World Academy of Science, Engineering and Technology
International Journal of Bioengineering and Life Sciences
Vol:10, No:05, 2016

# The Optimization of Topical Antineoplastic Therapy Using Controlled Release Systems Based on Amino-functionalized Mesoporous Silica

**Authors :** Lacramioara Ochiuz, Aurelia Vasile, Iulian Stoleriu, Cristina Ghiciuc, Maria Ignat

**Abstract :** Topical administration of chemotherapeutic agents (eg. carmustine, bexarotene, mechlorethamine etc.) in local treatment of cutaneous T-cell lymphoma (CTCL) is accompanied by multiple side effects, such as contact hypersensitivity, pruritus, skin atrophy or even secondary malignancies. A known method of reducing the side effects of anticancer agent is the development of modified drug release systems using drug incapsulation in biocompatible nanoporous inorganic matrices, such as mesoporous MCM-41 silica. Mesoporous MCM-41 silica is characterized by large specific surface, high pore volume, uniform porosity, and stable dispersion in aqueous medium, excellent biocompatibility, in vivo biodegradability and capacity to be functionalized with different organic groups. Therefore, MCM-41 is an attractive candidate for a wide range of biomedical applications, such as controlled drug release, bone regeneration, protein immobilization, enzymes, etc. The main advantage of this material lies in its ability to host a large amount of the active substance in uniform pore system with adjustable size in a mesoscopic range. Silanol groups allow surface controlled functionalization leading to control of drug loading and release. This study shows (I) the amino-grafting optimization of mesoporous MCM-41 silica matrix by means of co-condensation during synthesis and post-synthesis using APTES (3-aminopropyltriethoxysilane); (ii) loading the therapeutic agent (carmustine) obtaining a modified drug release systems; (iii) determining the profile of in vitro carmustine release from these systems; (iv) assessment of carmustine release kinetics by fitting on four mathematical models. Obtained powders have been described in terms of structure, texture, morphology thermogravimetric analysis. The concentration of the therapeutic agent in the dissolution medium has been determined by HPLC method. In vitro dissolution tests have been done using cell Enhancer in a 12 hours interval. Analysis of carmustine release kinetics from mesoporous systems was made by fitting to zero-order model, first-order model Higuchi model and Korsmeyer-Peppas model, respectively. Results showed that both types of highly ordered mesoporous silica (amino grafted by co-condensation process or post-synthesis) are thermally stable in aqueous medium. In what regards the degree of loading and efficiency of loading with the therapeutic agent, there has been noticed an increase of around 10% in case of co-condensation method application. This result shows that direct co-condensation leads to even distribution of amino groups on the pore walls while in case of post-synthesis grafting many amino groups are concentrated near the pore opening and/or on external surface. In vitro dissolution tests showed an extended carmustine release (more than 86% m/m) both from systems based on silica functionalized directly by co-condensation and after synthesis. Assessment of carmustine release kinetics revealed a release through diffusion from all studied systems as a result of fitting to Higuchi model. The results of this study proved that amino-functionalized mesoporous silica may be used as a matrix for optimizing the anti-cancer topical therapy by loading carmustine and developing prolonged-release systems.

**Keywords :** carmustine, silica, controlled, release
**Conference Title :** ICBE 2016 : International Conference on Biomaterials Engineering
**Conference Location :** Berlin, Germany
**Conference Dates :** May 19-20, 2016