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ORIGINAL PAPER

Physico-chemical properties of lignin–alginate based films in the presence of different plasticizers

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Abstract A lignin–alginate blended film was prepared in the presence of three different plasticizers, viz. glycerol, epichlorohydrin (EPC) and poly(ethylene glycol) (PEG) and the effect of each plasticizer was studied on physico-chemical properties of the blended film. Lignin extracted from *Acacia* wood by alkali extraction process was blended with alginate to obtain lignin–alginate film in the presence of different plasticizers. A film plasticized with glycerol displayed higher solubility and swelling percentage as compared to EPC and PEG plasticized films. The highest tensile strength was observed for film plasticized with PEG, and none of the plasticizers made any significant change on the bursting strength of the film. Incorporation of lignin considerably improved the light barrier properties of the films. Fourier transform infrared spectroscopy study of films suggested the existence of hydrogen bonding between lignin–alginate in the presence of plasticizers. In addition, EPC plasticized film displayed highest thermal stability, as confirmed by thermogravimetric analysis. Further studies demonstrated that plasticizers significantly affected the physico-chemical properties of the blended films. In conclusion, lignin–alginate film plasticized with EPC presented better physico-mechanical and light barrier properties which could be used in packaging and coating applications.

Keywords Lignin · Alginate · Film · Plasticizers · Fourier transform infrared spectroscopy

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Introduction

In recent years, there has been considerable progress in biopolymer-based packaging materials for environmentally sensitive goods and products. Efforts have been made to develop eco-friendly materials based on renewable resources rather than petrochemical-based materials [1]. Biopolymers, mainly carbohydrate-based films, can be used as edible films with good mechanical and water barrier properties [2]. Alginate, the major structural polysaccharides of brown algae, is a linked polyanionic copolymer of 1-4β-D-mannuronic (M) and α-L guluronic (G) residue, differing from each other in their relative proportions (M/G ratios). The proportion and distribution of the blocks determine the physico-chemical properties of a biopolymer. Sodium alginate is a polyelectrolyte with a negative charge on its backbone. It is water soluble, tasteless, odorless, and flexible glossy with low permeability to oxygen and oils [3–5]. The most interesting property of alginate is their ability to react with polyvalent metal ions [6]. It is typically used in the form of hydrogel in biomedicine, including wound healing, tissue engineering, and biosensor application as well as promising packaging materials [7–9]. It has certain distinctive properties, such as biocompatibility, non-toxicity, hydrophobicity, and chelating ability [10]. Further, compounds like natural antioxidant, antimicrobial agents, flavors and coloring agent can now be amalgamated into packaging materials to expand their functionality [3, 9]. Though alginate-based biocomposites have strong potential to be used for biomedical and packaging applications, but their low mechanical strength and loss of structural integrity limit their applications [11]. A major obstacle in their applications is the brittleness of the film. To overcome this problem, plasticizers and fillers such as