New discovery turns seaweed into biofuel in half the time

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University of Illinois scientists have engineered a new strain of yeast that converts seaweed into biofuel in half the time it took just months ago. That's a process that's important outside the Corn Belt, said Yong-Su Jin, a University of Illinois assistant professor of microbial genomics and a faculty member in its Institute for Genomic Biology.

"The key is the strain's ability to ferment cellobiose and galactose simultaneously, which makes the process much more efficient," Jin said.

Red seaweed, hydrolyzed for its fermentable sugars, yields glucose and galactose. But yeast prefers glucose and won't consume galactose until glucose is gone, which adds considerable time to the process, he said.

The new procedure hydrolyzes cellulose into cellobiose, a dimeric form of glucose, then exploits a newly engineered strain of Saccharomyces cerevisiae capable of fermenting cellobiose and galactose simultaneously.

The team introduced a new sugar transporter and enzyme that breaks down cellobiose at the intracellular level. The result is a yeast that consumes cellobiose and galactose in equal amounts at the same time, cutting the production time of biofuel from marine biomass in half, he said.

The research, performed with project funding from the Energy Biosciences Institute, included team members Suk-Jin Ha, Qiaosi Wei,

and Soo Rin Kim of the University of Illinois, Urbana-Champaign, and Jonathan M. Galazka and Jamie Cate of the University of California, Berkeley.

Jin compared the previous process to a person taking first a bite of a cheeseburger, then a bite of pickle. The process that uses the new strain puts the pickle in the cheeseburger sandwich so both foods are consumed at the same time.

Co-fermenting the two sugars also makes for a healthier yeast cell, he said.

"It's a faster, superior process. Our view is that this discovery greatly enhances the economic viability of marine biofuels and gives us a better product," he added.

Is seaweed a viable biofuel? Jin and his colleagues are using a red variety (Gelidium amansii) that is abundant on the coastlines of Southeast Asia. In island or peninsular nations that don't have room to grow other biofuel crops, using seaweed as a source of biofuels just makes good sense, he noted.

But biofuels made from marine biomass also have some advantages over fuels made from other biomass crops, he said.

"Producers of terrestrial biofuels have had difficulty breaking down recalcitrant fibers and extracting fermentable sugars. The harsh pretreatment processes used to release the sugars also result in toxic byproducts, inhibiting subsequent microbial fermentation," he said.

Jin cited two other reasons for use of seaweed biofuels. Production yields of marine plant biomass per unit area are much higher than those of terrestrial biomass. And rate of carbon dioxide fixation is much

higher in marine biomass, making it an appealing option for sequestration and recycling of carbon dioxide.

More information: The study appears in *Applied and Environmental Microbiology* and is available online at www://aem.asm.org/cgi/content/full/77/16/5822

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