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[Molecular Biology] Taiwan Scientists Identify Genetic Mismatch Causing Yeast Hybrids Sterile

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Academia Sinica Newsletter (2010/07/21) A team of Taiwan researchers have recently identified incompatible genes in three closely-related yeast species, increasing understanding about how distinct species form during the process of evolution. The research, led by Dr. Jun-Yi LEU, an Assistant Research Fellow from the Institute of Molecular Biology at Academia Sinica was published online in PLoS Biology on July 20, 2010.

If one species mates with another, the hybrids produced generally die or are unable to reproduce. From a scientific point of view, these hybrids are useful objects of study as they may offer clues about the intriguing question of how new species form. At the molecular level, one cause of the inability of hybrids to reproduce (reproductive isolation) is the cessation of gene flow between diverging populations, a necessary process for the creation of a new species (speciation). There are various types of genetic incompatibility, one of which is a “nuclear-mitochondrial” mismatch (known as cytonuclear incompatibility). The mitochondrion is a vital organelle playing a key role in cell respiration, the process by which cells produce energy. In a previous study, the same team had observed that a nuclear-mitochondrial mismatch causes hybrid sterility between two yeast species.

In this study, Dr. LEU and his colleagues attempted to determine whether cytonuclear incompatibility is a common cause of reproductive isolation in yeasts. The team investigated hybrids of baker’s yeast (S. cerevisiae) crossed with either S. bayanus or S. paradoxus. Their results revealed that most of the hybrid spores were respiration-deficient, indicating cytonuclear incompatibility. The researchers then went on to identify the genes causing this mismatch. They found that the gene MRS1, which encodes a protein (Mrs1) required to remove an intron from the mitochondrial COX1 gene, and the gene AIM22, which encodes a ligase required for mitochondrial protein lipoylation were responsible.

To trace how this incompatibility evolved, they found that changes in three amino acids are sufficient to make MRS1 incompatible in hybrids. In addition, the functional change of MRS1 is accompanied with the change of COX1 introns, indicating a coevolutionary relationship. Finally, they showed that the incompatibility occurred at different times in the different lineages over the course of yeast evolution, offering strong evidence supporting the speciation gene hypothesis.

The full article entitled “Multiple Molecular Mechanisms Cause Reproductive Isolation between Three Yeast Species” will be available on July 20, 2010 at the PLoS journal website at:
http://www.plosgenetics.org/home.action.

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Further Information:
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