

Supplementary Information for:

**High Efficiency Rare Earth Element Bioleaching with Systems
Biology Guided Engineering of *Gluconobacter oxydans***

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Supplementary Information Figures

Figure S1. Growth curves for wild-type *G. oxydans* and mutants considered in this article.

Figure S2. Comparison of REE-leaching with *G. oxydans* biolixiviant and nitric acid.

Figure S3. Effect of neat nitric acid and *G. oxydans* $\Delta pstS$, $P_{112}:mgdh$ biolixiviant on biological tissue (sort of), part one.

Figure S4. Effect of neat nitric acid and *G. oxydans* $\Delta pstS$, $P_{112}:mgdh$ biolixiviant on biological tissue (sort of), part two.

Supplementary Information Datasets

Dataset S1. Figure 1 data.

Dataset S2. Figure 2 data.

Dataset S3. Figure 3 data.

Dataset S4. Primers used for genetic modification of *G. oxydans*.

Dataset S5. Figure S1 data.

Dataset S6. Figure S2 data.

Supplementary Figures

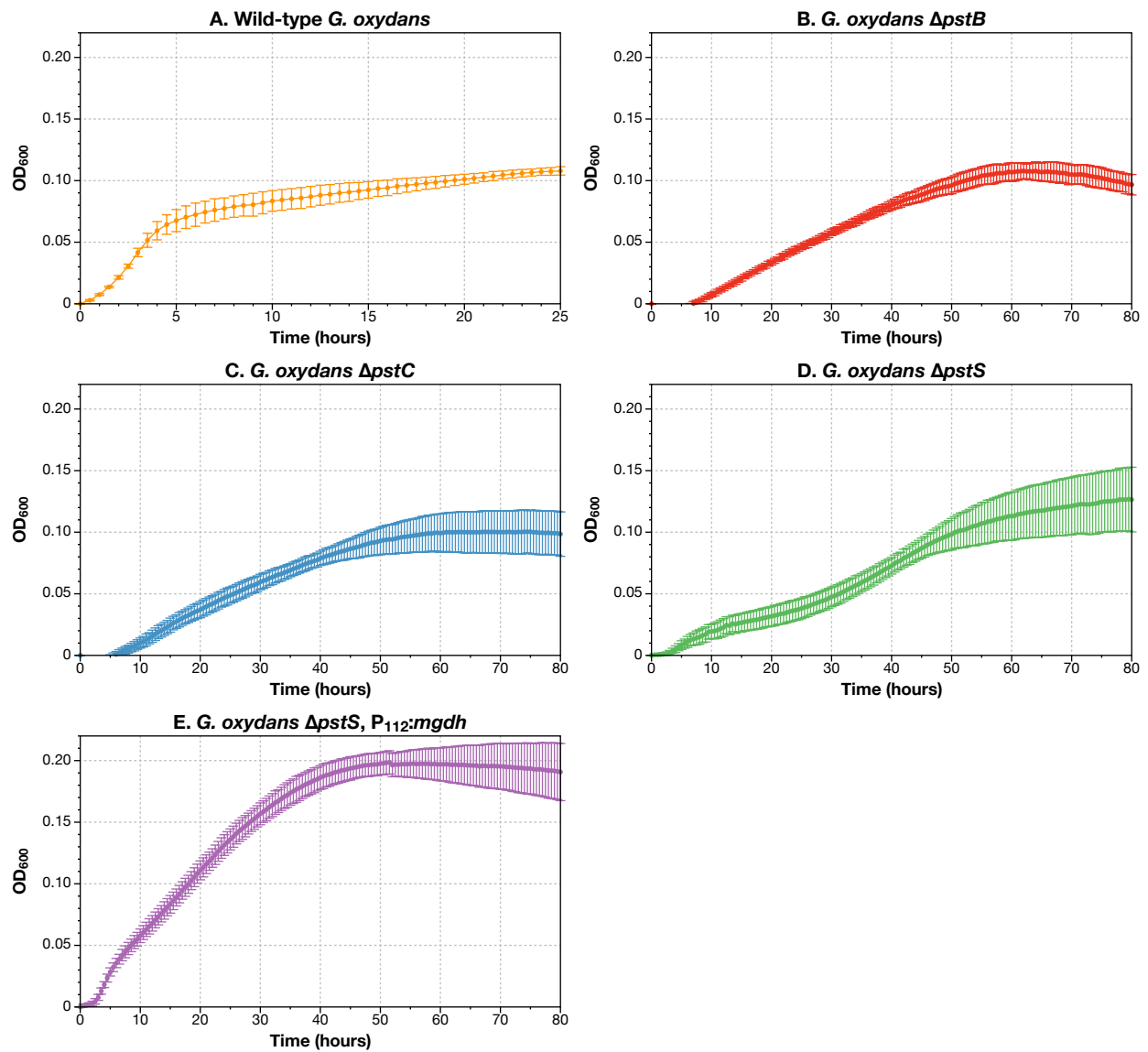


