JGIota: Sequencing Shiitakes with David Hibbett

Menaka: And now, a JGIota – a snippet about JGI-supported science. I'm **Menaka Wilhelm**, your host for this iota.

If you ask **David Hibbett**, he'll tell you – shiitake mushrooms are special.

David Hibbett: You know, they've got that sulfur aroma, that onion-like, or garlic-like aroma that's really distinctive. They're like no other mushroom. They're really like no other food I can think of.

Menaka: David is a professor of biology at Clark University in Worcester, Massachusetts. And he has personal experience with these mushrooms,

David Hibbett: Oh, yeah. I love them. I am actually, uh, part Japanese, so I grew up eating shiitake.

Menaka: As well as scientific.

David Hibbett: Well, the shiitake mushroom is *Lentinula edodes* so it's in the genus *Lentinula*. Actually, I've been working on Lentinula since I was in graduate school, so, yeah.

Menaka: And this week, he has a paper on *Lentinula* out in the journal *PNAS*. The *Lentinula* genus includes many fungi – the shiitakes of Asia and Australia, but also other species in Africa, the Americas, New Zealand, and islands in the tropics.

Partly, these fungi are fascinating for the way they decay wood. They're what's called white rot fungi, meaning that shiitakes — and the rest of the *Lentinula* genus — can do something special. They can take a tree stump and break it down completely. They can decompose every single one of its components.

David Hibbett: Including a very tough molecule called lignin, which is a major barrier, for the production of biofuels, for example.

Menaka: In stems, stalks, wood, and leaves, lignin works a little like mortar. It binds together two other plant materials, hemicellulose and cellulose. And lignin locks them together with strong chemical bonds – carbon-carbon bonds, and ether linkages. For chemical engineers, those bonds are a major road bump. Lignin often gets left out, or burned for energy, because it's so hard to break down. But if we could deconstruct lignin the way fungi do, we could turn it into useful fuels and chemicals. And the tools that fungi use to bust lignin are, of course, their enzymes.

David Hibbett: Enzymes are the teeth and claws of a fungus, right?

Menaka: Indeed – and one way to understand those enzymes is to take a look at the genes they come from. **David** and a team of 39 other researchers sampled and sequenced genomes of two dozen fungi from the *Lentinula* genus. They did that with the help of the JGI.

David Hibbett: And when we went in and looked at all of these *Lentinula* genomes, what we found is that they're pretty much all the same in terms of the repertoire of wood decay enzymes.

Menaka: So across dozens of samples, these fungi are all using the same set of enzymes to pull the components of wood apart. Which tells you a couple of things, he said.

David Hibbett: One, that tells us that those enzymes must be really important for *Lentinula* to make its living.

Menaka: Because, if this set of enzymes didn't matter, there would be species out there that evolved to use other enzymes. But since this is a pretty great set of wood decay tools — it can unlink lignin, after all — it shows up across the entire genus. And really, across the world, from the south coast of Brazil to Nepal, for example. Which tells you something else.

David Hibbett: Adaptation to new habitats, adaptation to new environments, doesn't seem to have much to do with changes in the decay apparatus. That's like a genus level characteristic.

Menaka: So that apparatus, that set of wood-busting enzymes, works well in lots of environments and conditions. It's a promising place to look for biomass breakdown inspiration. But as always, there's more to learn! There are *Lentinula* lineages from Vietnam, and the Democratic Republic of the Congo, that have never been genetically sequenced.

David Hibbett: So this is not the last word on *Lentinula* for sure, at least I hope not.