Functionalized mesoporous silica nanoparticles templated by pyridinium ionic liquid for hydrophilic and hydrophobic drug release application

ABSTRACT

Chemotherapy is the most common treatment for all cancer patients but this treatment poses many side effects due to lack of drug's selectivity. To overcome this problem, utilizing a better and more effective delivery agent is the solution. Mesoporous silica nanoparticles (MSNs) emerged as a promising platform in development of drug delivery agent. This is due to its desirable properties such as tunable pores, large surface area, good biocompatibility and easy functionalization. Furthermore, these properties can be tuned through the utilization of alternative template such as pyridinium ionic liquid. Besides, by employing surface functionalization, the effectiveness of MSNs as drug delivery agent may also increase. This work reported the usage of 1-hexadecylpyridinium bromide ionic liquid as template for MSNs production and the surface of MSNs was then further functionalized via post – grafting method in order to obtain MSN – NH2, MSN – SH and MSN – COOH as drug carrier, respectively. These functionalized MSNs were then used to study the drug loading and drug release of hydrophilic drug, gemcitabine and hydrophobic drug, quercetin. For quercetin, MSN-NH2 had the highest drug loading percentage (72%) and slowest release (14%) in 48 h while for gemcitabine, it was found that MSN-COOH had the highest drug loading percentage (45%) and slowest release (15%) in 48 h. Based on the results, it is suggested that mesoporous silica nanoparticle with surface functionalization has suitable properties for controlled drug release which gives constant release behavior over a period of time to avoid repeated administration of drug where the drug is administered at a fixed dosage and regular time interval.

Keyword: Mesoporous silica nanoparticles; Post-grafting; Organoalkoxysilanes; Anti-cancer drug; Drug delivery