Differential Evolution of Duplicated Medakafish mitf Genes

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Abstract:

Gene duplication is a major force of evolution. One whole genome duplication (WGD) event in the fish ancestor generated genome-wide duplicates in all modern species. Coloration and patterning on the animal body surface exhibit enormous diversity, representing a mysterious and ideal system for understanding gene evolution. Surface colors and patterns are determined primarily by pigment cells in the skin and eye. Thus, microphthalmia-associated transcription factor (Mitf) as a master regulator of melanocyte development is excellent for studying the evolution of WGD-derived gene duplicates. Here we report the evolution of mitf duplicate, mitf1 and mitf2, in the fish medaka (Oryzias latipes), which encode medaka co-homologs Mitf1 and Mitf2 of the mouse Mitf. Compared to mitf1, mitf2 exhibits an accelerated sequence divergence and loses melanocytic expression in embryos at critical developmental stages. Compared to a Xiphophorus counterpart, the medaka Mitf2 displayed a reduced activity in activating melanogenic gene expression by reporter assays and RT-PCR analyses. We show that the medaka Mitf2 has the ability to induce melanocyte differentiation in medaka embryonic stem cells but at a remarkably reduced efficiency compared to the Xiphophorus counterpart. Our data suggest differential evolution of the medaka mitf duplicate, with mitf1 adopting conservation and mitf2 employing degeneration, which is different from the duplication-degeneration-complementation proposed as the mechanism to preserve many gene duplicates in zebrafish. Our finding reveals species-specific variations for mitf duplicate evolution, in agreement with enormous diversity of body coloration and patterning.

Key Word:
mitf, gene duplicate, melanocyte, neural crest, pigmentation.

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