UNIVERSITI TEKNOLOGI MARA

BIO-MODIFIED MULTIWALLED CARBON NANOTUBES COATED WITH DOXORUBICIN (CNT-(PEG2000-NH2))/DOX) FOR IN VITRO NEUROBLASTOMA CELLS TOXICITY STUDY

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of the requirements for the degree of
Doctor of Philosophy

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

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ABSTRACT

Carbon nanotubes (CNTs) are nanoparticles widely used nowadays in many applications from engineering to biomedical science. For biomedical applications, CNTs are potential candidates as drug carriers in disease treatment and neuron and bone cell implants. As potential drug carriers for brain disease treatment, it is possible for the nano sized CNTs to pass through the blood brain barrier. However, treatment with CNTs reportedly causes toxicity effects because of the tendency of CNTs to agglomerate. Non-covalent functionalisation of CNTs with polyethylene glycol bis-amine (PEG2000-NH2) to increase its hydrophilic properties and biocompatibility when introduced to cells can reduce such agglomeration. The purpose of this study is to produce CNT from fermented tapioca for drug delivery using neuroblastoma cells as an in vitro model. In this study, CNTs were synthesised from a novel carbon source, the fermented tapioca which is a well-known Malay local delicacy. This carbon precursor is economical and reproducible, compared to fossil-fuel precursors that are being depleted. Doxorubicin (DOX) was used as the drug to treat the neuroblastoma cells. The CNTs were synthesised by using the immersed heater assisted thermal-chemical vapour deposition method (version model STF 40-1100, Malaysia), with a deposition time is 60 minutes. Multiwalled CNTs (MWCNT) were successfully synthesised, with diameter ranges of 30 - 120 nm at synthesis temperatures of 700 - 900 °C. CNTs synthesised at 800 °C (CNT-800) were subjected to further testing due to the formation of CNTs in the 30-50 nm diameter range which is desirable and of a uniform structure. CNT-800 were purified by using a concentrated acid mixture of H_2SO_4 and HNO_3 and functionalised. Neuroprotection test showed negative results for application of MWCNTs as treatment on oxidative damage and neurodegenerative disorder based on the response towards oxidative stress, with cell viability below 50%. It was found that the functionalised CNT-(PEG2000-NH2) at 10 µg/mL showed stable cell viability of 97 and 98% at 24 and 48 h post-treatment, respectively. In contrast, the CNT-(PEG2000-NH2)/DOX complex showed decreased cell viability of 44% at 48 h post-treatment compared to DOX alone (53%), with the decrease being statistically significant (one-way ANOVA; $p \leq 0.05$). Thus, when CNT-(PEG2000-NH2) used at 10 µg/mL, the MWCNTs conferred a high degree of cell viability (97%, 98%), and when treated with DOX it showed corresponding decreased in cell viability (44%). These findings suggested that MWCNTs were successfully synthesised from fermented tapioca and showed potential as a drug delivery agent for brain-related conditions.

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