Yeast missing sex genes undergo unexpected sexual reproduction

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An emerging form of the pathogenic yeast *Candida* is able to complete a full sexual cycle in a test tube, even though it's missing the genes for reproduction. And it may also do so while infecting us, according to Duke University Medical Center researchers.

"Sex contributes to the *Candida* yeast species' evolutionary success," said Joseph Heitman, M.D., Ph.D., director of the Center for Microbial Pathogenesis in the Duke Department of Molecular Genetics and Microbiology and co-author of two papers that tell the story in *Nature* and *Current Biology*. "I think the fact that it has a complete sex cycle is likely to play a role in the evolution of drug resistance in this emerging pathogenic yeast species. "

Yeast infections are notoriously hard to treat and yeast are one of the most successful pathogens and commensals in nature, he said. A commensal is an organism that benefits from associating with another organism without affecting the other. Humans are susceptible to three types of yeast infection: thrush (in the mouth and throat), vaginal infection, and a sometimes fatal systemic infection of bloodstream and organs, such as the kidney.

In a paper published online May 24 in *Nature*, Heitman's team reports that eight *Candida* species which have a sexual cycle were missing many of the genes related to reproduction found in other species.

"The unrecognized sex cycle could mean we need to develop new

treatments to combat what is really happening in humans infected by yeast," said co-author Jennifer Reedy M.D. Ph.D.

With co-author Anna Floyd, Heitman and Reedy explored the question further in a study appearing in the May 14 *Current Biology*. The major question was: how could the yeast sexually produce spores when they lack so many genes responsible for meiosis, the process of sexual cell division that reduces chromosomes to half their number in the progeny?

By examining and defining the structure and functions of the mating-type genes in yeast, Reedy learned that forms of *Candida* yeast undergo meiosis but generate offspring of several types. About two-thirds have the classic 50:50 division of chromosomes from the split parent cell, but a third of them have an extra chromosome or even double copies of all chromosomes.

"What we found is that the sexual cycle has a new way to create genetic diversity, and it provides a unique vantage point from which we can explore the mechanisms of sexual reproduction," Reedy said. "This provides a new way to study sexual reproduction and how chromosomal abnormalities arise."

Heitman said that *Candida*'s meiosis without meiotic genes may be what gives rise to the progeny with unusual numbers of chromosomes. "Or maybe the genes were lost for a reason, to provide a route to genetic diversity," Heitman said. "Or maybe these differing types of progeny are the unfortunate consequence of undergoing meiosis without the machinery that species normally have when they reproduce sexually."

Humans, too, have their share of oddly paired chromosomes. "Experts estimate that about 10 to 30 percent of human eggs or fusion products may be aneuploid, with chromosomes from mother and father not paired exactly one to one, but the great majority of those fusions of sperm and

egg don't make it to the implantation and pregnancy stage," Reedy said. "That's why it is important to find models like this, so that we may shed light on related human conditions."

Source: Duke University Medical Center (news : web)