

ABSTRACT

Cancer is a disease with a high mortality rate, while chemotherapy remains the primary treatment but has serious side effects. This study aims to synthesize GQDs and N-GQDs from rice straw waste using microwave technology and utilize them as nano-sized drug carriers. This study synthesizes eugenol derivatives, namely polyeugenol and dieugenol, which are then used as drugs combined with GQDs and N-GQDs. Evaluating and optimizing the combinatorial material of GQDs and eugenol derivatives as drug carriers in cancer therapy through antioxidant activity tests and viability tests on cancer cells is also one of the objectives of this study. The synthesis results were characterized using Fourier Transform Infrared Spectroscopy (FTIR) and Transmission Electron Microscopy. The characterization results showed that the materials had sizes below 10 nm, specifically 1.8 nm for GQDs and 2.6 nm for N-GQDs. The presence of new nitrogen-containing groups indicated the successful doping of nitrogen atoms into GQDs. The eugenol derivative, polyeugenol, was characterized using FTIR, while dieugenol was tested using Thin Layer Chromatography (TLC) and Nuclear Magnetic Resonance (NMR). The test results showed that dieugenol is a pure compound, and the synthesis of polyeugenol was successful, indicated by the disappearance of the vinyl and allyl groups. Antioxidant activity testing and cell viability screening using the MTT assay (3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide) on the combination of GQDs and eugenol derivatives aimed to evaluate their potential in drug delivery. The antioxidant activity test results showed that GQDs combined with drugs exhibited good properties, while GQDs without drug mixtures did not exhibit antioxidant activity. The cell viability screening results showed that GQDs without drug mixtures had higher cytotoxic properties compared to GQDs with drug mixtures. It was concluded that GQDs and N-GQDs combined with eugenol and its derivatives can be used as nanocarriers in MCF-7 breast cancer cells.

Keywords: *Anticancer, Graphene Quantum Dots, Eugenol and Its Derivatives, Antioxidant Activity Test, Cell Viability Screening*