Figure S1. Growth curves for wild-type *G. oxydans* and mutants considered in this article. All data for this figure can be found in **Dataset S5**. Experimental conditions are described in **Materials and Methods**. Note that we have truncated the time axis in panel **A** to show the very short lag phase in the wild-type *G. oxydans*. Also, wild-type *G. oxydans* starts to die after achieving stationary phase after about 25 hours, while the *pst* knockouts tend to survive for much longer. Error bars are calculated from standard deviation of 10 replicates per strain.

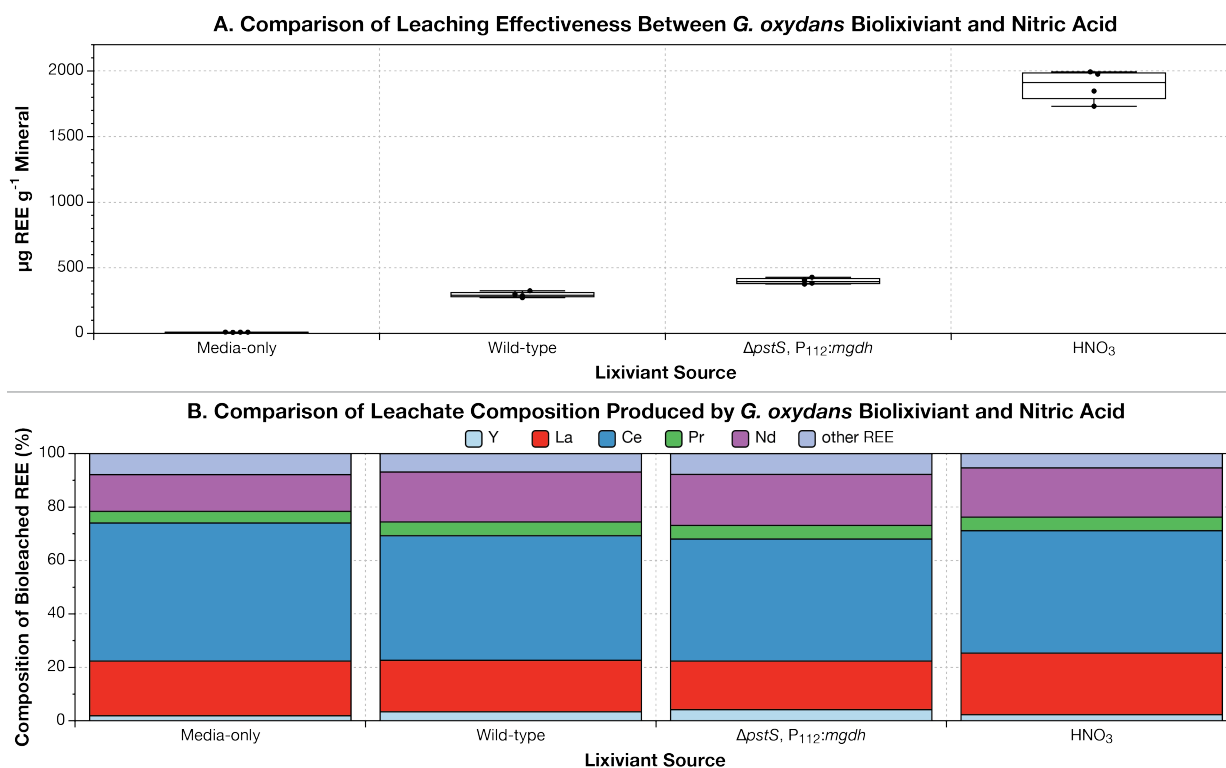


Figure S2. Comparison of REE-leaching with *G. oxydans* biolixiviant and nitric acid. 0.1 g of allanite was suspended in 1 mL of lixiviant (10% pulp density). The mixtures were incubated for 24 hours at room temperature with shaking at 1,500 rpm on an automatic vortexer. All data for this figure can be found in **Dataset S6**. The median total REE extraction is reported next to each box and whisker in panel **A**.

