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Learning secrets of world's most common organic compound driving research for biofuels

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Preliminary research at Kansas State University may make a difference one day at the gas pump.

Many scientists believe that cellulose, the most common organic compound on earth, has enough energy to be the next source for biofuels -- if a procedure to effectively break it down could be devised. Cellulose is a cell wall component that gives plants their rigidity.

Kathrin Schrick, assistant professor in Kansas State University's Division of Biology, has been awarded nearly $900,000 for the next four years from the National Science Foundation to investigate the role sterols, fat-soluble molecules, play in the cell's production of cellulose.

"If we can understand how it is made and how to break it down into simple sugars, then we can generate energy," Schrick said. "We know that sterols are important in making cellulose, but we are not clear how they work. This grant is funding research that should help us with that."

Cellulose is composed of complex fibers made of sugar. Since its strength functions to keep plant tissue sturdy, it also makes it difficult to break down, Schrick said. It requires harsh pretreatment and expensive enzymes, so Schrick hopes her research will provide an understanding of how cellulose is made, which might give insight on how to break it down more easily.

"Not even the structure of cellulose synthase, the enzyme responsible for activating cellulose machinery, is known. We can model it, we can imagine how it looks but we don't really know, and we know even less about how it functions," Schrick said.

Schrick has two hypotheses for sterols' association with the cellulose machinery. She believes that sterols either help to stabilize the construction of cellulose, or they transfer glucose residues to the machinery to make cellulose.

"We know that the machinery that builds cellulose sits in the plasma membrane. Our hypothesis is that the protein complex that makes cellulose actually needs to directly interact with sterols to function properly," she said.

Her hypotheses came from her discovery of a mutation in a dwarf Arabidopsis plant, a common model species used in scientific research. The mutant plant produces about 50 percent less cellulose than normal plants, causing the plant to be smaller and unable to reach maturity in the wild. Schrick went on to discover that mutations in several enzymes, required for the biosynthesis of sterols, affect the amount of cellulose produced.

"The sterol biosynthesis mutants have shown us that sterols are critical for cellulose synthesis, but we still don't understand why. We are using the latest tools to solve the problem at the molecular level, which will potentially lead to advances in the development of biofuels," she said.

Schrick is collaborating with several scientists nationally and internationally. Among them are Seth DeBolt at the University of Kentucky, a co-principle investigator on the grant, and Vincent Bulone at the Division of Glycosciences in the Royal Institute of Technology in Stockholm, Sweden.

Bulone was one of the first scientists to efficiently synthesize cellulose outside of the cell by gathering all the necessary components needed to build cellulose fibers in a test tube. The level of cellulose synthase activity achieved in Bulone's lab represents the highest proportion of cellulose reported from in vitro synthesis to date, Schrick said.

Provided by Kansas State University

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