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Lipid-coated mesoporous silica nanoparticles for enhanced delivery and cellular uptake of doxorubicin

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Delivery of chemotherapeutics, in higher doses to specific sites of action without side effects, is a big challenge. Recent developments in the field of nanotechnology, including the use of inorganic materials, have opened up new dimensions. Mesoporous silica nanoparticles as drug carrier address many problems related to chemotherapeutic targeting and delivery. Larger surface area and higher drug loading capacity, mechanical strength and stability, entrapping both hydrophilic and hydrophobic drugs, tailorable pore size and pore volume, inner and outer surface for modification and drug attachment, controlled particle size and distribution, lipid coating and gene delivery, make them a suitable candidate as a drug carrier. Hexagonal micelles of surfactants (CTAB: Cetyltrimethylammonium bromide) interact with silica source (TEOS: Tetraethylorthosilicate) to form a firm silica structure. Then removal of micelles leaves behind mesoporous silica nanoparticles. Mesoporous silica nanoparticle fabrication is based on hydrolysis and condensation reaction in a basic environment and a specific surfactant/silica molar mass ratio is crucial for the preparation of particles. Surfactant removal was confirmed by elemental analysis and the porous structure was confirmed by TEM images. Pore size was in the range of 2-3nm. Our studies have shown the high entrapment of doxorubicin in particles due to the availability of porous structure. Lipid coating of drug-loaded particles not only protects the drug from premature release in circulation but also due to the compatibility of a lipid bilayer with the cellular membrane, lipid-coated mesoporous silica nanoparticles enhance the cellular uptake of doxorubicin. In our studies, the lipid-coated silica nanoparticles have shown higher cellular toxicity as compared to non-lipid coated particles. Drug release profile and increase in cytotoxicity with time, support the hypothesis of sustained release of drug from lipid coated mesoporous silica nanoparticles.

Biography

Muhammad Umair Amin is Pharmacist by profession and has done his Master in Pharmaceutics. Currently he is doing PhD under DAAD/HEC Pakistan Scholarship program, in the supervision of Prof Dr Udo Bakowsky at Department of Pharmaceutics and Biopharmaceutics, Philipps University Marburg, Marburg, Germany. The major area of interest is development of drug carrier systems and characterization. Primary research goals are directed toward the fabrication of mesoporous inorganic drug delivery system and targeting of mesoporous nanoparticles loaded with anti-cancer drugs to resistant hypoxic tumor cells. Development of combine dosage form of Enzyme inhibitors and chemotherapeutic agent based mesoporous silica nanoparticles as a dosage form for better drug uptake, decreased tumor invasiveness and increased cytotoxic effects. He has an experience in research, teaching and administration in education institutions.

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