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21569 | Development of Carbon Dots as Fluorescence Probes for Bioimaging

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Background & Aim: Bioimaging allows real-time and non-invasive visualization of biological events using probes and detectors, thus supporting medical diagnoses and treatments, and driving scientific discoveries in various disciplines. The high fluorescence emission and photostability makes carbon dots (CDs) ideal candidates for bioimaging applications. These can be used as fluorescence probes to mark and track specific cells, tissues, and biomolecules, but also to screen the crossing of cells and/or tissues. The main objective of this work is to develop CDs to be used as fluorescence probes to screen the blood-brain barrier (BBB) permeability. **Methods:** The CDs were prepared by adapting a microwave-assisted method employing citric acid, urea and sodium fluoride as the precursors [1] and characterized by UV-Vis, Raman, and Fourier transform infrared (FTIR) spectroscopies, quantum yield (QY) and confocal microscopy. For the bioimaging tests, the CDs were added to a biomembrane (3D hydrogel) seeded with endothelial cells from the human umbilical vein (HUVEC-GFP). **Results:** A successful synthesis of CDs was confirmed by UV-Vis and Raman spectroscopies. The ability of the CDs to emit different colours when subjected to laser irradiation at different wavelengths was also shown (Figure 1), which is an important feature for bioimaging applications. The CDs presented QY up to 25.4%, the best performing sample being screened as a possible bioimaging tool to evaluate the permeability of the constructed 3D BBB model. The cell network in the hydrogel (BBB) is illustrated in Figure 2a. Next a drop of a CDs suspension was added, and after 1 and 10 min, images Figure 2b and 2c were collected, respectively. As observed, the cells become more fluorescent along the time, suggesting that the CDs were able to permeate the hydrogel. **Conclusions:** The prepared CDs have the potential to be used as a bioimaging tool to screen the BBB permeability. Nevertheless, more research is needed to validate our observations.

Keywords: Microwave Method, Multicolour Emission, Nanomaterials, Photoluminescence.

Acknowledgments

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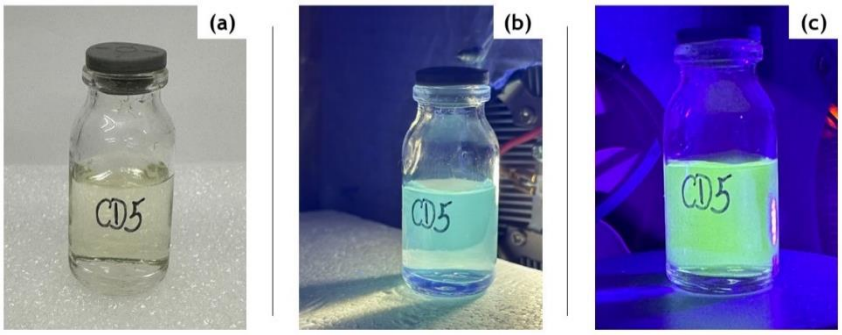

Figure 1: Images of the aqueous suspension prepared with a sample of CDs (referred to as CD_5) when subjected to (a) natural light, and (b) 365 nm and (c) 401 nm LED radiation.

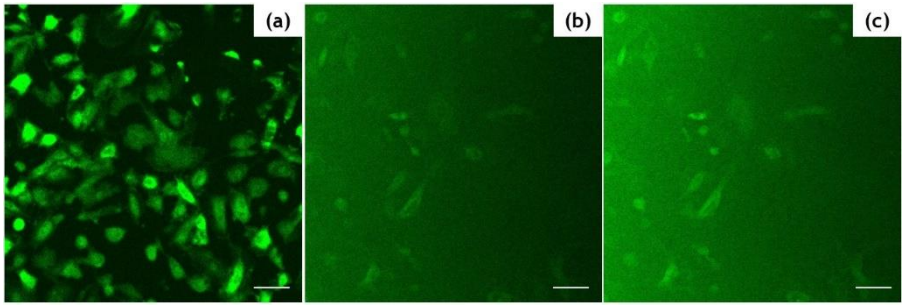

Figure 2: Images obtained by confocal microscopy analyses, where (a) depicts HUVEC-GFP cells in biohydrogel after 7 days of culture, and (b) and (c) were obtained 1 and 10 min after the addition of a CDs suspension to the cells/biohydrogel, respectively. The laser with a wavelength of 488 nm was used for image collection, with a 10x objective. Images post-processed using Image J.