18 July 2023

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INTERESTING ENGINEERING

Scientists genetically modify trees to produce more sustainable wood

They engineered trees that are more suitable for fiber production.

Loukia Papadopoulos | Jul 14, 2023 03:26 PM EST

A 2022 study by Ohio State University found that trees today are 30 percent bigger thanks to carbon dioxide. However, despite this fact, wood fiber production has been less efficient and productive in terms of meeting the growing demand for renewable tissue, paper, packaging, textile, and other fiber products.

That's why scientist Daniel Sulis and colleagues have turned to CRISPR editing to design wood where lignin – which must be cleaved and dissolved so fiber production can take place – is more suitable for fiber production.

The research was published in the journal *Science* on Thursday.

"The ability to isolate fibers from wood is largely determined by the content and composition of lignin, a biopolymer recalcitrant to chemical and enzymatic degradation. More than five decades of research have extensively investigated the individual components of lignin biosynthesis," said a press release on the new development.

"However, these efforts have predominantly focused on the modification of single genes or gene families. Here, Daniel Sulis and colleagues show that strategic multiplex CRISPR editing of monolignol biosynthesis genes improves wood properties beyond what can be achieved by editing single genes or gene families. The authors used their approach to generate modified wood composition in a species of poplar tree, where CRISPR editing increased the wood carbohydrate-to-lignin ratio up to 228 percent that of wild type, which sets the stage for more efficient fiber pulping."

Making paper production less polluting

In addition, trees engineered to have less lignin could make paper production less polluting.

"The edited wood alleviates a major fiber-production bottleneck … and could bring unprecedented operational efficiencies, bioeconomic opportunities, and environmental benefits," said the study's authors in their paper.

This isn't the first time scientists have experimented with the genes of trees.

In April of 2022, we reported on researchers at Living Carbon manipulating arboreal DNA to make a new type of tree that more effectively captures atmospheric carbon and holds onto it for a very, very long time.

At the time, Yumin Tao, the company's VP of biotechnology, led the team that figured out how adding a few genes from pumpkins and green algae could supercharge photosynthesis, significantly increasing the amount of carbon an engineered tree can store in its tissues.

Scientists have even been successful at creating lab-grown wood. A team of researchers at MIT engineered lab-grown timber that can replace deforestation-driving products made from real wood. They developed a technique that can produce timber of any shape and size without cutting a single tree.

Study abstract:
Lignin, a polymer formed by phenylpropanoid units, is responsible for the rigidity and resistance of the lignocellulosic cells in wood. In conventional pulp production, lignin must be cleaved and dissolved under alkaline conditions or first sulfonated to make it soluble so that fiber separation can take place. Delignification processes are reagent and energy intensive, leading to costly chemical recovery. Pulp treatment methods to remove wood extractives such as lignin have been developed, but they are not yet economically viable at an industrial scale. Sulis et al. present a multiplex CRISPR genome editing strategy to modify lignin biosynthesis genes and reduce the lignin content of Populus trichocarpa, a species of poplar. This approach could provide a solution to a key operational constraint in the paper and pulp industry.

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