THE ROLE OF CARBON DOTS' SYNTHESIS METHOD IN THE PHOTODYNAMIC THERAPY OF SQUAMOUS CELL CARCINOMA

A. Karagianni[1]*, A. Zourou[1], E. Alexandratou[2], K. V. Kordatos[1]

[1]Laboratory of Inorganic and Analytical Chemistry, School of Chemical Engineering, National Technical University of Athens, Athens 15780, Greece

[2]Laboratory of Biomedical Optics and Applied Biophysics, School of Electrical and Computer Engineering, National Technical University of Athens, Athens 15780, Greece

(*akaragianni1510@gmail.com)

ABSTRACT

Photodynamic therapy (PDT) is a therapeutic modality aiming to damage cancerous cells with the synergistic action of light, oxygen, and a drug called photosensitizer (PS). The success of the treatment is based on the production of singlet oxygen ($^1O_2$) and reactive oxygen species (ROS) as a result of PS's excitation with the appropriate wavelength. These oxygen species trigger the initiation of cellular death pathways, such as apoptosis and necrosis, leading to successful tumor destruction. Commonly used PSs possess complex structures and low water solubility, which limits their wide application in PDT as cancer theranostics. Current research interest is focused on the development of novel PSs based on nanotechnology. Carbon dots are a new kind of carbon-based nanostructures with increased fluorescence, non-toxicity, and excellent aqueous solubility. These features, along with the existence of abundant functional groups on CDs' surface facilitate their usage in bio-related applications, including PDT, either independently or in interaction with other molecules [1-4].

The aim of the present work is to synthesize carbon dots with various bottom-up techniques and evaluate their potential use as PSs in PDT. Specially, nitrogen-doped carbon dots were synthesized via hydrothermal and microwave treatment, microwave-assisted hydrothermal treatment, and via heating with a reflux condenser. CDs were characterized with FT-IR, UV-Vis, and PL spectroscopy, with an emphasis on their photophysical properties and the role of the following synthesis method. The ability of CDs to produce ROS was also examined, as well as their dark toxicity in the human epidermoid carcinoma A431 cell line, proving the superior biocompatibility of the hydrothermally synthesized CDs. Their photodynamic activity was studied against A431 cells, showing promising results for their application as photosensitizing drugs for PDT.

KEYWORDS: Carbon dots, Photodynamic Therapy, Skin cancer, Nanomedicine

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