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Biofuel from inedible plant material easier to produce following enzyme discovery

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Cambridge researchers have discovered key plant enzymes that normally make the energy stored in wood, straw, and other non-edible parts of plants difficult to extract. The findings, published today in *Proceedings of the National Academy of Sciences*, can be used to improve the viability of sustainable biofuels that do not adversely affect the food chain.

The team based at the University of Cambridge, and now part of the BBSRC Sustainable Bioenergy Centre (BSBEC), has identified and studied the genes for two enzymes that toughen wood, straw and stalks and so make it difficult to extract sugars to make bioethanol or other plant-derived products. This knowledge can now be used in crop breeding programs to make non-edible plant material that requires less processing, less energy and fewer chemicals for conversion to biofuels or other renewable products and therefore have an even lower overall impact on atmospheric carbon.

The research also increases the economic viability of producing sustainable biofuels from the inedible by-products of crops through increasing our understanding of plant structures.

Lead researcher Professor Paul Dupree said: "There is a lot of energy stored in wood and straw in the form of a substance called lignocellulose. We wanted to find ways of making it easier to get at this energy and extract it in the form of sugars that can be fermented to produce bioethanol and other products."

Lignocellulose is an important component of plants, giving them strength and rigidity. One of the main components of lignocellulose is called xylan. Xylan in wood and straw represents about a third of the sugars that could potentially be used to make bioethanol, but it is locked away. Releasing the energy from lignocellulose is an important challenge to tackle as it will allow the production of fuels from plants in a sustainable way that does not affect the food chain.

Professor Dupree continued: "What we didn't want to do was end up with floppy plants that can't grow properly, so it was important to find a way of making xylan easier to break down without having any major effects."

The team studied Arabidopsis plants (a plant that is easy to study in the laboratory) that lack two of the enzymes that build the xylan part of lignocellulose in plants. They found that although the stems of the plants are slightly weaker than normal, they grow normally and reach a normal size. They also tested how easy it is to extract sugars from these plants and discovered that it takes less effort to convert all the xylan into sugar.

Professor Dupree concluded: "The next stage will be to work with our colleagues who are developing new varieties of bioenergy crops such as willow and miscanthus grass to see if we can breed plants with these properties and to use our discovery to develop more sustainable processes for generating fuels from crop residues. We expect to work closely with industrial collaborators to see how we can quickly transfer this research into real applications for transport fuels."

Duncan Eggar, BBSRC Bioenergy Champion said: "As oil reserves deplete, we must urgently find alternatives to oil-based fuels, plastics, lubricants, and other products. This research is a good example where understanding the fundamental biology of plants gives us the foundation to use plants to produce a raft of important products.

"We know that we can store a tremendous amount of energy from the sun in the form of plant material and at the same time capture atmospheric carbon dioxide.

Working in consort with the other five hubs of the BBSRC Sustainable Bioenergy Centre, this research is aimed at improving our ability to release energy stored in plants in a form that is usable in normal everyday applications."

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