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Abstract

Targeted Delivery of Doxorubicin to Breast Cancer Cells by Multiwalled Carbon Nanotubes Functionalized with Lysine via 1,3-Dipolar Cycloaddition and Conjugation with Sugar Moieties †

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Abstract: Multiwalled carbon nanotubes (MWCNTs) have attracted considerable multidisciplinary interest and biomedical applications, such as drug delivery, because of their distinct physicochemical characteristics. The biomedical application of MWCNTs is limited by their low dispersibility in aqueous or non-aqueous mediums. Functionalizing MWCNTs is an effective way to overcome this drawback as it improves biocompatibility and also facilitate ligand attachment for targeted drug delivery. However, most functionalization approaches involve hazardous procedures and expensive chemicals. The current study employs a simple, cost-effective technique to functionalize MWCNTs with lysine by 1,3-dipolar cycloaddition for improved dispersibility and to provide a ligand anchoring ε-amino group for targeted delivery to breast cancer. MWCNTs had been functionalized with lysine and sugar moieties ligands (galactose/mannose) to formulate efficient nanocarriers that can bind to lectin receptors in MDA-MB-231 or MCF-7 cancer cells. Doxorubicin (Dox) was loaded into the ligands conjugated MWCNTs. In comparison to pristine MWCNTs, 1,3-lysinated MWCNTs conjugated with ligands demonstrated enhanced dispersion in aqueous medium and a greater drug loading capacity. In drug release studies MWCNTs were found to exhibit pH-dependent drug release, releasing 20% of the drug at pH 7.4, and 75% at pH 5.0. Dox-loaded MWCNTs also enhanced Dox accumulation inside the cancer cells, as evidenced by higher inhibition of MDA-MB-231 or MCF-7 proliferation compared to plain Dox, and unloaded Dox MWCNTs. The findings suggest that MWCNTs functionalized with lysine by 1,3-dipolar cycloaddition provide a potentially nontoxic nanoplatform with enhanced aqueous dispersibility and the potential for conjugation with ligands for the targeted delivery of Dox to breast cancer cells..

Keywords: multiwalled carbon nanotube; lysine; MDA-MB-231; sugar moieties

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