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## 1 Introduction

Coloration is a prominent trait in fish that is closely linked to their market value. *Sinibrama taeniatus* is an endemic fish in the upper Yangtze River that is highly valued for its ornamental and edible properties. In this study, we identified three chromatophore types in *S.taeniatus* and investigated changes in body color, chromatophores, and pigments at different developmental stages. Through RNA-seq and WGCNA analysis, we found a total of 4 pathways and 8 genes that may be highly correlated with the pigmentation of *S.taeniatus*.

## 2 The types of chromatophores in *Sinibrama taeniatus*

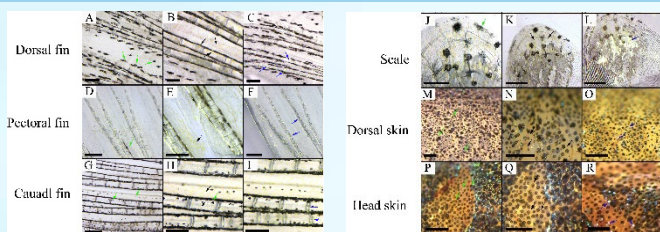


Figure 1 The morphological characteristics of chromatophores in *Sinibrama taeniatus*. (A–C) Chromatophores on dorsal fin; (D–F) Chromatophores on pectoral fin; (G–I) Chromatophores on tail fin; (J–L) Chromatophores on scale; (M–O) Chromatophores on dorsal skin; (P–R) Chromatophores on head skin. The green, black, and blue arrow indicates melanophore, xanthophore, and iridophore, respectively. The scale bar in Figure 1A–L is 0.5 mm.

Three types of chromatophores, black melanophore, yellow xanthophore, and silvery or blue iridophore were identified in *S. taeniatus*. These chromatophores form three monolayers, with iridophores on the top layer, melanophores in the middle layer, and xanthophores on the bottom layer.

## 3 Changes in chromatophores and pigments along with body color formation

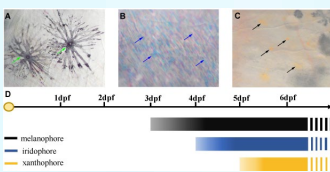


Figure 2 Time of the first occurrence of chromatophores in *Sinibrama taeniatus*. (A) Melanophore; (B) Iridophore; (C) Xanthophore; (D) Time table of the first appearance of every types of chromatophores.

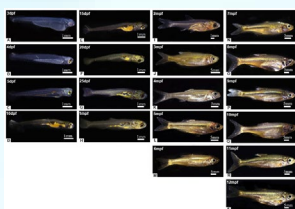


Figure 3 The body color of *Sinibrama taeniatus* at different developmental stages.

The appearance of melanophores was observed at 3 dpf followed by iridophores at 4 dpf and xanthophores at 5 dpf. In *S. taeniatus*, the larval and juvenile stages exhibit a translucence color due to the low pigmentation in most regions. The body colors of *S. taeniatus* are not fully developed until 12 mpf, with high concentrations of pigments such as melanin, guanine, peridine, and carotenoid at this stage.

## 4 Key pathways involved in pigmentation

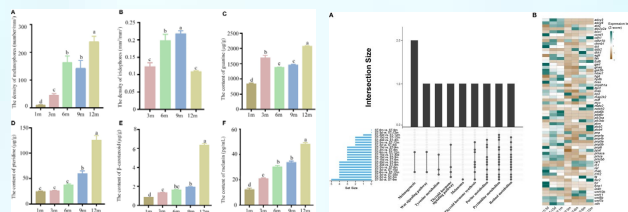


Figure 4 The chromatophores and pigments of *Sinibrama taeniatus* at different developmental stages

Figure 5 Enriched KEGG and DGEs in different developmental stages of *S. taeniatus*. (A) Significantly enriched KEGG items of DEGs. (B) Dynamic expression profiles of DEGs.

Four pathways with high frequency, including retinol metabolism, thyroid hormone synthesis, purine metabolism, and pyrimidine metabolism, may be closely related to pigmentation in *S. taeniatus*.

## 5 Hub genes involved in pigmentation

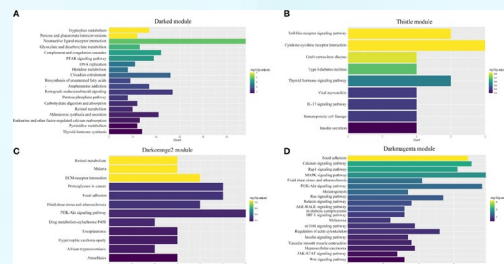


Figure 7 Enrichment analyses of four significant modules. (A) Darked module; (B) Thistle module; (C) Darkorange2 module; (D) Darkmagenta module.

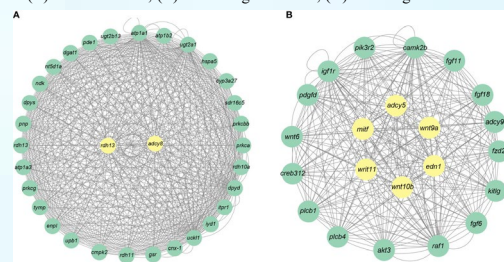


Figure 8 Gene co-expression networks for the darked and darkmagenta modules. (A) Darked module; (B) Darkmagenta module.

Co-expression network analysis identified two hub genes (*adcy8* and *rdh8*) in the darked module and six hub genes (*mitfa*, *wnt9a*, *wnt10b*, *wnt11*, *adcy5*, and *edn1*) in the darkmagenta module, highlighting their potential roles in pigmentation.

## 6 Conclusion

In this study, we examined the changes in chromatophores and pigments associated with body color formation in *S. taeniatus*. We identified key pathways and genes involved in pigmentation using transcriptome analyses, which will provide valuable information for studying the molecular mechanisms underlying body pigmentation in teleosts.