

COMPOSITE HYDROGEL WITH SILVER NANOPARTICLES AND MUSHROOM B-GLUCAN EXTRACT AS POTENTIAL WOUND DRESSING

Tomislav Marković¹, Jasmina Stojkovska¹, Jovana Zvicer¹, Bojana Balanč², Aleksandra Jovanović³, Branko Bugarski¹, Predrag Petrović²

¹University of Belgrade, Faculty of Technology and Metallurgy, Karnegijeva 4, Belgrade, Serbia

²University of Belgrade, Innovation Center of the Faculty of Technology and Metallurgy, Karnegijeva 4, Belgrade, Serbia, bisailovic@tmf.bg.ac.rs*

³University of Belgrade, Institute for the Application of Nuclear Energy INEP, Banatska 31b, Belgrade, Serbia

Abstract

*Puffballs are a group of macrofungi that produce enclosed, globose fruiting bodies. When young, they have a solid white interior (gleba), which turns into a powdery, brown spore-bearing mass as they mature. These fungi have been used in folk medicine worldwide, primarily as wound dressings. Since fungal β -glucans are known to aid in wound healing, this study utilized the β -glucan-enriched fraction from the pestle puffball (*Lycoperdon excipuliforme*) to synthesize silver nanoparticles (AgNPs), which were incorporated into alginate-based hydrogels for potential wound treatment. Silver nanoparticles were synthesized via a hydrothermal method using silver nitrate, sodium citrate, and varying concentrations of β -glucan extract as stabilizing agents: 0.4 mg/mL (S1), 0.8 mg/mL (S2), 1.6 mg/mL (S3), and 2.4 mg/mL (S4). Particle size was approximately 30 nm for all samples, with zeta potential ranging from -22.3 to -13, increasing with the extract concentration. A one-year stability study at room temperature showed minimal changes in UV-VIS spectra and particle size distribution, despite relatively low zeta potential, suggesting steric stabilization by β -glucan extract. To assess stability in physiological conditions, samples were diluted in 0.85% NaCl solution, and size distribution and UV-VIS absorption were monitored for seven days. Sample S4 exhibited the highest stability and was selected for further experiments. Its antibacterial activity was tested against common wound-infecting bacteria, *Staphylococcus aureus* and *Pseudomonas aeruginosa*, using the broth microdilution method. The minimum inhibitory concentration (MIC) was 35 μ g/mL for both strains, with minimum bactericidal concentrations (MBC) of 120 μ g/mL and 240 μ g/mL, respectively. S4 was then used to prepare an alginate-based hydrogel, and a release study was conducted to assess the product's potential efficacy. The hydrogel was made by mixing equal volumes of AgNP suspension and 4% sodium alginate solution, with the addition of 4% CaCl₂ solution in a circular mold. The release study, conducted in TRIS buffer (50 mM) with 0.85% NaCl at varying pH levels over 72 hours, showed pH-dependent release. At pH 8.5 (similar to that of infected wounds), an effective AgNP concentration (\sim 35 μ g/mL) was reached after \sim 3 hours, increasing to \sim 100 μ g/mL after 72 hours. These results suggest that fungal β -glucans are excellent stabilizing agents for AgNPs and that the combination of β -glucans' immunostimulatory and AgNPs' antibacterial properties may have a synergistic effect in the treatment of infected wounds. Hydrogel containing AgNPs both prolonged, and pH-dependent release of the particles.*

Keywords: wound dressing, hydrogel, silver nanoparticles, β -glucan, mushrooms, puffballs

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