The role of iron in Deinococcus radiodurans engineered for growth on toluene and the role of manganese in the extreme radiation resistance phenotype

Hassan Brim, Elena K. Gaidamakova, Vera Y. Matrosova, Min Zhai, Amudhan Venkateswaran, Marina Omelchenko, Kira S. Makarova, Lawrence P. Wackett, James K. Fredrickson, and Michael J. Daly

Uniformed Services University of the Health Sciences, Bethesda, MD; Tel: 301-295-0063, Email: egaidamakova@usuhs.mil; National Center for Biotechnology Information, NIH, Bethesda, MD; Department of Biochemistry, University of Minnesota, St. Paul, MN 55108; Pacific Northwest National Laboratory, Richland, WA 99352.

Abstract
Toluene and other fuel hydrocarbons are commonly found in association with radionuclides at numerous Department of Energy (DOE) sites, frequently occurring together with Cr(VI) and other heavy metals. In this study, the extremely radiation resistant bacterium Deinococcus radiodurans was engineered for complete toluene mineralization by cloned expression of toluene degradative systems from Pseudomonas sp. We have shown that this additional iron concentration does not confer radiation sensitivity. In contrast, manganese (Mn) limitation leads to a dramatic increase in survival following chronic radiation. We hypothesize that Mn may be required for maintaining radiation-resistant enzymes or for non-enzymatic protection during recovery.

Keywords: Deinococcus radiodurans, manganese, iron, radiation resistance, toluene.