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Preparation of Poly(ethylene glycol-co-acrylic acid) Grafted with Aliphatic Quaternary Ammonium Salts as Antibacterial Polymers

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Abstract

To improve the antibacterial performance of poly(ethylene glycol-co-acrylic acid) (PEAA) copolymer, aliphatic quaternary ammonium salts (QASS) was grafted into PEAA copolymers via a Steglich esterification reaction using *N,N*-dicyclohexylcarbodiimide (DCC) as a dehydrating agent. The polymers were synthesized using dodecyl dimethyl hydroxyethyl ammonium chloride (DDHAC), which was prepared by quaternization of dimethylethanolamine (DMEA) with 1-chlorododecane. These polymers effectively inhibited the growth of microorganisms due to their hydrophobic chains, which were bound to PEAA copolymers. The obtained PEAA-g-DDHAC (PGD) was investigated by attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR), proton nuclear magnetic resonance (^1H NMR), thermogravimetric analysis (TGA), differential scanning

calorimetry (DSC), and antibacterial tests. The results showed that the antibacterial effects of PGDs were significantly improved by alkyl grafting, and this improvement depended on reaction temperature. The highest antibacterial activity was observed for polymers synthesized at 135 °C against Gram-positive *Staphylococcus aureus* and Gram-negative *Escherichia coli*. Their decomposition rate was accelerated as the temperature increased above 165 °C because of the thermal decomposition of DDHAC.

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```