

Alginate as a potential polysaccharide for high oxygen barrier applications: influence of structure and composition

URENA M. (1), CARULLO D. (2), TH? THANH T. (1), FOURNIER P. (1), LAGORCE A. (1), KARBOWIAK T. (1)

1 Intitut Agro Dijon, Dijon, France
2 Universitdegli Studi di Milano, Milan, Italy

Alginate is a polysaccharide extracted from various species of brown seaweeds, which belong to the Phaeophyceae class. It is chemically a copolymer of (1 ? 4) linked ?-D-mannuronic acid (M) and ?-L-guluronic acid (G) monomers. It is non-toxic and exhibits unique colloidal properties, such as thickening, suspending, stabilizing, gel-producing and film-forming. Moreover, when used in the form of films, it has a very high barrier to oxygen and a very good release profile of encapsulated molecules.

Depending on the origin, alginate chains can be characterized by disparate molecular weight and M/G distribution. This can potentially have a significant impact on the physicochemical properties targeted. Therefore, this study aimed to characterize the effect of molecular weight (MW) and guluronic/mannuronic acids ratio on the functional properties of four different alginate types, considering both the aqueous film-forming solutions (rheological and interfacial properties) and the self-standing films (mechanical and barrier properties). Surprisingly, no significant differences were detected among the tested alginate samples in terms of averaged tensile properties, namely Young modulus (? 1.9 GPa), elongation at break (? 8.4 %) and tensile strength (? 42.5 MPa), as well as oxygen and water vapor permeances (PO_2 ? 7 ? 10⁻¹⁵ mol.m⁻².s⁻¹.Pa⁻¹, and PH_2O ? 1 ? 10⁻⁷ mol.m⁻².s⁻¹.Pa⁻¹ at semi-dry condition and 25 °C). Furthermore, a structure-dependent effect was disclosed for what respect to the flow behavior. The high MW alginates showed greater values of apparent viscosity, together with a more pronounced shear-thinning feature, compared to their low molecular weight counterparts. Finally, alginate was found to exhibit a remarkable release behavior of small molecules in simulating gastrointestinal media. Based on the properties highlighted so far, alginate may stand as a promising candidate for food packaging and pharmaceutical applications which, in most cases, require a strong shielding capacity towards oxygen penetration to protect either the food or the sensitive agents (e.g., probiotics, bacteria, antioxidant, antimicrobials).