Red-light Emissive Porphyrin-derived Carbon Dots as a Photosensitizing tool for Photodynamic Therapy

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Abstract:

Background: In recent decades, photodynamic therapy (PDT) has been one of the clinically attractive therapeutic approaches as an adjuvant anti-cancer therapy due to its good efficacy, fewer adverse effects, and minimally invasive nature. However, its wide medical application is still limited due to the deficiency of ideal photosensitizers (PSs) concerning water solubility, photostability, and singlet oxygen generation efficiency. Our study aimed to overcome the drawbacks of one of the already available porphyrin molecules.

Methods: Herein, a solvothermal method was applied to fabricate red-light-sensitive carbon dots (CDs), starting with Tetrakis (4-Carboxyphenyl) Porphyrin (TCPP) and urea. The morphology, surface chemistry, water solubility, lipophilicity, optical properties, photostability, and singlet oxygen quantum yield were evaluated.

Results: Compared to the starting porphyrin molecule, the water solubility and lipophilicity of the resultant CDs were significantly improved despite the basic porphyrin chemical structure being preserved, as indicated by optical characterization. In addition, the resultant CDs showed reasonable photostability upon light irradiation. Moreover, the singlet oxygen generation efficiency of the fabricated CDs was approximately 36 times higher than that of the starting porphyrin molecule.

Conclusion: The developed porphyrin-derived CDs could be a promising red-light responsive photosensitizing tool for PDT.

Keywords:

Carbon dots, Photodynamic therapy, Porphyrin-analogues photosensitizers, Red-light emission.