EFFECTS OF THREE DIFFERENT LEVELS OF DISSOLVED OXYGEN ON THE FEED INTAKE, GROWTH AND APPETITE OF FARMED ATLANTIC SALMON

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Introduction

Atlantic salmon (*Salmo salar*) can experience low and sometimes large variations in levels of dissolved oxygen (DO) in sea cages. The decreased DO levels can limit aerobic energy metabolisms, reduce feed intake and negatively affect growth performance.

The hypothalamus regulates appetite, feed intake and energy balance but how the neuronal cell populations involved in appetite control respond to low levels of DO is unknown. These neurons express orexigenic peptides *neuropeptide y* (*npy*) and *agouti-related protein 1* (*agrp1*), and the anorexigenic peptides *proopiomelanocortin a* (*pomca*) and *cocaine- and amphetamine-regulated transcript* (*cart*). Together these neuropeptides contribute to either stimulate or inhibit feed intake and their regulation might be at the base of the changes in appetite under different oxygen levels.

Objective

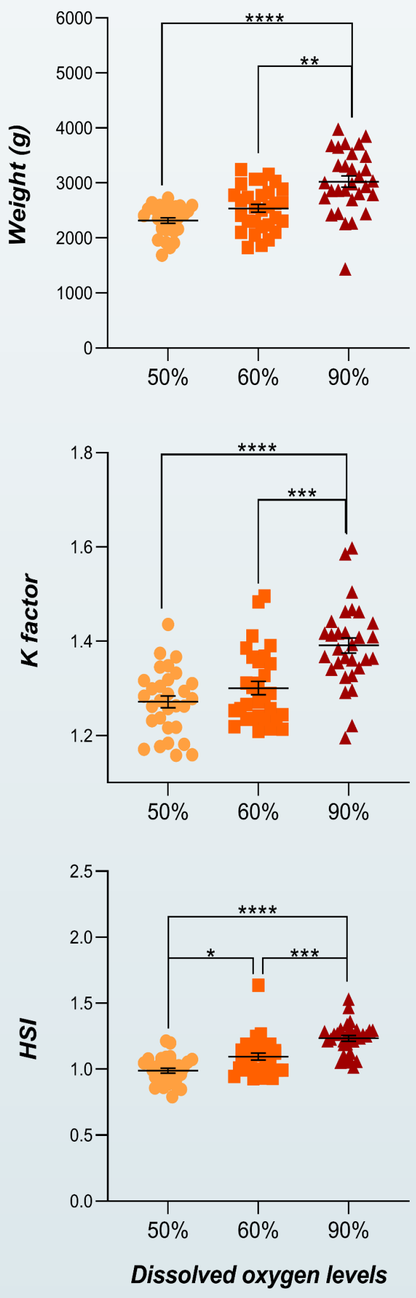
In this study we aimed to examine the response of long-term mild and moderately low levels of DO on the expression of the neuropeptides involved in control of appetite and feed intake in the hypothalamus and growth in Atlantic salmon.

Methodology

Post-smolt Atlantic salmon (1035 ± 13 g) were reared in triplicates tanks at either DO levels of 50%, 60% or 90%, at 12˚C, 22 ppt salinity and continuous light at Institute of Marine Research at Matre, Norway. Fish were fed twice a day for 1.5 hour and uneaten feed was collected to assess feed intake. After two months, 15 fish from each experimental group were collected just after the first meal of the day (fed group) or after 24 h fasting (fasted group). Each fish was measured for growth biometry and the brain collected for gene expression analysis. Hematocrit and ventilation frequency were used to assess respiratory compensation for low DO. Ventilation was analysed using videos captured one week before final sampling, consisting of 30 min recordings, 2 hours after the first meal.

