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Preparation and Properties of Gelatin-Bamboo Fibres Foams for Packaging Applications

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Abstract : Due to their excellent properties, polymer packaging foams have become increasingly essential in our current lifestyles. They are cost-effective and lightweight, with excellent mechanical and thermal insulation properties. However, they constitute a major environmental and health concern due to litter generation, ocean pollution, and microplastic contamination of the food chain. In recent years, considerable efforts have been made to develop more sustainable alternatives to conventional polymer packaging foams. As a result, biobased and compostable foams are increasingly becoming commercially available, such as starch-based loose-fill or PLA trays. However, there is still a need for bulk manufacturing of bio-foams planks for packaging applications as a viable alternative to their fossil fuel counterparts (i.e., polystyrene, polyethylene, and polyurethane). Gelatin is a promising biopolymer for packaging applications due to its biodegradability, availability, and biocompatibility, but its mechanical properties are poor compared to conventional plastics. However, as widely reported for other biopolymers, such as starch, the mechanical properties of gelatin-based bioplastics can be enhanced by formulation optimization, such as the incorporation of fibres from different crops, such as bamboo. This research aimed to produce gelatin-bamboo fibre foams by mechanical foaming and to study the effect of fibre content on the foams' properties and structure. As a result, foams with virtually no shrinkage, low density (<40 kg/m^3), low thermal conductivity (<0.044 W/m•K), and mechanical properties comparable to conventional plastics were produced. Further work should focus on developing formulations suitable for the packaging of water-sensitive products and processing optimization, especially the reduction of the drying time.

Keywords : biobased and compostable foam, sustainable packaging, natural polymer hydrogel, cold chain packaging
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