Genetic mismatch keeps yeast species distinct

July 20 2010

How species form and what keeps them distinct from each other, even though they can interbreed, is a key question in evolution. Researchers from Taiwan, led by Dr. Jun-Yi Leu, an Assistant Research Fellow from the Institute of Molecular Biology at Academia Sinica, have recently identified genes in three closely-related yeast species that cause sterility, increasing our understanding of how species can remain distinct. The findings will be published next week in the online, open access journal *PLoS Biology*.

If one species mates with another, the hybrids produced often die or are unable to reproduce. Such hybrids can provide clues about the process of speciation. At the molecular level, one cause of the inability of hybrids to reproduce (reproductive isolation) results from a mismatch between genes, which prevents those genes functioning properly. There are various types of such genetic incompatibility, one of which is a mismatch between genes in the nucleus and those in the mitochondrion (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 caused 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. They investigated hybrids of baker's yeast (*Saccharomyces cerevisiae*) crossed with two other yeast species - either *S. bayanus* or *S. paradoxus*. They revealed that most of the hybrid spores were respiration-deficient, indicating cytonuclear incompatibility. The

researchers then went on to identify 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 for the mismatch.

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 by a change of COX1 introns, indicating a coevolutionary relationship.

"Our results suggest that cytonuclear incompatibility can be achieved by multiple molecular mechanisms and it potentially represents a general mechanism of reproductive isolation in yeast species," said Dr. Leu. "It will be interesting to see whether such mitochondrial-nuclear incompatibility is also involved reproductive isolation in other organisms," he added.

More information: Chou J-Y, Hung Y-S, Lin K-H, Lee H-Y, Leu J-Y (2010) Multiple Molecular Mechanisms Cause Reproductive Isolation between Three Yeast Species. PLoS Biol 8(7): e1000432. doi:10.1371/journal.pbio.1000432