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Stress transfer quantification and optical properties tuning in gelatine-matrix natural composites

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This work reports on the preparation and characterization of natural composite materials prepared from bacterial cellulose (BC) incorporated into a (bovine) gelatin matrix. Composite morphology was studied using scanning electron microscopy and 2D Raman imaging revealing an inhomogeneous dispersion of BC within the gelatin matrix. The composite materials also showed controllable degrees of transparency to visible light and opacity to UV light depending on BC weight fraction. By adding a 10 wt% fraction of BC in gelatin, visible (λ=550 nm) and UV (λ=350 nm) transmittances were found to decrease by 35 and 40%, respectively. Additionally, stress transfer occurring between the gelatin and BC fibrils was quantified using Raman spectroscopy. This is the first report for a gelatin−matrix composite containing cellulose. As a function of strain, two distinct domains, both showing linear relationships, were observed for which an average initial shift rate with respect to strain of −0.63±0.2 cm−1%−1 was observed, followed by an average shift rate of −0.25±0.03 cm−1%−1. The average initial Raman band shift rate value corresponds to an average effective Young's modulus of 39±13 GPa and 73±25 GPa, respectively, for either a 2D and 3D network of BC fibrils embedded in the gelatin matrix. As a function of stress, a linear relationship was observed with a Raman band shift rate of −27±3 cm−1GPa−1. The potential use of these composite materials as a UV blocking food coating is discussed. This study is being expanded to other gelatine sources and also to the use of nano fibrillated cellulose (NFC).

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Effect of 3-mercapto-1-hexanol-epigallocatechin-3-gallate -β-lactoglobulin nanoparticles hydrocolloids against tumor growth

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(-)-Epigallocatechin-3-gallate (EGCG), the major catechin in green tea, is primary compound responsible for the health benefits. However, the instability and low bioavailability of EGCG limit its applications. In the present study, EGCG, 3-mercapto-1-hexanol (3MH) and β-lactoglobulin was co-assembled into 3MH-EGCG-β-LG nanoparticles to improve thermal stability and bioavailability of bioactive EGCG. With a molar ratio of 3MH/EGCG/β-LG of 32:32:1, 3MH-EGCG-β-LG nanoparticles were prepared with size 31 nm, zeta potential -32.5 mV and PDI 0.083. The nanoparticles showed a sustained release of EGCG in the simulated body fluid condition. 3MH-EGCG-β-LG nanoparticles (60 μg EGCG/mL, 3MH/EGCG/β-LG=32:32:1) significantly inhibited the growth of human melanoma A375 cells, human hepatoma HepG2 cells and human esophageal cancer TE-1cells. Animal experiments with nude mice bearing transplanted tumor from human melanoma A375 cells gave a tumor growth inhibition rate of 51.7% which was double of those of EGCG alone when the nude mice were treated with the nanoparticles at a equivalent dose of 10 mg EGCG/kg/d by tail intravenous injection lasted 14 days. Enzyme-linked immunosorbent assay showed that 3MH-EGCG-β-LG nanoparticles could significantly increase the content of IL-2, TNF-α and IFN-γ, and decrease the content of IL-6 in the mice serum. TUNEL and immunohistochemical detection showed that 3MH-EGCG-β-LG nanoparticles could significantly increase the apoptosis index and the activities of caspase-3, and decrease the content of PCNA and VEGF in the tumors. Experimental results also indicated that 3MH-EGCG-β-LG nanoparticles could significantly increase the activities of Caspase-3 and Caspase-9, which indicated that 3MH-EGCG-β-LG nanoparticles induced the apoptosis of A375 cells via mitochondrial-mediated signaling pathways.

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