Abstract (ENG)

Model organisms are essential tools in biological research, offering insights into the biology of other organisms. This research approach is enabled by the shared evolutionary origins of all living organisms and the conservation of metabolic and developmental pathways, as well as genetic material, over time. A broad range of model organisms supports biological research, from prokaryotes like bacteria and viruses to eukaryotes, including yeast, algae, and multicellular organisms. Widely used animal models include *C. elegans*, *Drosophila*, *Xenopus*, zebrafish (*Danio rerio*), chicken, mouse, and rat, with alternative models like medaka (*Oryzias latipes*) employed for specific research needs.

In this thesis, we demonstrate the potential of medaka as an alternative model organism for studying transcriptional regulation. The studies described here provide evidence that medaka is an excellent model organism and, in some cases, may be more suitable than the commonly used zebrafish.

The first case study explores the use of medaka as a model organism for analyzing gene function, focusing on *Pax6*, a key regulator of eye development across species. *Pax6* governs numerous target genes essential for ocular formation, yet its role during embryonic eye development remains less understood outside of mouse studies. Medaka, with three pax6 genes (*Pax6.1*, *Pax6.2*, and *Pax6.3*), is a more suitable model than zebrafish for studying pax6 genes in teleost fish, as zebrafish possess two *pax6.1* genes and lack *pax6.3*. The presence of *pax6.3* in medaka offers a valuable opportunity to investigate *pax6* genes from an evolutionary perspective.

The second part of this thesis describes two independent studies that demonstrate the potential of medaka for transgenic research. The first study uses medaka to investigate the role of the *Pitx2* gene and its enhancer, known as the asymmetric enhancer (ASE), in the epithalamus. Medaka allows for observation of gene expression patterns and assessment of changes following ASE mutagenesis, even in the F0 generation. The second study employs both medaka and zebrafish to examine the role and evolutionary conservation of the novel *Pax6* enhancer IrisE, illustrating the effective use of medaka as a complementary model alongside zebrafish.

In conclusion, this thesis highlights medaka's potential as a valuable model organism, particularly for studies of gene regulation and developmental biology. By emphasizing its unique advantages and complementarity to zebrafish, the findings presented here advance our understanding of transcriptional regulation and evolutionary genetics in vertebrates.