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Developing Functional Carbon-Dots Based Nanomaterials for Bacterial Inhibition

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Carbon dots (CDs) are emerging nanomaterials, attracting increasing attention due to their exceptional properties, such as good biocompatibility, environmental friendliness, versatile functionalization capabilities, and cost-effectiveness. These attributes position CDs and CD-based nanomaterials as promising candidates for various biomedical applications. This study focuses on the development of functional CD-based nanomaterials conjugated with a photosensitizer Chlorin E6 to enhance bacterial inhibition. By employing a novel microwave-assisted approach, we successfully fabricated N-doped CDs from diverse carbon sources various carbon sources (e.g. citric acid, ascorbic acid, tetraethylenepentamine (TEPA), spermidine and urea). Characterized through various analytical techniques including UV, fluorescence, FT-IR, TEM, DLS, and XRD, the resulting CDs demonstrated broad-spectrum antibacterial activities against E. coli, S. aureus, and MRSA. Remarkably, upon conjugation with Chlorin E6, these functional nanomaterials exhibited significantly enhanced antimicrobial efficacy under light exposure. At a concentration of merely 10 μg/mL, the conjugated CDs completely eradicated S. aureus and showed a substantial increase in inhibitory action against E. coli. Cytotoxicity assays on HaCaT cells indicated low toxicity, with cell viability above 80% for concentrations below 200 mg/mL. Our findings have revealed the great potential of these microwave-synthesized and photosensitizer-conjugated CDs in biomedicine, highlighting their applicability in photodynamic therapy and bioimaging. The profound antibacterial activity under light exposure opens new avenues for developing more efficient and cost-effective antimicrobial nanomaterials.

Biography:

Miss Siqi Wang obtained her bachelor's and master's degrees in pharmacy from Jiangsu University in China, where she was the recipient of several scholarships and awards. She has extensive research experience in molecular modelling, small anti-tumor molecule development, and cytotoxicity study. She also gained practical experience as an assistant pharmacist and teaching assistant. Presently, she is a third-year PhD student at Queen's University Belfast in the UK, specializing in nanomedicine and pharmaceutical nanotechnology. Her current research focuses on the development of carbon-based functional nanomaterials for diverse biomedical applications.