Silencing of jumping genes in pollen

February 5 2009

Scientists at the Instituto Gulbenkian de Ciência (IGC), in Portugal, are to date the only research group in the world capable of isolating the sperm cells in the pollen grain of the model plant Arabidopsis thaliana. This technique was crucial in a study to be published in the latest issue of the journal Cell, which describes how mobile sequences of DNA (called transposable elements) are silenced in the sperm cells, thus ensuring suppression of the mutagenic effects of these DNA elements.

Jörg Becker, José Feijó and their team, at the IGC, and Robert Martienssen and colleagues, at the Cold Spring Harbor Laboratory, CSHL,in the USA, have unveiled a mechanism for controlling transposable elements that appears to be extensible to other eukaryotes, such as the fruit fly, amoebae and algae.

Transposable elements are very common in all known genomes. In the human genome, for example, they make up 45% of the total genome. They are involved in the evolution of genomes, since when integrated back into the genome they can affect the function and organisation of other genes. However, transposable elements are mutagens, and, therefore, their activation needs to be under tight control, as it may be harmful to the cell and the organism. If such harmful mutations occur in sexual cells, they will be transmitted to the progeny and spread in the population.

Keith Slotkin of the Martienssen lab made the surprising observation that, unlike other cells in the adult plant, transposable elements are highly active in the pollen grain of Arabidopsis thaliana. Pollen grains

contain two sperm cells (the sexual cells) and an accompanying vegetative nucleus, whose DNA is not passed on to the next generation. Thanks to the technique developed by Jörg Becker's team, the researchers were able to pinpoint the location of the transposable elements' activity to the vegetative nucleus.

The researchers wanted to understand why the transposable elements weren't activated in the sperm cells. Using the sperm cell sorting technique developed at the IGC, they found that small interfering RNA's (siRNAs) accumulate in the neighbouring sperm cells, where they supposedly target the transposable elements and lead to their silencing, thus preventing the deleterious effects that their activation could have in ensuing plant development.

Says Jörg Becker, 'Overcoming the hurdles in optimising the technique was only possible because at the IGC groups researching pollen development work side-by-side with others developing cell-sorter techniques for lymphocytes. We are now able to look at the activation pattern of genes in sperm cells and are gathering surprising findings that these cells are genetically more active than previously thought. This pattern is now gradually being dissected to try to unravel the role of the genes activated in sperm cell in development of the sperm cells themselves and potentially even in the development of the embryo after fertilization.

This study suggests that also in other eukaryotic organisms which have companion cells to the sexual cells, this mechanism of silencing of transposable elements via siRNA synthesis in adjacent nuclei to the ones that carry hereditary genetic information may be acting.

Source: Instituto Gulbenkian de Ciencia