

New molecule may aid in production of biofuels and fungi-resistant plants

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In a recent study published in the *Journal of Biological Chemistry*, scientists report on the discovery of a new molecule that is essential for degradation of the biopolymer chitin. This new molecule could eventually aid in the engineering of fungi-resistant plants and could also lead to the discovery of similar molecules that can be used in cellulose-based biofuel production.

The research appears as the "Paper of the Week" in the August 5 issue of the *Journal of Biological Chemistry*, an American Society for Biochemistry and Molecular Biology journal.

"Chitin is an insoluble molecule that consists of tightly packed chains of polymerized sugars," explains study author Dr. Vincent G. H. Eijsink of the Norwegian University of Life Sciences. "It is synthesized by different crustaceans, mollusks, algae, insects, fungi and yeasts and is a major structural component of these organisms. For example, chitin gives strength and stiffness to the shells/cuticles of shrimps and insects and to the cell walls of fungi. Because chitin is an abundant resource and, most importantly, because it occurs in several types of plague organisms and parasites, chitin degradation is of great interest to humanity. For example, insects might be combated by interfering with their chitin metabolism. Insect viruses need to degrade insect chitin for infection. Fungi may also be combated by degrading the chitin in their cell walls."

More than one billion tons of chitin are produced by insects, fungi, and

marine organisms every year. Despite this abundant production, chitin does not accumulate in most ecosystems, indicating that the molecule is somehow degraded. Many aquatic and terrestrial microorganisms produce enzymes called chitinases which are responsible for breaking down chitin. Because chitin is a very tough molecule, chitinases have quite a challenge. In order to break the bonds between the sugar units, they must gain access to the bonds by somehow disrupting the packing of the sugar chains in the chitin molecule. How exactly chitinases overcome these challenges has been unclear until now.

Interested in learning more about how the breakdown of chitin occurs, Dr. Eijsink and his colleagues investigated chitin degradation by the soil bacterium *Serratia marcescens*. They discovered that in addition to producing chitinases, the bacterium also make a protein called CBP21 which binds to and disrupts the chitin polymer making it more accessible to degradation by chitinases. They showed that adding CBP21 dramatically speeds up the degradation of chitin by chitinases. CBP21 works by binding to chitin through highly specific interactions that disrupt the chitin structure making the individual sugar chains in the chitin polymer more amenable to enzymatic degradation.

The discovery of this new protein that participates in chitin degradation has many potential applications. For example, transgenic plants that expresses both chitinases and CBP21 would be able to combat fungi by degrading chitin in their cell walls. And, a better understanding of natural chitin turnover increases our ability to interfere with chitin metabolism in insects and other plague organisms.

CBP21 also has the potential to aid in the production of biofuel. "In principle, large quantities of chitin are available for exploration, primarily due to fishing and farming of crustaceans such as shrimps," says Dr. Eijsink. "However, a current lack of technology limits the exploitation of these waste streams. CBP21-like proteins may become an

important tool for effective, enzymatic processing of this valuable resource. More in general, one might say that our discovery may lead to discovery of proteins with similar functions in cellulose processing. This may be of major important for the cellulose field and production of biofuel."

Source: American Society for Biochemistry and Molecular Biology

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