

Mitochondrial synthesis of nucleic acid and protein synthesis

Mitochondria are equipped with a special genetic apparatus. Mitochondrial genes encode special ribosomal RNA (**15S** and **21S**), the ribosomal protein var-a, all mitochondrial tRNAs (more than 20), three of the nine subunits of cytochrome oxidase, apocytochrome B, and a few subunits of ATPase. Most of the mitochondrial proteins are encoded by nuclear DNA and synthesized in the cytoplasm.

Replication of mitochondrial DNA

Mitochondrial division **is not** coupled to cell nuclear division. Mitochondrial DNA (mtDNA) is found in the matrix. Human mtDNA is circular dsDNA composed of **16,569** bp. The light (L) and heavy (H) chains are distinguished according to their density when centrifuged in a CsCl gradient. Replication begins at a defined position (ori-H). It starts with displacement of the H chain by the newly synthesized H chain (so-called D-loop). The L chain is a template chain. After the DNA-polymerase γ reaches 2/3 of the total length of the DNA, it releases ori-L, from which the synthesis of the new chain L starts in the opposite direction. By the DNA-gyrase, both of the new double helices are gyrating into the superscrews.

Mitochondrial transcription

Transcription is catalyzed by a **special** mitochondrial RNA polymerase. In human mitochondria, it is initiated from only **two sites**, and the resulting transcripts are then split and edited into functional RNA. These are **two** rRNAs, **22** types of tRNAs and **13** different mRNAs, containing very few untranslated sequences.

Mitochondrial translation

Some mitochondrial tRNAs read up to 4 kinds of codons. The mitochondrial genetic code has its own specificities:

- AGA and AGG are terminators, outside the mitochondria they encode arginine;
- UGA, on the other hand, is not a terminator in the mitochondria, but a codon for tryptophan;
- AUA encodes methionine, not isoleucine.

None of the mitochondrial translation products leave the organelle. Most of the mitochondrial components are encoded by nuclear DNA and are synthesized by eukaryotic cytosolic ribosomes as protein precursors with signal sequences. They are then transported into the mitochondria by a process requiring ATP. It is possible that some mitochondrial genes moved into the nucleus during the evolution of life and vice versa. The expression of mitochondrial and nuclear genes for mitochondrial components is coordinated.

Sources

Related articles

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Bibliography

- ŠTÍPEK, Stanislav. *Stručná biochemie : uchování a exprese genetické informace*. 1. edition. Medprint, 1998. ISBN 80-902036-2-0.