



Genome-wide identification and skin expression of immunoglobulin superfamily in discus fish (*Symphysodon aequifasciatus*) reveal common genes associated with vertebrate lactation

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Introduction

- Discus fish *Symphysodon spp.* employs an unusual parental care behavior where free-swimming fry biting skin mucus of parents as a source of nutrition after hatching.
- The immunoglobulin superfamily (IgSF), refers to a combination of at least one immunoglobulin (Ig) domain, is one of the largest superfamilies in vertebrate genomes.
- Despite the potentially important role of immunoglobulin in discus fish, there is no systematic and comprehensive identification, especially related to its unique "lactation" behavior.
- In this study, discus IgSF proteins with at least one type of Ig domain were identified on the basis of whole-genome data.

Materials and methods

- The comprehensive analysis including phylogenetic construction, gene structures, chromosome location, conserved motifs, and gene duplications of the IgSF genes in discus fish were further investigated.
- Skin samples of seven periods of discus fish were collected for RNA-seq analysis, including be sexually mature but were not currently engaged in a breeding activity (NB), eggs spawned (E), eggs hatched (H), free-swimming fry bit on parents' skin mucus on the first day (D1), on the seventh day (D7), on the fourteenth day (D14) and on the fifth day after fry stopped biting on parents' skin mucus (NP).

Results

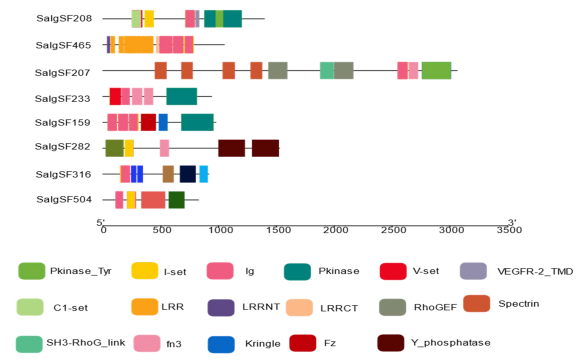


Fig. 1 Domain Analysis of IgSF discus fish

We found five types of Ig domain, including immunoglobulin, immunoglobulin C2-set_2, immunoglobulin C1-set, immunoglobulin I-set and immunoglobulin V-set, and 50 types of other associated domains by using PFAM and SMART analysis.

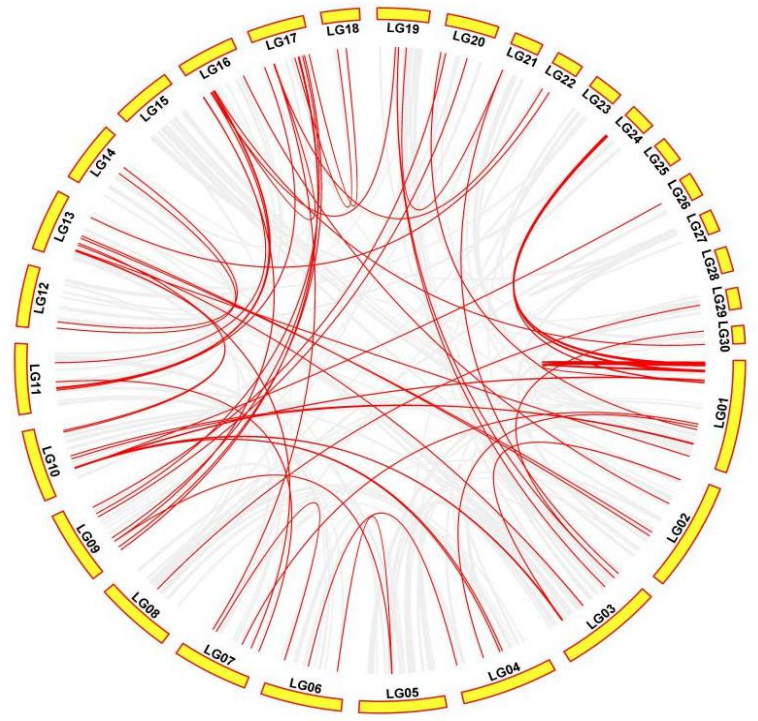


Fig. 2 Interchromosomal relationships of SalgSF genes. Gray lines indicate all synteny blocks in discus genome and the red lines indicate duplicated SalgSF genes.

There were a total of 132 pairs of collinearity events, including 92 pairs of tandem duplication and 40 pairs of segmental duplication.

