

Use of adjuvants to increase the efficacy of mRNA vaccines.

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Background and aim:

Viral diseases cause a major challenge in Atlantic salmon aquaculture, with current vaccines providing incomplete protection. mRNA-based vaccines offer a promising alternative, with the potential for enhanced immune activation. The use of adjuvants may further improve vaccine efficacy by strengthening innate immune responses. This study aims to evaluate how different adjuvants influence mRNA-driven immune responses in fish cells, with the goal of supporting the development of more effective vaccines for aquaculture.

Results:

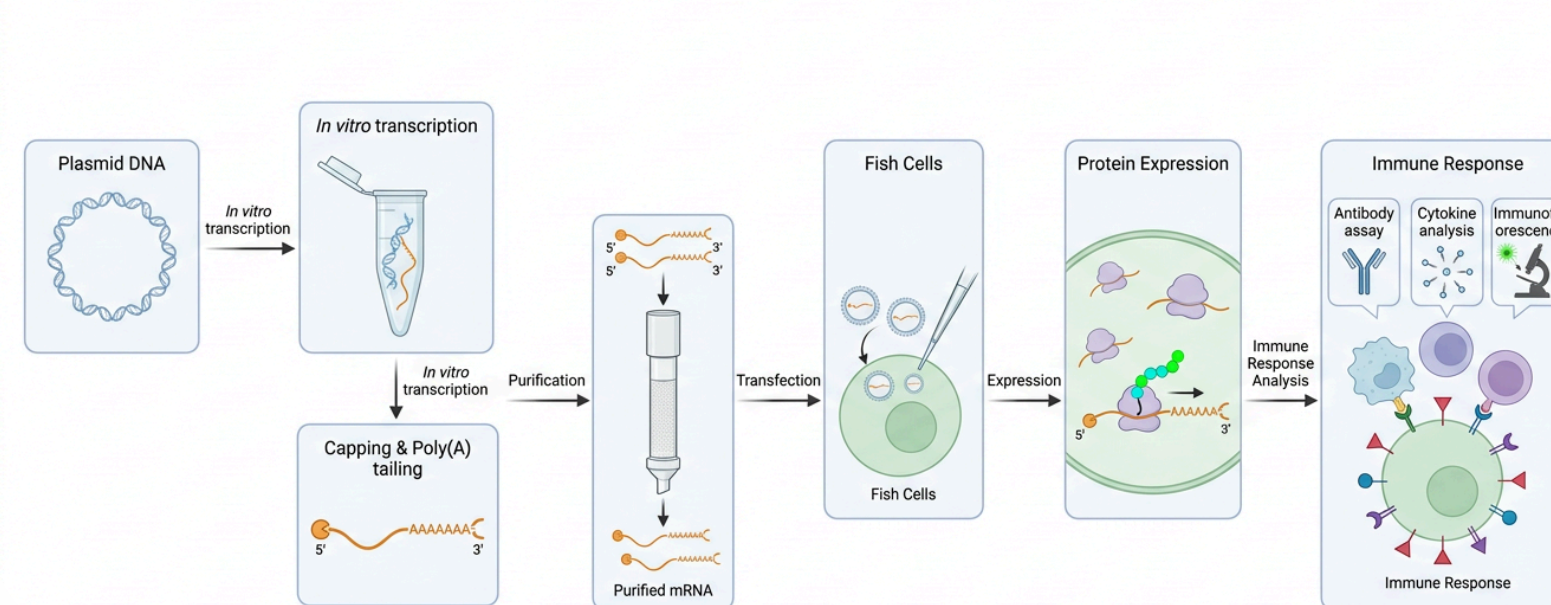
Transfection with four different adjuvants (adjuvant 1-4) in CHSE and ASK cells resulted in successful mRNA expression, confirmed by fluorescence microscopy (figure 2), and western blot analysis (figure 3 and 6).

Immunofluorescence microscopy showed detectable intracellular signal in adjuvant 1 and 3, while no clear signal was observed in adjuvant 2 and 4 (figure 2).

Western blot analysis of cell lysate showed strong intracellular protein expression, with adjuvant 3 displaying the highest signal intensity (figure 3).

