REVELATION OF KEY MOLECULES DURING AMOEBIC GILL DISEASE (AGD) IN ATLANTIC SALMON


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SUMMARY

This study investigated the expression of genes involved in Amoebic Gill Disease (AGD) pathogenesis in Atlantic Salmon (*Salmo salar*) during an experimental and a natural infection, including a post-freshwater treatment to eliminate the parasite. The results emphasise the importance of the studied genes in fish respiratory organs, and during AGD progression. This study also shows that freshwater treatment not only eliminates the parasite but also helps to restore gill homeostasis.

KNOWLEDGE NEED

Gill diseases, including AGD, are one of the main health challenges for the marine Atlantic salmon industry worldwide. Its impact has increased drastically in recent years due to the expansion of its geographic distribution and host range. Freshwater or hydrogen peroxide baths are the only available treatments, with no existing preventive measures. Epithelial proliferation and increased mucus secretion are common hallmarks of AGD, leading to respiratory distress in affected fish, followed by mortalities if left untreated. So far, the molecular mechanisms underlying these pathological changes are poorly understood. Characterisation of the proliferative host response in terms of expression dynamics of targeted genes is vital to improve our understanding of gill health and contribute to combating AGD.


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POTENTIAL IMPACT

- The results can contribute to a more timely and accurate detection of AGD pathogen presence, key for aquaculture farmers to prevent stock losses, improve fish welfare and increase profitability.
- The findings are an important starting point for future characterisation of poorly-known fish mucins. Further research on Muc5 sequences, and their differential expression in different gill conditions of Atlantic salmon and other fish species, could improve our understanding of gill health.
- This research could provide a basis for development of tools for diagnostics and vaccines of AGD. Comparative pathology with other respiratory disorders can provide valuable insights into pathogenic mechanisms and potential therapeutic targets.

EATiP - Strategic Research and Innovation Agenda (SRIA) Thematic Area 7- Aquatic Animal Health and Welfare; Goal 1 and Goal 3. To see the full list and descriptions of the thematic areas and goals, please visit: **eatip.eu/?page_id=46**

UNDERLYING SCIENCE

The hallmark signs of AGD are hyperplasia of the lamellar epithelium and increased production of gill mucus. This study investigated the expression of genes involved in mucus secretion, cell cycle regulation, immunity and oxidative stress in gills using a targeted 21-gene PCR array. Gill samples were obtained from experimental and natural *Neoparamoeba perurans* infections, and sampling points included progressive infection stages and post-freshwater treatment.

RESULTS

- The results indicate a key role of Muc5-type mucins and Th2 cytokines (interleukin 4/13) in respiratory organs of fish, as in mammals. This shows the potential of these as biomarkers for AGD. Indeed, Muc5-type mucins are the principal components of airway mucus in humans, and over-expression is a hallmark of various airway diseases.
- The expression profile of the selected genes provided a strong measure on the advancement of the disease; there was an increased response upon disease severity.
- The results also demonstrate that treatment of the disease with freshwater is not only effective against the parasite (amoeba) but also supports the partial restoration of the host immune, mucosal, structural and antioxidant status, i.e. re-establishing gill homeostasis under field conditions.
- The predictive model constructed, based on the expression values of the selected genes from the experimental infection, was able to accurately predict the disease severity of the field samples, indicating the reliability of the experimental infection model as a tool to study this disease under controlled conditions.

END-USERS & POTENTIAL APPLICATIONS

END-USER 1: Researchers in animal welfare, host-pathogen interactions and comparative immunology
APPLICATION: The results highlight the importance of several molecules and pathways on the progression of AGD. They enhance the information available on this disease and fish immune response and could be extrapolated to other fish species and related pathologies.

END-USER 2: Pharmaceutical industry
APPLICATION: The potential of Muc5-type mucins and interleukin 4/13 as biomarkers for AGD could support the development of tools for diagnostics, vaccines and/or disease treatment for AGD in salmon and other fish species.

END-USER 3: Aquaculture veterinarians
APPLICATION: The potential of Muc5-type mucins and interleukin 4/13 as biomarkers for AGD will support early detection and good management of AGD in salmon stocks.

END-USER 4: Aquaculture farmers
APPLICATION: The results will eventually help farmers with early detection and management of AGD in salmon (and potentially other fish species).

STATUS

Technology Readiness Level (TRL) 1 – basic principles observed. This is the first study exploring expression of gill mucins in Atlantic salmon during an infectious process.

- Further research on Muc5 sequences and their differential expression in different gill conditions of Atlantic salmon and other fish species is needed to improve our understanding of gill health.
- In the future, this study could form the basis for further research around diagnosing and vaccinating against AGD.

AT A GLANCE

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KNOWLEDGE TYPE: Scientific publication

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CONTACT DETAILS: Carla Piazzon, CSIC, Spain, carla.piazzon@csic.es
Mar Marcos Lopez, FishVet Group, Ireland, mar.marcos-lopez@fishvetgroup.com

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