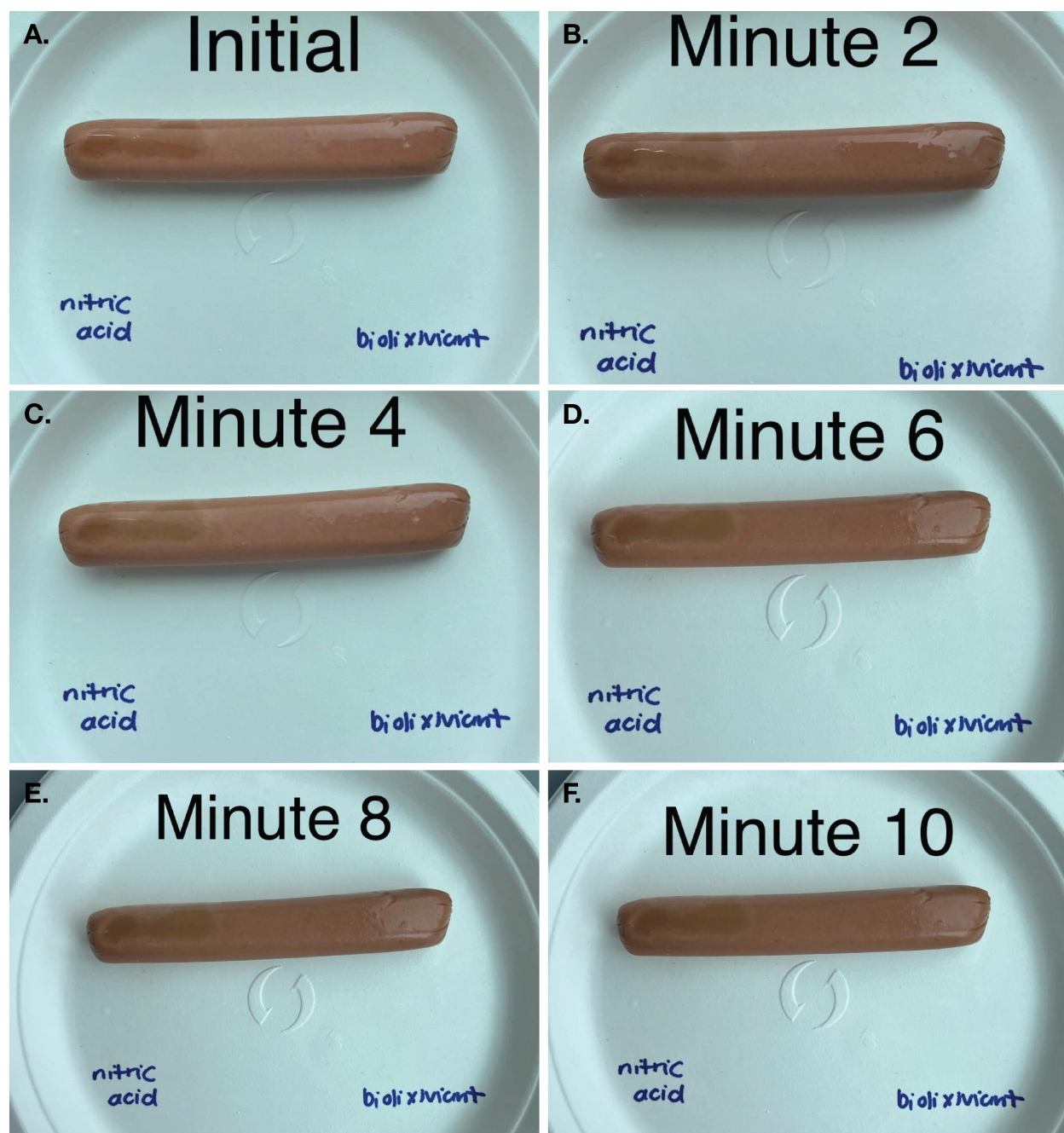


Figure S3. Effect of neat nitric acid and *G. oxydans* Δ *pstS*, *P*₁₁₂:*mgdh* biolixiviant on biological tissue (sort of), part one. We pipetted 100 μ L of nitric acid on the left end of a hot dog sausage and the same amount on the right end. The nitric acid end notably degrades while the biolixiviant end does not.



Figure S4. Effect of neat nitric acid and *G. oxydans* Δ pstS, P_{112} :mgdh biolixiviant on biological tissue (sort of), part two. We submerged a hot dog sausage in biolixiviant (left) and nitric acid (right) for 2 days.