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Enhancement in Bactericidal Activity of Hydantoin Based Microsphere from Smooth to Rough

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Abstract : There have been several attempts to prepare polymers with antimicrobial properties by doping with various N-halamines. Hydantoins (Cyclic N-halamine) is of importance due to their stability rechargeable chloroamide function, broad-spectrum anti-microbial action and ability to prevent resistance to the organisms. Polymerizable hydantoins are synthesized by tethering vinyl moieties to 5,5,-dialkyl hydantoin sacrificing the imide hydrogen in the molecule thereby restricting the halogen capture only to the amide nitrogen that results in compromised antibacterial activity. In order to increase the activity of the antimicrobial polymer, we have developed a scheme to maximize the attachment of chlorine to the amide and the imide moieties of hydantoin. Vinyl hydantoin monomer, (Z)-5-(4-((3-methylbuta-1,3-dien-2-yl)oxy)benzylidene)imidazolidine-2,4-dione (MBBID) was synthesized and copolymerized with a commercially available monomer, methyl methacrylate, by free radical polymerization. The antimicrobial activity of hydantoin is strongly dependent on their surface area and hence their microbial activity increases when incorporated in microspheres or nanoparticles as compared to their bulk counterpart. In this regard, smooth and rough surface microsphere of the vinyl monomer (MBBID) with commercial monomer was synthesized. The oxidative chlorine content of the copolymer ranged from 1.5 to 2.45 %. Further, to demonstrate the water purification potential, the thin column was packed with smooth or rough microspheres and challenged with simulated contaminated water that exhibited 6 log kill (total kill) of the bacteria in 20 minutes of exposure with smooth (25 mg/ml) and rough microsphere (15.0 mg/ml).

Keywords : cyclic N-halamine, vinyl hydantoin monomer, rough surface microsphere, simulated contaminated water
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