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ORIGINAL PAPER

Optimal glucose and inoculum concentrations for production of bioactive molecules by *Paenibacillus polymyxa* RNC-D

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The production of antimicrobial metabolites by *Paenibacillus polymyxa* RNC-D was assessed. Two process variables, glucose and inoculum concentrations, were evaluated at different levels (5–40 g L^{-1}, and at φ_r = 2.5–5.0 %, respectively), and their effects on biomass formation, minimal inhibitory concentration (MIC) against *Escherichia coli*, and surface tension reduction (STR) were studied. When the fermentation process was carried out under non-optimised conditions, the biomass, MIC, and STR achieved the following values: 0.6 g L^{-1}, 1 g L^{-1}, and 18.4 mN m^{-1}, respectively. The optimum glucose (16 g L^{-1}) and inoculum volume ratio (φ_r = 5.0 %) were defined in order to maximise the biomass formation, with a low value of MIC and high STR of extract. The experiments carried out under optimal conditions showed the following values for the dependent variables: biomass concentration 2.05 g L^{-1}, MIC 31.2 μg mL^{-1}, and STR 10.7 mN m^{-1}, which represented improvement of 241.7 %, 96.9 %, and 41.9 % for the responses of biomass, MIC, and STR, respectively. This is the first recorded study on the optimisation of culture conditions for the production of antimicrobial metabolites of *P. polymyxa* RNC-D, and constitutes an important step in the development of strategies to modulate the production of antimicrobial molecules by this microorganism at elevated levels.

Keywords: antimicrobial metabolites, fermentation, minimal inhibitory concentration, *Paenibacillus polymyxa*, surface tension, optimisation

Introduction

Endophytes are regarded as an outstanding source of bioactive natural products because they occupy a unique biological environment: living plants (Strobel et al., 2004). Plant-associated microorganisms are subjected to constant metabolic and environmental interactions and, as a consequence, these organisms should produce even more secondary metabolites (Schulz, 2002). These molecules are characterised by their diverse chemical structures and may be of use due to the wide range of their bioactivity against pathogens. *Paenibacillus polymyxa* strains, for example, are recognised for their ability to produce antimicrobial peptides active against a broad range of microorganisms. One group of compounds, bioactive against both Gram-positive and Gram-negative bacteria, includes polymyxins (Katz & Demain, 1977), jolipeptin (Ito & Koyama, 1972a, 1972b), polypeptins (Sogn, 1976), gavaserin, and saltavalin (Pichard et al., 1995). Another group is comprised of molecules responsible for the bioactivity against Gram-positive

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