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Nanoparticle embedded cellulosic film: Synergistic influence on antibacterial activity and sustainable agronomic evaluation

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ABSTRACT

The development of biohybrid nanocellulosic film was successfully achieved with synthesis of bimetallic nanoparticles from *Vaccinium vitis idaea* L. and their hybridization onto cellulose film. The characterization of biohybrid nanocellulosic film showed increased mechanical strength and conductivity. The developed film demonstrated antibacterial activity against medically important pathogens with highest activity was observed against *A. baumannii* strain and *E. coli* was less susceptible. Additionally, the film exhibited improved seed germination rate of *Oryza Savita* and showed catalytic activity in safranin dye degradation. Furthermore, the biohybrid nanocellulosic film extended the shelf life of tomato by preventing microbial spoilage and retained the freshness. Overall, the results obtained in the present investigation are promising with multiplicative properties of the films.

1. Introduction

Biohybrid nanocellulosic films (BNC) are innovative materials that combines the cellulose films and bimetallic nanoparticles. These films exhibit unique properties that makes them one of the ideal components for various applications (Maiuolo et al., 2021). The blending of bimetallic nanoparticles with cellulose enhances the desired applicative properties. The inherent properties like mechanical strength coupled with biocompatibility and biodegradability makes it one of the most versatile films (Muñoz-Bonilla et al., 2019). The incorporation of bimetallic nanoparticles onto the cellulose films introduces the new functionalities and enhances the desired activity. The synthesis of bimetallic nanoparticles has garnered significant impression in recent years owing to their versatile applications in different sectors (Arora et al., 2020). The combination of silver and copper at nanoscale dimensions offers enhanced functionalities. The incorporation also imparts catalytic and antimicrobial properties for the nano hybrid films (Baker et al., 2020a). The synthesis of bimetallic nanoparticles via biogenic source has been subject of interest to overcome the limitations posed by con-

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