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Conversion of CO_2 and xylose to ethylene and organic acids using cyanobacteria

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Algae are very efficient in capture of solar energy and in fixing CO_2. Some strains including our model cyanobacterium*Synechocystis* 6803 can use glucose. Three challenges are identified in the development of algal strains for the production of fuels and chemicals. 1), lipid harvesting is very energy intensive; a product that naturally separates from the cells is preferred. 2), most algae do not naturally grow on xylose and some other sugars, preventing the use of potentially abundant supply of lignocellulosic sugars to supplement photosynthesis for higher productivity in natural day/night cycles. 3), cell growth competes for carbon flux, reducing productivity while increasing cost. Therefore an ideal alga would be able to use both biomass sugars and CO_2, secrete the product out of the cells, with minimal cell growth. Progress has been made at National Renewable Energy Laboratory towards creating such an ideal photosynthetic whole cell catalyst. To address the first challenge, ethylene was produced photosynthetically from CO_2 and it naturally separates from cells and accumulates in culture headspace. To address the second challenge, our cyanobacterium was engineered to utilize xylose, and it enhanced ethylene production. To address the third challenge, we used nitrogen limitation to arrest cell growth, and redirected carbon flux by blocking the synthesis of storage compound glycogen. The cells, in a unique physiological state termed photocatalytic conversion, continued to fix CO_2 and excreted into the medium significant amounts of α-ketoglutarate and pyruvate, with little or no biomass growth. Recent omics data and flux models will be discussed.

Biography

Jianping Yu received his Ph.D. from Michigan State University. He is senior scientist at Biosciences Center, National Renewable Energy Laboratory. He has published more than 20 papers in reputed journals, including omics work, and is trying to apply metabolomics and flux modeling to bioenergy research.

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