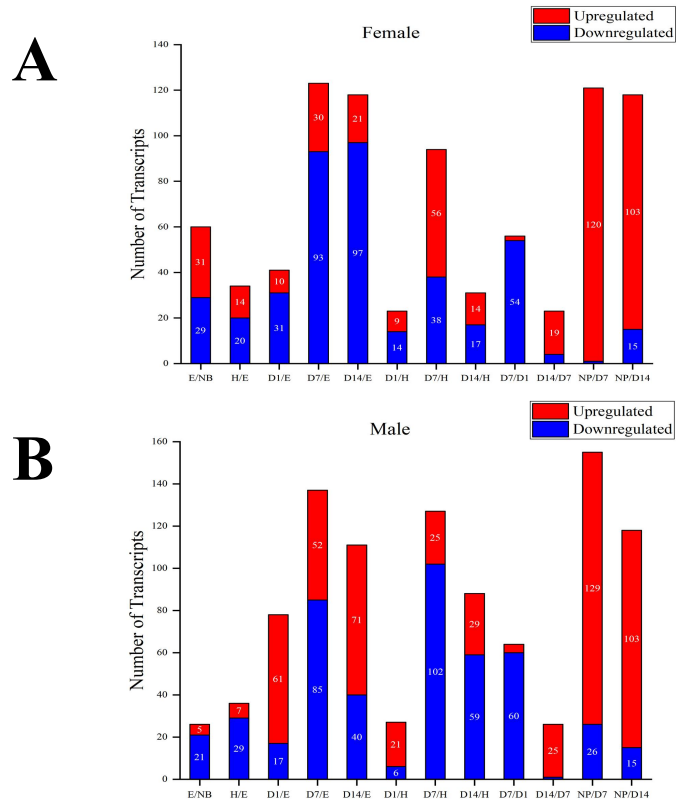


Fig. 3. The number of differentially expressed skin SalgSF genes between two periods of female (A) and male fish (B), respectively. Up/downregulation refers to the first reproductive stage for each comparison.

For female discus, 41, 123 and 118 DEGs were observed in egg spawned (E) compared with care stage (D1, D7 and D14) (Fig. 3A). For male discus, 78, 137 and 111 DEGs were found in egg spawned (E) compared with care stage (D1, D7 and D14), respectively (Fig. 3B). A large number of DEGs were also found in non-parental care compared with middle and late-care stage.

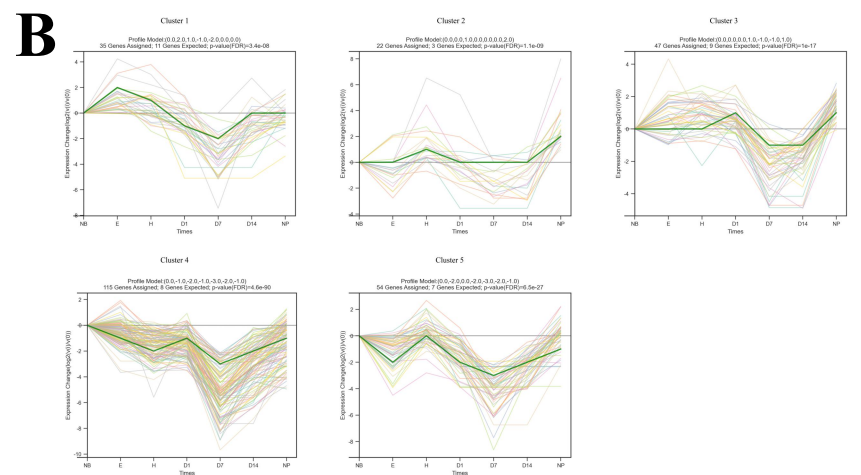
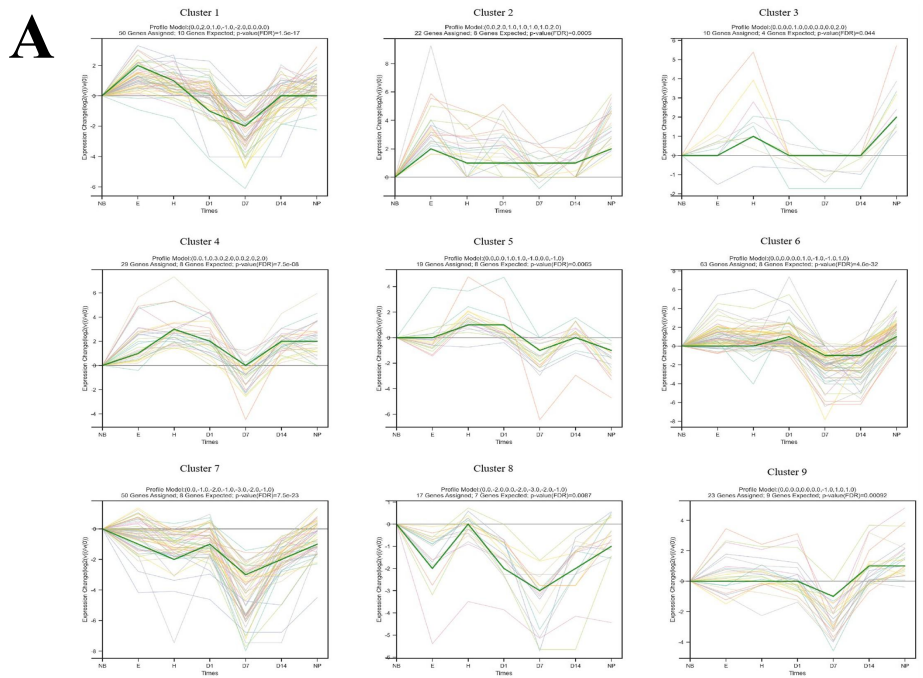


Fig. 4 Differentially expressed genes between random two periods were divided into nine clusters (A) in female discus and into five clusters (B) in male discus. The expression change (y-axis) reflects the standardized expression value, adjusted so that the average expression of each transcript is 0 and the standard deviation is 1.

Distinct expression patterns of IgSF genes in the skin of discus fish at different parental care stages were analyzed by RNA-seq. And we identified transcriptional changes associated with immune and lactation of a breeding circle.

Conclusion

- A total of 518 IgSF genes with typical Ig domain and 286 signal peptide were identified in discus genome.
- IgSF members derived from discus, zebrafish and human were clustered into 12 groups. Their conserved motifs within the same groups shared a great similarity. 40 and 92 pairs of segmental and tandem duplicated IgSF genes, respectively were identified.
- Most IgSF were found to be expressed in the skin of discus during parental care and exhibited a certain stages-specific pattern between male and female parents. Our findings increase the understanding of the evolution and function of IgSF in discus.