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Hydrothermal Synthesis of Antimicrobial Carbon Dots from the Soot of Three Different Essential Oils**Fernandez, A.B.^{1,2*}, Buddhinie, P.K. C.¹, Vithanage, M.²**¹*Department of Botany, University of Sri Jayewardenepura, Nugegoda, Sri Lanka*²*Ecosphere Resilience Research Centre, University of Sri Jayewardenepura, Nugegoda, Sri Lanka***breverlyfernandez@gmail.com***Abstract**

Carbon dots (CDs) have garnered the interest and demand of researchers over the years, and they are also favoured as a novel and better alternative to conventional antibiotics and other antimicrobial agents. While the antimicrobial properties of CDs differ with the precursors used, a synergistic effect is expected to arise from the use of antimicrobial compounds as precursors in the synthesis of CDs. Therefore, in this study, a novel green method was introduced for the hydrothermal synthesis of carbon dots using the soot of three essential oils (EOs) as the carbon source; clove (*Syzygium aromaticum*), cinnamon (*Cinnamomum zeylanicum*) and citrus (*Citrus aurantifolia*); in the absence of surface passivating agents. Here, the three essential oils were burned and the carbon soot from each oil was collected separately. Then the carbon soot was subjected to hydrothermal treatment by heating at 160° C for 3 hours without any doping or modification. The obtained carbon dots were characterized by Scanning Electron Microscopy (SEM), UV-Vis spectroscopy, FT-IR spectroscopy and Fluorescence analysis. The SEM images of the three types of essential oil-derived CDs were crucial for determining the size, shape, and surface morphology of the prepared CDs. While clove CDs and cinnamon CDs were mostly spherical in shape, citrus CDs exhibited irregular shapes, which could be attributed to the agglomeration of the particles as evident from the SEM images. The results showed that the average particle diameter of the CDs was found to be 56.50±7.75 nm, 56.11±8.11 nm, and 61.67±10.21 nm, for clove CDs, cinnamon CDs and citrus CDs, respectively. UV-Vis spectroscopy analysis further confirmed the formation of CDs as absorption peaks at wavelengths of 205 nm, 215 nm and 244 nm were obtained for citrus, cinnamon and clove CDs respectively. These peaks could be attributed to the $\pi \rightarrow \pi^*$ transition of C=C bonds of sp² carbons. FT-IR spectroscopy was carried out to determine the functional groups in the prepared CDs, as functional groups are responsible for the antimicrobial properties of CDs. In addition to these, the fluorescence analysis confirmed the synthesis of CDs, as CDs are known to be fluorescent. The antibacterial properties of the synthesized CDs were then investigated against *Pectobacterium* sp. isolated and characterized from the soft rot of carrot.

Keywords: Carbon dots, Essential oils, Hydrothermal synthesis, Antimicrobial, Aggregation