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Abstract

Characterization of Active Chitosan/Hydroxypropyl Methylcellulose/Orange Cellulose Nanocrystals Films Enriched with Ethyl Lauroyl Arginate for Food Packaging Applications †

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† Presented at the 2nd International Electronic Conference on Foods—Future Foods and Food Technologies for a Sustainable World, 15–30 October 2021; Available online: https://foods2021.sciforum.net/.

Abstract: Cellulose nanocrystals (CNCs) are extracted from orange peels using an alkaline/H_2O_2 bleaching pre-treatment followed by sulfuric acid hydrolysis. Extracted CNCs were added as a reinforcing agent into films based on chitosan/hydroxypropyl methylcellulose blend (CS/HPMC) enriched with lauroyl arginate ethyl (LAE) to produce a bionanocomposite active film. The size and morphology of CNCs were characterized by transmission electron microscopy. In addition, the effect of CNCs (10% *w*/*w* of biopolymer) and LAE (5% *w*/*w* of biopolymer) on microstructural, optical, mechanical, water barrier, and antimicrobial properties of the CS/HPMC films were analyzed. CNCs displayed a needle-like morphology with an average length of 500 nm and an average width of 40 nm. Scanning electron microscopy illustrated the structural integrity and compatibility between CS/HPMC/CNCs and the incorporated LAE. The successful incorporation of CNCs and LAE was confirmed by Fourier transform infrared spectroscopy, mainly due to the formation of hydrogen linkages between the film matrix and incorporated CNCs and LAE. This nanocomposite active film showed improvement in UV-Vis light barrier properties ($p < 0.05$). The addition of CNCs to CS/HPMC caused a reduction in water vapor permeability, while tensile strength was improved due to the homogeneous distribution of the nanoparticles within the polymer matrix. On the contrary, LAE's incorporation into CS/HPMC improved the elasticity and also caused antimicrobial activity against *Salmonella enterica* serovar Typhimurium and *Listeria monocytogenes*. Overall, nanocomposite films based on CS/HPMC/CNCs enriched with LAE could represent a suitable green approach for a partial replacement of synthetic plastics for packaging foods sensitive to microbiological decay and the spread of foodborne pathogens.

Keywords: antimicrobial activity; cellulose nano crystal; chitosan/hydroxypropyl methylcellulose blend film; food packaging; mechanical properties; scanning electron microscopy; Fourier transform infrared spectroscopy

Citation: Bigi, F.; Maurizzi, E.; Siesler, H.W.; Pulvirenti, A.; Haghighi, H. Characterization of Active Chitosan/Hydroxypropyl Methylcellulose/Orange Cellulose Nanocrystals Films Enriched with Ethyl Lauroyl Arginate for Food Packaging Applications. *Biol. Life Sci. Forum* **2021**, *6*, 121. https://doi.org/10.3390/Foods2021-10933

Academic Editor: Efstathios Giaouris

Published: 14 October 2021

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/Foods2021-10933/s1.

Author Contributions: Conceptualization: F.B. and E.M.; Methodology: F.B.; Validation; Formal analysis: E.M.; Resources: A.P.; Data curation: H.H. and H.W.S.; Writing—original draft preparation: F.B.; Writing—review and editing: E.M.; Visualization: H.H.; Supervision: A.P. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available within the article and Supplementary Material.

Conflicts of Interest: The authors declare no conflict of interest.