

Digestive ability of ancient insects could boost biofuel development

February 22 2018



The firebrat and silverfish are close relatives and have the ability to digest cellulose. Credit: The University of York

A study of the unusual digestive system of an ancient group of insects has provided new insights into future biofuel production.

Published in *Nature Communications*, the research reveals that the ability of some insects to efficiently digest [cellulose](#) could be exploited for industrial processes, such as the production of sustainable low carbon fuels to cut [greenhouse gas emissions](#) associated with fossil fuel use.

The surprising find occurred when the team at the University of York were investigating the digestive system of firebrats, which had been previously shown to thrive on crystalline cellulose, the natural fibre, abundant in straw, paper and cardboard.

Professor Simon McQueen Mason, from the University of York's Department of Biology, said: "Firebrats belong to one of the most primitive groups of insects; they appeared on land during the Devonian Period, some 420 million years ago. Despite this long evolutionary history, however, these insects have been generally overlooked by scientists. "Cellulose forms the fibres that give the cell walls of plants their strength and has a high degree of structural order, making it solid and tough."

Until now it was a mystery how firebrats had found a way to digest cellulose so effectively. In looking at their digestive system, the scientists discovered something they weren't expecting.

Dr Federico Sabbadin, from the University of York's Department of Biology, said: "Inside their gut the firebrats had a group of uncharacterised proteins that make up 20% of their carbohydrate digestive enzymes.

"On further inspection, these proteins proved to be a new class of [enzyme](#), called [lytic polysaccharide monooxygenases](#) (LPMOs), which attack crystalline polysaccharides. Our study revealed that these enzymes are used by firebrats to greatly increase the rate of cellulose digestion."

Previously, LPMOs were only known to occur in fungi, bacteria and viruses, but analysis of this new family showed it was widespread among invertebrates. Scientists suggest that it is possible that these enzymes could be adopted in [industrial processes](#) to break down cellulose into fermentable sugars for biofuel production.

Professor McQueen Mason said: "These digestive LPMOs appear to have evolved from enzymes that digest a substance called chitin, which protects the respiratory system of insects.

"We found that these ancestral genes are essential for metamorphosis and that interfering with their function is lethal to [insects](#). This could have important implications for the development of new methods to control disease-carrying mosquitoes and agricultural pests such as locusts."

Provided by University of York

Citation: Digestive ability of ancient insects could boost biofuel development (2018, February 22) retrieved 9 April 2024 from <https://phys.org/news/2018-02-digestive-ability-ancient-insects-boost.html>

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