Blocking carbon dioxide fixation in bacteria increases biofuel production

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Reducing the ability of certain bacteria to fix carbon dioxide can greatly increase their production of hydrogen gas that can be used as a biofuel. Researchers from the University of Washington, Seattle, report their findings in the current issue of online journal *mBio*.

"Hydrogen gas is a promising transportation fuel that can be used in hydrogen fuel cells to generate an electric current with water as the only waste product," says Caroline Harwood, who conducted the study with James McKinlay. "Phototrophic bacteria, like Rhodopseudomonas palustris obtain energy from light and carbon from organic compounds during anaerobic growth. Cells can naturally produce hydrogen gas biofuel as a way of disposing of excess electrons."

Feeding these bacteria more electron rich organic compounds though, does not always produce the logically expected result of increased hydrogen production. Harwood and McKinlay analyzed metabolic functions of R. palustris grown on four different compounds to better understand what other variables might be involved.

One factor involved appears to be the Calvin cycle, a series of biochemical reactions responsible for the process known as carbon dioxide fixation. The Calvin cycle converts carbon dioxide and electrons into organic compounds. Therefore carbon dioxide-fixation and hydrogen production naturally compete for electrons.

When they tested a strain of the bacterium, which had been genetically

modified to block carbon dioxide-fixation they observed an increased output of hydrogen from all four substrates.

The Calvin cycle was not the only variable affecting hydrogen production that Harwood and McKinlay identified in the paper. They also determined that the metabolic route a growth substrate took on its way to becoming a building block for making new cells also played a role.

"Our work illustrates how an understanding of bacterial metabolism and physiology can be applied to engineer microbes for the production of sustainable biofuels," says Harwood.

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