

ENCAPSULATION OF BACILLUS SUBTILIS IN ELECTROSPUN POLY(3-HYDROXYBUTYRATE) MATERIALS COATED WITH CELLULOSE DERIVATIVES FOR SUSTAINABLE AGRICULTURAL APPLICATIONS

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Introduction

A current trend in sustainable agriculture is the use of beneficial microorganisms to promote plant growth and biologically control phytopathogens. Innovative biocontrol agents can accelerate the reduction of pesticide dependence, ensuring environmentally friendly and sustainable farming practices. Encapsulation of selected bioagents into precisely designed polymeric carriers represents a rational approach to developing biohybrid materials for use as biocontrol formulations.

Experimental part

Poly(3-hydroxybutyrate) (PHB) was supplied by Biomer (Germany). Sodium carboxymethyl cellulose (CMC) and 2-hydroxyethyl cellulose (HEC) were obtained from Sigma-Aldrich (Germany). *Bacillus subtilis* strains were provided by the microbial collection of Biodinamika Ltd. (Bulgaria).

Results

Novel eco-friendly hybrid materials based on electrospun PHB coated with cellulose derivatives and *B. subtilis* were successfully fabricated using a combination of electrospinning and dip-coating techniques [1]. The influence of the type and molecular weight of cellulose derivatives on solution viscosity, film formation, mechanical properties, and bacterial incorporation and growth was investigated. Scanning electron microscopy revealed the morphology of fibers, films, and incorporated bacterial cells.

Conclusions

The dip-coating process enhanced the mechanical strength of fibrous PHB materials, preserved bacterial viability, and enabled long-term storage and controlled release. The developed hybrid materials, based on electrospun PHB coated with cellulose derivatives and encapsulated *Bacillus subtilis*, show strong potential as sustainable biocontrol systems for plant protection and growth promotion in eco-agriculture.

Keywords: *electrospinning; dip-coating; poly(3-hydroxybutyrate); cellulose derivatives; Bacillus subtilis.*

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[1] P. Tsekova, N. Nachev, I. Valcheva, D. Draganova, M. Naydenov, M. Spasova, O. Stoilova, *Polymers*, 2024, 16, 2749.

