THE ORIGIN AND EVOLUTION OF THE MITOCHONDRIAL GENOME

Summary

The origin of the eukaryotic cellular organisation was one of the most important evolutionary breakthroughs. Current models closely tie the origin of the eukaryotic cell to the endosymbiotic acquisition of mitochondria, that descent from the eubacterial lineage. Currently existing amitochondriate eukaryotes have organelles that appear to be degenerate mitochondria, deprived of the respiratory function, suggesting that the last common ancestor of Eukaryotes did contain a mitochondrial symbiont. In the course of evolution the organellar genome lost most of its informational content, most likely due to the degenerative effect acting on isolated asexual populations, known as the Müller's ratchet. In modern eukaryotes it encodes only a handful of proteins, while the majority of the mitochondrial proteome is encoded in the nucleus. Mitochondrial proteins are encoded partly by ancient eubacterial endosymbiont's genes that were transferred to the nucleus, partly by host's genes descended from the archaebacterial ancestor, and partly by genes of other origins, like the mitochondrial RNA polymerase genes, derived from bacteriophages. Why the mitochondria still retain their rudimentary genome, that requires a considerable expense to maintain and express, is not clear. Several explanations were put forward, linking the persistence of the mitochondrial genome to the particular biophysical properties of the proteins it encodes, or to its role in adaptation to the requirements of the environment.