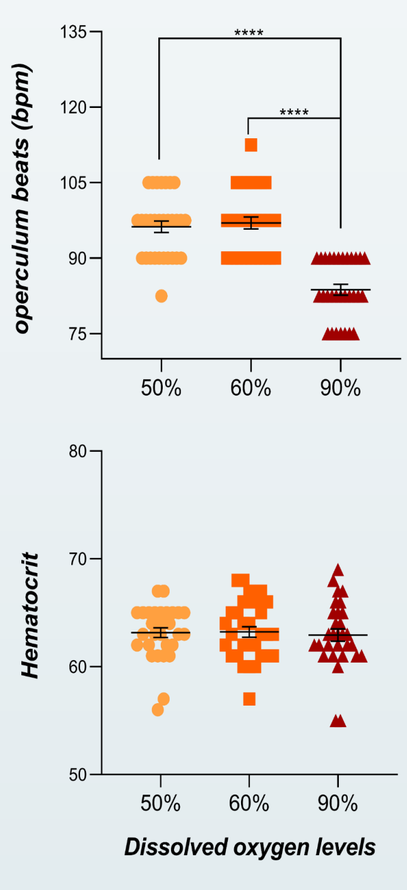
Results & Conclusion

Fig 1. Growth



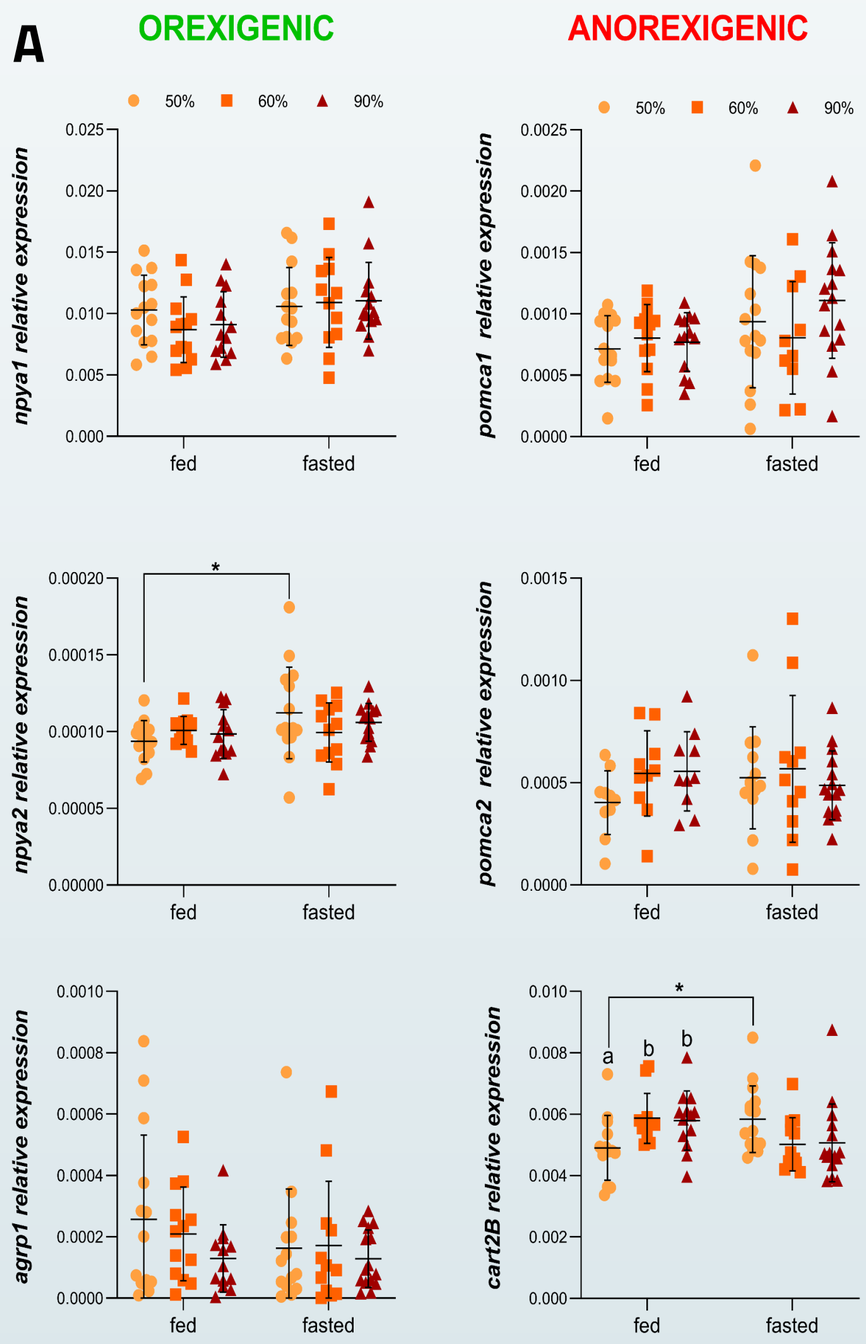
Growth and HSI. Bars represent mean ± SEM of data collected at the last sampling point (n=30/group).

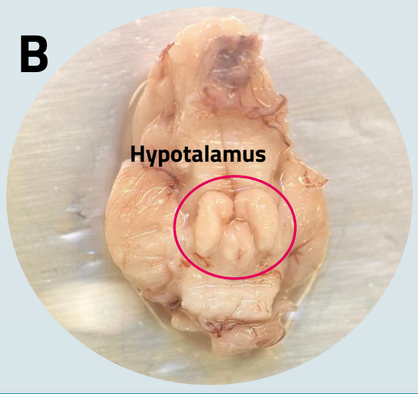
Fig 2. Respiratory parameters



Ventilation (opercular frequency) and hematocrit. Gills ventilation was recorded as a count of operculum openings and closings and expressed as beats per minute (bpm) from 10 fish/tank. Hematocrit bars represent mean ± SEM of data collected at the last sampling point (n=30/group).

Fig 3. Gene Expression





A: Hypothalamic appetite related genes expression. Bars represent mean ± SEM of data collected during fed state and 24 hours after feeding (n=15/group).

B: Atlantic salmon brain. In the circle the hypothalamus is highlighted before dissection.

1) The fish **at 90% DO performed best**, with a considerably higher body weight, K factor and HSI compared to 60% and 50% DO groups (Fig 1):

- The impact of **DO was distinctly significant on fish growth**, in all its parameters. Weight and K factor were clearly higher in fish reared at 90% DO.
- The **HSI was also affected** by the amount of oxygen and shows that less excess energy was available for liver storage (and body) at low DO.

2) **The fish partly compensated for low DO through respiration. Ventilation increased** under conditions of 50% and 60% DO groups. However, without affecting the number of red blood cells and maintained normal hematocrit levels (Fig 2).

3) The 60% and 50% DO groups consumed less food (Data not shown) but maintained an equal FCR compared to the 90% DO group.
Analysis of the hypothalamic region showed that (Fig 3A):

- There was a **lower mRNA expression of *cart2b*** in the 50 % DO group than the 60 and 90 % DO.
- In the same 50 % DO, fasting the fish for 24 hours induced an **increase of *npya2* and *cart2b***.
- This shows that these neuropeptides are involved in modulating appetite during low oxygen levels although their individual impact remains to be understood.

Acknowledgements

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