Addressing Arsenic Contamination: Creating a "Super" Bioremediator with Sub-Lethal Pretreatment

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Arsenic presence in groundwater is a major health hazard. Efficient ways to monitor and remove arsenic from water must be developed for communities to prevent the adverse health effects that result from chronic arsenic exposure. Bioremediation can be used to this effect, with the yeast strain Kluyveromyces marxianus. In the research reported here, pretreatment of K.marxianus with a sublethal dose of arsenic (4ppm) increases the ability of the yeast to bioremediate high concentrations of arsenic (16ppm or 64ppm) over those not pretreated, as remediation increased from 81.0 ± 1.4 % to 92.7 ±3.1 % removal of arsenic from contaminated water ($p<.01$). Pretreatment also increased percent viable yeast when subsequently exposed to high arsenic concentrations ($p<.01$). The suggested mechanism of bioremediation is arsenic uptake through the membrane protein Fps1p, controlled by the FPS1 gene. In pretreated yeast, FPS1 was upregulated 1.5-fold($p<.05$) by q-PCR. Beans germinated in water bioremediated by pretreated yeast exhibited increased percent change in mass over those in water bioremediated by untreated yeast: 199.7±38.9% to 132.3±3.4%($p<.01$). Applications of these findings are beneficial if field monitoring is available and sensitivity of current technology is increased. This research utilizes an Arduino color sensor with accepted arsenic test kits (Hach EZ kit), to increase the sensitivity of these kits from detecting only eleven values between 0-16 ppm to the entire range of values through mathematical modeling. This research demonstrated the high sensitivity of the Arduino, providing precise results in real time while exploiting the ability of the bioremediator potentiated by an initial sublethal exposure.

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