Synthesis and Characterization of Polymeric Biomaterials for Sustainable Agriculture

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Abstract:

Polymeric materials have long played a crucial role in the agricultural industry, taking on various forms such as films, fibres, gels, and coatings, and becoming indispensable in modern farming practices. Among these, functional polymers like chitosan and its derivatives have been extensively studied for their potential applications in agriculture. This study presents the synthesis of an amphiphilic chitosan-based semi-interpenetrating polymer network (SIPN) hydrogel designed for the controlled release of pesticides. The hydrogel is synthesized from the natural biopolymer chitosan and the monomer acrylic acid, using thiourea as a crosslinker in an autoclave. The polymerization conditions are optimized to achieve the maximum grafting percentage. The swelling behaviour of the hydrogel is analysed, and its properties are characterized using Fourier transform infrared spectroscopy (FT-IR), thermal analysis (TA), nuclear magnetic resonance (1H NMR), zeta potential, and scanning electron microscopy (SEM). The hydrogel's potential for the controlled release of an organophosphate pesticide is also evaluated. Experimental results demonstrate that the synthesized hydrogel can serve as an effective carrier for modulated pesticide release