Pigment genotype-by-diet interaction on growth in Atlantic salmon

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ABSTRACT:
Growth and fillet color are two important traits in farmed Atlantic salmon. The color of the fillet results from an uptake of supplementary astaxanthin. The relationship between astaxanthin deposition and growth is not fully understood but they are likely to be connected because of the antioxidant effect of the pigment. Such relationship may depend on the amount of marine omega-3 in the diet which has a positive effect on fillet color and robustness. The aim of this study was to examine the pigment QTL genotype by diet interaction in Atlantic salmon in terms of its effect on growth. Data in this study was from AquaIMPACT project (H2020 BG2018-818367). In June 2020, 959 Atlantic salmon with known pedigree and pigment QTL genotype from the Mowi breeding nucleus in Norway were distributed across six 5x5m^2 sea pens located in Averøy, Norway. The sea pens were evenly split between two different diets (3 replicates each) from Skretting ARC: a common extruded feed kernel coated with a standard oil mix rich in vegetable oil (standard diet or K diet) or coated with an oil mix (Veramaris®) enriched with omega-3-PUFA from microalgal oil (H diet). A bivariate animal mixed model, where body weights from different diets were treated as different traits, was fitted using REML with genomic relationship matrix generated from 53,186 SNP markers. The genomic based heritability (h^2) for growth, genetic correlation (r_g) – as a measure of genotype re-ranking and their SE were subsequently estimated. The h^2 for growth with H diet (0.40±0.01) was slightly higher than for growth with K diet (0.35±0.01). The r_g was close to unity (0.94±0.09), indicating marginal or no genotype re-ranking of between growth of fish fed by H and K diets. For the K diet, high pigment deposition genotype (PP) had higher and significant (P<0.05) mean weight (2.80 kg) than low pigment deposition genotype (pp; 2.67 kg). The use of H diet resulted in considerably positive effect on growth in both genotypes but the difference in mean weight between PP and pp genotypes became less and statistically non-significant (P>0.05). Mean genomic EBVs shows the same pattern. Higher growth in PP than in pp indicates that pigment genotypes may be associated with growth but it may be a diet-dependent trait as the difference in growth is less in H diet than in K diet. Selection for PP genotype not only increases astaxanthin deposition, leading to less pale fillet and higher level of antioxidant for health benefits, but also higher growth especially compared to K containing omega-3 PUFA levels typically used in the industry. Further study to confirm this finding should be conducted.

KEYWORDS:
Astaxanthin; heritability; genotype-by-environment; omega3; pigment; variance components.