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1 Genomic and transcriptomic approaches to study immunology in cyprinids: what is next?

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10 Abstract

11 Accelerated by the introduction of Next-Generation Sequencing (NGS), a number of genomes of cyprinid
12 fish species have been drafted, leading to a highly valuable collective resource of comparative genome
13 information on cyprinids (*Cyprinidae*). In addition, NGS-based transcriptome analyses of different
14 developmental stages, organs, or cell types, increasingly contribute to the understanding of complex
15 physiological processes, including immune responses. Cyprinids are a highly interesting family because
16 they comprise one of the most-diversified families of teleosts and because of their variation in ploidy
17 level, with diploid, triploid, tetraploid, hexaploid and sometimes even octoploid species. **The wealth of**
18 **data obtained from NGS technologies provides both challenges and opportunities for immunological**
19 **research, which will be discussed here.** Correct interpretation of ploidy effects on immune responses
20 requires knowledge of the degree of functional divergence between duplicated genes, which can differ
21 even between closely-related cyprinid fish species. We summarize NGS-based progress in analysing
22 immune responses and discuss the importance of respecting the presence of (multiple) duplicated gene
23 sequences when performing transcriptome analyses for detailed understanding of complex physiological
24 processes. Progressively, advances in NGS technology are providing workable methods to further
25 elucidate the implications of gene duplication events and functional divergence of duplicates genes and
26 proteins involved in immune responses in cyprinids. **We conclude with discussing how future applications**
27 **of NGS technologies and analysis methods could enhance immunological research and understanding.**

28 **Keywords:** NGS; Immunity; Carp; *Cyprinidae*; Whole Genome Duplication; Polyploidy;

29 Highlights:

- 30 - NGS is revolutionizing immunological research in cyprinids
31 - Cyprinids are a highly interesting family for comparative immunology
32 - Retention of duplicated genes can complicate NGS analyses
33 - **Incorporating genetic variation can improve the analyses of immune responses**

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