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Title of Thesis: Antimicrobial Polymers for Water Disinfection and Sterilization

ABSTRACT

The present research work is devoted towards the development of multi branched dendrimer and dendritic polymer networks with large number of quaternary ammonium groups for various biomedical applications like water disinfection/sterilization and for the development of specialty medical products like contact killing antimicrobial acrylic bone cement.

Different generations of poly(ethyleneglycol) diacrylate (PEGDA), tripropyleneglycol diacrylate (TPGDA) and polyamidoamine (PAMAM) dendrimers were synthesized by using Michael addition reaction chemistry. Dendritic copolymer networks of PEGDA and TPGDA dendrimers were synthesized by using EGDMA and PEGDA respectively as comonomers and APS/TEMED redox free radical initiator system. Ethyleneglycol dimethacrylate (EGDMA) terminated PAMAM dendrimer was polymerized by using AIBN as free radical initiator to produce PAMAM dendritic polymer network. All the synthesized dendrimer and dendritic polymer networks were quaternized with hydrochloric acid and characterized by using various analytical techniques.

It was observed that all tested quaternary ammonium dendrimers and dendritic polymer networks have broad spectrum antimicrobial properties. It was always observed that with increase in number of quaternary ammonium groups (with increase in generation number), antimicrobial

activity also increased linearly. Concentration of quaternary ammonium compound as well as their time of contact with the bacterial solution also had a considerable role in their antimicrobial action. 0.01g/mL quaternary ammonium dendrimer /dendritic polymer network showed almost double bactericidal activity than that of 0.005g/mL concentration. 0.005g/mL quaternary ammonium dendrimer/dendritic polymer was sufficient to kill a bacterial population of 10^8 CFU/mL. All synthesized quaternary ammonium dendrimers and dendritic polymer networks were tested *in-vitro* and *in-vivo* to evaluate their toxicity and was found be non toxic.

The present work was also devoted towards the development of quaternary ammonium dendrimer (QAD) containing acrylic bone cement and its evaluation for physical and contact killing antimicrobial properties. TPGDA G1.0 (=) was quaternized by using octyl iodide and were introduced into conventional PMMA bone cement formulation in varying percentage. Modified quaternary ammonium containing bone cement was tested against *E.coli* and *S.aureus* to evaluate their antimicrobial activity. They showed very good broad spectrum antimicrobial activity by completely killing bacteria coming in contact with them without releasing any bioactive agent. In-vitro cytotoxicity analysis of the newly formulated bone cement was also carried out using MTT assay. Antimicrobial acrylic bone cement containing quaternary ammonium dendrimer showed almost negligible cytotoxicity.