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Genetic engineering of bacteria for superior bioremediation capability

Environmental pollution is a serious problem. Chromate [Cr (VI)] and uranyl [U (IV)] are among the most serious pollutants in superfund sites and in 2,700 square miles of US Department of Energy waste sites as well as throughout the world. Both are carcinogens and are soluble, their leaching into the drinking water supplies is of great public health concern. Their reduced forms [Cr (III)] and [U (II)] respectively are insoluble and can therefore be sequestered at the initial site of contamination. Many bacterial metabolic enzymes can vicariously reduce these compounds but several do so by a single electron reduction. This sets up a redox cycle, generating Reactive Oxygen Species (ROS) that poison the bacteria, greatly diminishing their effectiveness. We isolated the enzyme ChrR from *Pseudomonas putida* and *Escherichia coli* which is an obligatory two-electron reducer of these compounds (the physiological role of ChrR is in bacterial antioxidant defense). Using error-prone PCR directed evolution, a stochastic algorithm and crystal structure solution, we have improved this enzyme several fold. The resulting bacteria reduced both compounds with much less ROS production and several-fold greater speed and efficiency. Their use holds the promise of bioremediating the above waste sites. ChrR is also effective in activating several prodrugs and we have also developed directed and specific cancer therapies using this enzyme by specific delivery of its gene to tumors.

Biography

A C Matin has obtained his PhD from University of California. He served as a Group Leader at State University of Groningen, The Netherlands before joining Stanford, where he has been full Professor for several years. He has served on several professional panels and Editorial Boards and is recipient of many awards. He is elected as Fellow of American Academy of Microbiology.

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