Enzyme cocktail could eliminate a step in biofuel process

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Conversion of biomass to fuel requires several steps: chemical pretreatment to break up the biomass – often dilute (sulfuric) acid, detoxification to remove the toxic chemicals required in pretreatment, and microbial fermentation to convert the soluble sugars to fuels. Virginia Tech researchers have discovered an enzyme mixture that works in the presence of the toxic infused liquid biomass (hydrolysate), meaning that the detoxification step is unnecessary, reducing the cost of producing biofuels as well as increasing biofuel yields by avoiding the production of by-products and synthesis of cell mass.

The research will be published in the January 2011 issue of the journal *Chemistry & Biology*.

"Enzymes self-assemble a cell-free synthetic pathway; that is, we can put the desired biological reactions to work without the other complex interactions that take place within a cell," said Y.H. Percival Zhang, associate professor of biological systems engineering at Virginia Tech.

"In microbial fermentations, glucose serves as both a growth substrate and a source of energy for generating a reduced power -- NADPH. In fact, only a small fraction of glucose is allocated to NADPH generation," he says. "The cell-free synthetic pathway process increases efficiency and reaction rate."

"By using an enzyme cocktail consisting of 12 purified enzymes and coenzymes, this work has also demonstrated that the enzyme cocktail

systems can work in the presence of microorganism-toxic compounds from dilute-acid pretreated biomass, suggesting that enzyme systems do not require high-purity substrates for biotransformation," said Zhang. "In other words, after pretreatment, we can do bioconversion directly, followed by chemical catalysis," he said.

The article, "Biohydrogenation from Biomass Sugar Mediated by in vitro Synthetic Enzymatic Pathways," was written by Yiran Wang, research scientist in biological systems engineering at Virginia Tech; Weidong Huang, visiting scholar from the University of Science and Technology of China; Noppadon Sathitsuksanoh and Zhiguang Zhu; biological systems engineering Ph.D. students at Virginia Tech; and Zhang.

A previously published article by Huang and Zhang compared the production of four biofuels – ethanol, butanol, fatty acide ethyl ester, and hydrogen, and report that hydrogen production through the synthetic pathway process is the most efficient for biofuels production. "Also, this analysis suggested that it was nearly economically impossible to produce advanced biofuels through aerobic fermentation as compared to anaerobic fermentations and enzyme cocktails," said Zhang.

More information: The article, "Analysis of biofuels production from sugar based on three criteria: thermodynamics, bioenergetics, and product separation," appears in the advanced online Dec. 16, 2010 edition of the journal *Energy & Environmental Science* (pubs.rsc.org/en/Content/Articl … g/2011/EE/C0EE00069H).

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