DOI: 10.1007/s10577-008-1922-2

Satellite DNA: Hallmarks of chromosome evolution and genome remodelling

R. Chaves
Institute for Biotechnology and Bioengineering, Centre of Genetics and Biotechnology of the University of Trás-os-Montes and Alto Douro (IBB/CGB-UTAD), 5001-801 Vila Real, Portugal

Heterochromatic regions harbour satellite DNA sequences which are a very dynamic component of mammalian genomes, constituting an important factor of genomic plasticity. Recent research provides a large and growing body of evidence indicating that tandem repetitive sequences and satellite DNA play an important role in mammalian evolution by promoting chromosomal rearrangements. Moreover, satellite DNAs and their transcripts seem to have an active regulatory role in eukaryotic organisms; chromatin modulation and control of gene expression are some of the traits in which satellite DNAs could be involved.
Different satellite sequences co-exist in the genome, forming a satellite DNA library made of independent evolutionary units that are ruled by the mechanisms of concerted evolution, leading to the emergence of species-specific satellite profiles. Changes in satellite DNA can be correlated with chromosomal evolution and influence the evolution of species.
There are several conjectures portrayed to explain the active role of satellite DNA in genomes remodeling. Since the breakpoints occur in the repetitive DNA blocks, the chromosome rearrangements would have low effects on the euchromatic genome by keeping syntenic segments intact. Another intriguing fact is that in the different mammalian evolutionary pathways subsequent incorporation of satellite DNA sequences occurs at repositioned centromere sites, but what the evolutionary advantage is of having repetitive DNA at centromeres remains a mystery. Some of the suggestions for this evidence are that the satellite DNA at centromeres might increase the loading of constitutive proteins, or promote a heterochromatic environment more favourable for sister chromatid cohesion. However, further experiments are needed to find conclusive evidence about the causal involvement of satellite DNA in chromosomal evolution and will certainly allow the ascertainment of the mechanisms that effectively explain the role of satellite DNA in chromosome and in genome evolution.
Here, special emphasis will be given to the “hallmarks” that constitute true evidence of the involvement of heterochromatic regions and satellite DNA in the evolution of chromosomes and in genomes’ remodelling. The value of satellite DNA markers in the reconstruction of group phylogenies, models for chromosome rearrangement and implications in function will be highlighted with examples from various mammalian groups such as Cetartiodactyla, Rodentia and Carnivora.