DEVELOPING A NOVEL VACCINE FOR PREVENTION OF RAINBOW TROUT FRY SYNDROME

PARTNERS

DawnFresh Farming, University of Stirling's Institute of Aquaculture, Tethys Aquaculture, Kames Fish Farming

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BACKGROUND

Rainbow trout fry syndrome (RTFS) is a bacterial disease caused by the Flavobacterium psychrophilum bacterium that primarily affects young Rainbow trout. This bacterium is known for thriving in cold water environments, particularly at temperatures below 15°C, such as those in the North Atlantic.

RTFS has been responsible for significant economic losses in aquaculture operations for decades due to reduced survivability and the cost of managing outbreaks. An average early-stage mortality of 10-40% in Rainbow trout can routinely be expected in many production sites due to RTFS.

Currently, no commercial vaccines are available in Europe or the UK, leaving antibiotics as the only course of action to treat and contain RTFS outbreaks. This project brought together researchers from the University of Stirling's Institute of Aquaculture and DawnFresh Farming to explore the development of a vaccine to prevent RTFS. Other partners included Kames Fish Farming and Tethys Aquaculture.

AIMS

The project collaborators aimed to produce a novel immersion vaccine against RTFS caused by F. psychrophilum and to test the vaccine's efficacy in the field in Scotland.

The study took place at two commercial trout farms and included control groups of Rainbow trout that were not vaccinated. Once the field trial was complete, the project team compared this data to the control group of unvaccinated fish. The team sought to evaluate the level of fish mortalities when a relevant outbreak occurs at one, three, and six months, respectively, after the final vaccination.

Such research has the potential to improve fish health and unlock additional capacity for aquaculture development.

IMMERSION VACCINE FIELD TRIALS

The diversity of F. psychrophilum isolates has slowed the development of a vaccine to prevent RTFS, along with the difficulties in vaccinating juvenile fish, the most vulnerable to the disease. The University of Stirling (UoS) developed an RTFS vaccine for trout and salmon by characterising over 300 isolates. Vaccine efficacy was tested in experimental disease challenge tests but had not yet been tested in the field prior to this project.

By serotyping and genotyping a large group of clinical F. psychrophilum isolates, strains which could provide cross-protection were selected for inclusion in the vaccine. As fish are susceptible to infection at the fry stage, when they are too small for vaccination by injection, an immersion vaccine, or dip vaccine, is essential to provide the earliest protection.

The partners at UoS demonstrated a high level of protection (Relative Percent Survival 84%) with this vaccine when applied by immersion in the laboratory environment. The vaccine was also protective against other strains of F. psychrophilum within the laboratory. To validate these promising results, field trials on fish farms known to have RTFS outbreaks were necessary to test the vaccine.

The vaccine was reproduced at a GMP facility (a facility or plant for the production of pharmaceutical products) based on the vaccine developed by UoS. A certificate was obtained to conduct field trials at two commercial Rainbow trout farms in Scotland. These trials took place over four months, during which the project team collected data daily and sent samples from outbreaks to UoS for analysis.

Groups of trout fry were immersed at both sites in the diluted vaccine for 30 seconds, while control groups were immersed for 30 seconds in hatchery water. Additionally, a booster was administered by the same method after 300 Celsius-based degree days. Vaccine efficacy was determined by evaluating whether there was a reduction in infection in the vaccinated groups compared to the control groups.

IMPACT

The study has shown that the novel immersion vaccine for RTFS was insufficient to protect against circulating strains of F. psychrophilum to Rainbow trout fry, even with a booster vaccination.

However, mucosal vaccination has emerged as an attractive option for large-scale vaccination. Little or no handling of the fish is required for mucosal vaccination, reducing the stress and subsequent immunosuppression that can be associated with injectable vaccines. Additionally, juvenile fish can be vaccinated using this method, indicating a possible solution to prevent diseases that affect fish before they can be vaccinated by injection.

Furthermore, the mucosa (the gills, skin and gut) represent the portal of entry for many pathogens. Therefore, it is important that the mucosal approach to vaccination in aquaculture is developed further. This may involve innovative approaches to developing vaccines, including novel delivery systems and mucosal adjuvants to improve the stimulation of the immune response to problematic bacterial, viral and parasitic pathogens.

In conclusion, the vaccine did not show a significant protective effect compared to the control group. However, a new approach to vaccine development is planned for a future project to include mucosal adjuvants and delivery systems, as well as using epitope mapping and proteomics of circulating strains of the pathogen to identify antigens.

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