Fiskeriforskning

Effects of carbon dioxide and pH on growth and risk of IPN in Atlantic salmon

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INTRODUCTION

Infectious pancreatic necrosis (IPN) is a virus disease that has been an increasing problem for Norwegian salmon farming industry. A major question is whether there is a causal link between reduced water quality due to intensive production and increased frequency of IPN-outbreaks. In the present study, we have examined the effects of long-term exposure to three different concentrations of carbon dioxide (CO_2) and low pH on growth and susceptibility to IPN virus in Atlantic salmon.

MATERIALS & METHODS

Nine groups of smoltifying salmon (initial weight of 40 g) were exposed to different CO_2 concentrations (4–20 mg/l) and pH levels (6,6–5,65) for 6 weeks in 10 °C freshwater (FW) (Table 1), and thereafter, transferred to seawater (SW, 10 °C) and bath challenged with IPN virus (IPNV). Mortality was registred for 42 days after the challenge. Other conditions were kept similar for all fish groups. In FW, renewal rates, oxygen saturation and water current were approximately 1,3 l/kg/min, 89 % and 0,9 m/sek, respectively. The fish density was about 25 kg/m³. Fish were fed continously by automatic disc feeders from 02.30 to 08.30 with Ewos Nutra Parr (3-4 mm). Smoltification was monitored by use of 24 h SW challenge tests. Length and weight measurements were carried out at day 0 and 43 in FW. In FW, pH, oxygen (O_2), temperature were recorded three to four times a day, whilst CO_2 were analysed up to three times per week. In SW, O_2 and temperature were recorded daily.

Group	Number of replicates	CO_2 (mg/l)	pH
Inlet water	-	3,10 ± 0,16 (7)	6,80 ± 0,02 (14)
Control	3	4,71 ± 0,19 (39)	6,49 ± 0,01 (66)
CO_2 + pH (1)	3	9,62 ± 0,30 (26)	6,04 ± 0,01 (72)
CO_2 + pH (2)	3	13,14 ± 0,37 (26)	5,90 ± 0,01 (72)
CO_2 + pH (3)	3	20,37 ± 0,45 (26)	5,65 ± 0,01 (73)
pH (1)	2	5,05 ± 0,31 (39)	6,03 ± 0,01 (47)
pH (2)	2	5,17 ± 0,29 (39)	5,96 ± 0,02 (47)
pH (3)	2	5,60 ± 0,28 (39)	5,75 ± 0,02 (48)

Table 1: Average CO_2 and pH (± SEM) in the inlet water and the outlet water of the different treatment groups during the exposure periode in FW (42 days). Number of samplings in parenthesis.

RESULTS AND DISCUSSION

There was a reduction in growth in fish kept at high CO_2 concentrations and low pH levels, but this was only significant for the groups exposed to the two highest CO_2 concentrations and lowest pH levels (Fig. 1). Fish exposed to the different pH levels alone showed growth rates comparable with the control group (Fig. 1). These results indicate that high CO_2 concentrations in combination with low pH levels impair the growth of salmon in the smoltification phase.

After transfer to SW and IPNV challenge, there was a tendency to increased mortality in groups of fish that had been exposed to the highest CO_2 concentrations and lowest pH levels in FW (Fig. 2). These differences were, however, not significant. Exposure to acidic FW did not increase mortality following IPNV challenge (Fig. 2).

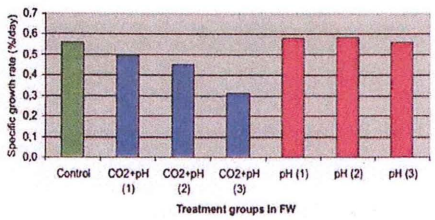

Figure 1: Specific growth rate (%/ day) in salmon exposed to different CO_2 concentrations and pH values for 6 weeks in FW.

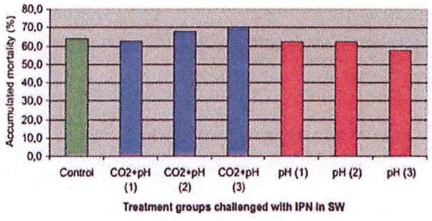

Figure 2. Accumulated mortality (%) in the different treatment groups in FW at the end of the IPNV challenge test in SW.

CONCLUSIONS

The data presented suggest that elevated CO_2 concentrations in combination with low pH levels in fresh water, reduce growth and survival following sea water transfer and IPN virus challenge in Atlantic salmon smolts. The negative effects on growth and survival appeared in groups exposed to CO_2 concentrations above 12-13 mg/l and pH levels under 5,90, indicating that these levels should be avoided in order to secure good health and growth in salmon.

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