P. putida secretes outer membrane vesicles for extracellular aromatic breakdown

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Background

- Natural microbial conversion processes funnel aromatic compound mixtures into single products and thus have emerged as a means to overcome heterogeneity towards valorization of the plant polymer lignin.
- However, the spatiotemporal mechanisms for lignin catabolism in bacteria – including the chassis microbe *Pseudomonas putida* KT2440 – remain unclear and thus hinder the industrialization of these processes.

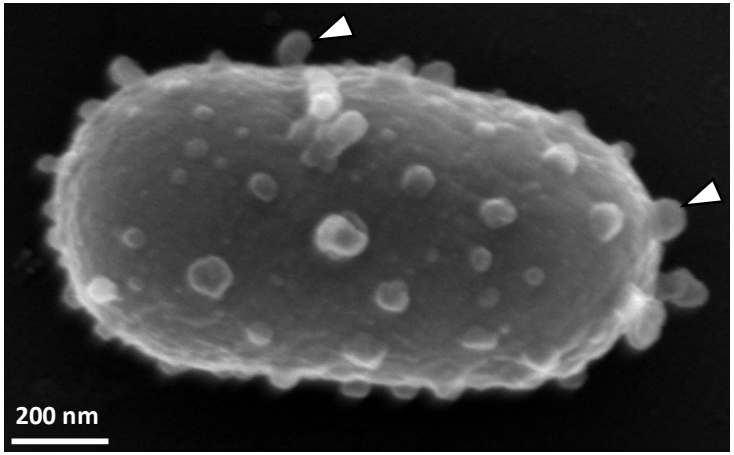
Conclusions

- *P. putida* selectively and dynamically secretes proteins to the extracellular space simultaneous with a reduction in β-O-4 bonds in the lignin substrate.
- Many of these proteins are encapsulated into outer membrane vesicles (OMVs, **Fig. A**), including those involved in the β-ketoadipate (βKA) pathway for aromatic catabolism, which are then secreted to the extracellular milieu.
- OMVs from lignin-rich cultivations covert βKA pathway intermediates *in vitro* and *in vivo,* demonstrating that enzymes within the OMVs are active.

Significance

- We propose a mechanism for nutrient acquisition from aromatic compounds by soil bacteria in the extracellular environment (**Fig. B**) which holds promise for improving microbial lignin conversion.

A



B

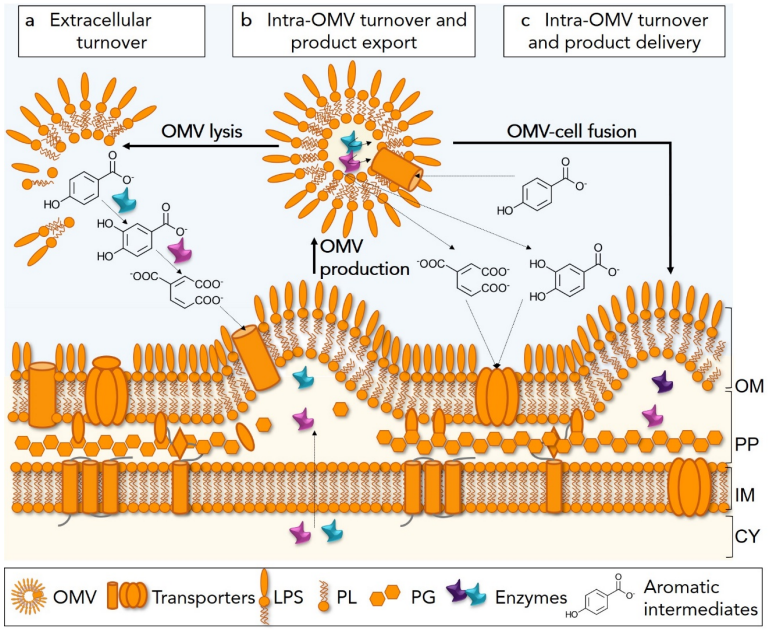


Figure (**A**) A *P. putida* cell imaged by scanning electron microscopy after 72 h of cultivation in lignin-rich medium where the cell surface is covered with "blebbing" outer membrane vesicles (two blebbing events are highlighted with a white arrowhead). (**B**) Model for OMV-mediated nutrient acquisition and/or catabolism of toxic substrates in *P. putida*.

Davinia Salvachúa, AZ Werner, I Pardo, M Michalska, BA Black, BS Donohoe, SJ Haugen, R Katahira, S Notonier, KJ Ramirez, A Amore, SO Purvine, EM Zink, PE Abraham, RJ Giannone, S Poudel, P Laible, RL Hettich, GT. Beckham, "Outer membrane vesicles catabolize lignin-derived aromatic compounds in *Pseudomonas putida* KT2440," *PNAS* 117:9302-9310; (2020) doi.org/10.1073/pnas.1921073117.

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