

Carbon dioxide limits for Atlantic salmon

RESEARCH QUESTION:

The objective of the present study was to determine the CO₂ concentration in 12 ppt salinity RAS up to which no negative consequences are observed for growth performance, health, or welfare of Atlantic salmon post-smolts. Six CO₂ concentrations (5–40 mg/L) were tested.

DURATION: 12 weeks, RAS

FISH SIZE TESTED: 70 - 400 g

SALINITY TESTED: Brackish water (12ppt), salt water

HIGHLIGHTS

- Fish showed no mortality, cataracts, nephrocalcinosis or signs of external injuries.
- Skin dermis layer was significantly thinner in fish exposed to 40 mg/L of CO₂.
- Body weight and growth were significantly lower at CO₂ concentrations ≥ 12 mg/L.
- CO₂ exposure effects during the RAS phase were carried over during an additional 6-week period to mimic a seawater phase.

RECOMMENDATIONS:

- The current study shows that growth in Atlantic salmon post-smolts is negatively linear-related to CO₂ exposure, indicating that the growth penalty of CO₂ starts at lower concentrations than previously reported (<12 mg/L).
- Results suggest that exposing Atlantic salmon post-smolt to an increase in CO₂ of 10 mg/L would correspondingly decrease their TGC (thermal growth coefficient) by approximately 0.2 units.
- As the highest TGC averaged 2.2 during this study, an approximate 10% of growth reduction was observed for every 10 mg/L increase in CO₂, over the range of CO₂ concentrations studied (5–40 mg/L).
- It is recommended to avoid water CO₂ concentrations >12 mg/L in RAS as it might affect further growth in the sea phase.

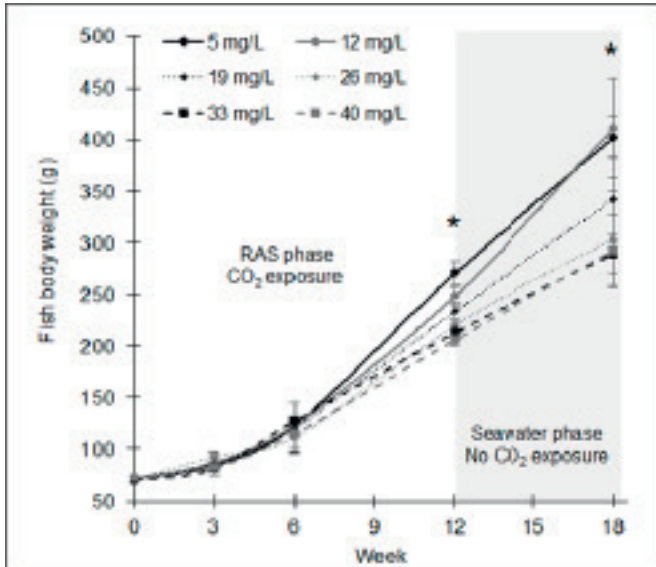


Figure 1. Growth curve for fish exposed to six CO₂ concentrations (5, 12, 19, 26, 33 and 40 mg/l) during an 18-week experimental period.

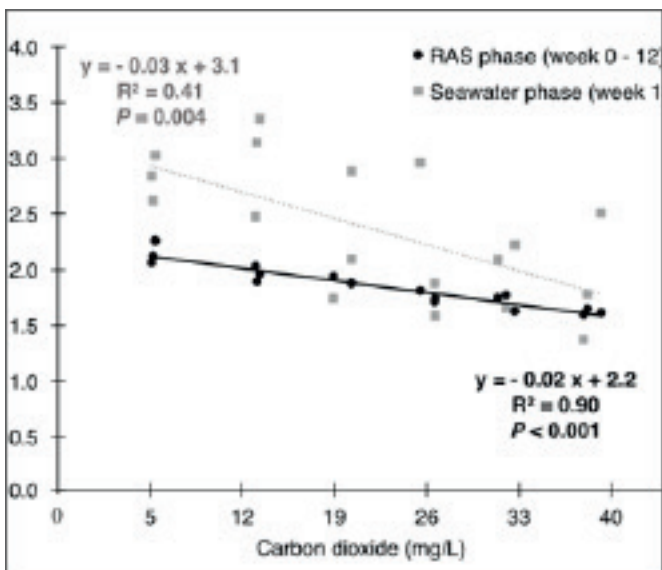


Figure 2. Linear regression models between measured CO₂ in the water and thermal growth coefficient (TGC) during RAS phase (week 0-12) and Seawater phase (week 13-18).

The factsheet is ready for implementation, but with the note that the testing has not been done for all industrial relevant conditions.

READ MORE:

Aslam, S.N., Navada, S., Bye, G.R., Mota, V.C., Terjesen, B.F., Mikkelsen, Ø., 2019. Effect of CO₂ on elemental concentrations in recirculating aquaculture system tanks. *Aquaculture*. 511, 734254.

Mota, V.C., Nilsen, T.O., Gerwins, J., Gallo, M., Kolarevic, J., Krasnov, A., Terjesen, B.F., 2020. Molecular and physiological responses to long-term carbon dioxide exposure in Atlantic salmon (*Salmo salar*). *Aquaculture*, 734715.

Mota, V.C., Nilsen, T.O., Gerwins, J., Gallo, M., Ytteborg, E., Baeverfjord, G., Kolarevic, J., Summerfelt, S.T., Terjesen, B.F., 2019. The effects of carbon dioxide on growth performance, welfare, and health of Atlantic salmon post-smolt (*Salmo salar*) in recirculating aquaculture systems. *Aquaculture*. 498, 578-586.