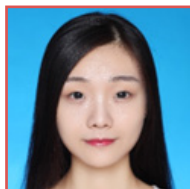


Development of Antibacterial Carbon Dots by Using a One-Pot Microwave-Assisted Approach



Siqi Wang, Colin P. McCoy, Gavin P. Andrews, Matthew Wylie, Yi Ge

School of Pharmacy, Queen's University Belfast, 97 Lisburn Road, Belfast, BT9 7BL, UK

Carbon dots (CDs), as emerging nanomaterials, have garnered significant attention for their exceptional properties including high biocompatibility, environmental friendliness, and versatile functionalization capabilities. These characteristics make CDs and carbon-dot-based nanomaterials promising candidates for various biomedical applications. In this study, we developed a novel microwave-assisted method to produce broad-spectrum antibacterial CDs, offering a cost-effective and green alternative to traditional synthesis. Using citric acid, ascorbic acid, tetraethylenepentamine, spermidine, and urea as carbon sources, N-doped CDs were synthesized at 200°C with 800W power, followed by purification via centrifugation and size exclusion chromatography. The resulting CDs were characterized by UV, FL, FT-IR, TEM, DLS and XRD. The agar well diffusion method and broth dilution method were employed to test and determine their activities of bacterial growth inhibition via MIC and MBC assays against *Escherichia coli* (*E. coli*), *Staphylococcus aureus* (*S. aureus*) and methicillin-resistant *Staphylococcus aureus* (MRSA). The time-kill kinetics assays of CDs against those three strains were conducted to investigate their antibacterial effect upon time. The CDs demonstrated significant inhibition, with MIC values of 0.625mg/mL for *S. aureus* and MRSA, and 1.250mg/mL for *E. coli*. Cytotoxicity tests on HaCaT cells showed over 80% viability at concentrations below 200 mg/mL, indicating low toxicity. Our findings highlight the potential of microwave-synthesized CDs in biomedicine and pharmaceutical science, with future research to explore their antibacterial mechanisms and applications in bioimaging and photodynamic therapy.

Biography:

Siqi Wang is a third-year Ph.D. student at Queen's University Belfast, specializing in nanotechnology applications within the pharmaceutical sciences. Her research is focused on developing carbon-dot-based nanomaterials for enhanced bacterial inhibition, specifically through the innovative use of microwave-assisted synthesis. Siqi's work has demonstrated some effective advancements in the field, notably through the conjugation of carbon dots with Chlorin E6, achieving remarkable antibacterial efficacy under light exposure. Her dedication to exploring environmentally friendly and cost-effective antimicrobial solutions positions her at the forefront of her field. Siqi's contributions are paving the way for novel treatments in biomedicine and pharmaceutical science.