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Antimicrobial potential of biosurfactant produced by *Rhodotorula mucilaginosa* using soybean molasses

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Abstract

The synthesis of biosurfactants aligns with the global shift toward sustainable industrial practices, driven by the demand for eco-friendly bioproducts that mitigate the environmental hazards of petroleum-derived molecules. Within this framework, the valorization of soybean processing residues, such as soybean molasses, offers a key opportunity. By integrating this byproduct into a circular economy model, emphasizing resource optimization and waste reduction, molasses serves as a cost-effective substrate for microbial cultivation, enabling the generation of high-value biotechnological products. This study aimed to implement circular economy practices by utilizing soybean molasses to optimize biosurfactant production by *Rhodotorula mucilaginosa*. Production was analyzed through a Design of Experiments (DOE) considering molasses dilution, temperature, and agitation speed as factors, with the emulsification index (E_{24}) and surface tension (ST) reduction as responses. Analysis of variance (ANOVA) with Tukey's adjustment ($p < 0.05$) identified the optimal production condition: a 1:5 molasses dilution at 50°C and 200 rpm. This condition achieved an E_{24} of 92.52% and reduced the ST from 72 to 26.6 mN/m. Initial antimicrobial assays to determine the Minimum Inhibitory Concentration (MIC) against the phytopathogen *Xanthomonas axonopodis* pv. *passiflorae*, *Xanthomonas euvesicatoria* pv. *perforans*, *Fusarium oxysporum*, and *Corynespora cassiicola* demonstrated complete inhibition across all tested biosurfactant concentrations (30 to 1.8 g/L). These results highlight the significant biotechnological potential of these biosurfactants as sustainable alternatives for phytopathogen control in agriculture.

Keywords: Agro-industrial byproducts; Circular economy; Biosurfactant; Phytopathogen control; Surface tension.

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