

Effects of Short-Term Water Velocity Stimulation on the Biochemical and Transcriptional Responses of Grass Carp (*Ctenopharyngodon idellus*)

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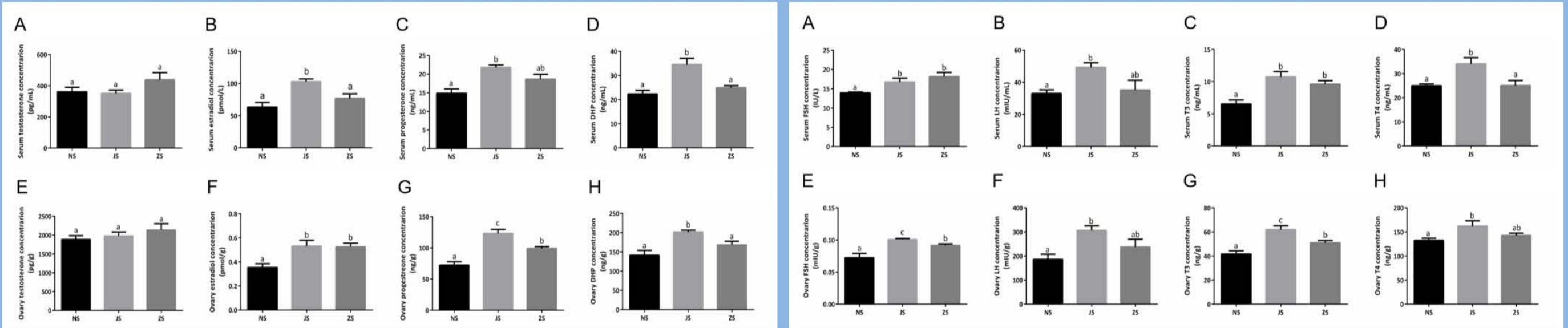
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Abstract

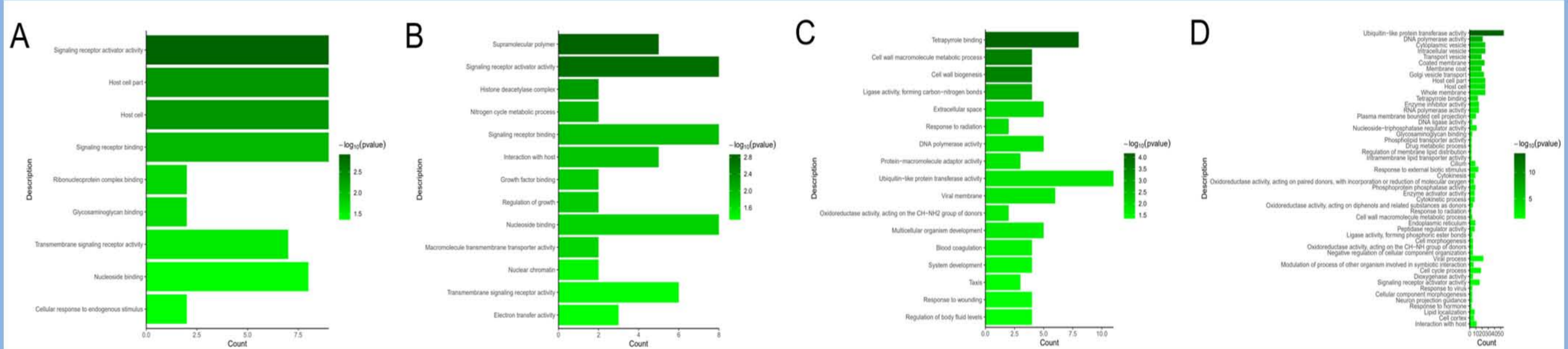
Since 2011, ecological operation trials of the Three Gorges Reservoir (TGR) have been continuously conducted to improve the spawning quantity of the four major Chinese carp species below the Gezhouba Dam. In particular, exploring the effects of short-term water velocity stimulation on ovarian development in grass carp (*Ctenopharyngodon idellus*) is essential to understand the response of natural reproduction to ecological flows. We performed ovary histology analysis and biochemical assays among individuals with or without stimulation by running water. Although there were no obvious effects on the ovarian development characteristics of grass carp under short-term water velocity stimulation, estradiol, progesterone, follicle-stimulating hormone (FSH), and triiodothyronine (T3) concentrations were elevated. Then, we further explored the ovarian development of grass carp under short-term water velocity stimulation by RNA sequencing of ovarian tissues. In total, 221 and 741 genes were up- or down-regulated under short-term water velocity stimulation, respectively, compared to the control group. The majority of differentially expressed genes (DEGs) were enriched in pathways including ABC transporters, cytokine-cytokine receptor interaction, ECM-receptor interaction, and steroid hormone biosynthesis. Important genes including *gpr4*, *vtg1*, C-type lectin, *hsd17b1*, *cyp19a1a*, *cyp17a1*, and *rdh12* that are involved in ovarian development were regulated. Our results provide new insights and reveal potential regulatory genes and pathways involved in the ovarian development of grass carp under short-term water velocity stimulation, which may be beneficial when devising further ecological regulation strategies.

