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*Abstract*

# Carbon Quantum Dot-Based UV-Protective Coatings †

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Ultraviolet (UV) light is a type of electromagnetic radiation that is usually divided into three fractions: UVC (100–280 nm/4.43–12.4 eV), UVB (280–315 nm/ 3.94–4.43 eV), and UVA (315–400 nm/ 3.10–3.94 eV). The wavelength of the UV radiation is slightly shorter than that of visible light (400–780 nm), but the photons that are associated with UV radiation carry much more energy (3.1–12.4 eV). UV light can negatively affect drug products/medicines, jeopardizing their quality. For instance, UV and visible light can accelerate the oxidation of fats and oils [1]. It also affects vitamins (A, $B_2$, $B_{12}$, D, E and K). Since the main source of UV radiation is the sun, a ubiquitous source, it is very important to find appropriate solutions to protect goods. Typically, light-sensitive products are packaged into opaque or dark-coloured packaging to avoid photodegradation. However, nowadays, consumers like to be able to see and inspect a certain food or beverage product before buying it. The consumer feels an increased sense of security if they can see the product in its true unaltered form [2]. Consequently, UV-shielding and transparent packaging are of increasing interest. In this work, the development of coatings with carbon quantum dots made using two different approaches is explored. The first one uses microwave-assisted synthesis, while the other is performed in an autoclave using a conventional oven. The size and dispersion of the carbon quantum dots in the liquid matrix and the way that these two parameters relate to the UV light absorption capacity are investigated. Additionally, the impact of the withdraw rate applied in the dip-coating process on colour variations (CIELAB) and UV-shielding is determined. The trade-off between colour and UV shielding is discussed. The best results for UV performance in the UV range of 280–400 nm were 95.9% and 97.9% for microwave-assisted synthesis (5 min) and the conventional oven (300 min), respectively.

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