Discovery: Yeast make plant hormone that speeds infection

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Reeta Prusty Rao, assistant professor of biology and biotechnology at Worcester Polytechnic Institute, examines plates on which samples of the yeast *Saccharomyces cerevisiae* are growing. Credit: Patrick O'Connor

In their ongoing studies of how yeast (fungi) can infect a host and cause disease, a research team at the Life Sciences and Bioengineering Center at Worcester Polytechnic Institute (WPI) has made an unexpected discovery. They found that yeast produce a hormone previously known to be made by plants, and that the presence of that hormone in sufficient quantity within the yeast's immediate environment triggers the fungal cells to become more infectious.

The WPI research team led by Reeta Prusty Rao, PhD, assistant professor of biology and biotechnology, working in collaboration with Jennifer Normanly, PhD, associate professor of biochemistry and

molecular biology at the University of Massachusetts in Amherst, reported their findings in the paper "Aberrant synthesis of indole-3-acetic acid in Saccharomyces cerevisiae triggers morphogenic transition, a virulence trait of dimorphic pathogenic fungi" published in the May 2010 issue of the journal *Genetics*. The paper was featured in the "highlights" section of the journal, where the editors called it a "surprising finding."

"This is a well-known plant hormone. In fact, it was first described in plants by Charles Darwin in 1880," Prusty Rao said. "So we were surprised to see it made in yeast, and to see its impact on virulence traits of fungi that cause disease in people."

Commonly called baker's yeast or brewer's yeast, the fungus *Saccharomyces cerevisiae* (*S. cerevisiae*) does not cause human disease. It is, however, a model system for studying other fungi like *Candida albicans* (*C. albicans*) that do cause diseases like thrush and vaginal yeast infections, which affect millions of people each year and are not easily cleared by the handful of anti-fungal drugs currently available. While most fungal infections do not cause serious harm, if one spreads to the bloodstream it can be deadly. Hospitalized patients with catheters or central intravenous lines are at risk, as the fungi can grow on those devices and enter the body. Because of the lack of an effective treatment, the mortality rate for some systemic fungal infections is nearly 45 percent. Prusty Rao's lab explores the basic biology of yeast to better understand the processes of fungal infections and to identify potential targets for new drug development.

Before fungi begin to infect a host, they first undergo a dramatic physical change and grow filaments that look like twigs on a leafless tree. The hormone indole-3-acetic acid (IAA) regulates how plants grow, causing them to extend shoots towards sunlight. Previous work by Prusty Rao and others has shown that yeast take-up IAA from the environment

to stimulate the growth of filaments. In the current study, Prusty Rao's team found that yeast also produce IAA themselves and secrete it into the environment around them. In this manner, the ongoing secretion and uptake of IAA presumably becomes a feedback loop giving the yeast information about the number of yeast nearby. If there are many yeast secreting IAA, then there is more in the environment to take up.

Furthermore, Prusty Rao's team found that when the concentration of IAA reached a certain threshold, the fungus began to change shape and grow filaments (see figure), providing "strong support" for a connection between the yeasts' production of IAA and fungal infection.

"If there is just one yeast cell sitting under your toe nail, then it won't be a problem—but if there are a thousand yeast cells there, then they can begin to filament and cause infection," Prusty Rao noted. "We believe the data show that IAA plays a role in the yeast's ability to know when there are sufficient numbers of them in close enough proximity to try and infect a host, be it a plant or a person."

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