Detection of Aeromonas salmonicida in fish tissue by real-time PCR

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DETECTION OF AEROMONAS SALMONICIDA IN FISH TISSUE BY REAL-TIME PCR

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Background

In Denmark rainbow trout (Oncorhyncus mykiss) are transferred from freshwater out to the sea, where outbreaks of furunculosis caused by the bacterium Aeromonas salmonicida subsp. salmonicida occur during elevated water temperatures [1]. One therefore speculates that some fish "carriers" might harbor the bacterium as a latent infection from freshwater to the sea [2]. Since past research involving carrier fish includes slow and laborious enrichment steps [3,4] a sensitive and simple method for detection of the carriers is highly needed.

Objective

To develop a highly sensitive, rapid and cost-effective real-time PCR assay that detects A. salmonicida in various tissue samples from not only rainbow trout showing clinical symptoms, but possible "carriers" as well.

Results

A highly sensitive and specific real-time PCR has been developed, based on previous research by Balcázar et al. [5]. The assay uses a self-quenched fluorogenic primer set designed from a DNA probe sequence for A. salmonicida, which is the most frequently used target for species-specific A. salmonicida molecular methods to date [5].

Specificity

Balcázar et al. [5] amplified DNA from all 16 A. salmonicida isolates tested, while all 26 non-A. salmonicida produced no product. In this study we also amplified DNA from all 28 Danish A. salmonicida isolates tested.

Sensitivity

When tested on five different rainbow trout tissue samples (gills, kidney, brain, intestine, spleen) spiked with various A. salmonicida dilutions, the assay showed no sign of inhibition.

![Standard curve plot constructed with serial 10-fold dilutions of 14.3 ng/μL to 1.43x10^-7 ng/μL of the purified A. salmonicida type strain ATCC 33568 recombinant plasmid DNA.](image)

Run a real-time PCR using Rotor-Gene Q
Time: 1.4–2 hours (20 samples per run in triplicate)

DNA extraction using Instagene matrix
Time: 1.2–3 hours (10-12 samples)

Extraction of five organs

Methods

Bacteriology

Time: Minimum 48 hours incubation time

Table 1: Bacteriology and real-time PCR assay results* from rainbow trout field samples at a Danish sea farm. The fish had an outbreak of furunculosis and were treated with antibiotics. The treatment finished 5 days before sampling.

<table>
<thead>
<tr>
<th>Fish #</th>
<th>Gills</th>
<th>Spleen</th>
<th>Intestine</th>
<th>Kidney</th>
<th>Brain</th>
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<tbody>
<tr>
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<td>13</td>
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</tbody>
</table>

![Bacteriology result / qPCR result](image)

- Negative result
- Positive result
- Uncertain qPCR result (i.e. either the average Cq of the sample replicates was higher than 38 or not all of the sample replicates produced a signal above the Cq threshold)

Conclusion

Preliminary results from a natural occurring outbreak show that the assay seems to be more sensitive compared to traditional bacterial methods. However, the situation was not optimal due to the antibiotic treatment at the fish farm that killed most bacteria prior to sampling. The dead bacteria could thus not be cultured with bacteriology while its DNA could be amplified by the real-time PCR. This is especially noticeable in the moribund fish # 15-37 where all bacteriology results are positive, while most of the real-time PCR results are negative. More testing thus needs to be done before drawing any firm conclusions. Nevertheless, if further results do show the same pattern as illustrated in fish # 09-42, this real-time PCR assay could become a vital part in detection of A. salmonicida. Particularly for finding carriers or latent infections.

Acknowledgement

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References

[1] DSF Grant no 09-063102 “Improved vaccination strategies in Marine aquaculture” (MarinVac), February 2008 - March 2012.

[The image is a diagram showing the assay process and a standard curve plot constructed with serial 10-fold dilutions.]

Fig 1: Standard curve plot constructed with serial 10-fold dilutions of 14.3 ng/μL to 1.43x10^-7 ng/μL of the purified A. salmonicida type strain ATCC 33568 recombinant plasmid DNA.