79. Integrated Biological Conversion of Gaseous Substrate into Lipids

Peng Hu, Sagar Chakraborty, Hongjuan Liu, Amit Kumar, **Gregory Stephanopoulos**

Department of Chemical Engineering, Massachusetts Institute of Technology, 77 Massachusetts Ave, Cambridge, MA 02139, USA.

Email: gregstep@mit.edu
http://bamel.scripts.mit.edu/gns/

The development of alternative fuel sources and the implementation of appropriate waste gas mitigation technologies have become high global priorities. Although possibilities for alternative sources are being explored, there has been relatively little discussion on gaseous substrates - such as syngas - as potential feedstocks for bioconversion to liquid fuel production. Sources of syngas include effluents of cement or steel manufacturing or the product of coal, methane or biomass gasification. Building on our previous studies, we introduce a two process system where in one stage syngas is converted to acetate and in the other acetate is converted to lipids. In this study, we choose *Moorella thermoacetica* and *Yarrowia lipolytica* as our model microorganisms. Metabolic engineering and process modeling suggest that the acetic acid produced by *M. thermoacetica* can be fed into the bioreactor containing *Y. lipolytica* for lipid production in an integrated system. In the first stage CO_2 is reduced in the presence of H_2 to acetate (30 g L^{-1}), and afterwards this acetate containing stream is fed into a aerobic bioreactor where an engineered *lipolytica* produces a lipid titer of 46 g L^{-1} with a productivity of 0.27 g L^{-1} h^{-1} and lipid content of 59 %. Thus by combining syngas fermentation with lipid production, we show that waste gas can be effectively converted into lipids, and that this integrated bioprocess has potential to be an economically viable technology for the production of alternative fuels. In addition, this finding provides a versatile approach that has the potential for utilizing other feedstocks such as municipal solid waste and food industry waste for the production of alternative fuels and chemicals.

Acknowledgement: This research was supported by the Department of Energy's Genomic Science Program.