Eco-Friendly synthesis of superhydrophobic antimicrobial film based on cellulose acetate/polycaprolactone loaded with the green biosynthesized copper nanoparticles for food packaging application

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Abstract

The current study aimed to design superhydrophobic antimicrobial films based on cellulose acetate/polycaprolactone, myco-synthesized copper nanoparticles (CuNPs) and stearic acid to be used for food packaging application. The fungus *Aspergillus terreus* AH20 was isolated and identified morphologically and genetically for the myco-synthesis of CuNPs. The findings proved that CuNPs was obtained with small particle size less than 50 nm and excellent stability; their zeta potential reordered values more than -30 mV. After the incorporation of CuNPs with the polymers-based film (cellulose acetate and polycaprolactone), it was observed that the film exhibited rough surface due to the deposition of nanoparticles as crowded particles or thin layer onto the outer surface of the resultant film. Additionally, the produced films displayed a good mechanical properties and excellent air permeability when compared with the films formed without CuNPs. Antimicrobial activity and cytotoxicity were evaluated for all the designed films. The antimicrobial results revealed that the synthesized films loaded with CuNPs exhibited superior antimicrobial activity against *Escherichia coli, Pseudomonas aeruginosa, Staphylococcus aureus, Bacillus subtilis, Candid. albicans, Aspergillus niger, A. terreus, Penicillium expansum* and *Fusarium oxysporum*. Moreover, cytotoxicity results illustrated that all designed films in the current study have no cytotoxicity on Wi38 normal cell line which confirmed the safety of these films in use. Based on these obtained data, it can be concluded that the designed biodegradable film loaded with the myco-synthesized CuNPs is considered as an efficient hydrophobic film and thus, suitable for food packaging applications.