Evidences of transposable elements activity in modular biological systems: gene clusters and the brain

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Abstract

Transposable elements (TEs) are DNA sequences capable to move from their genomic location to a new one. They have been considered as “junk” for a long time: DNA without any useful role, with the only purpose to survive within the host genome as parasites. Their activity can alter the genomes inducing mutations; however, it is increasingly evident that these elements have played an active role in the evolution by providing genomic sequences that can be used by the host genome to evolve novelties, for example acting as alternative promoters or enhancers.

TEs were found to be active in the brain of mammals suggesting their involvement in the diversification of neuronal functions. For this reason, the hypothesis of a role of TEs in the evolution and development of cognitive abilities has been proposed. Recently, a TEs expansion has also been observed in the *Octopus bimaculoides* genome. Similarly to mammals, octopuses present a complex nervous system and are considered extremely intelligent. Previously, a full-length element in the *Octopus vulgaris* neural transcriptome has been found in my laboratory, suggesting a potential somatic TEs activity in the octopus brain.

TEs were shown to be also a source of novel genes and exons. For instance, protein domains evolved from TEs have been described, such as a specific zinc finger (ZnF) DNA-binding domain in plants. Genes codifying for ZnF proteins are often found in many metazoan species to be organized in gene clusters, groups of co-localized genes encoding for proteins with similar function and domain composition. The observation that TEs are generally enriched in these regions suggested that TEs have actively contributed to the expansion and evolution of gene clusters.

In this work, with the aim to deciphering the complex organization of the genome and gain insight into the evolution of cellular complexity and intelligence of living organisms, I provide evidences of somatic TEs activity in the octopus brain and explore the hypothesis that an evolutionary relationship between TEs and gene clusters exists.