Results

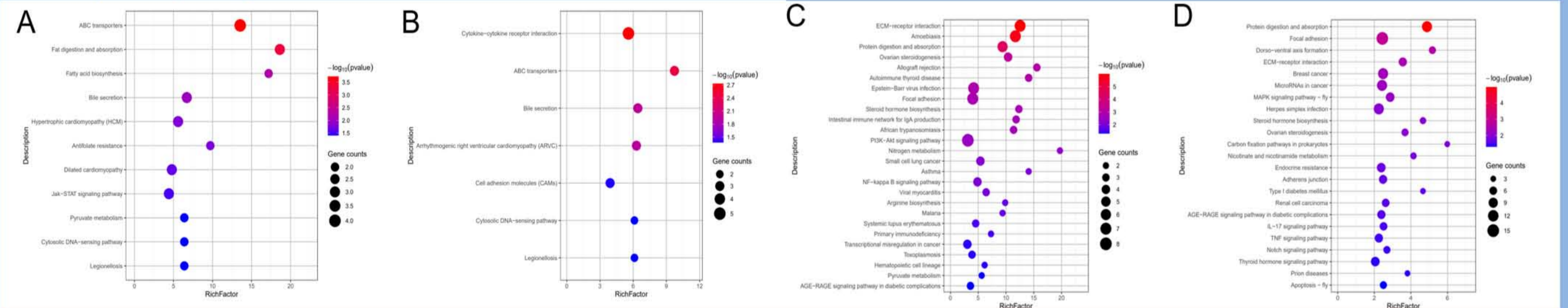
1 Estradiol, progesterone, follicle-stimulating hormone (FSH), and triiodothyronine (T3) concentrations were elevated.



2 Gene ontology analysis



3 KEGG pathway analysis



Conclusion

We investigated the ovarian development of grass carp under short-term water velocity stimulation by histology analysis, biochemical assays, and RNA-Seq technology. Although there was no obvious effect on the ovarian development characteristics of grass carp under short-term water velocity stimulation, estradiol, progesterone, FSH, and T3 concentrations were elevated. Totally, 962 DEGs with 741 down-regulated genes and 221 up-regulated genes were identified in transcriptome data. The key genes identified were enriched in ABC transporters, cytokine-cytokine receptor interaction, ECM-receptor interaction, and steroid hormone biosynthesis, which play an essential role in the response of the ovaries in grass carp to short-term water velocity stimulation. This study provides new insights into the ovarian development of grass carp under short-term water velocity stimulation. However, these transcriptomic data are still preliminary, and the function of the DEGs in reproductive cycle of fish species requires further investigation.