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A physiological role for Hg^{II} during phototrophic growth

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The bioaccumulation of toxic monomethylmercury is influenced by the redox reactions that determine the amount of mercury (Hg) substrate — Hg^{II} or Hg^0 — that is available for methylation. Phototrophic microorganisms can reduce Hg^{II} to Hg^0. This reduction has been linked to a mixotrophic lifestyle, in which microbes gain energy photosynthetically but acquire diverse carbon compounds for biosynthesis from the environment. Photomixotrophs must maintain redox homeostasis to disperse excess reducing power due to the accumulation of reduced enzyme cofactors[6]. Here we report laboratory experiments in which we exposed purple bacteria growing in a bioreactor to Hg^{II} and monitored Hg^0 concentrations. We show that phototrophs use Hg^{II} as an electron sink to maintain redox homeostasis. Hg^0 concentrations increased only when bacteria grew phototrophically, and when bacterial enzyme cofactor ratios indicated the presence of an intracellular redox imbalance. Under such conditions, bacterial growth rates increased with increasing Hg^{II} concentrations; when alternative electron sinks were added, Hg^0 production decreased. We conclude that Hg can fulfil a physiological function in bacteria, and that photomixotrophs can modify the availability of Hg to methylation sites.