Combining genomic and indirect selection to improve carcass yield in rainbow trout

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Summary

Carcass yield (i.e., the percentage of carcass weight out of wet body weight) is a trait of great economic importance in aquaculture, especially for species sold processed as gutted carcass or fillets such as rainbow trout. Headless gutted carcass percentage (HC) is a convenient selection criterion to improve carcass yield given that it is highly genetically correlated with the latter and also with fillet yield (i.e., the percentage of fillet weight out of wet body weight). However, recording HC requires sacrificing the fish and it cannot be recorded on selection candidates. Thus, selection is generally based on sibs' performance and consequently, the within-family component of the genetic variance cannot be exploited with traditional pedigree-based BLUP selection. Two alternatives to exploit this component would be to select on an indicator trait (IHC) genetically correlated with HC that can be recorded on live fish, or to apply genomic selection. The objective of this simulation study was to predict the potential of indirect and genomic selection to improve carcass yield in selective breeding programs for rainbow trout. Four different selection strategies were used: i) sib selection for HC, ii) indirect selection for IHC; iii) genomic selection for HC; and iv) genomic selection for IHC. The different selection strategies were evaluated both in a single trait setting, where selection was only for a yield trait (HC or IHC), and in a multitrait setting, where body weight was also selected. The different scenarios were compared at the same selection intensity and number of records (2,000) for HC (on sibs) and IHC (on candidates). Two different heritabilities for HC (0.55 and 0.25) were considered. For the highest heritability, the phenotypic gain for HC was higher with sib than with indirect selection for both BLUP and genomic selection. However, for the lowest heritability, the phenotypic gain for HC was lower with sib than with indirect selection. In all cases, the differences in phenotypic gains for HC between sib and indirect selection were not large. Therefore, given that sib selection implies extra costs associated with rearing and genotyping sibs, and indirect selection allows higher selection intensity for a given number of fish, indirect selection appears to be a more cost-effective option. The patterns found for single trait selection were maintained when the yield trait was selected simultaneously with body weight. As expected, the highest increase in the phenotypic mean of headless carcass was obtained with genomic selection. We conclude that the optimum approach to improve carcass yield is a combination of genomic and indirect selection in both single and multitrait selection scenarios.

Keywords: carcass yield, sib selection, indirect selection, genomic selection