Optimization of carbofuran insecticide degradation by Enterobacter sp. using response surface methodology (RSM)

ABSTRACT

Response surface methodology and Plackett-Burman experiments were applied to optimize the biodegradation of carbofuran by using Enterobacter sp. stain BRC05 isolated from selected agricultural areas in peninsular Malaysia. The significant factors influencing the degradation of carbofuran were assessed using two-level Plackett–Burman Design (PBD) with five variables. Plakett Burman experiment showed that the following four variables were significant for carbofuran degradation including, carbofuran concentration, temperature, pH and nitrogen sources. Significant variables obtained in Plackett-Burman Design were further optimize using Central Composite Design (CCD). The outcome of the design for carbofuran degradation for each runs of the PBD experiment base on the design matrix, showed that the minimum and the maximum carbofuran degradation percentage were found to be 6.7% and 79.77% as presented in runs 4 and 1, respectively. Results obtained using Central Composite Design showed that the relations between the factors affect carbofuran degradation with significant response. The predicted results in CCD indicated that highest carbofuran degradation of 95.40% could be realized with carbofuran concentration of 92.50 mg/L, pH of 6.0, temperature 27.50 °C, nitrogen sources of 0.45 g/L and reaction period of 6 days. The predicted values were in agreement with the actual values with coefficient of determination with R2 0.9719. Partial 16S rRNA sequence analysis showed that the carbofuran degrading isolate was closely related to members of the genera Enterobacter sp. The morphological and biochemical characteristics of the isolate also confirmed the phylogenetic signature. This study would provide an effective approach that could be beneficial for the bioremediation of carbofuran insecticide in polluted environment.

Keyword: Biodegradation; Carbofuran; Response surface methodology; Enterobacter sp.