Novel enzyme from tiny gribble could prove a boon for biofuels research

June 12 2013

(Phys.org) —Researchers from the United Kingdom, the Energy Department's National Renewable Energy Laboratory (NREL), and the University of Kentucky have recently published a paper describing a novel cellulose-degrading enzyme from a marine wood borer Limnoria quadripunctata, commonly known as the gribble.

Gribbles are biologically intriguing because they exhibit a relatively unique ability to produce their own enzymes instead of using symbiotic microbes to break down the biomass they eat. New biomass-degrading enzymes from novel sources such as the gribble may prove beneficial to the biofuels industry.

Gribbles are 1-3 millimeters in length, but collectively they bore through wood quickly, and are responsible for significant natural and man-made marine timber damage around the world. Scientists at Universities of Portsmouth and York in the United Kingdom and the University of Kentucky in the United States, with researchers from NREL, are hoping to turn that special talent into a source of novel enzymes for the biofuels industry.

A paper describing the crystal structure of a key enzyme produced by the gribble appears online in *Proceedings of the National Academy of Sciences*.

Gribbles live in inter-tidal zones and, similar to termites, they burrow into wood. Gribbles, unlike termites or many other animals including people, do not rely on gut bacteria to make enzymes to aid their digestion. Gribbles instead exhibit a sterile gut, and secrete their own enzymes into their guts made in a special organ termed the heptopancreas that runs the entire length of their body.

Interestingly, several of the enzymes produced by gribbles are in the same important enzyme classes that are typically harvested from fungi in the biosphere for industrially deconstructing the cellulose in biomass. The gribble enzymes hold promise of tolerating salts much better, likely due to the fact they evolved in a marine environment. This unique adaptation may have beneficial implications for the ability of the gribble enzymes to more efficiently operate in a high-solids, industrial environment, breaking biomass down more effectively into sugars, which can then be converted into ethanol or a hydrocarbon fuel to replace gasoline, diesel, or jet fuel.

The biofuels industry needs tough, efficient enzymes that are tolerant of industrial processes. "For biochemical conversion with enzymes, industry needs to push up to very high solids, with very little water around," NREL Senior Scientist Gregg Beckham, one of the co-authors, said. "The structure of the gribble enzyme reveals new evolutionary adaptations that may suggest mechanisms for producing more robust, industrial enzymes for high-solids loadings environments."

NREL ran computer simulations and aided in the structural and biochemical analysis of the enzyme.

The work leading to the paper provided deeper understanding of how the organism adapts and survives. NREL and UK scientists are now examining how features of the gribble enzymes could be incorporated into industrially relevant enzymes and settings.

More information: www.pnas.org/content/early/201 …

/31/1301502110.short

Provided by National Renewable Energy Laboratory