Researchers develop new 'portable power supply' for engineering microbes

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Penn State engineers have developed a new 'portable power supply' that will make it easier to manufacture plastics, therapeutics, fuels and other chemicals from sustainable feedstocks using diverse microbial organisms.

"Previously, when engineered DNA was found to work well in one organism, researchers would need to start from scratch to engineer a different organism," said Howard Salis, principal investigator and assistant professor of chemical engineering and assistant professor of agricultural and biological engineering. "With our 'portable power supply,' the same genetic parts can be used to engineer many different bacterial organisms. This will have a huge impact on how organisms are engineered to make many different products."

Their engineered system is analogous to the power supply inside all computers that plugs into power sockets and converts fluctuating AC power into a smooth DC current.

Manish Kushwaha, a post-doctoral fellow in agricultural and biological engineering, worked with Salis to build the system. He engineered a genetic circuit that could supply the organism with a portable RNA polymerase, a key enzyme responsible for reading DNA and making RNA, which is central to expressing the organism's genes. But that wasn't the difficult part.

Kushwaha explained, "The trick was to find a way to make the same

amount of RNA polymerase in different organisms without using organism-specific genetic parts. We wanted to find a way to make RNA polymerase inside a cell without relying on the cell's genetic machinery."

The solution was to introduce a genetic control system—a positive feedback loop and a negative feedback loop—so that RNA polymerase could be made in any bacterial cell regardless of differences in the cell's genetic machinery.

As reported in the July 17 issue of *Nature Communications*, Salis and Kushwaha demonstrated how their portable power supply works inside three very different bacterial organisms, showing how the same genetic parts could be used to make a recombinant protein and a 3-enzyme pathway.

The researchers hope their work will accelerate synthetic biology efforts in less well-studied bacterial organisms to better take advantage of their natural manufacturing abilities.

Their paper, titled "A portable expression resource for engineering cross-species genetic circuits and pathways," is available at nature.com.

More information: "A portable expression resource for engineering cross-species genetic circuits and pathways." *Nature Communications* 6, Article number: 7832 DOI: 10.1038/ncomms8832

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