A Novel Mechanism for Reduction of Mercury(II) by Mercury-Sensitive Dissimilatory Metal-Reducing bacteria.

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Shewanella oneidensis MR-1 is a facultative anaerobe that is of great interest for bioremediation in the subsurface due to its ability to reduce toxic metals and radionuclides. We present evidence that MR-1 can reduce ionic mercury [Hg(II)] to elemental mercury [Hg(0)] by a novel pathway that is not related to the well-characterized *mer* system. Additionally, MR-1 does not display Hg(II) resistance typical of an organism with a *mer* operon. In the presence of 200 nM Hg(II), in 24 hours live cells grown aerobically reduced 83±6.3% of the Hg(II), whereas autoclaved cells reduced 21±0.9%. Hg(II) reduction by MR-1 also occurred with iron oxyhydroxide and fumarate as terminal electron acceptors. Reduction of Hg(II) showed a strong dependence on the presence of an electron donor and an electron acceptor, as incubation of cells in media that lacked either resulted in activity that is not significantly different from that of autoclaved cells ($p > 0.01$). Unlike *mer*-mediated Hg(II) reduction, this activity is not inducible, as exposed cells and unexposed cells had a specific activity for reduction of Hg(II) of 3.14±0.25 and 3.07±0.35 nmol min^{-1} mg $protein^{-1}$ respectively. This activity is not restricted to MR-1, as two other dissimilatory metal-reducing bacteria (DMRB) that lack a *mer* system (*Geobacter sulfurreducens* PCA and *Geobacter metallireducens* GS-15) also are able to reduce Hg(II). Live and autoclaved cells of strain PCA had specific activities of 2.8±1.3 nmol Hg(II) min^{-1} mg $protein^{-1}$ and 0.34±0.5 nmol Hg(II) min^{-1} mg $protein^{-1}$, respectively. For strain GS-15, live and autoclaved cells had specific activities of 6.05±1.4 nmol Hg(II) min^{-1} mg $protein^{-1}$ and 1.65±0.9 nmol Hg(II) min^{-1} mg $protein^{-1}$, respectively. However, Hg(II) reduction is not universal among DMRB or anaerobes, as it was absent in *Anaeromyxobacter dehalogenans* strain 2CP-C, which can reduce iron, and the nitrate reducer *Pseudomonas stutzeri* OX1. The discovery of constitutive reduction of Hg(II) at low concentrations by DMRB may have future applications in the remediation of mercury in subsurface environments.