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Development of amine/carboxylic terminal functionalities thermo-responsive pluronic coated biodegradable polymer-based micro drug carrier for regeneration of osteoarthritis in vitro

Abstract: Osteoarthritis (OA) is a common degenerative disease that primarily affects joint cartilage. It impacts over 303 million people globally, making it a significant cause of disability. Treatment options are limited due to the difficult-to-reach damage, poor blood circulation to the joints, and the limited regenerative ability of cartilage. For OA treatment, we have developed a biodegradable, thermoresponsive injectable hydrogel made from poly(ε-caprolactone) (PCL) and poly(ε-caprolactone)/polylactide (PCL/PLA) microcarriers coated with Pluronic (P-123) for the localized delivery of methotrexate (MTX), a widely used immunosuppressive drug for OA. P123 is a triblock copolymer featuring a hydrophobic PO chain weighing 4000 Da and a hydrophilic EO chain with a 30% weight ratio. It shows thermal gelation at body temperature and has a Hydrophilic-Lipophilic Balance (HLB) between 8 and 14. We will fabricate size-controlled MTX-loaded thermally responsive microcarriers using an energy-efficient emulsification method with an oil-in-water emulsion. These biodegradable microcarriers aim to provide controlled drug release, acting as lubricants and alleviating pain in OA-affected joints. Moreover, the microparticles will serve as a temporary scaffold to promote cell attachment and growth, thereby aiding in cartilage regeneration. Further modifications to the Pluronic will introduce amine or carboxylic end terminals (EDP-123 and ADP-123, respectively), potentially improving the mechanical stability and thermal responsiveness of the microcarrier-hydrogel system. Thus, we hypothesize that adjusting the amount and ratio of ADP-123/EDP-123 copolymers used to coat the PCL microcarriers will enhance the injectability, gelation properties, and mechanical stability of the system.

Keywords: Osteoarthritis, PCL microcarrier, Injectable thermal gelling method, tissue regeneration.

Biography: Dr. Adhimoorthy Prasannan serves as an Assistant Professor in the Department of Materials Science and Engineering at NTUST, Taipei. He holds a Ph.D. in Materials Science and Engineering from NTUST and an M.Sc. in Polymer Science from the University of Madras, India. Dr. Prasannan specializes in polymer science, with a strong focus on fabricating polymer-based membranes, composites, and hydrides utilizing nanomaterials for diverse applications. With a prolific academic record of approximately 70 published research articles, his work has made significant contributions to advancements in membrane fabrication, polymeric micro- and nanomaterials, environmental science, and biomedical applications.