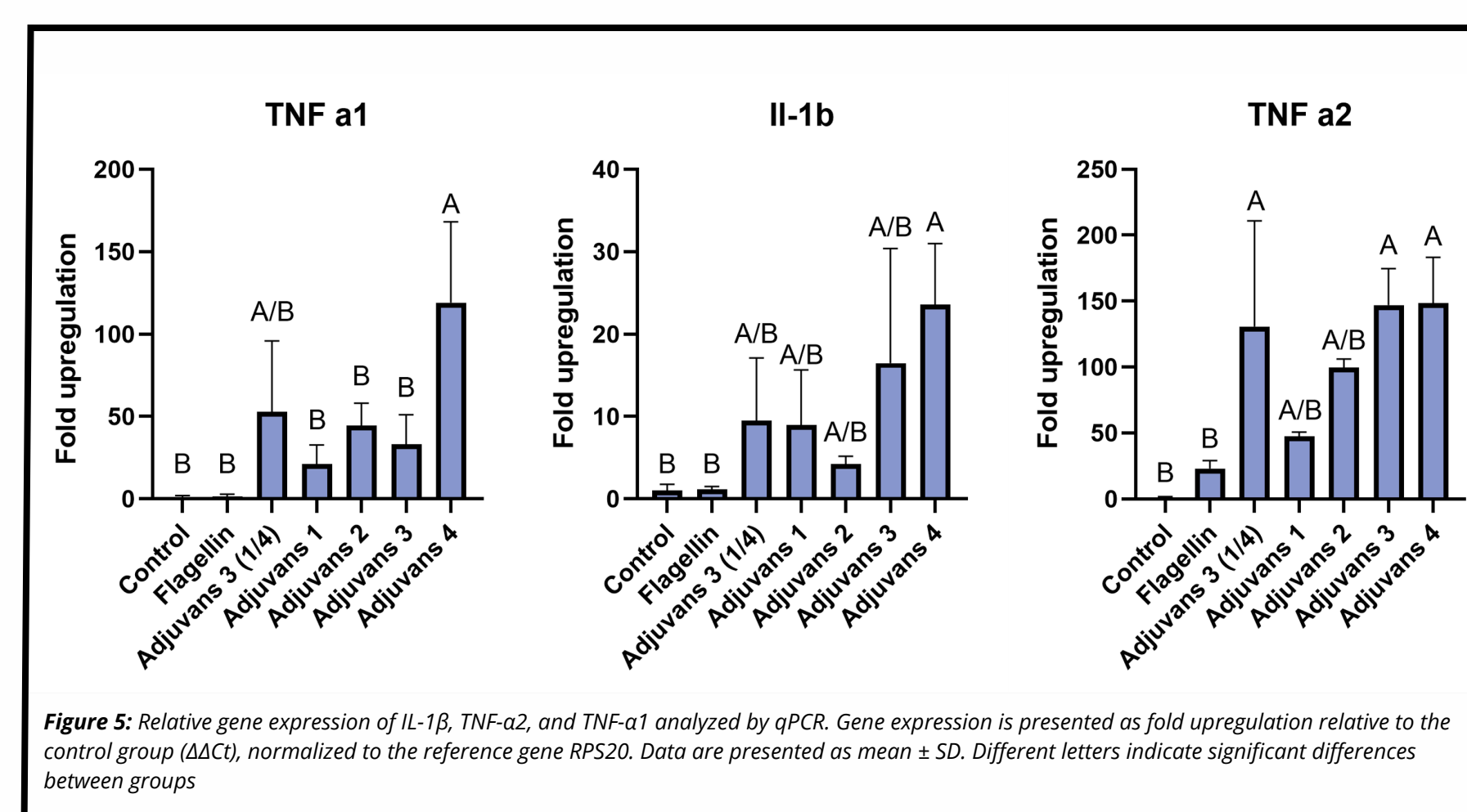
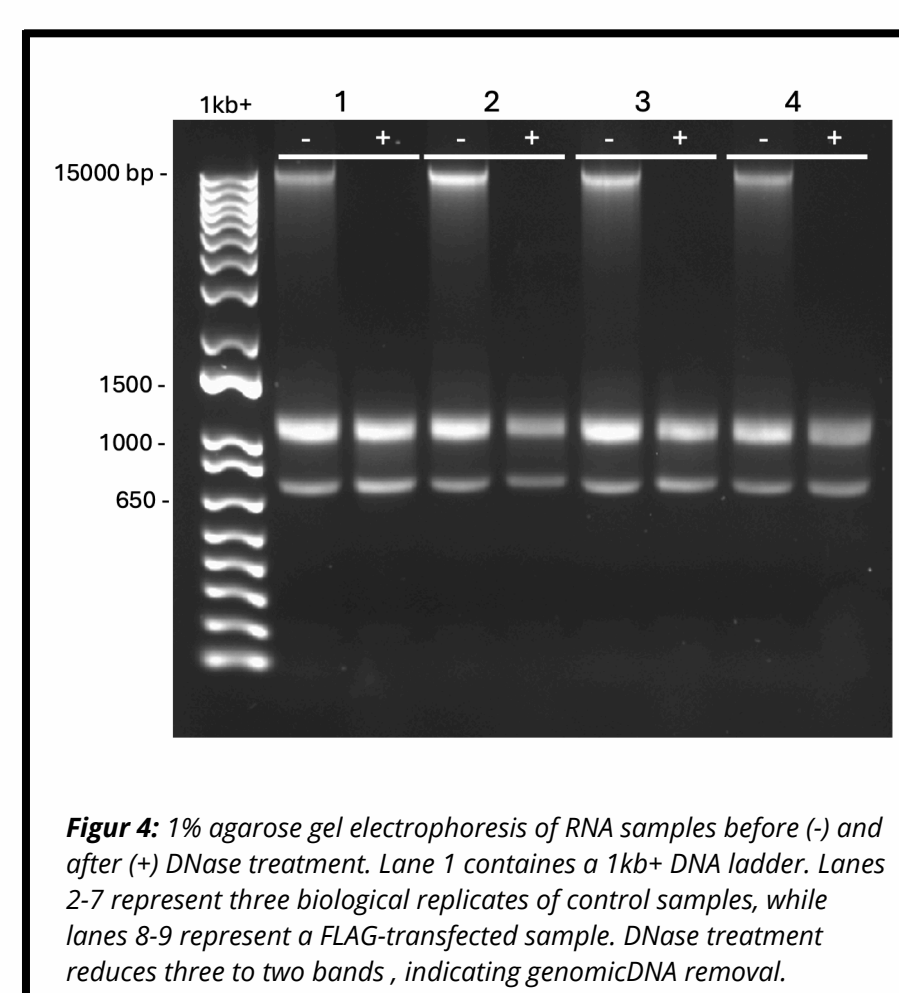
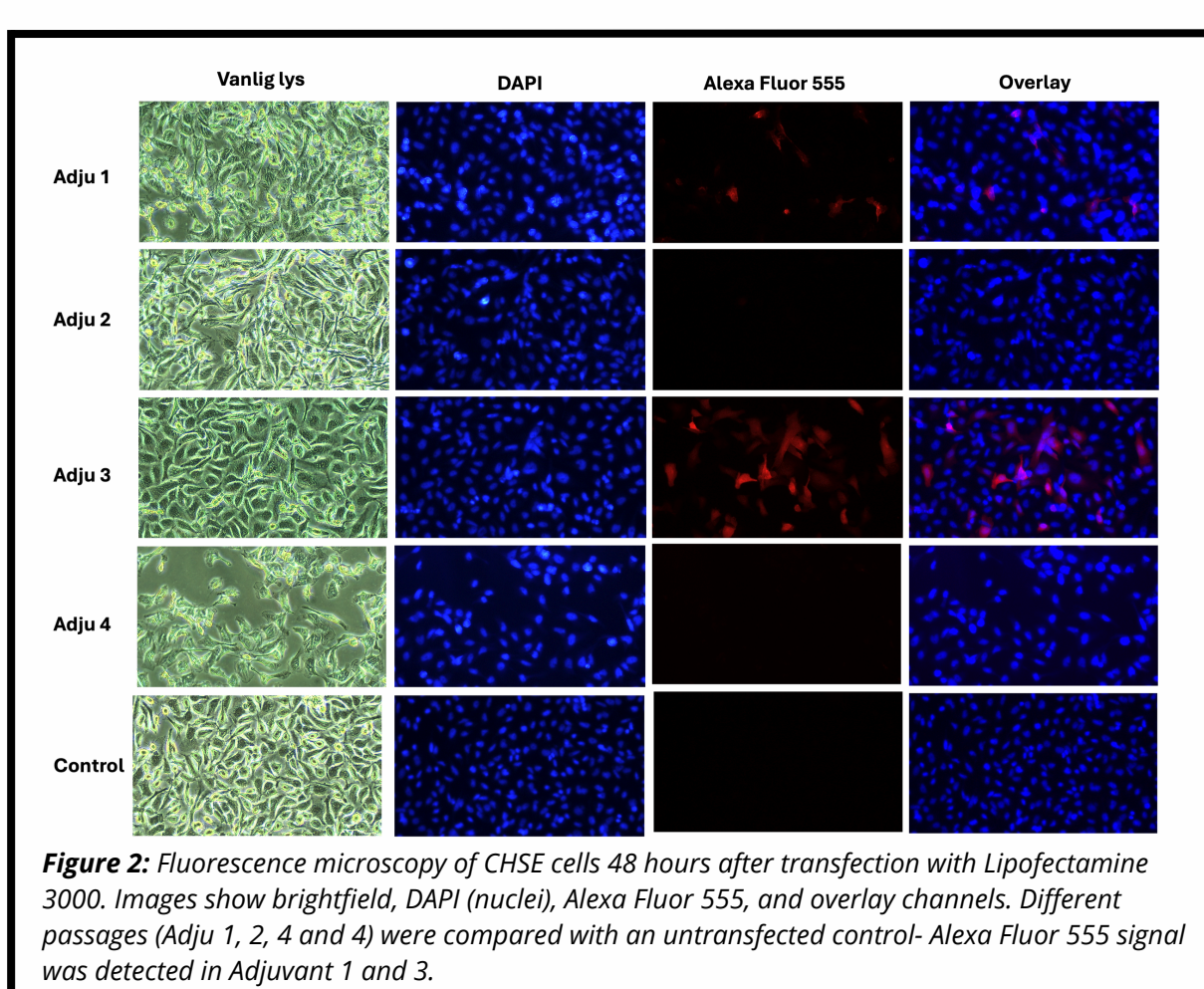
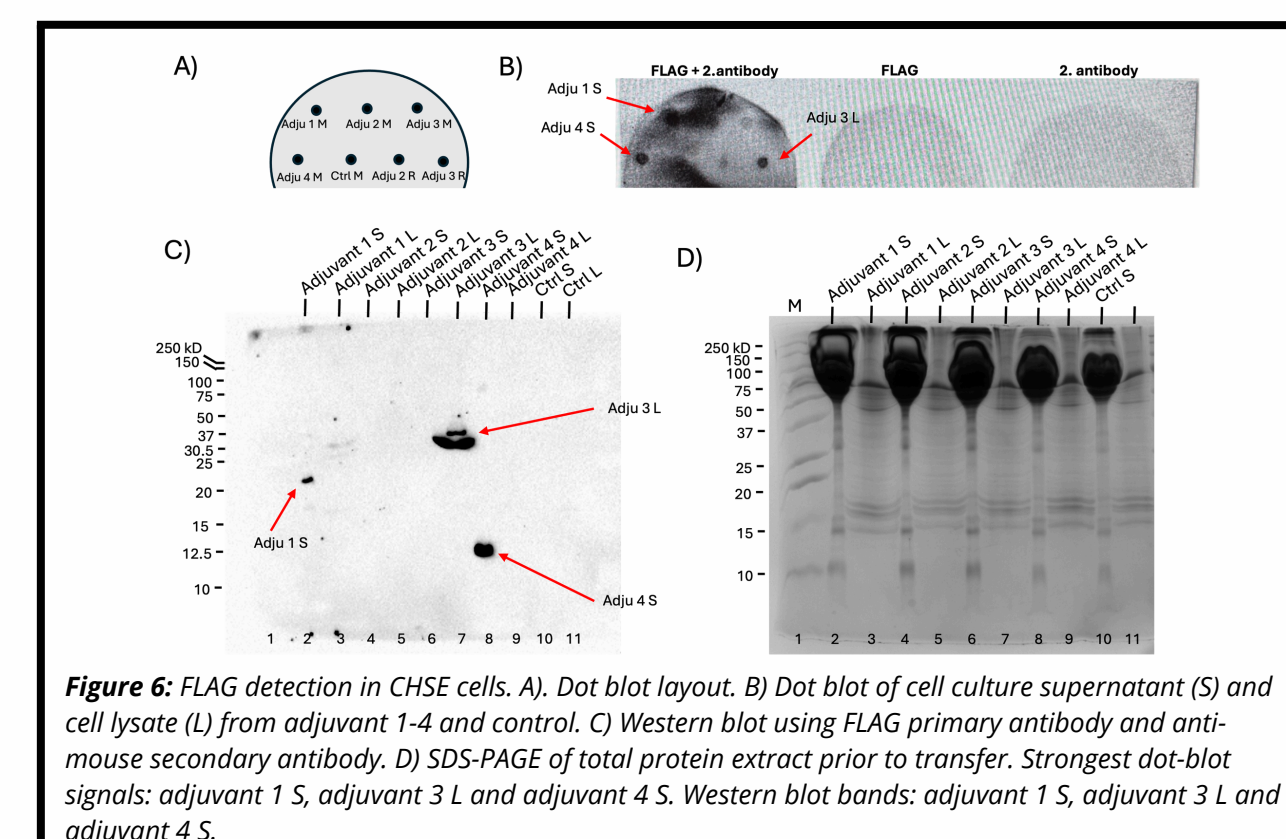
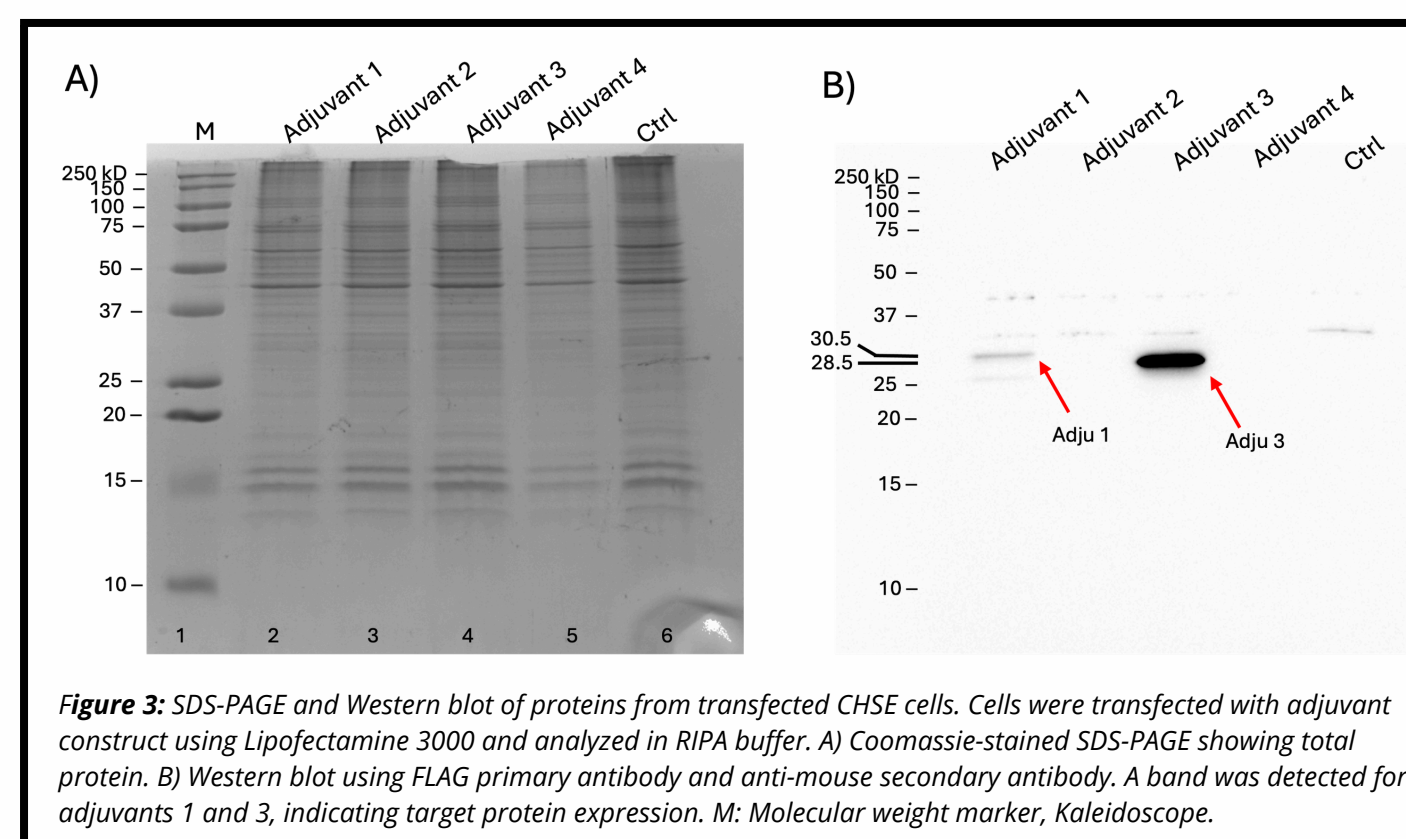
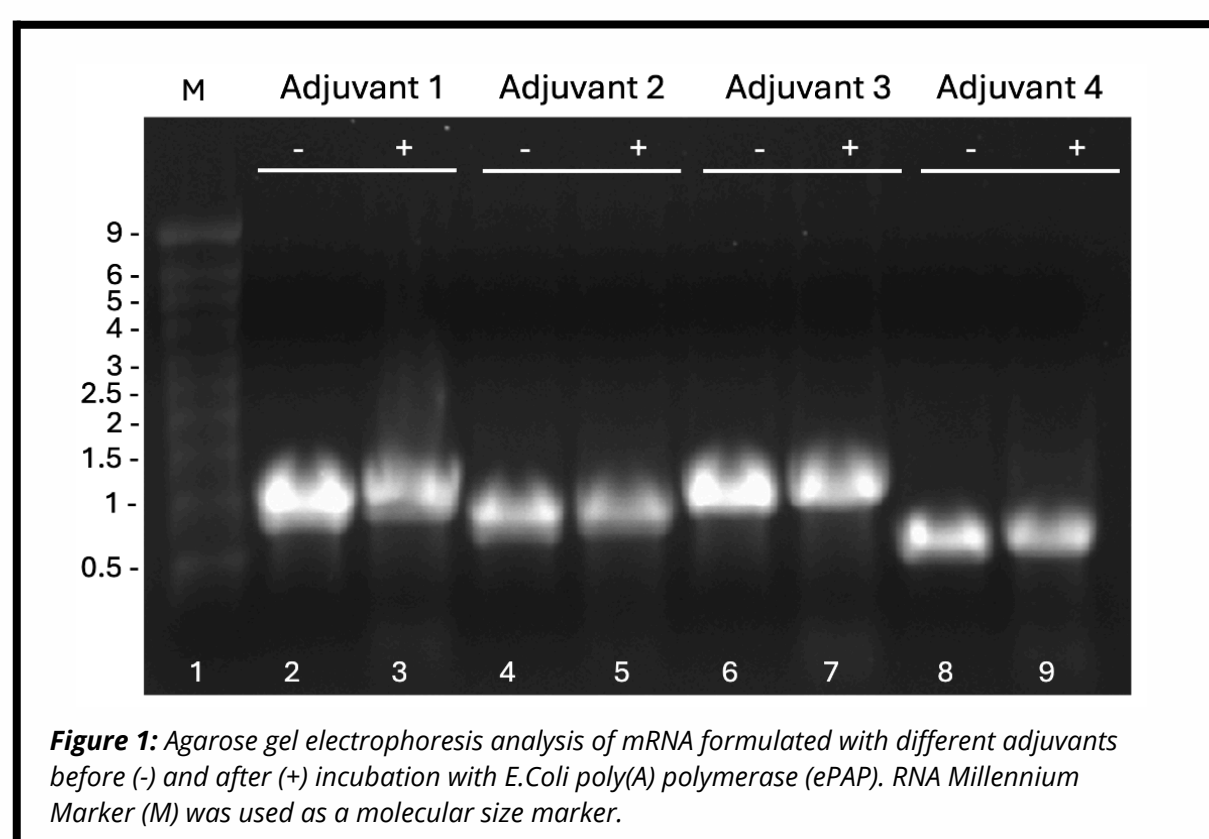
Western blot analysis of the cell culture supernatant revealed protein signals in adjuvant 1 and 4, while adjuvant 3 showed no signal (figure 6). qPCR analysis demonstrated upregulation of immune-related genes across all treatment groups (figure 5). Adjuvant 4 induced the highest expression levels of IL-1B, TNFa1 and TNFa2.

Scientific Workflow for mRNA Vaccine Production and Testing in Fish Cells



Methods:

- In vitro transcription
- Agarose gel electrophoresis
- Cell transfection
- Fluorescence microscopy
- Western blot
- Immunostaining
- RNA isolation
- cDNA synthesis
- qPCR



Discussion and future work:

This study shows that different adjuvants influence both mRNA-driven protein expression and immune activation in fish cells. Adjuvant 3 resulted in the strongest intracellular protein expression, while adjuvant 1 and 4 mainly showed protein detected in the supernatant, indicating increased secretion or extracellular release of the produced protein. All groups showed upregulation of immune-related genes, with adjuvant 4 inducing the strongest expression of IL-1β, TNFa1 and TNFa2. Overall, this indicates that adjuvants can shape both protein localization and immune response strength. Further studies should investigate how these adjuvants affect cellular uptake and processing of mRNA, and how they may be optimized to achieve a balanced protein expression and immune activation in vaccine applications for Atlantic salmon

References:

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