Novel and Environmentally Friendly Method of Heavy Metals and Radionuclides Removal Using Radiation Resistance Bacteria

Arafat, Anas (School: Riyadh School for Boys and Girls)

Increased human activity within energy reserves, wrong farming practices, and rapid industrialization have contributed to an increase in environmental contamination. Heavy metals, radionuclides, organic compounds, and pesticides are among the contaminants that pose the greatest threats to the environment and public health. In this study, nuclear techniques are used to investigate three types of bacteria (Staphylococcus capitis, epidermidis, and hominis) and their resistance to high-energy (gamma rays), which is the first study done of its kind. The aim of this study is to evaluate the above bacteria and their ability to remove the heavy metals of cadmium (Cd), lead (Pb), chromium (Cr), zinc (Zn), copper (Cu), and uranium (U) from soil and aqueous solutions. Staphylococcus epidermidis has not been studied before in the field of heavy metal removal. The three bacteria were exposed to up to 15 kGy. The soil and aqueous solutions were spiked with different concentrations of heavy metals and radionuclides at 10 and 100 ppm. The results showed that 98% of Al elements in the soil sample were removed in 72 hours by using Staphylococcus capitis and 40% using Staphylococcus hominis. Also, 91%, 74%, 81%, and 70% of Cr, Zn, Cd, and Pb elements, respectively, were removed in only 12 days by Staphylococcus epidermidis. Nevertheless, the result obtained from the uranium removal was 43% using Staphylococcus capitis. This indicates promising applications in wastewater treatment, radionuclides removal, and oil spills in soil and aqueous solutions. Further study can be extended to remove other heavy metals and radionuclides.