Enhanced carbofuran degradation using immobilized and free cells of Enterobacter sp. isolated from soil

ABSTRACT

Extensive use of carbofuran insecticide harms the environment and human health. Carbofuran is an endocrine disruptor and has the highest acute toxicity to humans than all groups of carbamate pesticides used. Carbofuran is highly mobile in soil and soluble in water with a lengthy half-life (50 days). Therefore, it has the potential to contaminate groundwater and nearby water bodies after rainfall events. A bacterial strain BRC05 was isolated from agricultural soil characterized and presumptively identified as Enterobacter sp. The strain was immobilized using gellan gum as an entrapment material. The effect of different heavy metals and the ability of the immobilized cells to degrade carbofuran were compared with their free cell counterparts. The results showed a significant increase in the degradation of carbofuran by immobilized cells compared with freely suspended cells. Carbofuran was completely degraded within 9 h by immobilized cells at 50 mg/L, while it took 12 h for free cells to degrade carbofuran at the same concentration. Besides, the immobilized cells completely degraded carbofuran within 38 h at 100 mg/L. On the other hand, free cells degraded the compound in 68 h. The viability of the freely suspended cell and degradation efficiency was inhibited at a concentration greater than 100 mg/L. Whereas, the immobilized cells almost completely degraded carbofuran at 100 mg/L. At 250 mg/L concentration, the rate of degradation decreased significantly in free cells. The immobilized cells could also be reused for about nine cycles without losing their degradation activity. Hence, the gellan gum-immobilized cells of Enterobacter sp. could be potentially used in the bioremediation of carbofuran in contaminated soil.

Keyword: Biodegradation; Carbofuran; Immobilization; Reusability