103a Metabolic Engineering of Yeast for Bioaccumulation of Arsenic

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Arsenic (As) is an extremely toxic metalloid that adversely affects human health and is currently ranked number one on the EPA's priority list. Increasingly restrictive federal regulation of allowable levels of arsenic in contaminated water (10 ppb) has prompted the development of novel remediation technologies for their removal. Biological methods are gaining momentum because of their potential in providing a cost effective and environmentally benign technology for arsenic remediation. A promising strategy is to engineer a “designer biosorbent” tailored specifically with enhanced arsenic uptake and accumulation capability.

In this research, a metabolically engineered yeast strain sequentially optimized for enhanced arsenic uptake and sequestration was developed. Specifically, the phosphate transporter Pho84p and the aquaglycerporin Fps1p, responsible for arsenate (As(V)) and arsenite (As(III)) uptake, respectively, were overexpressed, resulting in higher rates of arsenic uptake. In parallel, production of arsenic-binding phytochelatins by expressing a phytochelatin synthase (ATPCS) gene isolated from Arabidopsis thaliana was demonstrated. Cells expressing ATPCS not only produced an appreciable amount of PCs, they also accumulated 3-fold more arsenic than the control cells not expressing ATPCS. This result confirms that PCs are directly responsible for the increased arsenic binding and the overall enhanced bioaccumulation. We are in the process of combining these two strategies and the overall enhancement in arsenic accumulation will be discussed.