Bioluminescent method for the rapid screening of toxic heayy metals in environmental samples using Photobacterium leiognathi strain AK-MIE

ABSTRACT

Assessment of eco-toxicant using bioluminescent bacterial assay is a widely used and globally accepted method. In this work, a new luminescent bacterium was isolated from squid (Loligo duvauceli) and identified as Photobacterium leiognathi strain AK-MIE using 16S rRNA, phylogeny analysis. The predicted optimum conditions by RSM were 2.76% (w/v) NaCl, 2.28% (w/v) peptone, 0.34% (w/v) yeast extract, and pH 6.83 with 541,211.80 RLU of luminescent production whereas the predicted optimum conditions by ANN were 2.21% (w/v) NaCl, 2.27% (w/v) peptone, 0.39% (w/v) yeast extract, and pH 6.94 which produced 541,986.20 RLU. The validation analysis of both RSM and ANN show 0.60% and 0.69% deviation from the predicted results indicating that both models provided good quality predictions with ANN showing a superior data fitting capability for non-linear regression analysis. Toxicity tests show strain AK-MIE was sensitive to mercury (concentration causing 50% inhibition or IC50 of 0.00978 mg), followed by cadmium (IC50 of 0.5288 mg), copper IC50 of (0.8117 mg), silver (IC50 of 1.109 mg), and lead (IC50 of 10.71 mg) which are more sensitive than previously isolated luminescent bacteria, suggesting that strain AK-MIE has the potential to be used in toxicity assessment of heavy metals in the environment. Based on the field trial results, several sediment samples from industrial areas in Bangi, Selangor managed to inhibit the bioluminescence of strain AK-MIE. Validation method carried out using ICP-MS proved the presence of several toxic heavy metal elements.

Keyword: Luminescent bacteria; Heavy metals; Optimization; Response surface methodology; Artificial neural network