Biosynthesis of nucleic acids and proteosynthesis in mitochondria

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

Mitochondrial DNA replication

The division of mitochondria is not coupled with the division of the cell nucleus. Mitochondrial DNA (mtDNA) is found in the matrix. Human mtRNA is a circular dsDNA composed of 16569 bp. Light (L) and heavy (H) chains are distinguished according to the density during centrifugation in a CsCl gradient. Replication starts at a defined location (Iori-H). It starts by displacing the H chain with the newly synthesized H chain (the so-called D-loop). The string L is a matrix. After DNA polymerase γ reaches 2/3 of the total DNA length, it releases ori-L, from which the synthesis of a new chain L begins in the opposite direction. Both new double helices are coiled into superhelices with gyrase.

Mitochondrial transcription

Transcription is catalyzed by a special mitochondrial RNA polymerase. In human mitochondria, it is initiated from only two sites, the resulting transcripts are then cleaved and edited into functional RNA. There 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 peculiarities:

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

No mitochondrial translation products leave the organelle. The majority of mitochondrial components are encoded by nuclear DNA and are synthesized by cytosolic ribosomes in the form of 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. Expression of mitochondrial and nuclear genes for mitochondrial components is coordinated.

Links

Related Articles

- Mitochondria
- Energy system of the cell
- Genetic makeup of mitochondria
- Matroclinic inheritance
- Mitochondrial disease
- Mitochondrial neurogastrointestinal encephalomyopathy

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Source

- ŠTÍPEK, Stanislav. *Stručná biochemie.* 1. edition. Medprint, 1998. ISBN 80-902036-2-0.

Reference

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