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Biodegradable Nanocomposite Multifunctional Packaging Film for Fruits

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hydrophobicity without affecting the overall functionalities of the films.

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ORGANOCATALYTIC ACETYLATION OF PEA STARCH

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Starch is one of the most abundant macromolecules on earth. However, the suitability of this biopolymer as packaging material is hampered by its hydrophilic nature and tendency to retrogradate. Thus, starch biofilms are characterized by poor moisture resistivity and mechanical properties. The replacement of the hydroxyl groups of the anhydroglucose units by an esterification reaction has been approached to improve starch performance as packaging material. This chemical modification is normally performed using acids (or acid anhydrides) as donors of the non-polar acyl groups and sodium hydroxide or metal-based compounds as catalysts. The use of green organocatalysts for carbohydrate derivatization reactions is gaining prominence. However, the efficiency of the reaction in starch sources other than maize starch remains unexplored, neither has their compatibilization with normal starch during film-making been studied. The aim of this work is to provide mechanistic understanding of the parameters controlling the acetylation of pea starch by an organocatalyzed esterification process. The chemical and structural characteristics of the resulting modified starch, including the degree of substitution, together with their morphology, thermal and pasting properties were studied. Native and modified starchy biofilms were developed and their mechanical properties compared. Results showed that certain naturally-occurring compounds are efficient organocatalysts in the production of acetylated pea starch. Nevertheless, Nuclear Magnetic Resonance (1H NMR) evidenced that the organocatalyst can be esterified to the glucose and actively compete with the acetic anhydride donor. The molecular structure of the granules was maintained in low acetylated starch (DS<1), whereas granules were totally disrupted at longer reaction times (>3 hours). Acetylated pea starch was characterized by a lower phase transition temperature with a lower enthalpy as well as a dramatic reduction in the pasting properties in comparison to native starch. Organocatalytic acetylation of pea starch improved the moisture resistivity and mechanical properties of starch films.

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BIODEGRADABLE NANOCOMPOSITE MULTIFUNCTIONAL PACKAGING FILM FOR FRUITS

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Biopolymers have been used in food packaging in recent years due to high pollution rates and decreased biodegradation of synthetic polymers. Chitosan (CH) and Sodium alginate (SA) are both biodegradable biopolymers with excellent film forming capability. TiO2 nanoparticles have high mechanical strength, degradation ability and antimicrobial properties, which are beneficial in food packaging. The aim of the current work is to develop the biodegradable multifunctional nanocomposite film for fruit (i.e., Pear) packaging applications. Bionanocomposite film was prepared by solvent casting method using CH-SA and various concentrations of TiO2. The multifunctional properties such as UV barrier, thermal, water retention, mechanical, chemical, and antimicrobial were determined. The results showed that the TiO2 incorporated nanocomposite film has a higher tensile strength than the control films without TiO2. The highest UV barrier properties were observed in the developed nanocomposite films with increased TiO2 concentration. There was a reduction in film transparency and observed the opaque colour of the film, as the concentration of TiO2 increases. These nanocomposite films with TiO2 also showed higher thermal stability and water hydrophobicity properties. In addition, the antimicrobial studies demonstrated the enhanced antimicrobial properties of the nanocomposite films with TiO2 against bacteria Salmonella and Listeria monocytogenes with respect to the control film. The results concluded that the nanocomposite films incorporated with TiO2 has a potential to enhance the antibacterial and UV barrier, mechanical properties of the packaging film. Finally, the developed packaging materials can be employed as an active packaging to extend the shelf life and improve the quality of packaged fruits, as well as it can reduce the harmful impact on the environment.

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DEVELOPMENT OF ESSENTIAL OIL INCORPORATED POLYMER PLA/PBAT ACTIVE FILM FOR FOOD PACKAGING APPLICATIONS

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