Shrimp-Wrap: Fabrication and Characterization of a Strong, Biodegradable Chitosan Bioplastic Composite

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With more than 360 million tons of plastic produced each year, plastic pollution has become a critical issue as plastics accumulate in our environment and inside us; microplastics are even known to cross the blood-brain barrier. Bioplastics have emerged as a potential solution to replace single-use plastics. Most bioplastics can be made from renewable sources and degrade into harmless byproducts. A biopolymer that has gained attention in recent years is chitosan, a material derived from chitin, an abundant waste product of the seafood industry. Chitosan shows great promise as a packaging material due to its film-forming and antimicrobial properties but has not gained widespread use due to its weaker mechanical properties, high water permeation, and less scalable manufacturing methods compared to traditional plastics. In this study, a composite material of coffee filter paper and chitosan (~1:2 ratio by weight) was developed using glycerol as an eco-friendly plasticizer. Coffee filter paper was chosen as an ideal base material because its porosity allows the final material to remain translucent and lightweight, and it has relatively good strength and low cost. A custom-built tensile testing device was built to characterize the films. The addition of the filter paper base significantly increased the material's tensile strength and Young's modulus. Decreased water transmission through the films was demonstrated, and degradation tests and packaging demonstrations showed good results. The inclusion of this base will help make industrial-scale chitosan film production more viable. Overall, this composite material shows great potential as an environmentally friendly and biodegradable packaging option to replace single-use plastics and address our plastic pollution problems.

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