Bioremediation of Cadmium by Microbial Biofilms Developed Through Endophytic Fungi from Selected Mangrove Species and Soil Bacteria

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Cadmium is the most dangerous heavy metal characterized by high stability and toxicity even at low concentration. The potential use of metal-resistant microorganisms as an eco-friendly method in the treatment of heavy metal contaminated soil and water has become more important. Therefore, the biosorption removal of cadmium from aqueous solutions by using mono and mixed microbial cultures was investigated in this study. Twelve endophytic fungi were isolated from the leaves of *Avicennia marina* and *Lumnitzera racemosa*, whereas thirteen bacteria were isolated from the mangrove soil collected from the Puttalam lagoon in Puttalam district, Sri Lanka. Microbial isolates were grown in Potato Dextrose Agar and Nutrient Agar with different concentrations of Cd to select the most Cd resistant fungi and bacteria. Fungal-Bacterial Biofilms (FBB) were developed from the selected Cd resistant fungi and bacteria. The selected biofilms and mono cultures were inoculated in Cd supplemented Combine Carbon Broth (CCB) in the concentration range of 50-500 mg l^{-1}. Concentration levels of Cd in the CCB were measured periodically using Atomic Absorption Spectroscopy. Out of three fungal (LRA, LRC and AMA) and three bacterial (SB_2, SB_3 and SB_{12}) strains that showed the highest resistance against Cd, two fungal (LRA and LRC) and all three bacterial strains were selected for the formation of FBB. Screening assay revealed that LRA and SB_3 strains had significantly the highest resistance against Cd ($P < 0.05$). The lowest significant mean Cd concentration level in CCB was observed in $F_2B_1B_3$ biofilm (103.167 mg l^{-1}) that reduced the Cd concentration level by 58.74% after sixteen days of incubation ($P < 0.05$). Even though all the microbial cultures showed significant reduction of Cd concentration level, biofilms except $F_1B_1B_3$ (52.73%) showed much reduction than that of mono cultures. Thus, these results indicated the potential of biofilms to reduce the concentration of Cd in water very efficiently.

Keywords: Bioremediation, Cadmium, Biofilms