Designing Whole-Cell Biosensors for the Detection of Heavy Metals

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Heavy metals such as arsenic, cadmium, lead, and zinc are toxic industrial byproducts that often leach into local water supplies. Current methods of heavy metal detection vary in sensitivity and cost. This research aimed to create biosensors to detect heavy metals, which will decrease detection cost without compromising sensitivity. Two promoters, one regulated by arsenic (arsRp) and the other regulated by cadmium, lead, and zinc (zntAp), were isolated from E. coli DNA and amplified using specifically designed primers to run PCR. The PCR promoter products were then digested with restriction enzymes Age I and Nhe I to create sticky ends. pGLO plasmid DNA with the green fluorescent protein (GFP) gene under regulation of an arabinose promoter was digested using the same restriction enzymes to remove this promoter and create complementary sticky ends for the heavy metal promoters. pGLO plasmid backbones were ligated with either arsRp or zntAp separately resulting in two distinctly engineered plasmids that were sensitive to arsenic or to cadmium, lead, and zinc. Bacterial transformation was conducted to obtain bacterial biosensors that produce GFP in response to the presence of the specific heavy metals. This transformation was unsuccessful, indicating that a part or parts of the procedure should be revisited and redone. Gel electrophoresis of promoters indicated that these were successfully extracted and amplified, leaving the digest of the pGLO plasmid and the ligation suspect. Successful transformation will ultimately show that biosensors can be designed to detect a multitude of different heavy metals found in contaminated water supplies.