Deciphering the molecular mechanisms of puberty in Atlantic cod (*Gadus morhua)* for enhanced aquaculture sustainability

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Understanding the biological processes governing puberty in Atlantic cod (*Gadus morhua*) is crucial for optimizing aquaculture practices and mitigating environmental impacts. This study aimed to investigate the effects of photoperiod manipulation on the growth and sexual maturation of Atlantic cod, focusing on morphometric data and the transcriptome of the pituitary-liver-gonad (PLG) axis. We exposed cod to either continuous light or ambient light conditions from 16 to 22 months of age. Our results revealed that fish under continuous light remained sexually immature and exhibited significantly higher growth rates, with males and females reaching average body weights of 1,680 g and 1,500 g, respectively. In contrast, cod under ambient light reached puberty at 22 months, with average body weights of 823 g for males and 809 g for females (Figure 1).

To elucidate the molecular mechanisms underlying these phenotypic differences, we conducted RNA-seq analysis on the PLG axis. We identified several genes differentially expressed with photoperiod that are potentially involved in the regulation of puberty. The findings have significant implications for the aquaculture industry, where early sexual maturation is undesirable due to its association with negative traits such as reduced fillet quality, post-spawning mortalities, and environmental concerns related to gene flow into wild populations.

This study highlights the biological background and importance of photoperiod manipulation as a strategy to delay puberty in Atlantic cod, thereby improving growth performance and reducing adverse effects associated with early maturation. Identifying key genetic markers associated with delayed puberty can facilitate selective breeding programs aimed at enhancing aquaculture efficiency and sustainability.

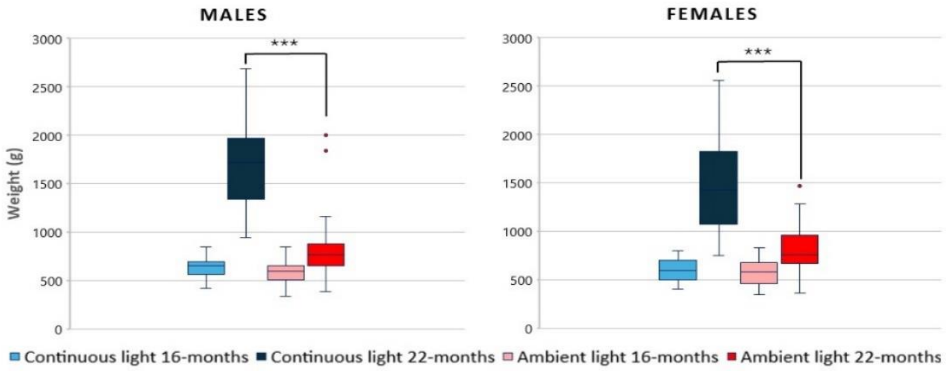

Figure 1. Impact of photoperiod manipulation on the growth of Atlantic cod.

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