

ABSTRACT

*Microbial contamination is one of the major causes of food quality deterioration and reduced shelf life. The development of antibacterial coating films based on biodegradable biopolymers has emerged as a promising strategy to enhance food safety while reducing the environmental impact associated with conventional synthetic packaging materials. Chitosan and gelatin are attractive candidates for coating film matrices due to their biodegradability, biocompatibility, and film-forming ability. However, their relatively poor mechanical properties and limited antibacterial performance necessitate further modification using functional materials such as graphitic carbon nitride (g-C₃N₄) and eugenol–ethylene glycol dimethacrylate copolymer (Co-EEGDMA). This study aimed to synthesize Co-EEGDMA, prepare antibacterial coating films based on chitosan/gelatin/g-C₃N₄ modified with Co-EEGDMA, and evaluate the effect of Co-EEGDMA concentration on the physical properties, antibacterial activity, and biodegradability of the resulting films. Co-EEGDMA was synthesized via cationic polymerization using BF₃O(C₂H₅)₂ as a catalyst, while g-C₃N₄ was prepared through melamine calcination at 550 °C for 4 h. The coating films were formulated with Co-EEGDMA concentrations of 1.25%, 2.50%, and 3.75%. The results demonstrated that Co-EEGDMA was successfully synthesized with a yield of 79% and an average molecular weight of 12,656.5 Da, while g-C₃N₄ was obtained as a yellow powder with a yield of 38.356%. The incorporation of Co-EEGDMA improved the mechanical properties of the coating films, with the optimum performance achieved at 3.75% Co-EEGDMA, resulting in a tensile strength of 64.50 MPa and an elongation at break of 31%. Contact angle measurements increased to 74°, indicating reduced surface hydrophilicity. SEM analysis revealed a more homogeneous morphology and more uniform pore distribution, while XRD analysis indicated a decrease in crystallinity due to enhanced intermolecular interactions within the film matrix. The highest antibacterial activity was observed for the coating film containing 3.75% Co-EEGDMA, which exhibited inhibition zones of 18 mm against both *Escherichia coli* and *Staphylococcus aureus*. Biodegradability testing showed that all coating films underwent degradation in soil, with weight loss values ranging from 60% to 96% after 14 days.*

Keywords: *Antibacterial coating film, Co-EEGDMA, graphitic carbon nitride, chitosan, gelatin, active food packaging*