MASTER'S THESIS

Red-emitting carbon dots and their biological application as antifungal/anti-biofilm agent

Huang, Regina

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Abstract

Carbon dots (CD) have emerged as the new eye-catching theranostic nanomaterials due to their distinctive features, including tunable emission, facile surface modification, high biocompatibility and low cytotoxicity. These distinguishing features allow full customizations of CD according to the needs of various studies. Of note, they have been widely employed as nano-vehicles with live-tracking systems in many biological applications to deliver medicine with low bioavailability to targeted sites. *Candida albicans*, a commonly seen commensal fungus accounts for life-threatening infections in humans, is the leading cause of oral candidiasis. Yet, the efficacy of the "gold standard" Amphotericin B (AmB) has been limited due to poor water solubility and dose-dependent cytotoxicity. In addition, the interactions of CD with *Candida* cells/biofilms and human epithelial tissues have not been fully investigated, and very limited studies have been done on CD-based antifungal drugs delivery for topical administration. Herein, AmB-conjugated guanylated CD (CD-Gu^+-AmB) tackling oral fungal infections were synthesized and possessed potent antifungal/anti-biofilm effects against *C. albicans*. Moreover, CD-Gu^+-AmB exhibit low cytotoxicity to primary human oral keratinocytes and can selectively accumulate in the cell nuclei. Above all, the first evidence of studying the penetration and exfoliation profiles of CD in a three-dimensional organotypic human oral epithelial tissue model was provided, and the accumulation of CD-Gu^+-AmB in the epithelial tissue can form a 'shielding' layer on oral epithelia against *C. albicans*. This study demonstrates that CD-Gu^+-AmB may serve as a promising antifungal agent for tackling *C. albicans* and *Candida*-induced oral candidiasis through fast epithelial penetration, extra-/intra-cellular embedding and gradual exfoliation.

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