Ameobas: Keeping it in the family

November 25 2008

Starving "social amoebae" called *Dictyostelium discoideum* seek the support of "kin" when they form multi-cellular organisms made up of dead stalks and living spores, said researchers from Baylor College of Medicine and Rice University in Houston in a report that appears online today in the open-access journal *Public Library of Science Biology*.

"In fact, these single cells aggregate based on genetic similarity, not true kinship," said Dr. Gad Shaulsky, professor of molecular and human genetics at BCM. However, it demonstrates a discrimination between "self" and "non-self" that is similar to that seen in the immune systems of higher organisms, he said.

Dictyostelium discoideum begins as a single-celled organism. As long as these single cells have sufficient food and a pleasant environment, they are happy to remain that way. However, when food supplies run low, they first move toward one another to form an aggregate. Eventually the aggregate forms a multi-cellular organism made up of spores that can survive and reproduce, and dead cells that form a stalk. The stalk to spore ratio is about one to four.

"Cooperation is one of the success stories of the evolution of life," said Dr. Joan Strassmann, professor and chair of ecology and evolutionary biology at Rice, "Part of that success involves allowing cooperation in a way that controls conflict. One of the best ways to control conflict is cooperating with genetically similar individuals."

This kind of work is important in understanding biofilms, colonies of bacteria or fungi that can harm humans and other mammals, she said. For example, people with cystic fibrosis are vulnerable to the formation of biofilms that can damage the lungs.

In previous work, the collaborators found that *Dictyostelium* cells sometimes "cheat" by avoiding the deadly stalk pathway, thereby increasing the chances that their genes will be reproduced in future generations.

In this work, they determined that while cheating is still a possibility, the aggregation by genetic similarity reduces the likelihood that the stalk cells will "die" for a genetically distant individual.

"It's not exclusive," said Shaulsky, "but it's a preference. In that context, what are the benefits of cooperating versus the risks? By segregating, they minimize the risk that cells of their genetic similarity will die.'

In the laboratory, the scientists mixed cells from genetically distinct strains and found that they segregate into clusters of genetically similar "kin" after they have aggregated into the multi-cellular form.

"It's as much a self, non-self mechanism as anything," said Strassmann. "The more distant you are genetically, the more able you are to trigger the non-self recognition."

Dr. Elizabeth Ostrowski, a post-doctoral researcher in the Strassmann/(Dr. David) Queller laboratory at Rice and first author on the report, said, "We knew that *Dictyostelium* was unusual in that it brings different genotypes together in the multi-cellular organism. These results suggest that these organisms also have mechanisms to limit the levels of genetic diversity in the multi-cellular organism." A human's cells, for example, have the same genome everywhere in the body because humans begin development as a single cell.

This kind of work shows the strength of *Dictyostelium* as a model for understanding other multi-cellular organisms, she said.

"What role does this discrimination for genetic similarity play in the ability of organisms to become multi-cellular?" she said.

"The big thing we found is that *Dictyostelium discoideum* have social behavior," said Dr. Mariko Katoh, an instructor in molecular and human genetics at BCM and the other first author on the report. "We didn't really know if they could discriminate when the genetic differences were small. That was the surprising part."

In the future, the scientists plan to determine the molecular mechanisms behind the aggregation phenomenon.

Citation: Ostrowski EA, Katoh M, Shaulsky G, Queller DC, Strassmann JE (2008) Kin discrimination increases with genetic distance in a social amoeba. PLoS Biol 6(11): e287. doi:10.1371/journal.pbio.0060287
biology.plosjournals.org/perls … journal.pbio.0060287

Source: Baylor College of Medicine