5. QTLs controlling swimming performance and their effect on growth in Nile tilapia (*Oreochromis niloticus*)

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Nile tilapia is widely used in aquaculture in over 120 countries, predominantly in ponds. A yield gap is often observed, resulting from a deficiency of dissolved oxygen in non-aerated ponds (hypoxic environment). Critical swimming speed (U_{crit}) is an important measurement of swimming performance and a good indicator for cardio-respiratory health. It offers a new opportunity to select fish with better fitness. However, the genomic architecture of swimming performance at whole genome level is not clear in Nile tilapia. For this study, swimming performance was measured in 1388 fish from GIFT strain in their early life, which were subsequently grown under a hypoxic environment until harvest. Our results showed that the heritability for U_{crit} was 0.31 ± 0.04. Genetic correlations between U_{crit} and harvest weight (-0.13 ± 0.13) and between U_{crit} and Daily Growth Coefficient (DGC) (-0.26 ± 0.13) were slightly negative. Nine SNPs were found to be suggestively associated with U_{crit}, of which five are located in a region between 12.18 to 19.89 Mb on LG14, while two SNPs are located between 18.85 Mb to 18.94 Mb on LG13. The remaining two SNPs are located on LG19 and LG12, respectively. Candidate genes in high linkage disequilibrium (LD) with these SNPs were identified, including *hip1*, *hectd1*, *elna*, *smyd1b*, *rrp12* and *pprc1*. This suggests possible involvement of neuronal growth, muscle activity, cardiovascular development and angiogenesis, and oxygen/hypoxia regulation. Three of these 9 SNPs were significantly associated with both harvest weight and DGC, and SNP genotypes that associated with lowest mean U_{crit} were associated with highest mean harvest weight and DGC. We found a clear pleiotropic effect of some SNPs that affect both growth and swimming performance in a hypoxic environment, while other SNPs had only effect on swimming performance, but not on growth. Swimming performance is a complex trait, potentially affected by the central nervous system, neuron development, oxygen adaptation and hypoxia regulation. Although fast swimming fish are assumed to have less optimized growth, such as lower DGC and harvest weight, candidate genetic markers identified in this study provide an opportunity to select fish with good cardio-respiratory health and growth.

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