

Transcription factors with a homeodomain

One of the most important types of TF (transcription factor) are **homeodomain proteins**.

- contain a highly conserved **homeodomain** composed of 60 amino acid residues, which include a DNA-binding helix-loop-helix motif. In addition, TFs may also contain other conserved sequences (e.g., Engrail genes, Lim genes, PAX genes, etc.).
- the homeodomain is encoded by a sequence of 180 nucleotides - the **homeobox**. These sequences were first observed in the *Drosophila* homeotic genes *antennapedia* and *bithorax*.
- The *Drosophila* m. gene complex consists of 8 genes containing a homeobox localized in 2 clusters on 1 chromosome.
- humans have **39 homologous homeobox genes - HOX** localized in 4 clusters on 4 different chromosomes.
- genes are activated and expressed in a precise order **in the direction 3'→5' according to their position on the chromosome**. This implies that in humans the 3'-genes are expressed earlier and earlier than the 5'-genes.

Functions of Hox genes

- play an important role in **craniocaudal body organization** and **differential (spatiotemporal) regulation** of some important developmental genes.
- Hox genes were originally thought to act only along the main body axis, but later it was shown that they are also expressed in *specific non-axial structures* of various organs (intestine, fingers, limbs), blood cells, sex organs, hair follicles.
- regulation of Hox genes is complex, the main regulator is along the anteroposterior axis **retinoic acid**. Also, after transcription, the mRNA of these genes can be inactivated by microRNAs.
- Hox gene mutations lead to morphological changes in the segmented structure:
 1. loss-of-function mutations - pre-recessive changes;
 2. gain-of-function mutations - back-to-front changes.

Links

Related articles

- Genetic control of differentiation in ontogeny

External links

- Transcription factors
- PAX genes

References used

- NOVOTNÁ, Božena – MAREŠ, Jaroslav. *Vývojová biologie pro mediky*. 1. edition. Praha : Karolinum, 2005. pp. 99. ISBN 80-246-1023-X.