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One-Step Synthesis and Characterization of Biodegradable 'Click-Able' Polyester Polymer for Biomedical Applications

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Abstract : In recent times, polymers have seen a great surge in interest in the field of medicine, particularly chemotherapeutics. One recent innovation is the conversion of polymeric materials into "polymeric nanoparticles". These nanoparticles can be designed and modified to encapsulate and transport drugs selectively to cancer cells, minimizing collateral damage to surrounding healthy tissues, and improve patient quality of life. In this study, we have synthesized pseudo-branched polyester polymers from bio-based small molecules, including sorbitol, glutaric acid and a propargylic acid derivative to further modify the polymer to make it "click-able" with an azide-modified target ligand. Melt polymerization technique was used for this polymerization reaction, using lipase enzyme catalyst NOVO 435. This reaction was conducted between 90- 95 °C for 72 hours. The polymer samples were collected in 24-hour increments for characterization and to monitor reaction progress. The resulting polymer was purified with the help of methanol dissolving and filtering with filter paper then characterized via NMR, GPC, FTIR, DSC, TGA and MALDI-TOF. Following characterization, these polymers were converted to a polymeric nanoparticle drug delivery system using solvent diffusion method, wherein DiI optical dye and chemotherapeutic drug Taxol can be encapsulated simultaneously. The efficacy of the nanoparticle's apoptotic effects were analyzed in-vitro by incubation with prostate cancer (LNCaP) and healthy (CHO) cells. MTT assays and fluorescence microscopy were used to assess the cellular uptake and viability of the cells after 24 hours at 37 °C and 5% CO2 atmosphere. Results of the assays and fluorescence imaging confirmed that the nanoparticles were successful in both selectively targeting and inducing apoptosis in 80% of the LNCaP cells within 24 hours without affecting the viability of the CHO cells. These results show the potential of using biodegradable polymers as a vehicle for receptor-specific drug delivery and a potential alternative for traditional systemic chemotherapy. Detailed experimental results will be discussed in the e-poster.

Keywords : chemotherapeutic drug, click chemistry, nanoparticle, prostat cancer
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