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Optimal culture and environmental circumstances for bacterial cellulose synthesis by *Bacillus licheniformis*

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Abstract:

Objectives: This study aimed to optimize bacterial cellulose (BC) production from *B. licheniformis* and characterize the produced films.

Methods: BC production was optimized by evaluating various nutrient media, carbon sources, nitrogen sources, pH levels, and temperatures. The produced BC films were characterized through solubility tests, swelling capacity measurements, in vitro degradation assays, Fourier Transform Infrared Spectroscopy (FTIR), Thermogravimetric Analysis (TGA), and Scanning Electron Microscopy (SEM).

Results: MHS nutrient medium yielded the highest BC production, 158 g/l. Glucose was the most efficient carbon source, 158 g/l. Optimal conditions were pH 7 and 35°C with a yield of 188 g/l. while yeast extract and peptone achieved maximum yields of 188 and 170 g/l, respectively. BC films exhibited insolubility in water and organic solvents, exceptional swelling capacity 2330%, and minimal degradation of 5-10% over 21 days. FTIR confirmed characteristic cellulose peaks (C-O-C, C-O, C-C, C-OH), while TGA demonstrated multistage thermal degradation and high thermal stability. SEM revealed a porous three-dimensional fibrous network with $CaCO_3$ granules integrated into the fiber structure.

Conclusion: BC was successfully produced from *B. licheniformis* under optimized conditions, demonstrating superior physicochemical properties and structural characteristics suitable for diverse industrial and biomedical applications.

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