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Optimization and Scale-Up of Solid-State Bioconversion for Microbial Coagulant Production toward Sustainable Water Treatment

By

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Volume: 27 Issue: 2 Page: 15-30

DOI: 10.31436/iiumej.v27i2.4237

Published

MAY 2026

Indexed 2026-05-22

Document Type Article

Abstract Microbial coagulants are emerging as an eco-friendly alternative to chemical coagulants owing to their non-toxicity, biodegradability, and sustainability. However, their use is limited by high production costs linked to expensive nutrient media and scalability issues. To address these challenges, this study developed a cost-effective microbial coagulant based on a fungus using cocopeat as a substrate. Growth conditions (malt extract, glucose, and pH) were optimized using the Face-Centered Central Composite Design (FCCCD) under Response Surface Methodology (RSM) to maximize coagulant yield. The performance in water treatment was evaluated using jar tests, and large-scale production techniques were investigated using a tray bioreactor and an agitated drum bioreactor (ADB). The fungal strain used in this study was identified as *Phanerochaete concrescens*, which demonstrated high turbidity-reducing efficiency, achieving a maximum flocculating activity of 93.06% in a standard jar test. These results were obtained under statistically optimized growth conditions, specifically 5 days of incubation at 25 degrees C, 70% moisture content, 3% malt extract, 2.5% glucose, and pH 7, confirming model predictions. *Phanerochaete concrescens* was successfully scaled using a tray fermenter, achieving a flocculation rate of 92% after 5 days of incubation at 70% moisture, pH 7, and a 3 cm substrate thickness. However, in a 30 L agitated bioreactor drum, flocculating activity was recorded at 29% due to insufficient fungal growth at the tested agitation rate. This study confirms the feasibility of a cost-effective microbial coagulant that can be scaled appropriately, offering a sustainable and biodegradable alternative to chemical coagulants.

Keywords **Author Keywords:** [microbial coagulant](#); [response surface methodology](#); [solid-state bioconversion](#); [scale-up](#); [water treatment](#)
Keywords Plus: [BIOFLOCCULANT](#); [FERMENTATION](#); [OIL](#)

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fellahmaroua06@gmail.com**Categories/
Classification**

Research Areas: Engineering

**Web of Science
Categories**[Engineering, Multidisciplinary](#)**Funding**[▼ View funding text](#)

Funding agency	Grant number
Islamic Development Bank (ISDB)	SPI20-001-0001
International Islamic University Malaysia (IIUM)	
Research Management Center (RMC)	

[+ See more data fields](#)**Journal information**

IIUM ENGINEERING JOURNAL

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ISSN 1511-788X

eISSN 2289-7860

Current Publisher KULLIYAH ENGINEERING, INT ISLAMIC UNIV
MALAYSIA, JALAN GOMBAK 53100, MALAYSIA

Research Areas Engineering

Web of Science Categories Engineering, Multidisciplinary

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