films with low mechanical strength, an undesirable characteristic for food packaging. To increase mechanical strength and resistance to moisture, crosslinking is typically performed. The most common crosslinking methodologies employ less durable physical interactions or a covalent network made using organic solvents, toxic crosslinking agents, or high temperatures. Here, we are investigating methods for preparing casein films crosslinked with polysaccharides in water-based processes and evaluating the use of UV light and enzymes, such as lipases and laccases, in these processes. Casein (solubilized in buffer pH 8) was mixed with ethyl hydroxyethylcellulose (EHEC) or sodium alginate (1:1) in the presence of the cited enzymes, with or without exposure to UV light (254 nm). The reactions occurred over 24 hours in an orbital shaker or a magnetic stirrer, depending on the presence of enzymes, at room temperature. The reactions were dried in petri plates, and the films formed by these different processes were evaluated for water resistance as a screening test for further characterization. The most effective methodology employed so far is the application of casein, EHEC, and laccase under UV exposure at room temperature (r.t.) for 24 hours, which maintains a stable state for 3 to 4 hours in water with minimal mass loss. New tests are being conducted to enhance the water resistance and mechanical properties of the films by applying genipin and glyoxal, covalent crosslinking agents, in combination with the already optimized conditions. The materials produced will be characterized using FTIR and MEV, among other techniques.

References:

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