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Physical pegylation enhances the cytotoxicity of 5-fluorouracil-loaded PLGA and PCL nanoparticles (Article) (Open Access)

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Abstract

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The main goal of this study is to evaluate the impact of physical incorporation of polyethylene glycol (PEG) into 5-fluorouracil (5-FU)-loaded polymeric nanoparticles (NPs). Methods: The 5-FU-loaded NPs were prepared utilizing a simple double emulsion method using polycaprolactone (PCL) and polylactic-co-glycolic acid (PLGA) with or without PEG 6000. The surface charge, particle size, and shape of NPs were evaluated by standard procedures. Both Fourier Transform Infrared Spectroscopy and X-ray diffraction spectra of the 5-FU loaded NPs were compared against the pure 5-FU. The in vitro release profile of 5-FU from the NPs was monitored by the dialysis tubing method. Cell death and apoptosis induction in response to 5-FU NP exposure were measured by MTT and Annexin–V/7amino-actinomycin D (7-AAD) assays, respectively, in Daoy, HepG2, and HT-29 cancer cell lines. Results: The 5-FU loaded NPs were found to be spherical in shape with size ranging between 176±6.7 and 253.9±8.6 nm. The zeta potential varied between –7.13±0.13 and –27.06±3.18 mV, and the entrapment efficiency was between 31.96% and 74.09%. The in vitro release of the drug followed a two-phase mode characterized by rapid release in the first 8 hrs followed by a period of slow release up to 72 hrs with composition-based variable extents. Cells exposed to NPs demonstrated a significant cell death which correlated with the ratio of PEG in the formulations in Daoy and HepG2 cells but not in HT-29 cells. Formulations (F1–F3) significantly induced early apoptosis in HT-29 cell lines. Conclusion: The physical PEGylation significantly enhanced the entrapment and loading efficiencies of 5-FU into NPs formulated with PLGA and PCL. It also fostered the in vitro cytotoxicity of 5-FU-loaded NPs in both Daoy and HepG2 cells. Induction of early apoptosis was confirmed for some of the formulations. © 2019 Ashour et al.

SciVal Topic Prominence

Topic: Microspheres | Pharmaceutical Preparations | PLGA microparticles

Prominence percentile: 96.997

Author keywords

Apoptosis | Colorectal carcinoma HT-29 | Emulsification-solvent evaporation technique | Hepatocellular carcinoma HepG2 | MTT assay

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Novel docetaxel chitosan-coated PLGA/PCL nanoparticles with magnified cytotoxicity and bioavailability
Badran, M.M. , Alomrani, A.H. , Harisa, G.I.
(2018) Biomedicine and Pharmacotherapy

EMTREE drug terms: 7 aminodactinomycin, fluorouracil, lipocortin 5, macrogol 6000, nanoparticle, polycaprolactone, polyglactin

EMTREE medical terms: antineoplastic activity, apoptosis, Article, biodegradability, cell death, controlled study, correlational study, cytotoxicity, Daoy cell line, dialysis, drug release, Fourier transform infrared spectroscopy, Hep-G2 cell line, HT-29 cell line, human, human cell, in vitro study, MTT assay, nanoemulsion, particle size, PEGylation, surface charge, treatment response, X ray diffraction, zeta potential

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Chemicals and CAS Registry Numbers:

7 aminodactinomycin, 7240-37-1; fluorouracil, 51-21-8; lipocortin 5, 111237-10-6; polycaprolactone, 24980-41-4, 25248-42-4; polyglactin, 26780-50-7, 34346-01-5

Device tradename:

Nicolet 380, Thermo, United States

Manufacturers:

Drug manufacturer:

Sigma Aldrich, United States

Device manufacturer:

Thermo, United States

Funding details

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Funding text #1

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Funding text #2

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