Researchers engineer E. coli to produce record-setting amounts of alternative fuel

March 17 2011, By Wileen Wong Kromhout

Researchers at UCLA's Henry Samueli School of Engineering and Applied Science have developed a way to produce normal butanol — often proposed as a "greener" fuel alternative to diesel and gasoline -- from bacteria at rates significantly higher than those achieved using current production methods.

The findings, reported online in the journal *Applied and Environmental Microbiology*, mark an important advance in the production of normal butanol, or n-butanol, a four-carbon chain alcohol that has been shown to work well with existing energy infrastructure, including in vehicles designed for gasoline, without modifications that would be required with other biofuels.

The UCLA team, led by James C. Liao, UCLA's Chancellor's Professor of Chemical and Biomolecular Engineering, demonstrated success in producing 15 to 30 grams of n-butanol per liter of culture medium using genetically engineered Escherichia coli — a record-setting increase over the typical one to four grams produced per liter in the past.

For the study, Liao and his team initially constructed an n-butanol biochemical pathway in E. coli, a microbe that doesn't naturally produce n-butanol, but found that production levels were limited. However, after adding metabolic driving forces to the pathway, the researchers witnessed a tenfold increase in the production of n-butanol. The metabolic driving forces pushed the carbon flux to n-butanol.

"Like human beings, microbes need an incentive to work," said Liao, the study's senior author.

"We created driving forces by genetically engineering the metabolism," said Claire R. Shen, a UCLA Engineering graduate student and lead author of the study.

While certain microbes, including species of the bacteria Clostridium, naturally produce n-butanol, Liao's team used E. coli because it is easier to manipulate and has been used industrially in producing various chemicals.

"By using E. coli, we can make it produce only the compound with no other byproducts," Liao said. "With native producing organisms like Clostridium, which naturally produces n-butanol, there are other byproducts that would add cost to the separation process."

The next step in the research, the researchers say, will be to transfer the study to industry for the development of a more robust industrial process.

The study was funded by the KAITEKI Institute Inc. of Japan, a strategic arm of Mitsubishi Chemical Holdings Corp., Japan's largest chemical company.

Provided by University of California Los Angeles