Parasites or not? Transposable elements in fruit flies

February 3 2012

The problem of parasitism occurs at all levels right down to the DNA scale. Genomes may contain up to 80 percent "foreign" DNA but details of the mechanisms by which this enters the host genome and how hosts attempt to combat its spread are still the subject of conjecture. Important new information comes from the group of Christian Schlotterer at the University of Veterinary Medicine, Vienna. The findings are published in the prestigious journal *PLoS Genetics*.

Nearly all organisms contain pieces of DNA that do not really belong to them. These "transposable elements", so called because they are capable of moving around within and between genomes, generally represent a drain on the host's resources and in certain cases may lead directly to disease, e.g. when they insert themselves within an essential host gene. The factors that govern the spread of transposable elements within a population are broadly understood but many of the finer points remain unclear. New work at the University of Veterinary Medicine, Vienna (Vetmeduni Vienna) may pave the way to a more profound knowledge of the intracellular battle that is constantly being played out between the host and invading DNA.

Robert Kofler and Andrea Betancourt in Schlötterer's group at the Vetmeduni Vienna's Institute of Population Genetics used new sequencing technologies to examine the variation in transposable elements within a population of fruit flies. Similar investigations had been undertaken previously but the scientists incorporated a number of refinements to ensure that their analysis considered both known and

previously unknown sites of insertion. For the first time, the researchers were able to catalogue all the transposable elements in a population of flies. And importantly they were also able to determine how frequently transposable elements occur at each particular site of insertion.

The findings were dramatic. The flies contain transposable elements at a large number of sites in the genome, although many insertion sites are affected in relatively few individuals. These are presumably sites of recent insertion and only the future will tell whether the elements are maintained there. Some older insertion sites are widespread but the majority seem not to be "fixed" in the population. In other words, most transposable elements are somehow purged before they become established. Schlötterer sums up the results by stating that "the genome is like a record of past wars between hosts and the parasitic DNA. There have been waves of attacks and the majority of them have been repelled, with only few transposable elements managing to survive and spread throughout the population."

Even more surprisingly, the scientists found about a dozen sites of insertion that were more frequent in the population than would be expected from their age (assessed via a different method). It seems, then, that there is positive selection for transposable elements at these sites, suggesting that insertion has a beneficial effect on the host. Such an effect had previously been shown for two insertions that give increased resistance against insecticides and these cases were refound by Schlötterer's analysis. The functions of the genes closest to the remaining insertions are highly diverse, so how the transposable elements may benefit the flies is unclear. As Schlötterer puts it, "perhaps we shouldn't really think of transposable elements as parasites at all. They represent a way for organisms to increase their genetic repertoire, which may be advantageous in helping them meet future challenges."

More information: The paper 'Sequencing of Pooled DNA Samples

(Pool-Seq) Uncovers Complex Dynamics of Transposable Element Insertions in Drosophila melanogaster' by Robert Kofler, Andrea J. Betancourt and Christian Schlötterer has just been published by the open access journal *PLoS Genetics*.

Provided by University of Veterinary Medicine -- Vienna