Termites? gut reactions show how to improve renewable fuel, researchers say

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(PhysOrg.com) -- Termite damage costs the U.S. more than $1 billion each year, but that same destructive power might help solve one of the nation's most pressing economic quandaries: sustainable fuel production.

After years of genetic sequencing, University of Florida researchers are beginning to harness the insects' ability to churn wood into fuel. That ability involves a mixture of enzymes from symbiotic bacteria and other single-celled organisms living in termites' guts, as well as enzymes from the termites themselves.

The team from UF's Institute of Food and Agricultural Sciences spent two years dissecting and analyzing gene sequences of more than 2,500 worker termite guts. In total, they identified 6,555 genes from the termites and associated gut fauna involved in the digestive process.

As the researchers reported Oct. 15 in the online journal *Biotechnology for Biofuels*, they've begun to identify which of these genes encode for enzymes that could significantly improve the production of cellulosic ethanol, a fuel made from inedible plant material that the U.S. Department of Energy estimates could replace half of our gasoline if the production process could be made more cost effective.

"Termites are very unique creatures, and this research helps give the most complete picture of how their systems collaborate to, very efficiently, break down really tough biological compounds to release fermentable sugars," said UF entomologist Mike Scharf, who leads the research.

The team has identified nearly 200 associated enzymes that help break down the problematic plant compound lignocellulose. This compound is the most costly barrier to wide-scale production of cellulosic ethanol because it must be broken down by intense heat or caustic chemicals.

Termites, however, are able to almost completely break down lignocellulose through simple digestion.

“The termite gut is a complicated and exotic package of biodiversity that manages these tasks with an efficiency that you really have to admire,” said Claudia Husseneder, a specialist in the molecular biology of termites at Louisiana State University who was not associated with UF’s research. “Mike’s work is on the cutting edge of understanding this system.”

In September, Scharf and the Savage, Maryland-based Chesapeake-PERL Inc., received a $750,000 grant from the U.S. Department of Energy to help develop his work into a product that can be used to help manufacture cellulosic ethanol.

Termites and their associated single-cell symbiotic organisms probably won’t have much to do with the processes that result from the work—except for their genes, of course. Scharf said that enzyme-producing genes will be transferred to a more controllable creature.

This has commonly meant that the genes would be transferred into genetically modified fungi or bacteria. However, Scharf said the genes would likely be transferred into other insects, such as caterpillars, to produce the enzymes on an industrial scale.

“Insects have played an important role in how this planet functions for millions of years," Scharf said. "They still have a lot they can teach us. There are still many ways we can learn to benefit from Earth's six-legged inhabitants."

Provided by University of Florida (news : web)