Researchers discover mechanism that prevents two species from reproducing

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Cornell researchers have discovered a genetic mechanism in fruit flies that prevents two closely related species from reproducing, a finding that offers clues to how species evolve.

When two populations of a species become geographically isolated from each other, their genes diverge from one another over time.

Eventually, when a male from one group mates with a female from the other group, the offspring will die or be born sterile, as crosses between horses and donkeys produce sterile mules. At this point, they have become two distinct species.

Now, Cornell researchers report in the October issue of *Public Library of Science Biology* (Vol. 7, No. 10) that rapidly evolving "junk" DNA may create incompatibilities between two related species, preventing them from reproducing. In this case, the researchers studied crosses between closely related fruit flies, *Drosophila melanogaster* and *D. simulans*. Nearly 100 years ago, scientists discovered that when male *D. melanogasters* mate with female *D. simulans*, normal males survive, but the female embryos die.

"It has remained an unsolved problem," said Patrick Ferree, the paper's lead author and a postdoctoral researcher in the lab of co-author Daniel Barbash, an assistant professor of molecular biology and genetics. "The question is, what are the elements that are killing these female hybrids and how are they doing that?"

The researchers found that the female hybrid embryos died very early in development. In most species, when the male's sperm (carrying either an X or Y chromosome) fertilizes the female's egg (containing an X chromosome), a new cell forms with a single nucleus containing a sex chromosome from each parent. If the offspring inherits its father's X chromosome, it becomes female; if it inherits a Y chromosome, it becomes male. Ferree and Barbash found that a unique segment of DNA in the father's X chromosome leads to embryo death of hybrid females.

The segment of DNA was found in the chromosome's heterochromatin, a densely packed region of highly repetitive sequences of junk DNA near the chromosome's center.

During the embryo's initial divisions, the researchers found, a specific segment of heterochromatin gets "sticky" and halts the process, preventing the entire X chromosome from separating properly; the result is that the early embryo dies.

Researchers have known that DNA in heterochromatin evolves faster than in other parts of the genome. Also, during early development, the proteins required for cell division come from the mother. The researchers speculate that the heterochromatin of the male D. melanogaster's X chromosome has rapidly evolved, such that after mating, the machinery involved in DNA packaging from a *D. simulans* mother no longer recognizes the D. melanogaster father's "junk" DNA, Ferree said.

The problematic region of D. melanogaster's X chromosome contains about 5 million base pairs of DNA, while the same region of *D. simulans*' X chromosome contains only about 100,000 base pairs, a 50-fold difference, said Ferree.

"It points to a species-specific difference in heterochromatin between these two species," he added. "This could explain other instances when you have female hybrid lethality," Ferree said.

Source: Cornell University (news : web)