Off flavour in recirculated aquaculture systems
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Off flavour in recirculated aquaculture systems

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Introduction

Earthy off-flavour (geosmin) in farmed fish is a global problem of major economic impact for fish farmers and wine producers. Especially in recirculated aquaculture systems (RAS) with low exchange of water it can significantly affect the economy of the farm. Geosmin is a secondary metabolite which is produced by a few organisms containing the geosmin synthetase gene (geoA).

Homology search of the geoA has allowed us to identify at least three abundant groups of bacteria that can produce geosmin:

1) Actinomycetales (Streptomyces and 5 other clades)
2) Freshwater Cyanobacteria
3) Myxococcales

Quantification were performed by qPCR for the most abundant groups using geoA and the impact on microbial community composition were carried out by amplicon sequencing of the 16S rRNA gene. Relative abundance of geosmin-producing bacteria were evaluated statistically with environmental and operational parameters in aquaculture systems as well as the effect on the entire microbial community.

Methods

Quantitation of 3 novel clades of bacteria containing the gene geoA

Method 1:

Quantification of geoA using degenerated primers

Method 2:

Correlations between environmental factors in the plants

Geosmin correlates positive to COD, phosphate, and temperature

Sample type

<table>
<thead>
<tr>
<th>Inflow water</th>
<th>Outflow water</th>
<th>Biofilter</th>
</tr>
</thead>
<tbody>
<tr>
<td>DK</td>
<td>CH</td>
<td>F</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

Total number of samples analysed > 50

Results

Quantification (qPCR) of the bacterial groups in each plant

<table>
<thead>
<tr>
<th>Sample</th>
<th>geoA gene (%) of total bacteria</th>
<th>Clade 1</th>
<th>Clade 3</th>
<th>Clade 5</th>
<th>Cyc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant 1 (Water, outdoor)</td>
<td>0.0052%</td>
<td>0.00083%</td>
<td>0.034%</td>
<td>0.035%</td>
<td></td>
</tr>
<tr>
<td>Plant 1 (Biofilter, outdoor)</td>
<td>1.14%</td>
<td>0.15%</td>
<td>0.0078%</td>
<td>0.0078%</td>
<td></td>
</tr>
<tr>
<td>Plant 2 (Water, outdoor)</td>
<td>0.0069%</td>
<td>0.00082%</td>
<td>0.00023%</td>
<td>0.014%</td>
<td></td>
</tr>
<tr>
<td>Plant 2 (Biofilter, outdoor)</td>
<td>0.039%</td>
<td>0.022%</td>
<td>0.00012%</td>
<td>0.048%</td>
<td></td>
</tr>
<tr>
<td>Plant 3 (Water, indoor)</td>
<td>0.0017%</td>
<td>0.00%</td>
<td>0.0062%</td>
<td>0.16%</td>
<td></td>
</tr>
<tr>
<td>Plant 3 (Biofilter, indoor)</td>
<td>0.047%</td>
<td>0.00043%</td>
<td>0.00017%</td>
<td>0.0031%</td>
<td></td>
</tr>
<tr>
<td>Plant 4 (Water, indoor)</td>
<td>0.000087%</td>
<td>0.00025%</td>
<td>0.0037%</td>
<td>0.0034%</td>
<td></td>
</tr>
<tr>
<td>Plant 4 (Biofilter, indoor)</td>
<td>0.0028%</td>
<td>0.21%</td>
<td>0.016%</td>
<td>0.032%</td>
<td></td>
</tr>
</tbody>
</table>

Conclusions

- Large differences between geoA-producing bacteria in plants
- geoA containing bacteria was found in low amounts in all plants (most abundant in filters)
- Several environmental factors correlate positive with geosmin. Such correlations can be used as a diagnostic tool in developing strategies to limit the growth of geosmin-producing bacteria.