

Physical properties and diffusion of gallic acid through alginate-nanocellulose composite gels

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Abstract

This research aimed to evaluate how the crystalline nanocellulose (CNC) as a composite material influenced the physical properties and the diffusion of gallic acid (GA), as hydrophilic polyphenol model, through the alginate (SA)-nanocellulose composite gels formed via ionic crosslinking. The combined SA-CNC solutions made from 1:0, 1:1, 2:0, 2:1, 2:2, and 2:3 solid-based ratio of sodium alginate-nanocellulose (SA-CNC) in final solutions were evaluated for viscosity, gel syneresis, dried gel rehydration properties, gel strength and stiffness, gel microstructure, and FTIR spectroscopy. The diffusion analysis was conducted by composite gel filtration method and the polyphenol diffused out from the gel was evaluated using the Folin-ciocalteu assay. It was found that the composite gel with the highest proportion of CNC reduced the gel syneresis (54.9%) and increased the gel rehydration capacity (94.0%). Composite gel with 2:1, 2:2, and 2:3 in SA-CNC ratio could significantly increase gel strength and stiffness, which indicated a tougher and tighter structure compared to the neat SA gels, with the 2:2 SA-CNC gel giving the highest gel stiffness. The SA-CNC combination altered the gel network structure and porosity on the gel fractal surface microstructure analysis. Furthermore, composite gel with 2:2 and 2:3 in SA-CNC ratio reduced the diffusion of gallic acid by 44.3% and 43% respectively from the gel. Therefore, it can be concluded that the incorporation of CNC as a composite material in alginate gels could improve the gel's physical properties and reduce the loss of GA from the gel.

Keywords: Alginate composite gels, Crystalline Nanocellulose, Gel physical properties, Gallic acid diffusion