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Electrospinning of Polycaprolactone Core-shell Nanofibers With Anti-Cancer Drug

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OBJECTIVES

- Develop a novel cancer drug delivery system using a biocompatible core shell nanostructures for targeted delivery and minimize side effects caused by conventional chemotherapy method
- Processing and manufacturing of drug loaded nanofibers and determination of structure property relationship.
- In-vitro drug release and cell viability tests of the drug loaded nanofiber in a standard biological media.

EXPERIMENTAL WORK

- Coaxial electrosprinning of biocompatible, biodegradable polymer encapsulating anticancer drug
- Testing of nanofibers in UV-Vis Spectrometer at a controlled temperature over a prolonged time period in a biological media.
- Different biocompatible polymer with different degradation rate has been used to develop drug loaded nanofibers to get variable drug release profile
- Nanofibers release drug by biodegradation of shell polymer of coaxial structure and diffusion from the pores of shell
- Confocal laser microscopy to represent drug release from the fiber mats
- Cytotoxicity tests were performed with human prostate cancer cells in the department of Biology.

FUTURE WORK

- Functionalize drug loaded nanofibers with cancer cell targeting agents such as antibody
- Conjugate nanofibers with pH sensitive polymer to obtain capability of delivering drug only at cancer cell environment
- Develop nanospheres encapsulating drug to obtain better permeability into human tissues and blood vessel
- In-vitro testing of cancer drug delivery device to get the cytotoxicity and killing curve
- Testing of drug loaded nanofibers in a zebra fish containing human prostatic cancer cell to show its efficacy

MATERIALS AND METHOD

- Polycaprolactone (PCL) solution was prepared by dissolving 14% PCL (avg. mw 80,000) into dimethylformamide (DMF) at 110°C
- 5% Fluorouracil (FU) was dissolved into DMF at 60°C
- 1% Rhodamine B and 5% Fluorouracil was dissolved into DMF at 60°C
- Nanofibers of PCL encapsulating FU was electrosprun at 1 ml/hr and 0.2ml/hr flow rate respectively under 21KV
- Nanofibers of PCL encapsulating fluorescent marker Rhodamine B and Fluorouracil was electrosprun at 0.9ml/hr and 0.2ml/hr flow rate respectively under 21.2KV
- Nanofiber were collected on a wax-paper on a flat plate collector. Nanofibers were washed using deionized water and dried in vacuum chamber for 8hours
- 20x20mm drug loaded nanofibers were put into PBS and their absorbance were recorded at 265nm using UV-Vis spectrometer to get drug release profile
- Human prostatic cancer cells were used to determine cytotoxicity of nanofibers

RESULTS

- SEM Images of FU loaded PCL Nanofibers
- EDS Plot Showing Presence of FU in Nanofibers
- Confocal Laser Microscopy of Fibers
- SEM Images of PCL Nanofibers After Releasing FU
- Cell Viability Test of Human Prostate Cancer Cells in FU Loaded PCL
- Drug Release Profile of FU Loaded PCL
- Microscopic Images of Prostate Cancer Cell After Treating With FU Loaded PCL

- SEM Images of FU loaded PCL nanofibers show beaded structures which suggests drug crystals was encapsulated within it. EDS plot shows negligible amount of drug is attached to the surface
- Drug release profile in a biological media of FU loaded PCL nanofibers exhibit a controlled release over a prolonged time period
- Cell viability test of human prostatic cell confirms the efficacy of FU Loaded PCL nanofibers
- Florescence of Nanofibers in confocal microscopy demonstrate that both FU and Rhodamine B is encapsulated within PCL nanofibers

Electrospinning of coaxial spinneret