Enhanced inorganic mercury(II) reduction by *Shewanella oneidensis* MR-1 in the presence of flavins

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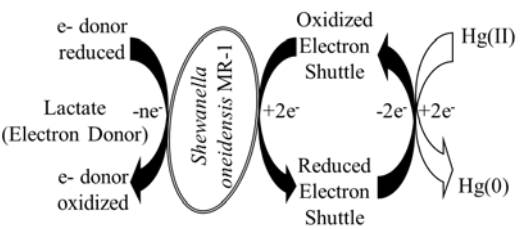
Shewanella oneidensis MR-1, a dissimilatory metal reducing bacterium, has been shown to reduce inorganic divalent mercury [Hg(II)] at low concentrations (< 0.3 μM) [1], however, the electron transport process for Hg(II) reduction to elemental mercury [Hg(0)] during anaerobic respiration of MR-1 was unclear. MR-1 secretes flavin mononucleotide (FMN) and riboflavin for extracellular electron transfer [2, 3]. The possibility of soluble Hg(II) reduction by secreted flavins was investigated using riboflavin as a model mediator, in the presence or absence of goethite. The highest reduction rate of Hg(II) by MR-1 was observed with riboflavin and goethite: 0.35±0.01 pmol min^{-1} mg $protein^{-1}$. The addition of ferrozine to block electron shuttling by biogenic Fe(II) dropped Hg(II) reduction rate to 0.21±0.02 pmol min^{-1} mg $protein^{-1}$, in the same experimental conditions. When riboflavin was not present in the reaction medium, the Hg(II) reduction rate declined to 0.06±0.03 pmol min^{-1} mg $protein^{-1}$. Further investigation using preincubated cells to accumulate endogenous flavins revealed that Hg(II) reduction rate by wild type MR-1 strain was significantly higher than that of Δbfe mutant lacking the ability to export flavins (64.8±8.4 vs 32.7±15.4 pmol min^{-1} mg $protein^{-1}$). The overall results



demonstrate that using flavins as an electron mediator, MR-1 can effectively reduce soluble Hg(II). This electron shuttling could be an important process of Hg detoxification in subsurface environments where dissolution of humic substances is limited.

[1] Wiatrowski *et al*. (2006) *Environ. Sci. Technol.* **40**, 6690–6696. [2] von Canstein *et al*. (2008) *Appl. Environ. Microbiol.* **74,** 615–623. [3] Marsili *et al*. (2008) *Proc. Natl. Acad. Sci. U.S.A.* **105,** 3968–3973.