

Dietary phosphorus in fresh and seawater – impacts on rapid growing farmed Atlantic salmon

Florian Sambras¹, Olav Breck², Sissel Albrektsen³, Paul Eckhard Witten⁴, Ramon Fontanillas⁵, Tårn Thomsen⁵, Per Gunnar Fjellidal¹

¹Institute of Marine Research (IMR), Matre Aquaculture Research Station, N-5984 Matredal, Norway; ²Marine Harvest ASA, Dreggen, Bergen, Norway; ³Nofima, Kjerreidviken 16, NO-5141 Fyllingsdalen, Norway; ⁴Biology Department, Ghent University, Ghent, Belgium; ⁵Skretting ARC, Stavanger, Norway

Introduction

Harvest size farmed Atlantic salmon often display spinal deformities, causing down-grading losses for the farmers and raising welfare issues. Several publications have pointed out low dietary P as one reason for deformity development. However, the aetiology can be multifactorial; elevated water temperature and high growth rates are also possible contributing factors.

Material and methods

This study investigated the effect of dietary phosphorus (P) on spinal deformity development in rapid growing Atlantic salmon. Fish were fed a low (LP), medium (MP) or high (HP) P diet from 3 to 500 g body mass (dietary P level in table below). The fish were reared at two temperatures (10 and 16 °C) from seawater (SW) transfer onwards:

- There was a full cross-over between diets at SW transfer (~100 g) giving 9 feeding groups that were reared on until 500 g in 16 °C SW.
- In addition, fish fed LP and HP in freshwater (FW) continued on these feeds in 10 °C SW until 500 g body mass, obtaining 2 additional feeding groups at 10 °C in SW

Results

Freshwater

At SW transfer, there was a significant higher proportion of radiological deformed fish in groups fed LP diets compared to MP and HP, respectively. The LP fish group also showed lower vertebra mineral content and stiffness.

10 °C seawater

At 500 g, fish fed LP diets in FW and SW had produced more deformed fish than HP.

16 °C seawater

Fish fed LP in FW had a negative effect on deformity occurrence at 500 g. There was also a trend towards decreasing deformity occurrence with increasing P level in FW when the fish were fed LP and MP in SW.

Regarding temperature in SW, fish produced at 10 and 16°C showed a similar prevalence of deformed fish.

Conclusions

- LP in FW induced the development of vertebral deformities
- Increasing P level in FW had a positive effect on deformity occurrence at 500 g in SW
- Increasing P levels in SW did not mitigate deformities when fish were fed LP in FW

Acknowledgements

This study was supported by the Fiskeri- og havbruksnæringens forskningsfond (FHF) funded project 'Fosforbehov hos hurtigvoksende laks i ferskvann og tidligsjøfase for å sikre god benhelse' (project no. 900798)

| Fish size | P level | Diet (g kg ⁻¹) | | |
|-----------|---------|----------------------------|-------|-------|
| | | LP | MP | HP |
| 3-20 g | Total | 7.0 | 11.25 | 13.85 |
| | Soluble | 4.6 | 7.6 | 9.7 |
| 20-100 g | Total | 8.6 | 11.4 | 13.75 |
| | Soluble | 4.4 | 7.5 | 9.4 |
| 100-500 g | Total | 9.8 | 11.7 | 13.1 |
| | Soluble | 5.0 | 7.1 | 9.0 |

