

STUDY OF CR(VI) DETOXIFICATION BY BASALT-INHABITING BACTERIA USING NAA AND ESR METHODS

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Mixtures of heavy metals have polluted many industrial regions in the world. The environmental contamination with heavy metals has become a serious health concern. Since metal ions cannot be destroyed in environments, factors which influence the detoxification of metals can dictate the metal toxicity to ecological receptors. Indigenous bacteria have been considered as a potential candidate for detoxifying heavy metal ions. Molecular insight into the fate of heavy metal species in bacteria is important in the development of new biotechnologies to clean-up contaminated sites. In our study chromium(VI), a widespread environmental pollution, was selected as a model heavy metal. Today there are only few studies that examine how microorganisms respond to chromium stress at higher doses.

Instrumental neutron activation analysis (NAA) and electron spin resonance (ESR) methods were applied to evaluate the potential of indigenous bacteria to detoxify Cr(VI) from heavily contaminated environment. The microbial reduction of toxic Cr(VI) to less toxic Cr(III) was studied in batch systems in the presence of high concentrations of Cr(VI) (50-1000 mg/L). Gram-positive *Arthrobacter oxydans* isolated from Columbia basalts (USA) that have been polluted with mixtures of heavy metals, radionuclides and organic compounds and also two Gram-positive bacteria isolated from polluted basalts from the Republic of Georgia were tested under aerobic conditions. All the bacterial samples were exposed to Cr(VI) action at a given concentration for five days.

NAA revealed that *A. oxydans* is able to accumulate Cr(VI) efficiently in the concentration range 50-500 mg/L. Dose-dependent ESR measurements of the formation of Cr(III) complexes ($g=2.02$, line width=650 gauss) in bacterial cells confirmed this character of Cr(VI) detoxification. The similar results are obtained for one of the bacterial isolate. For the other bacterium, the content of chromium inside the cells is increased continuously by increasing of Cr(VI) dose up to 1000 mg/L. According to ESR measurements in investigated bacteria reduction of Cr(VI) to Cr(III) proceeded through the formation of Cr(V) complexes ($g=1.980$, line width=12 gauss). A well pronounced correlation between the ability of the bacteria to accumulate Cr(VI) and their ability to reduce Cr(V) to Cr(III) observed in our experiments is discussed.