DEVELOPMENT AND CHARACTERIZATION OF ACTIVE BIODEGRADABLE BIOPLASTIC FILMS USING FISH SCALE GELATIN

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Abstract

The environmental impacts associated with conventional petroleum-based plastics have increased the demand for biodegradable and sustainable alternatives derived from renewable and cost-effective resources. This study aimed to develop and characterize biodegradable films using gelatin extracted from common carp (*Cyprinus carpio*) scales and starch as the primary film-forming materials, promoting the valorization of fish-processing waste for sustainable packaging applications. Gelatin was extracted through alkaline treatment, acid demineralization and subsequent extraction in distilled water with 6-12% extraction yield. Biodegradable films were prepared using four gelatin concentrations: F1 (4%), F2 (6%), F3 (8%), and F4 (10%), while maintaining constant starch concentration. Glycerol is used as plasticizer, citric acid as a cross-linking agent, and clove oil as a natural antimicrobial agent. The films were characterized by their visual appearance, physical properties (thickness, moisture content, and water solubility), mechanical properties (tensile strength and elongation at break), biodegradability and thermal stability. The prepared films were transparent, flexible and slightly yellowish appearance. FTIR analysis indicated the presence of characteristic functional groups and suggested possible interactions through shifts in absorption bands. As gelatin concentration increased, film thickness decreased from 0.178 ± 0.021 mm to 0.138 ± 0.013 mm, while water solubility increased from 48.01 ± 1.22% to 70.48 ± 0.40%. Moisture content also increased slightly and elongation at break vary from 53.85 ± 13.80 to 81.91 ±13.03. The highest tensile strength (1.295 ± 0.106 MPa) was observed in 10% gelatin film. Biodegradability decreased from 76.34 ± 2.51% to 61.82 ± 0.99%, while thermal stability improved with increasing gelatin concentration. Among the tested formulations, the film containing 10% gelatin (F4) exhibited the best overall performance. Overall, fish scale-derived gelatin is a promising eco-friendly alternative to petroleum-based plastics, providing a viable basis for the development of biodegradable films with optimized functional properties, while promoting waste valorization and circular economy.

Key words: Bioplastic film, eco-friendly packaging, fish scale gelatin, starch, waste valorization.