Bioremediation of Elevated Arsenite Concentrations in Source Water via Novel Transgenic E. coli Containing the Arsenite Oxidase Gene Cluster

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Arsenite contamination of source water presents a threat to dozens of developing countries that cannot afford remediatory solutions. The conversion of arsenite to arsenate via oxidation presents a 60 times decrease in toxicity. Rhizobium sp. NT-26 is one of the only bacteria that can perform this conversion autotrophically; however, this bacteria can survive in few environments. This project aims to develop a transgenic bacteria that contains the same mechanism for arsenite oxidation but is suitable for a multitude of niches. Polymerase chain reaction was run on NT-26 plasmid DNA to amplify the arsenite oxidase gene (Aro) cluster. The Aro gene cluster was digested with the pBAD30 expression vector, and the subsequent products were ligated. The recombinant vector was transformed into E. coli sp. C600 via electroporation and inoculated onto a selective culture plate. The resulting E. coli was tested for its ability to oxidize arsenite using silver nitrate and colorimetric analysis of the precipitate. In comparison with wild-type E. coli and NT-26, our transgenic bacteria oxidized the majority of the arsenite unlike the controls. This study proved that the Aro gene cluster can be expressed in other gram-negative bacteria. The implications of these findings are immense, as a transgenic bacteria able to detoxify arsenite contaminated waters by up to 60 times could potentially save millions of lives and also prevent life-shortening diseases linked to arsenic poisoning. Previous remediatory methods have been too expensive and energy consumptive. However, this new discovery holds the potential for energy and cost-effective bioremediation of arsenite.

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